ABSTRACT

Title of Dissertation: APPLIED STASIS THEORY AND Q-SORTING FOR ORGANIZING ENVIRONMENTAL SCIENCE COLLABORATION IN POLICY DELIBERATION: A CASE OF POULTRY HOUSE EMISSIONS—AMMONIA AND PARTICULATE MATTER—ON THE DELMARVA PENINSULA/EASTERN SHORE

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Doctor of Philosophy

2022

Dissertation directed by: Professor Robert Tjaden, Marine Estuarine Environmental Sciences

CONTEXT: Poultry farmers respond to national and global demand for low cost, packaged chicken. Raising poultry for market results in ammonia and poultry litter (manure and dust). However, for the Delmarva part of the Chesapeake Bay Watershed and Airsheds, ammonia and poultry litter mean nitrogen pollution, which effects water quality and human health. Therefore, this inquiry looks closely at the values and benefits that shape poultry farmer decisions about managing ammonia from their poultry houses using two technologies: Vegetated Emissions Buffers (**VEBs**) and Poultry Litter Treatments (**PLTs**).

QUESTION: How can we better understand the values and benefits embodied in ammonia management choices by poultry farmers?

METHODS: This dissertation uses three methods to engage with poultry farmers (2012-19) to better understand a range of values—economic and non-economic—about voluntary ammonia management strategies.

1. **Stasis theory** (Chapter Two),
2. **Scaling of conceptual diagrams** to three inch by four-inch cards, for designing visual Q-cards (Chapter Three),
3. **Q-sorting** of cards and findings (Chapter Four).

FINDINGS: The Q-sorting events in this November 2019 study (25 value/benefits statements, sorted with 13 poultry producers) did not meet respondent number thresholds for formal Q-method factor analysis. However, results were studied using exploratory data analysis and chi-square testing of Q-sorting data. One important finding is that these eight cards appeared as important in two analysis categories: first, six cards likely MOST IMPORTANT (Photo 1); and second, the next two cards (Photo 2) as perhaps SOMEWHAT IMPORTANT. These pictured two sets of cards are ranked overall as having greater importance to poultry farmers, compared to aggregate card rankings of the other 17 cards in the 25-member card set.

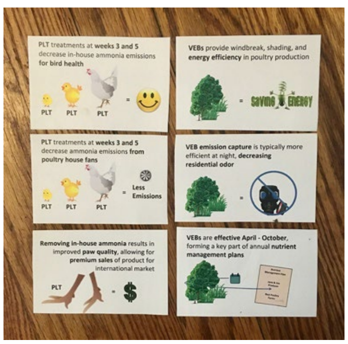

Photo 1: In the aggregate, these six cards were sorted most often into the MOST IMPORTANT category.

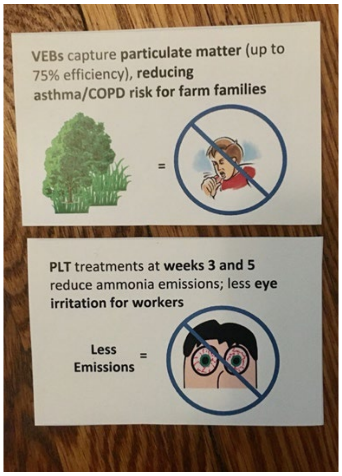

Photo 2: In the aggregate, these two cards were sorted most often into the IMPORTANT category.

The six cards in Photo 1 (MOST IMPORTANT) can be understood in several ways. First, these three cards (position noted in bold) represent economic benefits to poultry farmers, important for farm fiscal stability. The three cards on the left all represent health gains for chickens, meaning a better payout when healthy, unblemished, full-weight birds are sold to the poultry company:

- **Top-left card**: This card symbolizes healthy chickens as “happy”—a visual shorthand for healthy—commanding more per pound at payout.
- **Middle-left card**: This card shows reduced in-house ammonia, which means that chicken flesh is less likely to be burned or marred by ammonia, commanding more per pound at payout; generally, lowered in-house ammonia also means healthier birds, which is a specific value noted in just above in the top-left card description.
- **Bottom-left card:** This card shows unblemished chicken “paws” which can command an extra premium for Asian specialty food markets. This portion of the bird represents a newer market for poultry producers.

Within this group, two of these cards in Photo 1 (**top**- and **middle-left**) also show the value to farmers of using an enhanced schedule of PLTs to reduce ammonia *inside the poultry house.*

The right-hand cards in Photo 1 can be understood thusly as relying on VEB use:

- **Top-right card:** This card shows energy savings from using VEBs to shade poultry houses and provide winter wind cover, thereby reducing energy costs annually, supporting farm fiscal status.
- **Middle-right card:** This card symbolizes reduced ammonia odor by VEB capture, which can help avoid neighbor and nuisance complaints.
- **Bottom-right card:** This card shows the value of VEBs as helping the farmer meet existing nutrient management planning, a state-administered requirement for many poultry farmers. nitrogen and phosphorus are two nutrients associated with poultry production, poultry litter storage/composting, and poultry litter application as field fertilizer.

These three VEB-focused cards in Photo 1 share the common context of concerning ammonia management strategies *outside the poultry house*, relying on the pollution remediation strategies of VEBs, a type of designed hedgerow plant structure.

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The two cards in Photo 2, noted as IMPORTANT but not as MOST IMPORTANT as the six cards in Photo 1 just described, relate to farmer concerns about human health.

- **Top card:** This card show that poultry farmers can use VEBs outside poultry houses to capture ammonia and particle pollution, thereby improving local air quality, especially for farm families who live close to their poultry houses.
- **Bottom card:** This card show that poultry farmers can use enhanced PLTs to reduce in-house ammonia, thereby improving worker conditions inside the poultry house.

CONCLUSION: This case study demonstrates the value of Q-sorting used with Delmarva poultry farmers and attitudes about ammonia management. These findings can be also understood as ground-truthing evidence, in that the visual card-sorting data confirm as important the eight cards discussed above. These values/benefits depicted on these cards fit the poultry context of the Chesapeake Bay ecosystem. Additional Q-sorting activities with these cards or revised card sets to meet research needs are worthy undertakings.

This dissertation case study also shows the value of humanities within environmental policy deliberation. Stasis theory, from rhetorical studies, helped organize the complexity of this project, as well as made a clear role for valuing activities (including Q-sorting). A second field of humanities inquiry is science visualization studies. This field, closely allied with rhetoric, helped with design values to build clear and environmentally-situated picture cards for Q-sorting the ranked importance of these cards to poultry farmers.

Finally, the last chapter reflects on ways that a human dimensions approach supports a re-imagined Delmarva poultry production. One central design criterion about poultry production futures centers the role of poultry farmers, especially young farmers, in planning for resiliency. Among the pressures on poultry production is the well-documented wetter and warmer Delmarva, to climate change. The COVID-19 pandemic due to the 2019 emergence of the SARS-CoV-2 virus, also posed risks to Delmarva poultry resiliency. Scenario analysis and design options are better with humanist and social science knowledge, combined with environmental science.

APPLIED STASIS THEORY AND Q-SORTING FOR ORGANIZING ENVIRONMENTAL SCIENCE COLLABORATION FOR POLICY DELIBERATION: A CASE OF POULTRY HOUSE EMISSINS—AMMONIA AND PARTICULATE MATTER—ON THE DELMARVA PENINSULA/EASTERN SHORE

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Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2022

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2022

Preface

This dissertation combines humanities, social science, and natural science to look at a Chesapeake Bay land use problem: Ammonia pollution from Delmarva poultry production.

Land: where people live and move and have their being. Land is also *a text we read* seeking ways to live generously and gently in communities. Scientists, humanists, and poultry farmers *write on and can read this living text.* We can use knowledge to lighten our heavy footprints upon land, for human flourishing within healthy, generative, and just agro-ecosystems.

Some words upon the land are willfully unread. College Park, Maryland lies upon Nacotchtank land of the Piscataway Chiefdom. Today, the Piscataway Tribe is active: the Piscataway Indian Nation and Tayac Territory, and the Piscataway Conoy Tribe (including the Cedarville Band). On January 9, 2012, the state of Maryland recognized these tribes.

Most of the study in this dissertation took place near the University of Delaware. Tribes who hold heritage claims on the tri-state Delmarva peninsula are the Nanticoke and Lenni-Lenape peoples.

In both College Park and Delmarva, enslaved people and their descendants also inscribe the land. These stories—seldom read with the vigor and interest of fully humble, truthful people—are co-written with tribal communities and indentured colonists where intermarriage and common exile from the land remain a powerful historical narrative.

I express gratitude and wish to honor the many men and women who inhabited, cultivated, and nourished these two places upon Chesapeake land for thousands of years. When we name these people, we create conditions for deeds of recompense.

I also name the tribes of my home place. Piegan Band Blackfoot, Crow Nation, and Little Shell Chippewa. Among my classmates were many Little Shell children of this “landless” Ojibwe tribe. On December 20, 2019, the National Defense Authorization Act formally recognized the Little Shell people of Montana.

Foreword

This dissertation uses tools and content from the humanities, social sciences, and natural sciences to explore an environmental problem.

Every effort has been made to accommodate these different readers. Yet, reading across disciplines is difficult. I thank my readers in advance for this effort and their patience.

To this end, each chapter opens with an overview and each chapter includes the Q-sorting cards developed in this study.

Dedication

I name with such pleasure my three children—Hannah, Lucy, and Hal—who are good company and delightful people; they were likewise engaging and sweet children.

I also think with affection on the communities of scientists I have worked with: environmental policy, climate change communication, biodiversity inventories, economic valuation, medicinal plants, and even medical devices.

In my teaching work with colleagues, I remain grateful for pedagogy and praxis discussions on how to bring students into rich arenas where critical thinking skills and communication strategies help make better writers—and human beings.

Finally, I am keeping a promise to my very younger self.

Acknowledgements

To my committee, I cannot thank enough:

- Bob who understood the late-in-life dissertation quest and suggested Q-method to me;
- Katia taught my favorite class in all time: history of ecology in classic papers;
- Oliver shared a semester of teaching first-year students about data visualization;
- Alan hired me (1989) for climate change work; we are friends, still.
- Scott is both boss and colleague where stasis theory is part of writing instruction; and
- Alba, who worked with me on the original USDA grant.

I am ever grateful to many friends and family who provided practical and other types of support. To Joseph Riggio and Mark Hebert, friends since college, I love that we still laugh across miles and disciplines. To my friends who live close, I benefit from food, conviviality, and outside time together as we raised children and built community: Pamela Wagner, Pamela and Joseph Bellino, Michelle and Philip Koopman, Kate and Joe Kelly, Cathleen Hapeman and Bill Thomas, Peter McClintock and Susan Hines, Pamela Wexler, Ted Porter, Charles McNamara, and our local second line band, the Wild Anacostias.

Several Santa Clara University professors deserve mention: John Mooring taught me field botany using a California transect that included the desert in bloom ('83); William Eisinger showed me economic botany and ethnobotany; while the three Whites—Carol, David, and Fred—supported me in writing a senior thesis across philosophy, chemistry, and science writing.

Professors in graduate school also formed me: I appreciate Peter G. Brown's reading aloud from Isak Dinesen in environmental policy, Herman Daly for searing clarity on how human activity must be scaled to fit inside the biosphere, and finally Jeanne Fahnestock in English for the living tools of ancient and early modern rhetoric.

Graduate school, while grueling, makes for intellectual friendships. I appreciate Cameron Mozafari who worked with me early in the USDA project. He helped me sort which humanities frames are most helpful in understanding poultry farmer attitudes toward ammonia management. Stasis theory! We presented and published on how stasis theory — like scientific method — organizes complexity. We also teach in University of Maryland Writing programs upon a stasis theory spine.

I also appreciate River Yang, part of the USDA ammonia management community at USDA Beltsville. His graduate work in statistics helped me place Q-method into the statistics conventions that most scientists converse in. He also helped me run some very large data sets on his computer, during COVID-19 lockdown.

Table of Contents

List of Tables

List of Figures

List of Illustrations

List of Abbreviations

AFO = agricultural feeding operation

ARS = Agricultural Research Center of the USDA

BMP(s) = best management practice(s)

CAA = Clean Air Act

CAFO = concentrated agricultural feeding operation

CBF = Chesapeake Bay Foundation

CE = Cooperative Extension

CIG = Conservation Innovation Grant

CWA = Clean Water Act

DCA = Delaware Chicken Association, formerly DPI

DPI = Delaware Poultry Incorporated, now DCA (2020)

Delmarva = the Eastern Shore peninsula of Delaware, Maryland, and Virginia

Five W's = Who, What, Where, When, and Why

Four W's = Who, What, Where, and When

IAN = Integration and Application Network (of MEES and UMCES)

MAFO = Maryland agricultural feeding operation

MEES = Maryland Environmental and Estuarine Studies

N = Nitrogen

NH_3 = ammonia

P = Phosphorus

PCA = principal component analysis

PLT(s) = poultry litter treatment(s)

PM = particulate matter

P-set = participants who sort cards in a Q-study

Q-card = card for sorting in a Q-study

Q-set = the entire set of Q-statements on Q-cards, for sorting in a Q-study

VEB(s) = vegetated environmental buffer(s)

VEB-Scrubber = a short-hand for 2012-2017 USDA grant

UMCEES = University of Maryland Center for Environmental & Estuarine Studies

UMCES = University of Maryland Center for Environmental Science

UMS = University of Maryland System

USDA CIG = US Department of Agriculture Conservation Innovation Grant

US EPA = US Environmental Protection Agency

US OSHA = US Office of Safety and Health Administration

Chapter 1: Introduction and overview of context for ammonia pollution concern in the Delmarva poultry sector

Overview: This dissertation is concerned with voluntary management of ammonia effluent, a form of nitrogen pollution, in the Chesapeake Bay Watershed from poultry production. In this examination of ammonia pollution in the Chesapeake, two innovative evaluation tools are used for this environmental challenge. First, stasis theory from the humanities is used to frame the problem and situate possible approaches that make clearer the policy pathway by elevating poultry farmer participation in the policy formation process. Second, the tool used to include poultry farmers is Q-sorting, Q-sorting is a social science method that looks specifically at subjective views to improve understanding of the values that underly human preferences.

Chapter One, here, describes some of the socio-ecological context of ammonia management choices by poultry farmers on the Eastern Shore of Delaware, Maryland, and Virginia, also known as the Delmarva Peninsula. The farmers included in this study are largely Delaware residents. However, the poultry community—especially in Delaware and Maryland—work closely together, including through knowledge sharing and technical transfer at the University of Delaware and the University of Maryland system. This knowledge sharing and technical transfer occurs principally though Cooperative Extension services associated with these two universities. Virginia, farther south on the peninsula, is home to a smaller group of poultry farmers who work with Virginia-based Cooperative Extension entities.

This dissertation case study is part of an interdisciplinary environmental science project concerned with nitrogen pollution (2012-2017). This United States Department of Agriculture (USDA) Conservation Innovation Grant (CIG)[1] studied current best management practices (BMPs) but also called for enhanced participation of poultry farmers. One unusual design element of this USDA CIG project was inclusion of a humanist as a principal investigator, who is also the author of this dissertations.

This enhanced participation for poultry farmers and stakeholders used three approaches:

1. Scientists would locate, with permission, study sites on poultry farms, in addition to using laboratory and campus poultry farms.
2. This project would include *valuing*[2] activities about how farmers make subjective choices about ammonia management.

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[1]Grant Title:

Innovative Approaches to Capture Nitrogen and Air Pollutant Emissions from Poultry Operations, 2012-2015.

University of Delaware, University of Iowa, University of Maryland, Pennsylvania State University, and the USDA Agricultural Research Service; A science communication specialist, with a background in applied rhetoric, was a principal investigator.

[2] *Valuing* here means the economics and costs/benefits typically experienced at the farm level, as farmers try to keep their land in production and viable. However, expanding the sense of values about ammonia management borrows in part from critiques of use of valuation applied to ecosystems, ecosystem goods, and natural capital. *Ecosystem valuation* assigns a value, often monetary, to an ecosystem and/or its ecosystem services (what is provided to society by nature, for "free."). By quantifying how forests, water systems, soil, air, etc., provide social welfare benefits, some arguments for environmental protection are strengthened. However, some urge that human valuing also relies on "soft" reasons that reflect cultural, social, and spiritual values. This dissertation uses valuing as localized to poultry farmer decisions on ammonia management. Here, valuing will include the economics of the farm about ammonia management costs, but also look at the human values that also help shape choices.

3. Finally, the third enhancement required that elevation of poultry farmer expertise as part of the knowledge required for environmental policy deliberation.

Stasis theory, from classic and modern rhetoric, was adopted as a design technique by this author to incorporate these stated goals of this environmental science-to-policy project. improve stakeholder participation and plan for science communication documents and events. Chapter Two describes this stasis theory approach, which is a five-step cognitive heuristic for analyzing complexity. Stasis step four expressly concerns value, thereby providing a demonstrated, time-tested structure for poultry farmers to express their values about managing ammonia within the broader project.

The expression of these values by poultry farmers was elicited by using Q-method[3], from sociology. Q-sorting, rank-ordering a set of Q-cards depicting these values, is discussed extensively in Chapter Four. Illustration 1, at the end of this chapter, shows the 25 cards developed for this Q-study portion of the grant.

Most Q-studies use text-only cards. The Q-sort card set for this study used visual depictions of the values and benefits. Most Q-sort studies design cards with phrases or sentences that describe the subjective values being assessed, one value on each card. Environmental science relies in part on a long tradition of visual communication: complex concepts and ecological processes are sketched out as *conceptual diagrams*. These illustrations are widely used with non-expert audiences but also within the discipline, especially for novel information or synthesis concepts.

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[3] The author is indebted to Robert Tjaden, committee chair, about suggesting this mixed method instrument from social science to look at values. Q-Method is both qualitative and quantitative, which makes the instrument compelling for studies that examine content not easily described or analyzed solely in numerical ways. in the project more broadly but also to see how values are ranked with respect to other values within the context.

The process of developing small conceptual diagrams for these cards (roughly three inches by four inches, landscape format) is discussed in Chapter Four.

This opening chapter summarizes Delmarva poultry production, with attention paid to how the context shapes poultry farmer viewpoints. Understanding the context for these viewpoints is a necessary prologue to identifying and enumerating viewpoints that can be used design a card set for Q-inquiry with farmers. The *ranking* approach in Q-method offers an advantage over surveys: poultry farmers while sorting must make trade-offs in the values that underlie their ammonia management decision-making. Science communication about ammonia management is better with enhanced understanding of the poultry farmer audience. Trust can also be deepened, with poultry farmer participation early in an environmental policy deliberation process.

Summative findings in this chapter are noted in italics. These summative statements concerning the poultry production context are essential background information to use in developing the concourse (brainstorming for card content) for the Q-study[4] described in Chapter Four.

[4] From the concourse researchers develop a set of value statements (the Q-set) that can be presented to participants (the P-set). In this study, the Q-set concerns values inherent on ammonia management choices. The P-set is composed of poultry farmers making ammonia management choices who participated in this inquiry.

Background on Delmarva poultry production:

Commercial broiler chickens[5] are reared in large poultry houses[6] for meat production. Poultry—and supporting economic activity, including field crops— accounts for about two-thirds of Delmarva's gross agricultural income, with about third of all chicken processed for international markets. See Figure 1 below for an aerial view of several poultry houses on a farm lot. Ammonia—a gaseous compound of nitrogen and hydrogen (chemical formula NH_3[7]) exits exhaust fans of these poultry houses while chickens are grown out to market size. Ammonia, a byproduct of chicken metabolism, is colorless, highly irritating, presenting with a pungent, noxious odor.

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[5] Among the first domesticated animals, chickens (*Gallus gallus domesticus*) are raised on every continent save Antarctica, in nearly all ecosystems, including near the North Pole. Poultry is the most widely distributed livestock.

[6] Egg production also takes place in large poultry houses, but this study concerns Delmarva broiler production.

[77] NH_3 is the un-ionized (non-salt form) of ammonia, where NH_4+ is the ionized form. Generally, most air ammonia takes the NH_3 form. Total ammonia, which is measured in water systems, is the sum of both NH_3 and NH_4+.

Figure 1: Chicken farm near Salisbury, MD, close to the Wicomico River, with four poultry houses. Ammonia from poultry house exhaust fans is deposited in local tributaries of the Chesapeake Bay watershed, threatening air and water quality. Ammonia, especially when combined with particle pollution, also poses human lung health risks. (Nauman, 2008) With permission.

In addition to airborne ammonia in poultry house effluent, poultry production releases another type of pollution associated with *poultry litter*. Poultry litter is a mixture of dried bird droppings, bedding (pine shavings, typically), food residues, and feathers. Poultry litter is a rich source of several forms of nitrogen, including ammonia. By releasing forms of available nitrogen within soil systems, poultry litter is a desired, essential fertilizer for crops. Delmarva agriculture relies on poultry litter applications for fertilizer rather than from commercially produced fertilizer. In contrast globally, about 90 percent of commercial ammonia produced is used in fertilizer, to sustain food production for billions of people around the world.

Not all nitrogen from poultry litter-as-field-application is taken up by crops[8]. Some of the field-applied nitrogen “leaks” into local soil and water systems, entering the Chesapeake Bay watershed as an excess nutrient. Policymakers, scientists, and environmentalists, as well as farmers are aware of nitrogen pollution arising from agricultural production. Nutrient management plans (NMPs) in both Delaware and Maryland are developed by farmers in consultation with experts to reduce nitrogen pollution leakage, along with potassium. Nitrogen and potassium are called nutrients and together are a cause of nutrient pollution in the Chesapeake watershed. Later in

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[8] Delmarva truck crops include melons, strawberries, sweet corn, and tomatoes. Major field crops include corn (fodder and fuel-stock), soybeans, with winter grass cover planting to protect soil and sequester nitrogen. Soils tend to be mostly sandy, consequently poor at holding water. Overall, Delmarva soils are nutrient-poor. Poultry litter is a desired fertilizer and soil amendment (organic matter from bird droppings and bedding residues.

this chapter, details about NMPs are addressed, especially for the Delaware poultry farmer.

Another source of nitrogen pollution into soil and water systems comes from airborne ammonia exiting poultry house fans, which is deposited (to soil and water) relatively closely to poultry production. This dissertation study primarily concerns airborne ammonia from poultry house fans. However, this ammonia and poultry litter application nitrogen nutrient pollution from poultry production harms local water quality by "leaking" from field applications and by air and water deposition of air ammonia. Poultry farmers are aware of this ammonia deposition that arises from poultry production and is separate in origin from field application of poultry litter.

Delmarva poultry farmers understand that their chicken cohorts contribute to this nutrient pollution problem of nitrogen and phosphorus[9]. This case study focuses

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[9] Poultry litter is also a source of phosphorus, which impairs water quality through eutrophication. Through eutrophication, both nitrogen and phosphorus can cause algal blooms. Phosphorus flux to water is especially likely if the soil is already high in phosphorus. High phosphorus content characterizes many Delmarva soils. However, this dissertation concerns airborne ammonia, primarily and two types of atmospheric deposition of ammonia: air-to-soil and air-to-water. Phosphorus, typically, is not an air pollutant from agricultural production. Yet, phosphorus-associated air pollution occurs in industry and engine combustion, including phosphate-based fertilizer production.

primarily on the nitrogen originating as ammonia air pollution from poultry production, rather than looking simultaneously at these nutrients that enter the environment as solids, typically within poultry litter. However, awareness of how nitrogen and phosphorus tend to “move together” in soil and water systems helps explain why many policy measures often treat these elements simultaneously.[10]

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[10] Poultry litter is a local, inexpensive fertilizer source for nitrogen and phosphorus. Like other manures, poultry litter is an excellent fertilizer, but this manure mixture is less concentrated than chemically manufactured fertilizers, giving the mixture a relatively low “value” per ton, when evaluated commercially. This lower combined with weight makes poultry litter uneconomical to ship long distances. Additionally, the nitrogen in poultry litter is not stable with substantial amounts lost to the air (see volatilization below). Therefore, poultry litter is used quickly and locally.

Poultry litter, when stored and applied, can also be a source of airborne ammonia. Ammonia gas rises from compost piles and surface applications by *volatilization*. Ammonia loss from poultry litter is important not only agronomically but also environmentally. Field crop farmers pay attention to weather conditions during application sessions: in hot, dry, and windy conditions, volatilization rates speed up. Applying poultry litter before rain can help incorporate available nitrogen into the soil; however, litter application before large storms can cause a substantial loss of nutrients in surface runoff, which means that nitrogen moves into water systems. A related loss of nitrogen from soil to water is by leaching: nitrogen not taken up by plants moves lower in the soil profile, particularly in cold temperatures, thereby moving from a soil system into the watershed.

Due to all these mobility processes, only about 50% of nitrogen from poultry litter is available for plants in the application within a growing season.

Deposition of NH_3 from the atmosphere can lead to N loading of lakes, indirect acidification of soils of low buffering capacity through nitrification, and damage of sensitive crops such as tomato, cucumber, and conifers. See:

Brinson S, Cabrera M, Tyson S. (1994) Ammonia volatilization from surface-applied, fresh and composted poultry litter. *Plant Soil.*;**167**:213–218.

Cabrera ML, Chiang SC, Merka WC, Thompson SA, Pancorbo OC. (1993) Nitrogen transformations in surface-applied poultry litter: Effect of litter physical characteristics. *Soil Sci. Soc. Am. J.* **57**:1519–1525.

Cabrera ML. (1994). Water content effect on denitrification and ammonia volatilization in poultry litter. *Soil Sci. Soc.Am. J.* **58**:811–816.

However, poultry farmers see poultry litter-associated nitrogen pollution as primarily the responsibility of field crop farmers[11]. Yet, the relationship between poultry farmers and field farmers about nitrogen are very complex. For example, chicken production requires the growing of thousands of acres of nitrogen-intensive corn and soybeans to feed chickens.

Complexity of ammonia monitoring and regulation

State and federal regulators address the excess nitrogen pollution from poultry production in several ways, with primary reliance on voluntary and/or "soft"

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[11] Some farmers produce chicken and field crops. Poultry farmers who also field farm can use their poultry litter as a crop amendment. If so, these farmers – like all Delmarva field farmers— keep some type of nutrient management record. Formal documents are typically called Nutrient Management Plans (NMPs). NMPs govern field farm activity by acreage and poultry farming activity by number of birds. Since the mid-2000s, both DE and MD began focusing on poultry operations along with other livestock operations. Manure management is essential in nutrient pollution remediation, with these activities noted as agricultural feeding operations (AFOs). Delaware uses the AFO terminology. See footnote 11 for additional Delaware detail. In Maryland, the term Maryland Animal Feeding Operations (MAFOs) is used, which as a general category includes many poultry operations. Very large operations, locally and nationally are called concentrated animal feeding operations (CAFOs). Until recently, most Delmarva poultry operations were not large enough to meet CAFO designation. This may be changing.

regulatory strategies[12]. In Delaware, nutrient management laws function in three central areas, with regulations governing:

- nutrient management of nitrogen and phosphorus,
- waste management for Animal Feeding Operations (AFOs), and
- National Pollutant Discharge Elimination System (NPDES) of the federal Clean Water Act (CAA). Here, the instrument is permits for concentrated animal feeding operations (CAFOs). CAFOs are considered a point source of pollution, hence the permit requirement.

Delaware nutrient laws and the related regulations respond to two goals, both to serve overall public welfare:

- maintain and improve quality of state ground and surface waters; and
- help meet or exceed federally mandated water quality standards[13].

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[12] Most farmers in this study are assumed to be Delaware residents, therefore, Delaware State nutrient laws and regulations apply. Nearly all state control stems from the 1999 Delaware Nutrient Management Law (DNML), modified by amendments and regulatory agreements. Poultry farmers follow DNML in implementing required nutrient reporting if their farming activities meet one or both thresholds, for:

1. applying nutrients to 10 acres or more, requiring a NMP (field activity)and/or
2. managing Animal Feeding Operations (AFOs) with greater than 8 animal units, requiring an Animal Waste Management Plan (AWMP), which is a type of nutrient management planning document. An animal unit =1,000.

[13] These federal laws include the EPA-administered Clean Water Act and the Safe Drinking Water Act; federal laws governing Delmarva water quality include 303(d) provisions of the Clean Water Act concerning impaired waters, of which the Chesapeake Bay watershed is identified and managed. The management instrument includes the regional, federally authorized partnership called the Chesapeake Bay Program.

Because the farmers included in this study are largely assumed to be Delaware residents, this study focuses primarily on this state's regulations. However, many overlapping educational and nutrient credentialing activity exists between Delaware and Maryland poultry stakeholders. As well, the Chesapeake ecosystem spans state borders as does ammonia and nitrogen air and water pollution. Finally, the community of poultry farmers in Delaware and Maryland[14] are geographically close as well as socially organized within communities, through ongoing professional developing (through Cooperative Extension activities for example), and through policy and trade organizations and other alliances.

Ammonia and air pollution

Currently, federal policy stances toward agriculturally generated air ammonia reflects a limited approach. Most interpretations of applying the Clean Air Act (CAA) provides for more than theoretical federal authority for regulating ammonia

[14] The southern end of the Delmarva Peninsula includes Virginia, where the poultry industry is much smaller than in Delaware and Maryland. While much of this analysis can be understood as to apply also to poultry production in this part of Virginia, this dissertation focuses primarily on Delaware poultry farmers, with natural application to the closely adjacent Maryland poultry activity. Virginia poultry production is not specifically addressed.

emissions. Between 50--85%[15] of U.S. ammonia emissions are estimated to be from agricultural activity. However, the agricultural sector varies considerably from industrial sectors, addressed by the body of environmental statutes focused on emitted pollution (for both air and water).

More recent statutes and amendments of air regulation recognize that agricultural sources are vastly different from industrial sources; therefore, some regulatory exemptions are expressly codified in scoping language. For the CAA, Congress likely did not expect application of this early environmental regulatory law to then-understood agricultural sector activity.

However, more recent laws, including those with goals to protect community public health, do include agricultural emissions of ammonia. Here, reporting is the primary regulatory instrument. Federal reporting requirements for all types of air ammonia fall under two acts:

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[15] Estimates vary widely, with some studies including North American continent. Disaggregating U.S. and Canadian agricultural activity air emissions is difficult, in both measuring and modeling contexts.

1. the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); and
2. the Emergency Planning and Community Right-To-Know Act (EPCRA).

These two statutes do not hold administrative authority to fully regulate all agricultural emissions of ammonia. Yet, EPA regulators and scientists do keep large data sets over time directed at baseline quantitative information about these emissions. In 2008, however, the reporting requirement under EPCRA for farmer and ranchers concerning ammonia were largely vacated. This same 2008 rule also exempted small livestock farms (including many typically sized poultry farms) from reporting hazardous air releases under the original 1986 EPCRA.

Since the mid to late 1990s, the EPA has been wrestling with the problem of quantifying and estimating emissions from livestock waste—including poultry litter and poultry house emissions. At that time, EPA claimed it did not have sufficient air emissions data to develop accurate methods for determining whether livestock operations are subject to emissions permit requirements under the Clean Air Act and reporting requirements under CERCLA and EPCRA. Two events are central along this timeline of understanding agricultural emissions, and eventual regulation:

In 2005, allied livestock industries other than beef—dairy, pork, and poultry (both the broiler and egg sectors) entered into a $15 million study agreement with EPA to monitor air emissions at farms representing those four sectors across the U.S. Purdue University managed much of the science and technical details.

By 2010, this monitoring study was completed, with EPA releasing draft methods and some data in 2012. Yet, in 2013, EPA's scientific advisory board criticized the quality and quantity of EPA's data, as well as some of the emissions estimation and modeling methods.

Since the mid-2000s, federal level air pollution regulatory attempts to model agricultural ammonia—hence build a rational regulatory framework—have languished. The effort to develop ammonia emissions models, including for broiler and egg production, shifted largely to scientific institutions. Scientists, often in academic and research institutions, continue to investigate ways to quantify agricultural emissions of ammonia and understand how ammonia functions in the nitrogen cycle. Tools include direct measurement, ambient measurement, as well as modeling.

However, state, regional, and federal authorities increasingly face pressure to change "loosely regulated" agricultural ammonia policy for two reasons. The first reason is primarily environmental and concerns the movement of airborne ammonia to water and soil systems, due to atmospheric deposition. This deposition process for nitrogen is a primary cause of excess nutrient enrichment of large water bodies with agricultural activity in their watersheds. Two of the largest of these water systems are the Chesapeake Bay and the Gulf of Mexico. The interplay of air and water pollution of nutrients means that federal air and water quality regulations should logically apply.

The second reason for tightening regulatory control of ammonia emissions from agriculture concerns public health. EPCRA monitoring and reporting guidance is more applicable here and concerns the public's right to know about local health risks due to pollution.

At different times, the EPA has been petitioned by technical experts in public health to list ammonia air pollution of all types as a *criteria pollutant*; these criteria air pollutants are regulated by the CAA and identified by the EPA through the National Ambient Air Quality Standards (NAAQS). Currently, the six NAAQS criteria air pollutants are carbon monoxide, ground-level ozone, lead, nitrogen dioxide, particle pollution, and sulfur dioxide.

Air ammonia processes are intimately related to the formation of particle pollution. Ammonia is a precursor to fine particulate matter (PM), one of several types of particle pollution; this size class of PM is designated as PM2.5. Fine particulate matter is increasingly a public health problem due to lung health risks. Poultry litter is a source of several sizes of particle pollution. To date, poultry litter-associated particle pollution is studied, by government and scientific institutions, but not regulated under the NAAQS of the CAA.

If ammonia becomes a criteria air pollutant[16], regulation of agriculture ammonia could be tightened under existing provisions of the CAA. However, "counting" ammonia in agriculture is difficult for several reasons, including the mobility of nitrogen in air, soil, and water systems, separating pools of ammonia—including

[16] The path of least resistance would be to regulate ammonia as a precursor to particle pollution, especially the known formation of ammonia with particles into fine PM. Some observers expect that eventually the case can be made to include ammonia as a separate criteria air pollutant.

livestock-generated ammonia and field applications of ammonia-based fertilizer, including poultry litter.

And additional barrier to monitoring ammonia as a criteria air pollutant concerns food security. Food production and fertilizer use are essential to the viability of local, domestic, and global food systems. Regulating ammonia in the U.S. under the CAA would require consideration of what ammonia is excess to these food-generating ammonia necessities. Estimating ammonia sources and sinks from agriculture is difficult but necessary for the apportionment understanding that effective pollution regulation would require.

Farmers of all kinds pay attention to ammonia science and regulation; for Delmarva poultry farmers, air pollution regulation at the federal level, as well as state levels, could tighten and include the ammonia effluent from their poultry houses. As it stands now, the federally run regional Chesapeake Bay Program does focus on ammonia, but primarily in the form of nitrogen loading into the watershed from. Here the focus is on nitrogen as a water pollutant. Those ammonia effluent in the air is deposited into both soil and water systems, including on the Delmarva Peninsula.

Ammonia is not only an airborne pollutant, as framed by this discussion about air pollution laws. By air deposition to water and soil[17], ammonia that originates from poultry house exhaust fans can also be considered as also a water pollutant. Water pollution in the U.S. is managed at the federal level by several laws, principally the Clean Water Act (CWA).

Ammonia pollution impairs airsheds and watersheds

The EPA monitors water quality impairment by ammonia pollution, included ammonia deposited from agriculture. Here are some important events in that process:

(from 1990 forward) EPA promulgates national, recommended water quality criteria protecting water ecosystems from the negative effects of ammonia.

> In 2013, EPA's ammonia criteria reflected an adaptive management framework about ammonia that incorporated new data on sentinel species like sensitive freshwater mussels and snails, to revise earlier ammonia analysis data consultations in the late 1990s. These adaptive management revisions in 2013 were like similar science-based finding-commentary that the EPA received on its draft ammonia 2009 criteria.

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[17] In the Delmarva portion of the Chesapeake Bay watershed, ammonia that is deposited to soil – often called dry deposition—can became part of a flux of nitrogen whereby some of this deposited nitrogen moves through soil and into water systems of the Bay.

Both the 2009 and 2013 EPA consultative process replaces the previous ammonia criteria, dating from 1999.

In addition to the criteria document process noted above for ammonia, EPA publishes supporting information to assist states, territories, and authorized tribes in considering adoption of the new recommended criteria into their water quality standards. Many water quality standards reflect local conditions[18], which is true for Delaware (as well as Maryland), concerning Chesapeake Bay water quality.

What this federal and state attention to ammonia means for Delmarva poultry farmers is that state-level water quality preferences are now often more influential in how poultry farmers are asked to report their management of ammonia generated by poultry production.

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[18] Conditions are monitored in several ways, often cooperatively, by county, state, and regional authorities. Federal participation in this monitoring is also part of the background activity either by setting local regulatory standards for monitoring or frank monitoring. For the Chesapeake Bay now, this federal monitoring is taken up by the regional Chesapeake Bay Program of the U.S. EPA, beginning in part by 2008. Some community-based monitoring takes place in organizations like Riverkeeper groups. Finally, scientists are also part of conditions monitoring

From an airshed standpoint, Delmarva poultry production, including ammonia is regulated now largely at the state level. Delaware, Maryland, and Virginia all shape Delmarva poultry production, with Delaware and Maryland the larger actors here. Still, both states work within the federal air and water pollution frameworks for both air pollution and water pollution.

Implication for values/benefits[19] in managing ammonia: *Delmarva poultry farmers pay attention to the complex federal and state regulatory entities that focus on ammonia pollution from their poultry production, including the life cycle of poultry litter as it is stored/composted and used as field crop fertilizer. Monitoring and measuring improvements often lead to tightened regulatory control, which poultry farmers watch with concern. Additional concerns about the complexity of ammonia in air, soil and water systems mean that poultry farmers see regulation as possible under both air pollution regimes (CAA) and water quality regimes (CWA, and other federal and state instruments.*

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[19] Throughout this overview chapter, implications for the values/benefits embodied in ammonia management are noted in italics. These contextualized values/benefits are later important in the Q-sorting study of Chapter Four, where the sorting cards are designed to reflect these values/benefits. In summary, Chapter One is central to concourse development that yields a thoughtful, comprehensive but efficient Q-set: cards for sorting by poultry farmers.

Current Delaware-located ammonia regulatory experience:

This dissertation concerns the Delaware state regulatory context primarily, since the study geographic reflects Delaware poultry farmers, interacting with University of Delaware Cooperative Extension activities primarily. However, the Maryland context is also contributory to the Delmarva poultry context.

Delaware poultry farmers experience ammonia regulation largely in two ways: first, if the poultry farmers use poultry liter from their poultry production to fertilize field crops on land that they either own or lease. Here, the regulatory instrument is a Nutrient Management Plan (NMP). The second way Delmarva poultry farmers experience ammonia regulation concerns the scale of their poultry production: if they meet a threshold size of bird units[20], then, their farms are also managed by animal feeding operation (AFO) guidance, requiring production and filing[21] of an Animal Management Plan (AMP).

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[20](Delaware) Operating an AFO or CAFO of eight or more animal units, where 1 Animal Unit (AU) = 1000 pounds; for poultry this mean requires an AMP at the threshold of about 37,500 birds, for broiler chickens.

[21] (Delaware): Once filed and treating all elements, farmers are considered in compliance by issuance of a Delaware Department of Agriculture permit for farm operations; All plans about nutrients are due by March 1, annually.

In practical terms, for this USDA CIG grant, the term NMP —for smaller-scale poultry farmers with some field application of poultry litter—was assumed as the typical nutrient planning requirement document. Many farmers speak generally of nutrient management and nutrient management planning (here, meant as the larger farmer process of thinking about this work and requirement), hence NMP is a typical and useful way to note as part of poultry production activities. At the time of this study, 2012-2017, most Delaware poultry farmers in the study population produced poultry at numbers under the threshold to require CAFO certification. Since that time, CAFO size in Delaware has been reconfigured to include medium and large CAFO designations by bird cohort size[22].

At smaller scale, poultry production falls short of the threshold size that comes under state regulatory attention for pollution discharge (point source pollution) and does not require an Animal Management Plan. If a small-scale poultry farmer applies manure to fields that are owned or rented for crop production or fallow management, then this

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[22] (Delaware): A medium CAFO includes broiler cohorts between 37,500-124,999 chickens (25,000-81,999 layer hens); a large CAFO is characterized as having equal to or greater than 125,000 broiler chickens (C), (82,000 layer hens).

farmer is required to report field activities concerning nitrogen under a Nutrient Management Plan. Poultry farmers who produce chicken at any scale might also file NMPs if they advise or help other farmers certify through nutrient management programs. Generally, all poultry farmers pay attention to nutrient regulatory programs, to stay current on the complex regulatory environment they face, as well as pending changes in regulation at state, regional, and federal levels.

Ammonia from poultry production, as is the case in the aggregate for much of the ammonia generated from agricultural production, is classified as a non-point source of pollution.[23]

Non-point pollution is defined as diffuse, not easily traced to particular sources, which means that most regulatory efforts focus on voluntary stakeholder actions to lower emissions. In addition to regulatory guidance, poultry farmers follow a contract

[23] Assateague Coastal Trust v. Maryland State Department of the Environment Circuit Court Montgomery County Maryland, Case Number 482915-V, March 2021; The Honorable Judge Sharon V. Burrell), Associate Judge, Montgomery County Circuit Court, 6th Judicial Circuit.

with the poultry company they grow birds for. Ammonia management can be influenced by company rules, especially regarding the in-house poultry environment.

Regulatory context summarized

Managing poultry house ammonia by farmers is governed by an increasingly strict guidance of local, state, and federal standards yet the promulgation of these standards retains for farmers relative choice in selecting on-site ammonia management options. These voluntary practices, developed within agricultural research and interaction with farmers, are called best management practices (BMPs). Two BMPs for ammonia management choices available to farmers examined in this dissertation are:

- Increased scheduled use of **poultry litter treatments (PLTs)**,[24] a proprietary additive to the floor of poultry houses to precipitate out ammonia from the air into solid waste for collection; this precipitation reaction takes ammonia out of poultry house air, thereby lowering total ammonia emitted from the exhaust fans (Sims & Luka-McCafferty, 2002).
- Installation of **vegetated environmental buffers** (**VEBs**),[25] a hedgerow-like structure installed near poultry house fans to capture ammonia and particles

[24] In the mid 1990s, when poultry litter amendments (PLTs) were first introduced at wide scale, both *amendments* and *treatments* were used to name this practice. Over time, the term poultry litter treatments became more common.

[25] Vegetated environmental buffer is now standard. However, older documents sometimes use vegetated emissions buffer or emissions buffer. VEB practices have two origins: 1) heritage farming horticultural practices that include hedgerows, windbreaks, living fences, and shelterbelts; 2) the agro-

> (Li, 2014; Yao, 2014; Buser; 2015, 2016). VEBs offer other benefits, including shading that reduced energy costs, reducing ammonia odor, and serving to help farmers manage their build environments.

Because farmers have some flexibility about these ammonia remediation practices, understanding their viewpoints on these choices is helpful to all stakeholders concerned with ammonia pollution in both local airsheds and watersheds of the Chesapeake Bay. In Chapter Four, the Q-sorting activity focuses primarily on these two voluntary ammonia options, with a research assumption being that part of why a poultry farmer selects these BMPs (alone or in combination) is based on the perceived values/benefits of these ammonia remediation techniques.

Implication for values/benefits in managing ammonia:

Poultry farmers pay attention to their scale of production as hitting up against being redefined as a CAFO, which would mean that their livestock activity could be treated as a point source of ammonia pollution, thereby entering a tighter and more costly regulatory climate. Farmers sometimes face a difficulty in balancing economic health about scaling poultry production and staying under a CAFO threshold.

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ecological practices of conservation strips/buffers and riparian buffers, directed at soil conservation and water quality.

Ammonia threatens ecosystem health and human health

Airborne ammonia is a serious component of air pollution globally (Sutton and Howard, 2018), with contributory sources[26] other than agriculture. However, livestock keeping—including poultry—is a source of excess ammonia pollution in the environment, with ammonia deposition (originating in air, then falling on soil and water surfaces) from agricultural operations a key component of total ammonia pollution.

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[26] Gaseous ammonia is the most abundant alkaline (basic rather than acidic) gas in the earth's atmosphere. In addition, the form of ammonia is a major component of total reactive nitrogen. Reactive nitrogen is available for use in plant growth or to form other forms of nitrogen. Agriculture, especially by animal keeping and in fertilizer application, are the largest source of atmospheric ammonia, globally.. Other sources include industrial processes, vehicle emissions, and volatilization from soils and oceans. Emissions have been increasing over the last few decades, globally. These ammonia emissions also form atmospheric particulate pollution. Air ammonia poses three harms: degraded ecosystem health of both air and water systems, impaired human health, and factor in climate change (particle pollution is one problem; interaction with other forms of nitrogen (NO_x) as well as Sulphur (SO_X). See:

Mark A. Sutton, et al .(2020). "Alkaline air: changing perspectives on nitrogen and air pollution in an ammonia-rich world." *Philosophical Transactions of the Royal Society*

Over the past century (especially, post-World War II), total global emissions of ammonia have more than doubled: from 23 to 60 tera-grams[27] per year. Air pollution researchers agree that the lion's share of this increase in ammonia pollution is due to an increase globally in agriculture-based ammonia emissions. Generally, the global agriculturally-generated ammonia increase in the atmosphere (last 70s years or so) is now apportioned in two sources: nitrogen fertilizer use contributes about 33% of total ammonia pollution typically within cropping systems; the other agriculture ammonia source comes from combined livestock production (cattle, poultry, and swine), these sectors contributing 66% of total ammonia pollution associated with food production (Bouwman et al., 1997), with these percentages largely confirmed by Beusen et al., 2008).

In agriculture, ammonia associated with animal production generally outpaces ammonia generated from crop fertilization practices in a ratio of about 60 percent to about 30 percent (Behera et al., 2013; Zing et al., 2013). In other words, most

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[27] One tera-gram=1 billion kilograms (about 2.2 billion pounds). Pounds is a typical metric used in Chesapeake Bay pollution discussions and is the chief metric used in the "pollution diet" or Total Maximum Daily Loads (TMDL) of the Chesapeake Bay Program, the intergovernmental regulatory structure for the Bay watershed (nine states).

airborne ammonia pollution from agriculture comes from livestock feeding practices. A poultry house, technically, is at the least qualitatively, an animal feeding operation if not quantitatively a designated AFO or CAFO[28]; poultry houses collectively within the entire poultry production sector (DE, MD, VA, and lower PA[29]) are the chief source of ammonia pollution on the Delmarva Peninsula.

For nitrogen pollution in the Chesapeake Bay watershed, about one-third of the nitrogen entering the Bay and its tidal watershed is from atmospheric deposition primarily of ammonia (air, then to soil and water). Recent estimates suggest that roughly one-half of this Chesapeake Bay nitrogen deposition is due to ammonia. (Paerl et al., 2002; Linker et al., 2013). For ammonia entering the Bay in or near the Delmarva Peninsula, this ammonia is largely derived from poultry operations. (Aneja et al., 2001; Bittman, 1977; Mikkelsen, 2009; Battye et al., 2017).

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[28] Recall Delaware's size designations of medium- and larger-AFOs sizes, based on numbers of birds.

[29] Poultry houses in the lower Susquehanna River valley produce eggs (layers), while Delmarva poultry production is largely for meat production (broilers). The USDA Grant that helped give rise to this dissertation also included a laying hen poultry house as part of their ammonia remediation studies. PA is one of the states that include the entire Chesapeake Bay watershed, in addition to Delaware, Maryland, and Virginia. The other states in this very large watershed (and part of the federally directed regional Chesapeake Bay Program) are New York and West Virginia, as well as the District of Columbia.

Managing nitrogen pollution on the Delmarva Peninsula means managing ammonia generated from poultry production. Excess nitrogen, along with phosphorus[30], drives

[30] Nitrogen (N) and phosphorus (P) are nutrients of concern for Chesapeake Bay water quality. The large number of high-P soils in Delaware is related to poultry production. This excess P accumulates in poultry litter, which is later applied to crop land, eventually causing a buildup of soil P to values of concern for water quality. For the purposes of this study, the focus in on ammonia. In the aggregate, managing poultry-based air emissions from poultry production does not affect P flux into water systems. This movement into waterways stems primarily from poultry applied to croplands, as well as faulty poultry litter storage practices. See

Sims, J.T., and J.L. Campagnini. 2002. Phosphorus removal by Delaware crops. Nutrient management factsheet NM-06. Univ. of Delaware, Newark.

Managing P in poultry production focused primarily on altered diets, resulting in lower P accumulation in poultry litter. Some studies suggest that PLT can change P availability in soil after application. Bottom line:, P is managed as a land-based problem in manure. Ammonia, for poultry production, is primarily an air effluent problem. See

McGrath, J.M., J.T. Sims, W.W. Saylor, C.R. Angel, and R.O. Maguire. 2005. Broiler diet modification and litter storage: Impacts on phosphorus in litters, soils, and runoff. J. Environ. Qual.

Binford, G., G. Malone. 2009. Evaluating BMPs for Temporary Stockpiling of Poultry Litter. University of Delaware.

Moore, P.A. and D.R. Edwards. 2007. Long-term effects of poultry litter, alum-treated litter, and ammonium nitrate on phosphorus availability in soils. J. Environ. Qual. 36:163-174.

Warren, J.G., C.J. Penn, J.M. McGrath, and K. Sistani. 2008. The impact of alum additions on organic P transformations in poultry litter and soils receiving alum-treated poultry litter. J. Environ. Qual. 37:469-476.

nutrient pollution in the Chesapeake Bay, causing seasonal algal blooms that reduce water quality. See Figure 2 below.

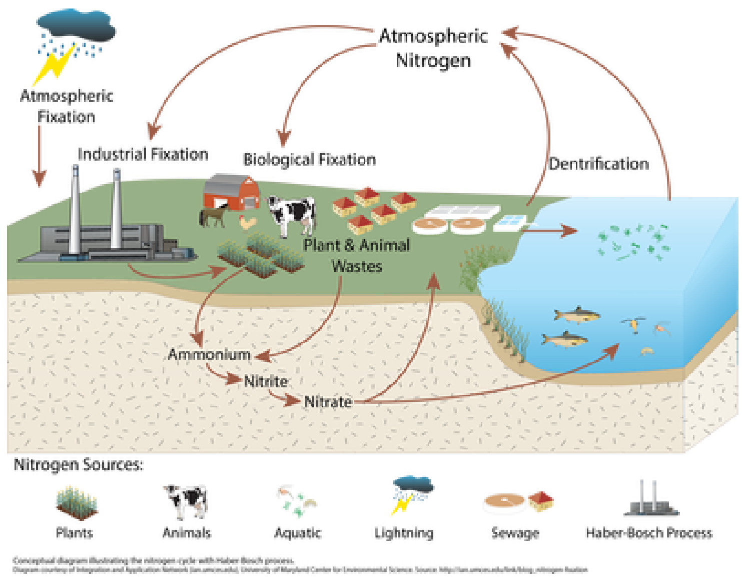

Figure 2: Nitrogen cycle in the Chesapeake. (Ward, 2008) With permission.

Figure 3 below depicts what ammonia effluent patterns look like specifically from poultry house production. Poultry farmers appreciate that this conceptual diagram leaves out the field application of poultry litter portion of ammonia (depicted jointly in Figure 2 above). Generally, poultry house ammonia deposition and field crop nitrogen seeping into waterways are "counted" and modeled together. However, as we shall see later, this 2019 study by Baker, raised several alarms in the Delmarva poultry community about measuring ammonia specifically from poultry house locations, as well as new approaches to modeling total ammonia generation from poultry house effluent.

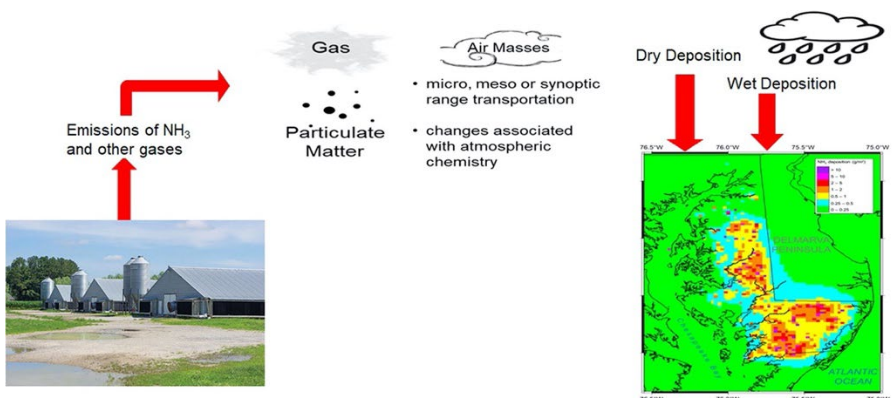

Figure 3: Ammonia Generation from Poultry Production, Maryland (Baker, 2022) with permission.

Implication for values/benefits in managing ammonia: *Poultry farmers are sensitive to being seen as responsible for both pools of agricultural ammonia pollution. Specifically, poultry farmers*[31] *want their attributed ammonia budgets to not count poultry litter-based nitrogen when used as field fertilizer (this is true, especially for*

[31] Recall that many poultry farmers both produce chickens and field crops. For discussion purposes here, poultry farmers are imagined to be primarily chicken producers. However, dual roles for farmers are common and can change over several years, as fields are left fallow, crops shifted due to incentives and market demand (like corn for biofuel), or field title changes by rental/lease, and sale agreements.

poultry farmers who do not have large and annual field farming activities). However, modeling agricultural ammonia, including from poultry production, is complex and typically includes poultry litter in aggregate ammonia flux analysis. Scientists who study ammonia generation from poultry operations are developing newer models and measurement methods that separate these two pools of ammonia pollution. However, more specific information on ammonia flux specifically from poultry production might lead to more regulatory control on poultry farmers. Now, most farmers vastly prefer the voluntary BMP approach to their non-point source[32] *ammonia production.*

New modeling and measuring of Delmarva poultry-generated ammonia

A 2020[33] study by atmospheric scientists, Jordan Baker and colleagues at North Carolina State University focused on the poultry house "pool" of ammonia effluent and pollution. They measured and modeled total ammonia from Maryland poultry

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[32] The EPA defines *point-source pollution* as any contaminant or noxious substance entering an environment from an easily identified and confined place. Classic point source pollution examples include smokestacks, discharge pipes, and sometimes drainage ditches. In contrast, *non-point-source pollution* characterizes pollutants released in a wide area, from diffuse sources. Agricultural ammonia has been treated largely as a non-point source pollutant. Over the last 50 years, the Clean Air Act and the "Clean Water Act have limited both point-source and nonpoint source pollution. Generally, point-source pollution is regulated more directly. Ammonia has not been regulated as a criteria pollutant under the Clean Air Act (CAA). However, a Maryland Circuit Court ruling in March 2020 (under appeal at time of this dissertation filing) might change ammonia's status as a pollutant. Because of wet and dry deposition, this ruling suggests that poultry-generated air ammonia can be regulated as a water pollutant. If so, then the CWA can apply to agricultural ammonia, through the nitrogen flows due to the deposition process.

[33] The 2019 online version generated responses: official publication date is March 2020.

production based on direct emission of ammonia from poultry houses (about 600 poultry houses assumed in this study) (Yao, 2018; Yang, 2020). Their methods represent newer ways to characterize, quantify, and identify sources of poultry-generated ammonia pollution (Yang, 2017; Yao, 2018), with one chief advantage the "backing out" of field application of poultry litter ammonia from poultry house-generated ammonia. From Baker (2020) two important findings offer new specificity about ammonia quantities and deposition location from poultry houses: first, these researchers found that the combined poultry production sources under study (approximately 600 poultry houses in Maryland) emit[34] an estimated 33.8 million pounds of ammonia per year to the air, with about 24.4 million pounds of that ammonia deposited to land and water on the Eastern Shore.

The second finding from Baker concerns where this poultry-house generated ammonia is deposited. Generally, the researchers found that this ammonia is deposited relatively close to the poultry house where the gas is generated. Overall,

[34] Discussion about Delmarva nutrient pollution tend to be conducted using pounds rather than metric units. A 12/2019 Chesapeake Bay Foundation press release converted the Baker figures from metric to English. Baker (using a velocity deposition for ammonia of 2.4 cm/s) estimated a total annual ammonia deposition of 11,100 Megagrams/year (10,600 Mg/yr deposition to land and 508 Mg/yr deposition to water). Conversion: 1 M=1,000,000 g=1.1023 US Tons.

about 30 percent of emitted ammonia is deposited to land or water within one third of a mile of the poultry house. About 70 percent of emitted ammonia is deposited within 31 miles of the generating poultry house (2020).

Baker's findings suggest that most of the ammonia pollution from Maryland[35] poultry production stays within the Bay watershed after being emitted. An additional reading of this finding is that the deposition of air-based ammonia occurs to water and soil close to the originating poultry house. This finding provides important spatial detail on ammonia deposition and warrants close follow up and inquiry in other Delmarva locations. One Delaware geographic level of study could be sub-watersheds with high poultry house numbers. For Delaware, Sussex County watersheds[36] are high in poultry production: the Indian River, Nanticoke River, and Broad Creek.

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[35] The Baker findings concern Maryland, which is closer to the Chesapeake Bay waters' edge (local Bay-land wind patterns) than much of Delaware. However, these findings are expected to apply to many other parts of the Delmarva poultry geographic area. Region and sub-region deposition studies are needed.

[36] DE watersheds do not all flow to the Chesapeake Bay. In the north, the Piedmont watershed (most of which is in PA) flows to the Delaware River basin. In north-central Delaware, a primary basin flows to the Delaware Bay/Estuary (includes part of Sussex County). Sussex County (about 300 square miles in eastern Sussex) includes the Inland Bays basin (Assawoman and Rehoboth Bays). The Chesapeake Bay basin cuts a north-south transect in eastern Delaware and includes parts of Sussex, as well as Kent and. This Chesapeake Bay basin also includes the MD counties of Caroline, Cecil, Kent, and Wicomico; and, finally, Chester County in PA.

This spatial finding about ammonia deposition implies two powerful conditions: for the specific sub watersheds of the Bay in this Maryland-located study, much of this ammonia pollution stays close to poultry farms—and people who live/work on those farms. In other words, the ammonia pollution from poultry production appears to stay close to location of production.

Implication for values/benefits in managing ammonia: *The Baker study and other ways to model ammonia generated by poultry production offer more specific ways to measure poultry house ammonia, separate from field applications of poultry litter. In addition to assigning ammonia generation responsibility, the Baker models also found evidence of the location of ammonia deposition. Ammonia deposition poses two types of risk:*

1. *water quality risks to Chesapeake Bay regional watersheds, especially the sub-sheds close to the geographic location of poultry houses; and*
2. *health risks from ammonia and particle pollution to people—including farm families—who live and work near poultry production.*

Delaware farmers paid close attention to this study. Delmarva is a region, with poultry an important social and economic binding activity.

Poultry farmer reaction to the Baker study

Some details of the 2020 Baker study were released late in 2019 under digital preprint conventions,[37] with the Chesapeake Bay Foundation (CBF) releasing some findings from the Baker study in a late 2019 press release. The CBF sponsored the Baker study; this funding source was acknowledged by the North Carolina researchers as per professional and publication standards (here, *Science of the Total Environment*, an Elsevier journal, established in 1972).

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[37] Digital access by November 2019; print publication March 2020. CBF press release, December 05, 2019. Nearly all commentary arose in Delmarva Press and on the DPI website in response to CBF press release summary of Baker findings. The March 2021 court ruling refers to the March 2020 paper, aka the Baker paper:

Baker, Jordan & Battye, William & Robarge, Wayne & Arya, S. & Aneja, Viney. (2020). Modeling and Measurements of Ammonia from Poultry Operations: Their Emissions, Transport, and Deposition in the Chesapeake Bay. Science of The Total Environment. 706. 135290.

The Delmarva Chicken Association (DCA)[38] responded quickly to the December 05, 2019, CBF press release.[39] Holly Porter, executive director for DCA—then called DPI—announced several objections, including concern about CBF sponsorship of this research. Regarding some of the methods in Baker, DPI objected generally to the modeling approach but seemed to accept some aspects of the researchers measurement techniques. Modeling and measuring are two different but complimentary approaches to estimating specific quantities of ammonia effluent from poultry production. Porter, for DCA, noted that modelers did not assume "rest" periods during poultry grow-out cohorts, meaning that Baker may have not included

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[38] Formerly Delaware Poultry Industry, Inc (DPI)) trade group. The Delaware Chicken Association (DCA) is the new name of the former DPI. This change was announced in November 2020. In this analysis, DCA was chosen over DPI even though at the time of this court ruling and political conversation, for clarity forward. DCA documents have all be renamed at their website; however, in news coverage from those dates, DPI is used. This name change seeks to center "chicken" within the name, mission, and revised logo; This name shift fits with two elements of applied rhetorical theory: that definitions matter and sometimes change over time and that definition-awareness can create closeness between speakers and audiences. See Chapter Two for discussion of stasis theory, definitions, and audience awareness in rhetorical situations.

[39] DCA, founded in 1948, is a 1,600-member trade association working on behalf of the broiler chicken industry in three states: Delaware, the Eastern Shore of Maryland, and Virginia's Eastern Shore. DC's educational program is extensive, with many instructional guides that include current BMP research on PLTs and VEBs. Indeed, DCA promulgated USDA CIG grant findings about VEB placement flexibility almost immediately after this information was shared in several Cooperative Extension sessions (DE) between 2015 and 2017.

down time between chicken “batches.” The modelers assumed poultry production during most weeks in a year.

Another DCA objection to model assumptions concerned a proposed lack of acknowledgment (by Baker) of two BMP strategies for managing ammonia, namely, PLT within poultry houses, and VEBs placed outside and near poultry houses. Analysis from the CPF responses to DCA noted that characterizing ammonia reduction amounts of VEBs and PLTs contribution would require consultation and data sharing[40] from poultry farmers and the poultry industry with scientists. Readers will note that focus of this dissertation is VEBs and PLTs as BMP choices made by poultry farmers to reduce ammonia from poultry production.

Researchers in the Baker paper had noted these limitations and were transparent about modeling assumptions and measurement conditions. Concerning PLTs and VEBs,

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[40] Consultation is taken up in Chapter Two, where consultation with poultry farmers is discussed in terms of farmer expertise and values farmers hold that shape ammonia choices. Chapter Five identifies farmer participation in data collection and data sharing as central to equitable and sustainable Delmarva poultry futures. The USDA CIG project included data collection at participating farm sites, one step toward better data and analysis cooperation within stakeholder communities.

researchers noted that this first iteration of their modeling did not consider these voluntary practices because they lacked detail on which farmers use PTL and on what schedules.

Improved modeling and measurement of ammonia effluent from poultry houses will rely on sustained exchange of knowledge and data between scientists and poultry farmers. For ammonia generated inside the poultry house and exiting by fan, details about PLT schedules are needed. Another aspect of ammonia generated within houses concerns the planned increase in size of newly installed poultry houses as well as ongoing breeding of proprietary breeds. Larger sized chickens produce more ammonia in their grow-out periods.

PLT occurs *within* poultry houses. VEBs, *outside*, are poultry-house adjacent. In the Baker study, direct measurement of ammonia deposition near poultry houses does acknowledge the ammonia-absorption presence of VEBs, as well as other Delmarva plant communities[41]—including small forest patches and riparian buffers, in addition to some fallow fields. This ameliorative action of VEBs is one of the chief functions of this phytoremediation strategy, which means plants absorbing or mediating pollution.

Data inputs for both modeling and measuring ammonia are best under cooperation between scientists and poultry farmers, as well as poultry companies who control many of the farmers' bird-rearing choices.

Implication for values/benefits in managing ammonia: *Poultry farmers and some other poultry industry stakeholders appreciate detailed knowledge from scientists about how to improve poultry production. However, some types of information that quantify ammonia production at the level of the farm, small watershed, or regional area, raise concerns in some stakeholders about how quantifying ammonia effluent sources better can lead to more stringent regulations. Note that many Delmarva farmers try to stay below the threshold for CAFO designation to avoid being treated as a point source of ammonia.*

[41] Ammonia and nitrogen move from emissions sources, with uptake by many plants close by. Some of the "lost" nitrogen in these modeling and measuring efforts assumes that several plant communities other than VEBs and field crops take up ammonia and incorporate into vegetative biomass.

In a curiously specific, important last paragraph in the press release, DPI's Porter suggested that the Baker analysis missed an important aspect of ammonia effluent:

> Even with these flawed assumptions in place, the model's predicted ammonia levels on Delmarva fell far short of concentrations noticeable by people, or concentrations with any effect on human health. When the researchers performed limited air monitoring on Delmarva, they recorded the highest levels of ammonia in a city and at a waterfront point close to southern Maryland[42] - not in rural, farmed areas. That's no surprise to Delmarva family farmers raising chickens who live and work on their farms, right alongside their flocks - after all, they care deeply about air quality, since they breathe the same air their neighbors do. (DPI, 2019)

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[42] This location, noted by DCA, is somewhat unclear but appears to be in response to Figure 4 in Baker, where Sample Location number 7 (No. 7) appears to be a location of measured high ambient ammonia. This sample location (No. 7) appears to be in Dorchester County (Taylor's Island, Hooper's Island, Fishing Island peninsulas), which is across from St. Mary's County, MD (near Leonardtown and Lusby) on the Western Shore. In the Baker paper, this identified location of high ammonia activity (No. 7) in their sampling nomenclature is acknowledged as experiencing marine wind influences, as well as other variables.

Porter (for DPI) seemed to be identifying a Baker-study location as a *hotspot*[43][44] of measured ammonia as not being anywhere near Delmarva poultry production. Ammonia accumulation and transport by air and water movement (nitrogen, too) is extremely complicated for the Chesapeake Bay system. Researchers in the Baker study did not dwell much on this location (identified as sampling site No. 7) measurement and appearing in red on their graphical displays of data. However, the choice of red by the Baker team is to denote amount on a color scale. Red, however, as a color signifier is often interpreted as meaning danger. Graphical communication use of red to technical readers likely "reads" as a high scale measure. However, to a non-technical reader—overhearing is common in digital distribution of technical literature—the red color and high scale condition can result in seeing danger[45]; hence

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[43] Generally, hotspot is defined as a location of significant activity or possibly danger. For example, a hotspot of nightclub activity or a hotspot of crime. In pollution studies, hotspot denotes a geographic location where emissions from specific sources is high enough that local individuals and communities may be exposed to elevated risks of harm to health. The term first appears in California in the 1970s. See the California Air Resources Board,

[44] What was being measured in Fig. 4 (No. 7 and other locations) from Baker is ammonia/nitrogen deposition. For No. 7 particularly, which is close to the main body of the Chesapeake Bay is other sources of ammonia and nitrogen transport, as well as other marine-shore influences. This data was used to generate data to develop and improve modeling of ammonia deposition. Figure 4 is not to be read as showing high ammonia testing locations as being directly due to specific poultry house ammonia effluent.

[45] The rhetorical power of color to signal quantity, scale, danger, difference, and other communication attributes is underexplored. Chapter Three, which looks at design approaches to small-scaled conceptual diagrams, briefly notes the role of color in science communication.

this data convention may be seen as a "hotspot.[46]" Scientists may need to become more aware of the many audiences for their research, especially in sensitive contexts like ammonia regulation on the Delmarva Peninsula.

This focus on hotspots in the Baker report by Porter for DCA reminds all that interpreting science data as well as understanding implications is very complicated.[47] In this same paragraph, Porter closes her press research by invoking lung health awareness.

As it happens, Porter is accurately invoking one motivation[48] for poultry farmers to address ammonia effluent on their farms. Many farmers and their families live close to their poultry houses, consequently, are worried about their lung health and that of

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[46] Definitions are a central part of stasis theory. See Chapter Two about care in ensuring that common definitions and descriptions means are shared, for collaboration but also in contentious deliberation.

[47] Chapter Five proposes a role for poultry farmers to use personal monitoring devises about ammonia. Farmers could share this data and build expertise in knowing their local, personal ammonia airshed. Data literacy can be improved. One motivation, even if the data is not shared, is that farmers learn about the ammonia risk to themselves, their workers, and their families especially if they live near their poultry houses.

[48] This dissertation study focuses on values and benefits embodied in ammonia management strategies. See the cards depicted in Illustration 1 at the end of Chapter One.

their families.[49] The argument being made by Porter for DCA, though, is that the ammonia effluent cannot be that bad because poultry farmers accept this amount of ammonia while living in proximity to this air pollutant. What is useful to consider, though, is that poultry farmers as noted in this study and other human beings are concerned about the health effects of environmental degradation, here air pollution especially (Alberini, 1997; Well, 2010). Also, important here in this discuss about the human health effects of pollution is the use of health proxies in economic valuation of environmental policy as well as pollution valuation work generally [50] (Dickie, 1992; Deluchi, 2002; Burtraw, 2003; Chilton, 2004).

Ammonia alone is not the only health risk. Dust particles from poultry production are of various sizes, including fine particulate matter (FPM), which biomedical science

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[49] See Chapter Four on Q-sorting. In the results, one of the values identified as important concerns lung risks posed by living near and working with poultry.

[50]See:
Millennium Ecosystem Assessment (MEA). 2005*a. Ecosystems and human well-being: general synthesis.* Island Press, Washington, D.C.
Millennium Ecosystem Assessment (MEA). 2005*b. Ecosystems and human well-being: current state and trends.* Island Press, Washington, D.C.
Millennium Ecosystem Assessment (MEA). 2005*c. Ecosystems and human well-being: health synthesis.* Island Press, Washington, D.C.

increasingly demonstrates as posing serious health problems. Further, ammonia molecules interact with dust particles of various sizes, forming FPM, increasingly of concern for human health (inside and outside the poultry house) because of the ability of very small particles to infiltrate deeply into lung tissues. Farmers may wish to know more about the special ammonia and particle pollution risks they face (along with their families and neighbors), on their poultry farms.

Implication for values/benefits in managing ammonia: *Explaining the complexity of ammonia, dust particles, and very fine particulate matter is essential to communicating the potential health risks of not managing poultry house effluent well. Poultry farmers, their families, and neighbors tend to be motivated to remediate pollution more so when human health risks are articulated well. Two lung diseases that ammonia and particles exacerbate are asthma (often beginning in childhood) and chronic obstructive pulmonary disorder (COPD).*

While lung problems from poultry production[51] and other types of organic dust in agriculture (Omland, 2002; Rinsky, 2019) have been thought of as primarily an

[51] A newer line of inquiry about lung health and poultry exposure concerns slaughterhouse poultry workers. The exposure to poultry dust is part of this profile, as processors handle birds, including high contact time with feathers. See:

occupational hazard for poultry workers and poultry farmers, scientists continue to study possible causal factors about livestock-generated ammonia air pollution, including that associated with poultry (Gerber, 2020) and lung health (Henneberger & Hopkins, 2019). Many studies focus on childhood asthma, with what look to be clear associations with measured animal feeding operation (AFO) ammonia and several markers of asthma response (Loftus, 2020).

Efforts to study ammonia and both childhood asthma and COPD in Maryland and Virginia are ongoing but face obstacles, including difficulties with sighting air pollution measuring gear close to poultry farms[52]. Political opposition is sustained, too. Briefly, in Maryland, two bills long proposed remain stalled in committee work and harmonization between the two houses of the state legislature: Senate Bill 542, the Community Healthy Air Act, calls for a standing committee for air quality monitoring, especially on the Eastern Shore. A related bill about poultry industry pollution is Senate Bill 546 that addresses air, water, and soil quality. 546 would codify new manure handling and water quality regulations with new permitting thresholds about construction of new poultry facilities. Neither bill advanced in the 2020 and 2021 legislative sessions.

Mirabelli, M. C., Chatterjee, A. B., Mora, D. C., Arcury, T. A., Blocker, J. N., Chen, H., Grzywacz, J. G., Marín, A. J., Schulz, M. R., & Quandt, S. A. (2015). Airway obstruction among Latino poultry processing workers in North Carolina. *Archives of environmental & occupational health*, *70*(1), 63–66. https://doi.org/10.1080/19338244.2013.787965

[52] In the USDA grant that inspired this dissertation, ammonia monitoring sensors and other atmospheric assessment equipment was not only permitted on two farm locations but the poultry farmers and their families became deeply interested in the testing, findings, and keeping ongoing relationships with some of the researchers.

A new ammonia monitoring project, however, is now underway, with direct participation by DCA. Along with the Maryland Department of the Environment and the Keith Campbell Foundation (Annapolis), this project will measure ammonia effluent in several lower Eastern Shore Maryland locations, including near poultry production[53]. Begun in 2019, with some interruption due to the pandemic, this project is also collecting preliminary data on levels of ammonia and particulate matter near poultry houses to compare with air quality conditions in other Maryland locations. Public health scientists in Maryland and elsewhere are awaiting this data[54] to use in examining childhood asthma rates in counties both in and adjacent to these study sites.

Implication for values/benefits in managing ammonia: *Poultry farmers feel often overly blamed for ammonia and nutrient (nitrogen and phosphorus) pollution in the Chesapeake Bay region. Many farmers are concerned about increasingly localized monitoring of ammonia effluent. Generally, poultry farmers see nutrient pollution in water systems as a larger problem of air and water nitrogen transport from areas/activities other than just Delmarva poultry farming.*

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[53] The Lower Eastern Shore Ambient Air Quality Monitoring Project agreement is between the Keith Campbell Foundation for the Environment and Delmarva Poultry Industry, Inc. (DPI) – now Delmarva Chicken Association (DCA), who provided $500,000 to the work, in cooperation with the Maryland Department of the Environment (MDE). In-kind contributions and technical assistance are the lion's share of MDE's contribution.

[54] Chapter Five proposes a "citizen sensing" air pollution approach in Delmarva, whereby farmers would own and operate sensing data equipment to monitor ammonia and particulate matter. Citizen sense projects often result in public participants becoming more aware of the invisible risks posted by air pollution. Such projects also include data education, which could help improve science communication and public understanding of air pollution extent and risks. Perhaps the Baker study use of red for scale and not specifically as a "hotspot" as interpreted by DCA could be one illustrative case about scientists intent to convey and what public readers might infer.

Health effects of ammonia and particle pollution are of concern but seen more as an occupational hazard experienced inside the poultry house by farmers and poultry workers. Privately, many poultry farmers and their families are worried about poultry fan effluent and the risks of asthma, pneumonia, and COPE to farm families and neighbors

However, recent activity about ammonia monitoring by the DCA suggest that poultry farmer and their advocates want to be deeply involved in the monitoring discussion and perhaps even in taking on a more direct role in ammonia monitoring.

<u>*Participant viewpoint: Poultry farmers see a halo of ammonia within local use of poultry litter*</u>

Economic framing of pollution would identify poultry litter as a negative externality of poultry production. Delmarva farmers—both crop farmers and poultry farmers—do not always view poultry litter as a negative. For Delmarva, poultry litter is a locally available, nitrogen-rich fertilizer that is much less expensive than nitrogen from commercial fertilizer sources. Poultry litter, by supporting crops at a relatively reduced cost, is—by some Delmarva farmer viewpoints—a positive or mixed externality. Farmers need *available or reactive* nitrogen to grow both truck and commodity crops for market. Poultry litter provides that available nitrogen, at extremely low cost. In addition, the organic matter in poultry litter offers soil amendment qualities not typically part of industrially-generated nitrogen fertilizer.

Even though most poultry farmers want to disaggregate poultry house ammonia pollution from poultry litter ammonia plus nitrogen pollution, some of these farmers also grow crops over their lifetime in agriculture. Even for those who raise poultry exclusively, farmers understand the centrality of fertilizers to agriculture in modern food production. Two extremely helpful literature reviews (Erisman et al. 2008; Leach et al. 2012) explain and quantify the *halo* and *shadow* associated with human uses of reactive nitrogen for agriculture. The Leach paper is marvelously adapted to public audiences interested in seeing that agricultural ammonia and nitrogen pollution reflects meeting a larger human need concerning low cost and varied food dietary choices, including the high-quality, low-fat protein of chicken meat.

Implication for values/benefits in managing ammonia: *Farmers see nitrogen's good face as an essential nutrient for soil fertility and plant growth. Some farmers are aware of the long history of communities and markets to secure much desired nitrogen fertilizer. Awareness of this value helps in understanding farmer viewpoints on managing ammonia. Manure use is a heritage farming technique, of long-standing value.*

Why is discussion of global nitrogen agricultural practices important for understanding Delmarva poultry production? Interestingly, the availability of poultry litter as a fertilizer amending on the Delmarva Peninsula means that the reactive and available nitrogen fertilizer largely comes from chicken manure, in the form of poultry litter. This local virtuous loop is, at heart, a local heritage farming practice of long standing: fields are dressed with locally available poultry litter at extremely low cost. However, this virtuous practice (seed by farmer viewpoints) can and does result in excess nitrogen run-off into soil and water systems, including the Chesapeake Bay watershed. Here is one part of the agricultural run-off problem for nitrogen from field application. However, airborne ammonia from poultry houses first off cases as effluent but is later deposited to soil and water; this ammonia deposition from poultry production is the focus on this dissertation. See Figure 3 above, from Baker, to see the ammonia-based nitrogen pathway for Chesapeake Bay nutrient loading.

Implication for values/benefits in managing ammonia: *Poultry farmers see the local use of manure in the form of poultry litter in two positive ways:*

1. *As a closing-the-loop virtuous activity whereby a byproduct of chicken production (poultry litter) is used to improve crop production for themselves or their neighbors;*

2. *That the use of poultry litter as a nitrogen (and phosphorus) fertilizer, along soil amendment qualities is a long-established heritage practice, with a sense of being* natural *and* organic, *rather than the use of chemically derived "big Ag" fertilizer.*

Use of this locally-available poultry litter as a crop fertilizer is important later in assessing poultry farmer preferences about some aspects of ammonia management (see Chapter Four on Q-sorting).

In contrast to the fertilizer "benefit" in poultry litter, poultry farmers are aware of ammonia problems from their exhaust fans. Ammonia effluent here largely does not have a second life as fertilizer. Poultry farmers also see that the localized conditions of this source of ammonia coming as it does from their poultry houses means they have some level of remediation control. Both VEBS and PLT, voluntary management practices described earlier, can help farmers capture ammonia at the site of production. Understanding farmer agency as already engaged in ammonia remediation practices is important to understanding how they value different reasons for managing poultry house ammonia.

Poultry farmer viewpoint: Historical context about nitrogen as agriculture technology

A chief value held by most farmers is immense pride in providing food for others. Agriculture technology—including fertilizers and other products to improve productivity—is used by farmers to increase production quantity and quality for many reasons, including for the farm to remain as a going business concern. Definitions of sustainability for farmers including staying in business. Some families wish to keep specific land in production, often within a family across generations.

Implication for values/benefits in managing ammonia: *These heritage aspects of farming practices and farmer expertise are central to understanding some of the choices that poultry farmers will make about why they manage ammonia from their production. Many poultry producer families are of several generations, with long ties to the localities and often specific parcels of land.*

The sense of "natural" fertilizer over chemically derived nitrogen fertilizer deserves mention. Poultry litter is a "natural" product. Using this type of fertilizer rather than purchasing a soil application product from, say, Cargill, is a rational act by farmers, which could be seen by a knowledge public, a virtuous, natural action. Crop farmers have at their use a low cost, natural form of fertilizer for their crops. Farmers work to remediate the water quality posed by poultry litter field application. Several best practices—tillage types, cover cropping, extensive testing, timing of application—all help secure the much-needed nitrogen for plants, while reducing nitrogen run-off into water. Delmarva poultry farmers want public stakeholders to understand that poultry litter can be part of local, integrated agro-ecological practices.

Implication for values/benefits in managing ammonia: *Working local land for crops, in addition to raising poultry, is important to many poultry farmers. Some poultry farmers are also crop farmers; poultry farmers understand the concerns of their crop farming neighbors. Poultry litter is transferred to crop farmers, sometimes for a fee but sometimes in less formal trade or barter/ gift transactions.*

Context: Delmarva poultry production central to regional economy

The Delaware Chicken Association (DCA) keeps records on the combined Delmarva poultry industry (Delaware, Maryland, Virginia). For 2020, the most recent compilation of economic activity[55], see Figure 4 below. Table 1, also below, excerpts the most useful data from Figure 4.

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[55]Assessments of the effect on COVID-19 on the global and domestic poultry industry; generally, the emerging consensus is that the early dip in sales due to market deformations at both the supply and

In 2020, the Delmarva chicken community:	1-year change	10-year change	20-year change
Raised **570 million** chickens.	-6%	2%	-5%
Processed **4.2 billion pounds** of chickens.	-1%	24%	31%
Operated **5,036 chicken houses** on independently owned farms.	-2%	8%	-12%
The houses had a capacity of **149 million chickens**.	3%	18%	17%
There were **1,278 chicken growers**.	-4%	-25%	-49%
They earned **$280 million in contract income**.	0.2%	35%*	26%*
There were **17,955 chicken company employees**.	-2%	21%	30%
They earned **$741 million in wages**, excluding benefits.	-5%	34%*	40%*
Feed ingredients for chickens were purchased for **$1 billion**.	-0.4%	2%*	43%*
The wholesale value of chicken produced was **$3.4 billion**.	-5%	47%*	63%*

* Inflation-adjusted.

Figure 4: Poultry production of broilers in Delmarva, 2020 (DCA, formerly DPI).

Detail from Figure 4 (above)	**1-yr**	**10-yr**	**20-yr**	**Notes:**
570 million chickens	**-6**	**2**	**-5**	Delmarva poultry industry is not growing steadily; pandemic effects likely in the 1-yr change
4.2 billion pounds of chicken	**-1**	**24**	**31**	Bird size/health/feed conversion ratios: important to productivity; pandemic effects likely (1-yr change)

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demand ends is now recovered. You can see a dip between 2020 and 2019, that reflects in part some aspects of the pandemic. However, USDA figures provide helpful information here for the entire US broiler (chicken for meat; not eggs), noting that both production and slaughter were down from 2019, year over year for the second, third, and fourth quarters, in large part due to COVID-19-related market disruptions.

