# Applying Q Methodology to Investigate How U.S. Meat Producers Prioritize Decisions Regarding Environmental Stewardship and Animal Wellbeing

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## Abstract

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U.S. meat producers continue to face challenges with how to improve production sustainability, while balancing environmental and animal wellbeing decisions. The industry is driven by changing consumer preferences and market trends that require the need for continued transformations towards a sustainable production practice. The objective of this Q methodology study is to better understand how U.S. meat producers prioritize sustainability-related decisions, in response to both internal and external pressures. The underlying goals of this research is to explore both the drivers of this complex decision-making landscape, while illuminating the tradeoffs made between environmental stewardship and animal wellbeing. The facilitators and barriers to the why behind producers' current operational decisions have been examined across very small to very large scale beef, pork, and broiler operations. Using principal component analysis (PCA), 38 variables produced three distinct discourses: Animal Husbandry: First and Foremost; Business Sustainability: A Balancing Act; Environmental Stewardship: A Holistic

Approach. These findings explain the tradeoffs made between high efficient production and affordable meat products with the sole prioritization of environmental stewardship or animal wellbeing. The key differences between these viewpoints lies within what can currently be prioritized given the resources allocated to each producer, while balancing personal beliefs with business viability. The need for flexible support systems that (1) reflect the needs of all producers and (2) reflect the needs of individual groupings of producers that differ between one another, is needed to increase sustainability-related practice adoption on animal agricultural operations.

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# 1.0 BACKGROUND

## *1.1 Meat Production and Consumption Trends in the United States*

Beginning as early as the 1840s, industrial agriculture has transformed how food is produced in the United States (Hendrickson & James, 2005; Horrigan et al., 2002; Montague & Pellerano, 2022). External pressures for farms to consolidate into fewer, yet larger operations, amplified production while newer technology and the development of Concentrated Animal Feeding Operations (CAFOs) fueled meat production – requiring lower inputs to yield a higher amount of meat products (Hribar & Schultz, 2010). The prevalence of CAFOs has continued to increase, as smaller farms have become less abundant across the nation (Pagliari et al., 2020). Since 1932, the total number of animal farms have declined altogether – suggesting that farm consolidation increased operation productivity and decreased the need for additional farms to meet demand (Keller, 2023). Paired with the reported decrease in the number of farms, U.S. meat production has increased by 185% between the years 1961 and 2018 (Ritchie et al., 2017). In 2017, there were 2.1 million livestock and poultry farms (defined as operations that intended to sell more than $1,000 worth of agricultural products per year) operating on a total of 910 million acres in the U.S. (USDA, 2017). In 2020, production exceeded a combined 86.0 billion pounds of beef and pork and 59.4 billion pounds of live weight broilers (USDA, 2021a, 2021b). In regards to consumption, both red meat and poultry have seen a general upward trend in consumption patterns – providing reasonable demand for the increase in U.S. meat production (Valcu-Lisman, 2022).

## *1.2 How is Sustainability Defined*

The United States Department of Agriculture (USDA) has referenced both the 1977 and 1990 Farm Bills to define sustainable agriculture as an integrated system of plant and animal production which will, over the long term, accomplish the following: satisfy human and fiber needs, enhance environmental quality and the natural resource base upon which the agricultural economy depends, make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls, sustain the economic viability of farm operations, and enhance the quality of life for farmers and society as a whole (USDA, 2011). It is widely accepted in the literature that sustainable agriculture, ideally, incorporates efficient output with three fundamental dimensions of sustainability: environmental, societal, and economics (Brundtland Commision, 1987; FAO, 2021; NCBA, 2017; Niles, 2013; Zhang et al., 2021). Environmental sustainability is the development of a production process that is compatible with the natural ecological processes. Societal sustainability depends on the social and/or cultural acceptability of the production practice, including consumer preferences and animal wellbeing. While economic sustainability considers the question of economic livelihoods of producers and food affordability for consumers (Smith & McDonald, 1998). In practice, meat producers and value chain actors are committed to contribute towards sustainable operations through the conservation of natural resources, caring for animals, respecting the open range, protecting biodiversity and wildlife, innovating across operations, and addressing climate change (NCBA, 2017).