See this 2021 USDA working paper: https://www.usda.gov/sites/default/files/documents/covid-impact-livestock-markets.pdf

5,036 poultry houses; 149 million chickens capacity	**-2** **3**	**8** **18**	**-12** **17**	New chicken houses are larger; capacity to grow chickens increasing
1,2788 chicken growers	**-4**	**-25**	**-49**	Chicken growers aging /leaving/not being replaced; more higher capacity houses might need fewer farmers but more poultry workers

Table 1: Selected attributes of Delmarva poultry industry 2020; excerpted from DCA in Figure 4**.**

Poultry farmers are very sensitive to future regulatory regimes that could revise regulatory frameworks[56] on ammonia generation. Some Delmarva poultry farmers are deeply concerned about being responsible for ammonia specifically but nitrogen more generally from poultry litter application of fertilizers. The argument goes: That is ammonia that is now the responsibility of the crop farmer or crop farming activity and not the poultry farmer or the poultry farming activity. For farmers that are both crop

[56] Recall the complexity of ammonia regulation described earlier: Federal oversight on air and water quality, including the regional Chesapeake Bay Program; state interpretation of federal laws and definitions about field farmer poultry litter applications and poultry farmer ammonia generated from agricultural feeding operations. At a threshold, AFOs can be categorized at CAFOs, where point pollution management regulations can be applied.

and poultry producers, they wonder about partitioning these roles in their farming activity generally.

To remind the reader of this dissertation: Poultry farmers are aware of the ammonia and particle pollution from their poultry house exhaust fans. Farmer remediation decision making about this effluent is the focus of this dissertation. All are aware of the complex interplay of ammonia pollution in a region, including from urban pollution sources or even some industrial sources that enter the Delmarva airshed from larger air circulation patterns.

Poultry farmer viewpoint: Delmarva broiler industry pride in chicken production

The contemporary broiler industry—chicken bred for meat—began in Delaware.

Delmarva was like the rest of the country, then. Households and small farms kept small flocks, primarily as egg layers. These eggs were sold, often by women[57], in

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[57] The author's grandmother was an "egg and butter" lady, bartering with neighbors and selling to several markets in Leavenworth, KS and both Kansas Cities (KS and MS).

information and local markets. Eating chicken was a by-product of keeping egg layers. An accident turned Sussex County, DE into what was in the mid-1990s, the nation's most populous county for chickens. Historian William Williams described the 1923 incident of Cecile Long Steele (Ocean View, DE) who ordered 50 chicks for her yard flock. Filling her order was Vernon Steen (Dagsboro, DE) who made a place error: he delivered 500 chicks.

Williams describes this foundation of the Delmarva poultry industry in his 1998 masterful *Delmarva's Chicken Industry: 75 Years of Progress*. Steele accepted all the birds, resolving to rear all 500 chicks. A little over four months later, the Sussex County housewife had 387 birds, weighing, on average, 2.5 pounds apiece. She sold the birds among neighbors for 62 cents a pound. Pleased with her earnings, Steele ordered 1,000 birds. By 1926, her family (husband Wilmer and children) were raising 10,000 chicks to table size, annually, for Delmarva small markets and butcher shops (Williams, 1998).

Delmarva poultry farmers are aware and proud of their heritage in developing the poultry industry. While the storied heritage of the Eastern Shore tends to be defined by watermen—who fish for oysters and blue crab—poultry farmers are no less proud of their heritage.

Implication for values/benefits in managing ammonia: *Many Delmarva Peninsula poultry farmers are agricultural production families for several generations. Poultry farmers are rightly proud of the food production heritage and a tradition of working family land. Further, poultry farmers know that the modern poultry industry story began on the Peninsula. A sense of heritage and pride is part of many farming decisions, with a wish to keep land in production.*

Context: Chicken in every pot[58]: now a global aspiration

Chicken's feed-to-pound efficiency and affordability allows a rising global middle class to consume chicken meat (and eggs), often imported from the U.S. The United Nations Food and Agriculture Organization (FAO) notes, that in 2013, least developed countries were increasingly dependent on imported poultry meat, rather than household or small farm-hold sources: chicken imports (frozen) increased from 3

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[58] People are nostalgic about food. See Chapter Five for nostalgia, technology, and rhetorical analysis from William Kurlinkus. Nostalgia shapes consumer demand including for chicken. Future poultry redesign can begin in examining the past, with some scrutiny of the rosy nostalgia haze for problems best left in the past.

percent (1961) to around 30 percent (FAO; 201; FAO, 2017). One reason for this preference for imported frozen chicken reflects a status preference for packaged food that might be safer, more convenient, and perceived to be a product far removed from wet markets and slaughter practices.[59] See Woo (2006) for a good summary of how wet markets, work, changes in consumer preferences, and concerns about zoonotic transmission in slaughter conditions.

Some additional aspects of poultry production make chicken easier to sell in international markets: small size, availability across seasons, and ease of slaughter and preparation.[60] Chicken is a relatively stable livestock-based protein source. Indeed, unlike beef and pork, poultry is not traded on the food commodities market. Beef and pork, on the other hand, is more seasonal (especially for cattle) both taking more resources and time to raise, process, store, and transport. Pigs and cattle entail

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[59] COVID-19 simply raises worry about food sources. Many middle- and upper-class people in countries with wet markets[59] may seek more imported, frozen meat like chicken in response to the COVID-19 crisis. Security concerns with food chain disruption is also heightened under the ongoing pandemic (time of writing).

[60] Chapter Five considers how the flexibility of poultry production in a food system might make for local supply chains, niche markets, and revised practice that center farmer agency and consumer preferences. Nostalgia plays a role here, particularly about how consumer wish their food was produced.

more risk, too. Chickens are produced largely inside, protected from weather. With beef especially, weather events can cause supply shortages and disruptions. Hedging is one way that beef and pork farmers and traders deal with such risks, with commodities trading one mechanism. Occasionally, all meat futures markets experience high volatility and the topic of markets perhaps shifting chicken futures[61] arises briefly (DePillis, 2014). However, chicken remains a non-futures-based food commodity.

More importantly, vertical integration of the poultry industry reduces risk substantially. Vertical integration also means that suppliers and purchases are already in close communication about contracts. Suppliers own or control most poultry production, including slaughtering. Much of the slaughter is connected to frozen food preparation, to fulfill contracts in place with end-users like fast food companies. Think KFC for fried chicken and McDonald's for chicken (Mc)nuggets. Restaurant food suppliers also purchase prepared poultry products for the highly lucrative

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[61] Chapter Five, the conclusion, briefly addresses several chicken "futures," all predicated by several scientists and analysis: antibiotic resistance, bird flu pandemics, climate-based changes about temperature, disruptions to supply chains, loss of genetic material due to use of few breeds for broiler production, etc.

“wings” markets. This context allows poultry companies to lock in prices for most of the time. The result: little need for a poultry futures market.

Implication for values/benefits in managing ammonia: *Delmarva economic stability depends in large part on the conditions of the poultry industry writ large. Poultry farmers know that they, increasingly, grow for both domestic and international markets, particularly a frozen meat commodity packaged for this demand. This ability to participate in these markets is mediated by the vertical integration practices that characterize the Delmarva poultry industry.*

Participant viewpoint: Global middle class: not surprising to Delmarva poultry farmers

Homi Kharas, now at the U.S.-based Brookings Institute, developed a synthesis definition and analysis framework for the Organisation for Economic Co-operation and Development (OECD) about the global middle class. Kharas’ definition:

> The middle class has been defined by myself and many others, before and since, as comprising those households with per capita incomes between $10 and $100 per person per day (pppd) in 2005 PPP terms (Kharas, 2010; World Bank, 2007; Ernst & Young, 2013; Bank of America Merrill Lynch, 2016).

This definition implies an annual income range for a four-person middle-class household of between $14,600 to $146,000 (Kharas, 2017).

The increasing use of imported frozen chicken reflect this improved condition for many global families. The COVID-19 pandemic is deforming food markets and wages. The larger point, however, is that Delmarva poultry farmers are very aware of global and domestic demand for their broilers. At a 2012 gathering of poultry producers in Georgetown, Delaware, a farmer said to the author that the first purchase made by developing country people upon entering the middle class is a refrigerator with a small freezer. He thinks about this fact often and how far his frozen birds travel.[62]

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[62] COVID-19 is interrupting—for now—this growth of the global middle class. A Pew Report (2021) released in March identifies two economic trends responsible for this interruption: first, losses in the global middle class of about 54 million, in 2020 compared to the number projected to enter the global middle class prior to pandemic onset; and second, an increase in the number of the poor is now estimated to be 131 million higher than expected because of the COVID-19 induced global recession. The World Bank Global Economic Prospects (January 2021) reports a loss of 4.3 percent in 2020 economic activity, and a loss of 6.8 percent from 2019. DCA spokesperson (March 21, 2021 Zoom meeting) estimated a downturn for Delmarva poultry production of about 5 percent due to pandemic associated food chain disruption

Multinational fast-food companies also are part of the global demand for frozen chicken. These companies are not transparent about much of this activity. Analysts think, though, that the Chinese market for U.S. frozen chicken includes urban fast food. These food companies still "sell" frozen chicken in China even during that pandemic. Some of this supply is held up in storage facilities located through the world. Processed frozen chicken for the restaurant industry is relatively easy to store and to ship, making poultry products nimble in face of politically generated changes including the tariffs faced by China, imposed by the Trump administration (2017-2019).

Implication for values/benefits in managing ammonia: *Poultry farmers are deeply aware of the global context in which their chicken products enter markets. Indeed, poultry farmers who might want to leave vertical integration contracts and grow for local markets face many barriers about scale and predictable income over the years during a transition phase. Some younger poultry farmers wonder if they can grow for local urban markets under a CSA type scheme or at "Amish" markets. Some Delmarva poultry farmers are Mennonite, with some connections and interests in sustainable smaller, niche markets.*

Environmental scientist approach: Framing chicken demand with nitrogen footprints

Environmental scientists at the Virginia Institute of Marine Science (VIMS) recently developed a nitrogen footprint—an *N-Print*—to link human demand for poultry with nitrogen pollution created by poultry production. The N-Print work of Galloway and Leech (2016) advocates for using nitrogen footprints, much like carbon footprints, to help consumers understand their role in the nitrogen pathway from poultry production and chicken consumption, with ammonia effluent one of the externalities.

Implication for values/benefits in managing ammonia: *Generally, environmentally sensitive food system analysis will tend to favor poultry over other land-reared livestock. Poultry farmers want their food product to be seen in this light as a greener (lower carbon) meat than beef or pork.*

Implication for values/benefits in managing ammonia: *Some discussion of chicken industry innovation on the Delmarva Peninsula includes options of a "seal" of Chesapeake friendly boutique chicken product. These discussions take place largely inside companies, with some thoughts that Perdue would be more likely to entertain such a seal. In 2015 Perdue (fourth-largest chicken producer in the U.S., purchased boutique meat producer Niman Ranch. In addition to pork (antibiotic-free) Niman also produces beef, lamb, even eggs in some alternative markets. Most interesting, though, Niman requires that its hogs "must be raised on pasture or in bedded pens." instead of CAFO operations. Scale of livestock feeding, and the related manure* *volume is a major contributor to ammonia emissions from agriculture, including poultry.*

<u>*Domestic consumer preferences: Shaping marginal changes in "poultry portfolio"*</u>

Food demand is complex. For example, health and convenience drive a great deal of domestic food demand. Chicken is perceived as healthier by U.S. consumers. Chicken storage and food prep is also, generally, easier than that of beef or pork.

Some consumers are sensitive to the relative carbon intensity of meat. Generally, poultry poses a lower carbon footprint that other meat options. Indeed, poultry farmers can argue that lower carbon-intensive chicken can be part of the many trade-offs made about managing pollution profiles. At the very least, thinking about N-Prints and "C-Prints" helps consumers see that demand for chicken contributes to nutrient loading in the Bay, as well as ammonia air pollution. Then, larger social problem-solving structures can place nutrient "blame" on poultry in a larger context of consumer demand and trade-offs about a lower carbon profile but higher nitrogen profile. Consumers are better able to sway larger poultry companies than are farmers.

Implication for values/benefits in managing ammonia: *Poultry farmers are aware of niche markets—less processed food, farm-to-table, and farmers-market culture. Poultry farmers often say that vertical integration means that these choices are largely not in their agency unless a company segments their products and a grower shifts under contract. For example, if Perdue were to offer specialty chicken under their label or to upscale grocery stores or restaurants, revised contracts could be proffered by the company and not likely initiated by the poultry farmer.*

Poultry farmer viewpoint: ammonia monitoring and point source looming in both air and water sheds

Delmarva's nitrogen pollution profile is well documented. Delmarva is a designated hotspot[63] of agriculture-generated nitrogen pollution, especially for the Chesapeake Bay watershed. For cropland-based nitrogen pollution, the Delmarva Peninsula ranked 17 out of 20 nitrogen hotspots nationally, identified by a 2021 University of Vermont Gund Environment Institute study, appearing as an open access review in

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[63] This definition will come up again in Chapter Five. A hotspot describes locations where emissions from specific sources such as water or air pollution may expose local populations to elevated health risks, such as cancer or lung problems (asthma and COPD).Hotspot terminology arose from health risk assessment concerning criteria air pollutants. "Toxic hot spot" likely began with the California Air Resources Board in the late mid 1990s and is now widely used.

Environmental Letters (Roy, 2021). Here, the hotspot designation refers to the entire region due to nutrient loading from poultry production in air and watersheds.

Nutrient and sediment numbers for Delmarva and other impaired water ways are monitored and promulgated regularly by many state and federal entities. Two useful, public-facing nutrient synthesis factsheet series are produced regularly by the U.S. Geological Survey (USGS) See (Philips, et al, 2017; Hyer, 2020).

Pollution control in the Chesapeake involves many land-use tradeoffs concerning nitrogen and carbon. Furthermore, global and local demand for poultry by consumers is not always an explicit factoring of carbon and/or nitrogen trade-offs. Food systems are based on human dietary needs, expressed also by available money for satisfying hunger. Two huge drivers of poultry choice by consumers concern the relatively low cost of poultry v. cattle and pork and, for more affluent consumers the health benefits of choosing chicken over beef, on the table.

Implication for values/benefits in managing ammonia: *Poultry farmers are increasingly aware of emerging health and environmental threats associated with poultry production at larger industrial scale. Ammonia hotspots can be one result,* *with water quality and human health consequences. One poultry production response is to use more screening (VEBs) and ammonia odor reduction strategies (VEBS and PLTs), for better neighbor relations and to not draw attention to poultry production and large quantities of stored manure.*

<u>*Context: Agricultural intensity over time*</u>

Poultry production on the Delmarva Peninsula reflects in part the history shift in agriculture from extensive to intensive. *Extensive* farming, in contrast to *intensive f*arming, first, tends to be practiced at a smaller scale, often reflecting traditional or heritage farming approaches. This intensive farmer occurs on land that is increasingly attractive for residential development.

Delmarva farmers are aware of viewscape[64] problems, for tourists to the area and for people moving to new residential communities. The use of trees and shrubs in hedgerow and windbreak configurations are heritage farming practices akin to some of these masking strategies, well deployed and developed in some parts of Europe. Vegetated emissions buffers (VEBs), a type of technically defined hedgerow, is a

[64] "Odor-scapes," too, as housing communities are increasingly located near poultry operations.

central nitrogen remediation technique noted earlier as a technique many poultry farmers now use to reduce ammonia from their poultry houses.

Implication for values/benefits in managing ammonia: *Intensive farming has higher energy costs. Most energy costs mean a higher carbon footprint profile. VEBs (primarily used to capture ammonia and particulate matter) also work as traditional windbreak and hedgerow stickers when sited near farm buildings. In the summer, VEBs reduce the fan run times and speeds, due to shading. Poultry farmers know this mixed benefit of VEBs, with the structure reducing energy costs. Increasingly, VEBs address nuisance problems faced by poultry farmers when neighbors object to the sights and smells of farms.*

Now, Delmarva is moving to more intensive production of poultry. Two opposing conditions are colliding: the first condition concerns labor, with the decline in numbers of poultry farmers by more than half over the past 20 years. Part of this is aging and part is due to land pressures. The second force concerns a shift to large poultry houses; many Delmarva residents and government officials are concerned with what will be even more concentrated AFOs.

<u>Poultry farmer viewpoint: Delmarva broiler sector faces huge domestic competition</u>

While Delmarva may be home to the poultry industry, domestic production share has dropped. Over the last ten years, the top five broiler-producing chicken states have become Alabama, Arkansas, Georgia, Mississippi, and North Carolina. See Figure 5 below for snapshot of national poultry production by state. Delmarva poultry production remains high, with regional presence in Eastern Seaboard markets.

Some long-time observers suggest that Delmarva states face increased regulation, especially from the U.S. federal Chesapeake Bay Program, that can explain a shift toward these states, all of which are in the South. Poultry companies pay close attention to what the future of poultry production will be; poultry companies have expanded their vertical integration practices to a number of these states, beginning in the 80s.

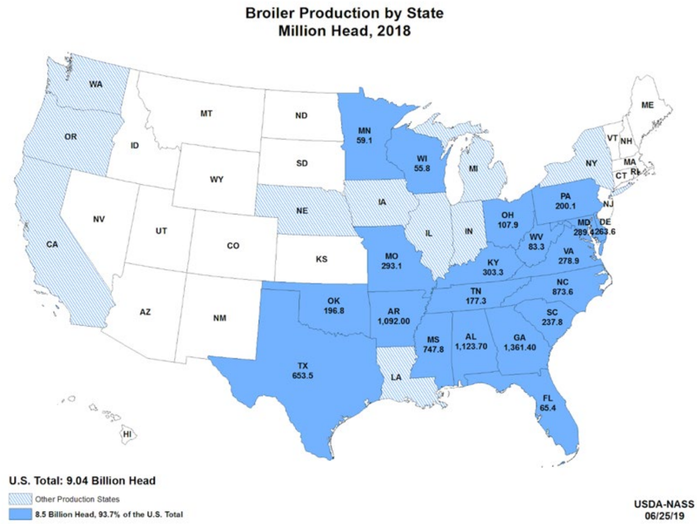

Figure 5: USDA Total US Broiler Production by State, updated quarterly. US total broiler production = 9.04 billion head. Detail on DE, MD, and VA total—in millions for each state, respectively: 263.6, 289.4, and 278.9. Estimates for Delmarva Peninsula for 2019 = 605 million broiler chickens raised. (USDA, 2019) (DPI now DCA, 2019)

Implication for values/benefits in managing ammonia: *Delmarva poultry farmers are concerned about competition from other U.S. growers to meet the lucrative markets for national and international poultry market demand. Staying competitive locally makes stringent nitrogen management—including ammonia—more difficult for many poultry farmers who see that ammonia from poultry houses might become a point source of regulatory pollution, compared to the non-point source of cropland poultry litter applications. Some farmers want the poultry litter ammonia and nitrogen profiles "backed out" of their obligations.*

Context: Poultry "farmer choices" within vertical integration of industry

In short, poultry farmers—called producers or contract farmers—grow contractually for one of several larger poultry companies (for example, Purdue, Tysons, Mountainair). More than 90% of all chickens raised for meat in the US (broiler chickens) are raised by contract farmers. The typical contract works this way: poultry producers are independent farmers (own or rent their land), who invest in and build poultry houses, yet partner with a chicken production and processing company to raise birds to market slaughter conditions. The production and processing company provides chickens, feed, veterinarian care, and technical advice and other specifications.

This contractual relationship between poultry producer (farmer) and company (food producer) is called vertical integration. Vertical integration in agriculture and agribusiness became a hallmark of farming commerce in the early 80s, though aspects of such integration activities and relationships are of much longer standing[65]. Simply

[65] Arthur Perdue widely is credited with creating vertical integration for poultry production on the Delmarva Peninsula. By 1968, Perdue Farms began operating poultry processing plant in Salisbury, MD. This move gave the company full vertical integration and quality control. From the 1930s forward, the Perdue family shifted from growing out chickens to providing chicks for other poultry

put, vertical integration calls for the supply chain of a company to be owned by that company. By the early 2000s, in the U.S. approximately 90% of poultry, 69% of hogs, and 29% of cattle were contractually produced through vertical integration (Skolstaden, 2008; USDA ERS, 2015). Figure 6 below shows how vertical integration works for poultry production.

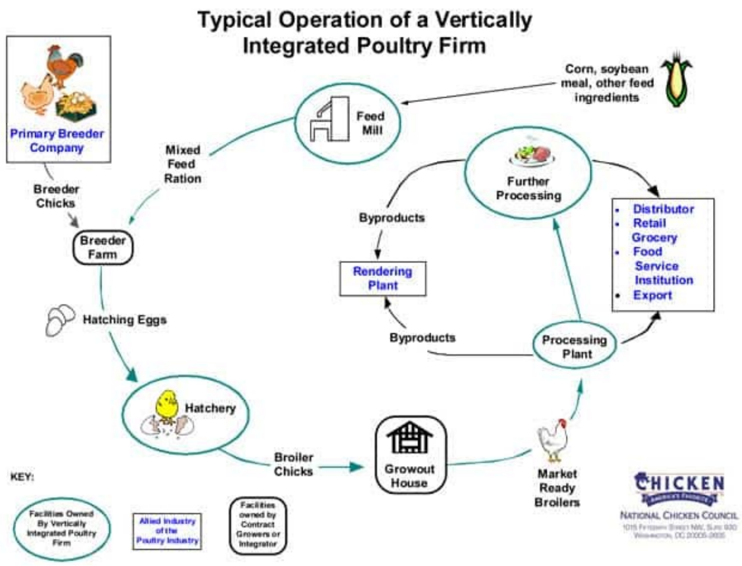

Figure 6: Vertical integration in poultry production. (National Chicken Council 2019

The independent poultry producer—farmer—is then paid an agreed amount per pound of meat, based on articulated production quality and efficiency standards.

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farmers. See William Williams cited in this chapter. Vertical integration is a longstanding competitive economic strategy, with Andrew Carnegie often credited with first widespread and large-scale use.

Within this system, better producers (quality of meat/efficiencies) are rewarded, often with bonus payments. Most generally, the system tries to reward chicken growers who demonstrate better feed efficiency, lower bird mortality, combined with other cost and quality standards. In a good season, this vertical integration system rewards two activities: efficiency of feed-to-flesh conversion and optimal bird care. Now, vertical integration does not generally account for the environmental externality of ammonia. However, some companies do pay attention to this problem by providing feed that helps down modulate ammonia production.

The PLT strategy in this study is now part of contractual control and supply, depending on the company. In other words, in the last five years or so, some poultry companies provide PTL amendment material in the quantities that will permit enhanced application, say, between three and even four applications in a grow-out period. Some companies mandate the timing of these treatments. Other companies consult with poultry farmers about timing of treatments.

Implication for values/benefits in managing ammonia: *Vertical integration means that poultry farmers make decisions about their birds within contracts held by the poultry company. However, farmers do have some control of some ammonia management options, including*

- *Timing and number of PLTs*[66] *although some of this is being mandated now by poultry companies.*
- *Use of and locations of VEBs on their land remain primarily farmer choice, with technical guidance and some financial assistance coming primarily through USDA programs.*

<u>Context: Managing nitrogen in Chesapeake air and watersheds can conflict with poultry farmer practices</u>

Poultry farmer sensitivity to nitrogen-based regulatory environments is high. For example, one concern is that better ammonia measurement and modeling might mean that poultry house emissions be reclassified as a point-source pollution rather than a non-point source pollutant. Significant regulatory change worries poultry producers. Federal regional focus on impaired waters includes the Chesapeake Bay. Regional federal regulatory focus concerns farmers.

A comprehensive March 2018 report published in the Proceedings of the Natural Academy of Sciences (PNAS) strongly finds recovery of Bay's underwater grasses is

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[66] At opening time of this study and grant (2012-2217), poultry farmers had more control over the timing of PLTs. By 2019, many poultry companies were codifying these treatments into the producer contract and even providing PLT amendments for use in poultry houses.

due in part to nitrogen and phosphorus nutrient reductions across all sources (PNAS).

This PNAS report confirms what many other research articles already claim: that central to improved Bay water quality overall is the Environmental Protection Agency's Chesapeake Watershed Total Maximum Daily Load (TMDL) requirements, along with other conservation incentives. Also called a "pollution diet," the TMDL is a historic and comprehensive federal, regional, and states partnership to improve water quality in the Chesapeake Bay and the watershed's contributing streams, creeks, and rivers. TMDL regulations cover pollutants in these classifications, working this way: A TMDL is assessed daily as the sum of

- waste allocations for point sources[67], and
- load allocations[68] for nonpoint sources,

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[67] Typically, direct measures or modeling based on direct measurements and ground-truthed modeling is used.

[68] Typically estimated and modeled. Ammonia from poultry house exhaust is nonpoint managed for now.

combined with a margin of safety that is based on reasonable ranges of uncertainty.

Future context: Toward enhanced ammonia-awareness and ammonia remediation

All farmers on the Delmarva Peninsula know that they contribute a huge amount of nutrients and sediment into the Chesapeake.

Implication for values/benefits in managing ammonia: *Poultry farmers are very sensitive to existing and future regulatory regimes at local (county), state, and increasingly federal levels, especially regulations concerning the Chesapeake Bay, like the TMDL quantification program or pollution diet of the federal Chesapeake Bay Program.*

This overview chapter covers some of the poultry production context for Delmarva farmers who manage ammonia from poultry houses. This dissertation study was nested inside a 2012-2017 USDA Conservation Innovation Grant (CIG) concerning ammonia from poultry production and deposition of ammonia on soil and water in the Chesapeake Bay ecosystem. This CIG project called for novel use of humanities to address the social dimensions of environmental policy deliberation that ammonia science can help inform.

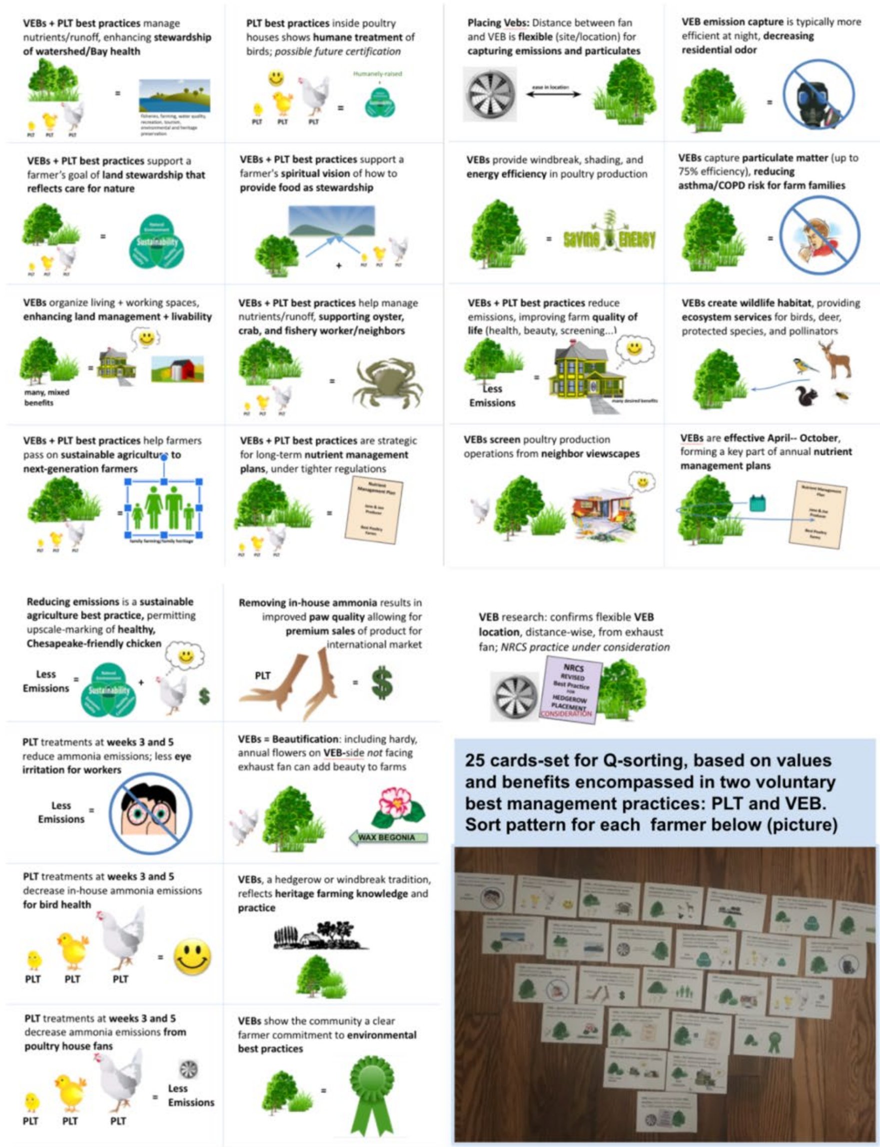
Chapter Two describes stasis theory, one of two humanities approaches used to design this collaborative project.

Chapter Three, in support of visually rich cards designed for the Q-sort study, reviews the conceptual diagram tradition from ecology. Science visualization and visual rhetoric values frame design choices, again, in support of adapting he conceptual diagram tradition to the three inch by four-inch card size. Finally, material aspects are card are reviewed, including the use of cards as elements in bibliography and archrival systems to arrange and comprehend complex information. The card sets used in Q-sorting events arrange complex information for respondents to rank.

Chapter Four describes findings about poultry farmer subjective viewpoints concerning how they choice to manage ammonia from their poultry houses. Q-method, a qualitative and quantitative method from social sciences is the primary investigation tool for this work. Q-method relies on card sorting where the cards are carefully designed to depict subjective viewpoints. The socio-environmental summary here helps form part of the concourse information, essential to card development.

Chapter Five proposes several future challenges for Delmarva poultry farmers as well as water quality protection for the Chesapeake Bay. Elements of both humanities knowledge and social science tools from Chapters Two, Three, and Four are reviewed in the context of what can happen next? Thinkers from the humanities as well as social sciences are discussed as having insight and process abilities that can help re-imaging poultry production, with sustained consultation with poultry farmers and other Delmarva stakeholders.

Illustration 1.1, appearing at the beginning of this chapter, also appears below as a courtesy to this reader. The background context described in Chapter One is essential to developing the cards used in the Q-sorting activities described in Chapter Four.



A	Emissions =Sust.->CB-friendly
B	PLT=Reduced Eye Irritation
C	PLT=Bird Health
D	PLT=Emissions
E	PLT/Paw Health=Profit
F	VEBs=Beautification
G	VEBs=Hedgerow/Heritage Farming
H	VEBs Show Env. Best Practice
I	VEB Distance is Flexible
J	VEBs=Energy efficiency
K	VEBs=Improves Farmer Life Quality
L	VEBs=Neighborhood Screen
M	VEBs=(night eff.)--> Res. Odor
N	VEBs=Reduces Human Health Risks
O	VEBs=Wildlife Habitat
P	VEBs (4/12-10/12) Part of NMP
Q	VEBs+PLT=CB Stewardship
R	VEBs+PLT=Farmer-Stewards
S	VEBs UP Management/Livability
T	VEBs+PLT= Sus Ag to Next Gen
U	PLT=Humane Treatment
V	VEBs+PLT= Spiritual Vision/Stewardship
W	VEBs+PLT->Fisheries
X	VEBs+PLT Anticipate Regs
Y	VEBs->NRCS Rewrite

Illustration 1.1: 25 cards developed for the Q-sorting study with Delmarva poultry farmers. Each card represents a value/benefit that a farmer might weigh in managing ammonia.

Chapter 2: Using applied stasis theory from the humanities to organize complex environmental science for policy deliberation

Overview: This chapter describes stasis theory, an information organizing tool from ancient and modern rhetoric, as a cognitive, hierarchical pattern that helps people understand and address complex social problems. Much like scientific method, stasis theory progresses through a set of disciplined and strategic question-asking practices. Five-step stasis theory moves from initial inquiry to proposed policy thusly:

1. describe a problem or challenge, with a concise, overall **conjecture** statement;
2. take inventory of available, stable knowledge that provides **definitional** context as well as specific knowledge that **describes** the knowledge essential for moving the problem forward toward resolution;
3. assess factors of **cause-effect** that bear upon the problem but also looks at ongoing disciplinary knowledge construction (causality and predictive modeling) that can advise toward resolution, including under conditions of uncertainty;
4. provide broad-based, stakeholder-inclusive structures for asking essential **questions of quality in terms of harms and benefits,** including where harms and benefits are not well understood; and
5. guide essential **policy deliberation and recommendations**, given what is known and identified in these preceding stasis steps one through four.

The steps in five-step stasis theory are named: Conjecture, Definition/Description, Causal Analysis, Value Assessment, and Policy

Five-step stasis theory helped organize this large interdisciplinary environmental policy project, described in Appendix A. This USDA Conservation Innovation Grant (CIG)[69] project focused on improving ammonia management by Delmarva poultry production to protect Chesapeake Bay air and water quality. Stasis theory, in addition to project organization, supported grant-required science communication documents and provided new ways to engage poultry farmer stakeholders during and after project completion (2012-2017).

The fourth stasis step -- concerned with value -- supported poultry farmer stakeholder engagement by giving these farmers a specific place in the project to rank the values and benefits they use while managing ammonia.

This fourth stasis step also called for valuing information in ways broader than economic and financial framing. Five-step stasis theory is especially accommodating to scientists because Fahnestock and Secor, designers of five-step stasis theory, elevated causal analysis to a "new" step.

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[69] **Grantees:** University of Delaware, University of Maryland, Oklahoma State University, Pennsylvania State University, USDA ARS (Beltsville)

Project Title: Innovative approaches to capture nitrogen and air pollutant emissions from poultry operations: VEBs for Warm Season and Acid Scrubbers for Cold Season

Agreement Number: 69-3A75-12-244

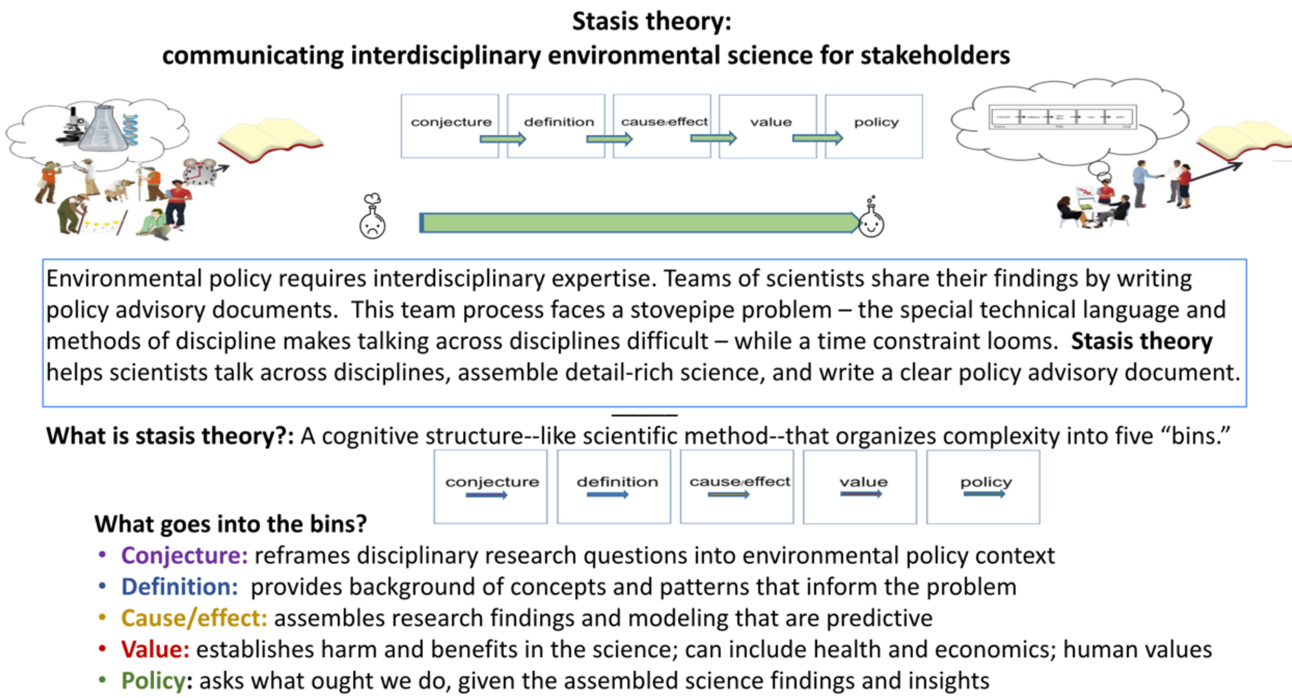

Illustration 2: This conceptional diagram maps out how five-step stasis theory helps interdisciplinary environmental scientists work together arranging science to inform rational environmental policy. Stasis theory also propels collaboration forward under time constraints, supporting communication of science as well as policy advisory document. Designed by the author.

Introduction to stasis theory

This chapter presents an application of stasis theory, from classical and modern rhetoric studies, to address a complex environmental problem: Ammonia effluent from poultry production harms ecosystem and human health, by degrading air and water quality in the Chesapeake Bay watershed. In this USDA Conservation

Innovation Grant project (see Appendix A), stasis theory offers a practical and meaningful frame in understanding poultry farmer preferences about their largely voluntary management of ammonia. Stasis theory includes a step where the human judgement of valuing is located – indeed *protected* – in a larger process that reflects human deliberation of policy formation. Stasis is based on inquiry (conjecture) that assembles detailed, expert knowledge (definition and causal analysis) to make rational decisions about policy. Oft times, human decision-making elides past a values or normative assessment in the complexity and urgency of decision making into policy deliberation.

By showing that stasis theory is a powerful organizing conceptual tool generally, this chapter demonstrates specifically how cooperative and organized question-asking practices can

1. propel productive science into policy deliberation policy work and
2. find a place for stakeholder values to appear in this deliberation.

This ammonia pollution deliberation case was organized, in part, by stasis theory and can serve as a practical case of what stasis mapping looks like in a field project. This dissertation joins a small but active area of applied stasis theory, many within English studies, to improve social problem understanding. Upon improved understanding and communication of these social problems, rational and communal problem solution work can commence. Applied stasis theory also helps create deliberative spaces for all stakeholders.

Stakeholder perspectives are centered by the value stasis. Personal, subjective values held by poultry farmers shape ammonia management practices, within and near their poultry houses. In this way, stasis theory through the valuing activity supports the primary method of inquiry used in Chapter Four of Q-sorting: a social science mixed method[70] that examines human subjectivity. Students of environmental policy will also note that stasis method, in step four, acknowledges the complex, difficult, and necessary work in the economic valuation of nature.

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[70] Mixed methods in social science combine qualitative and quantitative approaches. One of the most revered and storied practitioners of mixed methods was Elinor Awan Ostrom (1933-2012), winner of the 2009 Nobel Prize in economics, with Oliver Williamson (1923-2020).

Stasis theory also fully supports interdisciplinary scientists engaged in environmental policy deliberation. Five-step stasis theory includes two specific steps for full integration of two types of knowledge in science:

1. settled, canonical knowledge (the definition stasis) and the
2. ongoing inquiry of causal analysis[71] that characterizes science and technology writ large (the cause-effect stasis)

Causality analysis is elevated in stasis theory in ways that scientists will recognize as the heart of scientific method. Beyond the methodological familiarity between stasis theory and scientific method, the stasis steps of definition and causal analysis offer a categorizing framework whereby interdisciplinary science inquiry is supported by a specific pause (a *stasis*) to cross-train team members in disciplinary expertise. This cross training "check-in" early in a project and as needed during mutual deliberation by scientists can create efficiencies toward policy deliberation. A good place for

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[71] Causal analysis in science is often assembled into models (the structure of which can be thought of as definition-like). Five-step stasis theory encompasses modeling knowledge too. with acknowledgement of how science can also build model for prediction. Prediction is essential for policy work because what is typically being proposed is a redress of a current problem. Policy deliberation is future-oriented and relies on rational and transparent expertise about how to design what out to be.

scientists to check-in concerning the terms canonical to their lines of inquiry is early in a project, about definitions (stasis two).

A cautionary interdisciplinary tale about definition work (stasis two): The importance of definitions within interdisciplinary science is well illustrated in a 2016 "big science" case. For a complex Earth science grant, collaborating scientists found midway that they held differing canonical understandings of *oxygenation* (Anbar, et al, 2016). In short, scientists within two adjacent disciplines – surface Earth and solid Earth research communities -- struggled while communicating with each other. The US National Science Foundation (NSF) project – the Dynamics of Earth System Oxygenation[72] -- was hampered by scientist team members holding different functional definitions of the presence of oxygen.

To summarize the definitional "misfire" about oxygenation: solid Earth scientists (roughly depth-oriented researchers) and geobiologists (roughly near-surface researchers) share the word "oxygenation," yet do not use/define this concept in the

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[72]FESD Type I: The Dynamics of Earth System Oxygenation. NSF-GEO (9/1/2013-- 8/31/2018).

same way. Scientists did not realize this definition problem until they experienced team members talking past each other, with this confusion impeding their shared research progress.

Geobiologists, whose research assumes relatively high atmospheric levels of oxygen, speak of this element in terms of partial pressures and molarities[73]. What is being characterized are amounts of the presence and amount sof available (or free-to-react) oxygen. In addition to numerical values, geobiologists also use descriptors to describe environments with different amounts of oxygen : *anoxic* (absence of oxygen), *oxic* (presence of oxygen), as well as words of further categorization, including *euxinic* (both anoxic and containing sulfur compounds) and *suboxic* (margin zone between oxic and anoxic zones). Let's consider now the special language of solid Earth scientists.

For their discipline-specific language, solid Earth scientists speak about oxygen presence as locked within minerals, largely as compounds[74] -- hence, these scientists

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[73] Molarity: describing amount in terms of the number of moles[73] of solute per liter of solution)

[74] Malachite, a common ore containing "locked" oxygen smelted to extract copper, is primarily copper carbonate hydroxide, signified by the chemical formula $Cu_2(CO_3)\ (OH)_2$.

are not speaking of oxygen as a gas nor in solution. Solid Earth scientists say *oxygen fugacity*, reflecting the condition that oxygen in the deep Earth is mainly locked in minerals. Many minerals include oxides in their chemical formulae.

What does this definitional difference mean for the stasis discussion about the importance of definitions (stasis two) in this dissertation chapter? In the highly technical, discipline-specific vocabulary of shared research, essential research progress can be impeded at best and intellectually hampered at worst, without shared definitions. In a project focused on oxygen transport between upper sediments (study object for some geobiologists) and lower-level Earth layers (study object for some deep Earth scientists) productive conversation and collaboration was stalled in this project.

Students of the history of science will think immediately of the stove-pipe problem of disciplinary expertise. This geology case -- by a stasis-based intervention concerning definitions -- shows the power of stasis theory from the humanities to tease out some of the sociology of science puzzles about collaborative partnerships in big science.

Here is more on that case of stalled definitions: The research biographies of three co-authors on the *Nature* publication for the communication case just described are worth review. First, the biogeochemist: Ariel Anbar studies the past and future evolution of the Earth as a habitable planet. Part of Anbar's research focuses on environmental evolution, especially changes in ocean oxygenation through time. Anbar is at Arizona State University (ASU), where geologist and co-author Christy Till is, with Anbar, in the School of Earth and Space Exploration. Till is a deep Earth scientist leading a multidisciplinary research program on the role of magma in planetary evolution. Till's interest in magma centers on eruption triggers at active volcanoes in the US, including those in Yellowstone National Park.

Till and Anbar embody the two types of earth scientists who were served eventually by a "definitional check-in," made possible by English professor Mark Hannah, also at ASU and part of the same NSF research project.

Hannah writes on using applied rhetorical tools for improved understanding of complexity. The article referenced above in *Nature* is described and analyzed by

Hannah in an extensive case study about differentiated language use in this science partnership (Hannah, 2018).

One actionable take-away from Hannah's story is that stasis theory does help improve science deliberation. The "check-in" about language is best done early in a collaborative project. Debate students would recognize this early step in the forensic[75] competition as equivalent to "first, define your terms." Law students would also recognize this definition work as the strategy of examining "first things," including what laws apply. As we shall see in this chapter, forensic debate procedures and jurisprudence are stasis theory endeavors, with history traced to ancient Greek and Roman rhetoric.

Making the case for stasis theory in complex science-to-policy deliberation. Human social problem solving often suffers from an information overload about the range of knowledge that can illumine parts of these problems. A central benefit of the

[75] In Chapter Five, forensic skills and parliamentary procedure training is noted as part of the Future Farmers of America (FFA) program. Later in this chapter, the case is made by Fahnestock and others that knowledge generation in science is forensic, as is 1) evidence-based and 2) becomes part of an argument concerning discussion of findings or theory.

conceptual structure of stasis theory is that the hierarchy and directionality of stasis steps can support scientists to see themselves as a team of allied, expert guides for environmental decision making, and less as solitary expert specialists.

In a stasis theory frame, scientists can also see their separate but important role of "community expert" role as also advising on values and policies, in addition to the technical environmental science they help create. This advisory role as a member of a stakeholder community makes many scientists uncomfortable. Being aware of stasis steps can help scientists see a shift – perhaps boundary -- between analysis and science-based advisory roles. Stasis theory, in valuing activities, also helps create some opportunities for science experts to also articulate their viewpoints from living in the very ecosystem that is also under study.

Finally, applied stasis theory in environmental policy deliberation is truly a transdisciplinary innovation in social problem solving. Transdisciplinary work often requires new ways to use analytical tools in a synthesis manner toward understanding and wrestling with these complex problems. See Illustration 2 at the beginning of this chapter to review the conceptual diagram of how stasis theory can organize environmental policy deliberation.

Even if contemporary humanist contributions to the practice of science – the 2013-2018 oxygenation case just described -- argues for stasis theory, the very longevity of stasis theory also forms an argument. Indeed, evidence of stasis theory is extant for longer than evidence of formal scientific method, dating to the time of Francis Bacon (1561-1626). Bacon is understood to be among the first natural philosophers – what scientists were often called then – who called for step-wise study of nature by first asking questions, generating claims of likely explanation, then testing these claims in an experiment. This hypothesis-testing approach characterizes a great deal of the attributes of scientific method. However, in the early modern culture, stasis theory approaches were used in pedagogy and indeed critical analysis.

Where did stasis theory arise? Stasis theory is a set of staged questions that helps thinkers engage in problem analysis. Early users of stasis theory, in the Greek and Roman worlds before the common era, uncovered ways to *invent* speech (or writing) in response to resolving problems by argumentation and persuasion. Invention, for ancient Greeks and Romans, invoked the systematic thought and care those speakers/writers need to engage in before communicating.

Most extant and newer versions of stasis theory use a four or-five part set of questions, largely attributable to surviving remnant writings of ancient Greek rhetorician Hermagoras of Temnos.[76] Much of what we know about Hermagoras survives in the attributed writings of Cicero, the noted Roman orator, principally in two handbooks: *De Inventione* and *Rhetorica ad Herennium.* Two forms of modern stasis theory that originate in Greek and Roman rhetoric are found in the professional practices of journalism and jurisprudence.

In journalism, specific stasis questions survive as the "5 W's[77]" of who, what, where, when, and why. Hermagoras, though, advised the use of seven questions concerning circumstances of complexity, namely the familiar five (who, what, where, when, why) with two additional questions: in what way, by what means. This noted variation shows the modular and flexible nature of stasis theory approaches.

[76] Note that many pedagogical contexts over time cite Aristotle as central to stasis theory origins.

[77] For news reporting, the Four W's are identified as who, what, where, and when.

Lawyers will recognize stasis theory in how they analyze legal cases. Lawyers are taught a series of question categories: issue, rule, application, and conclusion (IRAC). First, a lawyer must know the issue or circumstance and whether a problem (crime, violation, lapse) exists. If so, then a lawyer proceeds to consider the rule (law, moral precept, cultural practice) that applies to the problem. Knowing the appropriate rule supports a lawyer in describing how this rule applies to the problem. Finally, these three earlier steps support the conclusion that legal minds may reach about the jurisprudential remedy for the problem.

Then, lawyers tend to argue[78] in these patterns to defend or prosecute, often in front of a deliberative body: judge, panel of judges, or a jury. Even though lawyers will recognize many of these rhetorical moves as part of their legal training, their rhetorical history including the special nomenclature of rhetoric is often absent. One argument to bringing this classical rhetorical terminology back to legal education is by Hannah, noted earlier in the case of oxygenation confusion (Hannah and Salmon, 2020).

[78] Stasis theory is a powerful way to discover (invent) arguments to use in persuasion. Indeed, most discussion about stasis theory is as an argumentation tool. This dissertation argues that for a related organizational power of stasis theory to collaborate across disciplines for policy deliberation.

Heath's overview (1994) about how stasis theory worked in classical settings and can work in modern contexts is very helpful and succinct for readers outside of classics, ancient history, and rhetorical studies. For the science context specifically, most observers (Gross, 2006) focus on stasis structures to address silos of specialized information within disciplines. Modern applied rhetoric continues to develop and apply stasis theory frames to disputes (a professional concern for jurisprudence) as well as to communicating knowledge (journalism for one).

Cognitive rhetoric and stasis theory

Psychologists and cognitive linguists would see the journalism and jurisprudential stasis frames as highly functional heuristics[79] or cognitive "hacks" that help human beings think through complex problems, to support a rational solution.

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[79] Heuristic: a problem-solving technique that employs a practical method or pattern. Now, heuristics tend to be seen as limited in terms of rational analysis or sub-optimal in some ways but are used by people to reach an immediate understanding or decision Heuristics can be mental shortcuts that ease the cognitive load of deciding. Stasis theory, in contrast, is a pattern that helps keep rational work and knowledge central to both human understanding and decision-making.

Turner[80] (1991) uses the cognitive frame of *image schema* to talk about the value of stasis theory as an analytical tool. Within cognitive science disciplines, an image schema denotes underlying structures and patterns that help give shape to simple, recurring cognitive processes (Lakoff, 1987).

Scientific method and stasis theory can be thought of as working like *image schemas*, namely cognitive patterns that recur within the thinking processes of meaning-

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[80] Turner and others largely from composition studies are often described as cognitive rhetoricians. Included with Turner are James Berlin, Patricia Bizell, Janet Emig, Linda Flower, and John Hayes. Turner often works with cognitive scientists including George Lakoff. Central articles in composition pedagogy that are associated with the beginning of this pedagogy-focused subdiscipline include:

Flower, Linda and John R. Hayes. (1981). "A Cognitive Process Theory of Writing." *College Composition and Communications*, 32: 365-87.

Hayes, John R. and Linda Flower.(1987). "Cognitive Processes in Revision." In Rosenberg (ed.), *Advances In Applied Psycholinguistics*. New York: Cambridge University Press.

For a comprehensive overview, see also

Fahnestock, Jeanne. (2005). "Rhetoric in the Age of Cognitive Science". *The Viability of Rhetoric*. Graff, Richard. ed. New York: State University of New York Press.

Foundational work of Turner with George Lakoff includes

Lakoff, George, and Mark Turner. (1989). *More than Cool Reason: A Field Guide to Poetic Metaphor*. Chicago: University of Chicago Press.

making. Scientific method is an image schema (and heuristic) that pays attention to research questions, using relatively standard patterns to conceive, study, and test hypotheses that help with research question resolution. Stasis theory also works like Turner's concept of image schema. Ancient and modern versions of stasis theory look at problems with stepwise question-asking practices

Other cognitive schema noted by Lakoff and similarly oriented theorists also fit with the cognitive appeal of stasis: applied stasis theory helps to organize high-stakes professional, interdisciplinary work because of the general image schema in human problem-solving just described. Underneath the larger problem-solving image schema are three supporting schemata:

1. the *container* schema,
2. the *link* schema, and
3. the source-path-goal schema.

Table 2 below (Mozafari[81]& Shea, 2014) displays these three schemas operating together in five-step stasis theory.

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[81] Mozafari, then a graduate student, worked in early years of this USDA CIG grant. This grant called for training graduate students from the humanities in this project.

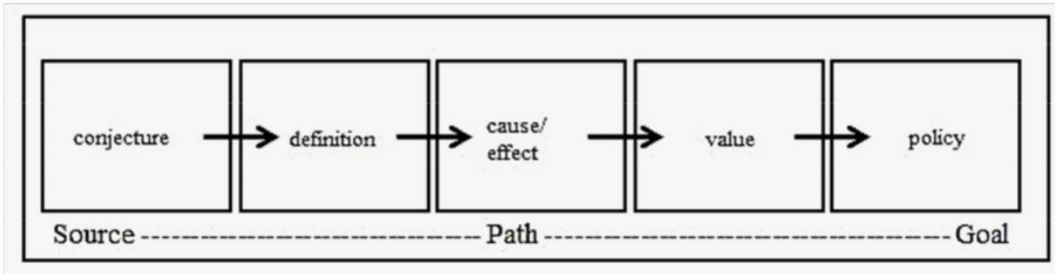

Table 2: Three schema overlain on five-step stasis theory. The five rectangular boxes depict the *container schema* understanding of stasis theory steps conceived as bins for information. The four arrows depict the *link schema* that shows movement of the intellectual process between these bins. The dotted link labeled with "Source." "Path," and "Goal" together form the *source-path-goal schema*, which captures the motion from the earliest conjecture questions toward policy formation (Mozafari & Shea, 2014).

These three underlying schemas (container, link, source-path-goal) that support cognitive problem-solving are discussed in a federal science-to-policy case. Useful from this 2014 study is the renaming of "container schema" into "bin," which made sense to this team of health scientists in a policy deliberation. In this deliberation, then, the five stasis steps were renamed bins, as in the

1. conjecture bin
2. definitional bin
3. cause-effect bin
4. value bin, and
5. policy pin.

This terminology of bins appears in Illustration 2 (beginning of this chapter), the conceptual diagram that maps out stasis theory in environmental science deliberation. Bin is also used in a detail extracted from Illustration 2, called Illustration 3 (below.)

This shift in terminology reflects the preferences of these scientists (2014 consultation) to say bin rather than stasis step.[82] However reluctant these scientists were about saying "stasis step," the idea of stasis was familiar to them. This familiarity led to a brief discussion about stasis as a technical term in science; small interactions of consensus form emotional engagement that can support receptivity and understanding across disciplines.

Scientists define *stasis* as a technical term, as do rhetoric experts. *Stasis* (prefix, root/stem, or suffix) is a technical term for most scientists, as in homeostasis within physiological systems. In rhetoric, stasis denotes a term of art about states of dynamic cognitive equilibrium[83]. Both scientists and humanists share a definition of stasis with this same sense of dynamic tension.

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[82] Scientists in the 2014 consultation expressed to the author that the word "stasis" was more abstract, while bin and binning was more concrete, with binning a good fit with the categorizing function that the stasis helps organize. In part, this preference for bin is helpful because of the container metaphor. Concrete language helps with conveying complex thoughts.

[83] This sense of dynamic equilibrium also characterizes some qualities of stasis steps, a frame from the humanities. The bins and the arrows suggest how information is categorized (bin represents place of relative stasis), while the arrows show how resolution, confirmation, new insight within a stasis bin often supports an energetic shift in cognitive discovery to share with colleagues or be used by colleagues and publics to work through the stasis in another bin. Indeed, Mark Turner's use of stasis, including his powerful frame from cognitive science, is deeply humanistic; One way to think about this is that one disciplinary corps of experts will explore and plumb a stage in a topic until a depth (the stasis of a bin) is reached. Then, the group, often supported by another group of experts can look at the next stasis bin where a next set of questions, is explored fully. One scientist in the 2014 consultation

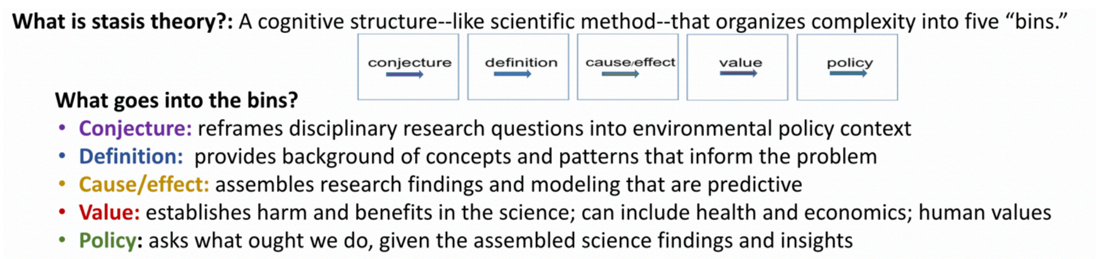

Illustration 3 (detail from Illustration 2 above): What goes into the stasis bins? Each bin of five-step stasis theory is characterized by a set of categorical questions. Bin terminology reflects a preference by scientists in using stasis theory. Also, the noun “binning” helps with placement of type of information in the categories.

Scientists do appreciate this idea of stasis, which suggests a refinement to illustrating stasis theory: within the container schema could be superimposed a set of two arrows,

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quipped to the author that this process of links across stasis is a bit like the stasis of punctuated equilibrium. In 1972, evolutionary scientists Stephen Jay Gould and Niles Eldredge rejected the idea of evolutions gradualism, proposing instead "punctuated equilibrium." Gould often called this equilibrium a stasis phenomenon. Species are generally stable, for extremely long periods of time (on the order of millions of years). This process across deep time is "punctuated" by a sudden “burst” of change, resulting in a new species.

facing each other in opposition. In other words, in between each stasis bin is a dynamic tension[84] of ideas that fit within these containers.

An understanding of the dynamism of stasis also supports the use of Turner's schema theory of how stasis theory works as a cognitive heuristic. Stasis theory, at the union of each step, also relies on a sense of overarching dynamic resolution that propels an intellectual process through each of the stasis steps. We can see the link schema as the dynamic equilibrium between each step, with the *source-path-goal schema* as the problem-solving quest toward resolution. Recall that the goal here is arriving at a policy recommendation that is based on the best available science, as well as the fourth step valuing harm and benefit in both the situation, as well as the proposed remedy.

Scientific method also reflects these three, interactive goal-oriented schema. Science follows as set of steps, toward the goal of proposing knowledge. First, the link

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[84] Updating these conceptual diagrams could include an animated version that shows both the stasis equilibrium between steps but also the overall path of source-path-goal from conjecture through to policy.

schema applies in that the steps are hierarchical – that the link order matters – and that prior steps, when addressed, give rise to the next step[85]. The steps can be understood as containers or bins (conjecture contains research question and testable hypotheses, for example).

Second, scientific method is goal-oriented, with the steps connected by what is a link schema (after the method yields results, the results and analyzed, for example). The steps, taken together are directed toward resolving the research question, thereby arriving at a findings stage of the process. This finding stage reflects the source-path-goal schema, where what is proposed is the *argument* for new knowledge.

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[85] Perhaps a better graphic model of stasis theory could be developed with animation as a visualization technique. Chapter Three deals with science visualization. Perhaps a post-dissertation task would take up an animated depiction of stasis theory, with a focus on the motion of dynamic forces between steps and the overall path-source-goal schema that propels deliberation through to policy proposal. Recursive steps are also essential in a stasis model of interdisciplinary science work. Scientists use literature review practices to look back on upon research that comes before one's own to establish a sound basis for new work. In interdisciplinary science for policy, often the work is divided by expertise area, in acts of trust. Sharing information across the stasis bins is also part of this checking, cross-training, and learning together. Animated, circular areas might capture this shared intellectual process quite wall. environmental science. However, the case for the source-path-goal schema is the sense of guardrails propelling work forward (often under a time constraint). One of the risks of recursivity, though, is that practices of returning to information in earlier steps without some guardrails about forward momentum, is becoming stalled. Much of the rich knowledge of applied stasis theory exists with writing pedagogy and composition studies. One helpful reading is

Simmons, M. and J. Grabill (2007) "Toward a Civic Rhetoric for Technologically and Scientifically Complex Places: Invention, Performance, and Participation." *College Composition and Communication*58:3 (February) 419-448.

Scientific method tends to be taught to young scientists by example (in mentoring and advising) and by close reading of articles, where scientists use the texts of others to mentor themselves as for content.[86] The essential relationship here – for teachers and texts --is that of mentoring.

Scientific method is also passed on by mentoring experiences within professional environments, typically laboratories, field locations, and the like. Not always is scientific method discussed within technical literature, although two particularly compelling and somewhat controversial reflections on knowledge construction are worth mention here: Platt (natural science) and Peters (physicist/biophysicist).

Limnologist Robert Henry Peters (1946-1986) wrote *A Critique for Ecology* (1991), which garnered praise and argumentative rejection (Grace, 2019). Peters may have had in mind an earlier and more general critique of scientific thinking by physicist

[86] These articles serve as mentor texts, a pedagogical concept from composition studies that begins with genre example but also supports the close reading of such texts for craft, more so than content.

and biophysicist Robert Platt (1918-1992. Platt's 1964 article "Strong Inference[87]" (*Science* magazine of the American Academy for the Advancement of Science – AAAS) articulated the Baconian (briefly just described) inductive methods first described in *Novum Organum.[88]* Platt's analysis arose in part by his close reading of classic scientific method guidance for ecologists (Chamberlain, 1890; reprinted in Science, 1965). What caused controversy and richly argued discussion (Louis et al., 2007) was that only a few science disciplines like physics and molecular biology made rapid progress in knowledge generation. Other fields by Platt's analysis – including ecology (Peters and others) – were "slow," largely in part by not following specific steps in both hypothesis generation and subsequent inference making. The shorthand for Platt's remedy was what he called *strong inference*.

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[87] Inference-making is a chief way that scientists make arguments by interrogating data sets, along with sustained consideration of their hypothesis or sets of hypotheses that bring the research question into studies.

[88] *Novum Organum*, full title *Novum Organum, sive Indicia Vera de Interpretatione Naturae* translated from Latin as New organon, or true directions concerning the interpretation of nature is a 1620 philosophical work by Francis Bacon. Bacon's hypothesis-driven, inductive method is the origin of modern scientific method. Good translation available on the web:

Bacon, F. (1620). The New Organon, or True Directions Concerning the Interpretation of Nature posted May 200 at www.constitution.org/bacon/nov_org.htm)

In response to Peters and especially Platt, several scientists offered useful reflection on inference-making, along with trenchant criticism including specific commentary on how to teach[89] scientific method to undergraduates and medical students (Davis, 2006; Nelson, 2010).

Noting that some of the richest conversations about scientific method occur in pedagogy settings, including laboratories and professional formation (post-doctoral positions, for one) full written documentation of the scope and power are not routinely available. Stasis theory is similarly "locked" in pedagogy. Stasis theory knowledge now tends to reside in English studies under composition pedagogy, typically as a method to teach critical thinking and writing skills. In this way, both stasis theory and scientific method deserve critical analysis and explicit instruction, including at the post-secondary level. Yet, this is a digression but also an explanation – particularly to scientists – about ways in which they do not see a larger literature of publication about stasis theory. Yet however much scientists do not know about stasis theory, this cognitive frame can help organize complex science.

[89] Selected pedagogy pieces included here, only, because the point here is that stasis theory, like scientific method is powerful and used with most of the written documentation largely residing in pedagogical materials, many of them unpublished.

Stasis theory, like all rhetorical approaches, is inherently flexible

More than one stasis method exists. For many years, four-step stasis theory dominated pedagogical and even many professional settings.

This chapter proposes using the five-step stasis approach, depicted in Illustrations 2 and 3 (detail selected from Illustration 1) and Table 3 concerning a *bin schema* associated with five-step stasis theory. However, many English studies contexts define stasis theory as a four-step, deliberative question-asking process. Before looking at the origins – and powerful utility of five-step stasis approach and its recent origins, let's review four-step stasis theory. Five-step stasis theory is a modification -- flexible extension -- of four-step stasis theory.

Typically, four-step stasis theory and the associated deliberative question sets (one set of questions per stasis step) use this nomenclature: Conjecture, definition, value, and action. (Fahnestock, 1993; Corbett and Eberly, 2000; Lunsford et al, 2009. Working definitions of these four stasis steps are

1. **Conjecture,** the first stasis, concerns the facts of the situation.

2. **Definition and/or description,** the second stasis, gives elaborated meaning to the situation, bringing in knowledge that explains complexity.
3. **Value**, the third stasis, supports assessment of the quality of the situation, best understood as looking at harms and/or benefits.
4. **Action** or **policy**, the fourth stasis, describes an appropriate response to the situation based on knowledge gathered in earlier steps. Another way to think of this last stasis in this four-step frame is by posing this question: *Given the earlier steps, what ought to be?*

Under this flexible and highly applicable four-step pattern of stasis theory, several disciplined question-asking practices under each stasis can improve understanding. The goal of the four sets of disciplined inquiry questions is improved critical thinking. In English studies, critical thinking is often a prelude to clear and ethical communication (composition and writing studies, as well as speech). Recall that stasis theory also contains the policy step of what ought to be. Ethical communication here means a full interrogation of the entire context, as a prelude to the persuasion/promulgation that the policy step requires.

The ancients largely prepared people for oral communication while modern people typically function in written contexts, though oral genres are still widely practiced (slide presentations, for one, court testimony, political speechmaking, etc.). Often the goals of the speaker/writer are to use stasis theory to organize communication for a persuasive [90]reason, say, to follow a particular policy. Stasis theory not only organizes complex contexts into understandable, staged information, stasis theory was an intellectual place (*topos*) to uncover arguments toward that policy. The valuing step asks: what is good? How do we know (seeks evidence or criterial of value)? Spending time in that stasis place of contemplating value is a necessary foundation to say, in the policy stasis, where what we should do should reflect what is explored to be good. Four-step stasis analysis, even without centering causality as a standalone stasis step, is powerful. As we shall see, the questions under other stasis steps do address causality.

The power of four-step stasis theory endures in the professions, too. For example, journalism news reporting uses the questions in four-step stasis theory. Some of these questions reflect the workplace heuristic of reporters: the Four W's of who, what, where, and when[91]. Stasis theory is a flexible, cognitively available tool, largely

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[90] Science tends to focus on knowledge dissemination of high quality, tested, vetted information. However, within scientific communication are subtle arguments about data interpretation, inferences to be made, as well as hypothesis testing.

[91] *Why* – the causal question – is often handled using quotes or interviews by experts, witnesses, or other engaged persons. Related journalism genres, including news analysis and opinion/editorial work, is deeply engaged I the why question. Both causal analysis genres are somewhat different from straight reporting pieces.

because of utility: explicit reflection on the questions underneath these four steps -- broader than for reporters -- demonstrates this utility.

Here are typical sets of questions that explore each stasis in the four-step stasis theory pattern described above:

Stasis 1: Conjecture concerning situational facts

- How did this situation begin? What are the causes?
- What in the situation changed to create the problem/issue?
- Did something happen?
- What are the facts of this situation? (consider using the six questions of journalism inquiry: who, what, when
- Does the situation include a secondary problem also requiring attention?
- How did this situation begin? What are the causes?
- What in the situation changed to create the problem/issue?
- Can the situation be changed by action or attention; what is this challenge?
- Will time solve this problem?

Stasis 2: Definition and/or description of the situation and central problem

- What is the nature of the problem (general type)?
- What exactly is the problem/issue (specific type and situation?
- What kind of a problem/issue is this (classify the type)?
- To what larger class of things or events does this problem belong to? (further broad classification)?
- What are the parts or the problem and how are they related?

Stasis 3: Quality: assessing value (harm and benefits)

- Can harm or benefit be seen?
- Do you need more evidence or research or time to assess quality?
- Essentiality: Is this situation good or bad?
- Scale: How serious is the problem/issue?
- Stakeholder experience: Who is affected (harms, benefits, especially)?
- Cost: What are the economics in the problem; what are other costs of solving the problem/issue or leaving the problem unaddressed.
- Causal risk: What happens if actors do not do anything?
- Is the problem one that will become worse in the future?
- Will time solve this problem?
- Is the situation one of neutrality?

Stasis 4: Action or Policy: what ought to be?

- Given what we know, should action be taken?
- Who, among stakeholders, has standing to solve the problem?
- Who should be consulted, warned, included in proposed action?
- What specifically should/can be done about this problem?
- Will addressing this problem cause problems for others?
    - downstream?
    - in the future?
- Contextual pre-conditions: What also needs to happen for this problem?
- Is there a timeframe for proposed action?
- How can actors know that remedies are working?

These sets of questions just enumerated are of such long-standing and widespread use that these questioning (interrogation) patterns are typically not cited. In effect, these questions reflect calm, rational cognitive uptake and are intrinsically available to all thoughtful persons. The analogy for scientists is that the question-asking practices of scientific method are of such long-standing and widespread use that this process is also often not cited. These cognitive approaches for interrogating information belong to all of us, in culture and within the rational processes of human thought. However, education and professional practice offer efficiencies in how to learn, remember, and use[92] these cognitive faculties.

Recall the IRAC stasis pattern from jurisprudence, noted earlier in this chapter. The IRAC approach is also a four-step stasis theory pattern. From seeing the utility of stasis theory for professional use (the law) and the critical thinking instruction (composition classes), the need for staging or ordering is clear. These two applied four-step stasis patterns are hierarchical. Generally, you work through the steps where

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[92] Learning, remembering, applying these are key elements of pedagogy in schools as well as apprentice-style contexts.

order[93] matters. First, the problem is explored (stases[94] one, two, three), giving rise to evidence for decisiveness about appropriate action(s) (in stasis four, the proposal). The motion forward fits with the source—path—goal schema mentioned earlier that explains movement through the stasis steps, where Mozafari and Shea reflect on and incorporate the cognitive rhetoric of Lakoff and Turner. Stasis is flexible, though. A question underneath a stasis can become so large in import that the question becomes a stasis step. Causality is one such question. This elevation of causality for the *why* question of journalism conduct explains why journalism features both four-step stasis (news reporting) and five-step stasis (news analysis).

Indeed, contemporary composition instruction uses both the law and journalism as rich sources of examples for student instruction about stasis as a tool of critical thinking (Lauer 1984; Bizzell, 1989). These cases are, essentially, mentoring examples for instruction.

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[93] Recursive examination is also possible and indeed likely. However, the overall move is directional from question to policy.

[94] *Stases* is plural for stasis.

Elevating causality: using a five-step stasis theory: In the late 70s-early 80s, some English composition instructors noted a need for an expansive and additional "bin" (stasis step based on existing questions) to consider fully the *evidence*[95] category of causality[96]. At the same time, composition pedagogy was enjoying a re-acquaintance with ancient and early modern rhetoric. In addition to use in composition pedagogy, classical stasis theory is a rediscovered tool for organizing and analyzing social and cultural knowledge, including in both arguments generally and but also in science findings[97] (Fahnestock, 1984; Gross, 2004). The pedagogy-articulation of five-step stasis theory is due in part to this rediscovery of ancient rhetoric for modern students. Two principal architects of five-step stasis are Jeanne Fahnestock and Marie Secor.

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[95] Composition instruction teaches the recognition and construction of arguments. Evidence is a central category of powerful argument. Scientists recognize this as their research-based inferences and conclusions are based on argument from evidence.

[96] Some say that Aristotle's rhetorical advice can be summed up in "all the means of persuasion." This dictum certainly supported renewed attention to causality. Problems arise within conditions of causality. Any proposal to address a problem must be anchored in the causality that can change the problem conditions into a position of desired social relief or renewal. Science and technology are often the locus explanatory causality (why?) and relief-causality (how can we fix this into what ought to be?).

[97] Science findings, especially as interpreted data, along with the inferences that the data sets and experimental findings make possible, are arguments. See

Fahnestock, J. (1986). Accommodating Science: The Rhetorical Life of Scientific Facts. *Written Communication*, *3*(3), 275–296. https://doi.org/10.1177/0741088386003003001

Five-step stasis inserts causality between steps thee and four (new third step):

This third step of stasis theory is re-articulated as a special location of dynamic inquiry about *why*, in what is now a five-step model of stasis. Fahnestock and Secor's five-step stasis theory requires a new order yet based on the four-step pattern: Conjecture, definition, *causal analysis*, value, and policy (1985; 1988). Now, definitions for these five steps become:

1. **Conjecture,** the first stasis, concerns the facts of the situation.
2. **Definition and/or description,** the second stasis, gives elaborated meaning to the situation, bringing in knowledge that explains complexity.
3. **Causal,** the *new third stasis*, where the knowledge focus concerns a range of causal conditions that cause the problem identified in the conjecture, as well as expand the notion of how causal relationships also shape the next steps of value and action.
4. **Value**, *now the fourth stasis*, supports assessment of the quality of the situation, best understood as looking at harms or benefits.
5. **Action** or **policy**, *now the fifth stasis*, describes an appropriate response to the situation based on knowledge gathered in earlier steps. Another way to think of this last stasis in this now five-step frame is this question: *what ought to be*?

The transformation from four-step stasis to five-step stasis is:

1. Steps one and two remain the same: **Conjecture**, **Definition**.

2. Step three is now **Causal**, the new step that elevates causality inquiry from questions under the categories in four-step stasis
3. The former steps three and four (**Value**, **Policy**) simply move to the right, as newly labeled steps four and five.

One central contribution of Fahnestock and Secor re-organizing four-step stasis into five-step stasis is recognition of the power of causal analysis to inform human deliberation. This powerful change is accomplished by modifying the linkage in four-step stasis systems between definition (stasis two) and quality/value (stasis three) (Fahnestock & Secor, 1985). Fahnestock and Secor acknowledge that their work is largely that of re-arrangement. However, without this re-organization, scientists would have a harder time seeing the heuristic value of four-step stasis theory. The causality is not foregrounded by elevation into a step; without this elevation, see connections between stasis theory (from the humanities) and scientific method (causality is a primarily conduct pattern for social and natural sciences).

Fahnestock and Secor (1981, 1990, 2003) devised this sound and powerful five-step stasis theory approach, recognizing the “living fossils” of stasis theory in journalism and jurisprudence, as well as in other cognitive patterns that people use to analyze complexity, including how scientists approach the intellectual heavy lifting in their questions. Fahnestock, particularly, is also a student of the history of science and rhetorical strategies in scientific communication

Scientists, in contrast to journalists, tend to address causality[98] sooner as a professional practice. Indeed, the hypothesis generation practices of science are deeply concerned with causality[99] and, in many disciplines and lines of inquiry also with modeling[100]. Yet, these research questions often reflect a known problem, with an ongoing science disciplinary effort toward relief. Take cancer and pollution. In the cases of biomedical science and environmental science, the work is nearly always conducted toward policy. Here, policy is not limited to government or official actions. Policy is more generic here and describes what ought to be (including what knowledge should be explored next). Most communities want less cancer and less pollution. In biomedical research the goals are to address human suffering by improved disease definition, diagnostic criteria/tools, and ultimately treatments that

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[98] Causal analysis for understanding natural processes, in addition to the related activities of prediction and modeling, is the central organizing activity of nearly all science inquiry and professional conduct.

[99] Scientists are careful to not use language of causality in their special conventions of talking about research conclusions; however, what is being examined in science is nearly always causal relationships.

[100] Modeling concerns assembling information (data, synthesis knowledge, proxy information for obscure, occult --- hidden --, and suspected knowledge) to predict.

cure or relived suffering. Similarly, environmental research and ecology addresses themselves to ecosystem health, where these conditions are interwoven with human health and social flourishing.

Environmental science and ecology, together and in specialized sub disciplines, are future oriented about the extent and consequences of environmental problems left unchecked, like ammonia pollution. The practice of modeling is both diagnostic and predictive. Like biomedical research, some environmental science inquiry is directed at interventions for restoration and resilience in the many natural and human-management systems we rely on. Care for human health and ecosystem health relies on a great deal of causal analysis research. Five-step stasis theory models work best with science generally, but environmental and ecological inquiry especially.

Five-step stasis theory and assembling science for policy: Deliberation is often policy-directed: what ought we do, given what we have reflected upon? Frank use of stasis theory for critical thinking in writing pedagogy is part of why Fahnestock and Secor shifted from four-step stasis to five-step stasis theory. Yet, stasis-based thinking is not limited to pedagogy. Indeed, Fahnestock also writes extensively on the rhetoric of science, including the uses of stasis theory in analyzing scientific discourse (Fahnestock, 2002; 2004; 2005). Some scientists, when learning about the extensive science discourse expertise of Fahnestock, are inclined to stay in conversation[101] about how stasis steps can help organize a complex environmental science effort toward policy. Indeed, this was the case with several scientists in the USDA CIG team.

This trust across disciplines may well be an attribute of successful transdisciplinary projects between science participants and humanities-focused participants. Indeed, some scientists in the USDA CIG project could see that stasis steps– stopping points for reflection and consultation – are deeply ingrained in the practice of scientific method[102], too.

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[101] Much of this chapter is focused on the arguments to persuade scientists to consider stasis theory to organize environmental science for policy deliberation. Staying in conversation creates a discourse space for this work. That Fahnestock is extremely knowledgeable about the special language and rhetorical moves of science was a successful argument formed in part by her scholarship being adjacent to theirs: science.

[102] The history of science reveals stages in the deepening sophistication of scientific practice and methods development. See writing by philosopher Karl Popper, for one, or visit the Stanford Library of Philosophy and look at History of Science entries. However, a short and thoughtful overview of scientific method history and practices (2006) is available in journal form by Irving Rothchild, available at his ResearchGate platform page. Scientists tend to appreciate this concise treatment, with the additional ethos of being written by a scientist. Rothchild, who died in 2006, was a respected reproductive embryologist.

Rothchild, I. (2006). Induction, deduction, and the scientific method: An eclectic overview of the practice of science. Available at

Arguing for stasis theory in environmental deliberation by using cases

A relatively new and rich literature from English Studies uses rhetorical faculties openly, including stasis theory, to write in policy analysis and social proposal settings. This work of applied stasis theory reflects a shift away from using stasis theory primarily to analyze and understand arguments[103], toward a broader use in service to society.

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https://www.researchgate.net/publication/239919508_Induction_deduction_and_the_scientific_method_An_eclectic_overview_of_the_practice_of_science

Francis Bacon clearly articulated the primacy of hypotheses generation and testing in truly revolutionary ways for contemporary and future scientists. Bacon described this method in his treatise *Novum Organum* or *New Instrument* (1620). Bacon considered his method the best way to understand a phenomenon (case, curiosity, problem, etc.) of interest. He divided his method into three distinct and overarching steps: 10 a description of facts; 2) a set of lists (from step 1) to classify these facts into three enumerated categories; and 3) upon reflect of knowledge contemplated in the first two steps, to reject whatever appears, in the light of these categorical tables, not to part the phenomenon under investigation and the determination of what relates to it. In the second step, which calls for classifying information by division into three categories. Bacon described these three classifications as 1) cases and qualities of the phenomena under investigation; 2) cases and qualities of the absence of the phenomena, and 3) cases of the phenomena presence in varying degrees. Bacon's first step, a comprehensive listing of what is known, reflects the way natural philosophers – scientists – approached the world. A full description was how knowledge was being built then, with the use of mathematics where possible, especially in astronomy and physics. This thorough cataloguing and subsequent categorizing of descript8ve facts, however, now shifted to problem description by creative and disciplined uses of guesses or conjecture. However, Bacon did raise the idea of testing ideas, which lead to the use of hypotheses as essential to scientific method steps.

[103] The power of stasis theory to excavate for arguments should not be downplayed. However, in many science contexts most scientists do now see themselves as making arguments so much as describing, testing, reporting research results as information. Scientists do make arguments even if they tend to frame their work as sharing information where the data and findings make the argument.

Stasis theory is a time-tested, powerful way to generate arguments; however, perhaps this renewed interest in using stasis theory is not so much as an argument-generative process. Rather, stasis theory can support scholars, practitioners, scientists, and stakeholders in generating policy options based on close, rational assembly of knowledge. Scientists would likely be more comfortable with stasis theory to stage and assemble knowledge than see stasis theory as an argument-generating heuristic (as lawyers use stasis steps).

Rhetoric scholars and others in English studies hold special analytical and language abilities to propose specific solutions rooted in rational knowledge assessment. These scholars identify stasis theory as central to their problem analysis. Some of the more recent -- and novel -- applied stasis frames[104] on social problem analyses include:

- Michelle Simmons (2007) examines risk communication and public participation practices in a case study concerning VX nerve agent disposal. Because of the risks posed to citizen who would live near disposal and storage locations, Simmons heighted the environmental health problem facing several communities, with prescriptive strategies for

[104] The author sees stasis theory steps in many policy documents, in addition to other rhetorical devices, faculties, or framing. Once trained in stasis, forever is this structure clear for students of rhetoric. This is similar to how scientists use the frame of scientific method to understand their world and evaluate writing by others. However, those listed here explicitly use stasis terms to describe the problem, context, and possible resolutions.

how people might gain power in similar decision-making processes. She clearly uses many rhetorical devises, including noting stasis theory specifically as a frame for gaining clarity about language and discourse to develop better arguments and address conflict. While Simmons only mentions stasis theory once, unlike the other scholars included in this annotated list, a chief value in her work is the centering of publics as stakeholders who have standing to request knowledge, as well as participate in public safety policy.

> *The centrality of stakeholder participation in this case study served as an exemplar of stakeholder participation for this USDA CIG project, especially as a model for consulting poultry farmers about their viewpoints on ammonia management (fits the value stasis)*[105].

- Sharon McKenzie Stevens (2007) writes about U.S. land policy in the Southwest; Stevens demonstrates that the presence of differences between stakeholders can be leveraged to solve, rather than aggravate. Her case study uses rhetorical approaches – including stasis analysis of grazing -- in identifying both narrative and science-based arguments. Her sensitivity to participation for stakeholders uses stasis as strategy to name collective identities. Stevens also co-edited a collection that uses rhetoric as an analysis frame in selected social movements (Stevens & Malesh, 2011).

> *Stevens uses stasis to map out both the complexities and players of cattle grazing upon western lands, many of them public. This land-use focus about food generation is shared by the Delmarva poultry farmer context; though in the USDA GIC project, ammonia deposition upon the land and water, is a different externality than that of the grazing wear and reshaping of plains ecosystems. For*

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[105] Each book annotation paragraph is followed a brief indented note in italics on applying the book to this USDA CIG project and the science communication work that forms the basis for this dissertation case study.

Delmarva, the rims and margins of the Chesapeake Bay intrude into the land, thereby creating the contact zone for nitrogen as a nutrient problem.

- Kathryn Northcut (2007) uses stasis theory to analyze early -- and energetic -- paleontology arguments within scientific literature about the 'birdness" of dinosaurs. Northcut's work reminds readers how "forensic[106]" science is, meaning that science, like law, is evidence-driven; science knowledge is proposed, defended, rejected, and defended again, with additional evidence in the field later entering canonical knowledge.

    The author of this dissertation sometimes shared this short article with scientists, as short, direct case (evidence) of the applicability of stasis theory to science knowledge construction. The charm of dinosaurs adds to the appeal. However, of chief interest to some science readers is that Northcut accurately described the process by which scientists argue, design experiments to address these arguments, and continue the tug and pull to build new knowledge that, at first, might appear controversial but can later be affirmed by others and become canonical[107]. Canonical science is definitional (stasis two).