### *1.3 Environmental Health and Animal Wellbeing Challenges*

Paired with the upward trend in meat production and consumption, the industry faces challenges that stem from industrialized agriculture – encompassing both environmental stewardship and animal wellbeing. Although producers have been attentive of these topics, reflected in current producer commitments (NCBA, 2017), recent consumer concerns have motivated the industry to continue to adopt sustainability-related practices. The additional demand for meat is anticipated to strain the management of our natural resources, planetary health, and the quality of the life for meat animals. Environmental concerns relate directly to anthropogenic greenhouse gas (GHG) emissions, water pollution and scarcity, biodiversity degradation, and the sheer size of both land and water footprints associated with meat production (González et al., 2020). The use of CAFOs to increase industry productivity, while minimizing inputs, have the potential to jeopardize the humane treatment of meat animals (Mateo-Sagasta et al., 2017). The industry is attracting consumer attention and concerns pertaining to the environmental impacts and animal wellbeing realities within livestock and poultry production. It is apparent that animal agriculture must consider their sustainability-related priorities to avoid detrimental effects on the environment and the wellbeing of both humans and animals (Bradford, 1999).

The health of our environment, paired with concerns of the humane treatment of livestock and poultry, is threatened as the intensification of animal agriculture attempts to satisfy the anticipated and growing demand of meat. The U.S. agricultural industry is noted to be responsible for approximately 10% of anthropogenic greenhouse gas (GHG) emissions and require a significant amount of natural resources (Gerber et al., 2013; Grossi et al., 2019; US EPA, 2015). In addition, animal agriculture occupies 40% of the land surface area in the nation (*USDA - National Agricultural Statistics Service - Census of Agriculture*, 2017). The associated production of animal waste can exceed the buffering capacity of the surrounding environment, resulting in the potential for toxic runoff polluting surface waters and groundwater (Mateo-Sagasta et al., 2017). It has been reported that 9.8 billion individual animals (livestock and poultry) in the U.S. can produce upwards of 1.4 billion tons of manure each year (Pagliari et al., 2020). While enlarged farm and field/pasture sizes contribute to the harmful loss of ecosystem biodiversity (Geiger et al., 2010). Moreover, CAFOs are an important tool in producing efficient meat products while making up 15% of total animal feeding operations in the U.S. (WDHS, 2015). Animal wellbeing concerns within animal agriculture primarily relate to the confinement of animals creating a challenge to balance an animal's ability to experience their natural behavior with efficient production. Differences in mitigation measures between operations have created misalignment within the industry, including: the careful planning of waste disposal, regulations at the local, state, and federal levels, and best management practices pertaining to the control, treatment, and prevention of inhumane animal treatment and environmental pollutants (WDHS, 2015). However, the exploration of *what* is driving decision-making, and the barriers preventing practice adoption, on meat operations is minimally researched but have been delineated through this study.

Producer reports have noted the importance of, and producers' commitment to, improving animal agricultural production practices through environmental stewardship and the prioritization of animal wellbeing (NCBA, 2017). Pressures from governmental mandates and regulations, environmental challenges, and consumer concerns are hypothesized to be influencing animal agricultural producers' decision-making and motivating producers to adopt change (Buller et al., 2018; Castonguay et al., 2023). There is a lack of research illuminating the drivers to decision-making and the tradeoffs made between environmental stewardship and animal wellbeing amongst producers. Previous research on the perceptions of sustainable animal agriculture focus on consumer perspectives; less is known about producer perspectives and the potential alignment (or lack thereof) between producer and consumer sustainability-related operational priorities and whether alignment or misalignment exist between producers. The purpose of this thesis was to investigate how U.S. meat producers prioritize sustainability-related decisions in response to consumer preferences, market trends, and potentially other pressures. The intention of this research is aimed to fill this gap in literature by uncovering the unknown regarding how sustainability-related decisions are approached in industry.

### *1.4 Sustainability Decisions within Animal Agriculture*

In recent years, considerations of consumer preferences and their demands, such as for sustainable products, have flooded the decision space (Smith & McDonald, 1998; Zhang et al., 2021). Sustainability decisions within animal agriculture have been defined to be the need to increase efficient production while slowing the rate of negative environmental impacts (Kebreab, 2013). Although greater efficiency may equate to a smaller carbon footprint within this industry and increased monetary value, it does not address sustainability outside the context of environmental concerns nor economic gain (Kebreab, 2013). Today, sustainable agriculture incorporates responsible use of natural resources paired with consumer interests in both animal and worker health and safety. Regarding the current collection of sustainability-related data, multiple species-specific industry organizations have taken the initiative to measure and report on sustainability-related metrics. The intention of these publicly accessed reports and tools is to increase producer understanding of their impact based on the protein that they raise. For example, the Pork Checkoff program has developed and implemented a "Pork Cares Farm Impact Report", allowing pork producers across the nation to measure and document their own efforts towards a sustainable operation. As for the broiler industry, the National Chicken Council provides a U.S. Broiler Chicken Sustainability Report to highlight the efforts by the industry to continuously improve upon their impact by supporting a sustainable meat production model. Lastly, multiple beef organizations (including the *Global Roundtable for Sustainable Beef* and *Beef, It's What's For Dinner*) have published industry reports throughout the years to track the noted improvements to a variety of intensity metrics pertinent to a sustainable industry. The listed efforts of the individual species organizations creates confidence that the animal agricultural industry is moving in the correct direction, but differences between sustainability-related priorities of individual producers (and across the three species) is unknown. To explore this lack of understanding, the inclusion of beef, pork, and broiler

producers (across multiple operational scales) into this study are intended to explore the potential alignment or misalignment between different characteristics of producers.

### *1.5 Significance*

Animal agriculture is challenged with negative consumer perceptions and misunderstandings regarding sustainability, particularly environmental impacts and treatment of meat animals. However, this industry plays a vital role in contributing to a sustainable, equitable, and resilient food system to support the livelihoods of millions (Tato, 2020). Shedding light on the complex decision-space within sustainability in animal systems helps to illustrate how producers make complex decisions and illuminate areas where barriers to sustainable practice adoption could be alleviated – supporting the changes producers need and want to make to improve environmental stewardship and animal wellbeing. The exploration of the key drivers and pressures in regards to each producer's relative prioritization of both environmental stewardship and animal wellbeing priorities has been explained in the results of this thesis – addressing the minimal research done so on this topic.

## 2.0 METHODOLOGY

### *2.1 Q Methodology*

Introduced by William Stepheson in 1953, Q methodology combines the strengths of both qualitative and quantitative study designs to explore human-subjectivity around a set of issues or topics (Stephenson, 1953). This structured approach uses a rank ordering exercise and factor analysis to explore consensus around common discourses (i.e., an individual's worldviews or perspectives) and uncover divergent views within a group (McKeown & Thomas, 1988). Q methodology has seen an increase in use in research pertaining to natural resource management and conservation (e.g., Carr & Heyman, 2012; Loring & Hinzman, 2018; Nelson et al., 2022). We have employed Q methodology in this study to explore how U.S. meat producers (i.e., beef, pork, broiler) prioritize decisions regarding environmental stewardship and animal wellbeing. As described below, the design of a Q study allows for an exploratory approach in identifying key drivers that influence decision-making. Study participants converge and diverge around essential items and themes, followed with interview questions, allowing for the exploration of factors (e.g., motivators, barriers) that provide reasoning for why participants hold particular perspectives.