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[106] *Forensic* rhetoric, from Aristotle's *On Rhetoric*, is the category of discourse focused on evidence, which places the location in inquiry in the past. Legal discourse is forensic. However, debate and speech conventions also use forensic to describe an evidence-based approach to the rhetoric of making a case. Aristotle's two other categories of rhetorical discourse are *deliberative* and *epideictic*, which are also time-sensitive contexts concerning future (policy is deliberative) and present actions, respectively. For more on how science is rhetorical, see:

Harris, R. A. (1991). Rhetoric of Science. *College English*, *53*(3), 282–307. https://doi.org/10.2307/378102

[107] One scientist in the USDA CIG project quipped, "This is like Thomas Kuhn's paradigm shift but described by your stasis steps; plus, dinosaurs!"

- Allen Brizee (2009) uses stasis theory to arrange and support business teamwork building, including division of authority and expertise, as well as considers stasis steps as helpful to policy disagreements about strategies.

  > *Brizee was taught by Fahnestock and shares her interest in five-step stasis theory as well as ways to apply stasis in problems of workplace tasks. Like the Northcut article on dinosaurs, this short article is accessible to scientists and showcases another aspect of how stasis can help in an environmental science context: stasis propels work in a team forward, toward the end goal, often a policy document.*

- Cameron Mozafari and dissertation author Shea (2014) describes a case of applied stasis theory to organize biomedical science for regulatory policy. Stasis theory use in this case helped with two challenges: first, stasis steps help keep science findings central in the final advisory document (written based on the forward pattern of five stasis steps); next, stasis theory helped calm disputes within the interdisciplinary team about which science disciplinary experts had content authority to determine or predict harm, in the value stasis. Using the definition and causal bins helped sort science findings into a specific arrangement. Using the link schema, scientists were able to extract the findings from earlier stasis bins that could help address questions under the value bin about harming human health.

  Environmental scientists appreciated seeing a case of biomedical team science writing a guidance document toward policy supported by stasis thinking. Guidance documents and science communication for public audiences are written in accessible language, with concision strategies focused on the interpretative needs of the reader. Stasis can help with arrangement, synthesis, and background accommodation information. Stasis can also help keep robust and specific science central in the deliberation., in this case a federal regulatory setting. Additionally, that a co-author in this paper was also the science *communication principal investigator (and this dissertation author) help build specific trust for this project.*

- Martin Camper (2015) describes an expansion of five-stasis step theory (after Fahnestock and Secor) into a six-part pattern that elevates use of an interpretive stasis. Camper draws on both the ancient Greco-Roman rhetorical traditions, as well as modern stasis theorists (especially work by Chaim Perelman and Lucie Olbrechts-Tyteca). Here, Camper is analyzing debates – a kind of interpretive conflict -- over the meaning of texts. Camper is bringing to the analytical fore, an interpretive "bin" that knits up rhetorical awareness from classical and modern rhetorical theory. This focus on interpretation simultaneously elevates audience awareness. Why? Interpretation resides in audiences. Camper's redesign into a six-part stasis approach shows the inherent flexibility of stasis theory as a cognitively available heuristic for participating in complexity.

    Camper's focus on interpretation -- and therein audience understanding -- of what is written is paramount toward debate resolution, typically coming to conflict in the value and policy bins. While much of his work, like Northcut earlier, concerns text analysis of arguments and inferences, elevating an interpretive stasis is helpful more broadly. Stasis, at the very definitional heart, means to rest in a dynamic equilibrium. "Dynamic equilibrium" can describe sustained intellectual effort. Scientists very much use deep and sustained interpretation activity as they reflect on their research and the research of others. Even the time this requires helps underscore how this activity is a stasis unto itself. Interpretive stasis work also characterizes how science communicators linger and reflect on how to accommodate complex science to non-technical audiences, all the while keeping fidelity to the knowledge while respecting the level of knowledge held by the poultry farmer. The author appreciated being reminded about the centrality of interpretation in communication successes. This

USDA CIG project required extensive team communication, as well as preparation for poultry farmer communication[108]*. The picture card sets, for example, were stronger by thinking specifically about interpretation as a stasis frame.*

- Scott Graham (2015), who often includes stasis in titles of his works, looks at systemic, multi-actor definitions (stasis two) about the rhetoric of pain, where patient definitions are included in powerful and centered ways. Graham's multi-actor approach is very much a stakeholder or audience inclusive frame. Two other works by Graham concern public participation in a pharmaceutical system (2012) and a co-authored stasis analysis of a team of scientists and technical experts operating under a short time frame to advise about earthquake risk (DeVasto et al., 2016).

  Delmarva poultry production and the shadow of ammonia is a complex system, nested with other systems, including food processing and production. Pain, health care, pharmaceutical research and the medical products industry: these are also complex systems. While Graham's content area did not immediately appeal specifically to scientists, sharing the article titles and abstracts, as well as some of the National Science Foundation funding sources helped build the case that a broader

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[108] Camper's work may very well matter more to science communicators in such a project than to scientist colleagues, in terms of demonstrating the usefulness of stasis method. However, an interpretive stasis applied to such projects would help keep author intentions (all scientists in project) and audience understanding (poultry farmers, primarily) in working relationships. Foregrounding this *interpretive stasis as a project value* early on helps avoid the science communication problems that occur when these tasks are attended to primarily at the end of such projects. Camper considers this intention-understanding instruction of interpretation further. See

Camper, M. (anticipated 2022). "Language-based Interpretive Arguments" chapter in *The Routledge Handbook of Language and Persuasion,* edited by Jeanne Fahnestock and Randy Allen Harris, Routledge.

community of scientist-leaders see a role for stasis analysis in human problem solving.

- William Kurlinkus (2019) thinks about technological nostalgia and tradition, with stasis analysis as a way forward in conflict resolution. Nostalgia shapes values and can describe some of the viewpoint differences between stakeholders, scientists, and policymakers. In addition to stasis as tool that both includes stakeholders and propels toward communal resolution, Kurlinkus also values a participatory design approach. This sense of inclusion of stakeholders and their values, helps valuing activity be broadened beyond economic terms only. One of Kurlinkus' case studies (2018) looks at how innovation can be dislocating in a work sector, here Appalachian coal workers.

    These stasis-based works by Kurlinkus were published after most of the planning and early activity of this USDA CIG project was completed. However, in some final documents, including this dissertation, the idea of nostalgia became helpful in interpreting the Q-sorting results discussed in Chapter 3. For example, some of cards noted the importance of heritage farming knowledge, including understanding VEBs as a kind of hedgerow. Other cards depicted keeping land for descendants to farm. Both of those cards invoke a sense of the past. Further and interestingly, nostalgia arose in imagining sustainable futures for the Delmarva poultry industry. Several cards in the sorting experience were future-directed: For example, a card certifying chicken as Bay-friendly. The condition of the Chesapeake is often viewed in nostalgic terms. Mapping a sustainable future for Delmarva poultry production where farmers' average age is about 57 will bring up many communal experiences, including loss, land-use changes, family farming choices. Some of these ideas will be revisited in Chapter Five, the conclusion.

These scholarly works using applied stasis just described carry two functions in this dissertation case study. For all readers, these annotations serve as evidence of the sub-disciplinary area within English Studies that is rhetoric, generally, and stasis theory, particularly. However, most of these annotations show a rigorous use of stasis theory in technical problems, many of them environmental. In this way, these cases form a repository of evidence that stasis theory matters in science-rich problems.

Stasis theory for environmental policy deliberation (2012-2019): Stasis theory was also presented to some scientists[109] in the USDA CIG project. Much of the exposition in this chapter is a tale of evidence: scientists would be most convinced about stasis applicability if presented with evidence. To begin with, this author was the lead science communication expert in this grant and well versed in stasis theory and application. Stasis theory helped the author with the several complex "production editor" roles for both project deliverables and stakeholder communication. In addition

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[109] Of the approximately 17 scientists and technical experts in this USDA CIG project, lead scientists interested in stasis and working closely with the author total about seven over the five-year duration.

to document tasks, the author was a principal investigator and responsible for some overall project management with others. Stasis steps helped the author keep tasks organized, across scientists and institutions against a time clock. Table 3 below is one example of how the author used stasis theory like a project management tool, for the sweep of work, in part to plan for document purposes.

Special role of the value stasis in this project: For scientists busy generating new knowledge about ammonia management (the causal analysis bin), the fourth stasis/bin of value makes clear a role for some sort of expert opinion based on research about how to rank the specific benefits of management technology. Ranking is a kind of valuing activity. Scientists in the project were open to bringing in public health research to be part of the fourth stasis.

In addition to using published public health sources, these scientists were also interested in bringing poultry farmers in to be part of this project. Farmer engagement about ammonia management is standard in this area of environmental science. However, the engagement is often technically focused: explain and transfer new knowledge to farmers. However, this author noted that farmers could be engaged about their subjective opinions (values) about their ammonia management decisions.

Stasis theory gave a “location” for both knowledge transfer and value inquiry in the USDA project.

The fourth stasis about values made cognitive and intellectual space available for a somewhat novel valuing activity (enter Q-sorting described in Chapter Four). Here, poultry farmers would be questioned about their values in choosing ammonia management strategies. Generally, these scientists were less interested in considering their own value reactions to the accompanying nitrogen science in this project. What remained uncomfortable was the probing of scientists about their feelings concerning value, even in pilot activities. Specifically, most scientists declined to be included in a Q-sorting activity. The sense of reluctance concerned professional roles, taken up later in this chapter in the short narrative about the *Conservation Biology* journal in 2012. However, scientists could see a role for respective inquiry into farmer values about ammonia management. At the very least, understanding poultry farmer values could improve communication of complex ammonia and nitrogen science.

In a similar sense of reluctance, the fifth stasis of policy, is another stasis step that scientists-as-investigators somewhat avoided. However, those most associated with direct stakeholder communication did see that expert option from scientists on environmental policy was a natural extension of research. Perhaps these scientists responded most fulsomely to the roles anticipated by the stasis steps. This role shift from researcher to advisor, as permitted by five-step stasis theory, can help scientists act both as disciplinary investigators but also as expert guides for society.

What stasis theory supported in the USDA CIG project: Between 2012 and 2019, five-step stasis theory was used to support environmental scientists working to reduce ammonia production from poultry farms. This work formed the basis of a 2012-2017 USDA CIG project[110] focused on voluntary ammonia management strategies used by Delmarva poultry farmers.

Stasis theory maps and takes inventory for complex interdisciplinary work:

[110] Grantees:

University of Delaware, University of Maryland, Oklahoma State University, Pennsylvania State University, USDA ARS (Beltsville)

Project Title: Innovative approaches to capture nitrogen and air pollutant emissions from poultry operations: VEBs for Warm Season and Acid Scrubbers for Cold Season

Agreement Number: 69-3A75-12-244

Table 3 below, shows one "moment"[111] in the grant at approximately year two where stasis steps/bins were used by the author to organize knowledge needed in the project and knowledge being generated by the project.

STASIS No. + BIN	QUESTIONS to INTERROGATE	SCIENTIST(S) / DISCIPLINE(S) / EXPERTISE
1st stasis **CONJECTURE BIN**	USDA CIG: How can scientists and poultry farmers **work together, combining VEBs and PLT to reduce airborne N and PM.** CONTEXT • Poultry farmers do not always trust the science that comes to them primarily through strong regulatory actions. • This study is complex, across several science areas in agriculture, air/water quality, and the nutrient management frame of EPA and states (DE, MD, VA).	SCIENCE EXPERTISE: Poultry litter experts, pollution fate analysts, horticulturalists, air pollution/air-shed analysts, agricultural engineers, soil scientists, phyto-remediation plant scientists, hydrologists, and science communication. FARMER KNOWLEDGE: poultry producers and families have substantial *embodied expertise* aka "chicken sense" on poultry production; they often live near these emissions-sheds, wanting to protect their families from lung illness, while farming amidst new nutrient management regulations. STAKEHOLDER CONTEXT: federal and state level nutrient management programs to protect the Chesapeake Bay, with complexities about both programs and regulations (USDA, EPA, Forest Service) in additional to state and locality contexts, including increased residential development

[111] The author built many of these tables over the course of the USDA CIG project. Some were part of identifying document types to be written. Some of the introductions to peer review articles in technical journals also relied on some information organized into similar displays of stasis activity in the project between 2012-2017, and beyond with research publications.

2nd stasis **DEFINITION BIN**	"SETTLED" KNOWLEDGE: What are background emissions levels? Plant composition of VEB? Exhaust fan use related to seasons and weather conditions? Record/establish baseline data.	Agricultural engineers with farmers monitor and record site emissions. Note: farmer trust is high due to tensions about point sources of pollution v. non-point source Plant scientists note plant health and location of emissions buffer strips, leading to species/cultivar preferences, width/height values, height-to-maturity time scales, etc. Novel techniques to deploy data collection are key here, including modification for farms.
3rd stasis **CAUSALITY BIN**	KNOWLEDGE IN PLAY: How much does VEB distance from fan effect N capture? What happens at night with VEB performance? How does VEB performance vary over seasons? Can VEBS and PLTs be coordinated across seasons?	Air and water pollution experts (air deposition drives water pollution in the Chesapeake Bay area). Fate analysis/airshed/watershed experts trace particle paths and model distribution patterns. Elevated airborne nitrogen deposition leads to water quality problems. Emissions buffering is tested/established.

4th stasis **VALUE BIN**	GOOD, BAD, NEUTRAL, NOT KNOWN (research needed?): How do our findings bear on *Human health**: rates of lung disease associated with particulates and NOx levels (summer air quality); *Ecosystem health: downwind,* downstream effects on air and water quality. *Economic effects*: air and water quality events can reduce crop yields, incur fines or pose other losses for farmers if nutrient management plans not met; reduced crab, oyster, fish yields due to nutrient deposition; diminished water quality for recreation, etc. How do farmers decide? What are decisions made at the margins	Two-part expertise consultation, of both literature and discipline experts. *Natural/biomedical science*: Epidemiologists/public health scientists, pulmonologists, pediatricians, immunologists, infectious disease specialists, etc. *Social science/Engaged*: Economists (local, regional, national), policy experts, regional development economists, as well as stakeholder and civil society NGOs; finally, environmental advocates, etc. What are the values/benefits that poultry producers use to decide on voluntary management of ammonia? • VEBS • PLT Will farmers tell us? Survey? **PLAN:** Q-sorting to look specifically at values/benefits that underlie poultry farmer decisions on ammonia.
5th stasis **POLICY BIN**	RATIONAL POLICY DEVELOPMENT: Given what we know; what are the science-informed options?	Here, the conversation scope typically widens to include policy experts, economists, regulators, legislators, politicians, business leaders, stakeholders (farmers, fishers, recreationalists, residents, etc.), and, finally, environmental activists and other advocacy NGO entities in the community.

	How do we communicate science findings, especially new ones, to poultry farmers and stakeholders? PLAN: Coop. Ex. Work in learning sessions/documents.	What do farmers prefer? (Q-sort analysis will reveal: • Visual cards under development

Table 3: Stasis mapping. This table is an applied stasis worksheet used in year two of the USDA project (2012-2017). This sheet organizes and characterizes the range of environmental science underway (steps 2 and 3). The fourth stasis step of value makes case for Q-sorting (author).

Table 3 is one admittedly larger snapshot of what a stasis analysis approach reveals about how an interdisciplinary science project directed at policy *looks like*. Each stasis step/bin is here (one through five) is aligned with some representative stasis questions, as well as the science discipline or a group of scientists who are working largely in these stasis bins. This grid is moderately granular, meaning that what is included is a good overall sense of the project in year two. One principle strategic goal, however, in creating these tables of applied stasis theory is that the table stands as a fair capture of the intellectual work of the entire project.

Keeping track of the moving parts, across more than 15 scientists, with four principal investigators at three institutions, is difficult. Project management software suits that need. However, project software typically does not arrange content richly by work phase. Project leaders appreciated these stasis-based tables in addition to project management software that identified deliverables, tasks, and due dates. Stasis tables and the questions asked under stasis bins helped elevated content and findings. These stasis tables also helped build the case for stakeholder engagement with Q-sorting (see Chapter Four) and the design of visual Q-sort cards based on conceptual diagram design criteria See Chapter Three).

Stasis theory, through a democratized value stasis, elevates stakeholder roles: Another role of five-step stasis theory concerned how to integrate poultry farmer stakeholders early in this process. Older models of science communication focus on the generation of excellent science, with some communication of policy-relevant details to policy makers. Not always are the range of stakeholders included. This USDA CIG project called for integration of poultry farmers early in this process. This charge in the grant brief was answered in two powerful ways: first, scientists worked with poultry farmers to measure ammonia and related attributes of deposition on the site of farm. Second, stasis theory allowed poultry farmers to be asked about their preferences concerning voluntary management of ammonia. This consultation took place within the project (2012-2017), not after, though some of the data collected in Chapter Four occurred in 2019.

Stasis theory supports scientists in seeing more than one role in policy deliberation: Recall from section one in this chapter is that five-step stasis theory elevates causal knowledge production, which embodies deep respect for scientific expertise. This causality bin (stasis three, elevated by Fahnestock and Secor) leads next to the value bin (stasis four), which offers a functional *pause*, before policy recommendation (stasis five). This pause gives scientists the deliberative space to shift from generating science to contemplating what that knowledge means for *right action*.[112] Many stakeholders expect scientists to offer advice about the science can mean for pathways forward. Moving from disciplinary expert to policy advisor shifts roles for scientists.

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[112] *Right action* comes from the normative analysis of what an ethics of environmental activity would prescribe. Environmental philosopher Peter G. Brown and environmental scientist Geoffrey Garver invoke the Quaker moral guide of being in "right relationship." A right relationship comes about by human beings interacting in ways respectful to all, including nature. An additional imperative for right relationship activity is communal: actions should aid the common good. They invoke a robust science community and their body of knowledge that would help identify the right actions toward a biosphere characterized by human community living a right relationship with the biosphere. See

Brown, P. G., & Garver, G. (2009). *Building right relationship: Building a whole Earth economy*. San Francisco: Berrett-Koehler Publishers, Inc.

Caveat: Environmental scientists and ecologists are often uncomfortable with this shift from discipline-specific inquiry to policy recommendation (described above). In 2012, the editor of *Conservation Biology*, arguably the most important synthesis journal in this field, was fired (Skolstad, 2012) after she requested that researchers remove "advocacy" statements appearing at the end of their papers under the analysis and discussion sections. Analysis and discussion sections (A and D of IMRAD format) typically occur at the end of research results papers.

This struggle over the appropriateness of scientists as policy advisors is long standing. However, this 2012 kerfuffle at *Conservation Biology* generated a great deal of soul searching for many environmental scientists about professional conduct as scientists. Some scientists prefer to generate excellent knowledge, vetted by peer review and other professional practices, with publication in journals their chief role. Other scientists note that environmental science is always directed at some sort of action. Environmental scientists whose work is encompassed by global environmental change tend to emphasize deep investment in discussing the implications of their science for policy.

Discussions of this type continue, often tensely. Recently, ecologists Peter Kareiva and Michelle Marvier wrote in a preface to their collection of essays (2017) on this tension:

> Working as editors for some of the major journals in our field, we have seen first-hand reviewers worrying as much about the political fallout and potential misinterpretation by the public as they do about the validity and rigor of the science." (2017)

Their edited book collection considers the philosophical and scientific struggles that roil some ecological science fields describing several cases since the 2012 *Conservation Biology* event. These cases demonstrate some of the underlying tension between conservation science and expert advocacy; both activities are central to environmental policy deliberation.

Understanding these tensions is important when supporting scientists who will communicate findings for stakeholder consideration. Stasis theory, especially through the value bin step, can help prepare scientists for this role shift.

Stasis theory and rhetorical tools help with audience differentiation for communication

An additional area of help from rhetorical studies concerns the centrality of audience awareness in preparing for and designing sensitive communication. Sensitivity is often seen as residing in stakeholder audiences, especially those who resist environmental regulations and laws. However, sensitivity to the rhetorical situation can also include care in accommodating science knowledge to non-expert readers. Rhetorical skill in designing policy communication does honor scientists who want their knowledge to be communicated accurately.

Policy deliberation nearly always means that several documents will be generated in the process of environmental science teams working toward policy. When a team includes a science writer trained in rhetoric, stasis frames can help conceive of and plan for these several audience-accommodated documents. Roughly, non-expert stakeholders will need a document that moves through the stasis bins of conjecture, background definitions, summary of key findings from new research (steps one, two and three); then, a taxonomy of the values (stasis bin four) that this environmental context raises. Working through these five stasis bins helps retain the science as central to understanding the valuing and policy deliberation “conversations.”

One temporal challenge here is that scientists typically need to cross train each other in background knowledge (stasis bin of definition) as a preface to explaining the new findings (stasis bin of causal analysis) that establish the rational basis for the next stages of valuing inquiry and consideration of policy choices. Recall the oxygenation case earlier in this chapter.

Another practical element of written documents is the different context for peer-reviewed publication and stakeholder communication. Policy consultation documents are written and promulgated more quickly than peer review processes for scientific publication. Audience considerations are also different from peer review contexts. In this way, stasis theory and other rhetorical tools offer scientists an applicable structure in which to select and arrange their complex, problem-relevant knowledge for stakeholder audiences.

Scientists often default to the IMRAD (introduction, method/materials, research results, analysis, and description) pattern that governs the genre arrangement in many research results articles. This genre patterns fits expectations of many technical readers.

When scientists write for lay audiences, they often model after the better forms of science journalism (like the Four or Five W's); neither of these two otherwise worthy document organization patterns from journalism fits the environmental deliberation contexts. Five-step stasis theory does fit the environmental science-to-policy context.

Five-step stasis theory helps with policy deliberation deadlines: Science consultation for policy often runs up against serious time limits. Stasis theory can help propel this process forward, efficiently (by dividing knowledge across domains of expertise, which helps meeting time goals) and effectively (keeping relevant science central, with opportunities to showcase new science findings) toward policy.

Let's explore this one general advantage of hierarchy: motion. Stasis theory is focused on an end of human action. Stasis propels an analysis forward -- toward a *telos*[113] of summative policy action, where the summation brings forward essential knowledge for sound decisions (policymaking). This is how the source-goal-policy schema described earlier, like scientific method, organizes activity toward the goal of advising for policy, based on scientific expertise.

For the USDA project that this dissertation is nested within, the competitive process about integrating science communication strategy within the interdisciplinary framework was noted as a central aspect of why the grant was awarded. Therefore, five-step stasis theory's first contribution for this project was a strategic revision of the original proposal, with a proposed value exploration phase (value bin/stasis step four) that would engage poultry farmers on the values and benefits they understand to underlie their voluntary ammonia management decisions.

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[113] *Telos*: (Greek: τέλος, transliteration *télos*, literally end, goal, or purpose) a concept used by Aristotle denoting the inherent purpose or objective of an act, community, field of study, person or other thing.

The decisions that these poultry farmers make on their ammonia remediation strategies are, in effect, polices, albeit at the individual farmer level. Therefore, these decisions about ammonia management fit the policy bin**.** Also noted as a contribution of five-step stasis theory is the policy bin (step five), writ large, concerns arriving at science-rich environmental policy recommendations about ammonia management.

Science communication[114] always has an audience outside of scientific experts. That the stasis bin of valuing (step four) would include stakeholder inquiry within the technical aspects of this project burnished the overall standing of the proposal (when resubmitted to USDA). Understanding audiences by stakeholder analysis is a key part of understanding the communication context. Developing effective communication documents is enhanced by understanding more about stakeholder views.

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[114] Scientific communication denotes technical communication between experts within a discipline and for technical experts in adjacent disciplines. Peer reviewed publication is the primary way that scientific communication is conducted. Science communication implies less technical audiences but often important decision makers, stakeholders, and public audiences.

Stasis approaches in the project also proved helpful for grant reporting requirements. The science communication expert used the five-step stasis theory pattern to draft and revise interim reports, some parts of research articles, and later the final report.

Stasis offers a map with guideposts for scientists in policy deliberation: All too often, the many tasks of such a project combined with project management software leave out the intellectual and collaborative engagement essential to these projects. For example, without the value stasis, many projects move quickly from research findings to policy communication.

Using the value bin from stasis theory gives all members of the consulting science team time to pause before the high stakes policy bin. A set of questions can be developed for team members to inquire about the implications of their findings and that of their fields for ecosystem health and human health. The value bin also gives pause to bring in other disciplines, through literature searches, to enumerate and evaluate both harm and benefits. Public health and environmental health expertise fit well into this value bin.

Scientists involved in such projects do not need to be experts in applied stasis theory. A science communication member can work in this capacity. However, how applied stasis theory works, along with visuals and examples, can serve as a template for examination and self-guidance. See the works noted early that use applied stasis theory and other rhetorical tools to examine complex human problems.

Finally, stasis theory, eventually, made sense to some project scientists as an important professional process. In conversation between team members, commentary arose about how parts of stasis theory resemble the steps of scientific method. Scientific method is also *telos*[115]-oriented. Scientists seek to understand the world in ways that build knowledge and inspire technology to improve human flourishing. This shared telos-quality makes scientific method and stasis theory powerful tools, especially in combination.

[115] Why. This is the central curiosity of science along with how.

The value bin (stasis step four) brings in public health knowledge: In addition to ecosystem health concerns, air and water pollution from poultry production raise concerns about human health. Particle pollution and ammonia combine in ways that form small particles (ammonia gas, plus poultry litter bedding, bird feathers, and aerosolized bird feces). This complex particle pollution -- particulate matter (PM) -- can harm human health, with emerging and ongoing research about how PM, at several size dimensions, poses serious problems for those living near poultry house exhaust fans. The risks primarily are to lung health, with asthma and chronic obstructive pulmonary disease (COPD) two of the serious lung conditions caused or exacerbate by inhaling PM.

Stasis theory in the valuing bin, forms a location to include public health findings as part of the way to understand the harms and trade-offs about the economic activity of poultry production. Much of the ecosystem health science findings belong in stasis three, the causal analysis bin (the largest knowledge-generative "space") of such projects.

The value bin (stasis step four) can build stakeholder trust: Currently, science communication activities in agro-ecological investigations -- indeed many science communication activities -- tend to be grafted on, later in the project, after experiment design and study completion. In contrast, this USDA CIG project relied closely on poultry farmer participation early on. For example, several site locations for ammonia monitoring were provide voluntarily by poultry farmer families. These farmers permitted the installation of air monitoring equipment that would measure the two pollutant effluents of ammonia and PM, as they exited specific poultry houses.

That these farmers allowed specific ammonia monitoring on their farms is notable as an act of trust – *ethos* in classical rhetoric, after Aristotle and others – toward lead scientists in this project. Recall from Chapter One that ammonia management is based primarily on voluntary best management practices (BMPs). However, measuring ammonia is a step toward clarity in understanding how much ammonia is emitted by poultry houses on particular poultry farms. The ability to measure more accurately specific amounts of ammonia and particle pollution from poultry production makes many poultry farmers nervous about a future of tighter regulation. This measurement context description underscores the trust by these poultry farmers to be a study site in this project. Chapter Five returns to the measurement and data context, proposing an enhanced role for poultry farmers. Trust about data shapes how poultry farmers view science activity concerning the Chesapeake Bay air and water systems.

Stasis theory, in the fourth stasis of value, also provided a “container” or collaborative space to develop ongoing trust between poultry farmers and project scientists. This trust, further, was developed during data gathering activities, making poultry farmers research partners with several scientists in this project. In this partnership, poultry farmers with their special knowledge as experts in food production, also guided aspects of data collection, ensuring that the location of monitors, for example, reflection ground conditions. Later, as project findings became clear, this trust also improves stakeholder receptiveness to listen to the new environmental knowledge as well as consider the implications of specific harm to local air and water quality. Most environmental and allied scientists who study poultry production want to be in close, communicative association with poultry farmers. By working closely with farmers, scientists can be more successful with environmental knowledge transfer and stakeholder discussions.

The value stasis/bin centers human dimensions of environmental policy deliberation: Valuing can be assessed by powerful tools. The social science method of Q-sorting was discussed as the chief way that stakeholder engagement would begin in the project, early on. Further, Q-sorting pilots and study data collection also represented concrete ways to interact with poultry farmers, present preliminary findings[116], and continue to think about the human dimensions of this project.

Thus, Table 3 above became a visual argument for heightening the fourth stasis step/value bin in this project. Namely, that specific study of poultry farmer viewpoints[117] would be planned:

1. How poultry farmers *value their choices about voluntary ammonia management* should be understood better; and
2. *Subjective viewpoints by these farmers likely influence their actions* (powerful policy "moments") about ammonia remediation.

[116] Literature review and ongoing research by project principal investigator Hong Li (University of Delaware) demonstrated early the effectiveness in scheduling PLTs more frequently, typically from two per grow-out cohort to three. Additional information in application best practices and treatment amounts was becoming clearer. This technical information was presented in Cooperative Extension learning sessions to farmers beginning in 2015. Currently, enhanced PLT schedules were a newer, emerging practice. Few poultry contracts specified timing and amounts, meaning that poultry farmers made their own decisions largely about changing schedules. Between 2017 and the present, enhanced PLTs are largely accepted best practices with many poultry grower contracts including specifications for this in-house ammonia management practice.

[117] This is the basis of the dissertation, assessing poultry farmer viewpoints about ammonia management.

This particular stasis table (Table 3 above) helped propose and build the case for a stakeholder engagement experience about values, using Q-method. Q-method, described in Chapter Four, is a mixed method from the social sciences that studies human subjectivity. Values and value expressions are deeply subjective since they reflect highly personal reactions to an external world yet are also formed by interior psychological processes.

Valuing/policymaking: *who* matters? farmer expertise and preferences recognized:

The fourth and fifth stasis (value and policy bins) give poultry producers open rhetorical spaces to share their lived expertise with others in the deliberation. Poultry farmers hold "chicken sense," a Delmarva version of what rhetoric and communication researcher Beverly Sauer calls "pit sense" from her work on risk and safety with miners (Sauer, 1998; Sauer, 1999).

Sauer's work elevates the *embodied* expertise of workers as having meaning for policy development. Her work with miners focused on a rhetoric of risk: miners face many safety hazards in the course of their work. However, several concepts from

Sauer help argue for including stakeholders in almost all science-to-policy deliberations. Embodied knowledge, for Sauer, centers praxis knowledge as essential to human problem solving. Poultry farmers learn by reading, by example, from training but also from moving through their world, here, caring for poultry.

This conferring of praxis knowledge expertise on farmers makes for a more respectful stakeholder engagement. Contrast this to "teach the science, the farmers will follow" stance that no one intends, but can characterize some of science communication settings.

Another humanities idea that supported this stance of respect and inclusion of poultry farmers is *conviviality* (1973) from social critic/philosopher and Roman Catholic priest Ivan Illich (1926-2002). This concept was intended as a counterbalancing tool to social mistrust of expertise by workers in society with practical knowledge (embodied, after Sauer and others including philosopher Merleau-Ponty[118] for his

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[118] Merleau-Ponty, M. (1945/1962). *Phenomenology of Perception*, Routledge

A good review of Merleau-Ponty and Cartesian understanding of human cognition and self-reference knowledge, See phrase “knowledge of the hands”). Rebuilding trust toward living well together. – one reason Illich chose conviviality as his term for redressing class struggle and inequity -- is touched upon in Chapter Five, whereby an ethical reconsideration of community could be part of poultry future imagining.

Prominence of the fourth stasis: The fourth stasis step/bin about value, valuing, and evaluation created space for project analysis about the values and benefits inherent in what ammonia management strategies farmers.

Scientists in this project were naturally more comfortable working in the science (definitional and causal stasis steps two and three), fully expecting to communicate their findings in lay audience -accommodated ways. However, this value stasis step created a bin for the science communication expert to assess farmer-held values. This bin offered space and time to reflect on how to communicate science to stakeholders

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Gibbs, R. W. (2006). Embodiment and Cognitive Science. Cambridge U. P.

who would make decisions on these voluntary best management practices to reduce ammonia at the level of the farm.

Without the fourth stasis theory step of valuing, scientists in this project may have struggled with stakeholder engagement “promised” in the grant. Stasis theory, with an elaborated “location” for valuing separate from scientific knowledge (settled knowledge in definitions) and active inquiry knowledge (cause-effect) is an undervalued process for social problem solving. The value bin became the province of the science communication expert. This division of expertise and labor helped scientists return to their causal and modeling work.

These operational values of stasis theory in this case study can be distilled into three overarching summative statements:

- Stasis theory helps include all actors from scientists, science communicators (Cooperative Extension agents, for one), humanists, and stakeholders.
- Stasis theory, especially within the value bin, can help build stakeholder trust, by inclusion of their viewpoints.
- Stasis theory helps scientist see two compatible roles in environmental policy deliberation:
    - builder of essential environmental science knowledge and
    - policy guide, based on this environmental science expertise.

Limitations:

Not all scientists want to learn about stasis theory: Like scientific method, stasis theory does not need to be "over-voiced" in such a project. Stasis theory, understood by a humanist within such projects, can operate as an underground cognitive organizing tool for both the scope of knowledge and the pacing of such projects. Scientific method operates similarly for scientists as their shared professional practice. For scientists, scientific method operates in the intellectual background (Gauch, 2003; Gauch, 2012) as part of their formative professional immersion into the doing of science. Noted earlier is that the vast repository of knowledge of both stasis theory and scientific method reside within the professions. We can use Sauer' use of Merleau-Ponty's important insistence about embodied knowledge. This knowledge is often passed on[119] between teacher and students, principal investigator, and post -doctoral researchers and even between practicing scientists as they teach and cross train one another in knowledge methods.

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[119] In practice, this exchange also resembles esoteric transfer of information, specialized, often unwritten knowledge that is shared by relatively small groups, often with long terms of initiation.

Hugh Gauch[120] – trained as a plant geneticist and in agricultural systems –is a soil systems specialist at Cornell also wrote a now classic approach to multivariate analysis in community ecology (Gauch, 1982). Including Gauch in this discussion, both this dissertation and for future policy deliberations, can be strategic in several ways. Gauch embodies the rhetorical appeal by credibility of speaker (*ethos*). Gauch is a deeply respected and highly published scientist. That he devoted time in 2003 and 2012[121] to write book-length reflection on scientific method helps build the credibility argument more generally for humanities expertise in science settings.

Gauch is a computational ecologist writing book-length descriptions of what scientific method is and how this process works. Gauch's discipline and his writing embody a two-part argument for scientists about why cognitive framing is often a pedagogical activity more than a scholarly activity. First, his ethos as a scientist

[120] Gauch's expertise is highly specialized. For example, he is co-author with ecologist Robert Whittaker on at least ten publications. He also wrote software for agricultural and community ecology use early in the digital shift for these fields. Gauch's interests are also in philosophy of science, history and praxis of scientific method, and a place for Christian identify within science professionalism.

[121] Gauch's 2012 version of inquiry has the advantage of his thought ripening over time and that he teaches scientific method to undergraduates at Cornell. This shorter version also demonstrates concision possible from years of exploration and teaching.

within the same field as environmental science in this project, forms a personal, professional connection about trusting scientists adjacent to your expertise. Making the analogy between scientific method and stasis theory is one argument used to persuade scientists to the applicability of stasis theory to complex environment science work, absent a large peer-revied publishing stream.

Another argument to demonstrate stasis theory utility forms the lion's share of this chapter: stasis theory within the subfield of rhetoric as having status in English studies.[122] Status here means disciplinary integrity, with developed methods and

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[122]A few scientists in this USDA CIG team felt that the stasis work was not useful nor compelling to them. These scientists appreciated, however, learning about Q-method to study subjectivity. More than one cognitive structure supports researchers in moving through a project. Indeed, scientific method contains the values of research carefully, observe carefully, record carefully, etc. Researchers could discover Q-method to assess stakeholder values in a few ways. Yet, the values-focus of stasis theory made possible a wide lens to look at a technique like Q-method that examines subjectivity in qualitative ways. Perhaps this dissertation chapter, should they stumble into reading this, would make clearer that working through the valuing stasis gave rise in this project to evening proposing Q-method, rather than a survey of poultry farmers about ammonia management practices. How else might values be studied "objectively"? Q-method, as a mixed qualitative and quantitative approach helps answer this question. An additional value of including humanists in such projects is that these experts can be trusted to look at other tools -- history, design, ethics, narrative structure, storyboarding, ethnography -- that might support the project's progress and final goals. This trust in expertise by others is also reflected in the respect a humanist bears toward science colleagues who understand the complex and confounding ways nitrogen moves through an environment, poultry nutrition and pollutant footprints, ability of plants to remediate air pollution, etc. Not all experts need deep fluency in the content and methods of all team members. Yet, cross training each other, dividing content areas, braiding the many strands of work all supporting wise deliberation– taken together can improve human problem solving.

lines of inquiry. The line of inquiry is where the publication record resides, for both science and English Studies. This shared importance of scientific method and stasis theory, also a method. as “hidden in plain sight” also forms a transparency argument for why stasis can be part of environmental science-to-policy deliberation.

Strategy forward? Relinquishing power to build allies and co-collaborators: As described in an applied stasis project for biomedical science and health care policy (Mozafari and Shea, 2014), five-step stasis theory supports all actors in complex interdisciplinary science consultation. One stasis-focus contribution is that team members can act as “allies and co-collaborators,” in guiding stakeholders and public audience to the shared goal: articulating an implementable policy decision.

Most people find allied relationships and collaboration difficult in policy development. One source of difficultly in this environmental deliberation concerns expertise status and stakeholder status. Collaboration is also easier when members in a collaboration hold similar status, even within disciplinary expertise spaces. Poultry farmers know that they are an audience for environmental science knowledge. Poultry farmers do not always feel in community with environmental scientists, nor having the same knowledge-making status. Poultry farmers would like their special applied knowledge of farming expertise to be seen as a knowledge area that should be placed somewhere on the stasis steps, likely the definition bin and the causal bin. This embodied knowledge is real and plays a huge role in how environmental policies fail or succeed. See Sauer's commentary on how "pit sense" from minors paves the way for acknowledging "chicken sense" for poultry farmers. Stasis theory steps make possible inclusion of farmers recognized for their expertise and specialized knowledge about ammonia and chicken rearing. In future conceptions, the author would like to place some poultry farmer expertise into stasis two and stasis three. Embodied knowledge would be part of the argument for this work.

One possible solution, asserted by feminist techno-futurist[123] Katie King (2012), is to stress the importance for scientists, specialists, and other experts to *recognize and then yield* some of their rational decision-making ethos to non-academic stakeholders, as well as disciplinary experts in the humanities. Perhaps King's strong statement can be revised into *recognize and share,* within the organizing structure of stasis steps.

[123] Chapter Five notes that Afrofuturist thinking can play a role in thinking about poultry futures.

Stasis four (the valuing bin) along with inclusion of poultry farmer stakeholders as having *standing* to make value assessments provides a first location for this two-step act of first yielding and then including. Scientists can learn more from poultry farmers based on this "chicken sense" as a documented kind of embodied expertise. Famers, when experience trust and respect, may speak in greater detail about what they know, think, and prefer.

Summary and preview of next chapters:

This chapter presents, describes, and proposes five-step stasis theory (after Fahnestock and Secor) to design environmental science for policy deliberation. Stasis steps can be thought of as place-holder categories, staged hierarchically to support a policy proposal. These stasis theory categories – think bins – help organize information but also the many actors in this process, including scientists and technical specialists across many disciplines.

Chapter Three concerns creation of the cards for sorting. While this chapter focuses on selected praxis aspects of science visualization for communication, Chapter Two is essential formative background for the content of these cards. Stasis four in five-step stasis theory permits capacious space for values exploration. The cards designed in this USDA project combine values frames with specific ammonia management trade-off. Herewith is Illustration 1.2 that summarizes the context in Chapter One for Delmarva poultry production as well as values analysis for poultry farmer decision-making.

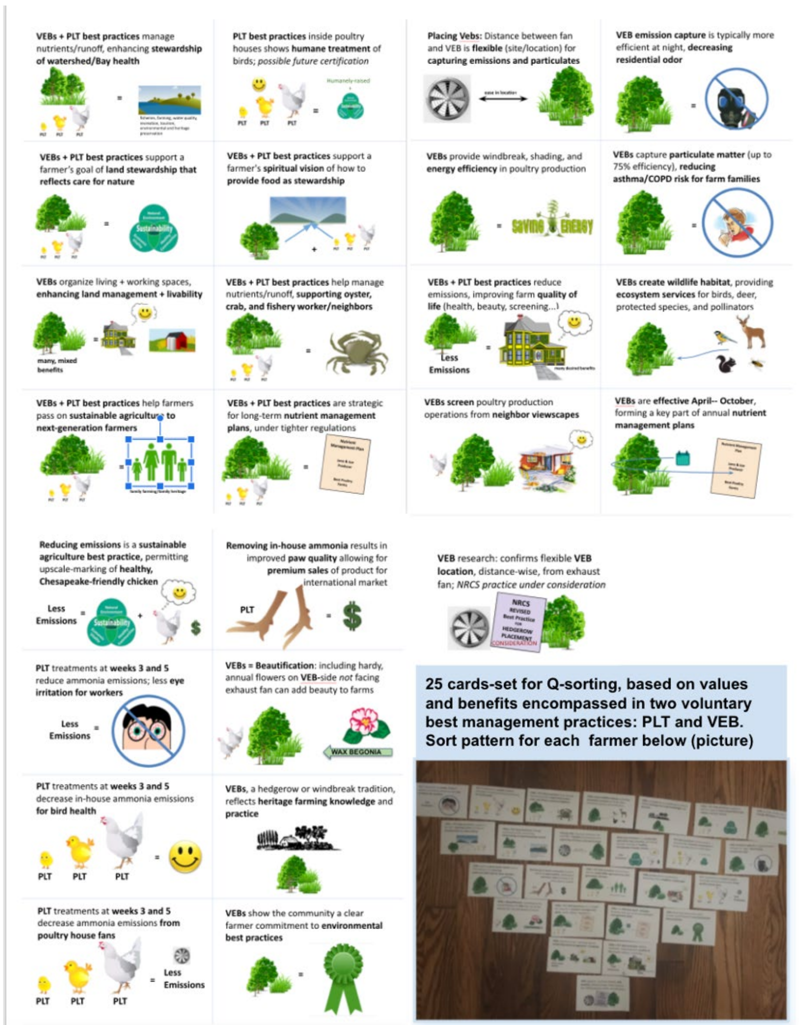
REPRODUCED FOR READER CONVENIENCE

Illustration 1.2: 25 cards developed for the Q-sorting study with Delmarva poultry farmers.

A second function of the value bin/step four is elevation of poultry farmer viewpoints. Chapter Four describes the mixed method tool of Q-method to assess farmer viewpoints. Q-method, which is both qualitative and quantitative in design, is an ideal tool to use with the value step of the project organizing structure.

Chapter Five will knit up a few of these strands – "chicken sense," conviviality, consultation, data collaboration -- as well as present a few other types of rhetoric toward the flourishing of Delmarva poultry production, while protecting the Chesapeake Bay airshed and watershed.

Chapter 3: Designing small-card conceptual diagrams for exploring values/benefits in poultry farmer preferences using Q-method



REPRODUCED FOR READER CONVENIENCE

Illustration 1.3: 25 cards developed for the Q-sorting study with Delmarva poultry farmers.

Overview: The Q-sort cards (see Illustration 1.3, above) use visuals paired with text to communicate 25 values and benefits that underlie poultry farmer choices in managing ammonia. Chapter Four (upcoming) will describe Q-method as used in this project. Typically, Q-sort cards use phrases, sentences, or short paragraphs to capture a set of statements that help assess respondent subjectivity. In this case study, the concepts used to explore poultry farmer subjectivity are complex and reflect several knowledge domains including ecological and environmental science findings, public health findings, and details of consumer preferences in chicken markets. In addition, this project elevated the agricultural knowledge that poultry farmers use to stay competitive and manage their land and property. Conceptual diagrams of these concepts were the rhetorical strategy selected for the Q-sort card sets, rather than text alone.

This chapter focuses on selected visual rhetoric choices in designing these cards. Science, including ecology and environmental science, uses conceptual diagrams to describe complexity, especially for causal or predictive knowledge. The conceptual diagram tradition in the sciences was adapted to fit the small size (approximately three inches by four inches) of cards for Q-sorting.

Part One: In downscaling visual diagrams to fit Q-sort cards, a brief review of two selected ecology visual communication cases is instructive. Additionally, the use of these science examples helped argue with the USDA CIG team for using “picture cards.”

Part Two of this chapter summarizes the applied visual rhetorical principles that two scientist-visual communication practitioners use (Frankel and Dennison). These scientists rely on strategies from design professionals as well as visual rhetoric experts.

Finally, this chapter looks briefly at the history of cards as tangible objects that help organize complexity. Seeing cards and systems for sorting as “complexity machines” helped build the case generally for Q-method and card-sorting. Q-method as a mixed method for social science inquiry method is relatively underused as well as sometimes misunderstood. Looking at a long tradition of cards and card systems to organize complexity, again, supported team members in seeing the physical appeal of this novel card sorting method.

A closing discussion element focuses on making a case for using a comic/cartoon aesthetic, principally to achieve readability of the conceptual diagram content on small cards.

Introduction:

This chapter looks at selected visual rhetoric practices in ecology and environmental science to design visual Q-sort cards for understanding poultry farmer choices about ammonia management. In Chapter Two, the fourth stasis of *value* creates a location to reflect generally on the values inherent to the environmental problem of ammonia management. Because poultry farmers are a primary decision maker concerning poultry-based ammonia pollution, looking at their values is helpful to the environmental problem of ammonia deposition into the Chesapeake Bay watershed. Chapter Four, upcoming, describes how card sorting from Q-method can help elicit subjective preferences about how poultry farmers think about their voluntary ammonia management options. Typically, Q-cards are text-only; however, the complexity of ammonia management within the Chesapeake Bay watershed is best handled by sorting cards that pair visuals with text to describe values and benefits. Using visuals and text make this planned card set a multimodal communication genre.

Conceptual diagrams in science are also multimodal[124] in that they combine text and visuals. In ecology and environmental sciences, conceptual diagrams tend to be in landscape orientation (long horizontal axis), in part, because the information depicted occurs in nature. In natural systems, one spatial quality that forms the background for many environmental problems is the landscape.

Vertical spatial scales are also used in environmental science, for example, many diagrams about atmospheric chemistry and weather use a vertical orientation to depict changes from the earth's surface in a gradient that moves up through layers. Soil and

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[124] Increasingly, some of the best conceptual diagrams, information graphics, and science visualizations include animation. In this way, these filmic visualizations are part of a long tradition of science films that educate on new or complex ideas. Animations are another example of multimodal communication.

water contents also use a vertical axis to show processes through layers of soil types and other geological strata and for water, activity within the water column. The use of landscape orientation in ecology and environmental science, however, remains a typical design choice, especially when the information is best captured in the landscape or *transect*[125] orientation.

The values and benefits underlying ammonia management choices are closely related to how this type of pollution moves across the land and water. This natural condition means that one design element for this card set is that the orientation will be landscape.

Orientation now settled; another card attribute is size. Conceptual diagrams are a good working genre to use in building the intellectual content of these cards. The size makes for another hard design constraint: the 3"x 4" size of the sorting card[126], which

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[125] In both geography and field science, the transect orientation is a study of objects and activity upon the landscape. Here, the context is the physicality of poultry farming in the Chesapeake Bay, with implications of ammonia presence in both airshed and watershed systems.

[126] This size comes from using 8.5" by 11" light weight card stock for printing cards in an 8 card by 2 card grid, which are then cut using a paper cutter.

means the design will need to be downscaled to fit the card, yet communication complexity to poultry farmers who will sort them. Design practices about size and readability [127]are available and will be looked at later. However, the concept of *mentor texts* (examples) is helpful here, about size and readability. Familiar – common, everyday -- landscape-oriented genres include postcards, many flash card sets, some postage stamps, some greeting cards, some trading cards (cigarette cards[128], for example), business cards, and even debit, gift, and credit cards. A sense of scale, color, image clarity can be gained from looking at these types of graphics. However, complexity of idea is not always part of these graphic examples.

Elements of visual rhetoric combined with a survey of *mentor* conceptual diagrams from science can guide design of these Q-sort cards for audience comprehension.

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[127] Here, readability is related to user testing: one key question, is the size useful for most respondents? And, because the conceptual diagram requires the reader to understand a concept, user testing is important for overall card-sorting effectiveness.

[128] Cigarette cards include the surviving genre of baseball and other sport cards, though the cigarette card tradition was much more prevalent in England than in the U.S. In the U.S., baseball cards were most associated with chewing gum and bubble gum brands. Sport cards tend to be portrait oriented, to feature the player, including the face.

Part One of this chapter looks at two classic conceptual diagrams from ecology papers as mentor graphics. Within these mentor graphics, a careful review can yield design values for building Q-sorting cards. The first classic visual case concerns ecologist Robert MacArthur's work on warblers and his theory of niche partitioning; the second visual case concerns island biogeography theory, from MacArthur (1930-1972), E.O. Wilson, and Daniel Simberloff, where Wilson and Simberloff are also noted ecologists.

Another source of design expertise about conceptual diagrams concerns the professional practice of scientists who are also visual communicators: Felice Frankel, trained in engineering, and marine ecologist William Dennison. Practitioner knowledge and experience in both science and design fits the environmental context of these cards.

Another source of design knowledge comes from Edward Tufte. The final design knowledge source is the visual rhetoric work of semiotics researchers Gunther Kress (1940-2019) and Theodore van Leeuwen. Design principles from these sources will be summarized in tables placed near the supporting exposition.

Part Two of this chapter looks briefly at the materiality of small cards (3” by 5”) to organize complex knowledge. Cards are a central material object used in the social science inquiry method described in Chapter Four, following. Card sorting and Q-method (Stephenson, 1935) are not as well-known as social science instruments like surveys. This materials-focused discussion helps build the case for card sorting from Q-method as a powerful tool for understanding complexity, organizing relevant information for problem solving, and decision-making.

Part One:

Case One: Warblers in Arcadia and Robert MacArthur’s diagrams

MacArthur studied warblers in Acadia National Park (Maine), publishing results in a seminal 1958 paper. He was interested in whether several species of warblers all occupied the same ecological niche. Generally, a “niche” describes the role an organism plays in a community. For a particular species, their niche encompasses both the physical and environmental conditions required, along with interactions this organism has with other species (predation or competition, typically).

MacArthur's findings divide or *partition* the tree environment that these warblers were feeding upon. Separate warbler species shared one tree but occupied several niches (spaces and feeding activity) within this tree. Niche partitioning is now an established term of art in ecology. Partitioning of an ecological niche for warblers means dividing the space upon the tree to exploit for feeding. Niche partitioning denotes a collection of sub-niches, adding nuance to earlier understanding of what an ecological niche.

Existing niche theory -- from Grinnell (1917) and Elton (1927), at the time of MacArthur's inquiry -- implied that one species per niche is canonical. MacArthur developed the finer grained idea of *niche resource partitioning:* different species of warblers used the same tree species (resources of seeds and associated insects[129]) differently, at different times in a season, and occupied smaller, sub-niches niches in the one tree. MacArthur's prose in this foundational article is widely known to be a sophisticated and compelling argument. However, his visual arguments are equally

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[129] Generally, for most species, warblers eat caterpillars and forms of mature arthropods (including ants, bees, beetles, bugs, flies, grasshoppers, spiders) but they also eat fruits and seeds (notably, pine seeds) especially during the colder months. Warblers forage by hopping along branches in conifer species, at different height levels in these trees.

compelling but also are gorgeously elegant[130], a desired and well-appreciated quality, especially in math and science communication.

MacArthur's thinking was revolutionary, supported by extensive field notes, coded observations in well-constructed data tables, mathematical analysis, described by fluid yet appropriately complex prose. However, here we focus on the summative visuals of his field work, communicated in simple black line art. Below are three illustrations (Figures 7-9) from MacArthur (1958) that present data as deft renderings that make clear the relationship among the five species of warblers and their spruce woodland habitat.

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[130] Elegant: conveyed with simplicity and explanatory power. A recent Society of Microbiology *mBio* open access editorial meditates on elegance: qualities that make a scientific model, experiment, method, or theory "elegant," with a focus on the life sciences. See

> Casadevall A, Fang FC. 2018. Elegant science. mBio 9:e00043-18. https://doi.org/10.1128/mBio.00043-18. Copyright © 2018 Casadevall and Fang.

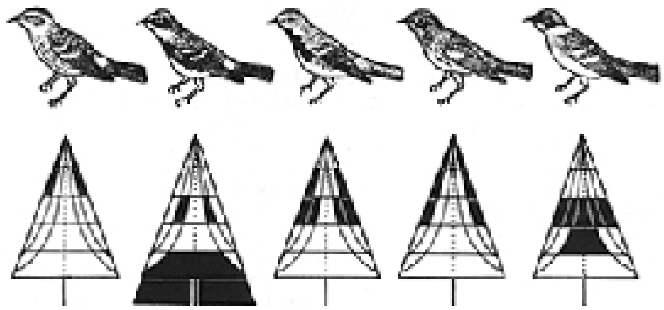

Figure 7: MacArthur's first illustration of warblers and tree feeding location. Warbler species (from left to right): Cape May, Yellow-rumped, Black-throated Green, Blackburnian, and Bay-breasted Warblers. Black areas in the stylized conifers under each bird species show where feeding activity is concentrated.

Figure 7 above shows four different warbler species, positioned over one species of tree, where different locations on the trees show where each warbler species feeds. Though small, the bird renderings are representative and *read*[131] well. Indeed, these side-view bird sketches are typical of bird guides of the time, when drawings, rather than photographs accompanied each species account. MacArthur, an avid birder, would have been quite familiar with these images.

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[131] *Read*, here means the verb form and not related to texts: from theater and design (can be understood within the conditions) by the reader, viewer, theatergoer, quickly and accurately.

Later in his paper (Figure 8 below), MacArthur leaves out the bird drawings and uses the names of the birds, linked to shaded feeding locations, in five tree side-view renderings.

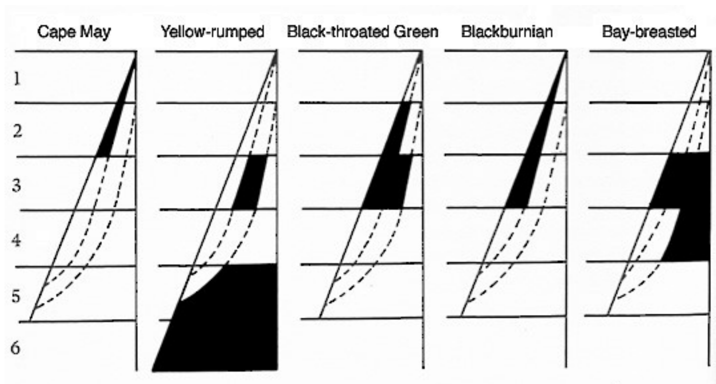

Figure 8: Detail from MacArthur's figure that narrows in feeding location by bird species niche within the tree. Here, the six zones are numbers on the Y-axis.

These design choices by MacArthur emphasizes that the tree is partitioned into sub-niches for each warbler species. MacArthur is teaching and arguing with pictures, where design and sequence help support the reader into the complexity of redefining niche theory.

Design choices in Figure 7 above help set up – support readers to anticipate -- Figure 8, just presented. MacArthur introduces the tree niche partitions idea in Figure 7, with the locational shading intact, and showing both the right and left sides of the tree cross-sections. In this set of conceptual diagrams, a great deal of thought was devoted to the order of ideas, to stage the complexity for the reader. The functional order is a kind of hierarchical pattern – an ordering – that reminds readers of the hierarchical pattern inherent in stasis theory from Chapter Two. Human understanding and conveyance of this complexity often relies on patterns, order, and hierarchy.

In Figure 9 below, MacArthur now focuses on the spruce tree, displaying both right and left portions of the vertical cross-sections, with two tree figures each showing different detail. Figure 9 incorporates the zone (1-6) information on the Y-axis, first shown in Figure 8, now used to important teaching effect. These two tree shapes represent detailed feeding patterns by two species (MacArthur's Fig. J, on the left, a myrtle warbler feeding pattern; MacArthur's Fig. 4 on the right, a black throated green warbler), with mathematical notes about the percentage of numbers of total seconds of observations on the left-hand side of the tree, and the percentage of total number of observations on the right-hand side of the tree. In each case[132], the sample sizes are noted.

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[132] Note: MacArthur includes seven additional visuals to show patterns of all the warblers. These images are not show here.

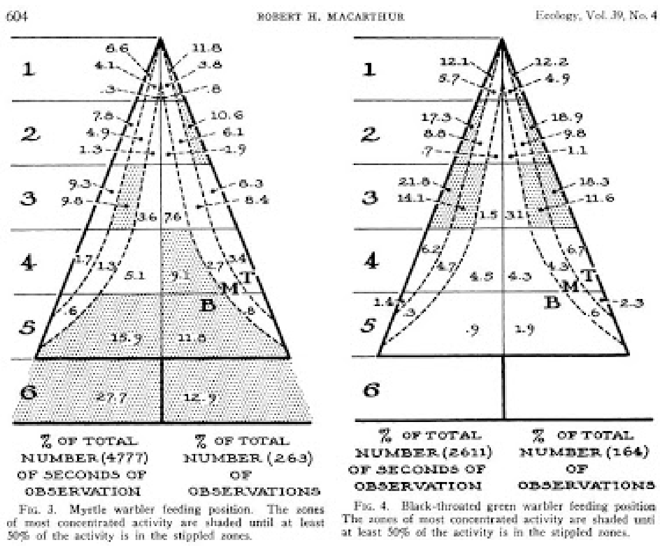

Figure 9: MacArthur narrows focus to two bird species; the Myrtle warbler on the left tree and the Black throated green warbler on the right-hand tree.

However, the design technique is clear: MacArthur deliberately stages the series of images, using the same line art design choices. This design strategy is called stepwise parallelism. Parallelism can support instructional staging; parallelism also “teaches” the viewer about graphical elements that will reappear. Finally, parallelism creates a sense of unity and belonginess. Later, this design strategy, especially the belongingness idea, will be used as a design constraint for this set of Q-cards, too.

Overall, MacArthur’s work provides readers of his foundational article a series of data-rich conceptual diagrams that communicate differentiated feeding activity of these birds. Yet, the most important communication from MacArthur’s set of staged conceptual diagrams is that he proposed a more general notion of how species (here, closely related warbler birds) divide food sources in a natural community: MacArthur called this division of food source exploitation *niche partitioning*, thereby deepening understanding in ecology of a central concept: ecological niche.

These simple, highly skillful diagrams support the prose discussion about warbler behavior feeding in trees. Yet, the diagrams also support a central *leap of inference* made by MacArthur in this paper. MacArthur used these conceptual diagrams to support his textual arguments that not only was he reporting on differences in warble feeding patterns, but he was also revising and deepening the niche theory knowledge first articulated by Grinnell and Elton. Reporting on feeding behavior alone could have comprised a specific field account of warbler behavior. However, MacArthur, aided by these visuals, along with prose and extensive data and formulae, was also building – (proposing and arguing for) theory.

All this information – and more -- about warblers and even the inference-making about redefining niche theory (from Grinnell and Elton) is available in the article's extensive data tables and equations, in addition to text. However, MacArthur's visualization process explains this knowledge (warblers feeding) and leap of knowledge elegantly and convincingly. This visual definition raises the idea of the centrality of definitions in science, including by pictures. Chapter Two on stasis theory describes stasis two as that of definitional work. MacArthur's warblers are a splendid example of the power of a pictural definition to argue for a theory shift.

What are the conceptual diagram lessons from MacArthur's warblers? As mentor graphics, his set of four images included here offers several design lessons, useful for creating visual Q-sort cards. Table 4 below summarizes some visualization values from MacArthur's 1958 paper (Figures 7-9). The table is organized to show general visualization attributes on the right, with take-aways specific to this case study for creating Q-sort cards.

The line between data display and conceptual diagram is not absolute.		Reminding environmental scientists about ecology conceptual diagram tradition is helpful when working through visualization design choices with scientists; helps improve their practices, too, as visualization is essential element in data displays.
Simple black and white illustrations can convey sophisticated meaning.		You can see that they are hand drawn, though the bird images may be an early version of clip art, from birding books. Could be copied or traced. Yet, the take-away is that the bird and tree renderings *read* as birds and trees. Effective.

Parallelism -- that a design can rely on consistency in a series not as a neatness pattern but a way to invite comparison/highlight difference.		MacArthur's figures are parallel by use of bird drawings, atop trees. Size and scale are the same. What is different is the location of the feeding, noted by shading on the trees. The use of cross-sections is consistent across his figures; cross-sections are a known design rendering view, which he relies on.
Parallelism norms support staging: successive drawings rely on conventions communicated earlier, but modified to emphasize detail, meaning.		The tree shapes are consistent across most images. Figure 2 shifts to a zone focus on trees, relying on cross-section. Figure 3 zooms in -- a scaling move --to look at two bird species in trees. Data about sample size, and two percentage constructions about feeding time and location is included in the visual.

Table 4: Mentor graphic by author based on MacArthur's 1958 illustrations.

MacArthur's 1958 warbler graphics depend in part on a *visual grammar*[133] that would have made sense to his readers, typically ecology and environmental science audiences. For example, they would understand the X-Y axis orientation and labeling,

[133] *Visual grammar* refers to a set of conventions, expectations, practices, and rules, which communicate meaning by visual design. More generally, a grammar of visual design describes how visual elements -- images like illustrations (diagrams, drawings, renderings, sketches), maps, paintings, pictures, photos, and the like -- are combined by designers with visually oriented text statements (labels, anchor phases within prose referencing visual elements, descriptions, etc.) to communicate meaning.

generally. Many of these visual elements are understood by general audiences, too. For example, the black and white renderings of the iconic color patterns of the individual warbler species would make sense to birders but also to children mature enough to look at images in a set and see similarities and differences[134]. Cross section visual cuts and half-cuts are "readable" by many audiences. These elements are parts of a visual grammar because knowing about how they function permits an audience to read, without too much trouble, the visual for meaning. Some graphics eventually become a visual icon themselves, for example, supply and demand curves.

Interestingly, MacArthur's ecological work appears also in Case Two, again about ecology. Case Two, like Case One, is discussed as a mentoring graphic. Both visualization examples show again his genius for theory and conceptual diagrams, as well as his very strong mathematical background. His co-author here is the esteemed

[134] Categories in lotto card games, for example, but also in "One of These Things" songs appearing regularly on *Sesame Street* for sketches, where viewers would be shown a group of four items, one of which was different from the other three. Music by Joe Raposo, lyrics by Raposo, Stone, and Hart, circa 1969. Visual grammar skills support "readability" and comprehension. These skills begin at earliest ages.

ecologist, myrmecologist[135] naturalist E.O. Wilson (1929-2021)[136], whose early work focused on ant species.

Case Two: Visualizing island biogeography theory with MacArthur, Wilson, and Daniel Simberloff

Figure 10 below shows migration and extinction curves[137], now understood as the cardinal image of island biogeography. These intersecting curves are part of a visual category of crisscross diagrams.

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[135] Ant specialist.

[136] Wilson died in the final stages of this dissertation. He had agreed to talk to me about his graphic memoir and requested that I send the dissertation when finalized. I am sad that that we did not speak about this work directly. He was a big fan of "science comics."

[137] Students of economics – and many others -- will see this type of "cross" diagram as the equally foundational visualization of supply and demand curves, what are often called Marshallian curves, which come from earliest depictions of mathematics sketches of X-Y axis relationships.

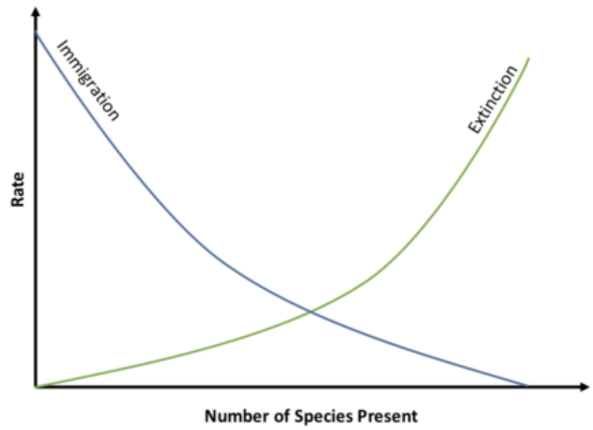

Figure 10: Theory of island biogeography simple sketch; namely, that the immigration (later typically called migration) rate over time of new species and the extinction rate of resident species overtime versus the number of species present on an island, measured over time. The intersection of these two curves shows where the immigration rate equals the extinction rate. Note: John Kyrk is credited as the illustrator in the 1967 edition; with permission.

MacArthur, highly trained in mathematics, would have been deeply familiar with the visual grammar of crisscross diagrams. MacArthur combined his considerable mathematical ability with his subject area of ecology. Island biogeography theory represents an intellectual collaboration between MacArthur and Wilson.

First, MacArthur drafted his thought experiment about species on “desert” islands, with many details on how to proceed with field work, in an unpublished manuscript

"The Theory of Island Biogeography," written with Wilson circa 1963. Later, Wilson and MacArthur wrote the book *The Theory of Island Biogeography* (1967).

MacArthur died suddenly at age 42, in 1972, without being able to conduct field work or design additional field experiments that would support his new theory. A central idea of island biogeography is that species equilibrium – numbers in equaling numbers out -- will be reached in "island" environments that reflect in-migration to the barren island and the extinction of some earlier colonizing species over time. These two forces of in-migration and out-by-extinction could be theorized, with partial equilibrium models helpful to determining the equilibrium point. MacArthur's theory was well articulated with many sound arguments, especially mathematical, but lacked experimental evidence. Still, MacArthur and Wilson were convinced that this theory had, as the saying goes, legs.

In the late 1960s, Wilson and then-graduate student Daniel Simberloff designed an experiment to test the research questions and related sets of hypotheses, based on ideas initially proposed by MacArthur and Wilson on island biogeography. Wilson and Simberloff used a field site featuring clumps of mangrove forest/islands in Florida. In several manipulations involving application of fumigants and selective tenting, these two ecologists finally achieved island barrenness and then set a watch for several years, keeping track of the comings and goings of species that pioneered the now un-tented locations. This resulting visual of immigration-extinction curves (Figure 11 below) is one of their illustrations, now classic in ecology much in the same way as Marshall's supply/demand curves are for economics.

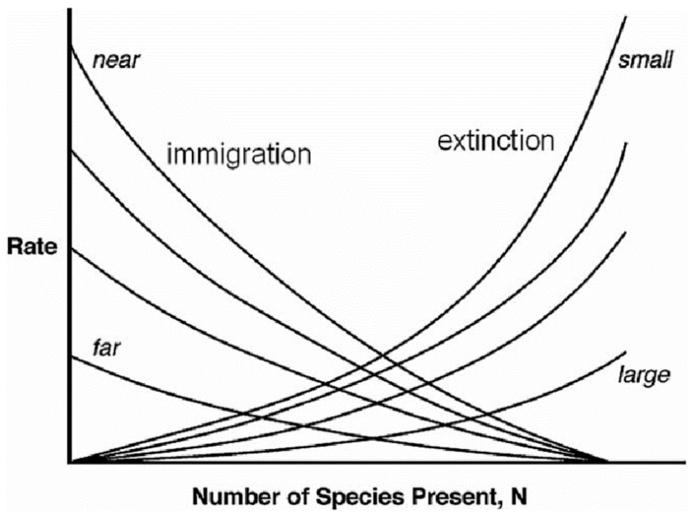

Figure 11: Immigration and extinction curves, from MacArthur and Wilson, that define island biogeography or what is called invasion biology. This work was confirmed by field work that includes Daniel Simberloff.

For ecologists viewing Figures 10 and 11, the X-axis shows the change in number of species, the N number (over time). The Y-axis (of both figures) captures the rate of change on the island sites from barren (no species) to full (stable community of species). The label on the descending curve (again, both figures) also captures the constraint that distance (near or far) to an island (diagrams can be drawn between combinations of island) shapes rates of species colonization and species extinction.

The label on the ascending curve (clearer in Figure 11) also captures another constraint: the size of the island also shapes the rates of colonization and extinction of species

When a concept first emerges in a field, images and text combined can argue powerfully for this new idea. Recall that new ideas in science are often controversial. Arguing for a new theory is best accomplished by heeding what Aristotle would advise: use all the available means for persuasion[138]. Here, in the case of island biogeography theory, the visual is a powerful argument (very much like MacArthur's

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[138] Rhetoric is "the faculty of observing, in any given case, the available means of persuasion." *Aristotle, The Art of Rhetoric*

visual argument about warblers and niche partitioning). Here, the visual is also a pictorial definition of the concept.

In Case One, MacArthur staged his warbler diagrams from simple to increasing complexity (with parallelism) to teach his peers about the meaning he was establishing about niche partitioning. He communicated a shift in theory within a detailed reporting of warbler feeding patterns. Come for the warbler feeding patterns; stay for niche portioning theory. His readers were then, largely scientists. Later, his readers were ecology, environmental science, and biology students[139].

In Case Two, the definitional graphic relies on labeled crisscross curves to show the relatedness of immigration and extinction.

Both definitions-by-graphic are foundational to ecology, with nearly all ecology students learning them in undergraduate school, if not in high school advanced biology.

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[139] The online Khan Academy has several teaching exhibits on MacArthur's warblers and the island biogeography theory of MacArthur and Wilson, with a research confirmation assist from Simberloff.

Table 5 below summarizes some design elements of island biogeography visualization that can serve as mentoring principles for designing Q-sort cards. As described earlier, these mentor tables show general visualization attributes on the right, with take-aways specific to Q-sort cards on the left.

Any X-Y graph is a commonplace[140] or widely understood visual grammar element for technical readers; the migration-extinction curve (X-Y genre) likely informs technical readers but not all novice readers (like ecology students and many public audiences).		Technical readers will understand these curves perhaps not poultry producers unless looking specifically at market demand/supply relationships, which they know because they farm at this point. Audience awareness lesson important! Technical experts often need support in designing illustrations for public audiences.
Variations of X-Y graphs are best labeled, to keep in mind novice readers and public audiences. Time is almost		That non-technical readers can be supported in these diagrams by clarity on the inclusion of time in the

[140] Commonplace generally denotes the ordinary. Coffee shops are *commonplace*, so are ties in the workplace.

The word comes from Latin: *locus communis* for "general topic." Commonplaces in rhetoric and cognition are ordinary elements that most of us know. Related to the idea presented earlier about a grammar of design elements.

always an *understood* part of the X-axis, aka, the arrow of time,[141] for technical readers.		X-axis. This is a simple annotation of such an image but often overlooked in science communication for public readers.
That text around a conceptual graph can improve understanding and prevent errors in interpretation.		Do not assume what people can "read" from visuals. Marry visuals with supportive text.
This example from MacArthur, Wilson, and Simberloff can be used with scientists to see how a designer can move from science data display to a lay-reader conceptual diagram.		What makes sense to technical readers might need annotation for most readers.

Table 5: Mentor graphic design values: depictions of island biogeography theory curves, based on Figures 9 and 10.

In summary, time spent studying these two cases of technical communication in ecology, helps make clear effective approaches to designing visual cards for Q-sorting with poultry farmers. Further, these science-rich examples can help a science

[141] Concept reminding of the "one-way direction" of time (1927) after British astrophysicist Arthur Eddington but also used by energy-based economists including Herman Daly whose work is noted in Chapter Five. The concept is self-evident, yet many lay readers appreciate being reminded that the X-axis often depicts times arrow.

communicator designer inhabit more fully what scientist and technical readers see in visuals like conceptual diagrams.

Case One take-away: MacArthur’s warblers make clear the value of visuals to communicate complexity.

Case Two take-away: Extinction-migration curves in island biogeography theory may appear to be a commonly understood criss-cross diagram. That these curves give rise to island biogeography theory show that what is clear to technical readers may not be clear to public audiences. These audiences can be helped with strategic text annotations, to improve understanding the full meaning of a conceptual diagram.

Limitations of cases

Both visual communication cases date from the mid 50s and the late 60s, when black line art, often rendered by hand, was the standard for many print contexts, including scientific publishing. One important, technical design value showcased here is the communication ability of a strong line. Strong and simple lines also invoke the expressed value in science and math for elegance. Illustrations, even when developed for pedagogy and public contexts -- like Figures 7, 8, 9 above-- rely strongly on the sense of line, which can be communicated effectively in black and white. However, color and other images can expand the meaning contained within the migration-extinction curves (line). Color can also delight and direct the eye, a power that is important for technical and lay contexts alike. The practical aesthetics of combining strong line with color will be taken up later. However, a few preview comments are helpful to keep in mind that the strong line aesthetic of both cases and the elegance of communicating complexity are design values that should guide in card design.

> **Value of color:** Color can also be an instructive, technical element of conceptual diagrams. Color and line as *instructive* remind of the design aesthetic of a child's picture book.[142] Conceptual diagrams are instructive, especially when used for public audience rather than technical audiences.

> **Visual literacy:** Not all people read the crisscross diagram in ways that scientists might. Poultry farmers might interpret such intersecting curves as market supply-demand depictions. Thinking on the audience is an important cautionary tale, ever present in technical communication.

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[142] Kress and van Leeuwen, discussed later in this chapter, often use Dutch artist Dick Bruna's "Miffy" books as an example of the design value of simplicity sometimes relegated to children's publications only. Miffy is a bunny.

> **Card size limitation:** (3" by 4"": So too, must the cards each communicate a complex value attribute, all the while fitting on a small card[143], with the appropriate gravitas to an environmental policy deliberation. Focus on small, simple graphics that can "read" well in this small size is another constraint how the illustration conveys content, allowing for emphasis.[144]

It is worth noting that the selection of these two ecology examples were chosen not only for the embedded lessons about effective visual communication in science: the team of scientists in this USDA CIG project focus on environmental inquiry. Environmental inquiry and ecology are closely related fields. Scientists appreciated these examples, from the science communication specialist/this author as arguments for developing visual cards for Q-sorting.

Another strategic element to sharing these conceptual diagram cases with this team concerned some of their research findings. This project required some technical instruction to farmers about key ammonia science research. Teaching that information within a presentation and including this knowledge upon the cards meant that

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[143] Card size becomes the primary design-limiting constraint, from which other choices knit forth.

[144] Later, returning to this mentor graphic meant that chicken illustrations could be presented as upright and relatively larger, meaning that the portrait orientation for chickens would emphasize that centrality of raising health birds to market size is the underlying goal of the farmer.

conceptual diagrams would be useful for the instruction portion. The two cases helped establish the use of conceptual diagrams in these cares, with detail on what design elements worked (see the tables) and some cautions (visual literacy of farmer audience compared to scientist presenters).

Science visualization has matured deeply since the 1950s, 1960s, 1970s, and 1980s, as we can see in the professional practices of two scientists who are deeply invested in science visualization and communication.

<u>*Part Two: Practitioners Frankel and Dennison, with a nod to Tufte*</u>

This section of Chapter Three is *praxis* focused, looking at two current scientists who are expert practitioners of science communication. In addition to science knowledge generation, these scientists create clear and powerful visualization, especially for lay audiences. However, the chief attribute of these two scientists for inclusion in this chapter is their generosity: both routinely and openly instruct their science and technical peers in visualization.

Felice Frankel[145]

When Frankel speaks to scientists about how to design their visual communication elements, she often uses her NIH “Picturing-to-Learn” project: when scientists shift to visual expressions of their research, often the researcher creates drawings to explain to others about the finding or the phenomena; this process of speaking to the lay audience itself clarifies the science more within the mind of the researcher, also. This clarification, made possible by the thought experiment of audience accommodation, improves most science visualizations.

The two visualization cases described earlier (Part One, this chapter) -- MacArthur's warblers/ecological niche partitioning and the combined island biogeography theory of MacArthur, Wilson, and Simberloff -- fit this principle used by Frankel: picturing science helps at all levels of cognition, from the researcher to the public or pedagogical audience. MacArthur used visuals to define and argue for a new understanding of ecological niche. His genre? Highly specialized ecology journal. His

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[145] Frankel holds joint appointments at the Massachusetts Institute of Technology, both in the departments of Chemical Engineering and Mechanical Engineering. Frankel is also a fellow of the American Association for the Advancement of Science (AAAS) and a Guggenheim Fellowship recipient.

audience? Other ecologists, especially those mathematically inclined and interested in population ecology.

While island biogeography theory (MacArthur, Wilson, Simberloff) was also aimed at a technical and specialized audience, their visualization was also used to argue for this new way of understanding invasion biology.

In both cases, now that these theories are widely accepted by experts, these two cases of visualization are often used in pedagogical settings for young environmental scientists and ecologists.

This insight from Frankel about visual supports to cognition is useful to scientists about clarifying their thinking but also points to the effort required to divide visualization work into at least two distinct audiences: the audience of researchers from that of non-technical readers. Sound visual rhetoric -- like effective scientific writing -- relies on audience accommodation strategies. Thinking about the needs of both audiences in developing a visual that truly supports the specific audience can be a mutually beneficial process.

One important way to improve audience uptake of information in conceptual diagrams is by usability testing. Common in engineering and design, usability testing includes audience experience in the development of designed experiences or products. A version of usability testing for scientists working in visualization would be to develop a practice group for review of visuals. Frankel's approach includes this usability element.

In addition to testing visuals, Frankel teaches scientists to draft and redraft their conceptual diagrams, with guidance from peer scientists. Frankel also encourages scientists to work together on drafting, testing, and revising images, much as some collegial groups of scientists tend to read each other's early manuscript drafts. Later, we will see this same peer collaboration advice from Dennison focused on visualization for environmental policy deliberation.

Frankel shares her work in many forms, including books and seminars/conference activities. However, she also places much of her work in an open MIT course space, making it highly accessible.

More than 35 tutorials from Frankel's course were consulted for this project. Here is a selection of some of her design principles:

1. You can **convey complexity** to a reader with simple drawing skills, including stick figures and "childlike"[146] drawings. Artistic skill helps but is not required.
2. Do not assume that your audience or reader sees what you see in the image you make. **Your science-eye is different from your audience's eye**.
3. What is **your purpose** in the visual? Ask: what is the "job" of the image?
    1. Showing a **detail**?
    2. Showing a **process**?
    3. Showing a **comparison**?
4. If you cannot come up with a one-word explanation for the job of your visual -- see the bolded terms above in item number 3 -- then **rethink and simplify**, perhaps adding another visual or set/series of visuals to capture the new, additional detail. This means you break down your ideas into the number of lessons needed.
5. **Test** your draft version again and again. Ask user: "What is the first thing you see?" [147]
6. Have the courage to **edit** and **trim** and **simplify**. When you test your visuals with a user, ask at the end of the test session: "What can I delete?"
7. Always **honor** your science conventions and **reveal** if you have enhanced an image, reversed a picture, or in some technical way inadvertently selected *in*

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[146] Frankel, in effect, supports a cartoon or comic ethic ultimately chosen for the card set. What covers this design choice is the higher design value of ensuring readability for the user of the card set. Here, the card set user is poultry farmers, with an average age of more than fifty.

[147] This question was central in testing the image for cards.

some information and left other information *out*. This is the science ethic of truth telling.

These seven principles, paraphrased, represent good norms that help focus the design of Q-sort cards. Several other books and resources by Frankel[148] are available.

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[148] *Visual Strategies: A Practical Guide to Graphics for Scientists and Engineers,* Yale University Press, 2012. Coauthored with Angela H. DePace. Frankel and DePace embed their principles within case studies and examples. The authors also begin the book by interviewing noted graphic designer Stefan Sagmeister who calls for design schools to partner with scientists. Communication to citizens about essential science and technology is his primary reason for this proposed collaboration. Both ecologist Wilson discussed earlier, and Milton Glaser, noted graphics designer from the NYU School of Visual Design, wrote cover blurbs for this book. An additional and practical note: Sagmeister designed this book for usability. For example, subject tabs make information retrieval quite easy. The thick vinyl cover means the book can endure field and lab conditions. The spine is an old-fashioned sewn spine, so the book lays open, supporting the reader in examining graphic spreads. The paper is heavy, approaching card-stock. Design take-aways from this book focus on creating effective conceptual diagrams as a process:

1. **Compose**: Identify, organize, arrange elements; figure out relationships.
2. **Abstract**: Define/distill essential qualities/meaning of the material.
3. **Select color:** Choose colors or other ways to
    1. Draw attention,
    2. Label parts,
    3. Show relationships (compare and contrast, show cause, etc.), and
    4. Indicate metrics: time, scale, measure, etc.
4. **Layer**: Add layers to portray complexity, show variation, place in space/time.
5. **Refine**: Test, edit with peers and protentional users, simplify[148].

Picturing Science and Engineering, MIT Press, 2018. The 447-page book of full color illustrations is a physical embodiment of several of Frankel's online spaces, including her tutorials from MIT, cases and lessons from the open edX MOOC, supplemental material from the MIT press website. Frankel's focus on scientific truth, transparency, and ethical design practices makes Frankel's Chapter Seven

Frankel's advice and her science ethos, again, helped create trust within the USDA CIG project about both these cards under development but also the role of science communication in this project.

This same sense of trust also applied to the second scientist-visual expert Dennison, to be discussed next. What Frankel shares with William Dennison is the importance of drafting, revising, and reviewing within a community of practice to generate effective science visualizations.

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particularly useful reading. "Image Adjustment and Enhancement" discusses the borders between art, representation, and truth quite well. The entire book is rich with case studies. Ecologists will be interested in Frankel's large images of two visuals by Charles Darwin to explain evolution in tree diagrams. She includes his notebook drawing of 1827, when he was formulating his idea and committing this concept to a paper sketch. Then, she shows his edited, more crafted version in 1859. She also includes a detail about Darwin's 1859 image, with tiny, dotted lines, perhaps depicting uncertainty in the length of the passage of time. Darwin did not include a legend on this use of tiny dots to make a line. Still, I appreciate -- and even agree -- with her inference. This case analysis, like the cases in this chapter from MacArthur and Wilson show the power of images to help clarify new thinking in science to the practitioner, as well as to peers.

Maryland environmental scientist and visual communicator: William Dennison[149]

Dennison directs a special group at the University of Maryland System Marine and Estuarine Environmental Science MEES) program – the Integration and Application Network (IAN). This program works closely with scientists and stakeholders about marine science findings and the implications of this research for environmental problem definition and deliberation for policy. IAN scientists and professional work with new scientists as they work through graduate programs but also expert and experienced scientists. IAN's approach—captured in the name -- is based on the related strategies of *integrating* environmental science across disciplines and *applying* that knowledge.