A Q study is typically structured around seven core steps; defining and building the concourse, developing the Q set (i.e., statements to be sorted), recruiting of the P set (participants to complete the sorting exercise), conducting the Q sorts (i.e., sorting exercise), post-Q sort interviews, quantitative analysis, and qualitative interpretation (Damio, 2016). These steps are detailed in sections below. During the Q sort, participants are instructed to order the Q set (noted as the *condition of instruction*) into a predetermined distribution (noted as a *Q sort grid*) (R. Brown, 1993). The Q sort grid is structured along a continuum; which in this study was

represented as *lowest priority to highest priority* in this study. Principal component analysis (PCA) was used to analyze the completed Q sorts and identified three factors – representing three distinct perspectives among the participants. Refer to the Figure 1 below for participant information and summary of project workflow.

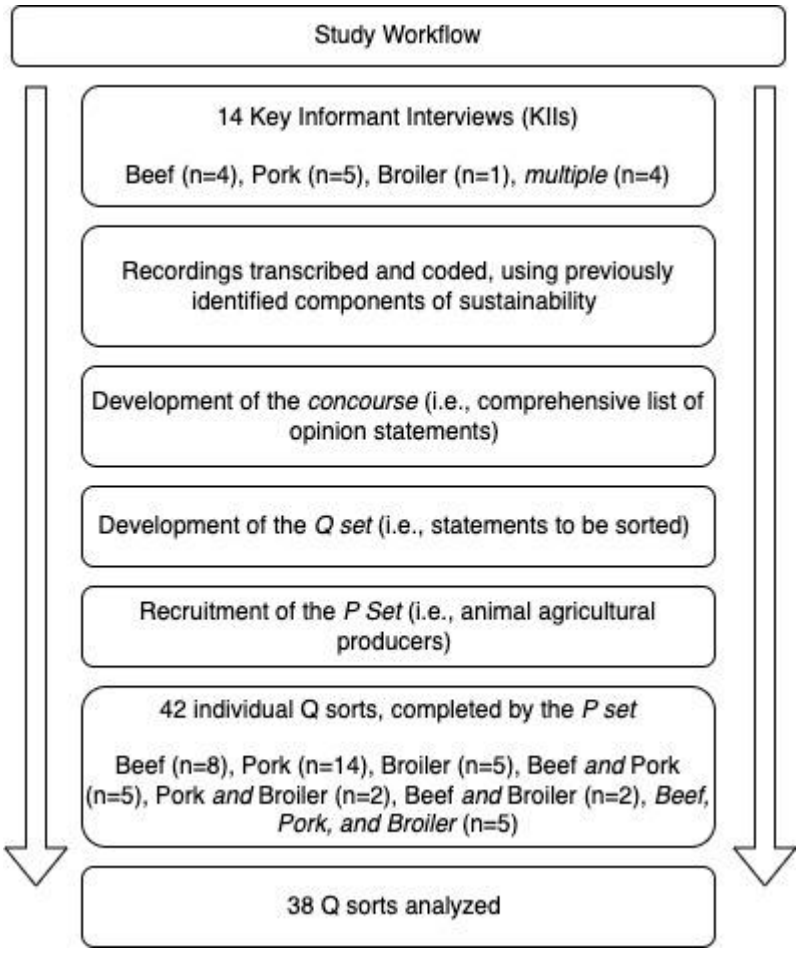


**Figure 1:** Study workflow and participant details.

## *2.2 Concourse*

The first step in a Q methodology study is to establish and build the *concourse*. Defined to be a comprehensive list of statements of a given topic described as “the flow of communicability surrounding any topic” (R. Brown, 1993). The concourse is designed to be a collection of all possible references that any one individual can perceive on the topic at hand. It is then intended for, and the responsibility of, the researcher to draw a complete list of relevant statements through a systematic approach for the purpose of developing the *Q set* (Exel & Graaf, 2005). This refined list of statements, or the Q set, is the sample provided to participants of the study to sort, with appropriate quantities ranging from 20 to 250 statements – with an average of 40 statements (Millar et al., 2022).