In addition to graduate level instruction in marine sciences, Dennison's IAN program supports scientists as they communicate environmental science for policy. Visual strategy work is key to this effort. In addition to ongoing training in classes and

[149] William "Bill" Dennison, University of Maryland System's Marine Environmental and Estuarine Sciences (MEES), directs the MEES Integration and Application Network (IAN). After a long career in marine science scholarship (Woods Hole, MD; Australia, Chesapeake Bay, among other settings) Dennison joined the then-new IAN program in the early 2000s.

seminars, IAN shares this communication knowledge: practical guides and tutorials for science communication are open access at their web site. Of note is the IAN Symbol Libraries (divided into two subsets of images and stand-alone symbols for making custom visuals). These libraries are used by scientists and others in creating conceptual diagrams.

Community of practice: IAN, MEES, and the Chesapeake Bay watershed

These transparent and open activities at IAN share with Frankel a commitment to public facing; For example, most MEES student projects appear on the IAN blog "Ecocheck." One goal of this openness is recognition of the need for communities of practice in science visualization. Getting the images "just right" requires trialing, drafting, proposing, peer editing – much like Frankel suggesting that scientists organize into visualization working groups.

Getting to "right" is difficult, especially if scientists rely on open-source graphics, widely available on the web. One of Dennison's most powerful cautions for scientists depicting animals is to avoid anthropomorphism, which is a risk in simple, cartoon-style graphics. This concern is reasonable and demonstrates that in designing visual communication of any kind, the designer faces trade-offs about competing design values or constraints. Aesthetic concerns often mean *ethos*[150] concerns, too.

Can a cartoon or comic design ethos carry the gravitas of science and environmental problems? This question turned out to be integral to designing cards for Q-sorting. Due to the small size, the readability of cartoon and comic design values took a design central role. Yet can these designs avoid the ethos problem that such graphics can invoke.

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[150] Earlier, the idea of visual grammar and audience readability was noted as an important design value. Comics/cartoons tend to be easily readable, with the quality of readability very desirable. This trade-off between readability and the ethos of gravitas reminds that design elements often require trade-offs in the execution of a final conceptual diagram. Debates about the typeface **Comic Sans** are similar, concerning audience readability (highly readable and may be preferred typeface for people with visual disabilities) and, perhaps, carrying a sense of juvenile ethos. See:

Kostelnick, C. (1990). The rhetoric of text design in professional communication. The Technical Writing Teacher, 17(3), 189–203.

Brumberger, E. R. (2003). The rhetoric of typography: The persona of typeface and text. Technical Communication, 50(2), 206–223.

Berry, J.D. (2004). Now read this: The Microsoft ClearType font collection. Seattle, WA: Microsoft Corporation.

Shaikh, A. D., Chaparro, B. S., & Fox, D. (2006). Personality of Cleartype Fonts. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *50*(17), 1834–1838. https://doi.org/10.1177/154193120605001725

The author of this dissertation took a science visualization course with Dennison in 2016. In a short IAN "Eco-check" blog post (See Appendix X "The Goldilocks Case"), the author works through the trade-offs in readability and desired gravitas in crab graphic developed by a classmate. By this time in the USDA CIG project, the need to use cartoon style, open-source graphics was becoming clear. Yet, elements of anthropomorphism could be avoided even within cartoon style.

Figures 12a and b below is a summary graphic from that "Eco Check" blog post about using the "Goldilocks Principle" to downplay the cartoonish within a comic-style aesthetic. Based on the three bears nursery story, the Goldilocks idea of "just right" appears in many settings but most famously in astrobiology, after Stephen Hawking. His "Goldilocks Zone" refers to stars with a habitable zone, for planets orbiting that star: "like Goldilocks, the development of intelligent life requires that planetary temperatures be 'just right'" (2011). Communication studies/composition pedagogy also uses a Goldilocks Principle, generally with three rules of thumb, all directed at supporting readers. First, providing *too much* information means your audience might lose focus; Second, too little information, and the audience might not understand nor be convinced. Finally, for the writer: getting to just right in a document can mean the difference between meeting audience needs or missing audience needs (and the writers' purposes). *Just right* – encompassing readability while maintaining gravitas (credibility or ethos) with audience – can assist in graphic design choices for conceptual diagrams.

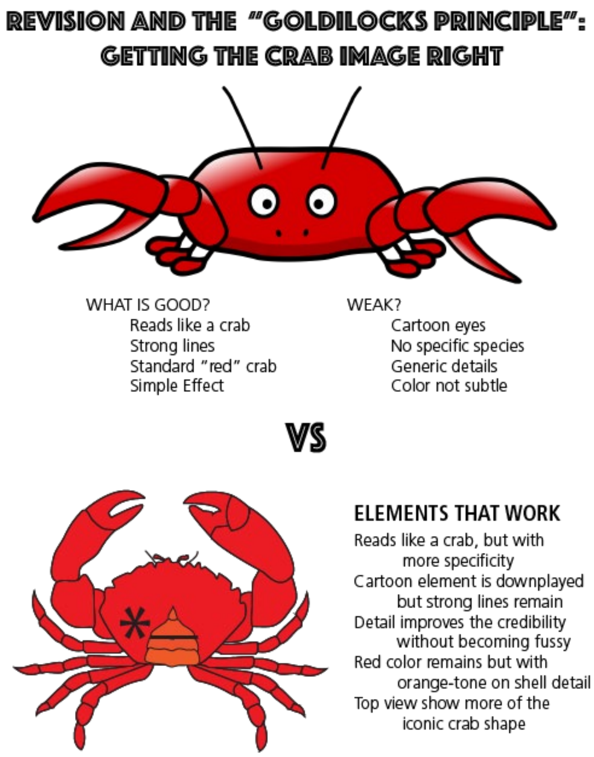
Figure 12a (top two red crab graphics) concerns crab species depiction, with the topmost image clearly anthropomorphic (humanoid eyes). The second revised red-crab graphic image is also by Noelle Olsen, then a graduate student in the same science visualization class. Olson, now a marine biologist, specializes in Jonah crab *Cancer borealis*. Jonah crabs, commercially valuable in Mid Atlantic fisheries, feature a rounded, rough-edged shell carapace (light brown) often with small light spots, and robust, black tipped claws. Note that not all this detail is captured in the two red crab images in Figure 12a. Also, for both crab and lobster depictions, typically the cooked red color of the shell is used, rather than brown, black-green, or other naturalistic features. Yet, red is the color typically used for "crab readability" even in conceptual diagrams meant for technical readers. This convention is changing as open access image sets are increasingly available for use by scientists. The IAN symbol library, open access, offers such images to scientists, using a design aesthetic that is faithful to naturalistic depictions.[151]

Color raises interesting perceptual issues in fidelity to truth and communicating quickly. Something about red is now an essential color for iconic crab, lobster, or even shrimp crustaceans. Even if not accurate as a depiction of nature, sometimes such choices are permitted because of the immediate recognition value. This immediacy is part of audience readability, and even capturing initial interest of readers.

Still, the Goldilocks' approach helps improve visualizations about narrowing in on "just right." However, what is lost here is the beauty of natural depictions. See Figure 12b below, for a realistic crab depiction from a 17th century biodiversity illustration manuscript. Realistic art often immediate coveys the gravitas of what is real, compared to what is quickly and economically rendered in a sketch. However,

[151] Many design mockups for the Q-sorting card set were attempted with IAN images. However, working within the small card size of 3" by 4" mean that the cards were not readable by users. This small size really forced the use of cartoon/comic design aesthetic.

shrinking this realistic crab image to the size of 3” by 4” card will lose detail. Further, the reduced image may not read as a crab. Preventing loss of recognizable detail became a prime design value, for construction of these cards.



N. Olsen built this female Jonah crab as part of her conceptual diagram on the mating embrace behavior of this species. The asterisk calls attention to a marker of sexual maturity.

Figure 12a, b: The Goldilocks rule; a case of crab communication. Image 12a uses two crab illustrations (Olsen N. 2017), with permission. Image by author.

Image 12b is from *Versuch einer Naturgeschichte der Krabben und Krebse* and may depict a Jonah crab (suggested by W. Stein, archival specialist at the Berlin Biodiversity Collection); with permission (Gottlieg, c. 1800).

Both Frankel and Dennison base many practical elements of their teaching materials and commentary on Edward Tufte's exposition of visual communication. While Tufte's focus is broader than simply science-focused communication, his work and books are essential reading for all who want to communicate accurately, clearly, and elegantly with visuals.

Selected guidance from design expert Edward Tufte

Tufte enjoys huge commercial success with his books, seminars, website, and other resources concerning use of visuals and document design in publications (beginning in the mid-1980s). In 2020, Tufte published his fifth design book: *Seeing with Fresh*

Eyes: Meaning, Space, Data, Truth. Here, Tufte is looking at very large data sets and visualization examples.

Two themes in Tufte's 2020 book are useful in this exposition: first, Tufte's focus on complex, large data sets and how to visualize them reflect science's ongoing design principle for elegance. Elegance, as artful simplicity, encompasses the idea of information density, noted in Tufte's other case studies but elegance is even more important in cases of science complexity.

Making inferences from data is a primary way that science builds knowledge. In most study design of hypothesis-driven science inquiry, statistics are part of this inference testing process. Many statistical tests and the associated visual displays that help build knowledge can also be assessed and understood by not only statistical thinking but also visual thinking. In this way, Tufte's approaches are a good companion to visualized statistics procedures in presenting complex[152] and large data sets in graphic

[152] Statisticians and students of the history of science will think immediately of William S. Cleveland, statistician, fore his sustained, thoughtful analysis of designing and interpretation visual display of information. See especially *The Elements of Graphing Data*

forms. Chapter Three devotes some time to violin plots, a relatively new summary statistics visualization that allows for comparison across related datasets. Comparison is an operational value often noted by Tufte as something that can be constructed with visual elements. His sparkline[153] graphics permit easy comparison.

The second theme in Tufte's *Seeing with Fresh Eyes* concerns the compelling emergent need for experts and lay audiences to become more graphic-data literate. So many personal, professional, and social decisions come from data analysis and the inferences that can be made. The decisions do not always follow a robust reading of the data or clarity on the additional assumptions that would support the type and strength of inferences being made. Chapter Five of this dissertation describes the

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[153] A *sparkline* is a tiny chart that provides a visual representation of data, where the information is extremely compact; here, the X-axis is often time. Tufte (1983) documented this graphics style coining them "intense continuous time-series." He used them as an icon of extreme compaction of visual information. Later, he noted their ability to provide parallel comparison. In 2006, Tufte introduced *sparkline* itself for tiny, intricate (high resolution graphics) Tufte wanted them to fit within texts as prose elements, wanting them to be near word-sized. See more at Tufte.com: *Edward Tufte (November 2013). "Sparkline theory and practice". Edward Tufte forum.*

increasing role that data collection and modeling about poultry production ammonia may be a similar case about data, especially about *whose* data. Data is used in decision making for social policy. Who owns and has access, as well as interpretive skills raises serious political questions?

What public analysis frames can illuminate data patterns and what conclusions can be drawn. One proposal is that poultry producers engage directly in data collection and manage ammonia effluent numbers from their poultry houses. Tufte's call for improved lay "visual literacy" supports more meaningful engagement by poultry farmers as environmental policy stakeholders. Regulatory changes may accompany this changing data story about whose ammonia effluent data comes to the foreground in deliberation and decision-making processes.

Indeed, many science data visualization practitioners -- both Frankel and Dennison – work to design and present data displays that reveal meaning for expert and public audiences alike. Tufte's approach, and that of many science communication practitioners, shifts the visualization act adjacent to the very work of data analysis. Powerful data visualization that is integral to analysis helps build a culture of clear, concise, and elegant communication of science to stakeholder audiences. Older models of science communication suggested orders that, first, data analysis would occur, meaning determined by experts, and, later, special design displays could communicate these simplified ideas and findings to public or decision-making audiences. Now, especially in very large data sets, data display choices are part of the analysis; indeed, the display choices often reveal the data and reasonable inference making (Healy, K. 2019; Ware, C. 1999; 2021).

Tufte's preferences as a data visualization expert also reflect this understanding that displays support data analysis. For example, Tufte collaborated with statistician John Tukey, a thoughtful innovator of visual information design (Zachry and Thralls, 2004).

Related to Tufte's design constraint of information density is concision, which applies to the design ethos for conceptual diagrams. Perhaps the single most important advice from Tufte that applies to concise conceptual diagrams is his admonition to avoid "chartjunk." Both Frankel and Dennison use and recommend Tufte's concision ethic, especially the avoidance of chartjunk.

What is chartjunk? At the heart of the chartjunk cautionary tale is simplicity. If the design element does not communicate essential information, leave that design element out. If two design elements do the same "job," decide which design element communicates better; then, revise to use that better element. Table 6 below, summarizes a few concision rules about chartjunk and the related concept of "big ducks." Both big ducks and chartjunk, along with many cautionary examples, appeared in the 1983 first book by Tufte: *The Visual Display of Quantitative Information*.

Avoid "chartjunk"	"The interior decoration of graphics generates a lot of ink that does not tell the viewer anything new. The purpose of decoration varies—to make the graphic appear more scientific and precise, to enliven the display, to give the designer an opportunity to exercise artistic skills. Regardless of its cause, it is all non-data-ink or redundant data-ink, and it is often chartjunk."	". . .it is all non-data-ink or redundant data-ink, and it is often chartjunk."
Avoid "big ducks"	"It is a form without function, that is its own end and shows, in data graphics, hardly any data at all." Tufte also emphasizes the as existing for the sake of promotion. A duck is worse than chartjunk. Montanans might translate a duck graphic as "all hat; no cattle."	 The "big duck" or "duck" is explicitly named after this building, The Big Duck, in Long Island, NY (Wikimedia images via Creative Commons Attribution)

Table 6: Chartjunk defined; with related "big duck" concept the "big duck," both in Tufte's first book (1983). *The Visual Display of Quantitative Information.* Also used are open access web discussions from Tufte's website. Summary by author.

Tufte's work is widely known and well incorporated into the practice of scientists who work with visualization. However, when discussing design constraints with environmental scientists, two of Tufte's cases are of special interest:

1. color guides to additives in farmed salmon that mimic colors that occur in wild-caught salmon products and
2. USDA color charts that assist in classifying soils.[154]

These two examples from Tufte arose in conversation with USDA CIG scientists, again as part of making arguments for designing visuals for Q-sorting cards. That Tufte was aware of these color scales in science help argue for this knowledge as central to the USDA CIG project.

[154] See the extensive illustrated blog entry "What color is your salmon, flamingo, leaf, soil, golden retriever, yolk, beer, diesel fuel? Measuring color in the field" at https://www.edwardtufte.com/bboard/q-and-a-fetch-msg?msg_id=0000XT This online entry is a larger discussion than what is presented in his books. In addition, the open comment thread includes helpful information from readers, some of whom are scientists.

Cartoons and downscaling conceptual diagrams: defense of comic ethos

The physicality of small cards (3” by 4”), interestingly, played a role in using comic-like art in the final version of the Q-sorting cards. This small size, combined with a need to include text in conveying complexity helped make a case for comic-style graphics. Simply: small visuals require simple yet strong line art, so that users can perceive the card content as they begin a sorting activity. An additional necessary element, within this small card size, was the use of text – short phrases to help clarify the value/benefits that each card represented. Recall the earlier definition that visual literacy is the ability to understand graphics (the visual grammar) along with accompanying textual information. These design of the cards for Q-sorting would need to fit basic visual literacy thresholds for poultry farmers, as well as the others who might sort these cards or draw inferences from their analysis.

Text takes up space in a graphic, especially at a font size that also supports user readability. The best way to achieve user readability – a hallmark of visual literacy – is by user testing[155]. Several card mock-ups were proposed and discussed. Much of

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[155] User testing is like the idea espoused by both Frankel and Dennison that scientists wanting to improve their practice of visual communication should organize themselves into working groups who help peer test each other’s trial visualization efforts.

this deliberation in the USDA CIG project took place by email, with file attachments. Eventually, the dissertation author realized that using the words “comic” and “cartoon” in describing the design choice impeded discussion. These words carried a negative connotation. Later, the author and two closely collaborating scientists from the USDA CIG team shifted to say, “Microsoft clip art” and “Open access clip art,” abbreviating to “clip art” in the trial discussions. Something about the ethos of comic/cartoon style did not advance the work of building graphics-plus-text samples toward making a card set for Q-sorting. Ethos impressions are related to feelings. “Comic” and “cartoon” suggest juvenile genres. “Clip art” – though often sharing a comic and cartoon aesthetic – suggests available, open-access, and free.

Additional deliberative dialogue about design choices often meant that that several scientists who had read about Q-method suggests that we stick with text-only cards. Most Q-sort studies use cards that display text only. The thinking was: we would save space by dropping clip art, thereby saving space for small paragraphs on each card, fully describing the benefits/values associated with ammonia management strategies. This preference for privileging text over text combined with graphics is understandable, especially when contemplating the complexity of ideas that these cards would need to convey. The author responded by making clearer the case for how graphics are conceptually efficient – information dense – in Tufte's phrase. MacArthur's warblers and the island biogeography collaboration of MacArthur, Wilson, and Simberloff appealed to this team. In effect, the two iconic visuals from ecology helped argue for the use of visuals in the Q-sort card set.

The brief review earlier in this chapter, of the ecology conceptual diagram tradition using two powerful examples (warblers and niche partitioning; island biogeography theory) reminded all team members of the cognitive value of pictures. Interpretative symbols with representational power carry more information than text alone. Two additional factors of this query-discussion among project scientists concerned: first, the communicative value of conceptual diagrams especially for lay audiences (poultry farmers); second, the special ethos of both MacArthur and Wilson as respected scientists, within the disciplinary sphere of the USDA CIG project members.

An additional argument from expertise was powerful, too. Visual rhetoric as a field is a humanities subdiscipline to consult about designing visual Q-sort cards. Tufte's eminence in design analysis was further supported by scholarship on visual communication.

Scholarship affirms the functionality of visual grammar, described earlier, from the applied approach of social semioticians Gunther Kress (1940-2019) and Theo van Leeuwen (1947). Social semiotics is the study of signs and symbols, within communities. How symbols work and which ones will be familiar to audiences is a powerful and practical frame for design. For example, one aspect of the power of MacArthur and Wilson's extinction-immigration curves in their theory of island biogeography is that imagined and target readers were already aware of the meaning of crisscross diagrams.

Conceptual diagrams are composed of symbols, developed and arranged to reflect meaning; in environmental science and ecology, conceptual diagrams often show processes. Knowing about symbol recognition for lay audiences is helpful, especially in accommodating science in visuals for poultry farmers.

The first (1996) edition[156] of *Reading Images: The Grammar of Visual Design* (Kress and van Leeuwen) offered additional guidance about designing for the existing

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[156] The author concurs with Jeanne Fahnestock that the range of type of exhibits in the first edition are richer than the two subsequent editions, hence, the use of this edition.

cognitive landscape of poultry farmers, as well as using text and visuals to clarify each card's communicated values.

Kress and van Leeuwen use many examples from popular print media, including children's books and commercial advertisements. These examples helped keep the non-technical reader in mind. Using card mockups, guided by Kress and van Leeuwen examples, strengthened the case for marrying images and text – essentially the conceptual diagram formula. Additional theory from communication studies further supported the images plus visuals approach. At the same time, one scientist in the USDA CIG project remarked that learning some of this applied theory helped her understand why and how conceptual diagrams work. Her ability to read conceptual diagrams critically and build them effectively was improved, too.

Case for multimodality

Using visuals and text together is a special research interest of Kress, writing alone, especially on multimodality (2010). *Monomodality* is a media attribute or design constraint that says only one mode or type of communication will be used. For example, Q-sort cards with text-only statements are monomodal. A child's picture book without text is monomodal. *Multimodality* describes cases where more than one type of communication mode -- generally text and visuals -- characterizes a genre. Kress (2010) sees the chief advantage of multimodality in this way: texts that integrate different communication modes improve the coherence experience and cognitive uptake of the user. Kress' idea about the value of multimodality helped counter in this project an early working proposal for this Q-sort study to simply use paragraphs on cards. Kress' ideas helped build the case – and arguments -- to spend time designing multimodal cards.

Table 7 below summarizes a few design principles from Kress and van Leeuwen (1996) and Kress (2010). The right-hand size describes selected concepts with the left-hand side showing application to Q-sort work (upcoming in Chapter Four).

Signs (symbols, elements of graphics) are key elements of visual communication; conceptual diagrams are composed of signs, hence a sign-making genre that synthesizes for meaning.		Fits with the Symbol Library approach by MEES through the IAN program; can also use clip art options (sharing same design aesthetic)
Signs are for sign-making, an emphasis on the reader's process as important in design; reader experience shapes choices in the designed document.		Designer needs to be aware of reader, their visual literacy and science/environment/farming context when they see values depicted on cards.

In sign-making, the meaning will arise in part from the community, making community awareness important; how many communities will “read” the graphics?		Two communities present here: science community symbol literacy may be different from the poultry farmer symbol literacy.
Color, perspective, line weight are choices in sign-making; care of what the image conveys shall guide choices.		This focus elevates the sense of cognitive value in what looks like aesthetic choices only.
Overall size of the diagram constrains choices; readability.		Begin with size. Design from 3”X4” card size.

Table 7: Selected lessons (Kress and van Leeuwen) concerning audience and signs; Theory→application. Summary by author.

Piloting conceptual diagrams on card

Usability testing – with scientists in the group, undergraduate students, and with a Cooperative Extension agent -- of these conceptual diagrams on small cards revealed immediately how hard downscaling images can be. Downscaling forces editing. Successful downscaling also keeps the images and the meaning they convey “readable” for the audience. Some cards were revised up to six times, to help ensure readability and comprehension.

The Cooperative Extension Agent also helped preview the setting in which the card sets would be sorted. Sorting – and viewing -- these cards would be poultry farmers whose average age approaches 60. The event would take place in early evenings in November, December, and/or January, lit by fluorescent lighting, with sorting on large cafeteria-style tables.

The needs of this specific audience also supported the clip art aesthetic over the more realistic ethos of the IAN Symbol library. The consistency of the widely available clip-art look supported the additional design value of coherence in the set. In other words, the cards looked as if they belonged to one another. In terms of the psychology of sorting, the sameness of the set meant that no card called attention to itself by appearing different (color scheme, line-heaviness, etc.).

Part 3: Cards

This section reflects briefly on the materiality of cards. Cards and card systems enjoy a long tradition of organizing complex information, for example bibliographic systems in libraries, archiving systems for collections, computer punch cards, etc.

commented on how the card sorting activity reminded them of card games. How the cards are "played" show patterns in storing, organizing, sorting, learning, arranging, sharing, collecting, and making decisions. Information and objects can be organized, stored, and retrieved. Cards are part of this meaning-making activity.

Working with cards is a deeply intentional human activity that helps create meaning, as well as offer pleasure, especially for playing cards. This exposition about how cards help manage complexity and decision-making strengthens the case for Q-sorting as a social science inquiry tool. See Chapter Four for a definition of Q-method and how this strategy was used in this project.

Q-method remains a somewhat undervalued, misunderstood, and underused social science tool. Several Q-method practitioners note that when a method shifts from accepted disciplinary approaches, the new approach may generate some conflict and even discomfort (Newman & Ramlo, 2010; Stenner & Stainton-Rogers, 2004). Q-method is a mixed method that combines qualitative and quantitative frames to inquiry into human subjectivity. Mixed method approaches in social science also face some skepticism (Ridenour and Newman, 2008).

Yet, approaches like Q specifically and mixed methods more generally can help build understanding (Shah & Corley, 2006). Q-methodology spans a divide between qualitative and quantitative methods. For the content area of this environmental deliberation project, additional discussion and clarifying arguments for Q-method were available within conservation and environmental policy inquiry (Swaffield & Fairweather, 1996; Webler, 2009; Bennett, 2016; Zabala, 2018). These types of studies where Q-sorting contributed to environmental policy deliberation also made the argument for how this card-based technique deserved a place in this project.

In Q-sorting, cards or slips of paper are sorted on a flat surface, typically a table[157]. In this way, Q-sorting as a card activity shares this table-physicality with many card activities, from poker games, fortune telling with tarot cards, memory card games like lotto, and even other card activities like crossing off numbers on a bingo card as they are called. Cards are handled, typically on a surface, which means that successful user design anticipates this materiality: cards, size, number, and room to sort (the surface), often next to others (shared surfaces like tables).

[157] During prototype and pilot sorting, the table space requirement per respondent became clear: each sort (play of the hand, in playing card parlance) required about 18 inches to 24 inches (approaching two feet) for placing cards in the template.

Another aspect of the materiality of cards, clearly, are the cards themselves. When users sort these cards, the *feel* of this activity invokes memories of other card activities. For example, playing cards and other types modeled on playing decks are often die-cut with rounded edges, printed on both sides. Many poultry farmers immediately noted a similarity, especially to playing solitaire or even lotto.

"Playing the cards"

A Q-sort by a respondent, to be usable, must fit into a template pattern (Figure 13 below) shown to respondents.

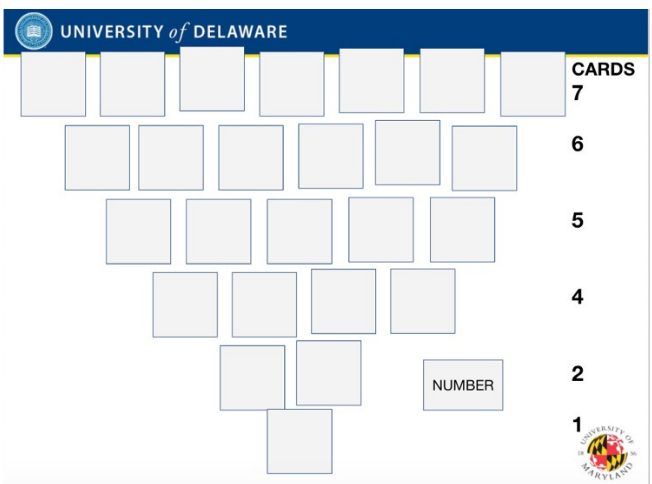

Figure 13: Sorting pattern for 25 cards, by author.

When introducing the sorting pattern, the organizer can remind respondents about the strong sense of pattern in using cards, say, in game: solitaire for example compared to poker games that rely first on hidden hands and then play of the hand (five or seven cards, typically). Some care about card playing and respondent views about gambling or general prohibitions about chance were needed with a couple of respondents. Here, the idea of collecting baseball cards was helpful, especially in pilot tests of both cards and images with undergraduate students. And, for scientists of certain ages, general comment can be made about computer cards being used to organize large amounts of data, as well as analyze (by programing) and retrieve (results). This idea of card systems organizing complexity for analysis and retrieval will be taken up later.

Being aware of a respondent's prior experience with cards is part of audience awareness in how to host a Q-sorting event. Interestingly, wondering about subjective attitudes in a respondent community about card playing is also at play here. At the least, thinking about this physicality of spreads (space for 25 cards to be sorted in pattern) helps prepare for adequate table space for participants to sort easily. For example, at one event, the available small card tables could seat four but only two could sort at a time. At one meeting, two people chose to sort on the floor. In an early and preliminary sorting event, a mat was laid upon a car hood for a quick sorting experience while on a field site visit.[158] Many of the sorting events used cafeteria-style tables, where care needed to be taken about respondents not overlapping their work areas, meaning that card sets could be mixed up.

The Q-sort approach includes a constraint that requires ranking cards from most important to least important in a set pattern. See Figure 13 above that shows the sorting pattern. This sorting pattern is the constraint that forces trade-offs and results in a normal distribution curve that permits formal Q-sort analysis, namely factor analysis.

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[158] This photograph below shows a tail-gate Q-sorting activity conducted by USDA. A rancher sorts, while the researcher takes notes. Recall that Q-method calls for researchers and respondent to interact during the sorting events.

Q-sorting on truck door (USDA "Content Play" , 2019 with permission.

Brief history of card systems to organize knowledge

In discussing how Q-sorting works with poultry farmers and ammonia management decisions, a brief overview of cards as information objects is a useful and enlightening exercise. One reason for this excursion is that an argument can be made for card sorting more generally in this context of trying to understand poultry farmer preferences about how they rank the value and benefits in ways they manage ammonia.

This section forms part of an answer to a colleague in the USDA CIG project who suggested that all these cards would be confusing and hard to make meaning from. "Why not a survey for this inquiry work? A survey would offer valuable information about, say, individual benefits farmers responded do in 25 questions. Why sort a set of cards?" The answer is that cards and patterns can help organize and classify complexity in ways different from a survey and follow-up data analysis of the answers.

Scientists often appreciate an argument from a disciplinary expert. Media historian Markus Krajewski[159] studies cards and card systems. Some of his work was summarized for this colleague, as part of an argument for Q-sorting in this USDA CIG project. Krajewski's ideas were then applied to the pioneering work of Joseph Grinnell, a field ornithologist who also pioneered managing specimen collections and the ecological data attached to these natural history specimens.

Physical utility of cards, cart sets, and complex knowledge

This brief overview uses Krajewski's 2002 book *Paper Machines: About Cards and Catalogs*, *1548-1929*, translated and published in English (2011) in the MIT Press[160] series "History and Foundations of Information Science."

For purposes of the Q-sorting and cards, the focus here is less upon larger elements of the historical bibliographic systems that Krajewski describes (cabinets and card

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[159] Krajewski is an associate professor of media history at Bauhaus University (Weimer, Germany) and studies library information systems, especially their physicality.

[160] The credibility of this celebrated university press at a major U.S. institution of applied and theoretical science also helped building the case among scientists for card sets and Q-sorting.

catalogs) and more on the physical “cards' ' that were housed in early library furniture. Card catalogs were first built to house the physical information objects of either cards or paper slips. This bibliographic work began in Austria, circa 1780. The first director of the Austrian Library asked his employees to take inventory of entire library holdings by copying all bibliographic details of each book on *slips of paper, all the same size*. Then, these slips were stored in 205 specially designed wooden boxes, then entire system known as the Josephinian catalog (2011). Most library and archive organizational systems trace their origins to this catalog.

Krajewski uses Alan Turing’s *machine* to describe the utility and function of card catalogs. A key argument for card and their ability to organize information for analysis and recall is that paper index cards are like *machine controller cards*[161] of early computer systems. This story, again, served as an argument for Q-sorting with cards.

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[161] One difference? Paper weight: slips of paper compared to card stock. Both card stock paper and regular paper weight was used in this project.

As it turns out, the card game idea is part of the history: In 1775, Abbé François Rozier and the Académie des Sciences in Paris organized an index of everything published between 1666 and 1770. To save paper costs, *playing cards* were repurposed.[162] Most playing cards at that time featured unmarked backs, thereby providing a clean slate for bibliography information entry on that clean side.

Why include this story about playing cards and library bibliographic development? Krajewski's story about how bibliographic and archival systems used playing cards to organize complex information placed the cards within a disciplinary context of gravitas. Further, the related case of ornithologist and ecologist Joseph Grinnell and his field note system being card-like made Q-sorting more acceptable to scientist team members. In this environmental deliberation phase, the cards came to be seen as a way for poultry farmers to work through the complexity of attitudes and background science knowledge about managing ammonia. Scientists were helped to this conclusion in part, of learning about the story of cards, card catalogs, and both the theory and technology of bibliography. Figure 10a below depicts the classic analog library card catalogue. The replacement, ironically, relies on what computer

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[162] Playing cards preceded cards as organizing objects.

punch cards made possible: shifting from analog to digital systems whereby much of our archives of information and ways to retrieve them are done in cyberspace by the tools made possible by computer science.

This shift from analog to digital is a *remediation* (Bolter and Grusin, 2000) of physical materials (cards) and tools (species cabinets[163], card catalogs) into digital ways of organizing information. Figure 14b (below) shows a remediation user interface (from Krajewski) based on the materiality of index cards. This interface is the gateway to the entire remediated database, which formerly resided within a card catalog as depicted in Figure 14a.

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[163] Physical specimens of natural material cannot be completely digitized. Species cabinets and herbarium collections are still tied to physical samples of animals, plants, and other materials in larger natural history archives including soil samples, mineral samples, and other objects. Complete digitization is not the goal with collections that archive tissues. Indeed, many of these collections will include what is called type specimens or iconic reference exemplars of what a species is. Still, digitization of these collections often includes photographs or increasingly some three-dimensional representations for pleasure viewing as well as remote study. In this way, collections at the Smithsonian Museum of Natural History, the U.C. Berkeley Museum of Vertebrate Zoology (Grinnell was the first director), the Jepson Herbarium of California, are also like archives/librarians that keep manuscripts and historic books in their collections. These objects are not completely replaced by digitization.

Bolter and Grusin argue that new visual tools achieve practical significance by paying design and function homage[164] to earlier media tools. For example, photography remediated realistic painting, film remediated stage production, and television production remediated film, stage, vaudeville, and radio. Elements remain, though in the shift to a new medium.

Figures 14a and b: Remediation example: a) Author's photograph of fabric imitating a library card catalog, designed at Spoonflower, a custom fabric printing service. b) Card image from *Synapsen*, Markus Krajewski's computer indexing program that uses "index cards" and other bibliographic images in the user interface. Used with permission.

Telling a story can be an argument: relating details from Krajewski's book helped build support for Q-sorting on cards, in the science team. However, the Grinnell story

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[164] This homage takes many forms, including outright substitution, rivalry, and even aesthetic "refashioning."

proved even more compelling. This case about field notes, notebooks, species account, archival cards, supplementary notes, and the physical species of ammiols within the archives arose from ecology itself.

Library bibliographic systems are similar to natural history museum archives. The case of note taking and cards at the Berkeley Museum of Vertebrate Zoology (MVZ) first captured the interest of several scientists, later the details part of a compelling to scientists in this project. The principal character in this case was acclaimed naturalist Joseph Grinnell. He developed a complex system of field notetaking that fed into archive practices. His 6” by 6” loose leaf note paper was modular and portable like cards. Field note-making enjoys a long tradition but was systematized at the turn of the century in California by Grinnell. (Herman,1986; Canfield, 2011).

Grinnell was a self-described naturalist[165] (ornithology) and then the new director of the MVZ. Grinnell documented his iconic field note system, which is still in effect (Grinnell, 1912). While Grinnell is also quite detailed about the physical attributes of

[165] Most scientists would also include him squarely as an ecologist, too.

notebook cover, paper inserts (sheaves), he, interestingly, cautioned against using notecards, saying that they will scatter and be lost, that securing paper within the three rings of the notebook guard against losses. Chapter Five knits up this strand, commenting on how this complex archiving system (from Grinnell at MVZ) gave rise to the important concept of *boundary objects*[166], a way to see how material (and now virtual objects) can organize a community of those interested in the objects. Boundary object theory will appear in Chapter Five, the conclusion.

This mobility of cards, heightened in Grinnell's field work, formed a compelling story, with the additional ethos of arising out of field work. Most of the scientists on this project conduct field work. Grinnell created the genre of field notes, along with

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[166] Beginning with sociology and science studies, a boundary object is a chunk of information –such as archival entries, field notes, specimens, and maps, even meta tags – accessed and used differently by different communities, often for some level of similar or even collaborative work on knowledge through scales of time and distance. Boundary objects are thought to be mutable or plastic, meaning that they can interpreted differently across communities but with enough immutable, static content to maintain integrity of the object, either material or virtual See:

Star, Susan; Griesemer, James (1989). "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39" (PDF). *Social Studies of Science*. **19** (3): 387–420. doi:10.1177/030631289019003001.

Leigh Star, Susan (2010). "This is Not a Boundary Object: Reflections on the Origin of a Concept". *Science, Technology, & Human Values*. **35** (5): 601–617. doi:10.1177/0162243910377624.

the related practices that would result in ecology/environmental science disciplines being well documented by robust and consistent data collection practices. Familiarity – leavened with an element of charm (picture cards) – was also an argument in favor of trying a new social science technique in this project. Grinnell's legacy, familiar to some, was also attractive to other scientists who were not aware of the Grinnell system. Scientists are inclined to respect the work and methods of other disciplines, especially those in adjacent to their own. This ethos familiarity of Grinnell's centrality to field work fit with the practice of many of these scientists who also use field methods.

Final practical notes

Documented in this chapter are reflections and practical takeaways about designing visual Q-sort cards used in this USDA CIG ammonia management project. The cards were used in pilot events, including with undergraduate students, and with Cooperative Extension agents planning the poultry farmer sessions. A few additional practical notes emerged.

> **Novelty:** card sorting can substitute for surveys in science policy consultations, including the work on agro-ecology work in Cooperative

Extension settings. After some of the sorting activities, Cooperative Extension agents wondered about how to work from the designed 25-card set into making other visual Q-sort cards. For example, could they build Q-sort events based in part on some of these cards to inquire about topics other than ammonia management. This positive response, generally, by Cooperative Extension agents suggests that Q-sorting can assist agents in working with poultry farmers.

Design for all: Cooperative Extension agents wanted to know immediately how to make similar cards. Interestingly, agents did not find the cards to be "too cartoonlike." One of the most important design criteria limitations became clear: the need for others to be able to reproduce these cards and card sets easily, without requiring the design and drawing abilities of professional graphics designers. Accessibility (free and web-available) of the clip art chosen offers another powerful advantage for choosing this design ethic.

Pleasure: related to novelty, sorting cards can be pleasurable, especially if the background conditions (tables, chairs, lighting, etc.) are comfortable. In a few tests and real events, some participants noted that sorting was engaging (compared to surveys[167]). Others noticed that some parts of sorting were

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[167] Typically, farmers take an exit survey about a Cooperative Extension learning session. Occasionally, the exit survey is required, linked to documentation for Nutrient Management credit programs run by states (Delaware, Maryland, Virginia). Many poultry farmers require such credits as part of ongoing certification systems about best practices about handling nitrogen and Phosphorus generated by farm activity.

frustrating. For example, finding a place for the MIDDLING cards was difficult, sometimes with fatigue setting in. Another aspect of pleasure is that the card sorting is optional. This study was designed for voluntary participation.[168]

Pocket-able/portable, missing cards

An ongoing "problem" with the Q-sorting cards is that some farmers tend to take some cards from the sets. Indeed, one of the most common problems that make for a bad sort is incompleteness, as in people not using all 25 cards, or mixing up one of their cards with that of a farmer sorting next to them on the same table. Some people asked to pocket individual cards, for several reasons, including that they want to think about what is on the card later. In this way, the cards can be seen also as a science communication artifact, like a brochure or fact sheet. Even if keeping track of all the cards is difficult, so to reserve complete sets for another sorting event, that people take cards means they want to think about the content on the cards. This pocketing of cards can also help agents and researcher understand audience subjectivity, generally. For example, in a very early prototyping event a card about attaching

[168] Some people who did not plan to stay, lingered a bit to watch the card sorting. A couple who farms together asked if they could take a set of cards home to think about what was on the cards. They were given a set of cards.

pollution scrubbing gear[169] to poultry exhaust fans was not clear. That card required revision.

Cards are small, portable, and attractive ways to instruct

The quality of being pocketable is a functional feature of cards (business cards, for example) and some brochures. Figures 15a and 15b below show an accordion-fold small booklet from the U.K. Health and Safety Executive (like the U.S. Occupational Safety and Health Administration). The U.K. booklet's content fits this case study context.

[169] In one event, the card depicting scrubbers on poultry exhaust fans seemed an expensive portent of future regulations. One farmer left quite angry about this card. Knowing this reactivity clarifies audiences.

Figure 15a and b) Pocket accordion book about poultry dust. The *top* (a-view) shows panels oriented on the card, while the *bottom* (b-view) shows the accordion-fold utility of this card. This booklet fits in pocket. (U.K Health and Safety Executive, 2015) with permission.

This booklet also uses a cartoon approach, like the design aesthetic chosen for this USDA CIG project: cartoon-oriented conceptual diagrams on small cards. The panels of this U.K. booklet show storyboard technique, demonstrating unity of design in that all panels are coherent in color values, graphic design, and the use of text to support graphics. Two of the panels show three-step processes, namely, the donning of respirator masks (panel 5 in Figure 15a above), and the unmasked process of inhaling poultry dust (panel 6, Figure 15a above). Two sets of symbols, namely red X's (panel 6) to indicate caution and red arrows (panels 3 and 4) to draw attention to animal handling standards.

Yet, for all the cartoon elements, including a droll farmer depiction, a reader still experiences gravitas. First, the context carries seriousness about respiratory illness caused by working conditions. Further elements of gravitas appear in the text – much of it cautionary -- that accompanies the panels.

This human health cautionary tale is well conveyed in this small, pocket-sized format, using simple cartoons like the aesthetic of clip art. Two differences are clear, though: the UK brochure uses lighter hues and lines that appear sketch-like. The clip art style[170] graphics for Q-sorting cards feature bold, primary colors, with strong graphic

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[170] Microsoft started walking away from MS Clip Art in 2009, but people only experienced this depending on what version of MS Office used. By 2013, however, people noticed and started typing about this on user forums. At some point in 2013, in rolling removals, Microsoft closed access to web-based clip art. By about 2017, MS Office sent requests for MS Clip Art to Bing, for an open access search. Some of the images in this 25 card Q-sort set are from legacy MS Clip Art resources. However, the "look" of MS Clip Art is widely imitated. All the images used to create this card set are open source.

lines. In some usability testing with undergraduate students, most students preferred the primary color scheme over the pastel scheme. One red-green color-blind student noted that the stronger black lines in the clip art images were easier to interpret than the lighter lines in the U.K. safety accordion booklet. Line thickness looks to be a compensation strategy that color-blind readers use to interpret graphics.

Graphic novels elevate the comic/cartoon style: A second comic-style graphic, with powerful gravitas, appears below in Figures 16a. This illustration comes from the cover of *Naturalist: A Graphic Adaptation*, based on Wilson's 1992 autobiography of the same name. This charming adaptation was rewritten and illustrated collaboratively by *New York Times* bestselling comics writer Jim Ottaviani and illustrator C.M. Butzer. Readers will recall meeting Wilson early in this chapter (Case Two) concerning visualization of island biogeography.

Figures 16a displays the cover, while 16b features two selected storyboard panels[171] from page 151 that capture Wilson's exposition of what he thought island

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[171] This adaptation devotes a great deal of ink on this fateful meeting. On page 149, the last two storyboard frames show the first meeting between the avuncular Wilson and the intense, mathematically-inclined Robert MacArthur. Their collaboration concerning island biogeography is captured in 37 frames across six pages; many frames show the iconic migration-extinction curves

biogeography theory entails. The second frame of 16b represents MacArthur's mathematical depiction of the details of migration and extinction curves. MacArthur's images explain graphically Wilson's spoken and written ideas.

What do the U.K. accordion booklet and this graphic novel adaptation share? Both mentor documents use comic-style illustrations for serious purposes. First, the U.K. pocket booklet is an eight-panel comic with three serious tasks:

1. posing a serious health question,
2. identifying a specific risk inherent in poultry production work, and
3. guiding the reader toward proper respiratory gear use.

Second, Wilson's re-envisioned 1992 memoir uses the sustained comic art form to remind a broad range of readers about the many stories of discovery by a most innovative thinker in all of ecology.

These two graphic examples help make the case for the design choice of brightly colored, comic-style Q-sorting cards in this study.

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discussed earlier in this chapter. Also, shown later in this inventive book several panels are the wild and muddy days of Wilson and Daniel Simberloff, circa 1967, field testing island biogeography theory in Florida mangrove habitats.

Figures 16a and b: E.O. Wilson, a comic book hero; a) Cover of 2020 graphic novel adaptation of Wilson’s 1992 memoir *Naturalist*; b) two panels (p.151) depicting Wilson and MacArthur discussing attributes of Wilson’s Island biogeography theory and MacArthur’s mathematical depictions of now iconic migration-extinction curves. MacArthur wears brown; Wilson, bespectacled, sports a blue button-down shirt. Used with permission.

Conceptual diagrams and science visualizations offer ideas that can help create information-rich and attractive Q-sorting cards. The analysis and method design values in this Chapter support the robustness of what Chapter Four presents about Q-sorting findings.

The work in this visualization chapter also reminds readers that the conceptual diagram genre from science is powerful rhetorically: complexity and process can be conveyed efficiently to readers in effective information transfer. Any rhetorical tasks about persuasion are enhanced because of clarity in knowledge. Chapter Two's focus on stasis theory, a center of rhetorical thinking, previews this important visual rhetoric work in this chapter. Stasis theory also is an organizing strategy, which dovetails nicely with the closing discussion on cards and card systems as known and essential organizing systems for information categorization and retrieval. The power of cards and card systems also helps argue for the validity of Q-method (upcoming in Chapter Four) and card sorting for human inquiry.

Chapter 4: Q-method described and Q-study results analyzed

Overview: This chapter describes Q-method, a social science technique that studies human subjectivity. Q-method was used in this USDA CIG project to study how poultry farmers view managing ammonia effluent from their poultry house exhaust fans. Two voluntary Best Management Practices (BMPs) in this study are poultry litter treatments (PLTs) and vegetated emissions buffers (VEBs).

First part: A mixed method, Q combines qualitative and quantitative tools and is not widely known. Therefore, this chapter

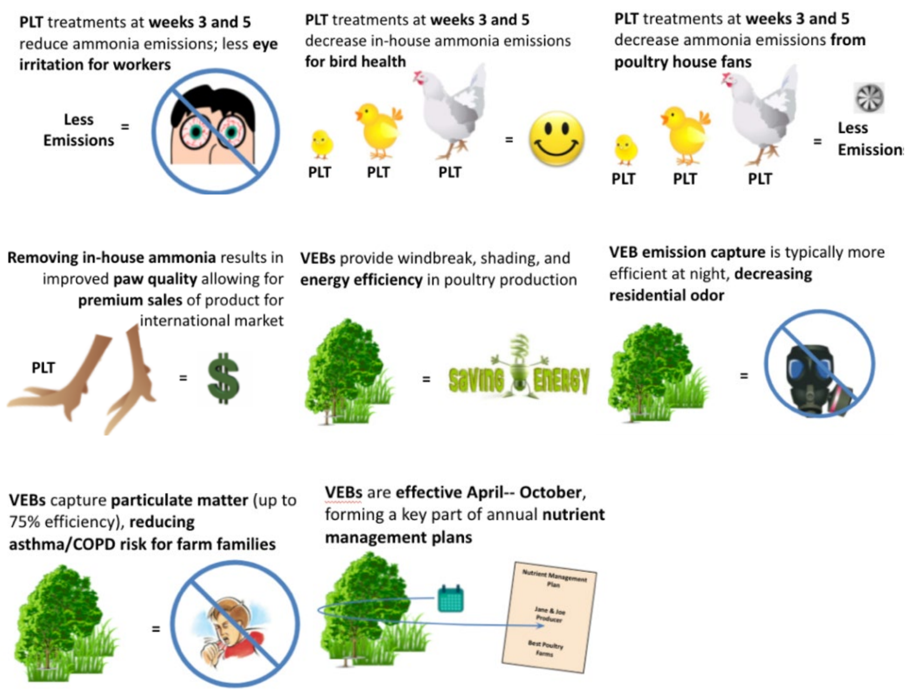
1. Introduces Q-method, then
2. Expands the definition with an elaborated description of the method and key elements. Then an example is
3. Presented based on a 2017 pilot study of this dissertation, using a modified Q-sorting card activity; Here with are described cautions made clear in the pilot from conception, within the sorting events, and finally in some of the data analysis approaches. Note: The results of this 2017 pilot were not able to be analyzed with Q-method approaches, due to not meeting required card numbers.

However, this pilot study acted as a valuable usability-testing experience, helping in development of a robust set of Q-sorting cards used in the 2019 study with poultry farmers.

Second part: The November 2019 Q-sorting events is

1. Introduced with discussion of Q-design steps used in this study, along with other
2. methodological elements of design and deployment, based on knowledge from 2017 pilot.
3. Results are analyzed with two approaches
    a. Exploratory data analysis and
    b. Chi-square testing
4. Analysis of results appears from step 3 are first presented in the tables and data displays; with additional
5. Discussion, followed by brief reflection on the
6. Implications for environmental policy deliberation

2019 case findings: Though this 2019 card sorting event did not meet threshold number of participants for a formal Q-sort factor analysis, data interrogation (exploratory data analysis and chi-square testing) identified eight cards that in the aggregate were sorted highly. These eight cards are



These eight cards[172] can be understood as important in the context of how poultry farmers make decisions.

- Economic concerns about **bird health and poultry house conditions** are clear in these three cards: Card **C**: PLT=Bird Health, Card **D:** PLT=Emissions, and Card **E:** PLT/Paw Health=Profit.

- Card **D**: PLT=Emissions ☟ denotes reduced emissions at the fan site, which suggests **benefits gained inside the house and providing benefits outside the house.** PLT strategies within a house also offer benefits outside the house.
- One **human health risk is inside the poultry house:** Card **B:** PLT=Reduced Eye Irritation describes this benefit.
- **Another human health risk is outside:** VEBs capture some ammonia and particle pollution after they exit the fan. See Card **N:** VEBs=Reduce Human Health Risks.
- **Odor is not only a nuisance** but also signals ammonia gas presence, a **human health risk**. VEBs also reduce odor. Card **M:** VEBs=(night eff.)-->☟Res. Odor.
- Many poultry farmers must **report on current ammonia management**. VEBs are part of an acceptable BMP strategy, captured in Card **P:** VEBs (4/12-10/12) Part of NMP.

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Illustration 1.4: 25 cards developed for the Q-sorting study with Delmarva poultry farmers.

Part 1: What is Q-method?

Q-methodology is a mixed method from social sciences: "Q-methodology" is simultaneously a qualitative and quantitative approach for the systematic study of subjectivity. Methods in social sciences that combine qualitative and quantitative tools are called mixed or mixed methods (Creswell, 2011). Physicist Susan Ramlo, noted Q-method theorist and practitioner, prefers her description that Q-method is neither quantitative nor qualitative but an inherent blend of both (Ramlo, 2021, 2015). When pressed, Ramlo identifies the centrality of qualitative inquiry in Q-method as more important than the quantitative aspect (2021).

Subjectivity concerns a person's viewpoint, opinion, beliefs, attitude, and the like (Brown, 1980). *Q* is used to contrast this subjectivity-focused method from other social science approaches, which tend to frame inquiry as seeking objectivity. William Stephenson, psychologist and physicist, first proposed the basis of Q-methodology in 1935 (Stephenson, 1953a), in a brief paper published in *Nature*. A nearly simultaneous publication by Stephenson offered more detail on the mechanics of Q-method (Stephenson, 1935b). Finally, while at the University of Chicago, Stephenson revised and published his original definitive description and procedures for Q-sorting (Stephenson, 1953b).

In the early 1990s, Stephen Brown, like Ramlo a leading Q-method researcher, noted just over 2,000 theoretical and applied papers in peer-reviewed literature that addressed or used Q-methodology (1993).

Introduction to Q-method basics

A Q-study relies on card sorting activities, where each card displays a subjective viewpoint that participants sort on a template grid in order of most important to least important. Each Q-study is based on these eight stages:

1. initial study design, based on Q-method approaches[173];

[173] In Q-studies, the design stage requires generation of a large set of possible viewpoints: the *concourse*. Some Q-researchers call this step formation of a *universe* of all possible subjective viewpoints or opinions that characterize the social context that gives rise to the study. Generating the concourse, leads to a next step: reducing the entire concourse (sometimes called the concourse universe or entire concourse of communication) to a reasonable, representative yet comprehensive sample of viewpoint statements. This reduced set of statements is called the Q-set (sometimes the Q-sample). Reducing this larger concourse is driven by reasonableness in two ways: first, some statements are very similar and would be hard for respondents to detect meaningful difference; and second, choosing several statements for the P-set that can be sorted into a pattern of symmetry.

2. preparation of viewpoint material for cards, sorting guidance, and sorting events;
3. identification of a participant group;
4. administration of the sorting event(s), which will result in
5. generation of data from these event(s), which will require careful
6. capture/record-making of the individual sorting data (by each participant), which means the particular sorting of cards into the template pattern.

In Step 2, a set of cards are developed, called the Q-set. In Step 3, a participant group is identified and called the P-set[174], for participants. The Q-set cards come from an expansive brainstorming process about all possible viewpoints, with this global and comprehensive set called the concourse. In some cases, this brainstorming process includes the use of focus groups. All cases of Q-sorting rely on extensive analysis of the context in which the Q-study will occur. The concourse statements are carefully edited down to a small but comprehensive set of cards that will form the basis of the card sorting activity. This set is called the Q-set.

Symmetry will make the sorting into a pattern template easier for participants. This pattern is an inverted normal distribution (bell shaped).

[174] In some studies, this group is called the R-set, for respondent. Participant and P-set are used in this document.

After the study is conducted, researchers work with data captured from the six steps, using factor analysis upon this data. As with other data sets, preparation of data for analysis is deliberate, including:

1. data check for sorting integrity, clarity, and participant privacy;
2. transformation (transcribing and transforming "pictures" of sorts[175], into datasheets/frames);
3. analysis and interpretation; and
4. write-up for dissemination, with a sense of care for analysis of choices, weaknesses in the study, and argument for the inferences that can be made from the study findings.

The above four steps show how Q-method is very like traditional data analysis techniques. These steps for a Q-study will be described in this chapter, within the context of card sorting with poultry farmers (P-set) on how they rank statements of value/benefits concerning their voluntary ammonia management choices (Q-set). The 2017 pilot Q-study described in this chapter – albeit flawed in several ways, including in the number of Q-sorting cards -- is instructive as to method application as well as a cautionary tale. Q is not widely known. Pilot or test run approaches is advised.

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[175] Because data tables from sorts include many "zeroes" due to the inverted curve of the sorting board, paying attention to data transformation to account for these expected zeroes is important. See Figure 21a and b below for this sorting template that shapes data table generation in Q-method.

Scientists need to see that the study "community" is not participants (here, poultry farmers) as much as the community is a set of viewpoints (here, values/benefits about ammonia management choices). That Q-method hold an unknown quality (despite being in use since the 1930s) means that many scientists are unaware of some foundational details in Q-method design, use, and interpretation.

In part two of this chapter, the 2019 Q-study with poultry farmers is described with results analyzed using exploratory data analysis and chi-square testing. These two analysis methods (exploratory data analysis and chi-square testing) were used because this 2019 Q-study did not meet participant minimum numbers to perform a formal Q-factor analysis, the standard data inquiry method of Q-sorting. This 2019 Q-study, like the 2017 pilot study noted above, was part of a USDA CIG project[176] (2012-

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[176] **Grantees:**

University of Delaware, University of Maryland, Oklahoma State University, Pennsylvania State University, USDA ARS (Beltsville)

Project Title: Innovative approaches to capture nitrogen and air pollutant emissions from poultry operations: VEBs for Warm Season and Acid Scrubbers for Cold Season
Agreement Number: 69-3A75-12-244

2017), in which this author was an investigator charged with humanities and science communication contributions. See Appendix A for more information on this project.

Even though both Q-study events, 2017 and 2019, did not meet minimum requirements for use of Q-sorting analysis methods, the resulting data sets are still useful for researcher inquiry.

Method description of Q-sorting design and implementation: Q-method assists researchers who want to understand the viewpoints of a study group. However, unlike survey methods where the primary object of study *is* the participants, Q-method research focuses on the *value statements* as the primary object of the study. In this way, Q-method is subjectivity-focused rather than population-sample focused. Stephenson called this pre-analytical condition an "inversion" (Stephenson, 1936), making a Q-sort study conceptually different from a survey study.

Study design constraint: Minimum numbers of P-set and Q-set enable factor analysis: For Q-sort data sets, the standard analytical approach is a factor analysis that helps reveal underlying relationships of these viewpoints, as depicted on the cards.

From Stephenson's time forward, the Q-set size is within a range of 40-70 statements (Brown, 1980). However, smaller sized Q-sets are fast becoming used in Q-sorting activities, both reported formally in peer-reviewed publications but also in many informal settings.[177] Once the Q-set size is determined, the P-set size is developed based on a few guidance principles.

Method summary of number guidance in Q-sets and P-sets

Several principles guide the numbers acceptable for Q-sets (card statements) and P-sets (participant number). Study design principles require first, development of the content and size of Q-set. Generally, for Q-sets, which are a reduction of the larger concourse of statements, these principles are used:

- The Q-set typically ranges from 30-70 statements (Stephenson, 1935).
- Since the 90s, a time of Q-method maturation and wider use, researchers noted that the Q-set numbers could be smaller, with guidance ranges revised to two dozen (24) to five dozen (60) (Michelle & Davis, 2011).

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[177] Like surveys, Q-sorting of cards are widely used whenever understanding more about human preferences is required in workplaces, communities, education, and other settings. Informal uses of Q-sorting often use small number of statements (Q-set) with small numbers of participants (P-set). Here the object of a quick sort is to get a sense of preferences and does not provide number within a Q-sort for formal analysis.

- An active Q-sort technical group is organized by an email list-serve[178] managed by Steven Brown at Kent State University; one perennial topic of discussion is designing a study with appropriate numbers of the Q-set and the P-set.
- Sorting event considerations: Study designers should note, however, that the sorting activity for participants takes both time and space. The larger the Q-set, the greater the number of cards. More cards require more time for all respondents to read, understand, rank, and place the card on a sorting template. The physical nature of sorting cards (from business card-size to index card size) requires a surface and "elbow" room to lay cards in the template. For many card-sorting settings, participants are sorting on shared table spaces, making the number and size of cards a factor in conditions for sorting. Not paying attention to this surface constraint comes up regularly on this Q-focused list serve at Kent State.

Once the Q-set number is set, that number shapes P-set size. Guidance principles for numbers in the P-set include:

- The number of participants[179] cannot be larger than the number of Q-statements.
- A ratio of participant to statements is often advised: From Webler and Tuler (2009), a suggested ratio of Q-participants (P-set) and Q-statements (Q-sets) is 3:1. However, also permitted is a limit of the highest ratio of Q-

[178] Contact: q-method@listserv.kent.edu

[179] This is often counter intuitive to researchers accustomed to the way sample sizes are constructed to reflect populations. The idea that more respondents, hence a larger P-set, is better is counter to the very principle of what Q-study means. What is being studied are the concourse (all possible statements) as reduced to a Q-set (like a sample but not quite). Attitudes within the P-set of respondents is the object of study, not traits of the respondents.

participants and Q-statements of 2:1.[180] For example, using the 3:1 ratio, a Q-set of 60 statements would work with as few as 20 participants in the P-set (60/3 = 20) up to 30 (60/2 = 30). For the 2:1 ratio, a P-set paired with a 60-item Q-set (60/2) could be as small as 30.

- The literature on numbers possible within P-sets presents the process of number selection as an artful choice, guided by principles, but also somewhat flexible given the practical nature of working with people. Ongoing discussion of this craft element of Q-study design is available at the Q-method discussion list serve noted above.[181]
- Smaller Q-set numbers mean smaller P-set numbers: Since the 90s, consensus in the community of practitioners accepts small numbers of Q-statements with a threshold being around 20, as in no Q-sets small than 20.

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[180] Generally, Q-method theorists point to the importance of the number of Q-statements to capture the subjectivity context fully. The number of participants should be a minimum but that more participants is not the goal. A small P-set, however, might be rather homogeneous. Homogeneous within a small number might not contain enough differing viewpoints held by each participant. When a proposed P-set tend to be homogenous, a larger number can help overcome that homogeneity problem, with the result better detection of underlying factors in the analysis.

However, as late as the 60s, Q-method guidelines called for abut 40-70 statements to be paired with a similar number of respondents but no more respondents than the number of Q-statements. See this1961 methods piece that is one of the first Q-method pieces widely disseminated in U.S:

Block, J. (2011). The Q-sort method in personality assessment and psychiatric research. Springfield, Ill: Thomas.

Finally, the computer programs that analyze Q-sort data sets also contain threshold presets that make analysis with small sizes in Q-sets and P-sets extremely difficult if not possible.

Open-access PQMethod at http://schmolck.userweb.mwn.de/qmethod/pqmanual.htm ;

Commercial PCQ at http://www.pcqsoft.com ; and more recently,

Principle Component Method (PCM) for Q-method R package at https://cran.r-project.org/web/packages/qmethod/ ;

(2020) SPSS option described at

https://www.ibm.com/support/knowledgecenter/en/SSLVMB_23.0.0/spss/base/syn_proximities_example7.html

[181] q-method@listserv.kent.edu is the official mailing- and discussion list for all things Q. It is hosted at Kent State University and moderated by Steven Brown, noted Q-method researcher.

In many cases, these small number “studies” are like the use of surveys informally, to gauge audience preferences.

- In the case of smaller Q-sets and hence P-sets, researchers caution that the inverted factor analysis pioneered by Stephenson might not be able to detect meaningful clusters or relatedness; indeed, the computer programs that automate factor analysis, will not run with numbers below these thresholds.
- A small body of papers uses a single respondent approach (Rhoads, 2017), to test the stability of card sorting over time for a particular research question. However, this single respondent sort where N=1 is not an argument for small P-set numbers.

What are the steps in a Q-sorting event when participants (P-set) sort cards (Q-set)? Each participant is given a set of unsorted Q-sort cards. Participants are asked to rank-order all the cards from LEAST IMPORTANT to MOST IMPORTANT (similar to a Likert scale[182]). Ranking is in done in two steps:

> Sorting the cards into two large piles of *more important* and *less important*, and, then,
>
> Sorting the remaining cards into a middling important pile; Participants may take cards from the first-sorted piles of *more important* and *less important* as the ranking becomes clearer to the preferences as they study the card content.

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[182] This comparison is helpful, when presenting Q-method to scientists. However, emphasis must be on how Q approaches focus on the *statements as a community* (the Q-set). What is being studied is subjectivity in the participant group (P-set).

This pre-sorting activity described in steps 1 and 2 above give participants time to consider the card content and make categories of the content according to their subjective preferences. Generally, participants in Q-studies find the first step easier in that what is seen as more important and less important is easier than sorting cards into the intermediate category of “middling” importance.

Participants are given additional guidance. For example, a slide of the sorting pattern is often shown. Participants can be given a template sort pattern at their tables. In other cases, participants can sort in many conditions with a flat surface for laying down cards, as long as study designers assist participants in placing cards according to a most important through least important pattern.[183]

Method in 2017 pilot event, a cautionary tale about design and deployment

[183] See Figure 17a and b (sorting directions and template) later, along with Illustration 4 (16 cards) for how percipients in the 2017 pilot sorting event were guided.

Not all scientists in this USDA CIG grant were initially convinced about Q-method generally. Q-method is very different from many approaches in social science, including with stakeholder engagement activities. To better demonstrate Q to scientists in this USDA CIG team, a pilot Q-sorting event (fall 2017) was planned as part of a regular Cooperative Extension training event. Key findings about poultry litter treatments (PLTs) and vegetated environmental buffers (VEBs) research from grant work would be part of the program. Recall from Chapter One that PTLs and VEBs are two best management practices (BMPs) that are voluntary ways that poultry farmers can manage ammonia from their poultry houses.

Several difficulties[184] just prior to the planned 2017 event resulted in miscommunication. Hence, two people in the USDA CIG team reduced the planned card set of 33 cards to 16 cards. The team members retained the cards that focused primarily on PLT and VEB findings from the USDA CIG team, along with cards about a poultry fan scrubber prototype. Many Cooperative Extension activities focus

[184] The University of Delaware Cooperative Extension agent most closely involved with the author of this dissertation died suddenly that fall, just before the pilot sorting events. This loss was deeply upsetting to all team members. W.B. was a respected and beloved member of the Delmarva Cooperative Extension family and poultry community. Some of the baton dropping occurred in the wake of this huge personal and professional loss.

on new research findings that support farmers in their practice. The cards about other subjective reasons for managing ammonia, say concern for water quality and Chesapeake Bay fisheries were taken out. Team members did not understand that more expansive nature of subjectivity testing within a larger card set with content other than PLT, VEB, and scrubbers. This meant that the minimum number of cards required for a Q-study was not met.

Their thinking, understandable, was thus: the large number of expected participants (about 100 registrants) would give a large sample size. Here, the team members were thinking about the value of a large sample size in conventional survey studies. However, Q-studies require sufficient Q-set numbers in addition to sufficient P-set numbers (participants to be 'surveyed"). What must be acknowledged is that the widespread use of surveys to inquire about stakeholder and other participant views dominates with environmental science for policy deliberation. As a method (as well as analysis tools), Q-method differs from survey methodology. That point must be emphasized in pre-planning work as well as pilot events.

Method diagnosis of communication difficulty

Two key attributes of Q-method were not well understood. First, that a minimum Q-set of 20 or so cards is required, with the related idea that a very large P-set of participants is note a primary design goal. Second, that the study object is the statements (Q-set) not so much the population of participants (P-set).

Method case reminder that Q-studies look broadly at subjective viewpoints

Another miscommunication concerned the range of topics in the learning session, compared to the concourse work and planned 33-card sorting activity. Cooperative Extension agents and scientists planned to present findings about a third type of ammonia-management technology (in addition to PTL and VEB strategies): a prototype fan scrubber unit. This fan scrubber was part of the original USDA CIG project description. Cards depicting the fan scrubber had been including in one planning event with a Cooperative Extension Agent W.B. However, since the research was not completed, W.B. and the author of this dissertation had planned to set fan scrubber cards aside for another future session. The scrubber fan cards remained in this set (see Illustration 4 below for the 16-card set used in this pilot event).

This miscommunication also meant that in the hand-off of preparation materials, some team members dropped out the many cards that looked more at human values about environmental protection. For example, consider a card that focuses on how a poultry farmer in a watershed views the clean water needs of watermen and other fishers. That card type was discarded in the last activity before the pilot event. One reason offered for why these cards were dropped is that they did not fir the three areas of the science identified in the USDA CIG grant. Diagnosis: some on the team thought that only material in the science presentation portion of the Cooperative Extension event should be on the cards. The "dropped cards" depicted environmental values, heritage farming preferences, and spiritual values.[185]

Method caution, before running a Q-sort study

Cross training about Q-method differences with other social science inquiry tools is important. One element concerns minimum numbers (Q-set and P-set) but the other element deals with viewpoint subjectivity: cards will include broad statements about human decision-making other than science and technology consultations. Time to

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[185] These cards were included in the 2019 card-sorting study and appear in Illustration 1.4 at the beginning of this chapter.

persuade team members about looking at the larger concourse of viewpoints was required. In short, some aspects of Q-method are unfamiliar and even unsettling to scientists. This tension requires management and awareness.

However, this flawed 2017 pilot Q-sorting event was very useful about the logistics[186] of running a Q-sort activity combined with a Cooperative Extension learning session. See Illustration 4 below, for this pilot set of cards. Readers can see PLT and VEB strategies (retained in the 2019 study event) in addition to three cards depicting the prototype scrubber.

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[186] Recall from earlier: Each participant is to be given a set of Q-sort cards. Participants are asked to rank-order the cards from *LEAST IMPORTANT* to *MOST IMPORTANT*. First, by sorting cards into *MORE IMPORTANT* and *LEAST IMPORTANT* piles, then, sorting other cards to a *MIDDLING IMPORTANT* pile. Participants work from these three piles to lay down individual cards on a flat surface, according to the given template sort pattern.

See Figures 17a and b and 18a and b in the text near the template sort pattern. In this way, each participant develops a unique sort from their individual point of view (according to some unstated operative preference, judgement or feeling about the Q-set content). Researchers then capture the sorting pattern for each participant by taking a photograph of the card sort, with an identifying number for recordkeeping.

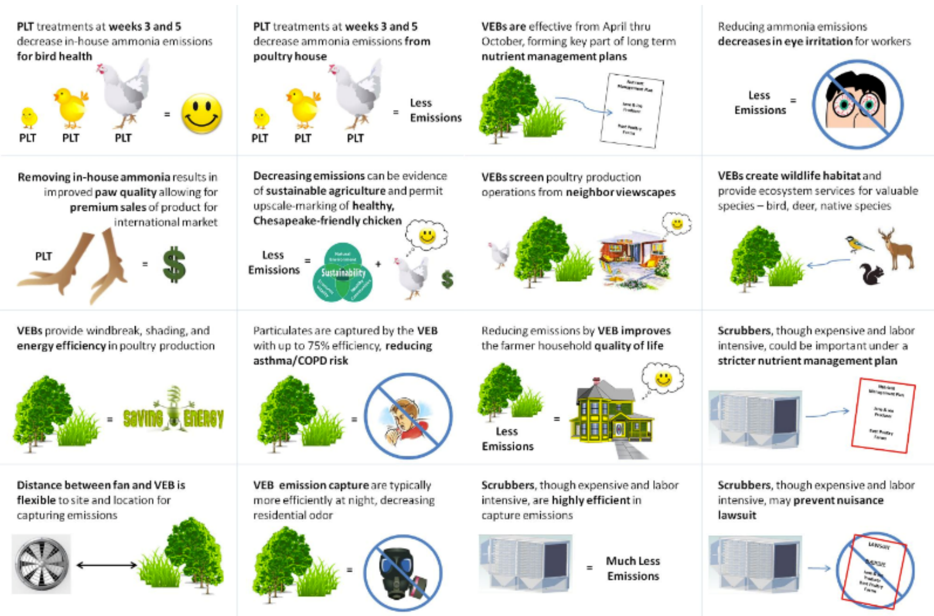

Illustration 4: 16-card set for sorting in a pilot session in 2017. Three ammonia management practices are represented: VEBs (8 cards), PTLs (2 cards), scrubber technology (3 cards). Three additional cards represent synthesis of more than one practice or note the overall benefits of ammonia/particle pollution remission. VEBs and PLTs represent best practices used by some poultry farmers. The scrubber technology is an infant technology, under study and trials by agricultural engineers, including some included in this USDA CIG project. *NOTE: 16 cards in a Q-set are not enough to do a formal factor analysis*

Next described are nine lessons about running a Q-sorting event from the 2017 pilot test run.

Pilot lesson 1: Random order of card sets is important. *The cards in each set prepared for each participant should be shuffled carefully and then either bundled with binder clips or placed in large envelopes before distribution. Therefore, each* *respondent is given a card set with cards arranged randomly. Each card set includes a unique identifier number, that serves to identify individual sorts but also preserve anonymity. At no time is a participant's personal information requested.*

Pilot lesson 2: Encourage pre-sorting into three categories. *Emphasize this pre-sorting step. Doing so keeps a participant from sorting directly from the order of the cards in their set. Sorting card sets into three 'holding" categories also makes for easier – less frustrating – sorting experience by the participant. The holding categories, see also Figure 17a below, are:*

MOST IMPORTANT
MIDDLING IMPORTANT
LEAST IMPORTANT (can include NOT important)

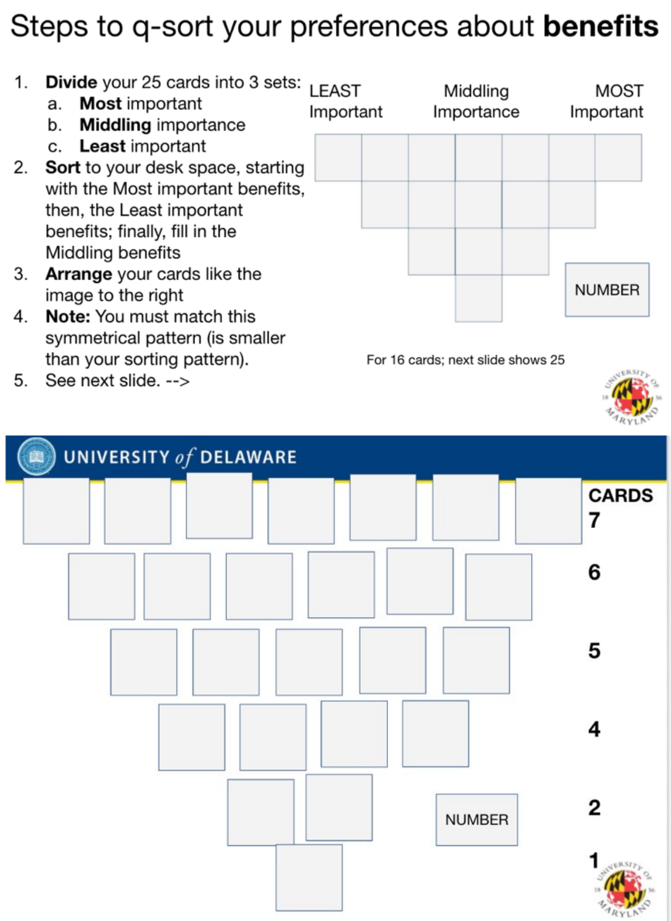

Figure 17a and b: Sorting template guidance. Figure a (top) shows directions plus idealized sort template for 16 cards. Figure b (bottom) shows the sorting template for 25 cards. Note, this revised design came from the pilot sorting event where participants were shown a more "naturalistic" sort pattern. In b) the numbers on the right guide participants into keeping the inverted pyramid or triangle V shape in line and all cards accounted for. Note: The 2017 pilot event used 16 cards, though 16 cards are too few for a Q-study.

Pilot lesson 3: Plan for horizontal table spacing of participants. *Each participant will need table space to accommodate the sorting space horizontal axis. This length* *can be estimated as multiplying the card length times the number of the cards in the top of the sorting pattern. Space between participants is important as their card sets can become co-mingled, meaning that the sorts might repeat a card or be missing a card. Sorting displays that are too close can introduce confusion when the sorts are photographed.*[187]

Pilot lesson 4: Photograph sorts immediately. *Having more than one roving photographer*[188] *to take a snapshot of each participant's sort is helpful. In this way, the photographer can check the sort including that the unique identifier number is in the view.*

Pilot lesson 5: Participants often resist using all cards in the requested pattern. *Researchers moving through the group can spot these such problems and encourage participants by explaining how using all cards helps researchers understand trade-offs. The most common problem seems to be semi-intentional "pocketing" of cards that are either hard to sort or the participant really resists this card content. For example, one participant said that he did not want to sort cards about the scrubber unit; that he would resist any regulatory efforts that would require such a unit on his farm. One strategy is to remind participants that this activity is voluntary. A*

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[187] Note: Q-method resources do not emphasize how important pilot events can be for logistical reasons, as well as physical requirements like space sufficient to sort cards, enough researchers to circulate and ask questions, time for sorting, collecting of materials at the end, and engaging fully with participants who want to talk about this process.

[188] Smart phones work as do tablet devices. Images then need to be transcribed into spreadsheets.

researcher can make notes, especially when a card invokes a strong negative reaction.

Pilot lesson 6: Sorting at the end is hard. *Two types of difficulty arise toward the end of the sorting activity. Sorting cards that are most important and least important tend to be easiest. Sorting cards in the middling section that abuts the least import portion of the sorting grid seems difficult for people. Offer the advice is to go with the first impression or the gut. Remind participants that there is not a right or wrong answer. Remind that indifference toward choices is human. Encourage them to use all the cards. Analogies that help include colors, food, and sports teams. We usually can identify the favorites and the least favorites. Sorting into the middling category can be somewhat of a catch-all.*

Pilot lesson 7: People take cards with them. *A moderate amount of card disappearance occurs. Some people ask to take cards with them. The motivation is sometimes expressed as wanting to think more about the ideas or even liking the look of the card. Letting people take cards seems a part of collegiality that can be accommodated. However, this means that careful examination of card sets for missing cards needs to take place between sorting events that will test the same card sets.*

Pilot lesson 8: Visual cards appealed to many participants. *This 16-card pilot was the first Q-sorting event using small pictures in color paired with words to communicate detail. Many farmers reported enjoying the sorting activity, compared to a user* *survey typical of many poultry learning/listening sessions. From this event and a few other quick pilot events including undergraduate students, several revisions were made to both the text and images on these cards. Some cards were dropped entirely, namely the scrubber cards. However, these cards – color, type of graphics (open access MS Word-style), ratio of words to images – affirmed some design choices. Usability testing in a pilot is helpful.*

Pilot lesson 9a: Scientists in the team became more confidence about Q-study value. *Chapter Two discussed how an argument needed to be made in defense of Q-sorting, rather than a survey or similar instrument. This pilot study, even with 16 cards, served as evidence of enthusiasm for a Q-sorting activity to use with poultry farmers. Cooperative Extension agents were particularly enthusiastic about an additional tool for use with their audiences.*

***Pilot lesson 9b:* A second value for scientists in the team concerned what Q-data looks like**. *This pilot Q-sort experience reflecting the many environmental, economic, and [189]social benefits of the three USDA CIG research area was shared with the team*

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[189] Early in the USDA CIG project a scrubber technology was part of the research inquiry, with field testing on farm sites as well as the University of Delaware experimental farm. This technology is not yet mature and so wase set aside midway during the 2012-2017 project span. However, researchers did note that during the pilot Q-sorting event, many farmers reacted strongly about this prototype scrubber technology. Scrubber retrofits to poultry houses in the E.U. are common and part of air quality management on intensive poultry farms. Delmarva farmers wondered if this technology was planned and responded with some wariness. Pilot studies of Q-sort cards can help researchers anticipate strong

(N=58)[190]*. Scientists were able to peek into how poultry ranked preferences, especially in individual sorts; this exercise showed the trade-offs that an individual farmer made. In this way, the power of Q-method to show tradeoffs was demonstrated. Scientists were also more convinced of the design values used in the cards: conceptual diagrams rendered within a four-color, comic/cartoon aesthetic.*

For researchers new to Q-method, a pilot event and other useability testing activities are highly recommended. For example, testing card content with several groups can help researchers revise this content to better communicate specific values and benefits to be ranked by participants. In this dissertation, the use of visual information paired with phrases required additional testing to scale the images to the card size as well as test the parting of picture (conceptual diagrams)[191] plus text phrase.

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reactions to some cards. Strong reactions can be part of Q-study, however, sometimes cards that invoke very strong feelings can swamp the patterns in which other cards are sorted.

[190] This number of participants (P-set of 58) appeared to scientists in the group as a worthy number for analysis. The author reminded them that we would learn a great deal from individual sort patterns but that the 16 cards in the Q-set were too few. A further quality of the 16-card set was that one member of the team decided that the only card types that should be sorted must be in the same content area as the training session: PTL, VEB, and scrubber technology. This miscommunication was unfortunate but not uncommon in larger teams spread across a geography of institutions and locations.

[191] See Chapter Three on conceptual diagram design values.

The 2017 pilot study also provide opportunities to test how to handle the unusual dataset. For example, the primary data collection objects were photographic images of each poultry farmer's card sort. These visual data objects needed to be transcribed for inclusion in a data sheet. An additional concern is that data entries follow the inverted pyramid of the sorted card patterns. Many cells will be deliberately empty. This quality of the data sheet will require data transformation for analysis.

The next set of pilot data take-aways (five pilot data lessons) offer detail on how to manage this data for analysis.

Pilot data lesson 1: Reviewing photographs for data integrity of each sort. *All photographs of participant Q-sorts were assessed for conformation to the inverted pyramid sorting shape. Each card display was also checked for the total number of cards and that each card in the entire card set appeared in each individual sort. Therefore, a "good sort," has these attributes:*

> *The participant sorted into the pattern (See Figure 17a and b earlier),*
> *That all cards appear in the sort, including the participant identifier number card, and*
> *No duplicate cards appear in the sort.*

Pilot data lesson 2: Labeling unacceptable or unconventional sorts and setting aside. *Card displays that did not fit the three criteria in Pilot data lesson 1 were* *coded as "uc" for unconventional and set aside, meaning these sorts were eliminated from the tranche of "good sorts." Other reasons concerning participant privacy also meant that sometimes a "good sort" would be excluded. For example, if a photograph of a card sort included identifying information -- too much of a respondent's hand, distinctive ring or watch, hat with distinctive logo, business card, etc. -- These sorts were also be labeled as uc and eliminated from analysis. The sorts are saved, however. These unconventual sorting experiences can improve planning in subsequent sorting events.*

Pilot data lesson 3: Marking ambiguous card positions sorts as unconventional (uc) and eliminating from analysis. *Another type of card sort can be discarded too. Some respondents will try to follow the template but shift a card or even the row so you cannot tell what the person intended. Such an ambiguous sorting pattern needs to be discarded or marked "uc", as described earlier.*[192] *Keeping the card sorts but marking them as "uc" for unconventional can help researchers in designing better events, where users are supported into making sorts that can be analyzed.*

Pilot data lessen 4: Keeping "ethnographic" notes during a sorting event. *Researchers interact with participants during a card sorting event. This engagement*

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[192] Keeping "bad" sorts for analysis is helpful. Patterns of error emerge that can be used to redesign sorting events to reduce the incidence of bad sorts. For example, a sorting template mat for each participant might be a good idea to reduce the numbers of these faulty sorts. However, creating a larger sorting template or "mat" can be difficult as the size needed may require specialized paper sizes and printing capability.

between researchers and participants is part of the essence of Q-method. Keeping notes on questions and conversations is helpful. Another important way to capture some ethnographic information to is to debrief with other researchers, especially the hosting Cooperative Extension agents. In ideal Q-method, the use of exit interviews, focus groups, and other ways to discuss the event with participants is advised. However, this ethnographic activity is hard to manage, in practice. Note: in most card sorting activities, researchers cannot work with all respondents. Part of this is the logistics of the larger number of participants. However, enough notes can be made from observation and conversation to provide some context to help with data interpretation and understanding.

Pilot data lesson 5: Remind researchers often about the pre-analytic focus of Q-method. *First, Q-sort elicits subjective preferences from participants. Second, ethnographic "capture" probes what these respondents were thinking in the sorting activity.*

The goal is not prediction. The goal is improved understanding of the ***participants*** *in the sorting events. This reminder during the data collections events and data preparation for analysis is important as more conventional science approaches tend to re-assert themselves.*

Part Two: 2019 Q-study with Delmarva poultry producers, using a 25-card sorting set

Introduction to 2019 case study

The 25-card set shown in Illustration 1.4 at the beginning of this chapter was used in a 2019 Q-sort study with Delmarva poultry farmers. This Q-sorting activity was redesigned from the 2017 pilot event to reflect final USDA CIG project science findings[193].

Information types from Q-approach. A Q-sort event typically produces three types of information for analysis. The first data set is the physical distribution of sorted cards by each participant. This study of individual sorts is a Q-method focus, in addition to looking at aggregate data from the sorting events, across all participants.

The second type of information -- arising from human interaction concerning the Q-sorting activity -- can take many forms: follow-up interviews, focus group discussion,

[193] See Appendix A for USDA CIG project description as well as a list of publications current through 2021.

or note-taking by the study designers in watching the Q-sort. Each of these ethnographic techniques can capture elements of the 'think-out-loud' narrative of some respondents. Talking to a respondent about their sorted pattern – if they are amenable – offers a rich encounter to understand why the pattern was sorted this way. This information often occurs within events, with notetaking and researcher debrief sessions.

The last type of information from a Q-sort is the aggregate sorted data across all participants. Special Q-sorting factor analysis procedures are used for this aggregate interrogation of the data set. However, exploratory data analysis and chi square testing can also be used with Q-sorting data sets. The 2019 Q-sorting events will be discussed with exploratory data analysis and chi-square testing procedures.

Method detail for 2019 Q-sorting events with Delmarva farmers: In November 2019, a Q-study was conducted with poultry farmers in two Cooperative Extension learning session events. Here, the Q-study used a 25-card set for sorting. See Illustration 1.4 from the beginning of this chapter and reproduced below for reader convenience.

The card-sorting events were part of two University of Delaware Cooperative Extension learning events, held to share new information of interest to poultry farmers. The first part of the evening included discussion of PLT knowledge from USDA CIG researchers. Also noted were ongoing evaluation of VEBs as ammonia/particle pollution capture structures near poultry house, also based on USDA CIG work. At the end of the presentations, poultry farmers were introduced to Q-sorting and invited to participate. Both the Cooperative Extension agent and the author noted that better understanding about poultry farmer viewpoints could help in developing programming, designing research, and well as build community among Delmarva stakeholders. Participation was voluntary; 13 farmer sorting responses fit criteria for analysis.


VEBs + PLT best practices manage nutrients/runoff, enhancing stewardship of watershed/Bay health
PLT best practices inside poultry houses shows humane treatment of birds; possible future certification
Placing Vebs: Distance between fan and VEB is flexible (site/location) for capturing emissions and particulates
VEB emission capture is typically more efficient at night, decreasing residential odor
VEBs + PLT best practices support a farmer's goal of land stewardship that reflects care for nature
VEBs + PLT best practices support a farmer's spiritual vision of how to provide food as stewardship
VEBs provide windbreak, shading, and energy efficiency in poultry production
VEBs capture particulate matter (up to 75% efficiency), reducing asthma/COPD risk for farm families
VEBs organize living + working spaces, enhancing land management + livability
many, mixed benefits
VEBs + PLT best practices help manage nutrients/runoff, supporting oyster, crab, and fishery worker/neighbors
VEBs + PLT best practices reduce emissions, improving farm quality of life (health, beauty, screening...)
Less Emissions
VEBs create wildlife habitat, providing ecosystem services for birds, deer, protected species, and pollinators
VEBs + PLT best practices help farmers pass on sustainable agriculture to next-generation farmers
VEBs + PLT best practices are strategic for long-term nutrient management plans, under tighter regulations
VEBs screen poultry production operations from neighbor viewscapes
VEBs are effective April-- October, forming a key part of annual nutrient management plans
Reducing emissions is a sustainable agriculture best practice, permitting upscale-marking of healthy, Chesapeake-friendly chicken
Less Emissions
Removing in-house ammonia results in improved paw quality allowing for premium sales of product for international market
PLT
VEB research: confirms flexible VEB location, distance-wise, from exhaust fan; NRCS practice under consideration
NRCS REVISED Best Practice FOR HEDGEROW PLACEMENT CONSIDERATION
PLT treatments at weeks 3 and 5 reduce ammonia emissions; less eye irritation for workers
Less Emissions
VEBs = Beautification: including hardy, annual flowers on VEB-side not facing exhaust fan can add beauty to farms
WAX BEGONIA
25 cards-set for Q-sorting, based on values and benefits encompassed in two voluntary best management practices: PLT and VEB. Sort pattern for each farmer below (picture)
PLT treatments at weeks 3 and 5 decrease in-house ammonia emissions for bird health
PLT PLT PLT
VEBs, a hedgerow or windbreak tradition, reflects heritage farming knowledge and practice
PLT treatments at weeks 3 and 5 decrease ammonia emissions from poultry house fans
Less Emissions
PLT PLT PLT
VEBs show the community a clear farmer commitment to environmental best practices

REPRODUCED HERE for READER CONVENIENCE
Illustration 1.4: 25 cards developed for the Q-sorting study with Delmarva poultry farmers. These cards were used in November 2019 sorting events. The lower right photograph shows a sample of how the cards sort into the template pattern.

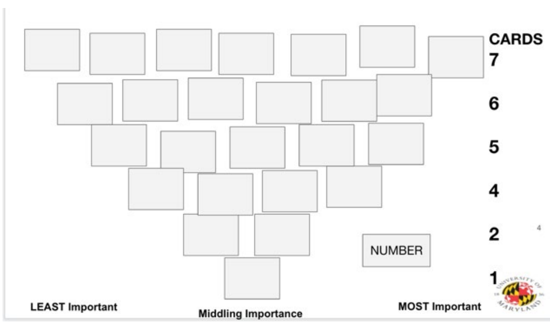
The 2019 study did not meet the threshold for a Q-sort factor analysis procedure. Specifically, the P-set needed to be close to 20[194] (Stephenson, 1938; Brown, 1993). For the two November 2019 sorting events, the P-set number was 13 (poultry farmers with "good" sorts, using all 25 cards). Hence, a factor analysis of this data set by Q-analysis practices was not possible.

However, researchers can learn a great deal from a Q-sorting dataset that does not meet threshold participant numbers. Two approaches are described: first, exploratory data analysis, with an emphasis on using violin plots; and second, chi-square testing because this data set is comprised of categorical variables.

[194] See the discussion of Q-method principles concerning the numbers of P-sets and Q-sets that constitute a Q-study that can be analyzed with factor analysis.

Method detail on 2019 Dataset: parameters of the data and/or assumptions for analysis

- Participants with good sorts, to include in the data sets: Participants= 13
- Q-statements = 25 cards that combine visuals and text.
- Sort categories in seven graduated preference columns from LEAST IMPORTANT to MOST IMPORTANT. See Figure 18a and b below, for template and photo of sort pattern.
- Assumption: underlying distribution of the data set is *nonparametric*[195].



[195] Nonparametric statistics is based on either being without a distribution or having a known and identified distribution but with the distribution's parameters unspecified. Beginning with an assumption of nonparametric statistics means that a wider frame of what is possible in the tests of both descriptive statistics and what statistical inferences might be made from data analysis.

Figures 18a and b: Template sorting pattern and sample sort photograph for November 2019 events. 8a) Sort pattern demonstrated for respondents, with card numbers shown on right; 8b) Photograph of what a Q-sort looks like, with 25-card set. All images by author.

Research results for 2019 Q-sorting study: exploratory data analysis and chi square testing

Exploratory data analysis[196]: This data analysis section is organized by key researcher questions that guide exploratory data analysis steps.

[196] Most Q-studies do not share the exploratory data analysis step. However, because this dissertation concerns the use of humanities and social science frames in environmental policy deliberation, showing the work helps with the mixed audience of readers.

Question 1: Which cards appear most often in the MOST IMPORTANT sort column?

Examining frequencies is a good first step and can help guide later tests. Let's look at the frequency of card appearance in column 7, the MOST IMPORTANT position in the sorting template (Figure 18a and b above). Figure 19 below, a bar graph, shows which cards appear most often in the MOST IMPORTANT POSITION (column 7 in the sorting template). Accompanying this bar graph of card frequency (Figure 19) is Illustration 5 below. Illustration 5 displays the five cards with the highest frequency of appearance in the MOST IMPORTANT card position. Table 8 below discusses what the positions of these cards as being sorted at higher frequency into the most important positions, compared to the other 20 cards. To restate: Figure 19, Illustration 5, and Table 8 (all below) can be examined together as these graphics contain information about the cards that appear with highest frequency, called "vote[197] frequency."

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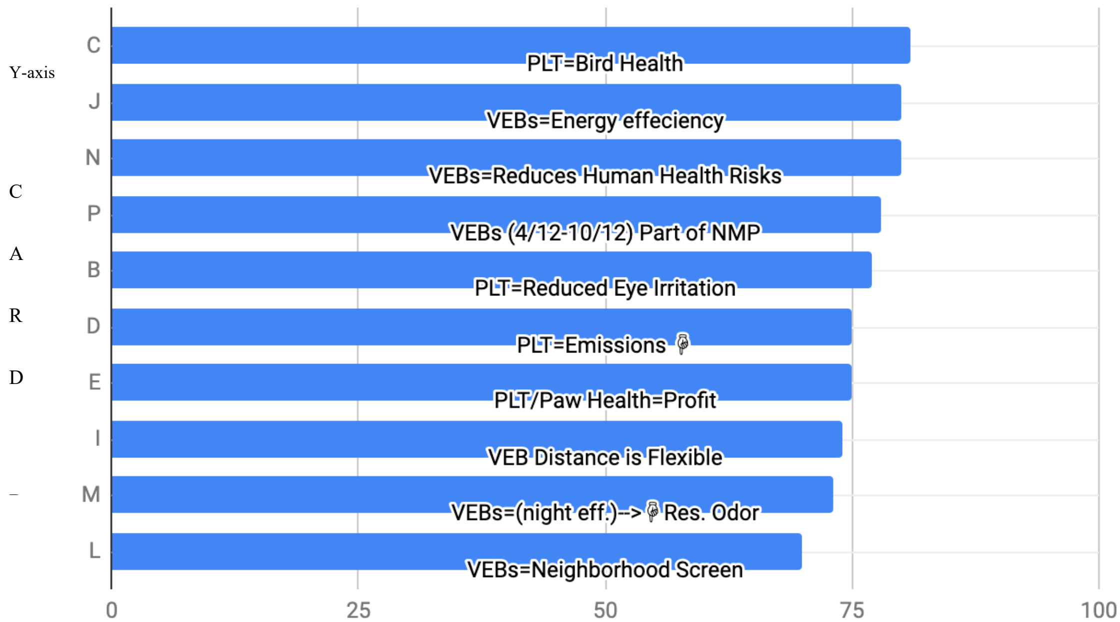
[197] "Vote" means that a card occurrence is noted as occupying a position in the ranked importance categories. This reflects a data transformation when the "zeros" that are an artifact of the inverted shape (Figure 17a and b; Figure 18a and b)). "Vote(s)" depict cells where a card is sorted, both for individual participant sorts as well as in the aggregate. Votes have been weighted, to eliminate the confounding zeroes. Weighting is done thusly:

> Column 1 is not weighted; all other columns are weighted by multiplying the column position number (1-7 preference
> Column 2 X 2
> Column 3 X 3
> Column 4 X 4



X-axis: "Vote frequency" or number of times a card appears in MOST IMPORTANT position

Figure 19 (bar graph): Top ten appearance of cards (X-axis by alphabet designation of 25 cards) by vote frequency of cards appearing in the MOST IMPORTANT column (Y-axis). Column number 7; aggregated data from 13 respondents working with 25 cards in November 2019 events. Each card appearing here is also described with a phrase appearing on each bar in the bar graph. Note: Because of the empty spaces in the data sheet, which reflect empty positions in a sorting template, each cell was

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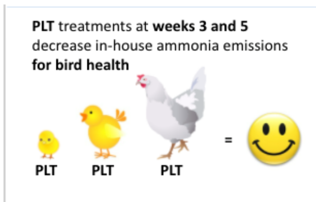
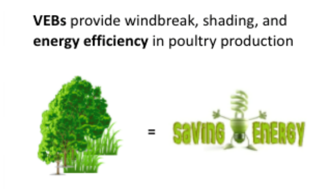
Column 5 X 5
Column 6 X 6
Column 7 X 7

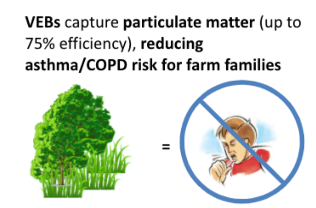
weighted. These weighted frequencies are called “votes” to distinguish from simple frequencies.



Card C: PLT = Bird health

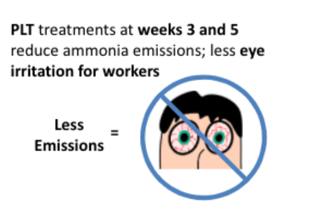


Card J: VEBs=Energy Efficiency



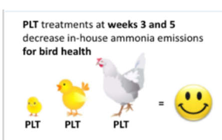
Card N: VEBs reduce Human Health Risks

Card P: VEBs=Part of NMPs [198]

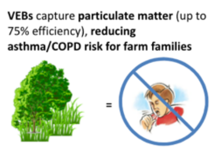


Card B: PLT=Reduced Eye Irritation
Illustration 5: Top five cards by “Votes” identified in Figure 22 in descending order, from top to bottom. Key: Card C:PLT=Bird Health, Card J:VEBs=Energy Efficiency, Card N:VEBs Reduce Human Health Risks, Card P:VEBs=Part of NMPs, and Card B:PLT=Reduced Eye Irritation.

Table 8 below presents these top five cards (vote frequency on the left) with what these frequencies might mean, given the background context.

1st frequent: CARD **C** PLT=Bird Health  **2nd frequent:** CARD **J** VEBs=Energy Efficiency	These two cards represent **strong economic incentives for making or saving money.** This card C where PLT= Bird Health can be seen as very important to farmers in the aggregate. However, this position might lead to this inference: Bird Health is the primary goal of poultry producers as price/lb. payout is directly related to healthy birds who convert grain to weight. In this way, the value underlying this card is an essential economic means of making bank in a grow-out season.

[198] VEBs (4/12-10/12) is equivalent to VEBs=Part of NMPs. Part of NMP On the card phrases used within the science team, this is the phrase, which captures the seasonal use of VEBS from April through October when the plants in the VEB are metabolically active to take up nitrogen and incorporate into their biomass.

	Shading the poultry house can reduce energy costs, especially in summer but also in winter; Card J denotes the long use of hedgerows as windbreak and shade cover, however VEBs are demonstrated "living tech" to remediate air pollution.
3rd frequent: CARD **N** VEBs=Reduce Human Health Risks  **5th frequent:** CARD **B** PLT=Reduced Eye Irritation 	People tend to **appreciate their health conditions,** near and in workplaces. **NEAR poultry houses**: For families of mixed generations who live very close to their poultry houses, Card N can be of importance for lung health. **WITHIN poultry houses** This is especially true because farmers typically work within their poultry houses. Many farmers do care about their workers, as well as following OSHA standards for work conditions. Card B reflects this concern. More than one farmer noted -- via side conversations -- that internal poultry house conditions are especially important when children and teens work in the poultry house. For families of mixed generations who live very close to their poultry houses, health concerns for children and elderly can be paramount. *Note: these two cards are classed here because of their shared health viewpoint.*
4th frequent: CARD **P** VEBs (4/12-10/12) Part of NMPs 	Farmers are sensitive to the **existing soft regulatory filing of seasonal nutrient management plans.** Economists confirm this present value focus over future focus. In consideration of this focus, a similar card is included in the 25-card set. Note: CARD **X** concerns future regulation and did not appear in these five top cards.

Note: Card **P** concerns a current regulatory requirement.	

Table 8: Summary table of what Figure 19 (votes) and Illustration 5 (cards) might mean concerning the aggregate vote frequency of these cards in the MOST IMPORTANT preference category. Note: Cards N and B, at positions third and fifth important, were placed together in this table because they both are health concerns.

The five-card set of highest frequency in the aggregate – shown in Table 8 above -- represents stand-alone strategies of either VEB-focused cards or PLT-focused cards. In the entire 25-card set, some cards reflect a combination of VEB and PLT strategies, as well as other poultry pollution viewpoints. That these cards reflect these two BMPs is not a surprise because Cooperative Extension agents and programs work extensively on poultry production using VEBs and PLTs. Additionally, during the 2019 sorting events, new knowledge about PLTs and VEBs was part of the presentation before the card sorting began.

Here is a summary of what the most frequently occurring card types "voted" into preference positions might hold in common[199] for possible farmer motivation:

- economics/savings of the seasonal grow-out of healthy birds,
- health risks, both near and within the poultry house,
- existing regulatory requirements must be met, and
- awareness of these two poultry farming practices.

Question 2: Which cards are most frequent in MIDDLING IMPORTANT sort columns?

See Figure 20 below for a bar graph of "MIDDLING Card Frequencies." Recall that the overall sorting pattern that the farmers sorted to is seven preference columns:

1. LEAST IMPORTANT (Col. 1)>
2. MIDDLING IMPORTANT (Cols. 2-6)>
3. MOST IMPORTANT (Col. 7).

In the MIDDLING IMPORTANT category, Column 4 is the midpoint of the entire sorting template. For this analysis, the MIDDLING category is defined as spanning columns 2-6. In other words, what is being eliminated are the LEAST IMPORTANT

[199] Looking for more detail on plausible explanations is very like the information that a Q-method factor analysis might be able to uncover. However, these human motivations are clear from understanding the context of how people behave.

and MOST IMPORTANT ends of the distribution, namely columns 1 and 7. Note that this choice is simply a winnowing decision or binning decision.

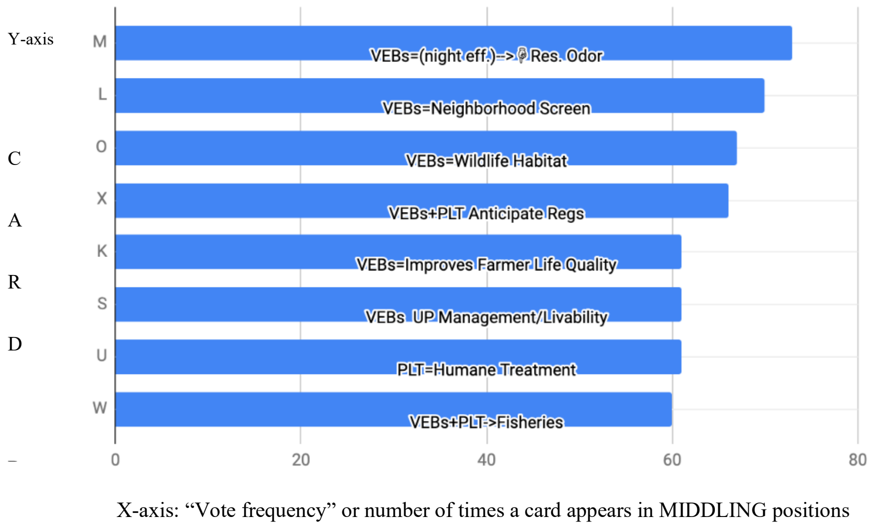


Figure 20: (bar graph) Top eight appearance of cards (X-axis by alphabet designation of 25 cards) by vote frequency of appearing in the MIDDLING IMPORTANCE portion of the sort pattern. In the aggregate, these cards appeared most frequently in columns 2, 3, 4, 5, 6, defined as the MIDDLING category.

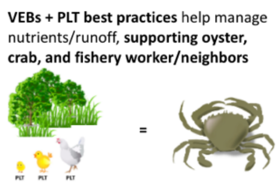
In the MIDDLING cards noted in Figure 20 above, none of these eight cards are directly driven by these three attributes, noted in Table 8 (five cards sorted MOST IMPORTANT), concerning the most frequently appearing card types:

- Economics of the seasonal grow-out of healthy birds
- Health risks, both near and within the poultry house
- Existing regulatory requirements.

Five of the cards are VEB-focused, with one card PLT focused; two of the cards combine PLT and VEB strategies.

Cards in Figure 20 (bar graph just above) might represent a range of underlying attributes of the values and benefits of managing ammonia by various strategies. Table 9 below presents these possible contributing reasons for eight cards in the MIDDLING category (based on Figure 20). On the left-hand side are the cards appearing as MIDDLING, while the right-hand size presents possible reasons, given the context.

1st frequency: CARD **M** VEBs (night efficiency)>Reduce Residential Odor  **2nd frequency:** CARD **L** VEBs=Neighborhood Screen  	Both cards **M** and **L** help with **neighbor relations** • Calm conflict with newer residents unused to farm activity • Might reduce legal exposure to nuisance lawsuits* • Anticipate local zoning revision activity*

3rd frequency: CARD **O** VEBs=Wildlife Habitat  **8th frequency:** CARD **W** VEBs+PLT->Fisheries 	VEBs can support birds, deer, and other species desired for recreation/tourism and permitted hunting. VEBs can be part of specialized habitat. • Card **O** prompted questions about conservation buffers and wooded streams; are they VEBs? **Awareness of ecosystem protection** from ammonia deposition, algal blooms, and rockfish, oyster, crab fisheries. • Card W provoked some discussion about relatives or neighbor who fish commercially *Note: cards are placed together because they share a category but rank 3rd and 8th*
5th frequency : CARD **K** VEBs+PLT Improve Farmer Life Quality  **6th frequency:** CARD **V** VEBS Up Management/ Livability	These two cards represent a **synthesis of attributes:** aesthetics, land management, heritage farm build environment practices like hedgerows, windbreaks, etc. CARD **K:** VEBs+PLT for farmers living close to poultry house; emphasis family living in proximity CARD **V**: VEBs only, with focus here is on farmer choice/farm/farm family livability on farm building/land choices.

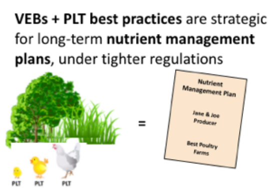
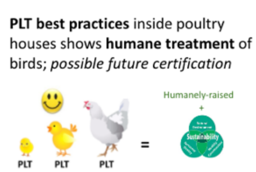
 	This card represents land use and the built farm environment. **Farmers confused but opened up discussion:* *Card ranking might tease out farmers who live on site and those using rented land for poultry production.*
4th frequency: CARD **X** VEBs+PLT Anticipate Regs*  	Card **X** is **future-focused**; many federal, regional, and state **regulatory frameworks** focus on Chesapeake Bay water quality. For example, farmers watch nutrient regulation closely. • Chesapeake Bay Report Cards • State and federal programs lie • Watershed Implementation Plans (WIPs) and • Total Maximum Daily Load (TMDL).
7th frequency: CARD **R** PLT=Human Treatment*  	Card **R** is **future-oriented and speculative.** Human certifications in meat production are increasingly part of market segmentation; farmers might wish to be part of labeling programs or will be pressed into these programs, depending on which poultry company they grow for.

Table 9: Summary of top eight cards (MIDDLING IMPORTANCE) by vote identified in Figure 20 with possible contributing reasons. These cards appeared, in the aggregate, with higher frequency in, position 6. of MIDDLING IMPORTANT sort-columns (defined as columns 2-6). Note: Cards O and W, 3rd and 8th, are placed together because they share a wildlife/ecosystem quality and can be discussed together. Key: * Indicates card that represent attributes that are future-oriented

The exploratory data analysis focus thus far is on cards that are sorted as either MOST IMPORTANT or of MIDDLING IMPORTANCE. This analysis choice is a first look at what the vote tally figures show (Figures 19 and 20, MOST and MIDDLING frequencies, respectively). On important caveat here is that simply looking at aggregate frequency is not the robust argument for aggregate importance. The frequency analysis helps show a sense of the direction of the data, which will be important in using chi- square testing. Frequency positions here are not absolute.

Brief note on findings about less important cards. Generally, in Q-method work, the focus is first on what is sorted as more important. Many researchers are someone silent about making inferences from context and research about cards ranked as less important. Some of the thinking for this is philosophical and concerns human preferences. Cards that appear as less important might be cards that are

- not well understood by respondents,
- too abstract and not well depicted in images and text (fault of designer),
- time sensitive: Future reasons and not current reasons,
- values that respondents do not want discussed in public (think about spiritual values in a public setting),
- “toss away” cards.

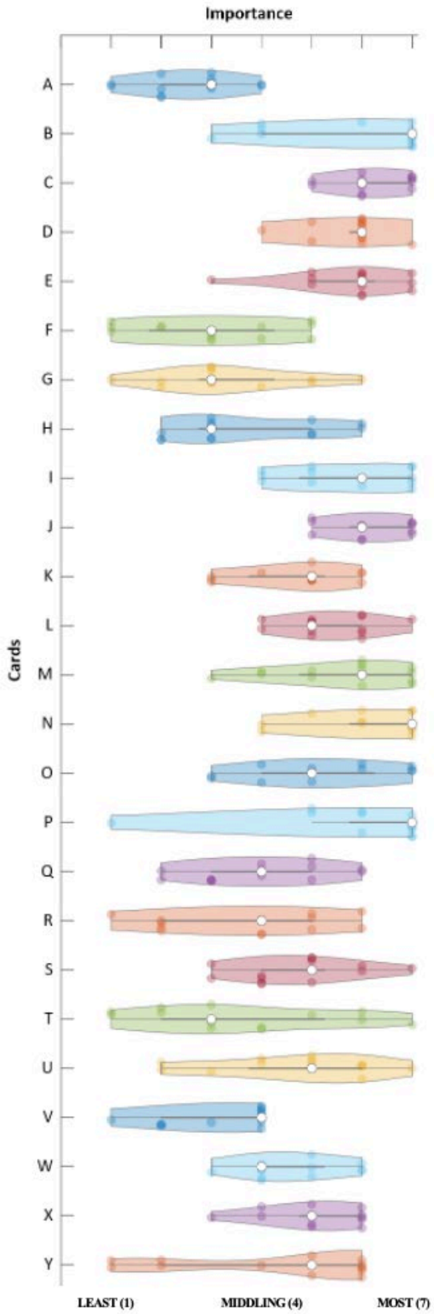
By “toss away” is meant card(s) that some respondents ask if they can discard. This wish to discard can represent disinterest or even dislike that is deep, so deep to not wish the card content to be included in the ranking. For example, in the 2017 pilot event that included three fan scrubber cards, several poultry farmer participants asked to not sort these cards. The idea of expensive fan scrubbers aroused a sense of ill feeling in some farmers present at the sorting activity. Indeed, this sense of strong feeling in the pilot study gave rise to many thoughtful discussions in the USDA CIG project.

Question 3: What about the distribution of response for each card type?

Summary statistics look at measures of central tendency within a distribution. Here, the distribution is not simply the pattern for each respondent sorting each of the 25 cards in the aggregate. Rather, we want to know the individual sort patterns of all card types (25 cards) in the 13 respondent sorts. Then, we can see how a card type is distributed across the preference rankings (C1-C7, from LEAST to MOST IMPORTANT).

An exploratory boxplot (not shown) was built but because the underlying distribution was different for each card type, the violin plot is a better data visualization. See the violin plot in Figure 21 below, where a companion key identifies the content of each card. Violin plots allow for quick comparisons of relative positions of the cards and a sense of what the distribution of each card looks like across the scale of LEAST IMPORTANT to MOST IMPORTANT, in the aggregate. This means that we can compare each of the 25 cards with each other, in this visualization, based on summary statistics and the underlying distribution pattern.

Violin plot analysis focuses on **position** (on the X-axis in this horizontal violin plot of preference ranks 1-7); **shape** of the violin plot, roughly fat and compressed or thin and long; and **skew**, which looks at the underlying distribution shown by curves on lines that outline the individual plots. Like box plots, violin plots also show the mean, which is part of the position information just noted.



Card	KEY
A	Emissions ¶=Sust.->CB-friendly
B	PLT=Reduced Eye Irritation
C	PLT=Bird Health
D	PLT=Emissions ¶
E	PLT/Paw Health=Profit
F	VEBs=Beautification
G	VEBs=Hedgerow/Heritage Farming
H	VEBs Show Env. Best Practice
I	VEB Distance is Flexible
J	VEBs=Energy efficiency
K	VEBs=Improves Farmer Life Quality
L	VEBs=Neighborhood Screen
M	VEBs=(night eff.)-->¶Res. Odor
N	VEBs=Reduces Human Health Risks
O	VEBs=Wildlife Habitat
P	VEBs (4/12-10/12) Part of NMP
Q	VEBs+PLT=CB Stewardship
R	VEBs+PLT=Farmer-Stewards
S	VEBs UP Management/Livability
T	VEBs+PLT= Sus Ag to Next Gen
U	PLT=Humane Treatment
V	VEBs+PLT= Spiritual Vision/Stewardship
W	VEBs+PLT->Fisheries
X	VEBs+PLT Anticipate Regs
Y	VEBs->NRCS Rewrite

Figure 21: Violin plot of 25 cards showing summary statistics and the underlying distribution of each card in the aggregate. The X-axis shows ascending importance from left to right (1-7); the Y-axis ascending A-Y for each of the 25 card types. (Sorted by 13 poultry farmers in two November 2019 events).[200] Key to cards below the violin plot.

Position: Reading the card position in the aggregate is clear by inspection; these three cards all have the mean (small circle) aligned at importance position 7, meaning MOST IMPORTANT

Card **B** PLT=Reduced Eye Irritation

Card **N** VEBs=Reduces Human Health Risks

Card **P** VEBs (4/12-10/12) Part of NMP.

Interestingly, a card thought to be MOST IMPORTANT by frequency but not appearing here in the violin plot analysis is

Card C PLT=Bird Health[201]

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[200] Violin plots created in Matlab by River Yang of UMCP and USDA, from data tables in this project.

[201] The sensitivity of violin plots here might suggest a contextual background and interpretation. Perhaps some farmers read this card as primarily about PLT schedules and not bird health making for higher per pound payment.

The mean also sets the position of the violin plot on the X-axis. Because the X-axis shows the preference scale, you can compare the relative positions of each card by preference ranking. This position aspect of violin plotting is a chief data visualization attribute for comparison purposes.

In addition to showing the mean and locating preference position, the violin **shape** associated with each card provides additional detail on what violin plots can tell us about farmer preferences.

Shape: In comparing the individual card violin's relative shape is important. For example, these four cards (**C, D, J**, and **L**) have relatively short violins, meaning that their distributions cluster tightly around the mean; their "standard deviations"[202] look similar and small, compared to other violins plots that are elongated. Cards with short violins:

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[202] Looking at standard deviation as being communicated by a violin plot is moderately misleading. What you get from violin plots is a way to see differences and compare the underlying distribution. If the violin plots are shaped relatively similarly and symmetrically around the mean point, with only a sense of long-tail stretch, you could talk about standard deviations more accurately. In other words, to use standard deviation to compare violin plots would require that the underlying distributions were normal in shape.

Card **C** PLT=Bird Health
Card **D** PLT=Emissions ☟
Card **J** VEBs=Energy Efficiency
Card **L** VEBs=Neighborhood Screen.

Caveat about thinking in terms of standard deviations with different distributions shown in violin plots: Recall that the distributions that underly the violin shape in all cards are different. This difference in underlying distribution means that using the idea of standard deviation to make comparisons is a bit misleading. Standard deviation, typically, reflects a normal distribution. Comparing standard deviations across the cards would assume that all cards share an underlying distribution. However, the shape of the violin plot reflects different underlying distributions. Indeed, this is a chief advantage to using violin plots with summary statistics over box plots with summary statistics.

Indeed, violin plots are valuable because you can compare differing underly distributions. In this way, violin plots are a good data visualization for Q-sorting data. Each card's distribution across the preference categories is expected to be different.

The compressed shape suggests that poultry farmer attitudes (across 13 total sorts) are relatively similar concerning values about ammonia management depicted on these card types discussed above: C, D, J, and L. What this means that most of the poultry farmers in these 2019 sorting events felt similarly about these four cards. An essential take-away for science communication documents designed for this audience is that farmer participants here largely agree on these values/benefits.

Similarly, about shape but for cards with a *long v*iolin shape, relatively, these four cards

Card **P** VEBs (4/12-10/12) Part of NMP
Card **R** VEBs+PLT=Farmer-Stewards
Card **T** VEBs+PLT= Sus Ag to Next Gen
Card **Y** VEBs->NRCS Rewrite

are similar yet with elongated shapes, hence, suggesting that different poultry farmers in the sorting exercise likely hold very different opinions towards these card types: **P, R, T,** and **Y**.

Knowing about these distribution differences, shown by shape pattern, helps in understanding the subjectivity range of respondents, but might also be useful for science communicators -- including Cooperative Extension agents -- in designing communication and workshops. The shapes do not answer all questions but help with imagining and inquiring about audience needs. For example, does the long length of some violin plots suggest widely varied knowledge about a topic on the card? Does a short length of some card plots suggest a common regional condition, say similar sub watershed location or proximity to a development?

Skew: Violin plots show skewness in the underlying distribution associated with each card type across the seven preference categories. Here, skewness describes the relative position of the card type on the preference (X-axis), where the right side from the midpoint (MIDDLING IMPORTANCE) is moving toward MORE IMPORTANCE. Similarly, if skew in a violin plot moves toward the left on the preference axis (X), that violin plot card type is moving toward LESS IMPORTANCE.

Clusters upon the preference axis:[203] Shapes of plots and location *vis-à-vis* the preference axis (X) give additional detail about how a card type fares across the seven preference categories. See Figure 21 of the violin plots above.

For example, these three cards listed below, are located relatively toward the left (LEAST IMPORTANT) on the horizontal (X) axis but with some stretch toward the right (MORE IMPORTANT)

Card **G** VEBs=Hedgerow/Heritage Farming
Card **H** VEBs Show Env. Best Practice
Card **T** VEBs+PLT= Sus Ag to Next Gen**.**

This shape *stretch* might suggest that most poultry farmers considered these cards as relatively unimportant, while a few farmers considered these cards as very important. In terms of audience understanding, the condition of highly varied subjective responses may shape some of the science communication needed with this card. Another good way to understand this variation within a card's distribution is to ask questions about why the variation might exist. For example, what if a state regulation

[203] X-axis where column 1 is least important and column 7 is most important. Column 4 is the midpoint.

differs between Maryland and Delaware, in a sort with residents of both states? Could that underlie difference?

Values depicted by cards: One way to approach this rich volume of information in violin plots would be to select a particular sub-topic of inquiry, say, cards depicting wildlife protection and fisheries protection, and then look at violin plots for these cards. This investigation approach begins with a card type and then looks at how this card fared in the violin plot (Figure 21 above). For example, the fisheries card is **W**, where the mean appears at preference 4, the sort column in the very center of the distribution: MIDDLING IMPORTANCE. Yet the underlying distribution notes that the card's remaining distribution is toward the MORE IMPORANT right hand size of the preference axis. This means that the importance, on average, is of MIDDLING IMPORTANCE, with uneven sorting across the rest of the X-axis (preference scale). Proportionally, more farmers sorted toward MORE IMPORTANT than sorted toward LESS IMPORTANT.

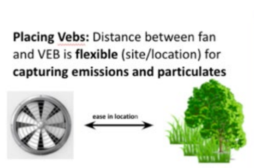
Seeing how violin plots show underlying distribution is helpful in thinking about stakeholders hold differing viewpoints on these cards. For example, do the farmers who sort Card **W** to the right (MORE IMPORTANT) live closer to the Delaware Bay and in that watershed basin? Do these farmers have family or neighbors who are watermen? Looking at the distribution can generate additional and productive questions to use in understanding poultry farmer choices. Here, ethnographic capture of conversation, questions, interviews, and the like can help with examining these human qualities further.

Analysis and discussion about exploratory data using hunches and who interpret): As it happens, several scientists in this USDA CIG project were surprised about the relatively low "importance" positions of these two cards in sorting:

Card **I** VEB Distance is Flexible

Card **Y** VEBs->NRCS Rewrite.

Table 10 below shows these two cards.

<table>
<tr><td>CARD I</td><td>VEB Distance is Flexible


</td></tr>
</table>

CARD Y	VEBs->NRCS Rewrite 

Table 10: Violin plot findings (from Figure 21) on two cards (I and Y) related to VEB placement flexibility and future regulatory implications. These cards are part of a case discussion here re scientist hunches about farmer sort positions.

Scientists, in both the 2017 pilot and the 2019 study being discussed here, thought that these cards would be ranked more highly than they were. It should be said that these two related cards invoked several implications of their recent research findings. Namely, based on their research, scientists were very confident that VEB location was much more flexible than previously thought. The VEB flexibility of location[204] means more choice for farmers to manage their built environments.

[204] The Delmarva Chicken Association (DCA) (formerly Delmarva Poultry Incorporated) is a strong proponent of VEBs and research on these pollution remediation strategies. At time of publication of this dissertation, the DCA 2020 VEB toolkit is the only published guidance for poultry farmers about this new research and implications for VEB design and deployment on poultry farmers. In addition to VEB location flexibility, DCA and other seek better quantification of nitrogen uptake by VEBs to improve ammonia pollution measurement and modeling. The USDA CIG project is part of this ammonia remediation quantification, with rough measurements of about 20 percent of ammonia within an annual monitoring period. USDA noted this VEB quantification in two ways: Inclusion of the findings in the 2019 USDA report on top agricultural research and in revised NRCS standards on VEBs for poultry farm use. See three resources:

In other words, the working hunch here was that poultry farmers would share a similar viewpoint to that of the scientists. These two cards (**I** and **Y** in Table 10 above) about VEB placement are discussed briefly below, as an example about how to use tis Q-sort data to understand more about the subjective viewpoints of the participating community. What these scientists thought might happen in Q-sort about Cards **I** and **Y** ranking higher did not bear out in either the 2017 pilot nor the 2019 Q-card sorting events. See Table 11 below for more discussion of these two cards.

This understandable hunch[205] about existential importance of refinements to VEB technical knowledge did not bear out in farmer responses as probed by these two Q-studies. This surprise by scientists means that scientist viewpoints may not be the same as other stakeholder viewpoints. In more traditional study design, scientists

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DCA (2020). VEB Toolkit, 2020; a technical guide available from DCA upon request. Georgetown, DE USDA (2019) ARS Annual Report. USDA. GPO.

NRCS (under revision) 2019 pending update on NRCS Practice Standard 422 on Hedgerows: 1) allow inclusion of perennial grasses into VEB, facing poultry house fan; f2) allow flexible distances for farmers to use in meeting this standard.

[205] Hunch is a stance that researchers can have about how card sorting will go. The stronger sense of hypothesis testing does not really fit here because Q-method assumes that the card sorts will occur to reflect the participants preferences. Hypothesis testing is not the inquiry frame in Q-method.

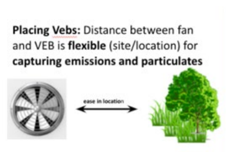
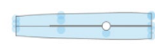
might cast this hunch as one of several testable hypotheses. However, in Q, this pre-analytical convention about hypothesis strength –is not part of the study framing. Rather, Q-method reminds us that all viewpoints are expected to appear in the distribution, with respondents ranking based on their internal and highly idiosyncratic thoughts and values. In other words, hypothesis testing is not a strong frame here in Q. This sense about hunches rather than hypothesis testing is not typical of many scientific method approaches. In upcoming work with chi square testing, hypothesis conventions will be addressed again.

Yet, this finding for Q and scientist surprise can form part of the basis for renewed public communication about these new technical findings about VEBs and ammonia/particle pollution capture from poultry production. Q-events are powerful ways to both communicate technical information to stakeholders, as well as gain viewpoint understanding for further science education strategies. In some ways, this work of communicating VEB technical flexibility did occur since 2017, in other ways. The Delmarva Chicken Association (DCA[206] has taken up VEB education work significantly since, based in part of these USDA CIG findings, and other VEB-

[206] Formerly known as Delmarva Poultry Industry, Inc. (DPI). The name change took place in 2021.

focused research. See Appendix A, which describes this USDA CIG project, for a list of publications.

See Table 11 below that summarizes some of the differences between what was expected (scientist hunches) and what farmers sorted (observed). The violin plot shapes for these cards are also included.

CARD	**Mean Importance**	**Shape**	**Comments**
CARD I VEB flexible 	**6** **Scale is 1-7:** 4=midpoint/MIDDLING		Farmer responses are more uniform Perhaps can as for this card value/benefit, the respondent community is more similar in response.
CARD Y NRCS rewrite 	**5** **Scale is 1-7:** 4=midpoint/MIDDLING		Variability in farmer response; some in long tail Perhaps can assume for this card value/benefit, respondents differ, with several ranking card as less important but others as more important. Researchers can explore or adjust

			science communication strategy.

Table 11: Looking at Cards **I** and **Y** about VEB placement flexibility, where scientist hunches did not hold. These findings come from the violin plots of Figure 21.

This narrative about Cards **I** and **V** also shows a pathway into thinking about the violin plot (Figure 21 above). For Card **I**, the shape is more compact, with the mean at 6 on the preference scale. The scientists could see that farmers tended to agree about the importance of this card and sorted the card at column 6 (mean), which is somewhat important where column 7 is most important. For Card **V**, the range of difference as shown by the shape means that farmers held more varied viewpoints about the future revision of a VEB standard. The mean position of this card in the aggregate is at column 5, where column 4 is the midpoint of the preference distribution.

Another take away here is a sense of the range of what important can mean. These cards did not rank in position 7, the position of MOST IMPORTANT. Yet, the cards did not fall toward the LEAST IMPORTANT side of the preference scale.

As this story focus on cards concerning VEB distances and new NRCS guidance on flexibility show, these cards can be looked at in several ways by comparing aspects of exploratory data analysis. In each exploration, what is achieved is additional understanding about the range of viewpoints that underly farmer motivations to manage ammonia in ways that fit their circumstances. What is also generated are a few relevant questions that can used to further ask of poultry farmers or seek answers by looking closely at the context.

Within Q-method is the expected presence of researchers during the Q-sorting activities. Questions and discussion between poultry farmers and researchers form part of the ethnographic capture important to Q-method. Among the notes taken and comments from immediate debriefing sessions is information that can help explain some of these findings. For example, the author overheard a conversation between two poultry farmers discussing a nuisance lawsuit with a turkey farmer in West Virginia. These farmers were discussing Cards **L** and **M**, wondering about if planting VEBs now, in anticipation of residential development might be prudent. See Table 12 below.

Card L	VEBs=Neighborhood Screen	What is the power of visuals to control neighbor complaints?

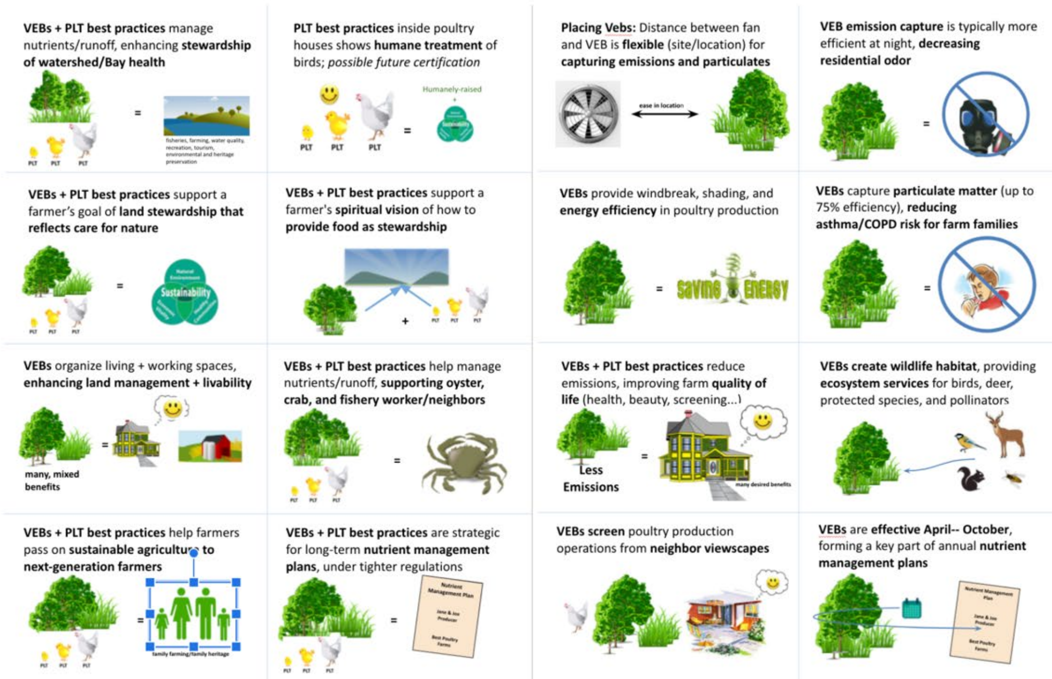
		
Card M	VEBs=(night eff.)-->¶Res. Odor 	Odor is an aesthetic as well as health risk experience.

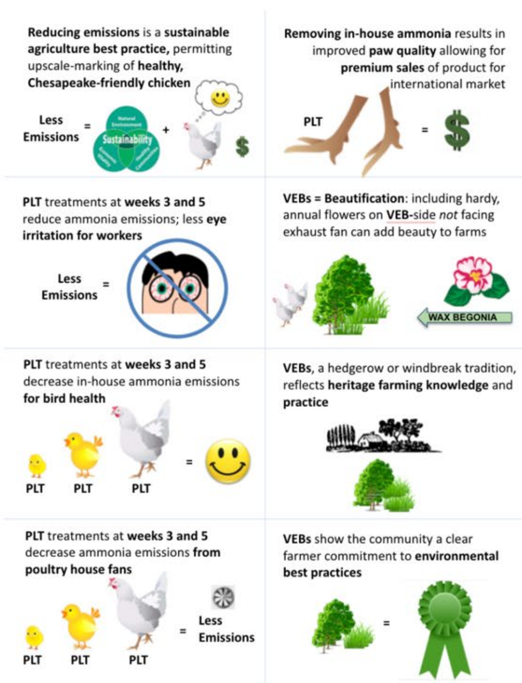
Table 12: Two cards (**L** and **M**) that might help poultry farmers avoid nuisance complaints from neighbors. The value of listening during sorting events is demonstrated. Note: Recall that Q-method assumes interaction between researchers and respondents.

Exploratory data analysis is a place of rich discovery. Confirmatory data analysis is another powerful tool for understanding data and meaning making.

Confirmatory analysis with two-tailed chi square testing

This dataset contains a P-set of 13 farmers (participants), when a minimum of about 20 in a P-set is required for a Q-factor analysis. Because the variables in this data set are categorical, chi square testing is possible. Chi square has inference making value even when a Q-study can be analyzed with factor approaches. When you cannot perform factor analysis, chi square is even more useful to Q-researchers as well as recognized by researchers outside of the Q-community. Figure 1.4, first presented in Chapter One but also placed in this chapter at the beginning of new discussions, is below for reader convenience.





25 cards-set for Q-sorting, based on values and benefits encompassed in two voluntary best management practices: PLT and VEB. Sort pattern for each farmer below (picture)

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Illustration 1.4: 25 cards developed for the Q-sorting study with Delmarva poultry farmers.

Chi square testing of Q-sorting with poultry producers: Table 13 below summarizes two-tailed chi square testing and Egon-Pearson adjusted chi share testing at 95 percent and 90 percent confidence levels. For this data set, recall that the two categorical variables explored are:

- card types (25), each depicting values/benefits inherent in farmer choice; and
- seven ordinal sort positions from LEAST IMPORTANT-> MOST IMPORTANT, signified by seven preference columns (C1-C7), where C1=LEAST IMPORTANT and C7=MOST IMPORTANT.

Card letter, number	Card phrase	Chi2-test				Adjusted Chi2-test*			
		95%		90%		95%		90%	
		Decision		Decision		Decision		Decision	
A, 1	Emissions ¶=Sust.->CB-friendly 	0	Random	0	Random	0	Random	0	Random
B, 2	PLT=Reduced Eye Irritation	1	Not random	1	Not random	1	Not random	1	Not random
C, 3	PLT=Bird Health	1	Not random	1	Not random	1	Not random	1	Not random
D, 4	PLT=Emissions ¶	1	Not random	1	Not random	1	Not random	1	Not random
E,5	PLT/Paw Health=Profit	0	Random	1	Not random	0	Random	0	Random
F, 6	VEBs=Beautification	0	Random	0	Random	0	Random	0	Random
G, 7	VEBs=Hedgerow/Heritage Farming	0	Random	0	Random	0	Random	0	Random
H, 8	VEBs Show Env. Best Practice	0	Random	0	Random	0	Random	0	Random
I, 9	VEB Distance is Flexible	0	Random	0	Random	0	Random	0	Random
J, 10	VEBs=Energy efficiency	0	Random	1	Not random	0	Random	1	Not random

K, 11	VEBs=Improves Farmer Life Quality	0	Random	1	Not random	0	Random	0	Random
L, 12	VEBs=Neighborhood Screen	0	Random	1	Not random	0	Random	0	Random
M, 13	VEBs=(night eff.)-->¶Res. Odor	0	Random	0	Random	0	Random	0	Random
N, 14	VEBs=Reduces Human Health Risks	1	Not random	1	Not random	0	Random	1	Not random
O, 15	VEBs=Wildlife Habitat	0	Random	0	Random	0	Random	0	Random
P, 16	VEBs (4/12-10/12) Part of NMP	1	Not random	1	Not random	0	Random	1	Not random
Q, 17	VEBs+PLT=CB Stewardship	0	Random	0	Random	0	Random	0	Random
R, 18	VEBs+PLT=Farmer-Stewards	0	Random	0	Random	0	Random	0	Random
S, 19	VEBs UP Management/Livability	0	Random	0	Random	0	Random	0	Random
T, 20	VEBs+PLT= Sus Ag to Next Gen	0	Random	0	Random	0	Random	0	Random
U, 21	PLT=Humane Treatment	0	Random	0	Random	0	Random	0	Random
V, 22	VEBs+PLT= Spiritual Vision/Stewardship	1	Not random	1	Not random	1	Not random	1	Not random
W, 23	VEBs+PLT->Fisheries	0	Random	1	Not random	0	Random	0	Random
X, 24	VEBs+PLT Anticipate Regs	0	Random	1	Not random	0	Random	0	Random
Y, 25	VEBs->NRCS Rewrite	0	Random	0	Random	0	Random	0	Random

Table 13: Summary of two-tail chi square testing; a seven-column sort pattern C1, C2, C3, C4, C6, and C7). Key: Green shading shows where null hypothesis can be rejected.

Hypothesis framing for Table 13: (H0), the original research assumption is *that no relationship exists between the column positions of the value statements*. In other words, the cards are sorted randomly and not based on farmer preferences. Reminder on study design: This assumption is essential to chi square testing; however, in a Q-study, this is not a pre-analytical assumption. What is assumed in designing a set of statements is that all the preferences are important in some ways, especially in a ranked sort of cards for each respondent

Data transformation: To eliminate cells with the value of zero, **transformation** is required to perform chi square: each entry in the cells was "treated" with *plus 1* to remove zero values. Since 1 is added to each entry in all cells, no bias is introduced to the data in terms of "importance." See Appendix B for data tables used in generating this exhibit table.

(**IMPORTANT adjustment**. Generally, a chi square test requires a minimum sample size of $N \geq 40$. In this study, the sample size is 13 (13 sorts by 13 farmers in two events); therefore, this chi square testable also includes the Egon-Pearson correction suggested to adjust for small sizes. This Egon-Pearson technique is more suited for small sample sizes, namely, lower than 40. The sample number in the study underway analysis here is 13 farmers who sorted cards that fit analysis criteria. The Egon Pearson difference is that the chi square value is adjusted by the formula of (N-1)/N.
Acknowledgement: C. Hapeman, USA, and R. Yang, UMCP and USDA, assisted me with this work.

From Table 13 above we see that several cards appear to be sorted by not random chance (depicted in green), meaning the null hypotheses can be rejected. However, two additional decision criteria are included in this table:

1. confidence levels (90 and 95 percent) and
2. both non adjusted and Egon-Pearson adjusted for small sample sizes.

At the 95 percent confidence level (stricter) and Egon-Pearson adjusted (also stricter) four cards are of interest: Cards **B, C, D,** and **V**. We will focus on cards meeting these stricter conditions; however, other cards identified in Table 13 could be looked at also, for fulsome understanding of meaning making from the chi square technique.

We should note that Table 13 above represents chi square testing on 25 card types with *all seven of the preference categories* (C1-C7). Recall that these are the categories that poultry farmers sorted into in the 2019 event. One way to think of this data set attribute is that we have seven pieces of information (think sorting bins) in this data set. Yet, we also have the small sample condition of 13 farmer-participants doing the sorting, hence the value of the Egon-Pearson correction.

What about looking at all these data points, re-organized from seven sorting bins of information into three bins of sorting[207]? This data transformation by *re-binning* is helpful when dealing with small sample sizes, which we are: P-set = 13 and the Q-set = 25.

We can re-bin the C1-C7 sort columns, *collapsing* the *seven preference categories* into *a set of three categories*; See Tables 14a and 14b below, which visualize this.

Seven preference columns from sorting template

1	2	3	4	5	6	7
Least Important C1	Less important C2	- Middling Important C3	Middling Important C4	+ Middling Important C5	More Important C6	Most Important C7

Table 14a: Seven ordinal ranks of the Q-sorting template, C1-C7; Seven sorting categories in Q-event.

"New": three columns of data set transformations from Table 14a

1	2	3
Less Important* nC1 = C1+C2	Middling Important nC2 = C3+C4+C5	More important* nC3= C6+C7

Table 14b: Three "collapsed" or re-binned new ordinal ranks: nC1 nC2 and nC3, where "n" stands for new.

[207] More pieces of information will be in each bin, hence making for a larger "sample" in each bin.

Information from the Q-event is retained but the categories are larger. Same pieces of information but sorted into larger bins (three bins rather than the seven bins of the original event). Table14b also assigns revised names for these new collapsed categories: LESS IMPORTANT. MIDDLING IMPORTANT, and MORE IMPORTANT. The careful reader may recall that in directions to participants, these pre-sorting categories are part of the sorting activity. *These categories include the extremes, named, least important (C1) and most important (C7)

Why this data transformation? All numbers in this categorical data set are small: 13 poultry farmers, sorting 25 cards, within seven preferences. Consider these new collapsed categories (re-binned) as helping assess a forest-view, rather than a tree-view; in other words, these new three categories are less granular than the seven-preference sorting categories. Combining these categories into three (LESS IMPORTANT, MIDDLING IMPORTANT, MORE IMPORTANT) from seven, means that number of cards appearing in each of the three collapsed categories (think sorting bins) is larger (a bigger sample, in effect), instead of a smaller number of cards in seven categories (more sorting bins but fewer cards to possibly be sorted in each category, in effect).

Table 15 below shows two-tailed chi square testing of the collapsed data set (at the 95 percent confidence level) but with those *seven sort positions collapsed or re-binned into three categories (nC1, nC2, nC3, where n = new transformed categories).* Because of the fewer number of categories (trading off granularity for larger numbers in a set of three rather than seven groups), only the stricter (95%) confidence level is shown here.

					α = 0.05		
(X'-E')^2/E'	**VOTES**	**VOTES**	**VOTES**		**df = 3-1 = 2**		**COMMENT**
Card letter, number, phrase	**nC1**	**nC2**	**nC3**	**Sum**	adjust χ2	**Decision**	
A, 1 Emissions 👇=Sust.->CB-friendly 🐔	1.11	0.31	2.93	4.35	6.49	**0**	Random
B, 2 PLT=Reduced Eye Irritation	2.93	0.38	5.93	9.23	6.49	**1**	Not random
C, 3 PLT=Bird Health	2.93	1.94	11.26	16.13	6.49	**1**	Not random
D, 4 PLT=Emissions 👇	2.93	1.01	8.38	12.31	6.49	**1**	Not random
E, 5 PLT/Paw Health=Profit	2.93	0.38	5.93	9.23	6.49	**1**	Not random
F, 6 VEBs=Beautification	0.35	0.90	2.93	4.17	6.49	**0**	Random
G, 7 VEBs=Hedgerow/Heritage Farming	0.11	1.79	1.56	3.46	6.49	**0**	Random
H, 8 VEBs Show Env. Best Practice	0.11	0.90	0.62	1.63	6.49	**0**	Random
I, 9 VEB Distance is Flexible	2.93	0.03	2.29	5.24	6.49	**0**	Random
J, 10 VEBs=Energy efficiency	2.93	1.01	8.38	12.31	6.49	**1**	Not random
K, 11	2.93	2.98	0.11	6.02	6.49	**0**	Random

VEBs=Improves Farmer Life Quality							
L, 12 VEBs=Neighborhood Screen	2.93	0.31	1.11	4.35	6.49	**0**	Random
M, 13 VEBs=(night eff.)-->¶Res. Odor	2.93	0.05	3.90	6.87	6.49	**1**	Not random
N, 14 VEBs=Reduce Human Health Risks	2.93	1.01	8.38	12.31	6.49	**1**	Not random
O, 15 VEBs=Wildlife Habitat	2.93	0.90	0.35	4.17	6.49	**0**	Random
P, 16 VEBs (4/12-10/12) Part of NMP	1.56	1.94	8.38	11.88	6.49	**1**	Not random
Q, 17 VEBs+PLT=CB Stewardship	0.62	1.79	0.62	3.04	6.49	**0**	Random
R, 18 VEBs+PLT=Farmer-Stewards	0.35	0.03	0.62	1.00	6.49	**0**	Random
S, 19 VEBs UP Management/Livability	2.93	2.98	0.11	6.02	6.49	**0**	Random
T, 20 VEBs+PLT= Sus Ag to Next Gen	0.02	0.03	0.11	0.15	6.49	**0**	Random
U, 21 PLT=Humane Treatment	0.62	0.03	0.35	1.00	6.49	**0**	Random
V, 22 VEBs+PLT=Spiritual Vision/Stewardship	0.02	1.79	2.93	4.73	6.49	**0**	Random
W, 23 VEBs+PLT->Fisheries	2.93	2.98	0.11	6.02	6.49	**0**	Random
X, 24 VEBs+PLT Anticipate Regs	2.93	0.90	0.35	4.17	6.49	**0**	Random
Y, 25 VEBs->NRCS Rewrite	0.02	1.01	1.11	2.13	6.49	**0**	Random

Table 15: Chi square testing (two-tailed) detail when seven "vote" categories are collapsed to three (see 14a and 14 b for method) at a confidence interval of 95%, adjusted for small sample size with Egon-Pearson technique. Entries in green show where null hypothesis can be rejected.

Note on data transformation within tables: The **expected values** in each of the three VOTE categories (C1-C7 recast into three categories) were assigned as 13/3 = 4.78

Note for three sort categories in columns 2, 3, 4, all labeled as "Votes": **nC1 = LESS IMPORTANT, nC2 = MIDDLING IMPORTANT, nC3 = MORE IMPORTANT.** Here, **nC1 = C1+C2** from Table 13; **nC2 = C3+ C4+C5** from Table 13; and **nC3 = C6 + C7** from Table 13.

Nomenclature: Let **n** signify new. Placed in front of each C variable. Because n is placed in front of the variable, no confusion about a summation activity occurs, namely, how readers might interpret **C as part of C1-C7.**

These collapsed categories relate to the study design and implementation: are the three categories that poultry producers were asked to pre-sort their cards into.

Table 16 below shows essential information extracted from Table 15 above, about which of the 25 cards showing as not random sorts *may* represent importance in the aggregate sort. For these eight cards (**B**, **C**, **D**, **E**, **J**, **M**, **N**, and **P**), the null hypothesis may be rejected, based on two-tailed chi square testing. This means that these cards, highlighted in green, deserve attention as their appearance in the sorting array is likely not due to randomness.

Note: we do not know from this analysis about their *position* across columns 1-7. Recall that farmer participants ***sort into positions*** to show preferences. Chi square is silent on position. Research questions, study design, and working hypotheses can help with determining position. Yet, Q-method does not work this way[208], in the pre-

[208] Additional comments on what chi square does and does not say in Q-inquiry: Earlier in this chapter, exposition describes the pre-analytic assumptions that characterize Q-method and how Q-approach differs from other social science inquiry methods. One chief difference, important to recall, before chi square findings are shared, is that Q-method does not begin with a hypothesis testing frame; rather Q-method assumes that subjectivity can be

1. described (the concourse or universe of statements) and
2. studied (using a reduced set of statements form the concourse) by asking a group of people (the participants) who hold views about the concern topic by ranking them into a sort pattern.

Q-researchers do not make hypotheses about which statements will be most important though they likely have hunches. Rather, Q-researchers expect to see individual sorts, as well as an aggregate these sorts to reveal information about viewpoints and how they are held by theses participants. Q-method assumes that the subjective views in the Q-set, which appear on cards to be sorted by respondents (the P-set) are important and will be ranked by respondents.

analytical stance. Q-researchers often have hunches or expectations[209] but no formal hypotheses about individual or aggregate sorts

Factor analysis can help with that pattern analysis. However, this 2019 study did not meet minimum numbers for factor analysis. Exploratory data analysis from earlier can help with making inferences from the chi square testing about the position of non-random data points on the seven-step preference scale (C1-C7).

Table 16 below identifies Cards **B, C, D, E, J, M, N**, and **P** (eight) where we can reject the null hypothesis. Three conditions apply in this analysis, the:

- stricter condition of 95 percent confidence level,
- small sample y Egon-Pearson adjustment, as well as
- three-bin data transformation (see Tables 14a and 14b above).

We are setting the strictest of analytical conditions to make inferences.

CARD Letter, number	CARD PHRASE BENEFIT/VALUE	DECISION	MEANING	COMMENT

[209] . Q-stances include:

- each participant sort represents that participants' trade-offs in ranking all the cards,
- aggregate sorts can reveal patterns about the group of participants, and
- these patterns might suggest that different subgroups within a participant group based on shared sorting patterns.

A, 1	Emissions 👇=Sust.->CB-friendly 🐔	**0**	Random	H0 assumed TRUE
B, 2	PLT=Reduced Eye Irritation	**1**	Not random	Could be true
C, 3	PLT=Bird Health	**1**	Not random	Could be true
D, 4	PLT=Emissions 👇	**1**	Not random	Could be true
E, 5	PLT/Paw Health=Profit	**1**	Not random	Could be true
F, 6	VEBs=Beautification	**0**	Random	H0 assumed TRUE
G, 7	VEBs=Hedgerow/Heritage Farming	**0**	Random	H0 assumed TRUE
H, 8	VEBs Show Env. Best Practice	**0**	Random	H0 assumed TRUE
I, 9	VEB Distance is Flexible	**0**	Random	H0 assumed TRUE
J, 10	VEBs=Energy efficiency	**1**	Not random	Could be true
K, 11	VEBs=Improves Farmer Life Quality	**0**	Random	H0 assumed TRUE
L, 12	VEBs=Neighborhood Screen	**0**	Random	H0 assumed TRUE
M, 13	VEBs=(night eff.)-->👇Res. Odor	**1**	Not random	Could be true
N, 14	VEBs=Reduce Human Health Risks	**1**	Not random	Could be true
O, 15	VEBs=Wildlife Habitat	**0**	Random	H0 assumed TRUE
P, 16	VEBs (4/12-10/12) Part of NMP	**1**	Not random	Could be true
Q, 17	VEBs+PLT=CB Stewardship	**0**	Random	H0 assumed TRUE
R, 18	VEBs+PLT=Farmer-Stewards	**0**	Random	H0 assumed TRUE
S, 19	VEBs UP Management/Livability	**0**	Random	H0 assumed TRUE
T, 20	VEBs+PLT= Sus Ag to Next Gen	**0**	Random	H0 assumed TRUE
U, 21	PLT=Humane Treatment	**0**	Random	H0 assumed TRUE
V, 22	VEBs+PLT= Spiritual Vision/Stewardship	**0**	Random	H0 assumed TRUE
W, 23	VEBs+PLT->Fisheries	**0**	Random	H0 assumed TRUE
X, 24	VEBs+PLT Anticipate Regs	**0**	Random	H0 assumed TRUE
Y, 25	VEBs->NRCS Rewrite	**0**	Random	H0 assumed TRUE

TABLE 16: Chi square text summary from method shown in Tables 14a and b (collapsed sorting categories from seven to three) and Table 15 chi square where $\alpha = 0.05$; Egon-Pearson adjusted) for 25 cards depicting values/benefits (cards A-Y), in three collapsed and ranked positions:

LESS IMPORTANT= (nC1 = C1 + C2),
MIDDLING IMPORTANT = (nC2 = C3 + C4 + C5), and
MORE IMPORTANT = (nC3 = C6, C7),

where C=column across a total of seven preference (from Table 10a,b) and nC = collapsed columns into three preferences.

Table 17 below presents these eight cards (**B**, **C, D**, **E, J**, **M**, **N**, and **P)** indicated by green highlight in Table 16 (above), where the null hypothesis cannot be rejected, meaning that the sorting is not random. Therefore, we can begin to infer some meaning. We do this with some guidance about the direction of the meaning from both frequency counts (Figure 17 above) and violin plots (Figure 21) earlier. Exploratory data analysis, particularly violin plots, help us think about the direction – or preference position -- of farmer-participant sorting.

In other words, chi square tells us that the positions of these cards in aggregated are not likely due to chance. Therefore, we assume that some background factor[210] with the preferences of these farmers contributes to their being important for us to learn more about. Chi square does not tell us, though, about the position on the preference axis that these cards fall. Frequency check and violin plot visualization (discussed earlier) helps us see that these cards are, likely, important.

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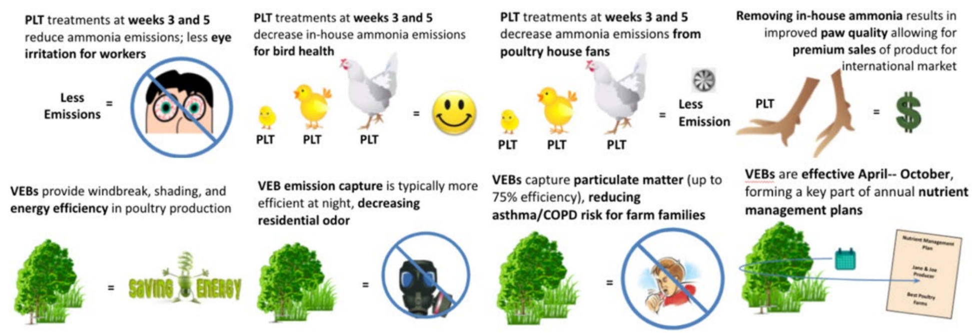
[210] Here, factor is used in a general sense. In formal Q-method analysis – when Q-set and P-set numbers are sufficient – factor analysis is the chief and primary analysis technique. Looking at clusters of cards that appear in a factor analysis help researchers think about what those common qualities might be.

Cards likely not random in the aggregate sort



Card letter, number	Text description
B, 2	PLT=Reduced Eye Irritation
C, 3	PLT=Bird Health
D,4	PLT=Emissions ☟
E, 5	PLT/Paw Health=Profit
J, 10	VEBs=Energy efficiency
M, 14	VEBs= (night eff.)-->☟Res. Odor
N, 15	VEBs=Reduces Human Health Risks
P, 16	VEBs (4/12-10/12) Part of NMP

Table 17: Here, H0 (the null hypothesis) can be rejected for these eight cards from Column 2 of Table 16; the sorting positions for these cards are not random by chi square testing.

Table 17 above identifies cards that most conventionally-inclined researchers would spend time considering, based largely on being able to reject the null hypothesis. However, Q-researchers tend to look at all cards in a Q-set. As described earlier, A Q-researcher might focus on any card, wondering that how that card fared? Also, all cards – appearing in any aggregate position on the sorting axis – can appear in clusters that would be revealed in a standard Q-method factor analysis. It is in this spirit – that all cards matter in Q-method approaches – that the next table showing cards where null hypothesis cannot be rejected.

Table 18 below sets out the 17 cards for which the null hypotheses cannot be rejected, meaning the inference-making process must regard that these positions are highly likely due to randomness. Yet, a Q-researchers might look at these cards for several reasons, particularly in the design of another test about poultry farmer preferences. In other words, this information may still matter even if chi square analysis does not show that null hypothesis cannot be rejected. Information can be meaningful in a research context even if statistical analysis does not find evidence of correlation, causation, relatedness, or significance.

Cards **letter, number, phrase** **<u>SORTING IS LIKELY RANDOM</u>**
A, 1: Emissions 👇=Sust.->CB-friendly 🐔
F, 6: VEBs=Beautification
G, 7: VEBs=Hedgerow/Heritage Farming

H, 8: VEBs Show Env. Best Practice
I, 9: VEB Distance is Flexible
K, 11: VEBs=Improves Farmer Life Quality
L, 12: VEBs=Neighborhood Screen
O, 15: VEBs=Wildlife Habitat
Q, 17: VEBs+PLT=CB Stewardship
R, 18: VEBs+PLT=Farmer-Stewards
S, 19: VEBs UP Management/Livability
T, 20: VEBs+PLT= Sus Ag to Next Gen
U, 21: PLT=Humane Treatment
V, 22: VEBs+PLT= Spiritual Vision/Stewardship
W, 23: VEBs+PLT->Fisheries
X, 24: VEBs+PLT Anticipate Regs
Y, 25: VEBs->NRCS Rewrite

Table 18: From chi square testing in Table 16, H0 (the null hypothesis) cannot be rejected for these 17 cards of 25 total.

Further, these cards in Table 18 can be looked at in other ways by researchers if the card value or benefit is important to the researcher[211] or science communication expert (Cooperative Extension agents, science communicators, for example). For

[211] Recall the earlier discussion about scientists who were very interested in how Cards **I:** VEB Distance is Flexible and **Y**: VEBs->NRCS Rewrite fared.

example, at less strict inference-making conditions, many of these cards cannot be rejected under null hypotheses conditions.

Returning to the exploratory analysis section and looking at the violin plot (Figure 21) can be helpful to shape thinking for further inquiry. For example, Card **V** (PLT= Spiritual Vision/Stewardship), is one card that appears as to be sorted likely as random (see Table 18, just above) by chi-square testing. However, the violin plot and frequency distribution would show the researcher that this card sorts toward the LEAST IMPORTANT direction (C1, C2). Without considering ethnographic notes[212] or broader discussion about human preferences, one might assume that spiritual values, including stewardship, are not important to poultry farmers as they select ammonia management strategies.

Further reflection might suggest that people do not always talk about their deepest core values in public settings. Sorting to the LEAST IMPORTANT side of the board raises many possibilities, including that people do not know what to make of a card's

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[212] Ethnographic aspects of Q-sorting events are important in such studies.

content. Equally likely is that toward the end of the sort, participants struggle in placing cards toward the LEAST IMPORTANT This case reminds of why researchers tend to focus primarily on what is sorted toward the MOST preferred send of a preference scale.

Understanding more about these cards can help in planning science communication or designing a follow-up study. For example, these card types-- with some additional cards perhaps to build a new card set of 25 or more cards -- might show new patterns of importance by poultry farmers. Chi square testing of a new, revised Q-sorting study can show the role of randomness, helpful in interpreting if the card positions (violin plots help reveal this) might "matter" even as the null hypothesis about their position can be rejected.[213]

[213] I note now that in consultation with several Q-researchers some asked – genuinely – why I would use chi square or other "regular and customary" statistics tests on this work at all. In some ways, this chapter hopes to answer this question, with my response: we can and should interrogate data in several ways. I think that the use of violin plots to "see" the different underlying distribution of cards as they are sorted is the best exemplar of my answer here.

Summative comments on chi square analysis

Table 19 below, is a summative chi square results comparison table based on earlier Tables 13 (yellow marked) and 15 (blue marked). Table 19 includes detail in these areas:

1. Two-tail chi square testing at both confidence intervals (90 percent and 95 percent);
2. Egon-Pearson adjusted two-tail chi square testing (on testing sets described in item 1) for small sample size; and
3. Showing both the seven-column preference sort (yellow) and the three-column collapsed column sort (blue).

	from Table 13				*from* Table 15
Card **Number, letter, phrase**	**Chi2-test** **7 groups (C1-C7)**		**Adjusted Chi2-test*** **7 groups (C1-C7)**		**Adjusted Chi2-test*** **3 groups (nC1-nC3)**
	95%	**90%**	**95%**	**90%**	**95%**

	Decision		Decision		Decision		Decision		Decision	
1, **A**: Emissions ☟=Sust.->CB-friendly	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
2, **B**: PLT=Reduced Eye Irritation	**1**	**Not random**	**1**	**Not random**	**1**	**Not random**	**1**	**Not random**	**1**	**Not random**
3, **C**: PLT=Bird Health	**1**	**Not random**	**1**	**Not random**	**1**	**Not random**	**1**	**Not random**	**1**	**Not random**
4, **D**: PLT=Emissions ☟	**1**	**Not random**	**1**	**Not random**	**1**	**Not random**	**1**	**Not random**	**1**	**Not random**
5, **E**: PLT/Paw Health=Profit	**0**	**Random**	**1**	**Not random**	**0**	**Random**	**0**	**Random**	**1**	**Not random**
6, **F**: VEBs=Beautification	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
7, **G**: VEBs=Hedgerow/Heritage Farming	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
8, **H**: VEBs Show Env. Best Practice	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
9, **I**: VEB Distance is Flexible	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
10, **J**: VEBs=Energy efficiency	**0**	**Random**	**1**	**Not random**	**0**	**Random**	**1**	**Not random**	**1**	**Not random**

11, K VEBs=Improves Farmer Life Quality	**0**	**Random**	**1**	**Not random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
12, L: VEBs=Neighborhood Screen	**0**	**Random**	**1**	**Not random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
13, M: VEBs=(night eff.)-->☟Res. Odor	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**1**	**Not random**
14, N VEBs=Reduces Human Health Risks	**1**	**Not random**	**1**	**Not random**	**0**	**Random**	**1**	**Not random**	**1**	**Not random**
15, O: VEBs=Wildlife Habitat	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
16, P: VEBs (4/12-10/12) Part of NMP	**1**	**Not random**	**1**	**Not random**	**0**	**Random**	**1**	**Not random**	**1**	**Not random**
17, Q: VEBs+PLT=CB Stewardship	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
18, R: VEBs+PLT=Farmer-Stewards	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
19, S: VEBs UP Management/Livability	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
20, T: VEBs+PLT= Sus Ag to Next Gen	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**
21, U: PLT=Humane Treatment	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**	**0**	**Random**

22, V: VEBs+PLT=Spiritual Vision/Stewardship	1	Not random	1	Not random	1	Not random	1	Not random	0	Random
23, W: VEBs+PLT->Fisheries	0	Random	1	Not random	0	Random	0	Random	0	Random
24, X: YVEBs+PLT Anticipate Regs	0	Random	1	Not random	0	Random	0	Random	0	Random
25, Y: VEBs->NRCS Rewrite	0	Random	0	Random	0	Random	0	Random	0	Random

Table 19: Comparison of Tables 13 and 15 summarizing chi square test, adjusted chi square test, at 95% and 90% confidence levels; Table 13 (yellow) uses all seven columns of preferences from LEAST to MOST IMPORTANCE (C1-C7). Table 15 (blue) uses three columns of preferences, collapsed from C1-C7 into LESS IMPORTANT, MIDDLING IMPORTANT, MORE IMPORTANT (nC1, nC2, nC3). In Table 15, the chi square test is adjusted by the Egon-Pearson correction.

Notes: card designations by letter and number not included here for portrait space considerations of this table.

For Table 9 earlier, the seven-group method (C1-C7) uses **seven "pieces" of grouped information**, namely, all seven categories of ranked preferences in the Q-sort, while in Table 11 earlier, the three-group method collapses the information from the seven-group approach into **three "pieces" of grouped information,** nC1, nC2, nC3. See notes in these tables places earlier for additional detail and background information.

*Egon-Pearson correction.

In general, each method depicted in the summary Table 19 just above -- of Table 13 with seven categories (yellow marked) and Table 15 with three categories (blue marked)-- has its pros and cons for fulsome analysis. These tradeoffs were noted earlier with this accompanying metaphor or forest views v. tree views. For example, regarding sample size, the seven-group method in Table 13 has more pieces of information (which is *good*) but each piece has a small sample size (which is generally known to be a limitation, i.e., *bad*).

Turning to Table 15 information (blue-marked) , the three-group collapsed method (nC1, nC2, nC3) has fewer pieces of information (*bad*), but each piece has a larger sample size (*good*). For sample size more generally, where we recall another determinant of this data set: we have 13 sorting arrays (poultry farmers), this study is marked by a relatively small sample size in total. Small sample-size work, generally, results in different results with many statistical tests.

In many ways, however, the results in this study from both data binning strategies (from seven to three) are not too dissimilar. Selecting to focus on information from Table 15 details (blue section) included in the summary Table 19 is just one reasonable way to think about chi square testing shows. That Table 19 shows all the way that chi square conventions were applied permits other readers to look at the trade-offs about binning as well as about correcting for small sample sizes with the

Egon-Pearson adjustment. What is being chosen in this discussion, are the strictest test conditions, which is a way to ensure that researcher bias is minimized.

Having said this, the discussion now will focus on the eight cards identified with a three-column sort, at the 95% confidence level. See the blue marked Table 19 (above). These cards appear below in Table 20.

Recall, that the overall aim of this analysis is not to predict the direction (locations on the preference axis) in a sorting pattern of specific cards. Chi square does not comment on position, here, as applied to a Q-method study. Chi square lets us know which cards are sorted such that the null hypothesis can be rejected. We can use information from chi square with frequency information earlier to address an analytical goal from card sorting: *The goal is better understanding of the relative perceived benefits/values to the cards that reflect inherent reasons underlying farmer choices in managing ammonia.*

from Table 15
Adjusted Chi2-test* 3 groups (nC1 through nC3)
95%
Decision

These three criteria above represent the chosen frame of strictness.

Card Letter, number	Sorting is NOT RANDOM	Mean from violin plot
B, 2	PLT=Reduced Eye Irritation	Mean = 7
C, 3	PLT=Bird Health	Mean = 6
D, 4	PLT=Emissions 👇	Mean = 6
E, 5	PLT/Paw Health=Profit	Mean = 6
J, 10	VEBs=Energy efficiency	Mean = 6
M, 14	VEBs=(night eff.)-->👇Res. Odor	Mean = 6
N, 15	VEBs=Reduces Human Health Risks	Mean = 7
P, 16	VEBs (4/12-10/12) Part of NMP	Mean = 7

Table 20: Eight cards from Table 15 (excerpted from far-right column 2 of Table 19) determined as not random by chi-square testing, along with violin plot mean (from Figure 21 above), to help identify likely card positions in the sort.

Violin plots (Figure 21) discussed earlier (in exploratory data analysis) helps identify where these cards likely appear as a function of frequency. All eight of these cards can be discussed as likely as important (the means of each card's underlying distribution are either 6 or 7). We consider the context to describe why these cards are likely to be important in the aggregate for Delmarva poultry farmers at the time of the sorting (November 2019).

Discussion of 2019 Q-sorting findings from exploratory and confirmatory analyses

This outline below describes some of the functional context (discussed in Chapter One) about voluntary ammonia management that yielded content for designing these 25 cards (Chapter Three discussions design choices in creating visual+text communication):

- **Technology-**based, economically standard card attributes of
  - **VEB**-based benefits/values that focus primarily on the use of vegetated emissions buffers,
  - **PLT-**based benefits/values that focus primarily on using poultry litter treatments, and
  - **VEB and PLT** practices combined as related benefits/values on managing ammonia.
- **Regulatory**-focused card attributes of
  - NMP benefits/values that acknowledge the importance of poultry producers using nutrient management plans on site,
  - Anticipating future local, state, regional, or national regulatory frameworks, and
  - Anticipating a new Natural Resources Conservation Service (NRCS) practice standard[214] on VEB technical details that can be part of farm

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[214] NRCS practice standards concerning VEBs are considered under the promulgation guidance for Hedgerow Plantings, Code 422. National standards through the USDA (the federal entity that overseas NRCS) tend to be written to specific conditions at the state and sometimes county level. For example, the 2015 NRCS Hedgerow planting guidance 422 for Delaware is subtitled "Trees and Shrubs for Poultry Houses." Note: the 2015 revision of this Delaware NRCS practice standard guidance document is based in part on the USDA CIG project that this dissertation grows out of and where the author served as an investigator. A second guidance document, also based on finding in this research project

incentive programs, including within several USDA credit, cost-sharing, or other technical assistance programs.

- Personal and/or public **health**-focused benefits/values
- Aesthetic, life quality, and/or nuisance benefits/values
- **Community** benefits/values of land and water quality
- **Personal code** benefits/values

A reasonable observer will note that many of these context attributes[215], in practicality, overlap. However, these attributes are helpful in seeing the range and type of reasons that guide ammonia practices in poultry production. Another attribute is time, especially a current regulatory requirement, compared to a future requirement. Finally, an attribute can be spatial: how large a farm lot is, how close to suburban development, etc.

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concerns warm season grasses in a VEB as an additional way for poultry farmers to use hedgerow ideas to reduce ammonia air pollution. See:

https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/mdpmcbr13164.pdf

https://agriculture.delaware.gov/wp-content/uploads/sites/108/2017/12/Warm-Season-Grasses-Fact-Sheet-422.pdf

[215] A Q-sort factor analysis would be useful here, to consider if clusters of cards suggest similar relationships that reflect some of the attributes noted here.

The next section considers the cards appearing in Table 20, with discussion about what may explain, in part, why they are sorted as important, in the aggregate, in the 2019 event.

Poultry farmers balance economics, health, time

Farmers act to keep their farms a going concern in the complex, highly competitive sector of Delmarva poultry production. To be specific, birds need to be grown out to health standards and target weights to command a good price. Bird health (weight, skin, and paws) within the poultry house can be compromised by high ammonia levels.

These economic concerns about **bird health and poultry house conditions** are clear in these three cards:

Card **C** PLT=Bird Health
Card **D** PLT=Emissions
Card **E** PLT/Paw Health=Profit.

These three cards rely on PLT strategies to make money. PLT strategies can be increased, say, from two treatments in a set period of six to ten weeks) to three treatments. More PLT applications in a grow-out season safeguard bird health as well as protect tissues -- skin, flesh, and feet. Healthy unblemished birds earn more money at conclusion of the contract.

Human health risk *inside* poultry house: PLT strategies inside the house reduce ammonia, making for better working conditions. Also, Card **B (**PLT=Reduced Eye Irritation) describes this benefit. Poultry care can be very labor intensive, requiring respiration and protective gear to reduce ammonia exposure. Eye irritation is one of the most often-cited complaints of in-house poultry work. Over time, exposure inside poultry houses can cause or exacerbate lung disease.

Lowing energy costs *outside* the poultry house: VEBs offer a return on investment when located to reduce energy costs. Again, Card **J** (VEBs=Energy efficiency) represents this benefit. VEBs reduce summer energy costs to power the large fans that reduce heat inside the poultry house. In effect, VEBs are a well-documented source of passive solar shading, which is like hedgerow or windbreak in heritage farming. In addition to cost savings, VEBS offer health and nuisance reduction benefits.

Reducing ammonia odor; ammonia capture for health and regulatory gains: VEBs offer additional benefits that farmers appear to recognize as valuable. Card **M** (VEBs=(night eff.)-->☟Res. Odor), from Table 20 described the demonstrated nighttime reduction of residential odor. Reducing odor is one “sign” of ammonia capture. Card **N** (VEBs=Reduce Human Health Risks), also from Table 20, is largely focused on the ability of VEBs to capture ammonia and particulate matter exiting poultry house exhaust fans. Ammonia, in addition to irritating eyes and skin, is also a lung irritant. PM is a known factor in two categories of commonly experienced lung dysfunction: asthma and Chronic Obstructive Pulmonary Disorders COPD).