In this study, a *verbal* concourse was developed through conducting a total of 14 Key Informant Interviews (KIIs) with key industry members and value chain stakeholders (e.g., industry groups, consumer facing companies, producers, and policy experts) across beef, pork, and broiler industries in order to develop a set of industry-specific priorities. Using a semi-structured interview guide (see appendix A – 8.1 *Key Informant Interview Guide*), interviewees were queried about common environmental and animal wellbeing priorities that producers are potentially faced with in regular, day-to-day, operational practices. Interviewees were also asked about consumer preferences, market trends, and additional pressures to explore the variety of influences underlying any given producer's decision-making.

Each KII was conducted and recorded via Zoom Video Conferencing[1], transcribed verbatim, and qualitatively assessed using qualitative best practices and Dedoose online software[2] (Caudle, 2010). To assess the interviews, a codebook was created. Parent codes were developed using the overarching pillars of sustainability from the USDA's widely accepted definition of sustainability: economic, environmental, and societal (USDA, 2011; Brundtland Commision, 1987). To develop child codes, or sub-categories within the three pillars, the use of industry standards, current producer commitments regarding animal husbandry practices, previous research highlighting sustainability assessment metrics, and an animal wellbeing conceptual framework were compiled together. Each source was refined into observable sustainability components that had the potential to be prioritized within the industry (Broom, 2021; FAO, 2021; Fraser, 2008; NCBA, 2017).

The fourteen KII interviews were then coded using the defined codebook (see Table 2). To uphold qualitative validity and reliability, two individual researchers doubled-coded 10% of the transcripts. Alterations were made to the codebook definitions, based on the coding crosscheck as noted, ensuring accurate application of each code for each transcript. Using the final codebook, the KIIs rendered industry priorities currently being weighed by animal agricultural producers. Across the fourteen KII transcripts, a total of 538 excerpts were noted to be pertaining directly to the sustainability components of interest – this comprehensive list of statements was defined to be the final concourse used in this study.

| **Parent Codes** *(pillars of sustainability)* | |
|---|---|
| **CODE** | **DESCRIPTION** |
| **Environment** | Statements related to an impact on the environment. May include examples relating to natural resource use/stewardship, nutrient management, biodiversity management, and/or pollution (air, water, land, and waste). |
| **Societal** | Statements related to an impact on society. May include examples of food health/access/affordability, community engagement, human well-being (including occupational health), and animal well-being (including the three pillars of animal |

[1] https://zoom.us/
[2] https://www.dedoose.com/

| | |
|---|---|
| | welfare: health and production, natural behavior, and affective state/feeling). |
| **Economic** | Statements related to an impact on economic considerations for livestock producers and value chain actors (which includes farms, businesses, and other operations). May include financial viability, risk, revenues, and expenses. |
| **Child Codes** *(observable components of sustainability)* | |
| **CODE** | **DESCRIPTION** |
| **Land** | Use (incl. statements of land practices, *e.g., grazing systems*), optimization, quality, pollution specific to land |
| **Water** | Use, efficiency, conservation, pollution specific to water |
| **Energy** | Use, efficiency, conservation (incl. alternative energy sources, *e.g., solar*) |
| **Air** | Use, quality (incl. odor, indoor air quality, and outdoor air quality, *e.g., air quality affecting neighboring communities*), pollution specific to air (incl. greenhouse gas emissions) |
| **Soil** | Quality, health, pollution specific to soil |
| **Resource Use** | General environmental/resource stewardship, reduction in use, resource efficiency (not specific to land, water, energy, air, or soil) |
| **Climate Change** | General climate issues/concerns, climate change, climate/carbon footprint, impacts on the environment (due to a change in climate) |
| **Biodiversity** | Wildlife conservation, land use biodiversity (co-coded with **land**), feedstuffs biodiversity, single species farming, micro/macro level biodiversity |
| **Animal Health and Production** | Physical health of the animal (incl. injury and disease), disease prevention (incl. vaccination protocol), disease treatment (incl. antibiotic stewardship, speed of diagnosis), access to water/feed (incl. efficient rate of gain) |
| **Animal Expression of Natural Behavior** | Ability to express freedom of movement (incl. sufficient space), normal patterns of animal behavior, company of the animals own kind (incl. animal to animal interaction(s)) |
| **Animal Affective State/Feelings** | Physical comfort, emotional distress (incl. fear and boredom) |
| **Agricultural Workforce** | Occupational health and safety, quality of life for workers, workforce retention, employee training |
| **Community** | Community (defined to be extension / outreach / education for specific groups of people, e.g., the public, school/education groups, etc.) engagement (incl. notes on production transparency), general health impacts at the community level, animal agricultural perceptions, quality of life for community members (i.e., human well-being) |
| **Consumer/Eater** | Consumer level preferences / trends / pressures / understanding / transparency (i.e., the individual eating the product, end-of-the-line consumer purchasing products directly for consumption NOT from the producer directly), safe food (including antimicrobial resistance health impacts/concerns), nutrition, food affordability |