Finally, Card **P** from Table 20 is worth some note. This card shows two ammonia management strategies and addressed the regulatory conditions that most poultry farmers act under (reporting of nutrient management strategies). Under voluntary BMPs knowledge of some 20 years, farmers know that VEBs are part of an acceptable strategy to reduce nutrient deposition to local air- and watersheds. Card **P** (VEBs (4/12-10/12) Part of NMP) on how VEB use on a farm lot can be part of a farmer’s required Nutrient Management Plan (NMP)

Special limitations on this analysis: Experts in designing and using Q-method will caution readers about interpreting a Q-data set with the tools of exploratory data analysis and chi square. Some of these cautions reflect the study design of a Q-sorting experience, the goal of Q-method as a qualitative inquiry tool (Stephenson, 1938), and the limits of Q-study on predicting more general aspects of a population (Brown, 1980; Brown, 1988).

Quality: Q-method is a qualitative inquiry. This means that questions of research validity -- randomness, for example -- are assessed differently than in quantitative research methods. In this dissertation case study, Q-study factor analysis techniques are not used. This data exploration, including chi square, is a useful way to derive some meaning from the study, especially to consider follow up Q-sort event that would meet threshold numbers for Q-analysis.

A Q-study recognizes from design that the information this type of qualitative-quantitative documents *is wholly subjective* (Dennis, 1993; 1992). Each farmer sorts a set of cards in a pattern that represents *their point of view* at that time about the values/benefits underlying voluntary management of ammonia. In other words, each card sort (like a particular hand or play of cards) is that individual's ranked perspective. Study designers consider that each farmer's rank-ordered set of statements is a valid expression of the respondent’s opinion. In this way, Q-method researchers hold a stance of respect[216] for participants to know themselves and report their viewpoints. Indeed, looking at an individual Q-sort “hand” combined with follow-up questions is an ideal way to understand what that poultry farmer is saying – or willing to tell -- about these trade-offs.

Follow-up questions require time. Many poultry farmers left these evening sessions soon after sorting. Additional support for validity of a Q-study is addressed before-hand, during development of the concourse of statements. Guiding this activity are conducting literature reviews about the ammonia problem, eliciting expert advice with “field” workers like Cooperative Extensive agents and poultry scientists.

Study validity, as tested in typically designed studies of survey research, does not really apply fully to the study of subjectivity. This limit also means not seeing the Q-sorting event as having predictive ability about a population (Delmarva poultry

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[216] In this way, Q-method fits well with the goals of stakeholder engagement and acknowledgement of embodied expertise that poultry farmers hold as experts.

farmers) from 13 poultry farmers sorting in November 2014 (a sample). Recall that the orientation of a Q-sort is sometimes called sideways, to emphasize that the sample here is the Q-set of statements for sorting (25 in this study), meaning that the population would be the entire concourse of statements used to generate the Q-set. Even with a defense of the Q-perspective here, the violin plot data display and chi square testing are reasonable ways to infer meaning from this data set.

That this Q-study, even without using factor analysis, identified cards as sorting high on favorability that survive the commonsense test, may form an argument for others to think of using Q-method in their environmental deliberation projects. This commonsense test included cards reflecting the economic concerning of keeping a farm going, the air pollution risks to human health, and adherence to currently require regulatory reporting tasks.

Implications for Environmental Policy Deliberation

Communities of interdisciplinary scientists guiding environmental policy:

- Q-method offers ways for environmental scientists to engage meaningfully with stakeholder and non-technical audiences on policy making.
- Card sorting in Q-method can be a science communication tool, especially when complex science is portrayed in conceptual diagrams.

- Environmental valuation experts could use Q-method to explore non-economic valuing of decision making by stakeholders whose actions shape ecosystem health.
- For federal government scientists and experts, Q-method offers a powerful tool to learn more about stakeholder preferences, in addition to surveys, which are sometimes disallowed by the Paperwork Reduction Act.

Knowledge-generating and pedagogical communities, including teachers, professional development experts, policy experts, and community leaders

- Q-methods and card sorting offer additional inquiry tools to assess the human and social dimensions of environmental change.
- The subjective-inquiry focus of Q-method can improve community engagement about non-economic values often missed in environmental deliberation.
- Because development of a rich, varied and comprehensive concourse of statements requires consultation with communities, closer ties might be developed that sustain groups in dialogue about ongoing environmental challenges.
- Card-sorting activities could be adapted to settings where environmental policy deliberation is tense.
- Visual cards for sorting informally or within a Q-study can improve information in settings where members do not speak the same language. International policy deliberation communities would welcome more ways to engage.
- Because preference discussions raise values other than those seen as economic or strategic for business, Q-style card sorting activities could be used to explore and make clear environmental justice concerns of stakeholder communities.

Some specific operational limitations about Q-method in this case:

- First part of sorting activity is relatively easy; sorting most and least favorite options easier than middling category.
- People are often confused about the horizontal axis, i.e., all of these cards in a column are of the same importance. In practice, people see a higher column positions as more important.
- Sorting fatigue is a problem in large Q-sets.
- Tiredness in evening meetings can be a problem; meeting conditions like crowded tables or lack of air conditioning can be factors in sorting events.
- Possible need for privacy about sorting some values; some farmers might not want to sort some cards in presence of other farmers or with “eavesdropping” by researchers.
- Partner/espoused farmers often want to sort together; consider this option in future sorting events but make notes.
- Raises question of how applicable frequentist statistics are in Q-data sets. Q-method researchers might reject use of chi square analysis on data sets. Prediction is not a chief goal in Q-method.

Chapter Five: Imagining rightly-scaled poultry production for linked human and ecosystem flourishing

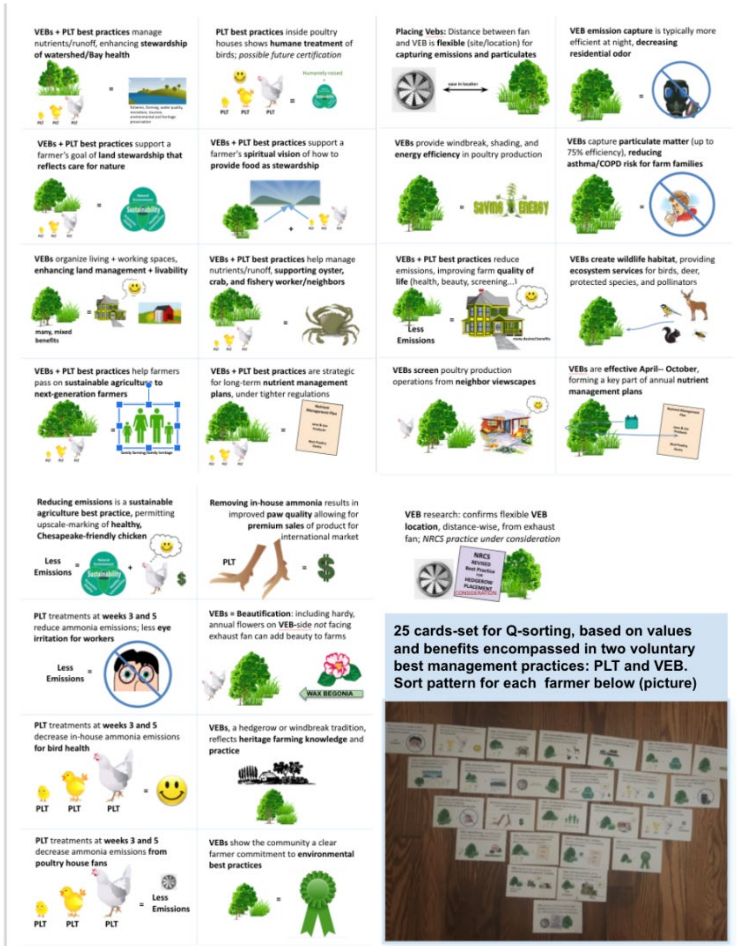

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Illustration 1.5: 25 cards developed for the Q-sorting study with Delmarva poultry farmers

Overview: How do we re-imagine Delmarva poultry? In a broad sense, this dissertation case study documents one way that a humanist with became central to environmental policy deliberation. This case can encourage others with special knowledge from the humanities and/or social sciences to enter these deliberations as equals who can help make clearer the human dimensions of environmental problems.

Read closely, this dissertation demonstrates three types of methods that environmental scientists engaged in research with policy deliberation goals may wish to know about. Chapter Two describes how stasis theory from classical and modern rhetoric can help arrange the complexity of multidisciplinary projects, propelling the overall progress toward a science-informed policy proposal. One central contribution of five-step stasis theory here is the exploration of human values by articulating a specific *stasis* (pause for inquiry). The value stasis, positioned after the necessary science is assembled yet before choosing policy options, calls for value assessment, other than economic. Here, public health concerns join with social, cultural, and spiritual values. Whose values matter here also made a collaborative space for poultry farmers to rank order the values that shape their ammonia management decisions. This stasis location to examine values prompted use of Q-method, a technique designed specifically to inquire about subjective values. Preparing for this part of the study required a necessary exploration of graphical design of environmental complexity.

Chapter Three focuses on an additional humanities method used in this case study: conceptual diagram visualization practices from ecology. This analysis helped to design visuals for cards to be used in Q-sorting. Many of the values/benefits concepts concerning ammonia management are complex, making conceptual diagrams an ideal genre for designing these visual Q-sort cards (See Illustration 1.5 above). Chapter Three also looks briefly at the materiality of cards and card systems, with their long history of organizing complexity. These excursions into visual rhetoric and card-organizing uses helped argue for the use of Q-sorting in this USDA CIG project.

The social science method in this project is Q-method, described in Chapter Four. Q-sorting of cards, a mixed method from social sciences, uses quantitative and qualitative elements to study human subjectivity. By sorting a set of Q-cards about values and benefits, poultry farmers ranked these values and benefits, demonstrating the range of viewpoints within that stakeholder community. A caveat here is that this Q-sorting card activity did not meet threshold numbers for a formal Q-method factor analysis; however, exploratory data analysis and chi-square testing provided information about Delmarva poultry farmers about how they approach voluntary management of ammonia. In the aggregate, these types of cards were ranked as very important in these poultry farmer decisions:

- keeping the farm afloat financially,
- meeting current regulatory requirements, and
- improving worker and family conditions concerning human health.

The card set designed for this USDA CIG project and dissertation study is multimodal, meaning that the cards use pictures paired with text to communicate values within the ammonia management context. Q-method generally uses text-only cards for sorting activities. Visual rhetorical practices from the humanities helped established the value of this science communication approach.

This final chapter speculates on imagined possible futures for Delmarva poultry farmers. The humanities are well poised for speculative possibilities. Selected scholars from the humanities and social sciences will be noted whose work might help with what can be next for poultry production in the Chesapeake Bay region.

Introduction:

This dissertation can be read in at least two ways: for specific findings about Delmarva poultry farmer viewpoints in 2019 on voluntary ammonia management and, more generally, as a case of transdisciplinary environmental policy deliberation where humanities and social science knowledge help organize a complex project of environmental science for policy deliberation.

Chapter Four shows several insights about how poultry farmers may view the many values and benefits of how they manage ammonia from their poultry houses. Specifically, analyzing the card-sorting data suggest that poultry farmers in these card-sorting events (November 2019) ranked these categories of values/benefits as important to their decisions:

- Support economic stability of the farm in two ways:
    - By producing healthy, plump birds commanding good per pound price from using poultry litter treatment (PTL) strategies inside the poultry house; and
    - By realizing energy savings from the shading/cooling effect of vegetated emissions buffers (VEBs), planted near poultry houses;
- Meet current regulatory reporting requirements of required nutrient management plans (NMPs), the primary way this nonpoint source pollution is regulated;
- Lower risks of human health problems associated with ammonia and particle pollution:
    - Lung problems like asthma and chronic obstructive pulmonary disease (COPD) for people and families living near poultry houses; and
    - Ammonia exposure, primarily, for farmers, family members, and employees working inside poultry houses.

Cards representing the above values were ranked as important by poultry farmers. That these values were ranked highly make sense since these values/benefits reflect powerful real pressures of economics, regulatory requirements, workplace conditions, and human health risks. However, what about what about the other cards and what they represent? A pre-analytical assumption of Q-method is that all viewpoints depicted in a card set matter. No card is so unimportant as to be excluded. Q-sorting is not directed at finding out, necessarily, the most important cards for the respondents, though knowing these "winners" is helpful. Rather, Q-sorting looks for patterns in individual sorts and an aggregated sort to better understand human subjectivity. In this way, Q-method does not work from a set of testable hypotheses to predict the ranked importance of cards.

Rather, Q-method can reveal information in both individual sorts and the aggregate sort (explored in Chapter Three). For the individual farmer, the sort shows how that participant ranked each value on a card with respect to other values depicted in the entire card set. Knowing that set of ranked choice helps in understanding individual farmer choices.

In the aggregate sort, researchers gain insight into how a group might view the relative importance of these cards, by looking at the combined sorts of all participants (13 farmers in this study). Recall that in Q, the study object is the set of subjective viewpoints and attributes of the farmers as a study population. A related pre-analytical assumption is that Q-method is not intended to make predictions about how future farmers may sort cards. Q-method allows careful analysis of the sorting by respondents of that day, in response to that Q-set of cards; however, the combinations of cards in both individual sort displays and in aggregate displays yield important information about how respondents rank their viewpoints with respect to the other viewpoints in the card set. Researchers, as well as Cooperative Extension agents and others, can learn more about the possible viewpoints of other poultry farmers from studying these results. In some essential way, what is also gained is the strong sense of the complexity of human values in making decisions, including ones that shape ecosystem health.

Two intellectual frames outside of natural science offer some additional insight into Q-method and the increased attention to values inquiry in community engagement: boundary object theory and citizen pollution sensing activities. Both boundary object theory and citizen pollution sensing activities arise from sociological inquiry. First, let's look at how Q-sorting cards work as boundary objects.

Q-sorting of cards bring scientists and poultry farmers together

The Q-cards in this project act as "boundary objects" between disciplinary experts (scientists, humanists, policymakers) and stakeholders (poultry farmers) in this project. A boundary object, developed by sociologist Susan Leigh Star with philosopher James Griesemer (1989), is a useful theoretical tool for synthesis across complex activities, with many actors representing different disciplines and goals.

> Boundary objects are objects which are both plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. They are weakly structured in common use, and become strongly structured in individual-site use. They may be abstract or concrete. They have different meanings in different social worlds, but their structure is common enough to more than one world to make them recognizable, a means of translation. The creation and management of boundary objects is key in developing and maintaining coherence across intersecting social worlds (2010).

Boundary objects can function as virtual or physical[217] objects; in this project the physical cards brought scientists and farmers together, especially in the sorting

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[217] Since the time of boundary object development, virtual objects are now encompassed by boundary object theory.

activities. However, boundary objects also function abstractly; in this project the conceptual work underlying the card design, as well as the analysis of the data set, is also part of a boundary object activity. Through this engagement, what can result is improved understanding between both parties about the science and values inherent in tackling ammonia from poultry production.

The very origin of boundary object theory might further persuade environmental scientists about the usefulness of this approach. Star and Griesemer defined the boundary object while studying methods standardization in the Berkeley Museum of Vertebrate Zoology (MVZ). A natural science archive, MVZ relied on field notes (using the iconic Grinnell method) and specimens collected in field work to be combined with storage, curation, and other record-keeping practices. All these field, archival, and curation practice work together for a robust, organized, and accessible archive. Further, these material artifacts and organizational practices make possible productive and collegial interaction between members of professional groups (scientists, museum professionals) as well as other engaged actors, among them, amateur collectors, California government officials, campus administration, students, and public audiences.

Chapter Three, at the end, commented on the materiality of cards and card systems to organize complexity (Krajewski). Cards in bibliographic and archival systems other than the MVZ also function as boundary objects. Here, communities of borrowers and researchers use objects within these systems, with the objects and system unite them in knowledge storage and knowledge retrieval activity. Now, most of these systems are *remediated* (from Bolter and Grusin) into digital environments. Indeed, one of the ongoing activities of libraries and archives is the digitization of materials, which requires attention to remediation practices. In the case of objects – a concern of MVZ and other specimen collections of plants and animals – three-dimensional archiving is part of the remediation process.

Like stasis theory, boundary object can help achieve coherence – locations, pathways, and destinations[218] -- in complex projects. Starr-Griesmer boundary object theory fits well with academic settings, including attempts to bring actors together from a range of disciplines. Recall that disciplines often are bounded – siloed – by knowledge

[218] The map schema here is like the source-path-goal schema mentioned in Mozafari and Shea (Chapter Two) on how stasis theory works as a type of cognitive rhetoric (Turner and Lakoff).

depth, conceptual complexity, and particular methods. Boundary objects work across boundaries, making them emblematic of the aims of all transdisciplinary human activity.

Over the last thirty years, boundary objects are just as likely to be virtual as physical. Star-Griesemer boundary object theory is widely used in computer science, information science, sociology of science, and education theory (Star, 2010). A boundary object, unlike another organizing objects like a mission statement or even subtle, deeply personal moral objects like shared values, does not require consensus to bind. In this USDA CIG project, the cards and card-sets act as boundary objects, helping to bring stakeholders of community together. Even though the cards largely reflect the benefits and values necessary to ammonia management choices, these cards also capture elements of the science, too. In this way, science findings[219] can be seen as values and benefits, too. Science findings embody the essential values of the scientific method: that the world can be known, described, tested, and evaluated.

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[219] Scientists might be somewhat surprised about the characterization of findings as having function as value objects. In environmental science especially, one primary value of documentation the status of environmental degradation (or restoration) hold value for human beings to make decisions about activity. Knowledge (in stasis theory, residing in bins two and three) carries value (bin four) for action (bin five).

Furthermore, in looking at questions of harm and benefit, science findings can detect a toxin and threshold levels of harm, to offer one example of a fact can, indeed, form a value element.

Community members are "freed" from a required condition of strong consensus, in part, because the boundary object is a uniting artifact in the complex collaboration of sorting. Q-sorting about farmer viewpoints assumes that all the depicted values and benefits (here, the card number total was 25) are important. Researchers may find that they have hunches or preferences about what will be important to poultry farmers, yet Q-method is less focused on predicting importance and more on seeing what an individual participant sorts into a pattern about that farmer's ranked, ordered responses.

That all values matter in a sorting experience, like boundary objects, can be an attribute of collegiality and acceptance. What matters is the ranked arrangement for that farmer, again a subtle but important shift in the pre-analytical assumptions of what a Q-inquiry is. A Q-sort does not seek determination of the top five values; rather, Q-method helps make clearer the range of possible viewpoints. Understanding viewpoints can assist stakeholders, especially decisionmakers, in deliberation:

thinking, preferring, and finally acting. During the process, discussion about the range of viewpoints within a group can assist in persuasion and reaching consensus.

In this way, cards and card sets (as concrete boundary objects) and stasis theory (hierarchical cognitive structure) both can help calm interdisciplinary and stakeholder disputes that often arise from complex policy deliberation projects. Both stasis theory steps and boundary object theory do not require that stakeholders agree. Rather, both the theoretical structure of stasis theory and the moveable flexibility of boundary objects, demonstrate that arranging knowledge for policy does not require as much agreement as sometimes thought. Sociology is the disciplinary home of boundary object theory. Applied sociology is also home to citizen pollution sensing efforts.

Poultry farmers, data generation/ownership/interpretation, and citizen pollution sensing: Chapter One described poultry farmer unease with ammonia air pollution being reclassified as point-source pollution rather than non-point source pollution. Additional worry for poultry farmers concerning airshed ammonia is being treated as a water pollutant because of deposition to water systems in the Chesapeake Bay watersheds. Two recent developments strongly heighten their concern about these re-definitions[220] of ammonia pollution:

1. The 2020 Baker study testing new ways to measure and model poultry house ammonia effluent, combined with
2. the March 2021 Maryland Circuit Court ruling on treated deposited ammonia as a pollutant under the Clean Water Act (now under appeal).

The Court action poses a re-definition[221] of airshed ammonia as in, actuality, a water quality pollutant[222] to be managed under the Clean Water Act.

Both events -- science publication about ammonia effluent methodology and a court case – shift attention sharply by stakeholders to science methods, data collection and

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[220] Definition battles take place in the second stasis or cognitive bin of definition and description. These struggles are often very intense and occupy a great deal of money, political force, and highly energetic engagement.

[221] Definition revision applies here. Recall that jurisprudence is the largest living repository of Roman rhetorical practices, including stasis theory (discussed briefly in Chapter Two). Judge Burrell is using IRAC – issue, rule, analysis, conclusion – analysis in her opinion. Central too is that the rule she is using is the Clean Water Act. In her analysis, the motility of nitrogen chemistry forms a scientific argument to apply a water pollution administration law rule to what looks to be an air pollutant and subject only to the Clean Air Act and other focused administrative laws.

[222] Under the Clean Air Act, ammonia is acknowledged as an airborne health threat but is not currently a *regulated or criteria pollutant* under the Clean Air Act; however, ammonia it is regarded as a precursor to several sizes of particle pollution, specifically, Particulate Matter 2.5 (PM2.5). Under this condition, ammonia may be regulated similarly to air criteria pollutants. The March 2020 Maryland State Circuit Court decision – now under appeal – does not call for ammonia regular under the Clean Air Act; rather, this decision, the Court ordered the Maryland Department of the Environment (MDE) to revisit the State's permit that regulates poultry CAFO pollution because of water quality concerns. The Court noted two water protection laws: the federal Clean Water Act and the regional Chesapeake Bay Program. Specifically, this Court found that MDE must regulate millions of pounds of ammonia from poultry house fans (air) that is deposited on soil and water (watershed location. Part of this ruling calls for counting of ammonia emissions and deposition plumes.

interpretation, and what are the inferences to be made for environmental policy formation.

U. K. sociologist Jennifer Gabrys[223] runs several "citizen sensing" projects, where people monitor air pollution with small mobile, networked devices[224] (2016; 2019). Two recent citizen sensing projects associated with Gabrys' "Program Earth" work in Pennsylvania are instructive, particularly for mid-Atlantic audiences. One project is air pollution-focused (Pritchard & Gabrys, 2016) with other project focused on fracking pollution (Gabrys et al, 2016). In each project, extensive training for citizens on how to interpret these data sets is provided. Data interpretation with stakeholders is an underexplored area for science communication, especially in policy deliberation.

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[223] Gabrys also writes about synthesis environmental policy work where the arts (and social sciences) must be collaborative experts with environmental scientists and economists. See

> Gabrys, Jennifer & Kathryn Yusoff (2012) Arts, Sciences and Climate Change: Practices and Politics at the Threshold, Science as Culture, 21:1, 1-24, DOI: 10.1080/09505431.2010.550139

[224] One device (does not measure ammonia) is the "Air Quality Egg" https://airqualityegg.wickeddevice.com/portal

The instructions/DIY/hack community also offers ways to enter device culture. For example, For one extensive example – from U.C. Berkeley's Hybrid Ecologies Lab -- of how to build an air quality sensor, see

"How to Build a Portable, Accurate, Low Cost, Open Source Air Particle Counter," http://www.instructables.com/id/How-to-Build-a-Portable-Accurate-Low-Cost-Open-Sou.

Chapter One of this dissertation described an unfortunate 2019 misunderstanding by the Delaware Chicken Association (DCA) spokesperson concerning a data image in the Baker study. One red[225] spot, on a map detail, showed a location measuring high amounts of ammonia during a sampling routine. DCA seemed to interpret that location as a stable ammonia pollution hotspot[226] and challenged that characterization publicly. This one detail in the graphic was not interpreted by the scientists (Baker and colleagues) in the same way as the spokesperson for Delmarva's poultry industry trade group. Data literacy is complex and requires disciplinary expertise. Yet, public audiences can be helped to better data fluency and graphic interpretation skills.

The Baker study was written in a research genre meant for other technical experts. However, technical scientific information disperses widely outside of journal subscriptions, especially in high-stakes environmental policy deliberation. The move

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[225] The rhetoric of color, especially in scales as well as alarm/alert signals is underexplored, too.

[226] Chapter One defines hotspots as a type of pollution concentration within an area that poses human health risk. The definition began in discussions of concentrations of criteria air pollutants but now means both air and water conditions.

toward open access publishing and pre-print conventions means that, increasingly, science articles are read by deeply invested lay audiences.

For data use, more generally in vigorous environmental policy debates, clear communication of data openly, with artful exposition of meaning, cannot be overstated. Political economics mean that science data and interpretations can be captured by a kind of *data capitalism*[227]; Risks about lack of trust about data, interpretation, and policy inferences (which are arguments) are real. Finally, a serious problem looms: data refusal, kin to expertise refusal[228]. The environmental footprint of Delmarva poultry production can be shaped by what might become a serious trust deficit about data and scientific expertise.

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[227] After Castells, and Deighton and Johnson, data capitalism describes commodification of data that supports power that is both asymmetrical and weighted toward privileged stakeholders. These stakeholders hold access, ability to interpret/make inferences from the data, and shape policy or markets based on this data expertise advantage. This uneven distribution is further supported by networked technologies that characterize communities that live and work largely online. See:

Castells, M. (2007). Communication, power and counter-power in the network society. International Journal of Communication, 1, 238-266.

Deighton, J., & Johnson, P. A. (2013). The Value of Data: Consequences for insight, innovation and efficiency in the US economy. *Data-Driven Marketing Institute*, *14*, 1-105.

[228] Political scientist Thomas Nichols writes about this serious social problem. See

Nichols, T. M. (2017). The death of expertise: The campaign against established knowledge and why it matters.

Improving familiarity with how to approach data sets and visualizations can bring citizens and scientists closer in deliberating for environmental policy. Visualization graphics that explain research result in graphical displays that show data and relationships that can be interpreted by scientists and other technical readers. Lay audiences, including stakeholders, do not always hold the same "graphics literacy" noted in Chapter Three. Being able to "read" and interpret data and data visualization should be part of the tool kit of all citizens. Gabrys' several citizen pollution sensing projects all focus on data interpretation skill transfer, too, in addition to data collection.

Stakeholder deliberation can be improved – and calmed – by data interpretation knowledge[229] being available more widely for stakeholders.

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[229] At the least, a skilled science communicator could revise this Baker visual into a conceptual diagram, with notes on how to interpret. A similar science communication task here would be to limit the applicability of one visual in a research article to a larger interpretation about a persistent ammonia hotspot.

Perhaps poultry farmers -- facing new regulation on their poultry house ammonia effluent -- would be amenable to a farmer-administered ammonia sensing network. Such a monitoring network could boost farmer technical knowledge acquisition – and agency -- about specific ammonia and particle pollution amounts exiting each poultry house.

Another possible use of citizen sensing devices, not networked, would be to monitor ammonia effluent as individual farmers[230], using the data information in farmer-to-farmer peer sharing or even eventually including information in Nutrient Management Plan (NMP) documents[231] shared with state regulators. Finally, non-networked pollution sensing systems could be used by farmers to monitor function of their farms, with an ability to clearly see the hyperlocal efficacy of Poultry Litter Treatments (PLTs) and/or Vegetated Environmental Buffers (VEBs). Farmer choice

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[230] Poultry farmers use air quality monitors inside poultry houses, as one way to check on bird health and risk to bird health. These monitors often are part of a poultry producer contract with a chicken processing company. Some of these monitors are likely networked with companies; however, both poultry farmers and poultry companies are often silent on vertical integration contract details. The point is, though, that poultry farmer already uses monitors that test for ammonia quantities specifically and air quality generally, albeit inside poultry houses.

[231] The complexity of nutrient reporting for Delmarva poultry farmers is discussed in Chapter One. The Maryland and Delaware states impose different reporting regulations for poultry farmers but the recent Maryland court ruling raised concerns for Delaware and Virginia poultry farmers and production stakeholders, too.

in management their land and production could be improved by such data evidence being managed by and available to farmers. Indeed, poultry farmers now use sensors inside their poultry houses to monitor conditions. Extending the monitoring technology (even unnetworked) to outside the poultry house would give farmers more data upon which to manage land and production.

A farmer-managed ammonia monitoring network on Delmarva would likely also be future oriented. Many observers estimate that the average age of Delmarva poultry farmers is between 50 and 60. Who will enter this essential agriculture sector over the next decade? Will poultry production shift to more contractual growers on rented land or land/poultry houses owned directly by poultry companies? Will Delmarva continue to lose market share of poultry production to other parts of the country?

Would younger poultry farmers – working land in their possession rather than contractually[232] -- see value in first collecting ammonia effluent data, and then,

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[232] If in the next two decades, poultry workers manage houses and land owned by poultry companies, monitoring decisions would be controlled by the poultry company. In-house sensors are used, with farmers monitoring them. These sensors are part of some poultry production contracts.

sharing and administering these ammonia data sets as a community? Poultry farmers are wary about farm-level monitoring of ammonia effluent for the many regulatory reasons noted in Chapter One, about point and non-point source classification, state water and air monitoring, as well as stricter imposition of federal statutes of the Clean Air Act (CAA) and the Clean Water Act (CWA), as well as the regional Chesapeake Bay Program. Would being able to talk about ammonia effluent specific amounts, by farmer, sub-watershed, and other geographical designations enjoin poultry farmers to have a say in tightening pollution regulation? Ammonia effluent monitoring at the exhaust fan “point” could be seen by poultry farmers as decision information for their airshed management; Farmers already use data about ammonia to adjust practices within the poultry house. That in-house sensing information helps a farmer grow healthy birds out to market weight and is not part of the regulatory observation culture they may distrust.

One encouraging aspect of the USDA CIG project concerned on-farm air quality monitoring. Scientists in this grant worked with several farm families to measure ammonia and particle pollution on their poultry farms (2012-2017). Developing these relationships was sensitive but did results in very good data sets, as well as strengthened relationships between these poultry farmers and project scientists.

Indeed, conveners of these this project often encounter surprise by others about poultry farmers engaging in this on-site air quality monitoring. Important to this context was trust between scientists, Cooperative Extension agents, and other principals in this project. One important take-away is that trust makes possible several communal activities directed at questions of balancing farm production with environmental quality.

Collegiality – and occasionally conviviality[233] -- and shared work build trust. Gaining familiarity with data, data collection, data analysis/visualization, and data interpretation might be another way to bring poultry farmers and scientists closer. Collaboration through shared interests in data[234] , data generation, indeed, data ownership is possible. Building trust, too, can help in the shared project of producing

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[233] Recall Illich's visual of conviviality, noted in Chapter Two: "I believe a desirable future depends on our deliberately choosing a life of action over a life of consumption, on our engendering a lifestyle which will enable us to be spontaneous, independent, yet related to each other, rather than maintaining a lifestyle which only allows us to produce and consume." -- *Tools for Conviviality.*

[234] Data and data sets could be also seen as boundary objects. Many boundary objects do not require complete agreement to help bind a community into a common activity area. Boundary object theory, in this regard, helps make an argument for citizen sensing of ammonia effluent by poultry farmers. The broader community of stakeholders could be brought together in new ways that could help in policy deliberation and formation.

chicken while preserving air and water quality in the supporting and surrounding ecosystems.

Gabrys thinks about such data engagement as empowering citizens to be active agents rather than passive subjects in pollution remediation. Part of this empowerment task is to make data more meaningful to citizens and others who are not pollution or policy experts. Gabrys relies, in part, on a theoretical understanding of matter articulated at the turn of the century that focuses on abstract meaning as having object status[235]. This object quality recalls the sociological construct about boundary objects from Starr and Griesemer noted earlier in this chapter. Boundary objects function to create communities of activity that do not rely on agreement to be a community. A shared boundary object – here, ammonia data generation – can help create communal understanding. This reminder of activity toward the mutual goals of agricultural

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[235] Whitehead's work about ethereal, matter-less objects having agency (creature-like) makes sense to computer scientists who work in object-oriented programming and platforms, as well as to users of multi-object oriented (MOOs) communities. Basically, what is being noted is the realness and power of objects. And, there is a rhetorical line of inquiry into these object worlds. See

Brown, Jim. "Toward an Object-Oriented Rhetoric." *The Blogora: Rhetoric Society of America*. 10 June 2010. Web. <http://rsa.cwrl.utexas.edu/node/3850>

production and environmental quality do not require agreement for cooperation cannot be understated.

Community pollution sensing projects fit the boundary object theory first articulated in the 1980s. However, Gabrys relies on a much earlier concept from philosophy. This metaphysical[236] idea is that of data – a particular kind of object -- being a creature and the act of understanding data (think creatures), which is a knowledge-based agency, as creaturing. These concepts might seem overly abstract. Yet Gabrys' large, multicounty, interdisciplinary projects originate partly due to her borrowing creatures and creaturing from the process philosophy of Whitehead.

Philosopher, mathematician, and historian of science Alfred North Whitehead (1861-1947) gave information, including data sets and data points, special status and even agency in the world, calling them creatures (Whitehead, 1911). Whitehead's definition that emphasized the lifelike qualities of some object, including data, later

[236]Metaphysics is the line of inquiry in philosophy dealing with first principles of objects, including abstract concepts such as being (ontology), causality, knowing (epistemology), identity, space, substance (materiality of "real" items), time, and space.

helped Gabrys – and others[237] – work through a complex undergirding about reality that ultimately helped support specific projects like bringing people together by democratizing data. The air quality data sensors in citizen sensing are distributed intentionally, along with capacity building for interpretation and use. All this work makes pollution type, amount, location, and trends more meaningful to people. Creaturing is the special concept that underscores this meaning for people and object agency of data.

Whitehead's idea of data objects as creatures (Stengers, et al., 2014) acknowledges the meaning as well as noting the agency that data can have, especially when networked. In other words, the "concrete facts" of pollution assume distinct, meaningful, and even actionable forms, based on data and data understanding. This understanding piece of this citizen sending projects is central to the work of teaching data literacy to publics. In teaching data literacy, agency is possible for these publics

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[237] Creaturing and creatures are also essential elements in a line of inquiry in rhetoric. See:
Davis, D. Diane. "Creaturely Rhetorics." *Philosophy and Rhetoric* 44.1 (2011): 88-94.

in understanding pollution. To, then, be able to participate in policy deliberation is an act of democracy.

Whitehead's theoretical ground for Gabrys' democratized (2019)[238] and networked pollution sensing projects does not need to be fully understood[239] to still offer value in a networked Delmarva ammonia sensing project.[240] Such a voluntary project would invite poultry farmers (and other Delmarva stakeholders, say, riverkeepers of a watershed) to collect, share, aggregate, and use data. One motivation about poultry

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[238] *How to Do Things with Sensor*s is Gabrys' manual for citizen sensing projects. An open access read-online version is available through the University of Minnesota Manifold book hosting site: https://manifold.umn.edu/projects/how-to-do-things-with-sensors
A one-page summary by Gabrys of how citizen sensing works appears in *Technospear Magazine*: https://technosphere-magazine.hkw.de/p/Sensing-Air-and-Generating-Worlds-of-Data-fL1Q5CVgGeJMDJmEdwCFr3

[239] Complex nitrogen chemistry does not need to be understood by all environmental scientists. Specialists in nutrient flux and nitrogen speciation in soil and water systems can offer their expertise and guide others with the best available knowledge.

[240] If being in a networked system of data partners is too risky for poultry farmers worried that their poultry houses will be identified as a specific ammonia pollution-generating location, pollution data sensors can be non-networked. The value here is that a poultry farmer will become aware of specific quantifies of ammonia at the poultry house site and upon the farm lot environs. The small data collection project would permit a farmer to see trends, daily, seasonally and perhaps after shifting the ammonia management plan. Still, the more powerful data "creaturing" for collective agency about Delmarva and Chesapeake water quality relies on networks of stakeholders. Close readers of this dissertation and colleagues of the author will recall that several poultry farmers did permit air pollution sensing on their poultry farms. This trust condition is notable and somewhat unusual. However, developing and retaining trust between scientists and poultry farmers is at the heart of poultry-generated pollution management.

farmers joining into data collection would also be to push back against other data sets. At the same time, Gabrys reports that when citizens monitor pollution themselves, the creaturing of data means that air pollution becomes very real and hyperlocal.

Such a proposed project like Chesapeake-based citizen sensing also testifies to the specific contributions that both humanities and social science inquiry can offer to an agro-ecology challenge in the Delmarva portion of the Chesapeake Bay water-and air- sheds. Looking at this wide and deep pre-analytical[241] knowledge from the humanities is one of the primary messages in this last chapter. Humanists and social scientists hold essential knowledge and operational methods to help address complex, pressing, and "wicked"[242] environmental problems.

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[241] Herman Daly, co-founder of ecological economics, spoke about pre-analytical knowledge, conditions, assumptions as absolutely essential to describing the world fully, understanding problems, identifying solutions, testing and modeling those solutions, all toward sustainable environmental policy.

[242] Wicked problems, after business professor C. West Churchman and two design theory professors, Horst Rittel and Melvin Webber, are problems whose social systemic complexity means that the problems intrinsically have no determinable end points. Wicked problems nearly always feature complex interdependencies; solving one aspect of a wicked problem may reveal or create other problems. The Rittel-Webber 1973 thought piece contrasted *wicked* problems with *tame* soluble problems, as in math, engineering, or even complex games like chess or go. See

> Rittel, Horst W.J.; Webber, Melvin M. (1973). "Dilemmas in a General Theory of Planning" (PDF). Policy Sciences. **4** (2): 155–169. doi:10.1007/bf01405730. Archived from the original (PDF) on 30 September 2007. [Reprinted in Cross, N., ed. (1984). Developments in Design Methodology. Chichester, England: John Wiley & Sons.]

If Whitehead's *creatures* and *creaturing* seem too rarified, a take-away would be that, increasingly, big data generation is a highly contentious activity concerning ownership and application. Data makes the abstract real (to creature, as in subjunctive verb mood) that actions, policies, regulations -- indeed -- struggle all flow from these sets of numbers that describe reality. Gabrys' work on citizen sensing is included in an edited collection about data publics (Mörtenböck & Mooshammer, 2020), where these large questions are examined in several social problem settings. Struggles over environmental policy can be informed by better open data practices.

Boundary object theory and citizen sensing activity are just two intellectual frames that can help scientists see the value of expertise from the humanities and science sciences in environmental science-to-environmental policy deliberation.

What can be? What ought to be? The humanities, including literary studies, help societies to imagine possible futures. Part of looking forward also means analyzing existing problems. Humanities can help frame possible environmental futures with theory and even literature. For, stasis theory as a frame, Chapter Two annotated briefly the western land-use work of Sharon McKenzie. She uses stasis theory to assess how to understand and deliberate about range uses for livestock balanced with ecosystem protection. Indeed, the author is indebted to her work as a mentoring text for what this dissertation could and should be. For literature and environmental futures, travel back to 1960 and publication of Rachel Carson's Silent Spring (1960). Behold the power of an essay for general audiences – rather than a research article – to shift an entire world to first see environmental peril, then to act to protect people and the planet. Long-form humanities exposition – in addition to literature – offers ideas and cautions about the future.

Imagining a sustainable, equitable, and efficient future[243] for Delmarva poultry: Valuing (fourth stasis), one of the most human of all actions, also points at what our desired futures ought to be (fifth stasis). From the Greeks -- Aristotle, Epicurus, Plate, Socrates, and others -- no less – these questions are two-fold:

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[243] This final section uses three practical attributes from ecological economics to flesh out a sustainable Delmarva poultry future. Ecological economics values economic activity, nested within the limits of the supporting ecosystem, that is sustainable, equitable, and efficient.

1. what is the good life? and
2. how can we know and secure such conditions that create the good life?

In prescriptive ways, this fifth policy stasis of the good life, as well as the fourth stasis/cognitive bin of valuation, are normative. Normative describes ethical and moral guides, in addition to rational, relevant knowledge generated by science, to outline better moral conditions. Ecological economics elevates normative thinking as essential to a rightly scaled economy that fits within the biophysical boundaries of the planet and associated energy systems. These three normative frames – *sustainability, equity, and efficiency* – come from Herman Daly, one of the founders of ecological economics. He pairs each of these normative frames with three function descriptors from economics – *scale, distribution, and allocation*. Daly combines them:

- a *sustainable* system is of good *scale*,
- *equity* is found in just *distribution*, and, finally,
- *efficiency* relies on robust *allocation*.

Let's use Daly's normative framing[244] to imagine Delmarva poultry production and the supporting Chesapeake Bay ecosystem thusly (1992). Table 21 below pictures

[244] See Daly, H., and J. Farley. 2003. *Ecological Economics: Principles and Applications*. Island Press, Washington, DC.

Daly's three normative frames with the three functions of economic systems. Combining the normative with the economic is an efficient way to ensure that economics alone does not drive policymaking. Daly's work centers human values and ecological constraints, within economics.

	ECOLOGICAL ECONOMICS: Nesting economic activity *within* biophysical systems			
Normative	**FRAMES**	**SUSTAINABILITY**	**EQUITY**	**EFFICIENCY**
Economic	**FUNCTIONS**	**SCALE**	**DISTRIBUTION**	**ALLOCATION**

Table 21: Daly's design criteria for a right-sized economy: normative frames combined with economic functions. Author designed this and other tables.

Daly, H. 2008. *A Steady-State Economy: A Failed Growth Economy and a Steady-State Economy Are Not the Same Thing; They Are the Very Different Alternatives We Face*. UK Sustainable Development Commission, London, United Kingdom.

Daly, H. 1973. *Toward a Steady-State Economy*. W. H. Freeman, San Francisco, California.

Sustainability: What shifts Delmarva poultry production practices would be sustainable both economically and environmentally? Some of the market aspects of economic sustainability are discussed below under the third normative frame of efficiency, a hallmark of robust economic activity. For discussion purposes here, though, sustainability means that the economic activity (level and type) in poultry production does not create more illth[245] (John Ruskin) than wealth (Daly, 2010). In this way, sustainability[246] is write large to encompass the demand that the Chesapeake Bay ecosystems makes upon local poultry activity to keep provisioning for this food production.

Daly speaks and writes about sustainability as the type of growth that does not produce more illth than wealth. He notes than many externalities along with limits to

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[245] *Illth*, coined by polymath English writer John Ruskin (1819-1900) in a series of essays on economics, is the reverse of wealth in the sense of *ill* being the opposite of *well*. From

Ruskin, John. (1860) *Unto This Last*, with 1912 copy available in digitized form at the *Library of Congress*

[246] Sustainability for farmers matters, too. This is looked at under scale, in Daly's system. Scale here means both scale of combined poultry production as well as what scale a farmer might want/ to farm at.

extraction (fuel, minerals, even labor) result in uneconomic growth. Illth, at this level, degrades the economic wealth that is created. He further reminds that the sources (where we extract natural resources and energy) and sinks (where we discard waste) are limited. Using sources depletes; generating waste pollutes. These sources and sinks are in the world we inhabit, our biophysical planet.

Put simply, sustainability requires that economic systems fit within the biophysical circumscription of the supporting and surrounding ecosystem.[247] We can rewrite "Daly Rules" for sustainability of Delmarva poultry production as:

1. **Source rule 1**: Chesapeake-located renewable resources[248] such as soil, air, and water, as well as feed crops for poultry, must be used no faster to support

[247] This approach, where economic activity faces the biophysical limits of nature, is like the conceptional thinking of systems ecologist H.T. Odum (1924 –2002) coined "emergy" (1956), devising an accounting system of embodied energy. For this context, see:

> Odum, H.T., 1984. Energy analysis of the environmental role in agriculture. Pp. 24-51, in *Energy and Agriculture*, ed. by G. Stanhill. Springer Verlag, Berlin.
>
> Odum, H.T., 1986. Energy in ecosystems. In Environmental Monographs and Symposia, N. Polunin, ed. John Wiley, NY.
>
> Odum, H.T., 1994. Ecological and General Systems: An Introduction to Systems Ecology. University Press of Colorado, Niwot. 644 pp. Revised edition of Systems Ecology, 1983, Wiley.
>
> Odum H.T., 1996. Environmental Accounting. Emergy and Environmental Decision Making. John Wiley & Sons, N.Y.

[248] Projects that use poultry litter, composted, as a source of biogas are emerging as a broader response to dealing with livestock manure. Near Seaford, DE, a new and large biogas anaerobic digester is planned. On the proposed site is Perdue's former pellet fertilizer plant, which will likely house other components of the digester. Fertilizer sales of the pelletized poultry litter never took off, in part because of the costs of transport and robust competition from commercial fertilizer companies with long-standing contracts in other parts of the country where soils require nitrogen fertilization. Smaller,

poultry production than at the rate which they regenerate or can be remediated or restored by ecologically based interventions.

    a. For labor, Daly notes that people have limits, too; including exhaustion; unwillingness to work more hours or under unsafe or dehumanizing conditions.
    b. Labor is not as portable as capital: do enough people live close enough to be employed at wages that will bring them and keep them in poultry work?

2. **Source rule 2:** Non-renewable resources such as inputs for feed crops (some types noted in rule 1 as a renewable resource) and specialized inputs for rearing bird cohorts (components of poultry litter amendments, vitamins, medications, etc.), and fossil fuels must be used no faster than renewable substitutes for these inputs can be developed.
3. **Sink rule:** Pollution and wastes (primarily ammonia, particle pollution, and the excess volume of stored/composted poultry litter) must be emitted no faster or in amounts no greater than can be managed in natural systems by absorption or by human actions[249] authentic recycling can transform them or "lock" into inert forms (say, bricks)[250]. Fossil fuel use poses devastating sink problems for the atmosphere and local climate disruption.
    a. For poultry litter, the net volume[251] of this output from poultry production outpaces the ability of Delmarva soil and water systems to

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farm-scaled biogas energy generation is also possible, but the scale tends to not fit farm budgets and would need to be subsidized.

[249] Transformation often requires non-negligible amounts of energy.

[250] Making bricks or other building forms from poultry litter could be explored, along with the current focus on using pelletized poultry litter as a fuel. German and Australia both make bricks from human manure.

[251] Earlier in several locations, principally Chapter One, the use of poultry litter as a valuable fertilizer for field crops is noted. This is a virtuous loop, no doubt. However, poultry litter on Delmarva on balance is a case of too much of a good thing in the wrong place. Perdue Incorporated runs several poultry litter management activities including research into biogas energy generation from digesting poultry litter. Perdue also manages several poultry litter composting sites, as well as proof-of-concept facilities aimed at pelletizing poultry litter into a commercial fertilizer product. Despite all these

> keep nutrients (nitrogen from ammonia and phosphorus) out of the Chesapeake Bay. The sink of the Bay is limited in ability to keep taking on these nutrients without resulting in algal blooms, dead zones, and other deleterious conditions for Bay ecosystem health. Many economic activities in the Bay are harmed by algal blooms, including crab and oyster fisheries.

How could a collaborative deliberation about future sustainability for poultry farmers and sustainability for the Chesapeake be staged? One way could use card sorting: Q-sorting cards and card sets could be designed for such complexity and based on close reading of Daly's normative themes and economic functions:

- Normative themes of sustainability, equity, and efficiency[252];
- Economic functions of scale, distribution, and allocation.

Card sets could be designed with the poultry context expanded outside concerns solely about ammonia management and combined with Daly's future-focused

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activities and that of researchers in academia and industry, poultry litter remains a serious problem for Delmarva and the Chesapeake Bay.

[252] Efficiency is also an economic function, yet, here Daly implies that efficiency also characterizes a quality for human community that is more akin to not wasting resources, as well as sinks. Within human community, to not waste can also mean that resources and sinks are shared or understood to be held in common. This *holding in commons*, especially from Ostrom and others, is an expansive condition that includes the natural resources and sinks on which life depends (air, water, land, food), as well as human-built public spaces (public schools, public parks, knowledge institutions, town halls, and networks like bandwidth and the world wide web). These commons are created places where people gather, speak, share, and negotiate how and why they will care for those resources, for one another, communally.

framework. Within the 25-card set used in Chapter Four, some cards focus on sustainability. See Illustration 6 below for three such cards that reflect a local ecosystem health value for poultry farmers.

Illustration 6. These three cards focus on poultry and Chesapeake ecosystem sustainability. From left to right: The first card depicts the combined use of vegetated emissions buffers (VEBs) and poultry litter treatments (PLT) based on farmer vision of land stewardship. The middle card depicts intentional reduction of pollution including nitrogen as part of a marketing niche re Chesapeake-friendly chicken. The last card depicts the combines use of VEBs and PLT specifically for watershed/Bay health.

Cards that hint at ecosystem care, but also focus on other topics include the three in Illustration 7 below:

Illustration 7. These three cards show values/benefits related ecosystem sustainability. From left to right: The first card focuses on care for neighbors who work in oyster and crab fisheries. The middle card focuses on a farmer's spiritual values about care for creation and the virtue of food provision. The last card focuses on the land-based values of wildlife protection, for use values like hunting, tourism, and a specific ecosystem service of pollinator protection.

Re-imaging poultry futures as sustainable pose scenarios of climate changes. Card sorting as a science communication activity[253] can also be linked to Delmarva-specific knowledge essential for all stakeholders about climate-change driven futures. Extreme weather events, including some hurricanes, nor-easters, and summer storms raise the reality of "felt" climate change in a many public communities. Additionally, cards could be modified/developed to think more directly about climate change scenarios facing poultry production in terms of sources and sinks, under a warmer, wetter Delmarva bio-geo-ecosystem (Boesch, 2008; Boesech, 2013). Scenario exploration is deeply futured oriented and can also rely on findings about climate adaptation, mitigation, and ecosystem resilience.

Card sorting is only one way to think about poultry futures. Collaborative discussions can take many forms. Occasions for these future-focused imagining events could be Cooperative Extension sessions, student/youth events organized by 4H and Future

[253] Note: Q-cards do not always need to be sorted and analyzed. Sorting of cards, paired with discussion, can be a goal for science communication. Indeed, such activities can be part of piloting cards for a formal Q-study. In this way, card shorting alone can support many policy deliberation goals.

Farmers of America, as well as faith-based groups. Where could such collaborative discussions be held? Some of these collaborative discussions will raise uncomfortable topics and might be best designed carefully, in conditions of trust as well as with skilled presenters with some conflict management skills. For example, William Dennison, of Chapter Four, and colleagues at IAN (UMCEES) could work with Cooperative Extension agents in both the Maryland and Delaware systems, as well as with Virginia-focused[254] stakeholders, too.

Perhaps Delmarva churches could be locations of such events, along with design and hosting with, say, atmospheric scientist Katherine Hayhoe, who is also an evangelical Christian. Hayhoe's experience with lay audience communication about climate change is vast. Hayhoe is also skilled at discussing values within complex social

[254] Cooperative Extension activities in Virginia include the Eastern Shore Agricultural Research and Extension Center, as well as other nutrient management education associated with Virginia state agriculture and environmentally focused departments. Also important in Virginia water quality activity is the Virginia Institute of Marine Science (VIMS), especially through their Eastern Shore Laboratory. Poultry production in Virginia is smaller in scale than that of Delaware and Maryland. However, field application of poultry litter is part of the nutrient profile in Virginia. VIMS researchers James Galloway and Alison Leach developed the N-print approach to nitrogen footprints discussed in Chapter One

problems, especially the values held by people with strong faith allegiances as they consider social problem solving. Many poultry farmers on the Delmarva Peninsula attend church regularly.

Daly's ecological economics approach also support values-based discussion. Table 22 below features a detail from Table 21 above showing Daly's fully articulated design criteria for a just and sustainable society. Discussions of economic sustainability are at heart discussions about a scale of activity that respects sources and sinks.

Normative	FRAMES	SUSTAINABILITY
Economic	FUNCTION	SCALE

Table 22: The normative frame of Sustainability and the economic function of Scale; first of three details from Daly's ecological economics approach illustrated in Table 21 above.

Table 22's detail from Daly is, by inspection, an apt two-part approach to imagine a Chesapeake-friendly poultry future. Sustainability and scale can encompass both economic sustainability (for region and for individual farmers) and ecosystems sustainability by rethinking scale of poultry production. However, the most comprehensive re-imagining of human systems raise other problems intrinsic to the primary activity of poultry production. Daly's vision of economics also includes the normative frame of equity and the economic function of allocation. See this detail in Table 23 below, which is based on his fuller vision in Table 21.

Equity and allocation raise many macroeconomic conditions including the income inequality and labor conditions where wages never secure basic needs. Other equity concerns encompass the often-hidden labor practices with immigrants, including off-the-books payments and contractual wage theft. Re-envisioning Delmarva poultry production along with these two elements of Daly's ecological economic guidance would require a direct facing of these ethical macroeconomic challenges. Still, economic sectors can be shifted by several avenues. Consumer preferences and ground conditions (say, the emerging labor changes ushered in by the pandemic) can shift practices but more deliberate policy clarity on what is happening requires knowledge and transparency. Let's look more closely at equity and distribution, for a re-imagined poultry industry.

Normative	**F R A**	**EQUITY**

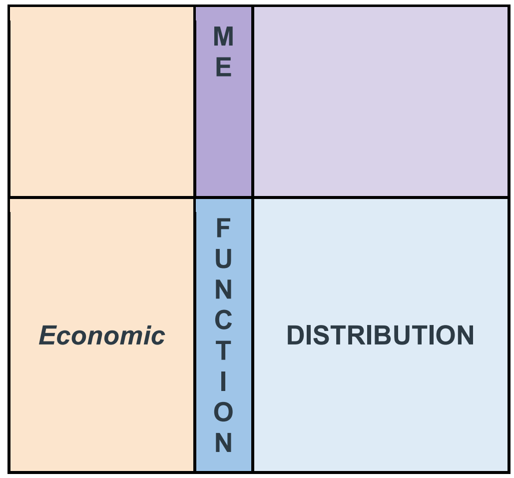

Table 23: The normative frame of Equity and the economic function of Distribution; second of three details taken from Daly's ecological economics approach illustrated in Table 21 above.

Equity: Daly pairs the normative frame of equity with the economic function of distribution. Ecological economics calls for human systems that support equitable distribution. Q-sorting – supported by the fourth stasis step of value -- offers specific ways to incorporate human (cultural, spiritual, and both personal and social norms) into environmental policy deliberation.

Equity can be understood as fairness, a value common to many people, cultures, and codes of conduct. Observers of and actors in environmental policy speak often of the need to include non-economic values like social norms into environmental policy deliberative processes. See especially (Kinzig, 2013);[255] yet, this understanding about human values as broader than simply being economic is of long standing and across many disciplines. Q-sorting and the fourth stasis step centered non-economic values inquiry at the very heart of this dissertation and the author's intention for sustained study. Valuing activity in environmental policy is often performed primarily as an economic activity (valuation of ecosystem services, natural capital, debt-for-nature, etc.). Daly's economic economics is compatible with Q-sorting, which seeks to understand human subjectivity, and the fourth stasis step of stasis theory to pause for a full examination of values.

Some of the cards used in this dissertation study do invoke the human value of fairness. For example, cards about keeping family land in production, for descendants and relatives, reflects a wish for intergenerational family equity and for labor (and love) invested to persist across time, with benefits accruing to descendants. This sense

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[255] Notable among co-authors are scientists Paul R. Erhlich, Gretchen Daily, and Michael Oppenheim. Economist Kenneth Arrow is widely acknowledged by ecological economists as important for their new, transdisciplinary discipline. Yet, most important here is political scientist Elinor Ostrom. Ostrom advocated strongly for mixed method approaches – quantitative and qualitative approaches in combination -- in social science. Q-method is a mixed method. Ostrom's ideas and that of these co-authors would welcome humanities scholars in this work about understanding social norms and personal values in ecosystem protection.

of fairness is personal, arising out of years of people working with land that they are deeply invested in, with time, treasure, and immense feeling.

Most people will agree that human beings can make claims upon society about equity, especially the conditions under which people work. Processing poultry from slaughter to packaging is labor intensive. Poultry farmers do not perform this labor but hand off full-sized birds to the poultry company who manages this stage of production. Looking at the complex labor chains required to bring poultry from farm to table is not part of this study. Yet, any imagined future of Delmarva poultry production would consider this systemic piece, as well as the larger food systems that poultry companies operate within.

At the end of this chapter, resilience of Delmarva poultry production will acknowledge new risks to the complex and global food systems, especially the ways that COVID-19 deformed supply chains and labor markets. COVID-19 is a cautionary tale about vulnerability, where resiliency awareness can be part of the sustainability normative frame and the scale economic function just noted. Chicken processing was not taken up in this project nor do any of the cards reflect this very real concern about equity and fairness. Yet this moral problem about the low wages, difficult conditions, and hiring/firing practices for slaughter/packaging workers hovers in the background. This food processing system, again due to COVID, called some of these conditions into sharp relieve, including their essential worker status about safe and uninterrupted food supply.

Equity claims would consider how these Delmarva community members experience belonging, safe conditions, and possibilities for stable and affordable housing, among other basic needs. One card (Illustration 8 below) does address working conditions inside poultry houses. Poultry farmers, some family members, and hired workers called "chicken catchers" work inside poultry houses during the grow-out phase.

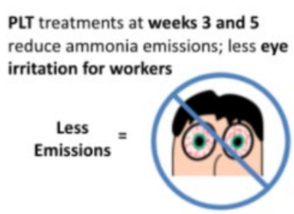

Illustration 8 (card): Reduction in ammonia inside poultry houses can improve the working conditions of those who spend time in the poultry house on bird care, feeding, maintenance of systems, etc.

Consumers shape ethical practices in poultry production. For example, consumers demanded no or low antibiotic conditions for chicken beginning in the 1970s, with poultry producers meeting this market demand, as demand swelled, and consumers organized themselves to communicate this preference.

Some consumers express concern about the conditions under which broiler and laying chickens live. One card (See Illustration 9) suggested this concern, combined with the options of niche marketing for poultry based on animal welfare. Here, the use of enhanced PTL schedules (three instead of two) reduced in-house ammonia, thereby creating better conditions for chickens[256] raised this way.

The card in Illustration 9 below could be adapted or modified to depict about human welfare in poultry slaughter and processing, which also assumes that a future-based context for card-sorting is larger than the ammonia management-focus of this dissertation.

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[256] Sifting through all ethical measures concerning poultry production did occur during card idea generation. Thinking about human safety and reasonable working conditions was often on the minds of people in this project. The interior of poultry houses is noxious, stifling, and extremely unpleasant work. Farmers do not like working inside their houses and often prevent family members from working inside the poultry houses until they are teenagers. Even then, some farmers do not permit their children to work inside houses. This is where the "chicken catcher" job arises: dead birds need to be removed immediately. These birds might need to be examined by a veterinarian, too, as a sentinel of specific disease inside the house. Thinking about the working conditions of poultry workers or anyone inside the production house raises broader issues about labor in poultry production systems.

Illustration 9: Consumer demand for humanely produced livestock, including chickens, sometimes supports niche markets where a premium is charged for birds raised this way. Sometimes, outside groups conduct the certification audit. Europe is more likely than the U.S. to raise livestock to higher animal welfare standards, wherein labeling signifies this niche project.

Efficiency: Daly's last normative frame is efficiency, with the companion economic function of allocation. See Table 24 below. Efficiency[257], here, functions primarily as a normative frame (not wasting) paired with the economic function of allocation. Daly asks us to remember the primary job of economies: distribution of what is needed by some metric of efficiency. Apples need to leave the farm and arrive in town so that people who do not grow apple trees can enjoy the fruit. All members of this market encounter want low waste (normative understanding of efficiency) of this

[257] Neoclassical economists claim the efficiency concept, too. Though Daly would counter with the failure of economic thinking to handle waste and externalities well. Hence, Daly shifts efficiency into the normative category.

desired food, as well as a market allocation of supply and demand[258]. Farmers charge and apple-desiring consumers pay.

Normative	FRAME	EFFICIENCY
Economic	FUNCTION	ALLOCATION

Table 24: Normative frame of Distribution and the economic function of Allocation; third of three details from Herman Daly's ecological economics approach in Table 21 above.

Hidden within this normative frame—economic part of efficiency plus distribution -- is what Daly and others focused on in articulating earth-safe economics. In other

[258] This point is where the criss cross lines of market demand and market supply meet. This iconic image – an element of visual grammar – was discussed in Chapter Three.

words, we may not want growth so much as we want steady state economies. Market demand conditions do not require unfettered growth for market satisfaction between producers and consumers. Recall earlier, Daly's concern about uneconomic growth that produces more illth than wealth; uneconomic growth[259] costs more than the activity provides in social and economic benefits. Herein lies the huge difference between ecological economics and all other macroeconomics areas of analysis, including environmental economics and resource economics, and clearly neoclassical economics.

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[259] The careful reader will see that the function of scale is important here, too. "Everything is related to everything else" – said by many -- is one of biologist Barry Commoner's four laws of ecology. In his book (1971) *The Closing Circle,* Commoner offers these three additional laws: 2) everything must go somewhere, 3) nature knows best, and 4) there is no such thing as a free lunch. See:

Commoner, B. (1971). *The closing circle: Nature, man, and technology*. New York: Alfred A. Knopf.

Unchecked growth writ large is not sustainable for planetary sources and sinks; for Delmarva and the essential and storied poultry heritage, how much more growth is possible, given constraints on human inputs as well as the nitrogen footprint (and carbon footprint) upon the Chesapeake Bay. *Ecological macroeconomics* predicts the unfettered, unexamined economic growth requires ongoing and voracious transformation of natural capital (sources) into more goods and services, plus the generation of humanmade capital (increasingly held by fewer and fewer individuals) and waste (pollution).

Can poultry production be re-scaled, re-calibrated toward a localized food supply system? Can a re-envisioned efficiency of local chicken production meet local table needs? Changing scale will mean modifying a complex poultry production system that includes farmers and poultry companies. which is a smaller, sustainably scaled allocation. Daly's vision of normative[260] economics can inform a future-oriented imagining Delmarva poultry.

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[260] What is the good life? (value stasis); How do we know? (definition/description stasis combined with the causal analysis stasis); How shall we build that life? (policy stasis).

What do consumers want? Can Delmarva produce healthy, local, Bay-friendly chicken? People are nostalgic about food and food production. For poultry, this nostalgia includes chickens roaming freely, providing meat and eggs. A farm family along with a skilled local butcher prepares and sells meat that is clean, attractive, and delicious. We also wish to cook and eat with a sense of local context: homemade Maryland-style chicken, crabs, hush puppies, fish peppers, oysters, Old Bay spice blend, and Smith Island cake.

Nostalgia is also part of many growing niche markets: slow-food, farm-to-table, locavore/low carbon miles, clean-eating, ethical consumption. These niches reflect market responses[261] to expressed consumer preferences about their food. Farm-to-table activity for both homes and restaurants show that niche markets can be financially stable as well as "laboratories of provision" after laboratories of democracy[262].

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[261] See Schindler, Robert M.; Holbrook, Morris B. (2003-04-01). "Nostalgia for early experience as a determinant of consumer preferences". *Psychology and Marketing*. **20** (4): 275–302. .

[262] Often misattributed, this phrase was coined by U.S. Supreme Court Justice (1916-1939) Louis Brandeis in *New State Ice Co. v. Liebmann.* Brandeis wrote: ". . . a single courageous State may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country."

During COVID-19, especially in the first year (2020), consumer preference for food delivery meant that more food, including livestock products, shifted in part to subscriptions. Subscription food services before COVID-19 tended to represent food products, with consumer-preferred attributes like locally sourced, low-carbon miles, supporting small farmers and ranchers, processing choices (few additives, no frozen steps, no hormones, or antibiotics, etc.), and other pleasant, often nostalgic qualities. Nostalgia does have a place with imagined futures for poultry production.

Mining the past for nostalgia to re-imagine sustainable futures: The humanities can help with nostalgia, an extremely powerful force in the human imagination. History is one discipline for this work. Other disciplines can help, too. For example, food studies anthropology, psychology, and sociology, from social sciences, as well as American studies, English, and history, in the humanities. For example, American studies professor Psyche Forson-Williams writes about food, including a history of chicken that centers the historic and cultural contribution of African American women (Williams-Forson, 2002) about rearing these “yard” birds, selling eggs, and preparing chicken in ways that are classic American table offerings. More generally, she writes about the largely unacknowledged role of African American people in food culture (Williams-Forson, 2011; Williams-Forson in edited collection; 2015).

Nostalgia can be examined by the lens of history for what occurred, contrasted with what we hope to have occurred. This interrogation of food nostalgia is helpful to rethinking Delmarva chicken. For example, 2011 Forson-Williams’ *Foodways* book posits poultry production as a locally circumscribed food culture that always included producers and consumers not always considered: lower income people and people of color.

Nostalgia frames can also chain us back to thinkers who always considered small scale economies as vibrant and reflective of social values include E.F. Schumacher (1911-1977)[263] and futurist Hazel Henderson.[264]

Chapter Two notes Kurlinkus' analysis of the rhetoric of nostalgia. His rhetorical take offers additional ways of thinking through the nostalgia themes[265] that shape consumer responses to how they imagine their food to be produced. Farm nostalgia

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[263] Schumacher was a statistician and an economist, who counted J.M. Keynes as a mentor. His thinking is the ancestor of concepts now called appropriate technology, user-centered design; and ecologically-benign technology He was inspired by Ivan Illich's conviviality idea noted in Chapter Two, as part of acknowledging poultry farmer expertise and specialized knowledge. Schumacher and Illich were both deeply influenced by Roman Catholic social teaching, including a preferential option for the most vulnerable, including laborers and those living in poverty. In an odd but interesting 1971 experience central to this dissertation, Schumacher was elected president of the British Soil Association, whose focus shifted from soil health to broader charitable work about organic farming, revision modern intensivist practices to more ecologically-inspired ones. See:

> Schumacher, E. F., & McKibben, B. (2014). *Small is beautiful: Economics as if people mattered*. Re-issued with commentary by environmentalist William McKibben. Also see:
>
> Schumacher, E.F. (1973). *Small is beautiful*: *Economics as if people mattered.*

[264] Hazel Henderson uses books and film to communicate differently scaled economic sectors. Her work was central to development of socially responsible investing. See

> Henderson, H. (1988). *The politics of the solar age: Alternatives to economics*. Indianapolis, Ind: Knowledge Systems, Inc.
>
> Hazel Henderson et al., *Calvert-Henderson Quality of Life Indicators*, Calvert Group, 2000.
>
> Henderson, H., Ethical Markets Media., Films for the Humanities & Sciences (Firm), & Films Media Group. (2013). *Fostering Homegrown Reliable Economies*. New York, N.Y: Films Media Group.

[265] Delmarva poultry farmers are very proud that the modern poultry industry originated in Delaware, with Cecile Steel and others. This nostalgia can be placed within a re-imaging that markets chicken with that origin story in mind, as well as placing that sector within a wish to produce chicken for tables, most of them local, while at the same time preserving the health of the Chesapeake Bay.

includes food production marked by kindness (human treatment of animals and agricultural workers) by families living and working on bucolic farms and ranches.

What does this humanities and social science knowledge offer in re-imaging Delmarva poultry production? Design values could be examined and articulated, anchoring in what consumers want, including at higher per unit cost, compared to the relatively low price of chicken experienced by most consumers now. One design value could be that poultry farmers (and slaughter workers) matter in enhanced ways that current food production systems disallow. What incentives – or frank disruptions to food chains, -- could shift control toward farmers away from large, internationally focused companies. This means that power could no longer be vested so completely in the four to six poultry companies who manage production through vertical integration contracts, slaughter and processing, and marketing as well as delivery logistics?

Health: slow emergencies (public health) and sudden disruptions (COVID-19): Poultry farmers are concerned about lung health for themselves, family, poultry workers, and the community. A clear picture about Delmarva-based lung risks remains to be developed with local evidence. Chapter One describes a collaborative study underway now between Maryland state government, the poultry industry, and several a foundation partner. Even through many studies in the U.S. and globally caution about lung risks posed by airborne ammonia and particle pollution, no alarming findings to date concern local health metrics. This lack of evidence may reflect the lower population numbers on the Delmarva Peninsula and local air movement patterns. Simply stated, concentrations of ammonia and particulate matter may not hold long enough in areas where people are concentrated enough for effects to be seen in exiting studies. However, a great deal of cautionary information does exist on another Delmarva poultry industry public health problem: antibiotic resistance associated with poultry production.

Johns Hopkins environmental health scientist Ellen Silbergeld studies the poultry industry and other intensive livestock operations for public health sustainability. She notes the complex, linked problems of food safety, public health, and antibiotic resistance for livestock manure, including poultry litter. Silbergeld's work on Delmarva poultry manure spans more than 30 years (Silbergeld, 2011; 2016). Her synthesis book *Chickenizing* (2016) calls for science-driven poultry production regulation to address the several systemic public health problems bound up in poultry litter.

The poultry industry would counter her proposals, focusing on their industry-wide reduced reliance on antibiotic amendments to feed. Silbergeld applauds this largely industry-based move[266] (lead by Perdue). For example, for all livestock husbandry practices, FDA (2017) reported a 33 percent, one-year decrease in domestic sales/distribution of all antimicrobial products intended for use in food-producing animals. For poultry, nationally, the U.S. Poultry and Egg Association (2019) reported a 95 percent drop in use of in-feed tetracycline for broiler chickens, over the last decade. Most recently, *Poultry Health Today* (2020) reported a huge increase in the number of broiler chickens raised with "no antibiotics ever": 58 percent of total U.S. broiler production in 2019. The 2019 increase in antibiotic-free poultry production is a nearly seven-point increase from the baseline antibiotic use reported in 2018.

Consumer preferences drove antibiotic-free poultry production, in part, due to nostalgic visions of how farming should be. Consumer nostalgia can be harnessed in

[266] Silbergeld is joined by science journalist Maryn McKenna in tracing this industry move to meeting widely expressed consumer preferences about antibiotic-free chicken meat and eggs. See McKenna's 2006 *Big Chicken,* published by the National Geographic Press.

ways that further reform and revise consumer supply chains. Advertising professionals know this.

Yet, reducing antibiotic use is insufficient to address public health risks posed by poultry manure management. Antibiotic-laced feed is not the only driver of the slumbering problem with antibiotic resistance. Livestock excrement – in lagoons for pigs and dairy cattle, as well as in finishing yards for beef cattle – is a breeding ground for the complex microbial interactions that can impair human use of antibiotics to treat infections. All the while, lagoons and poultry litter compost piles can become reservoirs of infectious disease for both animals and people. Silbergeld notes that location can matter in the incidence of disease in human communities near these livestock storage facilities. Her proposed prescriptive regulations would protect public health[267] locally for Delmarva residents as well as broadly. Antibiotic resistance is a problem without borders, both for the health risks to people and animals but also that manure reservoirs are evolutionary breeding grounds for "superbugs" as well as transfer of resistance genes between microbes. For the

[267] Silbergeld's analysis also includes the safety of poultry farmer families, workers, as well as workers in the related slaughter and food packaging sectors.

Chesapeake Bay watershed, microbe transfer to water systems is also a possible serious contact zone for disease spread and harm to aquatic life.

A future for Delmarva poultry could focus more broadly on additional public health concerns, including framing that demonstrates the causal links between human health and ecosystem health. This risk is a slow-moving emergency, documented and predicted by a range of scientists working across several disciplines. At some point, an event may happen, say, catastrophic failure of a class of antibiotics in a region with high volumes of livestock manure or infectious disease outbreak traced to local manure storage (Silbergeld, 2016; McKenna, 2017). Poultry farmers can be future-oriented, too, and stay aware of the risks and possible strategies to mitigate against the worst of these scenarios. Getting risk mitigation right can be insurance against serious disruption and become a competitive advantage under some future disruptions. Slow moving emergencies can erupt suddenly.

Things are the same, until they are not: The COVID-19 pandemic, extending into 2021 at the time of this writing, is a case of a sudden threat to many global systems, including food production by Delmarva farmers and poultry companies.

When a large and sustained emergency, hits an essential socio-economic system like food, geographer Ruth DeFries calls this blow a *hatche*t. A hatchet blow disorients and harms communities. COVID-19 is such a hatchet. DeFries, noted land-use geographer, studies the carbon and other emissions profiles embedded in the spatial conduct of agriculture. Her work is especially concerned with land-use patterns for agriculture and built environments[268] DeFries integrated her land-use research findings with the history of food production in agricultural systems, writing *The Big Ratchet: How Humanity Thrives in the Face of Natural Crisis* (2014).

DeFries' book contrasts *ratchet* changes that are often slow (population increases, improved income standards, and demand) with *hatchet* changes (limiting factors or sudden, unforeseen events including war, environmental collapse, pandemic); then, DeFries describes the resulting *pivot* (solution organized by human response, including technology). Most pivots, thus far in modern agriculture, are successful:

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[268] See Chapter One in this dissertation for brief discussion of Brookings scholar Homi Kharas' work on middle class growth in developing countries over the last three decades.

more and better food distribution, with improved access. Yet, these pivot activities nearly always trigger new ratchets. In this way, the problems are without an endpoint, fitting the widely understood Rittel-Webber definition of *wicked* problems. Hatchets confound these ratchet conditions as they are hard baked into human and earth systems. Still, communities can design for resiliency and flexibility that undergird what a good pivot can look like. Forewarned can be forearmed, with design changes to avoid some of the rachets within systems and the hatches that surprise systems.

The 2019-pandemic can be seen as a hatchet event, with many implications for workers in agriculture and food production, as well as global and domestic supply chains. Pivots early in the pandemic included several reactions, including subscription delivery of groceries, grocery store pick-up, personal shoppers. USDA, among other institutions, gathers data on these changes and others, with some of that analysis starting to become public.

Food disruption has the attention of many policymakers, including in the U.S. Many elements of federal legislative activity include pivot details in many pending bills. Executive actions, including at USDA, focus on these disruptions globally, regionally, and domestically, with emphasis on how farmers are faring. Despite these disruptions, larger food processing companies look to be posting record profits. An additional concern about food processing companies that deal with livestock is the concentration of these companies into what can only be described as oligarchic. Now, just four firms control approximately 55-85% of the market for these three products: beef from cattle, pork from pigs, and meat and egg from poultry (primarily chicken): according to U.S. Department of Agriculture data. This is dramatic consolidation of food production.

Disruptions like COVID-19 can usher in other pivot changes, as described by DeFries. DeFries is one ecological geographer whose work led her to write a book about food systems for popular readers. DeFries uses a trifecta of metaphor – rachet, hatchet, pivot – a time-honored tradition in humanities -- to communicate complexity and help audiences enter a discussion and be persuaded. In this way, DeFries' book is a masterclass in science communication rhetoric. Note, she could have contained this thinking into scientific journals, but she selected the cardinal genre of the humanities: a long form book.

Pivot forces include consumer preferences as well as producer responses. Subscription food services, including for meat, are just one response to the pandemic that may endure. Where consumers and producers meet is described by the crisscross diagram of supply and demand (described as a commonplace image in Chapter Three). Some of these subscription services bring consumers closer to farmers, perhaps eliding or even pushing aside the larger meat processing firms. One quality that supports farm-to-consumer submarkets is nostalgia.

Resilience, efficiency (and scale) facing risk of crisis?[269]: This sense of nostalgia can enter discussion about what ought to be, especially if a grand project could look at ethical, joyful (recall conviviality as a human value discussed in Chapter Two), and green futures for Delmarva poultry production. Kurlinkus' rhetorical analysis of nostalgia (looks backward, to be selective and deliberate about looking forward) is one model (2019). Looking ahead is prudent but consumers often hanker after aspects of a past about food and especially about how farming used to be.

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[269] In addition to food production/livestock manure risks about antibiotic resistance, other food crisis can become endemic to poultry production: bird flu, with risks to food supply and bird-human transmission; COVID-19 and future pandemic effects on poultry consumption, transportation, and the economics of poultry farming, processing, storing, and marketing.

Nostalgia can also be interrogated by rhetorical tools for the false memories of a rosy long ago. Technology and applied science to agriculture including nitrogen-fertilizer practices is essential to feeding an increasingly large population of people and domestic animals. Nostalgia within a critical frame can help a collaborative community sift the past for ideas and practices that could be blueprints, whole or partial, in designing poultry production for climate resilience and sustainability (Daly's conception). For example, the grange[270] movement of U.S. and Canadian farmers is a historical case argument for more communal and cooperative organizations that center farmer knowledge, expertise, and livelihoods.

Nostalgia can also help examine the exploitative history of all land-extraction systems, including human labor and small-scale entrepreneurship. For example, the iconic story of Cecile Steele in founding Delmarva poultry production is also a story of shifted economic power from women to men and later powerful industrial agriculture interests. This overall "chicken" story, including the Delmarva one

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[270] One granger organization was Patrons of Husbandry, also called the Grange, (founded just after the Civil war). The goals were to share improved agriculture methods, as well as address the social and economic needs of farmers and rural communities. Related cooperative activities include the sharing of mechanized farm gear, including threshing machines, and shared silo and other grain storage systems.

documented so well by Williams[271], is largely silent about the Black women and men who were also central actors in this narrative. Nationally, the USDA and other agricultural policy institutions are reexamining the conditions of Black farmers. These current conditions cannot be understood nor policy redress possible without the use of history. Redesign for equity requires cleared-eyed analysis of current conditions and past conditions about the labor conditions of human beings in food production systems.

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[271]Williams was cited in Chapter One. Williams also wrote about slavery in Delaware, as well as environmental history in the state. See

Williams, W. H. (1996). *Slavery and freedom in Delaware, 1639-1865*. Wilmington, Del: SR Books.

Williams, W. H. (2008). *Man and nature in Delaware: An environmental history of the first state, 1631-2000*. Dover, DE: Delaware Heritage Press. (Published posthumously).

MSS 0570, William H. Williams papers, Special Collections, University of Delaware Library, Newark, Delaware.

Back to this dissertation: inviting scientists and humanists to fulsome collaboration: Three methods, somewhat novel to environmental science policy deliberation, are the chief methodological takeaways of this dissertation.

First, **stasis theory from the humanities**: Stasis theory can help arrange the intellectual process and division of labor for designing for poultry industry resiliency. Ammonia management and water quality is one of many, interlinked problems that attend poultry production, processing, transport, and marketing – all for people to prepare and cook food, for eating at tables, often with others. Stasis theory, like scientific method, is stepwise, with earlier stages essential to the question-asking practices of next steps. For scientists and others who think that English studies primarily focus on the narratives and characters of literary genres, this foundational area may be a bit of a surprise but no less welcome. Critical thinking methods from both science and the humanities can work together for problem understanding and problem resolution.

Q-sorting from social sciences: Q-analysis is a mixed method that combines qualitative and quantitative inquiry. Human dimensions components of environmental problems require both types of tools for fuller expression of the role of attitudes and behavior. Chapter Three describes this somewhat underused tool, as well as describes some of the take-aways about poultry farmer viewpoints toward ammonia management strategies. The card-sorting activity at the heart of Q-method holds other values, including an ability to map out the values in a social problem.

The card-sorting in this dissertation is one way – a boundary object, if you will – that can help create collaborative thinking and even partnerships between Delmarva stakeholders toward a sustainable, equitable, and efficient poultry industry within the biophysical confines of the Chesapeake Bay ecosystem. Future-oriented readers who are taken with the idea of citizen sensing and networked pollution monitoring can see these devices as boundary objects, too. Recall that a boundary object helps make meaning across complex knowledge domains without requiring agreement. This idea of seeing a community without requiring agreement to be in community can be part of a theoretical grounding about utility of card sorting events and farmer ammonia monitoring. Even if communities include stakeholders who are wary of one another as they act within Delmarva *chicken politics*, they might find shared values in a data experience and/or sorting cards[272]; sharing boundary object experiences -- poultry futures card sets and networked devices, perhaps -- can build trust for sharing knowledge and deliberating the problem-solution choices.

Finally, the third method[273], which governed the visual design of Q-sorting cards: **visual rhetoric in science communication from the humanities.** in communicating to public audiences about complex environmental findings, including the risks posed to human health and ecosystem health. Chapter Three describes how visual rhetoric and design choices that supported the visual Q-sort cards used in this dissertation study. More generally, visual communication of complexity is essential to meaningful inclusion of non-technical stakeholders in environmental policy deliberation. Though this dissertation study focused on how visual rhetoric and science communication aware shaped design of Q-sorting cards, visualization knowledge can serve a much

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[272] Designing cards and sets could be a rich activity, especially if led within a faith setting with someone like respected atmospheric scientist and evangelical Christian Katherine Heyhoe. Cards sorting does not always need to be part of a Q-study. The activity can be an occasion for collaboration and conversation.

[273] The order of the dissertation chapters presents stasis theory (Chapter Two) and visual rhetoric (Chapter Three) before Q-method and findings (Chapter Four); the dissertation order reflects the methodological order of using stasis theory and visual rhetoric to support content and visual design in the Q-sorting cards.

larger role. Imagining a future requires visual skills. Even the mapping idea toward a desired common future is highly visual as a metaphor to organize the steps to achieve such a destination.

Science fiction is such a pictorial genre about possible futures. Bruce Sterling[274] notes the design use of science fiction in much of his fiction and commentary on science fiction. Afrofuturistic science fiction, including that of Octavia Butler[275] (1947-2006; 1995 MacArthur Foundation "Genius") imagines in rich detail alternative worlds for Black community featuring economic, political, and social systems very different than the past. These vast canvases of a designed worlds are thought experiments, very like how Einstein sought to understand foundational elements of the universe. The

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[274] Sterling, founder of cyberpunk science fiction genre, also supports green design (Viridian projects),\ including his very popular, self-coined "bright green" environmental weblog "Worldchanging". Sterling's sustainable design ideas appear in *Shaping Things* (2005), a taxonomy of created objects, with sustainability a chief design constraint.

[275] Butler's *Kindred* (1979) is set partly in Maryland. She visited Talbot County, on the Delmarva Peninsula for field research. Her time travel-structure in this novel also uses slave narratives to give voice to her characters. Scholars see that both Harriet Tubman's life and Frederick Douglass' writings influenced the structure of her novel.

power to imagine is deeply human, containing seeds of possible worlds[276] and the policy maps to build toward those destinations.

Picturing a Delmarva poultry future; Remembering a Montana dairy farm, I now ask for a moment of personal nostalgia. On one test site for this USDA project in 2012, several young people -- children of the farm joined by neighbors and cousins -- talked about their shared dream of a combined farm. Field crops and both meat birds and egg birds would be raised. One place to sell these goods would be in Amish farm markets up and down the Mid Atlantic. Some of these young people were members of Future Farmers of America[277], a high school club of national organization and closely tied to USDA Cooperative Extension educational programs, like 4H.

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[276] Butler created an entire religious and spiritual philosophy in *Parable of the Sower* (1993), of her Earthseed series. This series depicts how the Earthseed Community survives the imagined environmental, political, and socioeconomic collapse of late 21st-century America. Butler's Earthseed vision centers philosophical views and religious interventions – selected values -- as solutions to the problems this community faces, including farming and food provision. Some young Black urban farmers note Earthseed community as inspiration, including Douglas Adams of Mount Rainier, Maryland who runs New Brooklyn Farms (New York City and Maryland). Adams is looking to raise chickens for eggs and meat with Eco City Farms (Bladensburg), a nonprofit farm started with seed money and technical assistance by the University of Maryland, College Park.

[277] Poultry futures are discussed by young people in both Future Farmers of America (FFA) and 4H; Centrally important to identifying ideas and arguing for policy proposes is the Parliamentary Procedures activity for FFA members, typically in high school. This national program includes several poultry science program areas, as well as areas about farming futures and even agro-ecology practices. These young people already re-imagine their farming futures. Finding ways to bring these programs and events to the larger Delmarva poultry stakeholder community is an important opportunity. Science

These young people expressed hope in keeping land within the family, including for poultry production. One young person expressed a specific interest to try to raise and sell birds, with some of the attributes of the small flocks they raised for family eating. That meant some time out-of-doors, with more varied diets. Could this scale into economically sustainable poultry production? They wonder. As did I, when the USDA CIG project began with air sensor installation at this poultry farm.

I was reminded, long ago, when a beloved local dairy foundered as milk production systems corporatized leaving out small- and mid-scale producers. The Ayrshire Dairy (1908-1973), run by relatives, hosted many community activities, including FFA and 4H, in which I participated. Like the poultry farm just described, this dairy kept a family herd, so that no one would forget how to hand milk. The Mitchell family still

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research programs – high school, as well as FFA and 4H – are places for student contribution to poultry innovation. For example, breeds of chicken are often raised for county and state fair competitions. Often, these breeds are fancy with man aesthetic values. However, students may wish to breed and show for sustainability; keep heritage breeds (work with the Livestock Conservancy, for example) viable, forming a gene stock for resiliency breeding under climate change, and even breeding taste, where FFA and 4H activities could be combined with good synergy. Young people are often freer to work with small flocks on their land than their parents are, given the limits of poultry company contracts. Student-led demonstration projects could be scaled up and deployed through conservation demonstration projects like the farms that are part of the Biophilia Foundation.

holds the land, on the meanders of the Missouri River just south of Great Falls, Montana. The historic barns were taken down in 2017, the lumber sold as vintage reclamation.

Now, I live in Maryland, close to Washington, D.C. Milk delivery is available from four companies, one of them a large coop near Hagerstown, MD. Two of these companies use returnable glass milk bottles. Each of these milk enterprises are organized at some level as a small dairy coop; family dairy farming *right sized* to fit that Goldilocks spot of sustainable, heritage farming. Two of the three dairy coops sell at farmers markets in the Metro DC and Philadelphia areas, along with subscription delivery options. The pandemic moved one of the other companies to join a subscription service for meat, milk, and selected cheeses but under another grocery company offering full-service options for delivery.

What about co-op system for farm-to-home or farm-to-farmer markets as part of Delmarva futures? Could niche markets for help keep more Delmarva family land in poultry production? Can smaller scale experiments – laboratories of right-sized poultry production -- demonstrate economic sustainability with a smaller air and water pollution footprint? Could Delmarva poultry farmers work with urban farmers and Black food system entrepreneurs to improve food choices in underserved communities?

Managing ammonia and particle pollution from Delmarva poultry production is ongoing. Thinking through the details of this work is a narrow and targeted focus; however, this ammonia problem is nested within a larger poultry production system/regional economy that also requires ongoing commitment to helping stakeholders know and trust one another, together building knowledge, deploying technology, and implanting best practices for ammonia remediation and farming.

Might these same young people interested in local poultry production changes also see data participation to get there? Might they build or buy networked air sensing devices to monitor, calibrate, manage their poultry production in collective ways, and work together on remediation strategies?

Ecology is systems science at several scales. Stakeholders in a complex system who hold essential knowledge about food production – including poultry farmers -- should be centered within agro-ecological policy deliberation. Recognition of their embodied knowledge, as well as vulnerability as to livelihood, is important for systems reform that reflects a scale for food production that preserves the provisioning ecosystems of land, air, and water.

Philosopher, rhetoric scholar, and polymath Kenneth Burke (1897-1993), wrote about ecology in his book *Attitudes*, the sense of which was excerpted in a popular magazine, about the power of ecology.

> Among the sciences, there is one little fellow named Ecology, and in time we shall pay him more attention. He teaches us that the total economy of this planet cannot be guided by an efficient rationale of exploitation alone, but that the exploiting part must itself eventually suffer if it too greatly disturbs the balance of the whole (as big beasts would starve, if they succeeded in catching all the little beasts that are their prey their very lack of efficiency in the exploitation of their ability as hunters thus acting as efficiency on a higher level, where considerations of balance count for more than consideration of one tracked purposiveness. (From *Attitudes toward History* and appearing in *Fortune* (1970)[278]

[278] Burke, K. (1959). *Attitudes toward history*. Los Altos, Calif: Hermes Publications.

Bowen, William. "Our New Awareness of the Great Web." *Fortune* Feb. 1970: 198-99.

Story told by Robert Wess, Oregon State University in "Ecocriticism and Kenneth Burke: An Introduction" appearing in the Journal of the Kenneth Burke Society: Volume 2, Issue 2, Spring 2006.

Next, I invoke a moss specialist, forest ecologist, professor, and enrolled member of the Citizen Potawatomi Nation: Robin Wall Kimmerer, PhD.

> Even a wounded world is feeding us. Even a wounded world holds us, giving us moments of wonder and joy. I choose joy over despair. Not because I have my head in the sand, but because joy is what the earth gives me daily and I must return the gift.[279]

[279] Kimmerer, R. W. (2013). Braiding sweetgrass: Indigenous wisdom, scientific knowledge, and the teachings of plants. Milkweed Editions: Minneapolis, MN.

Appendix A: USDA Description

USDA Conservation Innovation Grant: Innovative, Seasonable Technology for Managing Poultry House Emissions: VEBs for Warm Season and Acid Scrubbers for Cold Season

Preface note: This grant provides the occasion for this dissertation, both the overall environmental science-to-policy case, as well as the special topics of using humanities and social science to integrate science communication into an environmental science project. The dissertation author was a co-investigator, at the University of Maryland.

Overview of 2012-2017 USDA CIG Grant

Grantee Name: University of Delaware, University of Maryland, Oklahoma State University, Pennsylvania State University, USDA ARS

Project Title: Innovative approaches to capture nitrogen and air pollutant emissions from poultry operations: VEBs for Warm Season and Acid Scrubbers for Cold Season

Agreement Number: 69-3A75-12-244

Project Director: Hong Li

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Period Start Date: September 1, 2012

Project End Date: August 31, 2017

Summary of key science findings and implications concerning airshed ammonia management in and near poultry houses, of this grant (two findings and two implications). The first finding concerns VEB (vegetated environmental buffer) technology and implications for farmer use of VEBs as well as USDA guidance on these practices to reduce ammonia pollution from poultry production. The second finding concerns detail on how ammonia is deposited in the Choptank River of the Eastern Shore, part of the Chesapeake Bay Watershed. This finding suggests additional scientific analysis of the fate and transport of ammonia from poultry production is necessary, for better understanding of Nitrogen pollution in this location and, perhaps, more generally.

FIRST FINDING: VEB Effectiveness and Design

SUMMARY

1. Distance between the VEB and poultry house fans does not affect the VEB effectiveness nor impede fan function.
2. Ambient wind speed is the most important environmental aspect that effects the effectiveness of VEB capture of air pollution.
    a. The VEB is most effective when the wind is calm, especially at night.
    b. When the wind is more active, the emissions can be picked up and travel over the buffer as opposed to through the buffer.
3. VEBs remove between 20—70% of the poultry-house atmospheric emissions.
4. When trees and shrubs are combined with grasses, with the grasses planted near fan, the emissions can be trapped in the gap between the grasses and adjacent shrub and tree rows.

POLICY IMPLICATION: Revised voluntary best practice standard

NRCS is studying these USDA CIG project findings about VEB effectiveness in remediating ammonia and PM effluent from poultry houses. As a technical line of inquiry advances, NRCS and other USDA entities sometimes promulgate a standard or best practices guideline to assign farmers in using agricultural technology in optimal and cost-effective ways. These findings offer specific guidance to farmers about VEB design and placement. ARS, including ARS Beltsville (part of this project), is reviewing their Soil and Air National Program, with plans to include these findings that quantify the effectiveness of VEBs in capturing poultry emissions (ammonia, PM, and VOCs).

New agricultural practice standards that can include VEBs are being developed by NRCS and several cooperating state and regional partners. These are the existing NRCS practice standard where ammonia control fits: NRCS hedgerow (#380) or NRCS windbreaks (#422).

NRCS is using this USDA CIG research and other research (from combined efforts of university-based researchers and their partners at ARS centers) conducted concerning and quantifying the effectiveness of vegetative buffers (hedgerows) for controlling (mitigating) emissions of airborne particulates, ammonia, and volatile organic compounds emitted from poultry houses. Additionally, some federal, state, county, and regional programs assist in financing[280] of such VEB installations or renewal of aging VEb-like structures.

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[280] Many programs provide technical assistance, with some cost-share options. For example, a USDA EQIP program (2012 in California) offered a combined program for, first, Windbreak/Shelterbelt

VEBs are a variation on a storied land practice by farmers: planting trees and shrubs strategically to better manage land and livestock. Known as hedgerows, windbreaks, and shelterbelts. VEBs, however, deepen the knowledge of this practice, by studying the form and function (size, age, plant composition, soil conditions, performance in weather and across seasons; and renewal) of these plantings to address pollution from agriculture. In Delmarva, the use is primarily directed at poultry-house fan emissions. However, Tyndall and others look at VEBs to remediate air pollution from other livestock operations, including dairy, pigs, and feedlot conditions for cows.

Establishment (No. 380) to work with a program on irrigation (No. 441, 442) to establish this ammonia control system. Here, the name of VEB is not yet common.

In Delaware, no EQIP funding of VEBs directly is underway; however, NRCS-DE works with the nonprofit Delmarva Poultry Industry (DPI) to help farmers with VEBs. For example, while NRCS provided cost-share funding for "poultry windbreaks," DPI provides technical assistance through their Vegetative Environmental Buffers (VEB) program. What is underway, are revisions of terms, as more knowledge becomes clear on how to make a traditional windbreak, a VEB, by design and maintenance elements. VEB mentions are frequent on the NRCS-DE website (search January 2020).

DPI also helps MD poultry farmers, in similar ways; However, the NCRS Website notes some EQIP support for hedgerow, shelterbelt, windbreak that are directed at livestock farmers, including poultry producers, with some of this developing circa 2012. More generally, the current focus by NCRS-MD activity concerns riparian and forest buffering support. Only one mention of a VEB on the NRCS-MD website, January 2020.

NRCS VA notes a few programs of tree plantings for odor control, with cost-sharing plans, with the first ones noted circa 2014. VEBS are not mentioned on their website, as of January 2020.

This USDA CIG grant-based research suggests important finding useful for planning VEB locations. Specifically, researchers showed that ambient wind speed is the most important environmental factor affecting the ability of vegetative buffers to control emissions. Their analysis also shows that the distance between the buffers and the poultry house fans did not affect buffer effectiveness nor impede the function of the fans—the latter being a concern of poultry farmers. This finding of location flexibility of a VEB installation will be welcomed by farmers because they will have more control over the land-use arrangements. This finding that location is less sensitive is also somewhat counter-intuitive to a widely held thought that to be effective, VEBs must be sited in specific proximity to the exhaust fan in narrowly-defined distances. Here, research and hypothesis-testing can improve agricultural technology and serve farmers by developing sound knowledge bases for decision-making.

Based on the results of this USDA CIG research, NRCS officials in Delaware and Maryland are revising their recommended design standards for poultry house hedgerows.[281] The working title on this guidance is "NRCS Conservation Practice

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[281] In Chapter Two and Chapter Five see some discussion about the importance of definitions (stasis two) considers the use of "hedgerow" rather than VEBs; VEBs, hedgerow tradition in agriculture, is a type of long-standing, farmer-embodied knowledge, another way to think about the importance of definitions (stasis two).

Standard 422—Hedgerow Planting" and will include tall, stiff-stemmed grasses (like *Miscanthus* and *Panicum* species) as a first-line or initial barrier, located at the poultry house ventilation fans. Next in line in this hedgerow arrangement --first followed by an intervening gap to allow some particle pollution to settle[282] out—are several rows of shrubs/trees, typically Austree willows, followed by some conifer-types like cedars and *Thuga* species.

This NRCS guidance recognizes that these several layers are an optimum design for capturing emissions but not always feasible, due to space limitations including how closely spaced existing poultry houses are. However, most poultry house arrangements can benefit from some sort of hedgerow-type practice for ammonia and PM capture, as well as visual screening of poultry production from neighbor viewscapes.

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[282] At the site of the poultry house fan, the effluent contains relatively large particles of features and bedding (wood shavings, for example). Letting them drop into this gap between the grasses and the shrubs in the hedgerow helps protect plant leaf surfaces from being so heavily coated with debris-dust to interview with light for photosynthesis (topside of leaves) and gas exchange (underside of leaves).

In promulgating guidance and sharing research results that include ARS technical participation, NRCS runs training workshops for field staff, to include their technical expertise and prepare for direct work with poultry producers. One goal of this step-in technology transfer is to strengthen ARS communication with NRCS and Partner conservation professionals to improve better understanding of how new design attributes of these vegetative buffers can improve hedgerow use by farmers. Further, these consultation- focused events on VEB functions support farmers with environmental footprint management. Discussions drill down to the details level: how to improve installation and lifetime, effectiveness so that farmers can remain in compliance with federal and state regulatory requirements while also maintaining a profitable farming operation. Generally, as VEBs and other plant-based bioremediation strategies have been proffered and deployed (circa early 2000s for VEBs and earlier for riparian buffer[283] strategies) poultry farmers have readily

[283] From environmental science, especially the agroforestry line of inquiry: Riparian buffers are the largely natural vegetation lining the edge of a waterway's bank out through the riparian zone (streams, dry creeks, as well as rivers; some include the overgrown margins of built waterways, including canals and irrigation ditches. These plants *buffer* pollutants from entering the waterway from runoff as well as control erosion and provide some habitat. One of the most important buffering activities to prevent nutrient (including Nitrogen and Phosphorous) input into the watershed. This essential buffering activity gives rise to the name vegetated environmental *buffers.*

adopted the use of these vegetative buffers as an economical and effective method of reducing air and water quality impacts of poultry production.

SECOND FINDING: (re)Thinking critically about agricultural ammonia air deposition in the Chesapeake: In a paper related to this project (Mccarty, 2014), researchers found for the Choptank Estuary, Nitrogen in the form of nitrate (called nitrate-N) is “highly conserved.” What this means is that this “tranche” of Nitrogen found is of long standing in this waterway of the Chesapeake Bay. Most models of eutrophication call for Nitrogen forms entering the water to be quickly consumed in microbial processes. Recall that Nitrogen, along with Phosphorus especially, are nutrients used by water microbes, which is the primary pathway for eutrophication and ultimately, dead zones, in the Bay. Yet, despite this evidence of Nitrogen in the form of Nitrate (N-nitrate) in the Choptank estuary, eutrophication processes still occur seasonally in this estuary. This process of eutrophication requires nutrients (Phosphorus and Carbon) and some form of N. That this volume of N is not consumed in entirety by water microbes poses intriguing questions for those who study Nitrogen fate pathways in the Chesapeake Bay. See also for background: (Mccarty, et al, 2008).

Implication for poultry producers and stakeholders: If this Nitrogen enters the water through atmospheric deposition as of poultry house-derived ammonia, then remediation of airshed ammonia close to the poultry house is a key pollution prevention strategy. This paper notes that an estimated 18,000 metric tons of ammonia are released from poultry houses on the Eastern Shore annually (these figures are difficult to confirm, more broadly in the inquiry). More analysis is forthcoming from these researchers concerning ammonia deposition.

Implications for understanding ammonia mobility: Ammonia fate and transport analysis from agriculture remains an important line of inquiry for environmental scientists. During the past two decades, beginning in earnest in 2000, U.S. scientists have studied atmospheric agricultural emissions with intense scrutiny on those from livestock feeding (AFOs and CAFOs). This activity is in response, in part, to a 2002 National Academy of Science urgent report, calling for the collection emission data from these facilities (National Academy of Science, 2002). One of these agricultural air pollutants of greatest concern is NH3, with poultry manure reportedly contributing 27% of the total NH3 emission in the U.S. (U.S. EPA, 2004).

For the Delmarva Peninsula and the Chesapeake Bay Watershed, ammonia from poultry production is a large source of Nitrogen pollution. At the level of the poultry house, Moore et al. (2011) evaluated NH3 emissions from four tunnel ventilated broiler poultry houses in NW Arkansas. These researchers found that NH3 emissions during the flock grow-out period (in house), between flocks (cleaning and maintenance of house), during storage (of poultry litter + chicken manure) and following land application (poultry litter and chicken manure fertilized fields) were 28.3, 9.09, 0.18, and 7.91 grams of NH3 per bird, respectively. The total NH3 emission, across this “life cycle” of broiler production was 45.5 grams per bird; notably, the majority (82%) of these NH3 emissions occurred while the poultry litter was *still in the poultry house*. In this same study, the authors observed that because most NH3 emission are poultry-house situation, remediation technologies that reduce in-house NH3 should be developed and used.

Additionally, Moore et al. (2011) commented on the value of harnessing available Nitrogen for use as fertilizer. They found the total NH3 emissions for a typical broiler farm with four houses (as described earlier) reported was 15,571 kg N per year, which was higher than the amount of N remaining in the house as litter or cake[284] (14,464 kg N per year). This Nitrogen “loss” at the poultry house exhaust fan not only represents a huge waste of an important natural source form of fertilizer (Nitrogen is generally the number one element limiting crop production), but this effluent also causes substantial air and water pollution. In this way, Nitrogen casts a halo, if forms are in the right place at the right time. Likewise, in the wrong place and wrong time, Nitrogen casts a shadow.

Not all fate movements of this “sticky” molecule are well understood. For example, in England (Jones, 2013) scientists are curious about what might be upwind deposition of ammonia-form Nitrogen. More generally, fate analysis of Nitrogen flux and the human-driven portions of the Nitrogen cycle remain under analysis. For example, a 2019 comprehensive paper, representing a community of Nitrogen-deposition focused scientists in the EU and the UK examines best measures (Payne et al, 2019), with their general preference for metrics with long-histories for the best analysis of deposition patterns. The findings of McCarty and researchers involved in

[284] When poultry litter encounters moisture, the mixture will clump together, which is called “caking”. Too much moisture within a poultry house causes caking. Good ventilation helps keep moisture levels down, preventing conditions that cause cake to form.

this USDA CIG project fit with this methodological emphasis on ammonia fate analysis, including that of what looks to be highly conserved Nitrogen findings—plausibly from poultry farm airshed ammonia deposition.

Global concern about ammonia (from about 2005 forward) as an air pollutant is rising, as levels of many other air pollutants are declining. Most of this ammonia is believed to come from agriculture, especially animal feeding practices.

In considering this unusual finding and inference by these researchers—highly conserved Nitrogen in the Choptank watershed—these researchers surmise that this Nitrogen might arise from the transport of airshed ammonia, likely from poultry house effluent. Note that the form of Nitrogen found in the Choptank is N-Nitrate. Nitrate is the species of Nitrogen that occurs most commonly in water.

Airshed poultry house ammonia capture is the primary focus of the USDA CIG research project that is the subject of this dissertation case study. This novel finding about airshed ammonia deposition as, perhaps, a less-immediate driver of eutrophication in the Choptank watershed is worth inquiry and discussion. Better ammonia control—indeed, remediation of all forms of reactive Nitrogen in the Chesapeake Bay watershed—relies on fuller understanding of the specific fate and transport pathways.

DETAILED PROJECT DESCRIPTION

Project need and context: Implementing best management practices (BMPs) and developing new BMPs or best-available technologies to mitigate Agricultural Feeding Operations (AFO)[285] air emissions have been a focus for the USDA NRCS under the Conservation Innovation Grants (CIG) and Environmental Quality Improvement Programs (EQIP), as well as many Land-Grant university projects.

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[285] Re: Concentrated Agricultural Feeding Operations (CAFO); not all agree about the definitional lines between and AFO entity and a CAFO entity. Currently, most analysts see the typical poultry production operations as AFOs and not CAFOS. However, as poultry house sizes increase, this definitional boundary between poultry as AFO into poultry as CAFO may soon be crossed. Generally, the USDA looks at measures of intensivity to distinguish between types of industrial scale agricultural feeding operations. USDA defines an intensive animal feeding operation (AFO), as one where "…over 1000 animal units are confined for over 45 days a year." Livestock units are defined thusly: "An animal unit is the equivalent of 1000 pounds of "live" animal weight. A thousand animal units equates to 1000 cows, 700 cows used for dairy purposes, 2500 pigs weighing more than 55 lbs., 125,000 [broiler] chickens, or 82,000 egg laying hens or pullets. See this USDA NRCS page for updates. This process of definition began circa 2003, with regulatory updates concerning practices most recently in 2011. https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/livestock/afo/

Scientists, policy experts, government regulators, and farmers all are interested in producing high quality agricultural products in ways that are sensitive to environmental concerns.

Of increasing concern to these stakeholders is the presence of ammonia in the airshed as a serious pollutant. Agricultural sources of ammonia are of great concern, globally, nationally, and regionally. Development of cost-effective air emission mitigation and assessing the effectiveness of these technologies is urgently needed to improve environmental performance and to help producers address increasing Federal regulatory pressures.

Poultry producers and scientists worked together to use vegetative environmental buffers (VEBs) and acid-precipitating scrubbers to capture ammonia (NH3), volatile organic compounds (VOCs), and particulate matter (PM), for five years, in varied conditions, using three different locations.

First, **what are VEBs?** VEBs are strategic "hedgerows" composed of trees, shrubs, and, more recently, grasses planted near the exhaust fans of poultry houses to capture NH3, VOCs, and PM. Recent studies demonstrate that

> 1) VEB plants near fans take up more NH3 than plants located further away from fans,
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> 2) VEB plants can capture particles, and,
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> 3) odors were decreased downwind of VEBs.

Scientists found additional emissions reductions, through the contribution of grasses, especially *Miscanthus* (nonnative annual and perennial grasses) and *Panicum* (native and perennial switchgrass) species, if added to VEBs. Panicum grasses are useful because of their perennial habit and low cost, relative to some shrubs and trees.

VEB findings in this project confirm those of other studies on the effectiveness of VEBs in remediating ammonia from livestock housing. For this project (over three years of experiments series, including five sets of day and nighttime study), VEBs

1. VEBs captured[286] up to 25% of ammonia and PM

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[286] VEBs were more efficient during lower turbulence (low ambient wind speeds).

2. VEBs dispersed some of the plume from the poultry house fans, making for better conditions near the poultry house site. This is important for farmers who live near their poultry houses.

Figure 1: (Far left image) A typical VEB configuration, around a poultry house to bio-remediate ammonia and particle pollution. (Center image) Detail of *Miscanthus* stand, located near the **poultry fan outtake. (Far-right image) Foreground is mature Panicum plant near fan exhaust outtake.** Taken from the CIG program informational website VEB-Scrubber, short version of the final report, at https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/9/706/files/2013/02/FinalReportU_CIG_69-3A75-12-244-262ecmy.pdf

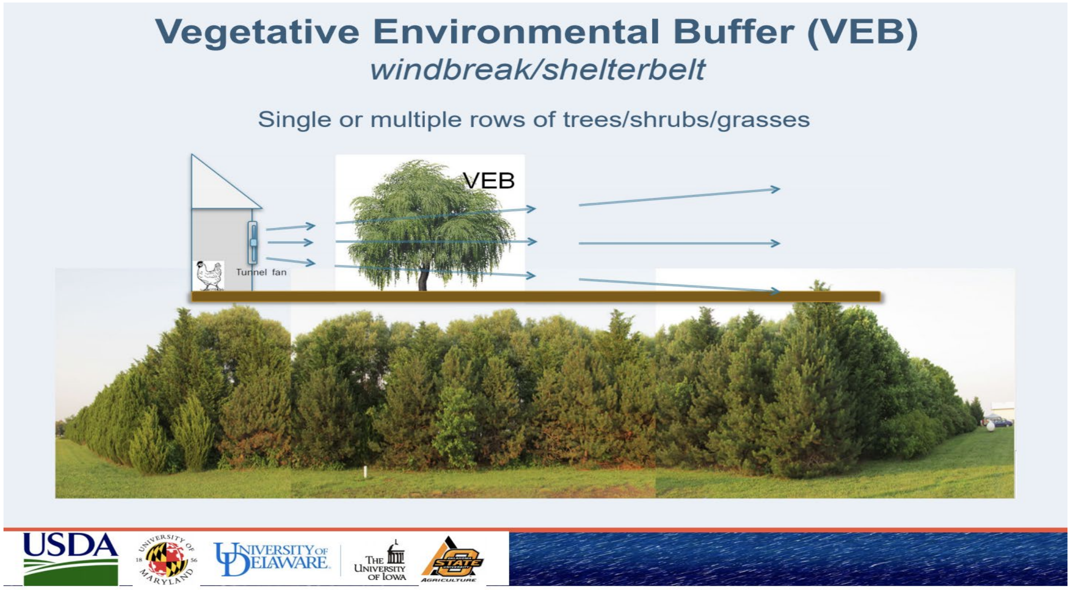

Figure: 2 Project image by C. Hapeman and Marybeth Shea

Secondly, what are **Scrubbers?**: Scrubbers[287] remove ammonia (NH3) gas and PM from poultry exhaust plumes this way: air from inside the poultry house passes through a scrubbing liquid (water and diluted acids) and reacts with the liquid, forming ammonium salts, effectively "scrubbing" the air. Scrubbers can be a powerful tool in reducing both dust and odor; however, many currently available scrubbers are expensive. This USDA CIG study used a prototype scrubber that offered effective remediation at lower cost. Further, this two-stage scrubber system was designed with sustainability in mind: the ammonium salt precipitate from scrubbers could be returned to crop production as a captured fertilizer, and soil

[287] Scrubber systems (Two types: chemical scrubbers and gas scrubbers) air pollution control devices that can remove some pollution, typically in the form of gases or particles, from exhaust streams. Scrubber technology is one of the primary and proven retrofit approaches that help control pollution, including that from power plants. Here, scrubbers help remove sulfur compounds from plant flue gases, which has helped reduce the problem of acid rain dramatically.

amendment.

Figure 3: Two-stage prototype scrubbers, at three locations: Two in Delaware and one in Pennsylvania. From the CIG program informational website VEB-Scrubber, short version of the final report, at https://cpb-us-w2.wpmucdn.com/sites.udel.edu/dist/9/706/files/2013/02/FinalReportU_CIG_69-3A75-12-244-262ecmy.pdf

What is innovative about this study on VEBs and Scrubbers? This project deployed and tested emerging scientific approaches to managing airborne poultry house emissions that used VEBs and scrubbers *in tandem* to achieve environmental goals in a cost-effective, low-impact manner, and considered conditions across the seasons.

Another important aspect of this project concerned field applications. Three broilers farms in Delaware and Pennsylvania were used to quantify the reduction efficiency of VEBs on downwind gaseous and PM concentrations and emissions in warm seasons.

Time-integrated PM, NH3, and VOCs samples were collected at many downwind locations and heights of the three sites with and without VEBs.

RESULTS

VEB Results: Concerning VEB performance at these field-tested sites: Results showed 20% or higher PM and NH3 concentration and emission reductions by the VEBs. VEBs also showed promising potential in decreasing the ozone formation potential (OFP). Ozone is a criteria air pollutant; additionally, Ozone is a lung irritant, which can pose health risks for poultry workers, poultry farmers, and families and communities living close to poultry houses. The health risks due to ozone exposure are dose and time dependent.

VEBs and fan performance: Data, from this analysis and from a review of the literature, also showed that grass VEBs[288] (and grass portions of VEB hedgerows

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[288] Some poultry producers plant grasses—*Miscanthus* and *Panicum* species—very near their fan exhausts. These grasses can provide a close screen to capture effluent gasses and particles and, if damaged by ammonia and particles, can be easily replaced at relatively low cost. These fan-proximate plantings can be used in addition to fuller VEBs, located in other places around the entities poultry houses (often more than one).

constructed of several layers of plants, including shrubs) had negligible adverse effects on fan performance at two times of fan diameters.

Scrubber results: Relatively low-cost two-stage acid scrubbers designed by USDA ARS were installed on minimum exhaust fans and evaluated over an 18-month period on four farms in Arkansas, Delaware, and Pennsylvania. The capturing efficiency of the scrubber on NH3 was up to 44% with daily to weekly maintenance routines

More frequent maintenance tasks and scheduled can significantly improve the capturing efficiency. However, scrubbers are not yet scaled at costs that would fit with most poultry producer budgets. For farmers, the high cost of these scrubber units, coupled with labor-intensive farm-site maintenance schedules, meant that this portion of the analysis was set aside in year-four of the project. See Chapter 3 and 4 for poultry producer reaction to the cost and maintenance of these units.

Research about such scrubber technology continues, with an eye for cost-effective design and ease-of-maintenance schedules. Recapture of the acid-precipitate residue as fertilizer/soil amendment crop field input remains of interest to those developing scrubber options.

In this project, poultry producers and scientists worked together to on two remediation technologies: First, the use of vegetative environmental buffers (VEBs)—planted areas, much like hedgerows— to capture airborne ammonia (NH3, a form of Nitrogen) and particulate matter (PM) exiting poultry houses by exhaust fans. The second technology also concerned the poultry house exhaust fan: an acid-reaction based "scrubbers" to capture (NH3), PM, and other noxious gases called Volatile Organic Compounds (VOCs). The EPA identifies these air pollutant types as criteria air pollutants.[289]

This five-year project deployed and tested—some existing, others emerging—scientific approaches to managing airborne poultry house emissions that used VEBs

[289] Criteria air pollutants (EPA): particulate matter, photochemical oxidants (including ozone), carbon monoxide, sulfur oxides, nitrogen oxides and lead. EPA calls these pollutants "criteria" air pollutants because the agency sets National Ambient Air Quality Standards (NAAQS) of the Clean Air Act (CAA) for them based on these criteria: the latest scientific information regarding their effects on health or welfare.

and scrubbers, including in tandem, to achieve science-based environmental goals in a cost-effective, low-impact manner. Three working broilers farms in Delaware and Pennsylvania were used as site locations to quantify the effectiveness of both VEBs and the scrubbers. Researchers were interested in real-world conditions, including the pollution-remediation efficiency of VEBs in varied wind conditions, as well as what happens across seasons, when temperature also shape air flow conditions, as well as include precipitation in the forms of rain and snow.

One of the methods used by this team of scientists concerned time series measurement. Samples were collected over time and included sampling patterns to reflect many downwind locations of VEBs by distance from exhaust fans. Also studied at each site was the heights of the VEB, which can be a rough measure of the maturity of the VEBs.

Data analysis by several scientists, in consultation with participating poultry producers who lived or worked on the poultry farm site, yielded several useful types of practical knowledge. Among the findings:

> First, VEBs are effective, as documented in the literature, but also confirmed for conditions localized to Delmarva and for poultry production. Results

overall showed reductions of 20% or higher for both NH3 and PM. Both NH3 and PM carry health risks for poultry workers and households near the poultry houses. Remediating airborne pollution, reducing soil and water deposition of NH3 and PM is a desired environmental end-goal of air pollution regulation. The health benefits in lowered air pollution levels are also desired, first as part of the motivation and science for the Clean Air Act, but also desired personally be those who work in poultry production or live adjacent to poultry houses.

Second, in addition to capturing ammonia and particle pollution, VEBs also showed promising potential in decreasing ozone formation potential. Ozone is also a criteria air pollutant. Ozone also carries human health risks.

Third, (discussed above in summary form) several important details about VEB siting and compositions were confirmed.

Fan performance: grass-based VEB portions—comparable to shrub-berms—had negligible adverse effect on fan performance at a two-times-the-distance of fan diameter. In other words, a 24-inch fan by diameter at 48 inches from a VEB planting still accomplished the desired volume of air flow to ensure good circulation with the poultry house.

Site flexibility: for VEBs constructed on a berm, with an arrangement of hardy plants, including large shrubs, location was rather site flexible. This means that poultry producers can place VEBs quite flexibly, in ways that fit their landholdings and existing building footprints.

Regarding the scrubber technology included in this project: relatively low-cost, two-stage acid scrubbers (designed by USDA ARC scientists) were tested on four farm locations. Scrubbers remediate ammonia, primarily, with some residual capture of particle pollution. Scrubbers were installed on selected exhaust fans in poultry houses on these working farm locations. Then, scrubber performance was evaluated over an 18-month period.

The overall capturing efficiency of these scrubber units on NH3 was up to 44% of the total emitted, with scrubbers attended to by onsite labor with a daily to weekly maintenance schedule. More frequent maintenance can significantly improve the capture of NH3. Several technical details of this scrubber retrofit on exhaust fans have returned this option to the drawing board. However, the results are encouraging to capture air pollution from poultry production. What was studied is that scrubber technology can be used with VEBs.

One of the limitations of VEBs concerns winter performance: VEBs, increasingly of interest as options that are both affordable and effective, have seasonal limitations. VEBs are living structures: plants work well in the late spring through early fall when the buffer plants are in full leaf foliage. These VEBS work well during this warm season, which is a boon to farmers because of the high volume of ammonia and particle pollution emitted from fans. Poultry house tunnel fans run more consistently during summer, to lower inside temperatures and cool the birds.

However, buffer efficiency is less late fall and winter, which are dormant seasons for plants. Then, a scrubber offers advantages: working in colder weather, offering a potential option for continued emission reductions over the entire season. Research on scrubbers continues (Moore, 2018).

Concluding remarks: Recent research has shown that over half of nitrogen excreted by chickens is lost into the atmosphere via ammonia volatilization *before the litter is removed from poultry houses*. In "counting" the fate and transport of Nitrogen pollution from poultry production, remediation and capture at the poultry house is strategic and cost effective. Large quantities of particulate matter and volatile organic compounds (VOCs) are also emitted from animal rearing facilities.

Scientists, poultry producers, and analysts need a suite of nitrogen remediation options to meet environmental, human health, and economic goals. Indeed, in the science communication portion of this project (Chapters 2 and 3), several air remediation methods were included in the presentation, with a fuller expression of the mixed and simultaneous goals of all stakeholders: some pollution remediation options might be valued for their provision of mixed benefits. Additionally, understanding more about the fate and transport of Nitrogen-pollution from poultry production can lead to agricultural practices, including the agroforestry use of VEBs to improve the social, economic, and environmental sustainability of poultry production.

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List of institutions/participants

Hong Li, University of Delaware, led this USDA Conservation Innovation Grant (CIG). Li has considerable experience in large scale, multi-year monitoring projects to measure gaseous pollutant and particulate emissions from AFOs, especially poultry operations. He coordinated the team, and oversaw fabrication of the mobile monitoring system, managed the collection of NH3 concentration measurements, and the calibration of site ventilation fans. His university colleagues, Eric Benson, Stephen Collier, and Bill Brown[290], assisted with measurements, especially at DE sites, where distribution modeling was an important activity.

Mike Buser, Oklahoma State University, is an expert in the measurement of PM emissions from agricultural operations and will oversee the installation, collection, and analysis of PM samples. For 10 years, he has worked with Greg Holt, USDA Agriculture Research Service - Lubbock, TX, analyzing PM samples. Buser designed and crafted new sampling equipment for this project and related studies.

Alba Torrents, UMCP, and **Cathleen Hapeman** and **Laura McConnell**, USDA Agriculture Research Service - Beltsville, MD, are experts in environmental sampling and analysis techniques for gaseous and particulate pollutants and have conducted

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[290] Bill Brown died during this project.

many joint studies for over 20 years. They were responsible for carrying out collection and analysis of VOC samples and worked with other team members to coordinate sampling and data analysis, especially at the PA and DE sites.

Philip Moore, USDA Agricultural Research Service - Fayetteville, AK, is an expert in nutrient management and the control of emissions from poultry production; he holds a patent in scrubber technology. He led scrubber construction/installation and coordinated with team members to evaluate scrubber effectiveness.

Paul Patterson and **Greg Martin**, Pennsylvania State University, study the impact of VEBs for NH3, PM, odor, and virus mitigation both in experiments and on commercial poultry farms. They helped manage the PA study site, providing expertise and leadership in outreach and through extension training materials.

Marybeth Shea, environmental consultant at the University of Maryland, developed stakeholder communication documents. Project leaders also participated in outreach activities and conducted field days.

Additional experts:

Qi Yao, University of Delaware

William Willis, University of Iowa

William Eichinger, University of Iowa

John Prueger, USDA ARS

Kyoung Ro, USDA ARS

Greg Holt, USDA ARS

Peter Downey, USDA ARS

Chen Zhang, University of Delaware

Chongyang Li, University of Delaware

River Yang, University of Maryland, USDA ARS Beltsville

Selected publications, presentations, and other communication events (chronological order)

Moore, P. (2013). Development of an Acid Scrubber for Reducing Ammonia Emissions from Animal Rearing Facilities. Waste to Worth. Denver, Colorado. 3/29/2013.

Yao, Q. (2014). Assessing the Release of Ammonia and Particulate Matter Emissions from Poultry Houses. Chesapeake-Potomac Regional Chapter (CPRC) SETAC 2014 Annual Spring Meeting. 4/48/2014

Li, H. (2014). Seasonable Technology for Managing Poultry House Emission, Penn State University Poultry Management and Health Seminar. 5/13/2014

Moore, P. 2014. Development of an Acid Scrubber for Removal of Ammonia from Mechanically Ventilated Broiler Houses. Webinar portal for conservation of natural resources. 5/21/2104

Sutterfield, D. (2014). Design and development of and isokinetic multi-point particulate matter air sampling system. ASABE annual international meeting. 7/14/2014

Moore, P. (2014). Development and Testing of the ARS Ai Scrubber: A Simple Acid Scrubber for Reducing Ammonia, Dust and Odors from Poultry and Swine Facilities. 7/15/2014

Sutterfield, D. (2014). Velocity profile development for a poultry facility acid scrubber. ASABE annual international meeting. 7/16/2014 Li, H. 2014. Effectiveness of Vegetative Environmental Buffers on Trace-Gas Plume Concentration. ASABE annual international meeting. 7/16/2014

Yao, Q. (2014). Utilizing vegetative environmental buffers to mitigate ammonia and particulate matter emissions from poultry houses. 248th ACS National Meeting and Exposition. 8/11/2014

Hapeman, C. (2014). Seasonable Technology for Managing Poultry House Emission. Poultry Buffer Air and Water Quality Training and Field Day. Princess Ann, MD. 10/29/2014

Li, H. (2014). Vegetative environmental buffer for broiler farms. Delmarva Poultry Grower's Field Day. Hurlock, MD. 10/31/2014

Buser, M. (2015). Evaluating the effectiveness of VEBs in mitigating particulate matter emissions from poultry houses. ASABE annual international meeting. 7/20/2016

Yao, Q. (2015). Assessing the effectiveness of vegetative environmental buffers in mitigating air pollutants from poultry houses. Chesapeake-Potomac Regional Chapter (CPRC) SETAC 2015 Annual Spring Meeting. 4/25/2015

Li. H, C. Zhang, H. Xin. (2015). Performance of an infrared photoacoustic single gas analyzer in measuring ammonia from poultry houses. Applied Engineering in Agriculture 31(3):471-477

Zhang, C. (2015). Using wet scrubber to capture ammonia emission from broiler houses ASABE annual meeting. 7/27/2015

Patterson, P. & Martin, G. (2016). Odors and particulates: monitoring, assessments, and control measures. Poultry Science Annual Meeting. 7/11/2016 Craig, C.

2016.Alternative wet scrubber design for removing particulate matter from poultry house ventilation fans. ASABE annual international meeting. 7/19/2016

Zhang, C. (2016). Using wet scrubber to reduce ammonia emission from broiler house. ASABE annual international meeting. 7/20/2016

Buser, M. (2016). Mitigating ammonia and volatile organic compounds (VOCs) emissions from poultry houses using vegetative environmental buffers. ASABE annual international meeting. 7/20/2016

Li, H. (2016). Assessment of fan performances affected by vegetative environmental buffers. ASABE annual international meeting. 7/20/2016 Li, H.,

Hapeman, C. and Shea, M. (2016). Poultry emission and mitigation workshop. Dover, Delaware. 11/2/2016

Yao, Q., Hapeman, C., Li, H., Buser, M., Alfieri, J., Wanjura, J., ... & Torrents, A. (2016, August). Assessing the effectiveness of vegetative environmental buffers in mitigating air pollutant emissions from poultry houses. In *abstracts of papers of the American Chemical Society* (Vol. 252). 1155 16TH ST, NW, Washington, DC 20036

Yao, Qi, Cathleen Hapeman, Hong Li, Michael Buser, Joseph Alfieri, John Wanjura, Laura McConnell et al. (2016) "Assessing the effectiveness of vegetative environmental buffers in mitigating air pollutant emissions from poultry houses." In *abstracts of papers of the American Chemical Society*, vol. 252. 1155 16th ST, NW, Washington, DC 20036 us

Li., H. (2016(. Poultry Air Emissions and Mitigation Technologies. Delaware Ag Week. Delaware State Fairgrounds, Harrington, DE. 1/9/2017

Willis, W. B., Eichinger, W. E., Prueger, J. H., Hapeman, C. J., Li, H., Buser, M. D., & Hatfield, J. L. (2017). Particulate capture efficiency of a vegetative environmental buffer surrounding an animal feeding operation. Agriculture, Ecosystems & Environment 240:101–108.

Willis, W.B., W.E. Eichinger, J.H. Prueger, C.J. Hapeman, H. Li, M.D. Buser, J.L. Hatfield, J.D. Wanjura, G.A. Holt, A. Torrents, S.J. Plenner, W. Clarida, S.D. Browne, P.M. Downey, and Q. Yao. (2017). Lidar method to estimate emission rates from extended sources. J. Atmos. Oceanic Technol. 34, 335–345

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Yang, Z., Yao, Q., Buser, M.D., Alfieri, J.C., Li, H., Torrents, A., McConnell, L.L., Downey, P.M., Hapeman, C.J. (2020). Modification and validation of the Gaussian plume model (GPM) to predict ammonia and particulate matter dispersion. Atmospheric Pollution Research, 11(7), 1063-1072.

Appendix B

Summary

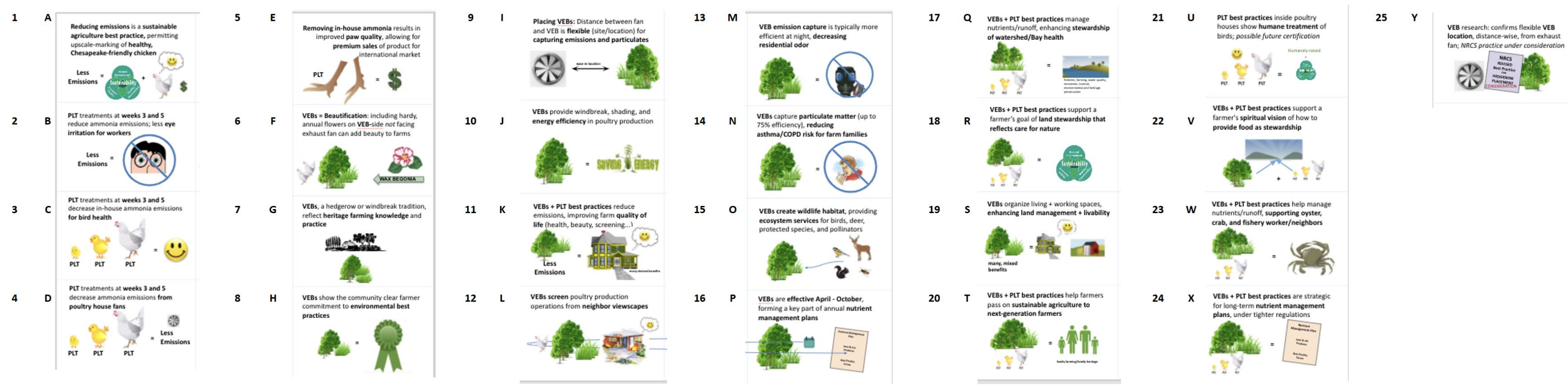
		SUM VOTES (weighted)
A	Emissions ☟=Sust.->CB-friendly 🐔	33
B	PLT=Reduced Eye Irritation	77
C	PLT=Bird Health	81
D	PLT=Emissions ☟	75
E	PLT/Paw Health=Profit	75
F	VEBs=Beautification	39
G	VEBs=Hedgerow/Heritage Farming	43
H	VEBs Show Env. Best Practice	48
I	VEB Distance is Flexible	74
J	VEBs=Energy Efficiency	80
K	VEBs=Improves Farmer Life Quality	61
L	VEBs=Neighborhood Screen	70
M	VEBs=(night eff.)-->☟Res. Odor	73
N	VEBs=Reduces Human Health Risks	80
O	VEBs=Wildlife Habitat	67
P	VEBs (4/12-10/12) Part of NMP	78
Q	VEBs+PLT=CB Stewardship	52
R	VEBs+PLT=Farmer-Stewards	48
S	VEBs UP Management/Livability	61
T	VEBs+PLT= Sus Ag to Next Gen	47
U	PLT=Humane Treatment	61
V	VEBs+PLT= Spiritual Vision/Stewardship	42
W	VEBs+PLT->Fisheries	60
X	VEBs+PLT Anticipate Regs	66
Y	VEBs->NRCS Rewrite	56

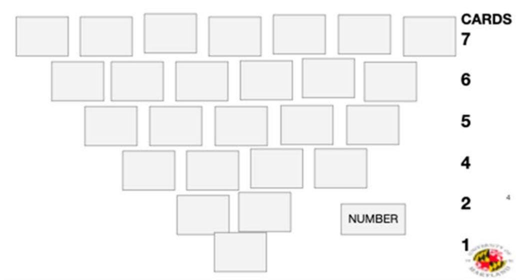
Tentative Color Coding of Card Clusters	
A	Emissions ☟=Sust.->CB-friendly 🐔
B	PLT=Reduced Eye Irritation
C	PLT=Bird Health
D	PLT=Emissions ☟
E	PLT/Paw Health=Profit
F	VEBs=Beautification
G	VEBs=Hedgerow/Heritage Farming
H	VEBs Show Env. Best Practice
I	VEB Distance is Flexible
J	VEBs=Energy Efficiency
K	VEBs=Improves Farmer Life Quality
L	VEBs=Neighborhood Screen
M	VEBs=(night eff.)-->☟Res. Odor
N	VEBs=Reduce Human Health Risks
O	VEBs=Wildlife Habitat
P	VEBs (4/12-10/12) Part of NMP
Q	VEBs+PLT=CB Stewardship
R	VEBs+PLT=Farmer-Stewards
S	VEBs UP Management/Livability
T	VEBs+PLT= Sus Ag to Next Gen
U	PLT=Humane Treatment
V	VEBs+PLT= Spiritual Vision/Stewardship
W	VEBs+PLT->Fisheries
X	VEBs+PLT Anticipate Regs
Y	VEBs->NRCS Rewrite

Notes:
Column A contains A-Y alphabet card IDs. Column B contains short phrase ID.

	SORT FROM LOW TO HIGH	SUM VOTES (weighted)
A	Emissions 👇=Sust.->CB-friendly 🐔	33
F	VEBs=Beautification	39
V	VEBs+PLT= Spiritual Vision/Stewardship	42
G	VEBs=Hedgerow/Heritage Farming	43
T	VEBs+PLT= Sus Ag to Next Gen	47
H	VEBs Show Env. Best Practice	48
R	VEBs+PLT=Farmer-Stewards	48
Q	VEBs+PLT=CB Stewardship	52
Y	VEBs->NRCS Rewrite	56
W	VEBs+PLT->Fisheries	60
K	VEBs=Improves Farmer Life Quality	61
S	VEBs UP Management/Livability	61
U	PLT=Humane Treatment	61
X	VEBs+PLT Anticipate Regs	66
O	VEBs=Wildlife Habitat	67
L	VEBs=Neighborhood Screen	70
M	VEBs=(night eff.)-->👇Res. Odor	73
I	VEB Distance is Flexible	74
D	PLT=Emissions 👇	75
E	PLT/Paw Health=Profit	75
B	PLT=Reduced Eye Irritation	77
P	VEBs (4/12-10/12) Part of NMP	78
J	VEBs=Energy Efficiency	80
N	VEBs=Reduce Human Health Risks	80
C	PLT=Bird Health	81

	SORT FROM HIGH TO LOW	SUM VOTES (weighted)
C	PLT=Bird Health	81
J	VEBs=Energy Efficiency	80
N	VEBs=Reduce Human Health Risks	80
P	VEBs (4/12-10/12) Part of NMP	78
B	PLT=Reduced Eye Irritation	77
D	PLT=Emissions 👇	75
E	PLT/Paw Health=Profit	75
I	VEB Distance is Flexible	74
M	VEBs=(night eff.)-->👇Res. Odor	73
L	VEBs=Neighborhood Screen	70
O	VEBs=Wildlife Habitat	67
X	VEBs+PLT Anticipate Regs	66
K	VEBs=Improves Farmer Life Quality	61
S	VEBs UP Management/Livability	61
U	PLT=Humane Treatment	61
W	VEBs+PLT->Fisheries	60
Y	VEBs->NRCS Rewrite	56
Q	VEBs+PLT=CB Stewardship	52
H	VEBs Show Env. Best Practice	48
R	VEBs+PLT=Farmer-Stewards	48
T	VEBs+PLT= Sus Ag to Next Gen	47
G	VEBs=Hedgerow/Heritage Farming	43
V	VEBs+PLT= Spiritual Vision/Stewardship	42
F	VEBs=Beautification	39
A	Emissions 👇=Sust.->CB-friendly 🐔	33





Notes:
Column I is the card number ID. Typically, card ID is by letter. This is because the sorting pattern of Most important to Least Important is arranged by 7 columns, numbered 107.
25 cards are reproduced here. Columns I and J show both numerical and alphabetical ID, respectively. Typically, alphabetical ID is used for cards. Numbers are used for the sorting columns 1--7, showing Most Important to Least Important.

Vote summaries by column

Part 1 of 2

		SUM VOTES (weighted)	SUM VOTES	sort column 1	VOTES	VOTES (weighted)	sort column 2	VOTES	VOTES (weighted)	sort column 3	VOTES	VOTES (weighted)
A	Emissions 👇=Sust.->CB-friendly 🐔	33	13		2	2		4	8		5	15
B	PLT=Reduced Eye Irritation	77	13		0	0		0	0		1	3
C	PLT=Bird Health	81	13		0	0		0	0		0	0
D	PLT=Emissions 👇	75	13		0	0		0	0		0	0
E	PLT/Paw Health=Profit	75	13		0	0		0	0		1	3
F	VEBs=Beautification	39	13		3	3		2	4		3	9
G	VEBs=Hedgerow/Heritage Farming	43	13		1	1		2	4		6	18
H	VEBs Show Env. Best Practice	48	13		0	0		3	6		5	15
I	VEB Distance is Flexible	74	13		0	0		0	0		0	0
J	VEBs=Energy Efficiency	80	13		0	0		0	0		0	0
K	VEBs=Improves Farmer Life Quality	61	13		0	0		0	0		3	9
L	VEBs=Neighborhood Screen	70	13		0	0		0	0		0	0
M	VEBs=(night eff.)-->👇Res. Odor	73	13		0	0		0	0		1	3
N	VEBs=Reduces Human Health Risks	80	13		0	0		0	0		0	0
O	VEBs=Wildlife Habitat	67	13		0	0		0	0		2	6
P	VEBs (4/12-10/12) Part of NMP	78	13		1	1		0	0		0	0
Q	VEBs+PLT=CB Stewardship	52	13		0	0		2	4		3	9
R	VEBs+PLT=Farmer-Stewards	48	13		1	1		4	8		0	0
S	VEBs UP Management/Livability	61	13		0	0		0	0		2	6
T	VEBs+PLT= Sus Ag to Next Gen	47	13		2	2		2	4		3	9
U	PLT=Humane Treatment	61	13		0	0		2	4		1	3
V	VEBs+PLT= Spiritual Vision/Stewardship	42	13		1	1		3	6		1	3
W	VEBs+PLT->Fisheries	60	13		0	0		0	0		1	3
X	VEBs+PLT Anticipate Regs	66	13		0	0		0	0		1	3
Y	VEBs->NRCS Rewrite	56	13		2	2		2	4		0	0
Sum/Numbers	**Tally check/Talley Weight check**				**13**	**13**		**26**	**52**		**39**	**117**

Part 2 of 2

		sort column	VOTES	VOTES (weighted)	sort column	VOTES	VOTES (weighted)	sort column	VOTES	VOTES (weighted)	sort column	VOTES	VOTES (weighted)
		4			5			6			7		
A	Emissions ¶=Sust.->CB-friendly		2	8		0	0		0	0		0	0
B	PLT=Reduced Eye Irritation		3	12		0	0		1	6		8	56
C	PLT=Bird Health		0	0		2	10		6	36		5	35
D	PLT=Emissions ¶		1	4		2	10		9	54		1	7
E	PLT/Paw Health=Profit		0	0		3	15		6	36		3	21
F	VEBs=Beautification		2	8		3	15		0	0		0	0
G	VEBs=Hedgerow/Heritage Farming		1	4		2	10		1	6		0	0
H	VEBs Show Env. Best Practice		0	0		3	15		2	12		0	0
I	VEB Distance is Flexible		3	12		3	15		2	12		5	35
J	VEBs=Energy Efficiency		0	0		3	15		5	30		5	35
K	VEBs=Improves Farmer Life Quality		1	4		6	30		3	18		0	0
L	VEBs=Neighborhood Screen		2	8		5	25		5	30		1	7
M	VEBs=(night eff.)-->¶Res. Odor		2	8		2	10		4	24		4	28
N	VEBs=Reduces Human Health Risks		2	8		1	5		3	18		7	49
O	VEBs=Wildlife Habitat		2	8		4	20		2	12		3	21
P	VEBs (4/12-10/12) Part of NMP		0	0		2	10		3	18		7	49
Q	VEBs+PLT=CB Stewardship		3	12		3	15		2	12		0	0
R	VEBs+PLT=Farmer-Stewards		3	12		3	15		2	12		0	0
S	VEBs UP Management/Livability		4	16		4	20		2	12		1	7
T	VEBs+PLT= Sus Ag to Next Gen		2	8		1	5		2	12		1	7
U	PLT=Humane Treatment		2	8		3	15		4	24		1	7
V	VEBs+PLT= Spiritual Vision/Stewardship		8	32		0	0		0	0		0	0
W	VEBs+PLT->Fisheries		6	24		3	15		3	18		0	0
X	VEBs+PLT Anticipate Regs		2	8		5	25		5	30		0	0
Y	VEBs->NRCS Rewrite		1	4		2	10		6	36		0	0
Sum/Numbers	**Tally check/Talley Weight check**		**52**	**208**		**65**	**325**		**78**	**468**		**52**	**364**

Notes:
Weighted votes reflect the valuing act of the sorting surface. The right side of the sorting surface is bounded by Sorting Column 7 (column X in this sheet) where respondents place the one card that is most important to them. Sorting Column 1 (column f in this sheet) is where respondents place the one card that is least important to them.

Weighted votes by card

Part 1 of 3

	A	B	C	D	E	F	G	H	I
	Emissions 👇=Sust.->CB-friendly 🐔	PLT=Reduced Eye Irritation	PLT=Bird Health	PLT=Emissions 👇	PLT/Paw Health=Profit	VEBs=Beautification	VEBs=Hedgerow/Heritage Farming	VEBs Show Env. Best Practice	VEB Distance is Flexible
1	**4**	**7**	**7**	**7**	**7**	**5**	**6**	**6**	**7**
2	**4**	**7**	**7**	**6**	**7**	**5**	**5**	**6**	**7**
3	**3**	**7**	**7**	**6**	**7**	**5**	**5**	**5**	**7**
4	**3**	**7**	**7**	**6**	**6**	**4**	**4**	**5**	**7**
5	**3**	**7**	**7**	**6**	**6**	**4**	**3**	**5**	**7**
6	**3**	**7**	**6**	**6**	**6**	**3**	**3**	**3**	**6**
7	**3**	**7**	**6**	**6**	**6**	**3**	**3**	**3**	**6**
8	**2**	**7**	**6**	**6**	**6**	**3**	**3**	**3**	**5**
9	**2**	**6**	**6**	**6**	**6**	**2**	**3**	**3**	**5**
10	**2**	**4**	**6**	**6**	**5**	**2**	**3**	**3**	**5**
11	**2**	**4**	**6**	**5**	**5**	**1**	**2**	**2**	**4**
12	**1**	**4**	**5**	**5**	**5**	**1**	**2**	**2**	**4**
13	**1**	**3**	**5**	**4**	**3**	**1**	**1**	**2**	**4**
Average	2.54	5.92	6.23	5.77	5.77	3.00	3.31	3.69	5.69
Median	3.00	7.00	6.00	6.00	6.00	3.00	3.00	3.00	6.00
St Dev	0.97	1.55	0.73	0.73	1.09	1.53	1.38	1.49	1.25
Min	1.00	3.00	5.00	4.00	3.00	1.00	1.00	2.00	4.00
Max	4.00	7.00	7.00	7.00	7.00	5.00	6.00	6.00	7.00

Part 2 of 3

	J	K	L	M	N	O	P	Q	R
	VEBs=Energy Efficiency	VEBs=Improves Farmer Life Quality	VEBs=Neighborhood Screen	VEBs=(night eff.)-->☟Res. Odor	VEBs=Reduces Human Health Risks	VEBs=Wildlife Habitat	VEBs (4/12-10/12) Part of NMP	VEBs+PLT=CB Stewardship	VEBs+PLT=Farmer-Stewards
1	**7**	**6**	**7**	**7**	**7**	**7**	**7**	**6**	**6**
2	**7**	**6**	**6**	**7**	**7**	**7**	**7**	**6**	**6**
3	**7**	**6**	**6**	**7**	**7**	**7**	**7**	**5**	**5**
4	**7**	**5**	**6**	**7**	**7**	**6**	**7**	**5**	**5**
5	**7**	**5**	**6**	**6**	**7**	**6**	**7**	**5**	**5**
6	**6**	**5**	**6**	**6**	**7**	**5**	**7**	**4**	**4**
7	**6**	**5**	**5**	**6**	**7**	**5**	**7**	**4**	**4**
8	**6**	**5**	**5**	**6**	**6**	**5**	**6**	**4**	**4**
9	**6**	**5**	**5**	**5**	**6**	**5**	**6**	**3**	**2**
10	**6**	**4**	**5**	**5**	**6**	**4**	**6**	**3**	**2**
11	**5**	**3**	**5**	**4**	**5**	**4**	**5**	**3**	**2**
12	**5**	**3**	**4**	**4**	**4**	**3**	**5**	**2**	**2**
13	**5**	**3**	**4**	**3**	**4**	**3**	**1**	**2**	**1**
Average	6.15	4.69	5.38	5.62	6.15	5.15	6.00	4.00	3.69
Median	6.00	5.00	5.00	6.00	7.00	5.00	7.00	4.00	4.00
St Dev	0.80	1.11	0.87	1.33	1.14	1.41	1.68	1.35	1.70
Min	5.00	3.00	4.00	3.00	4.00	3.00	1.00	2.00	1.00
Max	7.00	6.00	7.00	7.00	7.00	7.00	7.00	6.00	6.00

Part 3 of 3

	S	T	U	V	W	X	Y
	VEBs UP Management/Livability	VEBs+PLT= Sus Ag to Next Gen	PLT=Humane Treatment	VEBs+PLT= Spiritual Vision/Stewardship	VEBs+PLT->Fisheries	VEBs+PLT Anticipate Regs	VEBs->NRCS Rewrite
1	**7**	**7**	**7**	**4**	**6**	**6**	**6**
2	**6**	**6**	**6**	**4**	**6**	**6**	**6**
3	**6**	**6**	**6**	**4**	**6**	**6**	**6**
4	**5**	**5**	**6**	**4**	**5**	**6**	**6**
5	**5**	**4**	**6**	**4**	**5**	**6**	**6**
6	**5**	**4**	**5**	**4**	**5**	**5**	**6**
7	**5**	**3**	**5**	**4**	**4**	**5**	**5**
8	**4**	**3**	**5**	**4**	**4**	**5**	**5**
9	**4**	**3**	**4**	**3**	**4**	**5**	**4**
10	**4**	**2**	**4**	**2**	**4**	**5**	**2**
11	**4**	**2**	**3**	**2**	**4**	**4**	**2**
12	**3**	**1**	**2**	**2**	**4**	**4**	**1**
13	**3**	**1**	**2**	**1**	**3**	**3**	**1**
Average	4.69	3.62	4.69	3.23	4.62	5.08	4.31
Median	5.00	3.00	5.00	4.00	4.00	5.00	5.00
St Dev	1.18	1.94	1.60	1.09	0.96	0.95	2.06
Min	3.00	1.00	2.00	1.00	3.00	3.00	1.00
Max	7.00	7.00	7.00	4.00	6.00	6.00	6.00

Notes:
Information comes from Vote tally sheets (1-4), representing a series of transformations including stripping code to leave values only in cells within arrangements. One goal: data preparation for box plot visualizations.

Vote tally raw (unweighted)
Part 1 of 11

		A	A	F	F	F	G	P	R	T	T	V	Y	Y	A	A	A	A	F	F	G	G	H	H	H	Q	Q	R	R	R	R	T	T
A	Emissions ↓=Sust.->CB-friendly	1	1	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	PLT=Emissions ↓	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	0	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->↓Res. Odor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	2	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
U	PLT=Humane Treatment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

		U	U	V	V	V	Y	Y	A	A	A	A	A	B	E	F	F	F	G	G	G	G	G	G	H	H	H	H	H	K	K	K	M
A	Emissions ¶=Sust.->CB-friendly	0	0	0	0	0	0	0	3	3	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	PLT=Emissions ¶	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	3	0	0	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	3	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->¶Res. Odor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
N	VEBs=Reduces Human Health Risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	PLT=Humane Treatment	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

		O	O	Q	Q	Q	S	S	T	T	T	U	V	W	X	A	A	B	B	B	D	F	F	G	I	I	I	K	L	L	M	M	N
A	Emissions ¶=Sust.->CB-friendly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	PLT=Emissions ¶	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0
M	VEBs=(night eff.)-->¶Res. Odor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0
N	VEBs=Reduces Human Health Risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
O	VEBs=Wildlife Habitat	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	0	0	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	0	3	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	PLT=Humane Treatment	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		3	3	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

		N	O	O	Q	Q	Q	R	R	R	S	S	S	S	T	T	U	U	V	V	V	V	V	V	V	V	W	W	W	W	W	W	X
A	Emissions ¶=Sust.->CB-friendly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	PLT=Emissions ¶	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->¶Res. Odor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	0	0	0	4	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	PLT=Humane Treatment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	4	4	4	4	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Y	VEBs->NRCS Rewrite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

		X	Y	C	C	D	D	E	E	E	F	F	F	G	G	H	H	H	I	I	I	J	J	J	K	K	K	K	K	K	L	L	L
A	Emissions ¶=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**5**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶	**0**	**0**	**0**	**0**	**5**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**5**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**5**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**5**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**5**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**5**	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**5**	**5**	**5**	**5**	**5**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5**	**5**	**5**
M	VEBs=(night eff.)-->¶Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

		L	L	M	M	N	O	O	O	O	P	P	Q	Q	Q	R	R	R	S	S	S	S	T	U	U	U	W	W	W	X	X	X	X
A	Emissions ↓=Sust.->CB-friendly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	PLT=Emissions ↓	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->↓Res. Odor	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	0	0	0	0	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	0	0	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	0	0	0	0	0	0	0	0	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	5	5	0	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0
U	PLT=Humane Treatment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	5	0	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	5	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5	5	5
Y	VEBs->NRCS Rewrite	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

		X	Y	Y	B	C	C	C	C	C	C	D	D	D	D	D	D	D	D	D	E	E	E	E	E	E	G	H	H	I	I	J	J
A	Emissions ¶=Sust.->CB-friendly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	6	6	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	PLT=Emissions ¶	0	0	0	0	0	0	0	0	0	0	6	6	6	6	6	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	6	6	6	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	6
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->¶Res. Odor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	PLT=Humane Treatment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	0	5	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6

		J	*J*	*J*	*K*	*K*	*K*	*L*	*L*	*L*	*L*	*L*	*M*	*M*	*M*	*M*	*N*	*N*	*N*	*O*	*O*	*P*	*P*	*P*	*Q*	*Q*	*R*	*R*	*S*	*S*	*T*	*T*	*U*
A	Emissions ¶=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**6**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**6**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**6**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**6**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6

		U	U	U	W	W	W	X	X	X	X	X	Y	Y	Y	Y	Y	Y	B	B	B	B	B	B	B	B	C	C	C	C	C	D	E
A	Emissions ¶=Sust.->CB-friendly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	7	7	7	7	7	7	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	7	7	7	7	0	0
D	PLT=Emissions ¶	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
F	VEBs=Beautification	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->¶Res. Odor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	PLT=Humane Treatment	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	6	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	0	0	0	0	0	0	0	0	0	0	0	6	6	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

		E	E	I	I	I	I	I	J	J	J	J	J	L	M	M	M	M	N	N	N	N	N	N	N	O	O	O	P	P	P	P	P
A	Emissions ☟=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**7**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**7**	**7**	**7**	**7**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**7**	**7**	**7**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**7**	**7**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**7**	**7**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**7**	**7**	**7**	**7**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7

Part 11 of 11

		P	*P*	*S*	*T*	*U*
A	Emissions ¶=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**7**	**7**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**7**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**7**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**7**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**
		7	7	7	7	7

Vote tally 1 (first cut; weight)
Sort column 1 of 7: Part 1 of 4

		sort column	VOTES	VOTES (weighted)																					
		1			*A*	*A*	*F*	*F*	*F*	*G*	*P*	*R*	*T*	*T*	*V*	*Y*	*Y*								
A	Emissions 👇=Sust.->CB-friendly 🐔		2	2	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions 👇		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification		3	3	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming		1	1	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->👇Res. Odor		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP		1	1	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards		1	1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen		2	2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship		1	1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite		2	2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
			13	13	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0

Sort column 1 of 7: Part 2 of 4

	sort column 1																				
A	Emissions ¶=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**A**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**B**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**C**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶	**0**	**0**	**0**	**0**	**0**	**0**	**D**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**E**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**F**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**G**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**H**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**I**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**J**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**K**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**L**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**M**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**N**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**O**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**P**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**Q**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**R**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**T**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**U**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**V**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**W**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**X**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**Y**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sort column 1 of 7: Part 3 of 4

	sort column 1																				
A	Emissions ☟=Sust.->CB-friendly 🐔	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**A**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**B**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**C**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**D**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**E**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**F**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**G**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**H**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**I**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**J**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**K**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**L**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**M**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**N**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**O**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**P**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Q**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**R**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**T**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**U**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**V**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**W**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**X**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Y**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0

Sort column 1 of 7: Part 4 of 4

	sort column 1																		
A	Emissions ☟=Sust.->CB-friendly 🐔	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sort column 2 of 7: Part 1 of 4

	sort column	VOTES	VOTES (weighted)	A	A	A	A	F	F	G	G	H	H	H	Q	Q	R	R	R	R	T	T	U	U
	2																							
A	Emissions ☟=Sust.->CB-friendly 🐔	4	8	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	PLT=Emissions ☟	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	VEBs=Beautification	2	4	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	2	4	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	3	6	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->☟Res. Odor	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	2	4	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	4	8	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
U	PLT=Humane Treatment	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
V	VEBs+PLT= Spiritual Vision/Stewardship	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		26	52	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 2 of 7: Part 2 of 4

	sort column 2	V	V	V	Y	Y																
A	Emissions ¶=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**A**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**B**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**C**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶	**0**	**0**	**0**	**0**	**0**	**0**	**D**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**E**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**F**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**G**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**H**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**I**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**J**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**K**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**L**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**M**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**N**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**O**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**P**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**Q**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**R**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**T**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**U**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**1**	**1**	**1**	**0**	**0**	**0**	**V**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**W**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**X**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**1**	**1**	**0**	**Y**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		1	1	1	1	1	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sort column 2 of 7: Part 3 of 4

	sort column 2																					
A	Emissions ¶=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**A**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**B**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**C**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**D**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**E**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**F**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**G**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**H**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**I**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**J**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**K**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**L**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**M**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**N**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**O**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**P**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Q**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**R**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**T**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**U**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**V**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**W**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**X**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Y**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0

Sort column 2 of 7: Part 4 of 4

	sort column 2																		
A	Emissions ☟=Sust.->CB-friendly 🐔	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sort column 3 of 7: Part 1 of 4

		sort column	VOTES	VOTES (weighted)																					
		3			*A*	*A*	*A*	*A*	*A*	*B*	*E*	*F*	*F*	*F*	*G*	*G*	*G*	*G*	*G*	*G*	*H*	*H*	*H*	*H*	*H*
A	Emissions ☟=Sust.->CB-friendly 🐔		5	15	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation		1	3	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit		1	3	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification		3	9	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming		6	18	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice		5	15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**
I	VEB Distance is Flexible		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality		3	9	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor		1	3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat		2	6	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship		3	9	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability		2	6	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen		3	9	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment		1	3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship		1	3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries		1	3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs		1	3	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
			39	117	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 3 of 7: Part 2 of 4

	sort column 3	K	K	K	M	O	O		Q	Q	Q	S	S	T	T	T	U	V	W	X		
A	Emissions ¶=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**A**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**B**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**C**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶	**0**	**0**	**0**	**0**	**0**	**0**	**D**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**E**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**F**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**G**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**H**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**I**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**J**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**1**	**1**	**1**	**0**	**0**	**0**	**K**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**L**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor	**0**	**0**	**0**	**1**	**0**	**0**	**M**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**N**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**1**	**1**	**O**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**P**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**Q**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**R**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**T**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**U**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**V**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**W**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**X**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**Y**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	0	0

Sort column 3 of 7: Part 3 of 4

	sort column 3																					
A	Emissions ¶=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**A**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**B**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**C**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**D**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**E**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**F**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**G**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**H**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**I**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**J**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**K**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**L**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**M**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**N**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**O**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**P**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Q**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**R**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**T**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**U**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**V**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**W**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**X**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Y**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0

Sort column 3 of 7: Part 4 of 4

	sort column 3																		
A	Emissions ☟=Sust.->CB-friendly 🐔	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sort column 4 of 7: Part 1 of 4

		sort column	VOTES	VOTES (weighted)																					
		4			*A*	*A*	*B*	*B*	*B*	*D*	*F*	*F*	*G*	*I*	*I*	*I*	*K*	*L*	*L*	*M*	*M*	*N*	*N*	*O*	*O*
A	Emissions 👇=Sust.->CB-friendly 🐔		2	8	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation		3	12	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions 👇		1	4	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification		2	8	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming		1	4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible		3	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality		1	4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen		2	8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->👇Res. Odor		2	8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks		2	8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**
O	VEBs=Wildlife Habitat		2	8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
P	VEBs (4/12-10/12) Part of NMP		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship		3	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards		3	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability		4	16	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen		2	8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment		2	8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship		8	32	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries		6	24	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs		2	8	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite		1	4	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
			52	208	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 4 of 7: Part 2 of 4

	sort column 4	Q	Q	Q	R	R	R		S	S	S	S	T	T	U	U	V	V	V	V	V	V
A	Emissions ¶=Sust.->CB-friendly	0	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	PLT=Emissions ¶	0	0	0	0	0	0	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	0	0	0	0	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	H	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	J	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	K	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	L	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->¶Res. Odor	0	0	0	0	0	0	M	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	0	0	0	0	0	0	N	0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	0	0	0	0	0	O	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	1	1	1	0	0	0	Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	1	1	1	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	S	1	1	1	1	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	T	0	0	0	0	1	1	0	0	0	0	0	0	0	0
U	PLT=Humane Treatment	0	0	0	0	0	0	U	0	0	0	0	0	0	1	1	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	V	0	0	0	0	0	0	0	0	1	1	1	1	1	1
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	0	0	0	0	0	0	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 4 of 7: Part 3 of 4

	sort column 4	V	V	W	W	W	W	W	W	X	X	Y										
A	Emissions ↓=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**A**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**B**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**C**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ↓	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**D**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**E**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**F**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**G**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**H**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**I**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**J**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**K**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**L**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->↓Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**M**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**N**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**O**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**P**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Q**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**R**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**T**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**U**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**V**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**W**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**X**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**Y**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		1	1	1	1	1	1	1	1	1	1	1	0	0		0	0	0	0	0	0	0

Sort column 4 of 7: Part 4 of 4

	sort column **4**																		
A	Emissions ☟=Sust.->CB-friendly 🐔	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sort column 5 of 7: Part 1 of 4

		sort column	VOTES	VOTES (weighted)																					
		5			*C*	*C*	*D*	*D*	*E*	*E*	*E*	*F*	*F*	*F*	*G*	*G*	*H*	*H*	*H*	*I*	*I*	*I*	*J*	*J*	*J*
A	Emissions ☟=Sust.->CB-friendly 🐔		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health		2	10	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟		2	10	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit		3	15	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification		3	15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming		2	10	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice		3	15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible		3	15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**
J	VEBs=Energy Efficiency		3	15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**
K	VEBs=Improves Farmer Life Quality		6	30	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen		5	25	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor		2	10	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks		1	5	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat		4	20	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP		2	10	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship		3	15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards		3	15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability		4	20	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen		1	5	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment		3	15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries		3	15	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs		5	25	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite		2	10	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
			65	325	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 5 of 7: Part 2 of 4

	sort column 5	K	K	K	K	K	K		L	L	L	L	L	M	M	N	O	O	O	O	P	P
A	Emissions ¶=Sust.->CB-friendly	0	0	0	0	0	0	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	B	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	C	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D	PLT=Emissions ¶	0	0	0	0	0	0	D	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	0	0	0	0	F	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	G	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	H	0	0	0	0	0	0	0	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	I	0	0	0	0	0	0	0	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	J	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	1	1	1	1	1	1	K	0	0	0	0	0	0	0	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	L	1	1	1	1	1	0	0	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->¶Res. Odor	0	0	0	0	0	0	M	0	0	0	0	0	1	1	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	0	0	0	0	0	0	N	0	0	0	0	0	0	0	1	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	0	0	0	0	0	O	0	0	0	0	0	0	0	0	1	1	1	1	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	P	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Q	VEBs+PLT=CB Stewardship	0	0	0	0	0	0	Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	R	0	0	0	0	0	0	0	0	0	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	S	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	T	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	PLT=Humane Treatment	0	0	0	0	0	0	U	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	V	0	0	0	0	0	0	0	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	W	0	0	0	0	0	0	0	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	0	0	0	0	0	0	Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 5 of 7: Part 3 of 4

		sort column																					
		5	Q	Q	Q	R	R	R	S	S	S	S	T	U	U		U	W	W	W	X	X	X
A	Emissions ¶=Sust.->CB-friendly		0	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation		0	0	0	0	0	0	0	0	0	0	0	0	0	B	0	0	0	0	0	0	0
C	PLT=Bird Health		0	0	0	0	0	0	0	0	0	0	0	0	0	C	0	0	0	0	0	0	0
D	PLT=Emissions ¶		0	0	0	0	0	0	0	0	0	0	0	0	0	D	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit		0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	0	0
F	VEBs=Beautification		0	0	0	0	0	0	0	0	0	0	0	0	0	F	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming		0	0	0	0	0	0	0	0	0	0	0	0	0	G	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice		0	0	0	0	0	0	0	0	0	0	0	0	0	H	0	0	0	0	0	0	0
I	VEB Distance is Flexible		0	0	0	0	0	0	0	0	0	0	0	0	0	I	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency		0	0	0	0	0	0	0	0	0	0	0	0	0	J	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality		0	0	0	0	0	0	0	0	0	0	0	0	0	K	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen		0	0	0	0	0	0	0	0	0	0	0	0	0	L	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->¶Res. Odor		0	0	0	0	0	0	0	0	0	0	0	0	0	M	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks		0	0	0	0	0	0	0	0	0	0	0	0	0	N	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat		0	0	0	0	0	0	0	0	0	0	0	0	0	O	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP		0	0	0	0	0	0	0	0	0	0	0	0	0	P	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship		1	1	1	0	0	0	0	0	0	0	0	0	0	Q	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards		0	0	0	1	1	1	0	0	0	0	0	0	0	R	0	0	0	0	0	0	0
S	VEBs UP Management/Livability		0	0	0	0	0	0	1	1	1	1	0	0	0	S	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen		0	0	0	0	0	0	0	0	0	0	1	0	0	T	0	0	0	0	0	0	0
U	PLT=Humane Treatment		0	0	0	0	0	0	0	0	0	0	0	1	1	U	1	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship		0	0	0	0	0	0	0	0	0	0	0	0	0	V	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries		0	0	0	0	0	0	0	0	0	0	0	0	0	W	0	1	1	1	0	0	0
X	VEBs+PLT Anticipate Regs		0	0	0	0	0	0	0	0	0	0	0	0	0	X	0	0	0	0	1	1	1
Y	VEBs->NRCS Rewrite		0	0	0	0	0	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0
			1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1

Sort column 5 of 7: Part 4 of 4

	sort column 5	X	X	Y	Y														
A	Emissions ¶=Sust.->CB-friendly	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sort column 6 of 7: Part 1 of 4

		sort column	VOTES	VOTES (weighted)																					
		6			*B*	*C*	*C*	*C*	*C*	*C*	*C*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*E*	*E*	*E*	*E*	*E*
A	Emissions ¶=Sust.->CB-friendly		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation		1	6	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health		6	36	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶		9	54	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit		6	36	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**
F	VEBs=Beautification		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming		1	6	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice		2	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible		2	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency		5	30	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality		3	18	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen		5	30	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor		4	24	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks		3	18	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat		2	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP		3	18	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship		2	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards		2	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability		2	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen		2	12	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment		4	24	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries		3	18	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs		5	30	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite		6	36	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
			78	468	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 6 of 7: Part 2 of 4

	sort column 6	*E*	*G*	*H*	*H*	*I*	*I*		*J*	*J*	*J*	*J*	*J*	*K*	*K*	*K*	*L*	*L*	*L*	*L*	*L*	*M*
A	Emissions 👇=Sust.->CB-friendly 🐔	**0**	**0**	**0**	**0**	**0**	**0**	**A**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**B**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**C**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions 👇	**0**	**0**	**0**	**0**	**0**	**0**	**D**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**1**	**0**	**0**	**0**	**0**	**0**	**E**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**F**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**1**	**0**	**0**	**0**	**0**	**G**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**1**	**1**	**0**	**0**	**H**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**1**	**1**	**I**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**J**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**K**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**L**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**
M	VEBs=(night eff.)-->👇Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**M**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**N**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**O**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**P**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**Q**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**R**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**T**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**U**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**V**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**W**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**X**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**Y**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 6 of 7: Part 3 of 4

	sort column 6	M	M	M	N	N	N	O	O	P	P	P	Q	Q		R	R	S	S	T	T	U
A	Emissions 👇=Sust.->CB-friendly 🐔	0	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	0	0	0	0	0	0	0	B	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	0	0	0	0	0	0	0	C	0	0	0	0	0	0	0
D	PLT=Emissions 👇	0	0	0	0	0	0	0	0	0	0	0	0	0	D	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	0	0	0	0	0	0	0	0	0	0	0	F	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	0	0	0	0	0	0	0	G	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	0	0	0	0	0	0	0	H	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	I	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	J	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	K	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	0	0	0	0	0	0	0	L	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->👇Res. Odor	1	1	1	0	0	0	0	0	0	0	0	0	0	M	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	0	0	0	1	1	1	0	0	0	0	0	0	0	N	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	0	0	0	0	0	0	1	1	0	0	0	0	0	O	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	0	0	0	0	0	0	0	1	1	1	0	0	P	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	0	0	0	0	0	0	0	0	0	0	0	1	1	Q	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	0	0	0	0	0	0	0	R	1	1	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	0	0	0	0	0	0	0	S	0	0	1	1	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	0	0	0	0	0	0	0	T	0	0	0	0	1	1	0
U	PLT=Humane Treatment	0	0	0	0	0	0	0	0	0	0	0	0	0	U	0	0	0	0	0	0	1
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	V	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	W	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	0	0	0	0	0	0	0	X	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	0	0	0	0	0	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	1	1	1	1	1	1		1	1	1	1	1	1	1

Sort column 6 of 7: Part 4 of 4

	sort column																		
	6	***U***	***U***	***U***	***W***	***W***	***W***	***X***	***X***	***X***	***X***	***X***	***Y***	***Y***	***Y***	***Y***	***Y***	***Y***	
A	Emissions 👇=Sust.->CB-friendly 🐔	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions 👇	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->👇Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**0**
		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0

Sort column 7 of 7: Part 1 of 4

		sort column	VOTES	VOTES (weighted)																					
		7			*B*	*B*	*B*	*B*	*B*	*B*	*B*	*B*	*C*	*C*	*C*	*C*	*C*	*D*	*E*	*E*	*E*	*I*	*I*	*I*	*I*
A	Emissions ☟=Sust.->CB-friendly 🐔		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation		8	56	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health		5	35	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟		1	7	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit		3	21	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**0**	**0**
F	VEBs=Beautification		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible		5	35	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
J	VEBs=Energy Efficiency		5	35	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen		1	7	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor		4	28	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks		7	49	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat		3	21	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP		7	49	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability		1	7	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen		1	7	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment		1	7	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite		0	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
			52	364	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 7 of 7: Part 2 of 4

		sort column																					
		7	***I***	***J***	***J***	***J***	***J***	***J***		***L***	***M***	***M***	***M***	***M***	***N***	***N***	***N***	***N***	***N***	***N***	***N***	***O***	***O***
A	Emissions ¶=Sust.->CB-friendly		**0**	**0**	**0**	**0**	**0**	**0**	**A**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation		**0**	**0**	**0**	**0**	**0**	**0**	**B**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health		**0**	**0**	**0**	**0**	**0**	**0**	**C**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ¶		**0**	**0**	**0**	**0**	**0**	**0**	**D**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit		**0**	**0**	**0**	**0**	**0**	**0**	**E**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification		**0**	**0**	**0**	**0**	**0**	**0**	**F**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming		**0**	**0**	**0**	**0**	**0**	**0**	**G**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice		**0**	**0**	**0**	**0**	**0**	**0**	**H**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible		**1**	**0**	**0**	**0**	**0**	**0**	**I**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency		**0**	**1**	**1**	**1**	**1**	**1**	**J**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality		**0**	**0**	**0**	**0**	**0**	**0**	**K**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen		**0**	**0**	**0**	**0**	**0**	**0**	**L**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->¶Res. Odor		**0**	**0**	**0**	**0**	**0**	**0**	**M**	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks		**0**	**0**	**0**	**0**	**0**	**0**	**N**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**
O	VEBs=Wildlife Habitat		**0**	**0**	**0**	**0**	**0**	**0**	**O**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**
P	VEBs (4/12-10/12) Part of NMP		**0**	**0**	**0**	**0**	**0**	**0**	**P**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship		**0**	**0**	**0**	**0**	**0**	**0**	**Q**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards		**0**	**0**	**0**	**0**	**0**	**0**	**R**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability		**0**	**0**	**0**	**0**	**0**	**0**	**S**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen		**0**	**0**	**0**	**0**	**0**	**0**	**T**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment		**0**	**0**	**0**	**0**	**0**	**0**	**U**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship		**0**	**0**	**0**	**0**	**0**	**0**	**V**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries		**0**	**0**	**0**	**0**	**0**	**0**	**W**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs		**0**	**0**	**0**	**0**	**0**	**0**	**X**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite		**0**	**0**	**0**	**0**	**0**	**0**	**Y**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
			1	1	1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sort column 7 of 7: Part 3 of 4

	sort column 7	O	P	P	P	P	P	P	P	S	T	U										
A	Emissions ↓=Sust.->CB-friendly	0	0	0	0	0	0	0	0	0	0	0	0	0	A	0	0	0	0	0	0	0
B	PLT=Reduced Eye Irritation	0	0	0	0	0	0	0	0	0	0	0	0	0	B	0	0	0	0	0	0	0
C	PLT=Bird Health	0	0	0	0	0	0	0	0	0	0	0	0	0	C	0	0	0	0	0	0	0
D	PLT=Emissions ↓	0	0	0	0	0	0	0	0	0	0	0	0	0	D	0	0	0	0	0	0	0
E	PLT/Paw Health=Profit	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	0	0
F	VEBs=Beautification	0	0	0	0	0	0	0	0	0	0	0	0	0	F	0	0	0	0	0	0	0
G	VEBs=Hedgerow/Heritage Farming	0	0	0	0	0	0	0	0	0	0	0	0	0	G	0	0	0	0	0	0	0
H	VEBs Show Env. Best Practice	0	0	0	0	0	0	0	0	0	0	0	0	0	H	0	0	0	0	0	0	0
I	VEB Distance is Flexible	0	0	0	0	0	0	0	0	0	0	0	0	0	I	0	0	0	0	0	0	0
J	VEBs=Energy Efficiency	0	0	0	0	0	0	0	0	0	0	0	0	0	J	0	0	0	0	0	0	0
K	VEBs=Improves Farmer Life Quality	0	0	0	0	0	0	0	0	0	0	0	0	0	K	0	0	0	0	0	0	0
L	VEBs=Neighborhood Screen	0	0	0	0	0	0	0	0	0	0	0	0	0	L	0	0	0	0	0	0	0
M	VEBs=(night eff.)-->↓Res. Odor	0	0	0	0	0	0	0	0	0	0	0	0	0	M	0	0	0	0	0	0	0
N	VEBs=Reduces Human Health Risks	0	0	0	0	0	0	0	0	0	0	0	0	0	N	0	0	0	0	0	0	0
O	VEBs=Wildlife Habitat	1	0	0	0	0	0	0	0	0	0	0	0	0	O	0	0	0	0	0	0	0
P	VEBs (4/12-10/12) Part of NMP	0	1	1	1	1	1	1	1	0	0	0	0	0	P	0	0	0	0	0	0	0
Q	VEBs+PLT=CB Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	Q	0	0	0	0	0	0	0
R	VEBs+PLT=Farmer-Stewards	0	0	0	0	0	0	0	0	0	0	0	0	0	R	0	0	0	0	0	0	0
S	VEBs UP Management/Livability	0	0	0	0	0	0	0	0	1	0	0	0	0	S	0	0	0	0	0	0	0
T	VEBs+PLT= Sus Ag to Next Gen	0	0	0	0	0	0	0	0	0	1	0	0	0	T	0	0	0	0	0	0	0
U	PLT=Humane Treatment	0	0	0	0	0	0	0	0	0	0	1	0	0	U	0	0	0	0	0	0	0
V	VEBs+PLT= Spiritual Vision/Stewardship	0	0	0	0	0	0	0	0	0	0	0	0	0	V	0	0	0	0	0	0	0
W	VEBs+PLT->Fisheries	0	0	0	0	0	0	0	0	0	0	0	0	0	W	0	0	0	0	0	0	0
X	VEBs+PLT Anticipate Regs	0	0	0	0	0	0	0	0	0	0	0	0	0	X	0	0	0	0	0	0	0
Y	VEBs->NRCS Rewrite	0	0	0	0	0	0	0	0	0	0	0	0	0	Y	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	1	1	1	1	0	0		0	0	0	0	0	0	0

Sort column 7 of 7: Part 4 of 4

	sort column 7																		
A	Emissions ☟=Sust.->CB-friendly 🐔	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
D	PLT=Emissions ☟	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
E	PLT/Paw Health=Profit	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
F	VEBs=Beautification	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
H	VEBs Show Env. Best Practice	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
M	VEBs=(night eff.)-->☟Res. Odor	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
O	VEBs=Wildlife Habitat	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
P	VEBs (4/12-10/12) Part of NMP	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Q	VEBs+PLT=CB Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
R	VEBs+PLT=Farmer-Stewards	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
T	VEBs+PLT= Sus Ag to Next Gen	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
U	PLT=Humane Treatment	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
V	VEBs+PLT= Spiritual Vision/Stewardship	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Y	VEBs->NRCS Rewrite	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Notes:
Weight is to remind us that the columns, though numerical, are really qualitative categories. I.E. Column 1 is the LEAST important card/position. Column 7 is the MOST important card/position.