| | |
|---|---|
| **Profitability** | The ability (or lack thereof) for the producer/operation to yield a financial gain |
| **Viability** | Ability to pass the operation down to further generations, marketing/succession plans, feasibility to adopt/make changes (incl. financial feasibility, technology access) |
| **Customer/Buyer** | Customers/entities level preferences / trends / pressures (i.e., purchasing directly from producers or from producer-partnered intermediaries, *e.g., individuals at farmers markets, McDonald's, grocery stores*, incl. customer purchase stipulations/demands) |
| **Risk** | Operation diversification, Food Safety, biosecurity precautions, disaster planning and preparedness, risk accompanying operational change or sustainable practice adoption (*e.g., risk of economic payback for investing in a sustainable practice*), record-keeping (e.g., BQA audit), compliance, traceability, certification |

**Table 2:** Parent and child codes used in the qualitative assessment of each Key Informant Interview (KII).

### *2.3 Q Set*

The concourse underwent a series of refinement processes in order to systematically choose the final statements that comprised the Q set. The final statements reflected industry priorities that had the potential to be sorted against one another to be able to explore relative prioritization preferences among animal agricultural producers. To develop the Q set, or the final list of priority statements, the 538 excerpts went through four initial cycles of refining (i.e., a systematic approach in choosing which excerpts to include and exclude), rephrasing (to increase readability and clarity), and categorizing excerpts that correlated to subthemes that stemmed from each child code previously coded for (e.g., the excerpts coded with "Land" had emerging subthemes that included both "Land quality" and "Land use" and both subthemes were developed to distinguish differing priorities among numerous excerpts within the same child code).

Throughout the refinement process, being conducted concurrently with rephrasing and categorizing excerpts, excerpts were excluded based on criteria including: excerpts that were *not* a priority (e.g., operational practices), *not* within the producers' purview to prioritize, *not* a priority that could be ranked against another (note: it was a requirement for all statements within the final Q set to have the ability to be sorted against one another to explore relative prioritization preferences), species specific excerpts (i.e., those pertaining to only one of the three species), either too broad or too specific of an excerpt, compound excerpts (i.e., an excerpt having more than one priority in a given sentence), strong valence that may introduce bias (i.e., excerpts that included tradeoffs versus an operational priority) and duplicated priorities (excerpts that were well covered, and read better, in another were prioritized while the substitute was excluded).

Throughout these four initial cycles of refinement, the 538 excerpts were sorted into three categories: “possible Q statements”, “potential to rephrase, *if needed*”, and “not possible Q statements”. Those sorted into the third category were not revisited, based on the exclusion criteria previously listed. The second category were excerpts that had the potential to be final Q statements, but were only revisited if it was noted that a child code or subtheme was absent from the retained excerpts as the list continued to be refined (*note: excerpts in the second category were rephrased to fit within the Q set while maintaining the intention of the original excerpt. Due to the room for misinterpretation in this process, it was only used when necessary to do so to include key priorities into the final Q set*). From the original 538 excerpts concourse, 79 excerpts were considered “possible Q statements” and underwent further refinement.

To ensure that the final Q set was reflective of the three sustainability pillars (environmental, societal, and economics), a crosscheck was performed on the 79 excerpts. It was noted that the pillar of *economics*, and the excerpts coded as such, was a reason to prioritize either an excerpt coded as *environmental* or *societal* rather than phrased as a stand-alone priority. This distinction led to a study team decision to remove those statements coded as with *economics* from the final Q set, and instead to include *economics* as a driver for the qualitative questioning (see section 2.7 - Q Sort) to unravel the underlying motivations behind each participant's prioritization. The crosscheck noted the sum of *environmental* and *societal* excerpts, and continued as refinement progressed, to ensure approximate equal distribution between the two pillars.

Additionally, the statements were crosschecked against the child codes, confirming that the observable components of sustainability that were intended to be uncovered in the KIIs were seen in the refined list of possible Q statements, before continuing. Through the additional three phases of refinement, statements that were excluded were based on the following criteria: *not* a priority that could be ranked against another, too specific of a statement, a compounded statement, a general duplication, and for readability/clarity purposes. Totalling seven cycles, the original excerpts were scrutinized for further enhancement while vetted against pre-existing materials to uphold researcher confidence of the representativeness of environmental and societal sustainability priorities within animal agricultural production. A total of 45 possible Q statements were derived from these seven cycles of refinement and reflected 21 *societal* priorities, 21 *environmental* priorities, and 3 statements that encompassed a combination of *societal*, *environmental*, and *economic* components. Additionally, each of the 18 child codes were represented, at least once, in this first draft of the final Q set. These 45 possible Q statements were used in the next phase of ensuring study validity, piloting the sorting exercise with numerous perspectives and levels of involvement in this study. These Q sort pilots led to a final Q set consisting of 38 statements (as explained in succeeding paragraphs). A visual overview of the refinement process can be found in Figure 3, below.