Hence:
Column 1 is not weighted, while these columns are weighted thusly:
Column 2 X 2
Column 3 X 3
Column 4 X 4
Column 5 X 5
Column 6 X 6
Column 7 X 7

Aggregated Sorts by letters transposition

Part 1 of 5

Sort column	Aggregated cards in each sort column >>>																															
1	*A*	*A*	*F*	*F*	*F*	*G*	*P*	*R*	*T*	*T*	*V*	*Y*	*Y*																			
2	*A*	*A*	*A*	*A*	*F*	*F*	*G*	*G*	*H*	*H*	*H*	*Q*	*Q*	*R*	*R*	*R*	*R*	*T*	*T*	*U*	*U*	*V*	*V*	*V*	*Y*	*Y*						
3	*A*	*A*	*A*	*A*	*A*	*B*	*E*	*F*	*F*	*F*	*G*	*G*	*G*	*G*	*G*	*G*	*H*	*H*	*H*	*H*	*H*	*K*	*K*	*K*	*M*	*O*	*O*	*Q*	*Q*	*Q*	*S*	*S*	*T*
4	*A*	*A*	*B*	*B*	*B*	*D*	*F*	*F*	*G*	*I*	*I*	*I*	*K*	*L*	*L*	*M*	*M*	*N*	*N*	*O*	*O*	*Q*	*Q*	*Q*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*T*	*T*
5	*C*	*C*	*D*	*D*	*E*	*E*	*E*	*F*	*F*	*F*	*G*	*G*	*H*	*H*	*H*	*I*	*I*	*I*	*J*	*J*	*J*	*K*	*K*	*K*	*K*	*K*	*K*	*L*	*L*	*L*	*L*	*L*	*M*
6	*B*	*C*	*C*	*C*	*C*	*C*	*C*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*D*	*E*	*E*	*E*	*E*	*E*	*E*	*G*	*H*	*H*	*I*	*I*	*J*	*J*	*J*	*J*	*J*	*K*
7	*B*	*B*	*B*	*B*	*B*	*B*	*B*	*B*	*C*	*C*	*C*	*C*	*C*	*D*	*E*	*E*	*E*	*I*	*I*	*I*	*I*	*I*	*J*	*J*	*J*	*J*	*J*	*L*	*M*	*M*	*M*	*M*	*N*
	1	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Part 2 of 5

Sort column																																
1																																
2																																
3	*T*	*T*	*U*	*V*	*W*	*X*																										
4	*U*	*U*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*V*	*W*	*W*	*W*	*W*	*W*	*W*	*X*	*X*	*Y*													
5	*M*	*N*	*O*	*O*	*O*	*O*	*P*	*P*	*Q*	*Q*	*Q*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*T*	*U*	*U*	*U*	*W*	*W*	*W*	*X*	*X*	*X*	*X*	*X*	*Y*	*Y*	
6	*K*	*K*	*L*	*L*	*L*	*L*	*L*	*M*	*M*	*M*	*M*	*N*	*N*	*N*	*O*	*O*	*P*	*P*	*P*	*Q*	*Q*	*R*	*R*	*S*	*S*	*T*	*T*	*U*	*U*	*U*	*U*	*W*	*W*
7	*N*	*N*	*N*	*N*	*N*	*N*	*O*	*O*	*O*	*P*	*P*	*P*	*P*	*P*	*P*	*P*	*S*	*T*	*U*													
	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Part 3 of 5

Sort column																																	
1																																	
2																																	
3																																	
4																																	
5																																	
6	*W*	*X*	*X*	*X*	*X*	*X*	*Y*	*Y*	*Y*	*Y*	*Y*	*Y*																					
7																																	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Part 4 of 5

Sort column																																	
1																																	
2																																	
3																																	
4																																	
5																																	
6																																	
7																																	
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sort column																								
1																								
2																								
3																								
4																								
5																								
6																								
7																								
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Aggregated sorts by letters

1	*2*	*3*	*5*	*6*	*7*	*5*	**<< number of values in column AKA the number of cards that appear in these sorting columns in**
3	*6*	*9*	*2*	*5*	*8*	*2*	**the aggregate**
1	**2**	**3**	**4**	**5**	**6**	**7**	**<< sort column number**
A	A	A	A	C	B	B	
A	A	A	A	C	C	B	
F	A	A	B	D	C	B	
F	A	A	B	D	C	B	
F	F	A	B	E	C	B	
G	F	B	D	E	C	B	
P	G	E	F	E	C	B	
R	G	F	F	F	D	B	
T	H	F	G	F	D	C	
T	H	F	I	F	D	C	
V	H	G	I	G	D	C	
Y	Q	G	I	G	D	C	
Y	Q	G	K	H	D	C	
	R	G	L	H	D	D	
	R	G	L	H	D	E	
	R	G	M	I	D	E	
	R	H	M	I	E	E	
	T	H	N	I	E	I	
	T	H	N	J	E	I	
	U	H	O	J	E	I	
	U	H	O	J	E	I	
	V	K	Q	K	E	I	
	V	K	Q	K	G	J	
	V	K	Q	K	H	J	
	Y	M	R	K	H	J	
	Y	O	R	K	I	J	
		O	R	K	I	J	
		Q	S	L	J	L	
		Q	S	L	J	M	
		Q	S	L	J	M	
		S	S	L	J	M	
		S	T	L	J	M	
		T	T	M	K	N	
		T	U	M	K	N	
		T	U	N	K	N	
		U	V	O	L	N	
		V	V	O	L	N	
		W	V	O	L	N	
		X	V	O	L	N	
			V	P	L	O	

			V	P	M	O
			V	Q	M	O
			V	Q	M	P
			W	Q	M	P
			W	R	N	P
			W	R	N	P
			W	R	N	P
			W	S	O	P
			W	S	O	P
			X	S	P	S
			X	S	P	T
			Y	T	P	U
				U	Q	
				U	Q	
				U	R	
				W	R	
				W	S	
				W	S	
				X	T	
				X	T	
				X	U	
				X	U	
				X	U	
				Y	U	
				Y	W	
					W	
					W	
					X	
					X	
					X	
					X	
					X	
					Y	
					Y	
					Y	
					Y	
					Y	
					Y	

Notes:
This arrangement helps provide a check on the tallies in all columns, by number of respondents. Caution: the alignment is misleading as to the look of the sorting display for individual farmer sorts (N= 13). HOWEVER, in the aggregate, you do not keep this pattern strictly, as what you are seeing is that the card types (by letter) as they appear in the column position from combining all farmer sorts.

Q-Sorts by letters columns no detail

1	2	3	4	5	6	7	1
R	Q	A	L	C	E	N	
	T	X	W	I	U	B	
		G	V	K	M	J	
			D	H	S	P	
				F	O		
					Y		
T	R	Q	N	E	K	L	2
	G	H	B	I	J	M	
		V	F	U	D	C	
			A	O	P	S	
				Y	X		
					W		
F	R	Q	N	K	E	B	3
	G	H	I	D	M	C	
		A	V	S	P	U	
			W	O	T	J	
				Y	X		
					L		
F	H	Q	K	X	E	B	4
	R	G	I	L	M	N	
		A	V	S	P	J	
			W	O	U	T	
				C	D		
					Y		
G	H	B	V	K	D	E	5
	A	W	U	T	X	C	
		S	I	L	J	P	
			M	N	Q	O	
				F	Y		
					R		
Y	H	K	V	M	E	C	6
	T	A	W	U	I	B	
		O	S	L	J	N	
			F	Q	X	P	
				G	D		
					R		
Y	R	E	V	K	M	I	7
	A	T	W	U	J	N	
		F	O	S	L	P	
			G	Q	X	B	
				D	C		
					H		

F	U	H	A	E	K	N	8
	Y	S	Q	W	J	B	
		G	T	X	O	P	
			V	I	C	M	
				R	D		
					L		

A	V	U	S	F	K	I	9
	Y	H	Q	J	N	B	
		G	T	X	L	P	
			O	W	C	M	
				R	D		
					E		

A	V	M	S	K	Y	I	10
	F	T	Q	X	D	O	
		G	R	J	L	P	
			B	W	E	C	
				H	U		
					N		

T	V	A	S	P	W	O	11
	F	K	X	J	C	E	
		G	R	M	B	N	
			Y	L	I	D	
				H	U		
					Q		

V	Q	F	L	P	D	J	12
	A	K	M	O	C	E	
		H	U	X	N	B	
			R	S	Y	I	
				G	W		
					T		

P	U	F	V	K	Y	I	13
	A	T	B	L	S	J	
		O	W	E	H	M	
			X	Q	C	N	
				R	D		
					G		

Notes:
This is a stripped down "look" at the 13 Q sorts: shows what each farmer sorted into the template given.
Letters used when focus is on position of card.

Q-Sorts by letters columns with PLT, VEB noted

2	3	4	5	6	7	
Q	A	L	C	E	N	1
T	X	W	I	U	B	
	G	V	K	M	J	
		D	H	S	P	
			F	O		
				Y		
R	Q	N	E	K	L	2
G	H	B	I	J	M	
	V	F	U	D	C	
		A	O	P	S	
			Y	X		
				W		
R	Q	N	K	E	B	3
G	H	I	D	M	C	
	A	V	S	P	U	
		W	O	T	J	
			Y	X		
				L		
H	Q	K	X	E	B	4
R	G	I	L	M	N	
	A	V	S	P	J	
		W	O	U	T	
			C	D		
				Y		
H	B	V	K	D	E	5
A	W	U	T	X	C	
	S	I	L	J	P	
		M	N	Q	O	
			F	Y		
				R		
H	K	V	M	E	C	6
T	A	W	U	I	B	
	O	S	L	J	N	
		F	Q	X	P	
			G	D		
				R		
R	E	V	K	M	I	7
A	T	W	U	J	N	
	F	O	S	L	P	
		G	Q	X	B	
			D	C		
				H		

B/2	PLT=Reduced Eye Irritation	B
C/3	PLT=Bird Health	C
D/4	PLT=Emissions ¶	D
E/5	PLT/Paw Health=Profit	E
F/6	VEBs=Beautification	F
G/7	VEBs=Hedgerow/Heritage Farming	G
H/8	VEBs Show Env. Best Practice	H
I/9	VEB Distance is Flexible	I
J/10	VEBs=Energy Efficiency	J
K/11	VEBs=Improves Farmer Life Quality	K
L/12	VEBs=Neighborhood Screen	L
M/13	VEBs=(night eff.)-->¶Res. Odor	M
N/14	VEBs=Reduce Human Health Risks	N
O/15	VEBs=Wildlife Habitat	O
P/16	VEBs (4/12-10/12) Part of NMP	P

A/1	Emissions ¶=Sust.->CB-friendly	A
B/2	PLT=Reduced Eye Irritation	B
C/3	PLT=Bird Health	C
D/4	PLT=Emissions ¶	D
E/5	PLT/Paw Health=Profit	E
F/6	VEBs=Beautification	F
G/7	VEBs=Hedgerow/Heritage Farming	G
H/8	VEBs Show Env. Best Practice	H
I/9	VEB Distance is Flexible	I
J/10	VEBs=Energy Efficiency	J
K/11	VEBs=Improves Farmer Life Quality	K
L/12	VEBs=Neighborhood Screen	L
M/13	VEBs=(night eff.)-->¶Res. Odor	M
N/14	VEBs=Reduce Human Health Risks	N
O/15	VEBs=Wildlife Habitat	O
P/16	VEBs (4/12-10/12) Part of NMP	P
Q/17	VEBs+PLT=CB Stewardship	Q
R/18	VEBs+PLT=Farmer-Stewards	R
S/19	VEBs UP Management/Livability	S
T/20	VEBs+PLT= Sus Ag to Next Gen	T
U/21	PLT=Humane Treatment	U
V/22	VEBs+PLT= Spiritual Vision/Stewardship	V
W/23	VEBs+PLT->Fisheries	W
X/24	VEBs+PLT Anticipate Regs	X
Y/25	VEBs->NRCS Rewrite	Y

U	H	A	E	K	N	8
Y	S	Q	W	J	B	
	G	T	X	O	P	
		V	I	C	M	
			R	D		
				L		
V	U	S	F	K	I	9
Y	H	Q	J	N	B	
	G	T	X	L	P	
		O	W	C	M	
			R	D		
				E		
V	M	S	K	Y	I	10
F	T	Q	X	D	O	
	G	R	J	L	P	
		B	W	E	C	
			H	U		
				N		
V	A	S	P	W	O	11
F	K	X	J	C	E	
	G	R	M	B	N	
		Y	L	I	D	
			H	U		
				Q		
Q	F	L	P	D	J	12
A	K	M	O	C	E	
	H	U	X	N	B	
		R	S	Y	I	
			G	W		
				T		
U	F	V	K	Y	I	13
A	T	B	L	S	J	
	O	W	E	H	M	
		X	Q	C	N	
			R	D		
				G		

Notes:
1: These approximate the sorts displays but you have to recognize that the columns are misleading about the inverted normal distribution shape of the sorting template.
You can see the 13 good sorts here. Note: really good example of how tables LOSE the asymmetry of the sort pattern (inverted normal distribution)
2: PLT cards in melon; VEB cards in green
Looking at the two BMT strategies that are the primary focus on the study.

Column A contains A-Y alphabet card IDs. Column B contains short phrase ID.

A/1: Certification/future-oriented + hypothetical

S/19: Not well understood; could be linked in future to VEB flexibility. Concerns built environment of the farm.

U/21: Certification oriented/hypothetical

Y/25: FUTURE ORIENTED

Q-Sorts converted from numbers to letters; named

Part 1 of 7

	NUMBER	1	2	3	4	5	6	7
1	**283**	***R*** VEBs+PLT->Land Stewardship	***Q*** VEBs+PLT->CB Health	***A*** Emissions¶=Sus->CB-friendly	***L*** VEBs=Neighborhood Screen	***C*** PLT=Bird Health	***E*** PLT/Paw Health=Profit	***N*** VEBs=Reduced Human Health Risks
	283		***T*** VEBs+PLT->Sus Ag/Next Gen	***X*** VEBs+PLT->Strategic NMP	***W*** VEBs+PLT Support Fishers	***I*** VEB Distance is Flexible	***U*** VEBs+PLT=Humane Animal Treatment	***B*** Less NH3=Reduced Eye Irritation
	283			***G*** VEBs=Heritage Farming Practice	***V*** VEBs+PLT Reflect Spiritual Values	***K*** VEBs=Improves Farmer Life Quality	***M*** VEBs = Reduced Odors	***J*** VEBs=Energy Efficiency
	283				***D*** PLT=Less Emissions	***H*** VEBs Show Farm Sustainability	***S*** VEBs Enhance Farm Livability	***P*** VEBs Part of NMPlans
	283					***F*** VEBs=Beatification	***O*** VEBs = Wildlife Habitat	
	283						***Y*** VEBs+PLT->Revised NRCS Standard	
2	**212**	***T*** VEBs+PLT= Sus Ag to Next Gen	***R*** VEBs+PLT=Farmer -Stewards	***Q*** VEBs+PLT=CB Stewardship	***N*** VEBs=Reduce Human Health Risks	***E*** PLT/Paw Health=Profit	***K*** VEBs=Improves Farmer Life Quality	***L*** VEBs=Neighborhood Screen
	212		***G*** VEBs=Hedgerow/ Heritage Farming	***H*** VEBs Show Env. Best Practice	***B*** PLT=Reduced Eye Irritation	***I*** VEB Distance is Flexible	***J*** VEBs=Energy Efficiency	***M*** VEBs=(night eff.)-->¶Res. Odor
	212			***V*** VEBs+PLT= Spiritual Vision/Stewardship	***F*** VEBs=Beautification	***U*** PLT=Humane Treatment	***D*** PLT=Emissions ¶	***C*** PLT=Bird Health
	212				***A*** Emissions ¶=Sust.->CB-friendly	***O*** VEBs = Wildlife Habitat	***P*** VEBs (4/12-10/12) Part of NMP	***S*** VEBs UP Management/Livability
	212					***Y*** VEBs->NRCS Rewrite	***X*** VEBs+PLT Anticipate Regs	
	212						***W*** VEBs+PLT->Fisheries	

	NUMBER		1		2		3		4		5		6		7
3	**254**	***F***	VEBs=Beautification	***R***	VEBs+PLT=Farmer-Stewards	***Q***	VEBs+PLT=CB Stewardship	***N***	VEBs=Reduce Human Health Risks	***K***	VEBs=Improves Farmer Life Quality	***E***	PLT/Paw Health=Profit	***B***	PLT=Reduced Eye Irritation
	254			***G***	VEBs=Hedgerow/Heritage Farming	***H***	VEBs Show Env. Best Practice	***I***	VEB Distance is Flexible	***D***	PLT=Emissions ☟	***M***	VEBs=(night eff.)-->☟Res. Odor	***C***	PLT=Bird Health
	254					***A***	Emissions ☟=Sust.->CB-friendly	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***S***	VEBs UP Management/Livability	***P***	VEBs (4/12-10/12) Part of NMP	***U***	PLT=Humane Treatment
	254							***W***	VEBs+PLT->Fisheries	***O***	VEBs=Wildlife Habitat	***T***	VEBs+PLT= Sus Ag to Next Gen	***J***	VERBs=Energy Efficiency
	254									***Y***	VEBs->NRCS Rewrite	***X***	VEBs+PLT Anticipate Regs		
	254											***L***	VEBs=Neighborhood Screen		
4	**270**	***F***	VEBs=Beautification	***H***	VEBs Show Env. Best Practice	***Q***	VEBs+PLT=CB Stewardship	***K***	VEBs=Improves Farmer Life Quality	***X***	VEBs+PLT Anticipate Regs	***E***	PLT/Paw Health=Profit	***B***	PLT=Reduced Eye Irritation
	270			***R***	VEBs+PLT=Farmer-Stewards	***G***	VEBs=Hedgerow/Heritage Farming	***I***	VEB Distance is Flexible	***L***	VEBs=Neighborhood Screen	***M***	VEBs=(night eff.)-->☟Res. Odor	***N***	VEBs=Reduce Human Health Risks
	270					***A***	Emissions ☟=Sust.->CB-friendly	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***S***	VEBs UP Management/Livability	***P***	VEBs (4/12-10/12) Part of NMP	***J***	VEBs=Energy Efficiency
	270							***W***	VEBs+PLT->Fisheries	***O***	VEBs=Wildlife Habitat	***U***	PLT=Humane Treatment	***T***	VEBs+PLT= Sus Ag to Next Gen
	270									***C***	PLT=Bird Health	***D***	PLT=Emissions ☟		
	270											***Y***	VEBs->NRCS Rewrite		

	NUMBER		1		2		3		4		5		6		7
5	**249**	***G***	VEBs=Hedgerow/Heritage Farming	***H***	VEBs Show Env. Best Practice	***B***	PLT=Reduced Eye Irritation	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***K***	VEBs=Improves Farmer Life Quality	***D***	PLT=Emissions ☞	***E***	PLT/Paw Health=Profit
	249			***A***	Emissions ☞=Sust.->CB-friendly	***W***	VEBs+PLT->Fisheries	***U***	PLT=Humane Treatment	***T***	VEBs+PLT= Sus Ag to Next Gen	***X***	VEBs+PLT Anticipate Regs	***C***	PLT=Bird Health
	249					***S***	VEBs UP Management/Livability	***I***	VEB Distance is Flexible	***L***	VEBs=Neighborhood Screen	***J***	VEBs=Energy Efficiency	***P***	VEBs (4/12-10/12) Part of NMP
	249							***M***	VEBs=(night eff.)->☞Res. Odor	***N***	VEBs=Reduce Human Health Risks	***Q***	VEBs+PLT=CB Stewardship	***O***	VEBs=Wildlife Habitat
	249									***F***	VEBs=Beautification	***Y***	VEBs->NRCS Rewrite		
	249											***R***	VEBs+PLT=Farmer-Stewards		
6	**265**	***Y***	VEBs->NRCS Rewrite	***H***	VEBs Show Env. Best Practice	***K***	VEBs=Improves Farmer Life Quality	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***M***	VEBs=(night eff.)->☞Res. Odor	***E***	PLT/Paw Health=Profit	***C***	PLT=Bird Health
	265			***T***	VEBs+PLT= Sus Ag to Next Gen	***A***	Emissions ☞=Sust.->CB-friendly	***W***	VEBs+PLT->Fisheries	***U***	PLT=Humane Treatment	***I***	VEB Distance is Flexible	***B***	PLT=Reduced Eye Irritation
	265					***O***	VEBs=Wildlife Habitat	***S***	VEBs UP Management/Livability	***L***	VEBs=Neighborhood Screen	***J***	VEBs=Energy Efficiency	***N***	VEBs=Reduce Human Health Risks
	265							***F***	VEBs=Beautification	***Q***	VEBs+PLT=CB Stewardship	***X***	VEBs+PLT Anticipate Regs	***P***	VEBs (4/12-10/12) Part of NMP
	265									***G***	VEBs=Hedgerow/Heritage Farming	***D***	PLT=Emissions ☞		
	265											***R***	VEBs+PLT=Farmer-Stewards		

	NUMBER		1		2		3		4		5		6		7
7	202	Y	VEBs->NRCS Rewrite	R	VEBs+PLT=Farmer-Stewards	E	PLT/Paw Health=Profit	V	VEBs+PLT= Spiritual Vision/Stewardship	K	VEBs=Improves Farmer Life Quality	M	VEBs=(night eff.)-->☟Res. Odor	I	VEB Distance is Flexible
	202			A	Emissions ☟=Sust.->CB-friendly	T	VEBs+PLT= Sus Ag to Next Gen	W	VEBs+PLT->Fisheries	U	PLT=Humane Treatment	J	VEBs=Energy Efficiency	N	VEBs=Reduce Human Health Risks
	202					F	VEBs=Beautification	O	VEBs=Wildlife Habitat	S	VEBs UP Management/Livability	L	VEBs=Neighborhood Screen	P	VEBs (4/12-10/12) Part of NMP
	202							G	VEBs=Hedgerow/Heritage Farming	Q	VEBs+PLT=CB Stewardship	X	VEBs+PLT Anticipate Regs	B	PLT=Reduced Eye Irritation
	202									D	PLT=Emissions ☟	C	PLT=Bird Health		
	202											H	VEBs Show Env. Best Practice		
8	285	F	VEBs=Beautification	U	PLT=Humane Treatment	H	VEBs Show Env. Best Practice	A	Emissions ☟=Sust.->CB-friendly	E	PLT/Paw Health=Profit	K	VEBs=Improves Farmer Life Quality	N	VEBs=Reduce Human Health Risks
	285			Y	VEBs->NRCS Rewrite	S	VEBs UP Management/Livability	Q	VEBs+PLT=CB Stewardship	W	VEBs+PLT->Fisheries	J	VEBs=Energy Efficiency	B	PLT=Reduced Eye Irritation
	285					G	VEBs=Hedgerow/Heritage Farming	T	VEBs+PLT= Sus Ag to Next Gen	X	VEBs+PLT Anticipate Regs	O	VEBs=Wildlife Habitat	P	VEBs (4/12-10/12) Part of NMP
	285							V	VEBs+PLT= Spiritual Vision/Stewardship	I	VEB Distance is Flexible	C	PLT=Bird Health	M	VEBs=(night eff.)-->☟Res. Odor
	285									R	VEBs+PLT=Farmer-Stewards	D	PLT=Emissions ☟		
	285											L	VEBs=Neighborhood Screen		

	NUMBER	1	2	3	4	5	6	7
9	**314**	***A*** Emissions ☟=Sust.->CB-friendly	***V*** VEBs+PLT= Spiritual Vision/Stewardship	***U*** PLT=Humane Treatment	***S*** VEBs UP Management/Livability	***F*** VEBs=Beautification	***K*** VEBs=Improves Farmer Life Quality	***I*** VEB Distance is Flexible
	314		***Y*** VEBs->NRCS Rewrite	***H*** VEBs Show Env. Best Practice	***Q*** VEBs+PLT=CB Stewardship	***J*** VEBs=Energy Efficiency	***N*** VEBs=Reduce Human Health Risks	***B*** PLT=Reduced Eye Irritation
	314			***G*** VEBs=Hedgerow/Heritage Farming	***T*** VEBs+PLT= Sus Ag to Next Gen	***X*** VEBs+PLT Anticipate Regs	***L*** VEBs=Neighborhood Screen	***P*** VEBs (4/12-10/12) Part of NMP
	314				***O*** VEBs=Wildlife Habitat	***W*** VEBs+PLT->Fisheries	***C*** PLT=Bird Health	***M*** VEBs=(night eff.)-->☟Res. Odor
	314					***R*** VEBs+PLT=Farmer-Stewards	***D*** PLT=Emissions ☟	
	314						***E*** PLT/Paw Health=Profit	
10	**330**	***A*** Emissions ☟=Sust.->CB-friendly	***V*** VEBs+PLT= Spiritual Vision/Stewardship	***M*** VEBs=(night eff.)-->☟Res. Odor	***S*** VEBs UP Management/Livability	***K*** VEBs=Improves Farmer Life Quality	***Y*** VEBs->NRCS Rewrite	***I*** VEB Distance is Flexible
	330		***F*** VEBs=Beautification	***T*** VEBs+PLT= Sus Ag to Next Gen	***Q*** VEBs+PLT=CB Stewardship	***X*** VEBs+PLT Anticipate Regs	***D*** PLT=Emissions ☟	***O*** VEBs=Wildlife Habitat
	330			***G*** VEBs=Hedgerow/Heritage Farming	***R*** VEBs+PLT=Farmer-Stewards	***J*** VEBs=Energy Efficiency	***L*** VEBs=Neighborhood Screen	***P*** VEBs (4/12-10/12) Part of NMP
	330				***B*** PLT=Reduced Eye Irritation	***W*** VEBs+PLT->Fisheries	***E*** PLT/Paw Health=Profit	***C*** PLT=Bird Health
	330					***H*** VEBs Show Env. Best Practi	***U*** PLT=Humane Treatment	
	330						***N*** VEBs=Reduce Human Health Risks	

	NUMBER	1	2	3	4	5	6	7
11	**362**	*T* VEBs+PLT->Sus Ag/Next Gen	*V* VEBs+PLT= Spiritual Vision/Stewardship	*A* Emissions ¶=Sust.->CB-friendly	*S* VEBs UP Management/Li vability	*P* VEBs (4/12-10/12) Part of NMP	*W* VEBs+PLT->Fisher ies	*O* VEBs=Wildlife Habitat
	362		*F* VEBs=Beautification	*K* VEBs=Improves Farmer Life Quality	*X* VEBs+PLT Anticipate Regs	*J* VEBs=Energy Efficiency	*C* PLT=Bird Health	*E* PLT/Paw Health=Profit
	362			*G* VEBs=Hedgerow/ Heritage Farming	*R* VEBs+PLT=Farm er-Stewards	*M* VEBs=(night eff.)- ->¶Res. Odor	*B* PLT=Reduced Eye Irritation	*N* VEBs=Reduce Human Health Risks
	362				*Y* VEBs->NRCS Rewrite	*L* VEBs=Neighborho od Screen	*I* VEB Distance is Flexible	*D* PLT=Emissions ¶
	362					*H* VEBs Show Env. Best Practice	*U* PLT=Humane Treatment	
	362						*Q* VEBs+PLT=CB Stewardship	
12	**378**	*V* VEBs+PLT= Spiritual Vision/Stewardship	*Q* VEBs+PLT=CB Stewardship	*F* VEBs=Beautificati on	*L* VEBs=Neighborh ood Screen	*P* VEBs (4/12-10/12) Part of NMP	*D* PLT=Emissions ¶	*J* VEBs=Energy Efficiency
	378		*A* Emissions ¶=Sust.->CB-friendly	*K* VEBs=Improves Farmer Life Quality	*M* VEBs=(night eff.)-->¶Res. Odor	*O* VEBs=Wildlife Habitat	*C* PLT=Bird Health	*E* PLT/Paw Health=Profit
	378			*H* VEBs Show Env. Best Practice	*U* PLT=Humane Treatment	*X* VEBs+PLT Anticipate Regs	*N* VEBs=Reduce Human Health Risks	*B* PLT=Reduced Eye Irritation
	378				*R* VEBs+PLT=Farm er-Stewards	*S* VEBs UP Management/Liva bility	*Y* VEBs->NRCS Rewrite	*I* VEB Distance is Flexible
	378					*G* VEBs=Hedgerow/ Heritage Farming	*W* VEBs+PLT->Fisher ies	
	378						*T* VEBs+PLT->Sus Ag/Next Gen	

Part 7 of 7

	NUMBER	1	2	3	4	5	6	7
13	**394**	***P*** VEBs (4/12-10/12) Part of NMP	***U*** PLT=Humane Treatment	***F*** VEBs=Beautification	***V*** VEBs+PLT= Spiritual Vision/Stewardship	***K*** VEBs=Improves Farmer Life Quality	***Y*** VEBs->NRCS Rewrite	***I*** VEB Distance is Flexible
	394		***A*** Emissions ☟=Sust.->CB-friendly	***T*** VEBs+PLT->Sus Ag/Next Gen	***B*** PLT=Reduced Eye Irritation	***L*** VEBs=Neighborhood Screen	***S*** VEBs UP Management/Livability	***J*** VEBs=Energy Efficiency
	394			***O*** VEBs=Wildlife Habitat	***W*** VEBs+PLT->Fisheries	***E*** PLT/Paw Health=Profit	***H*** VEBs Show Env. Best Practice	***M*** VEBs=(night eff.)->☟Res. Odor
	394				***X*** VEBs+PLT Anticipate Regs	***Q*** VEBs+PLT=CB Stewardship	***C*** PLT=Bird Health	***N*** VEBs=Reduce Human Health Risks
	394					***R*** VEBs+PLT=Farmer-Stewards	***D*** PLT=Emissions ☟	
	394						***G*** VEBs=Hedgerow/Heritage Farming	

Notes:
13 Q sorts transcribed from photographs.
This is the first data transcription directly from the photographs.

Q-Sorts converted from numbers to letters; named

Part 1 of 13

	NUMBER		1		2		3		4		5		6		7
1	**283**	***R***	VEBs+PLT->Land Stewardship	***Q***	VEBs+PLT->CB Health	***A***	Emissions¶=Sus->CB-friendly	***L***	VEBs=Neighborhood Screen	***C***	PLT=Bird Health	***E***	PLT/Paw Health=Profit	***N***	VEBs=Reduced Human Health Risks
	283			***T***	VEBs+PLT->Sus Ag/Next Gen	***X***	VEBs+PLT->Strategic NMP	***W***	VEBs+PLT Support Fishers	***I***	VEB Distance is Flexible	***U***	VEBs+PLT=Humane Animal Treatment	***B***	Less NH3=Reduced Eye Irritation
	283					***G***	VEBs=Heritage Farming Practice	***V***	VEBs+PLT Reflect Spiritual Values	***K***	VEBs=Improves Farmer Life Quality	***M***	VEBs = Reduced Odors	***J***	VEBs=Energy Efficiency
	283							***D***	PLT=Less Emissions	***H***	VEBs Show Farm Sustainability	***S***	VEBs Enhance Farm Livability	***P***	VEBs Part of NMPlans
	283									***F***	VEBs=Beatification	***O***	VEBs = Wildlife Habitat		
	283											***Y***	VEBs+PLT->Revised NRCS Standard		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
	MISSING	***325***													

	NUMBER		1		2		3		4		5		6		7
2	**212**	***T***	VEBs+PLT= Sus Ag to Next Gen	***R***	VEBs+PLT=Farmer-Stewards	***Q***	VEBs+PLT=CB Stewardship	***N***	VEBs=Reduce Human Health Risks	***E***	PLT/Paw Health=Profit	***K***	VEBs=Improves Farmer Life Quality	***L***	VEBs=Neighborho od Screen
	212			***G***	VEBs=Hedgerow/H eritage Farming	***H***	VEBs Show Env. Best Practice	***B***	PLT=Reduced Eye Irritation	***I***	VEB Distance is Flexible	***J***	VEBs=Energy Efficiency	***M***	VEBs=(night eff.)- ->¶Res. Odor
	212					***V***	VEBs+PLT= Spiritual Vision/Stewardship	***F***	VEBs=Beautificatio n	***U***	PLT=Humane Treatment	***D***	PLT=Emissions ¶	***C***	PLT=Bird Health
	212							***A***	Emissions ¶=Sust.->CB-friendly	***O***	VEBs = Wildlife Habitat	***P***	VEBs (4/12-10/12) Part of NMP	***S***	VEBs UP Management/Liva bility
	212									***Y***	VEBs->NRCS Rewrite	***X***	VEBs+PLT Anticipate Regs		
	212											***W***	VEBs+PLT->Fisherie s		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
		3													
	MISSING	***2***													
		5													

	NUMBER		1		2		3		4		5		6		7
3	**254**	***F***	VEBs=Beautification	***R***	VEBs+PLT=Farmer-Stewards	***Q***	VEBs+PLT=CB Stewardship	***N***	VEBs=Reduce Human Health Risks	***K***	VEBs=Improves Farmer Life Quality	***E***	PLT/Paw Health=Profit	***B***	PLT=Reduced Eye Irritation
	254			***G***	VEBs=Hedgerow/Heritage Farming	***H***	VEBs Show Env. Best Practice	***I***	VEB Distance is Flexible	***D***	PLT=Emissions ☟	***M***	VEBs=(night eff.)->☟Res. Odor	***C***	PLT=Bird Health
	254					***A***	Emissions ☟=Sust.->CB-friendly	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***S***	VEBs UP Management/Livability	***P***	VEBs (4/12-10/12) Part of NMP	***U***	PLT=Humane Treatment
	254							***W***	VEBs+PLT->Fisheries	***O***	VEBs=Wildlife Habitat	***T***	VEBs+PLT= Sus Ag to Next Gen	***J***	VERBs=Energy Efficiency
	254									***Y***	VEBs->NRCS Rewrite	***X***	VEBs+PLT Anticipate Regs		
	254											***L***	VEBs=Neighborhood Screen		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
		3													
	MISSING	***2***													
		5													

	NUMBER		1		2		3		4		5		6		7
4	270	F	VEBs=Beautification	H	VEBs Show Env. Best Practice	Q	VEBs+PLT=CB Stewardship	K	VEBs=Improves Farmer Life Quality	X	VEBs+PLT Anticipate Regs	E	PLT/Paw Health=Profit	B	PLT=Reduced Eye Irritation
	270			R	VEBs+PLT=Farmer-Stewards	G	VEBs=Hedgerow/Heritage Farming	I	VEB Distance is Flexible	L	VEBs=Neighborhood Screen	M	VEBs=(night eff.)-->☟Res. Odor	N	VEBs=Reduce Human Health Risks
	270					A	Emissions ☟=Sust.->CB-friendly	V	VEBs+PLT= Spiritual Vision/Stewardship	S	VEBs UP Management/Livability	P	VEBs (4/12-10/12) Part of NMP	J	VEBs=Energy Efficiency
	270							W	VEBs+PLT->Fisheries	O	VEBs=Wildlife Habitat	U	PLT=Humane Treatment	T	VEBs+PLT= Sus Ag to Next Gen
	270									C	PLT=Bird Health	D	PLT=Emissions ☟		
	270											Y	VEBs->NRCS Rewrite		
		0		*0*		*0*		*0*		*0*		*0*		*0*	
	TOTAL	0													
	MISSING	*3* *2* *5*													

	NUMBER	1	2	3	4	5	6	7
5	249	*G* VEBs=Hedgerow/Heritage Farming	*H* VEBs Show Env. Best Practice	*B* PLT=Reduced Eye Irritation	*V* VEBs+PLT= Spiritual Vision/Stewardship	*K* VEBs=Improves Farmer Life Quality	*D* PLT=Emissions ☞	*E* PLT/Paw Health=Profit
	249		*A* Emissions ☞=Sust.->CB-friendly	*W* VEBs+PLT->Fisheries	*U* PLT=Humane Treatment	*T* VEBs+PLT= Sus Ag to Next Gen	*X* VEBs+PLT Anticipate Regs	*C* PLT=Bird Health
	249			*S* VEBs UP Management/Livability	*I* VEB Distance is Flexible	*L* VEBs=Neighborhood Screen	*J* VEBs=Energy Efficiency	*P* VEBs (4/12-10/12) Part of NMP
	249				*M* VEBs=(night eff.)->☞Res. Odor	*N* VEBs=Reduce Human Health Risks	*Q* VEBs+PLT=CB Stewardship	*O* VEBs=Wildlife Habitat
	249					*F* VEBs=Beautification	*Y* VEBs->NRCS Rewrite	
	249						*R* VEBs+PLT=Farmer-Stewards	
		0	***0***	***0***	***0***	***0***	***0***	***0***
	TOTAL	**0**						
	MISSING	***325***						

	NUMBER		1		2		3		4		5		6		7
6	**265**	***Y***	VEBs->NRCS Rewrite	***H***	VEBs Show Env. Best Practice	***K***	VEBs=Improves Farmer Life Quality	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***M***	VEBs=(night eff.)-->↓Res. Odor	***E***	PLT/Paw Health=Profit	***C***	PLT=Bird Health
	265			***T***	VEBs+PLT= Sus Ag to Next Gen	***A***	Emissions ↓=Sust.->CB-friendly	***W***	VEBs+PLT->Fisheries	***U***	PLT=Humane Treatment	***I***	VEB Distance is Flexible	***B***	PLT=Reduced Eye Irritation
	265					***O***	VEBs=Wildlife Habitat	***S***	VEBs UP Management/Livability	***L***	VEBs=Neighborhood Screen	***J***	VEBs=Energy Efficiency	***N***	VEBs=Reduce Human Health Risks
	265							***F***	VEBs=Beautification	***Q***	VEBs+PLT=CB Stewardship	***X***	VEBs+PLT Anticipate Regs	***P***	VEBs (4/12-10/12) Part of NMP
	265									***G***	VEBs=Hedgerow/Heritage Farming	***D***	PLT=Emissions ↓		
	265											***R***	VEBs+PLT=Farmer-Stewards		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
		3													
	MISSING	2													
		5													

	NUMBER		1		2		3		4		5		6		7
7	**202**	***Y***	VEBs->NRCS Rewrite	***R***	VEBs+PLT=Farmer-Stewards	***E***	PLT/Paw Health=Profit	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***K***	VEBs=Improves Farmer Life Quality	***M***	VEBs=(night eff.)-->¶Res. Odor	***I***	VEB Distance is Flexible
	202			***A***	Emissions ¶=Sust.->CB-friendly 	***T***	VEBs+PLT= Sus Ag to Next Gen	***W***	VEBs+PLT->Fisheries	***U***	PLT=Humane Treatment	***J***	VEBs=Energy Efficiency	***N***	VEBs=Reduce Human Health Risks
	202					***F***	VEBs=Beautification	***O***	VEBs=Wildlife Habitat	***S***	VEBs UP Management/Livability	***L***	VEBs=Neighborhood Screen	***P***	VEBs (4/12-10/12) Part of NMP
	202							***G***	VEBs=Hedgerow/Heritage Farming	***Q***	VEBs+PLT=CB Stewardship	***X***	VEBs+PLT Anticipate Regs	***B***	PLT=Reduced Eye Irritation
	202									***D***	PLT=Emissions ¶	***C***	PLT=Bird Health		
	202											***H***	VEBs Show Env. Best Practice		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
	MISSING	3 2 5													

	NUMBER		1		2		3		4		5		6		7
8	**285**	***F***	VEBs=Beautification	***U***	PLT=Humane Treatment	***H***	VEBs Show Env. Best Practice	***A***	Emissions =Sust.->CB-friendly	***E***	PLT/Paw Health=Profit	***K***	VEBs=Improves Farmer Life Quality	***N***	VEBs=Reduce Human Health Risks
	285			***Y***	VEBs->NRCS Rewrite	***S***	VEBs UP Management/Livability	***Q***	VEBs+PLT=CB Stewardship	***W***	VEBs+PLT->Fisheries	***J***	VEBs=Energy Efficiency	***B***	PLT=Reduced Eye Irritation
	285					***G***	VEBs=Hedgerow/Heritage Farming	***T***	VEBs+PLT= Sus Ag to Next Gen	***X***	VEBs+PLT Anticipate Regs	***O***	VEBs=Wildlife Habitat	***P***	VEBs (4/12-10/12) Part of NMP
	285							***V***	VEBs+PLT= Spiritual Vision/Stewardship	***I***	VEB Distance is Flexible	***C***	PLT=Bird Health	***M***	VEBs=(night eff.)->Res. Odor
	285									***R***	VEBs+PLT=Farmer-Stewards	***D***	PLT=Emissions		
	285											***L***	VEBs=Neighborhood Screen		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
		3													
	MISS	2													
	ING	5													

	NUMBER		1		2		3		4		5		6		7
9	**314**	***A***	Emissions ¶=Sust.->CB-friendly	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***U***	PLT=Humane Treatment	***S***	VEBs UP Management/Livability	***F***	VEBs=Beautification	***K***	VEBs=Improves Farmer Life Quality	***I***	VEB Distance is Flexible
	314			***Y***	VEBs->NRCS Rewrite	***H***	VEBs Show Env. Best Practice	***Q***	VEBs+PLT=CB Stewardship	***J***	VEBs=Energy Efficiency	***N***	VEBs=Reduce Human Health Risks	***B***	PLT=Reduced Eye Irritation
	314					***G***	VEBs=Hedgerow/Heritage Farming	***T***	VEBs+PLT= Sus Ag to Next Gen	***X***	VEBs+PLT Anticipate Regs	***L***	VEBs=Neighborhood Screen	***P***	VEBs (4/12-10/12) Part of NMP
	314							***O***	VEBs=Wildlife Habitat	***W***	VEBs+PLT->Fisheries	***C***	PLT=Bird Health	***M***	VEBs=(night eff.)-->¶Res. Odor
	314									***R***	VEBs+PLT=Farmer-Stewards	***D***	PLT=Emissions ¶		
	314											***E***	PLT/Paw Health=Profit		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
	MISSING	3 2 5													

	NUMBER		1		2		3		4		5		6		7
10	**330**	***A***	Emissions ¶=Sust.->CB-friendly	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***M***	VEBs=(night eff.)-->¶Res. Odor	***S***	VEBs UP Management/Livability	***K***	VEBs=Improves Farmer Life Quality	***Y***	VEBs->NRCS Rewrite	***I***	VEB Distance is Flexible
	330			***F***	VEBs=Beautification	***T***	VEBs+PLT= Sus Ag to Next Gen	***Q***	VEBs+PLT=CB Stewardship	***X***	VEBs+PLT Anticipate Regs	***D***	PLT=Emissions ¶	***O***	VEBs=Wildlife Habitat
	330					***G***	VEBs=Hedgerow/ Heritage Farming	***R***	VEBs+PLT=Farmer-Stewards	***J***	VEBs=Energy Efficiency	***L***	VEBs=Neighborhood Screen	***P***	VEBs (4/12-10/12) Part of NMP
	330							***B***	PLT=Reduced Eye Irritation	***W***	VEBs+PLT->Fisheries	***E***	PLT/Paw Health=Profit	***C***	PLT=Bird Health
	330									***H***	VEBs Show Env. Best Practi	***U***	PLT=Humane Treatment		
	330											***N***	VEBs=Reduce Human Health Risks		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
	MISSING	3 2 5													

	NUMBER		1		2		3		4		5		6		7
1 1	362	*T*	VEBs+PLT->Sus Ag/Next Gen	*V*	VEBs+PLT= Spiritual Vision/Stewardship	*A*	Emissions ¶=Sust.->CB-friendly	*S*	VEBs UP Management/Livability	*P*	VEBs (4/12-10/12) Part of NMP	*W*	VEBs+PLT->Fisheries	*O*	VEBs=Wildlife Habitat
				F	VEBs=Beautification	*K*	VEBs=Improves Farmer Life Quality	*X*	VEBs+PLT Anticipate Regs	*J*	VEBs=Energy Efficiency	*C*	PLT=Bird Health	*E*	PLT/Paw Health=Profit
						G	VEBs=Hedgerow/Heritage Farming	*R*	VEBs+PLT=Farmer-Stewards	*M*	VEBs=(night eff.)->¶Res. Odor	*B*	PLT=Reduced Eye Irritation	*N*	VEBs=Reduce Human Health Risks
								Y	VEBs->NRCS Rewrite	*L*	VEBs=Neighborhood Screen	*I*	VEB Distance is Flexible	*D*	PLT=Emissions ¶
										H	VEBs Show Env. Best Practice	*U*	PLT=Humane Treatment		
												Q	VEBs+PLT=CB Stewardship		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
		3													
	MISSING	2													
		5													

Part 12 of 13

	NUMBER		1		2		3		4		5		6		7
1 2	**378**	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***Q***	VEBs+PLT=CB Stewardship	***F***	VEBs=Beautification	***L***	VEBs=Neighborhood Screen	***P***	VEBs (4/12-10/12) Part of NMP	***D***	PLT=Emissions ¶	***J***	VEBs=Energy Efficiency
	378			***A***	Emissions ¶=Sust.->CB-friendly	***K***	VEBs=Improves Farmer Life Quality	***M***	VEBs=(night eff.)-->¶Res. Odor	***O***	VEBs=Wildlife Habitat	***C***	PLT=Bird Health	***E***	PLT/Paw Health=Profit
	378					***H***	VEBs Show Env. Best Practice	***U***	PLT=Humane Treatment	***X***	VEBs+PLT Anticipate Regs	***N***	VEBs=Reduce Human Health Risks	***B***	PLT=Reduced Eye Irritation
	378							***R***	VEBs+PLT=Farmer-Stewards	***S***	VEBs UP Management/Livability	***Y***	VEBs->NRCS Rewrite	***I***	VEB Distance is Flexible
	378									***G***	VEBs=Hedgerow/Heritage Farming	***W***	VEBs+PLT->Fisheries		
	378											***T***	VEBs+PLT->Sus Ag/Next Gen		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
	MISSING	325													

Part 13 of 13

	NUMBER		1		2		3		4		5		6		7
13	**394**	***P***	VEBs (4/12-10/12) Part of NMP	***U***	PLT=Humane Treatment	***F***	VEBs=Beautification	***V***	VEBs+PLT= Spiritual Vision/Stewardship	***K***	VEBs=Improves Farmer Life Quality	***Y***	VEBs->NRCS Rewrite	***I***	VEB Distance is Flexible
	394			***A***	Emissions ￼=Sust.->CB-friendly ￼	***T***	VEBs+PLT->Sus Ag/Next Gen	***B***	PLT=Reduced Eye Irritation	***L***	VEBs=Neighborhood Screen	***S***	VEBs UP Management/Livability	***J***	VEBs=Energy Efficiency
	394					***O***	VEBs=Wildlife Habitat	***W***	VEBs+PLT->Fisheries	***E***	PLT/Paw Health=Profit	***H***	VEBs Show Env. Best Practice	***M***	VEBs=(night eff.)-->￼Res. Odor
								X	VEBs+PLT Anticipate Regs	***Q***	VEBs+PLT=CB Stewardship	***C***	PLT=Bird Health	***N***	VEBs=Reduce Human Health Risks
										R	VEBs+PLT=Farmer-Stewards	***D***	PLT=Emissions ￼		
												G	VEBs=Hedgerow/Heritage Farming		
		0		***0***		***0***		***0***		***0***		***0***		***0***	
	TOTAL	**0**													
	MISSING	325													

Notes:
CAUTION: filling the cells this way only APPROXIMATES the positions of the card sort
Total and Missing are a check on each sort being complete.

Q-Sorts transcribed to nums with numerical check

Part 1 of 13

	NUMBER		1		2		3		4		5		6		7
1	283	*1 8*	VEBs+PLT->Land Stewardship	*1 7*	VEBs+PLT->CB Health	*1*	Emissions=Sus-> CB-friendly	*1 2*	VEBs=Neighborhood Screen	*3*	PLT=Bird Health	*5*	PLT/Paw Health=Profit	*1 4*	VEBs=Reduced Human Health Risks
	283			*2 0*	VEBs+PLT->Sus Ag/Next Gen	*2 4*	VEBs+PLT->Strategic NMP	*2 3*	VEBs+PLT Support Fishers	*9*	VEB Distance is Flexible	*2 1*	VEBs+PLT=Humane Animal Treatment	*2*	Less NH3=Reduced Eye Irritation
	283					*7*	VEBs=Heritage Farming Practice	*2 2*	VEBs+PLT Reflect Spiritual Values	*1 1*	VEBs=Improves Farmer Life Quality	*1 3*	VEBs = Reduced Odors	*1 0*	VEBs=Energy Efficiency
	283							*4*	PLT=Less Emissions	*8*	VEBs Show Farm Sustainability	*1 9*	VEBs Enhance Farm Livability	*1 6*	VEBs Part of NMPlans
	283									*6*	VEBs=Beatification	*1 5*	VEBs = Wildlife Habitat		
	283											*2 5*	VEBs+PLT->Revised NRCS Standard		
		1 8		*3 7*		*3 2*		*6 1*		*3 7*		*9 8*		*4 2*	
	TOTAL	3 2 5													
	MISSING	*0*													

	NUMBER		1		2		3		4		5		6		7
2	**212**	***2 0***	VEBs+PLT= Sus Ag to Next Gen	***1 8***	VEBs+PLT=Farmer- Stewards	***1 7***	VEBs+PLT=CB Stewardship	***1 4***	VEBs=Reduce Human Health Risks	***5***	PLT/Paw Health=Profit	***1 1***	VEBs=Improves Farmer Life Quality	***1 2***	VEBs=Neighborho od Screen
	212			***7***	VEBs=Hedgerow/H eritage Farming	***8***	VEBs Show Env. Best Practice	***2***	PLT=Reduced Eye Irritation	***9***	VEB Distance is Flexible	***1 0***	VEBs=Energy Efficiency	***1 3***	VEBs=(night eff.)- ->☟Res. Odor
	212					***2 2***	VEBs+PLT= Spiritual Vision/Stewardship	***6***	VEBs=Beautificatio n	***2 1***	PLT=Humane Treatment	***4***	PLT=Emissions ☟	***3***	PLT=Bird Health
	212							***1***	Emissions ☟=Sust.->CB- friendly	***1 5***	VEBs = Wildlife Habitat	***1 6***	VEBs (4/12-10/12) Part of NMP	***1 9***	VEBs UP Management/Liv ability
	212									***2 5***	VEBs->NRCS Rewrite	***2 4***	VEBs+PLT Anticipate Regs		
	212											***2 3***	VEBs+PLT->Fisherie s		
		2 0		***2 5***		***4 7***		***2 3***		***7 5***		***8 8***		***4 7***	
	TOTAL	**3 2 5**													
	MISSING	***0***													

	NUMBER		1		2		3		4		5		6		7
3	254	6	VEBs=Beautification	18	VEBs+PLT=Farmer-Stewards	17	VEBs+PLT=CB Stewardship	14	VEBs=Reduce Human Health Risks	11	VEBs=Improves Farmer Life Quality	5	PLT/Paw Health=Profit	2	PLT=Reduced Eye Irritation
	254			7	VEBs=Hedgerow/Heritage Farming	8	VEBs Show Env. Best Practice	9	VEB Distance is Flexible	4	PLT=Emissions ☟	13	VEBs=(night eff.)-->☟Res. Odor	3	PLT=Bird Health
	254					1	Emissions ☟=Sust.->CB-friendly	22	VEBs+PLT= Spiritual Vision/Stewardship	19	VEBs UP Management/Livability	16	VEBs (4/12-10/12) Part of NMP	21	PLT=Humane Treatment
	254							23	VEBs+PLT->Fisheries	15	VEBs=Wildlife Habitat	20	VEBs+PLT= Sus Ag to Next Gen	10	VERBs=Energy Efficiency
	254									25	VEBs->NRCS Rewrite	24	VEBs+PLT Anticipate Regs		
	254											12	VEBs=Neighborhood Screen		
		6		25		26		68		74		90		36	
	TOTAL	325													
	MISSING	*0*													

	NUMBER		1		2		3		4		5		6		7
4	270	6	VEBs=Beautification	8	VEBs Show Env. Best Practice	17	VEBs+PLT=CB Stewardship	11	VEBs=Improves Farmer Life Quality	24	VEBs+PLT Anticipate Regs	5	PLT/Paw Health=Profit	2	PLT=Reduced Eye Irritation
	270			18	VEBs+PLT=Farmer-Stewards	7	VEBs=Hedgerow/Heritage Farming	9	VEB Distance is Flexible	12	VEBs=Neighborhood Screen	13	VEBs=(night eff.)->☟Res. Odor	14	VEBs=Reduce Human Health Risks
	270					1	Emissions ☟=Sust.->CB-friendly	22	VEBs+PLT= Spiritual Vision/Stewardship	19	VEBs UP Management/Livability	16	VEBs (4/12-10/12) Part of NMP	10	VEBs=Energy Efficiency
	270							23	VEBs+PLT->Fisheries	15	VEBs=Wildlife Habitat	21	PLT=Humane Treatment	20	VEBs+PLT= Sus Ag to Next Gen
	270									3	PLT=Bird Health	4	PLT=Emissions ☟		
	270											25	VEBs->NRCS Rewrite		
		6		26		25		65		73		84		46	
	TOTAL	325													
	MISSING	*0*													

	NUMBER		1		2		3		4		5		6		7
5	**249**	*7*	VEBs=Hedgerow/Heritage Farming	*8*	VEBs Show Env. Best Practice	*2*	PLT=Reduced Eye Irritation	*2 2*	VEBs+PLT= Spiritual Vision/Stewardship	*1 1*	VEBs=Improves Farmer Life Quality	*4*	PLT=Emissions ¶	*5*	PLT/Paw Health=Profit
	249			*1*	Emissions ¶=Sust.->CB-friendly	*2 3*	VEBs+PLT->Fisheries	*2 1*	PLT=Humane Treatment	*2 0*	VEBs+PLT= Sus Ag to Next Gen	*2 4*	VEBs+PLT Anticipate Regs	*3*	PLT=Bird Health
	249					*1 9*	VEBs UP Management/Livability	*9*	VEB Distance is Flexible	*1 2*	VEBs=Neighborhood Screen	*1 0*	VEBs=Energy Efficiency	*1 6*	VEBs (4/12-10/12) Part of NMP
	249							*1 3*	VEBs=(night eff.)->¶Res. Odor	*1 4*	VEBs=Reduce Human Health Risks	*1 7*	VEBs+PLT=CB Stewardship	*1 5*	VEBs=Wildlife Habitat
	249									*6*	VEBs=Beautification	*2 5*	VEBs->NRCS Rewrite		
	249											*1 8*	VEBs+PLT=Farmer-Stewards		
		7		*9*		*4 4*		*6 5*		*6 3*		*9 8*		*3 9*	
	TOTAL	**325**													
	MISSING	***0***													

	NUM BER		1		2		3		4		5		6		7
6	265	2 5	VEBs->NRC S Rewrite	8	VEBs Show Env. Best Practice	1 1	VEBs=Improves Farmer Life Quality	2 2	VEBs+PLT= Spiritual Vision/Stewardship	1 3	VEBs=(night eff.)- ->¶Res. Odor	5	PLT/Paw Health=Profit	3	PLT=Bird Health
	265			2 0	VEBs+PLT= Sus Ag to Next Gen	1	Emissions ¶=Sust.->CB-friendly	2 3	VEBs+PLT->Fisheries	2 1	PLT=Humane Treatment	9	VEB Distance is Flexible	2	PLT=Reduced Eye Irritation
	265					1 5	VEBs=Wildlife Habitat	1 9	VEBs UP Management/Livabilit y	1 2	VEBs=Neighborhoo d Screen	1 0	VEBs=Energy Efficiency	1 4	VEBs=Reduce Human Health Risks
	265							6	VEBs=Beautification	1 7	VEBs+PLT=CB Stewardship	2 4	VEBs+PLT Anticipate Regs	1 6	VEBs (4/12-10/12) Part of NMP
	265									7	VEBs=Hedgerow/H eritage Farming	4	PLT=Emissions ¶		
	265											1 8	VEBs+PLT=Farm er-Stewards		
		2 5		2 8		2 7		7 0		7 0		7 0		3 5	
	TOT AL	3 2 5													
	MISS ING	0													

	NUMBER		1		2		3		4		5		6		7
7	202	25	VEBs->NRCS Rewrite	18	VEBs+PLT=Farmer-Stewards	5	PLT/Paw Health=Profit	22	VEBs+PLT= Spiritual Vision/Stewardship	11	VEBs=Improves Farmer Life Quality	13	VEBs=(night eff.)->¶Res. Odor	9	VEB Distance is Flexible
	202			1	Emissions ¶=Sust.->CB-friendly	20	VEBs+PLT= Sus Ag to Next Gen	23	VEBs+PLT->Fisheries	21	PLT=Humane Treatment	10	VEBs=Energy Efficiency	14	VEBs=Reduce Human Health Risks
	202					6	VEBs=Beautification	15	VEBs=Wildlife Habitat	19	VEBs UP Management/Livability	12	VEBs=Neighborhood Screen	16	VEBs (4/12-10/12) Part of NMP
	202							7	VEBs=Hedgerow/Heritage Farming	17	VEBs+PLT=CB Stewardship	24	VEBs+PLT Anticipate Regs	2	PLT=Reduced Eye Irritation
	202									4	PLT=Emissions ¶	3	PLT=Bird Health		
	202											8	VEBs Show Env. Best Practice		
		25		19		31		67		72		70		41	
	TOTAL	325													
	MISSING	0													

	NUMBER		1		2		3		4		5		6		7
8	285	6	VEBs=Beautification	21	PLT=Humane Treatment	8	VEBs Show Env. Best Practice	1	Emissions ↓=Sust.->CB-friendly	5	PLT/Paw Health=Profit	11	VEBs=Improves Farmer Life Quality	14	VEBs=Reduce Human Health Risks
	285			25	VEBs->NRCS Rewrite	19	VEBs UP Management/Livability	17	VEBs+PLT=CB Stewardship	23	VEBs+PLT->Fisheries	10	VEBs=Energy Efficiency	2	PLT=Reduced Eye Irritation
	285					7	VEBs=Hedgerow/Heritage Farming	20	VEBs+PLT= Sus Ag to Next Gen	24	VEBs+PLT Anticipate Regs	15	VEBs=Wildlife Habitat	16	VEBs (4/12-10/12) Part of NMP
	285							22	VEBs+PLT= Spiritual Vision/Stewardship	9	VEB Distance is Flexible	3	PLT=Bird Health	13	VEBs=(night eff.)->↓Res. Odor
	285									18	VEBs+PLT=Farmer-Stewards	4	PLT=Emissions ↓		
	285											12	VEBs=Neighborhood Screen		
		6		46		34		60		79		55		45	
	TOTAL	325													
	MISSING	0													

	NUMBER		1		2		3		4		5		6		7
9	**314**	*1*	Emissions ¶=Sust.->CB-friendly 🐧	*2* *2*	VEBs+PLT= Spiritual Vision/Stewardship	*2* *1*	PLT=Humane Treatment	*1* *9*	VEBs UP Management/Livability	*6*	VEBs=Beautification	*1* *1*	VEBs=Improves Farmer Life Quality	*9*	VEB Distance is Flexible
	314			*2* *5*	VEBs->NRCS Rewrite	*8*	VEBs Show Env. Best Practice	*1* *7*	VEBs+PLT=CB Stewardship	*1* *0*	VEBs=Energy Efficiency	*1* *4*	VEBs=Reduce Human Health Risks	*2*	PLT=Reduced Eye Irritation
	314					*7*	VEBs=Hedgerow/Heritage Farming	*2* *0*	VEBs+PLT= Sus Ag to Next Gen	*2* *4*	VEBs+PLT Anticipate Regs	*1* *2*	VEBs=Neighborhood Screen	*1* *6*	VEBs (4/12-10/12) Part of NMP
	314							*1* *5*	VEBs=Wildlife Habitat	*2* *3*	VEBs+PLT->Fisheries	*3*	PLT=Bird Health	*1* *3*	VEBs=(night eff.)-->¶Res. Odor
	314									*1* *8*	VEBs+PLT=Farmer-Stewards	*4*	PLT=Emissions ¶		
	314											*5*	PLT/Paw Health=Profit		
		1		*4* *7*		*3* *6*		*7* *1*		*8* *1*		*4* *9*		*4* *0*	
	TOTAL	**3** **2** **5**													
	MISSING	0													

	NUMBER		1		2		3		4		5		6		7
10	330	*1*	Emissions ¶=Sust.->CB-friendly	*22*	VEBs+PLT= Spiritual Vision/Stewardship	*13*	VEBs=(night eff.)-->¶Res. Odor	*19*	VEBs UP Management/Livability	*11*	VEBs=Improves Farmer Life Quality	*25*	VEBs->NRCS Rewrite	*9*	VEB Distance is Flexible
	330			*6*	VEBs=Beautification	*20*	VEBs+PLT= Sus Ag to Next Gen	*17*	VEBs+PLT=CB Stewardship	*24*	VEBs+PLT Anticipate Regs	*4*	PLT=Emissions ¶	*15*	VEBs=Wildlife Habitat
	330					*7*	VEBs=Hedgerow/ Heritage Farming	*18*	VEBs+PLT=Farmer-Stewards	*10*	VEBs=Energy Efficiency	*12*	VEBs=Neighborhood Screen	*16*	VEBs (4/12-10/12) Part of NMP
	330							*2*	PLT=Reduced Eye Irritation	*23*	VEBs+PLT->Fisheries	*5*	PLT/Paw Health=Profit	*3*	PLT=Bird Health
	330									*8*	VEBs Show Env. Best Practi	*21*	PLT=Humane Treatment		
	330											*14*	VEBs=Reduce Human Health Risks		
		1		*28*		*40*		*56*		*76*		*81*		*43*	
	TOTAL	325													
	MISSING	0													

	NUMBER		1		2		3		4		5		6		7
1 1	362	*2 0*	VEBs+PLT->Sus Ag/Next Gen	*2 2*	VEBs+PLT= Spiritual Vision/Stewardship	*1*	Emissions ☟=Sust.->CB-friendly	*1 9*	VEBs UP Management/Liv ability	*1 6*	VEBs (4/12-10/12) Part of NMP	*2 3*	VEBs+PLT->Fis heries	*1 5*	VEBs=Wildlife Habitat
				6	VEBs=Beautification	*1 1*	VEBs=Improves Farmer Life Quality	*2 4*	VEBs+PLT Anticipate Regs	*1 0*	VEBs=Energy Efficiency	*3*	PLT=Bird Health	*5*	PLT/Paw Health=Profit
						7	VEBs=Hedgerow/H eritage Farming	*1 8*	VEBs+PLT=Farmer -Stewards	*1 3*	VEBs=(night eff.)- ->☟Res. Odor	*2*	PLT=Reduced Eye Irritation	*1 4*	VEBs=Reduce Human Health Risks
								2 5	VEBs->NRCS Rewrite	*1 2*	VEBs=Neighborh ood Screen	*9*	VEB Distance is Flexible	*4*	PLT=Emissions ☟
										8	VEBs Show Env. Best Practice	*2 1*	PLT=Humane Treatment		
												1 7	VEBs+PLT=CB Stewardship		
		2 0		*2 8*		*1 9*		*8 6*		*5 9*		*7 5*		*3 8*	
	TOTAL	3 2 5													
	MISSING	0													

	NUMBER		1		2		3		4		5		6		7
1 2	378	22	VEBs+PLT= Spiritual Vision/Stewardship	17	VEBs+PLT=CB Stewardship	6	VEBs=Beautification	12	VEBs=Neighborhood Screen	16	VEBs (4/12-10/12) Part of NMP	4	PLT=Emissions ☞	10	VEBs=Energy Efficiency
	378			1	Emissions ☞=Sust.->CB-friendly	11	VEBs=Improves Farmer Life Quality	13	VEBs=(night eff.)-->☞Res. Odor	15	VEBs=Wildlife Habitat	3	PLT=Bird Health	5	PLT/Paw Health=Profit
	378					8	VEBs Show Env. Best Practice	21	PLT=Humane Treatment	24	VEBs+PLT Anticipate Regs	14	VEBs=Reduce Human Health Risks	2	PLT=Reduced Eye Irritation
	378							18	VEBs+PLT=Farmer-Stewards	19	VEBs UP Management/Livability	25	VEBs->NRCS Rewrite	9	VEB Distance is Flexible
	378									7	VEBs=Hedgerow/Heritage Farming	23	VEBs+PLT->Fisheries		
	378											20	VEBs+PLT->Sus Ag/Next Gen		
		22		18		25		64		81		89		26	
TOTAL		325													
MISSING		0													

Part 13 of 13

	NUMBER		1		2		3		4		5		6		7
13	394	16	VEBs (4/12-10/12) Part of NMP	21	PLT=Humane Treatment	6	VEBs=Beautification	22	VEBs+PLT= Spiritual Vision/Stewardship	11	VEBs=Improves Farmer Life Quality	25	VEBs->NRCS Rewrite	9	VEB Distance is Flexible
	394			1	Emissions ¶=Sust.->CB-friendly	20	VEBs+PLT->Sus Ag/Next Gen	2	PLT=Reduced Eye Irritation	12	VEBs=Neighborhood Screen	19	VEBs UP Management/Livability	10	VEBs=Energy Efficiency
	394					15	VEBs=Wildlife Habitat	23	VEBs+PLT->Fisheries	5	PLT/Paw Health=Profit	8	VEBs Show Env. Best Practice	13	VEBs=(night eff.)->¶Res. Odor
								24	VEBs+PLT Anticipate Regs	17	VEBs+PLT=CB Stewardship	3	PLT=Bird Health	14	VEBs=Reduce Human Health Risks
										18	VEBs+PLT=Farmer-Stewards	4	PLT=Emissions ¶		
												7	VEBs=Hedgerow/ Heritage Farming		
		16		22		41		71		63		66		46	
	TOTAL	325													
	MISSING	0													

Notes:
This sheet contains the 13 sorts, transcribed from photos. Column A is the sort number. Column B is the unique identifier that represents a card included with the sort. Protect respondent identity.
These sorts are a close mimic of the sorting pattern of 25 cards by 13 respondents. at the lower portion of this sheet are two images that show the sorting pattern over 7 columns from LEAST important (Column 1) to MOST important (Column 7)

X2 observed values on 13 respondents/25 cards

	OBSERVED	1	2	3	4	5	6	7	8	9	10	11	12	13
A	Emissions ☟=Sust.->CB-friendly	**4**	**4**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**1**
B	PLT=Reduced Eye Irritation	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**6**	**4**	**4**	**4**	**3**
C	PLT=Bird Health	**7**	**7**	**7**	**7**	**7**	**6**	**6**	**6**	**6**	**6**	**6**	**5**	**5**
D	PLT=Emissions ☟	**7**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**5**	**5**	**4**
E	PLT/Paw Health=Profit	**7**	**7**	**7**	**6**	**6**	**6**	**6**	**6**	**6**	**5**	**5**	**5**	**3**
F	VEBs=Beautification	**5**	**5**	**5**	**4**	**4**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**
G	VEBs=Hedgerow/Heritage Farming	**6**	**5**	**5**	**4**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**1**
H	VEBs Show Env. Best Practice	**6**	**6**	**5**	**5**	**5**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**
I	VEB Distance is Flexible	**7**	**7**	**7**	**7**	**7**	**6**	**6**	**5**	**5**	**5**	**4**	**4**	**4**
J	VEBs=Energy Efficiency	**7**	**7**	**7**	**7**	**7**	**6**	**6**	**6**	**6**	**6**	**5**	**5**	**5**
K	VEBs=Improves Farmer Life Quality	**6**	**6**	**6**	**5**	**5**	**5**	**5**	**5**	**5**	**4**	**3**	**3**	**3**
L	VEBs=Neighborhood Screen	**7**	**6**	**6**	**6**	**6**	**6**	**5**	**5**	**5**	**5**	**5**	**4**	**4**
M	VEBs=(night eff.)-->☟Res. Odor	**7**	**7**	**7**	**7**	**6**	**6**	**6**	**6**	**5**	**5**	**4**	**4**	**3**
N	VEBs=Reduces Human Health Risks	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**6**	**6**	**6**	**5**	**4**	**4**
O	VEBs=Wildlife Habitat	**7**	**7**	**7**	**6**	**6**	**5**	**5**	**5**	**5**	**4**	**4**	**3**	**3**
P	VEBs (4/12-10/12) Part of NMP	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**6**	**6**	**6**	**5**	**5**	**1**
Q	VEBs+PLT=CB Stewardship	**6**	**6**	**5**	**5**	**5**	**4**	**4**	**4**	**3**	**3**	**3**	**2**	**2**
R	VEBs+PLT=Farmer-Stewards	**6**	**6**	**5**	**5**	**5**	**4**	**4**	**4**	**2**	**2**	**2**	**2**	**1**
S	VEBs UP Management/Livability	**7**	**6**	**6**	**5**	**5**	**5**	**5**	**4**	**4**	**4**	**4**	**3**	**3**
T	VEBs+PLT= Sus Ag to Next Gen	**7**	**6**	**6**	**5**	**4**	**4**	**3**	**3**	**3**	**2**	**2**	**1**	**1**
U	PLT=Humane Treatment	**7**	**6**	**6**	**6**	**6**	**5**	**5**	**5**	**4**	**4**	**3**	**2**	**2**
V	VEBs+PLT= Spiritual Vision/Stewardship	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**3**	**2**	**2**	**2**	**1**
W	VEBs+PLT->Fisheries	**6**	**6**	**6**	**5**	**5**	**5**	**4**	**4**	**4**	**4**	**4**	**4**	**3**
X	VEBs+PLT Anticipate Regs	**6**	**6**	**6**	**6**	**6**	**5**	**5**	**5**	**5**	**5**	**4**	**4**	**3**
Y	VEBs->NRCS Rewrite	**6**	**6**	**6**	**6**	**6**	**6**	**5**	**5**	**4**	**2**	**2**	**1**	**1**
SUM		**159**	**135**	**149**	**141**	**138**	**138**	**5904000**						

Notes:
Information comes from Vote tally sheets (1-4), representing a series of transformations including stripping code to leave values only in cells within arrangements. One goal: data preparation for box plot visualizations.

X2 DRAFT tables for: Vote summaries by column

	OBSERVED VALUES	VOTES	VOTES	VOTES	VOTES	VOTES	VOTES	VOTES
		C1	C2	C3	C4	C5	C6	C7
A	Emissions ☟=Sust.->CB-friendly	2	4	5	2	0	0	0
B	PLT=Reduced Eye Irritation	0	0	1	3	0	1	8
C	PLT=Bird Health	0	0	0	0	2	6	5
D	PLT=Emissions ☟	0	0	0	1	2	9	1
E	PLT/Paw Health=Profit	0	0	1	0	3	6	3
F	VEBs=Beautification	3	2	3	2	3	0	0
G	VEBs=Hedgerow/Heritage Farming	1	2	6	1	2	1	0
H	VEBs Show Env. Best Practice	0	3	5	0	3	2	0
I	VEB Distance is Flexible	0	0	0	3	3	2	5
J	VEBs=Energy Efficiency	0	0	0	0	3	5	5
K	VEBs=Improves Farmer Life Quality	0	0	3	1	6	3	0
L	VEBs=Neighborhood Screen	0	0	0	2	5	5	1
M	VEBs=(night eff.)-->☟Res. Odor	0	0	1	2	2	4	4
N	VEBs=Reduces Human Health Risks	0	0	0	2	1	3	7
O	VEBs=Wildlife Habitat	0	0	2	2	4	2	3
P	VEBs (4/12-10/12) Part of NMP	1	0	0	0	2	3	7
Q	VEBs+PLT=CB Stewardship	0	2	3	3	3	2	0
R	VEBs+PLT=Farmer-Stewards	1	4	0	3	3	2	0
S	VEBs UP Management/Livability	0	0	2	4	4	2	1
T	VEBs+PLT= Sus Ag to Next Gen	2	2	3	2	1	2	1
U	PLT=Humane Treatment	0	2	1	2	3	4	1
V	VEBs+PLT= Spiritual Vision/Stewardship	1	3	1	8	0	0	0
W	VEBs+PLT->Fisheries	0	0	1	6	3	3	0
X	VEBs+PLT Anticipate Regs	0	0	1	2	5	5	0
Y	VEBs->NRCS Rewrite	2	2	0	1	2	6	0

Note:
Null H = no relationship between Card Value (A-Y) and placement in Columns 1-7)
Hypothesis = there is meaning about Card Value (A-Y) and placement in Columns 1-7)

These are unweighted, hence the zeros. Will need to use weighted values for chi square; confirmed with Cathleen H. and later River.
Can also redo by collapsing columns. Improves the sample size by putting more "bits" into three columns.....
Finally, Egon-Pearson correction can be used for both Preference categories =C1, C2, C3, C4, C7, C6, and C7 and Preferences = c1, c2, and c3

X2 DRAFT tables CONT; Ex. Values all cell

	OBSERVED VALUES	VOTES	VOTES	VOTES	VOTES	VOTES	VOTES	VOTES
		C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
A	Emissions ☟=Sust.->CB-friendly	**2**	**4**	**5**	**2**	**0**	**0**	**0**
B	PLT=Reduced Eye Irritation	**0**	**0**	**1**	**3**	**0**	**1**	**8**
C	PLT=Bird Health	**0**	**0**	**0**	**0**	**2**	**6**	**5**
D	PLT=Emissions ☟	**0**	**0**	**0**	**1**	**2**	**9**	**1**
E	PLT/Paw Health=Profit	**0**	**0**	**1**	**0**	**3**	**6**	**3**
F	VEBs=Beautification	**3**	**2**	**3**	**2**	**3**	**0**	**0**
G	VEBs=Hedgerow/Heritage Farming	**1**	**2**	**6**	**1**	**2**	**1**	**0**
H	VEBs Show Env. Best Practice	**0**	**3**	**5**	**0**	**3**	**2**	**0**
I	VEB Distance is Flexible	**0**	**0**	**0**	**3**	**3**	**2**	**5**
J	VEBs=Energy Efficiency	**0**	**0**	**0**	**0**	**3**	**5**	**5**
K	VEBs=Improves Farmer Life Quality	**0**	**0**	**3**	**1**	**6**	**3**	**0**
L	VEBs=Neighborhood Screen	**0**	**0**	**0**	**2**	**5**	**5**	**1**
M	VEBs=(night eff.)-->☟Res. Odor	**0**	**0**	**1**	**2**	**2**	**4**	**4**
N	VEBs=Reduces Human Health Risks	**0**	**0**	**0**	**2**	**1**	**3**	**7**
O	VEBs=Wildlife Habitat	**0**	**0**	**2**	**2**	**4**	**2**	**3**
P	VEBs (4/12-10/12) Part of NMP	**1**	**0**	**0**	**0**	**2**	**3**	**7**
Q	VEBs+PLT=CB Stewardship	**0**	**2**	**3**	**3**	**3**	**2**	**0**
R	VEBs+PLT=Farmer-Stewards	**1**	**4**	**0**	**3**	**3**	**2**	**0**
S	VEBs UP Management/Livability	**0**	**0**	**2**	**4**	**4**	**2**	**1**
T	VEBs+PLT= Sus Ag to Next Gen	**2**	**2**	**3**	**2**	**1**	**2**	**1**
U	PLT=Humane Treatment	**0**	**2**	**1**	**2**	**3**	**4**	**1**
V	VEBs+PLT= Spiritual Vision/Stewardship	**1**	**3**	**1**	**8**	**0**	**0**	**0**
W	VEBs+PLT->Fisheries	**0**	**0**	**1**	**6**	**3**	**3**	**0**
X	VEBs+PLT Anticipate Regs	**0**	**0**	**1**	**2**	**5**	**5**	**0**
Y	VEBs->NRCS Rewrite	**2**	**2**	**0**	**1**	**2**	**6**	**0**

Notes:
Null H = no relationship between Card Value (A-Y) and placement in Columns 1-7)
Hypothesis = there is meaning about Card Value (A-Y) and placement in Columns 1-7)

C1 (like C7) has only 1 cell in the sort space column) Is LEAST important in sorting space

C2 (like C6) has two cells in the sorting column.
C5 (like C3) has
C6 (like C2) has two cells in the sort column
C7 (Like C1) has only one cell in the sort space column)
IS MOST important sort position
Weighted votes reflect the valuing act of the sorting surface. The right side of the sorting surface is bounded by Sorting Column 7 (column X in this sheet) where respondents place the one card that is most important to them. Sorting Column 1 (column f in this sheet) is where respondents place the one card that is least important to them.
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