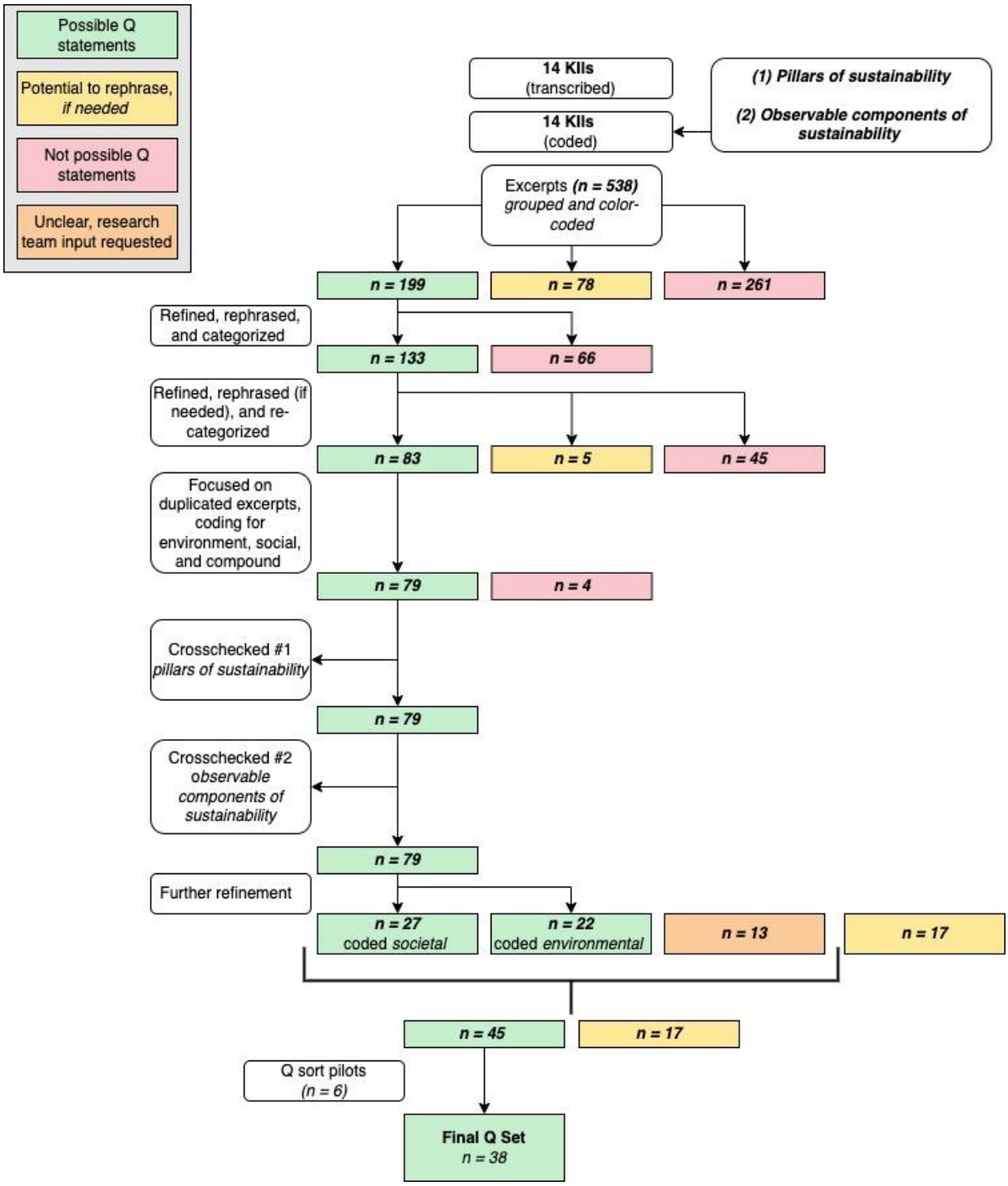


**Figure 3:** Systematic process in refining the concourse into the final Q set used in this study.

### *2.4 Q Sort Interview Guide*

An interview guide was developed to coordinate the interactive sorting exercise and conversation (known as the *Q sort)* between interview facilitators and study participants (see appendix A – 8.2 *Q Sort Interview Guide)*. The interview guide was created to ensure that facilitator introductions, project background, participant consent, producer characteristics and operation specific questions, sorting exercise directions, and questions about the pressures/drivers influencing producers and their decisions were consistent across all interviews.

### *2.5 Q Methodology Pilot*

Once researchers determined a comprehensive list of animal agricultural priorities (representing both environmental stewardship and animal wellbeing) and the interview guide was finalized, both were piloted with six people who were not included in the final sample or P set. The purpose of these pilots were to test for clarity and organization of the interview guide questions and process; to ensure Q set statement clarity, readability, and appropriateness; and to assess usability and troubleshooting of the software and overall timing.

A total of six pilots illuminated potential pitfalls and refinements needed in the interview and sorting exercise process. These pilots were comprised of three internal members of the study team, while the remaining three were external volunteers – each providing a distinct producer perspective. The first internal pilot, the co-principal investigator of the project, assumed the role of an animal agricultural producer – drawing on personal experience and providing feedback about the content of the interview guide, focusing primarily on the clarity of the Q set and post-sorting exercise discussion. The second internal pilot, the second co-principal investigator of the project, provided feedback on the qualitative components of the interview. The third internal pilot, a graduate student within the research team, suggested edits to the overall interview process to decrease the presence of unclear or confusing language. The first external pilot, a small-scale beef producer, allowed for a complete runthrough of the interview guide – with intentional pauses throughout to receive feedback. The second pilot, a small-scale diversified producer, filled a similar role as the first (providing suggestions throughout to increase the quality of the interview/sorting exercise). The last external pilot was an industry member who provided feedback in relation to areas where potential criticism (e.g., how interview facilitators explained the project objectives and how the term “sustainability” was used and defined) may arise from the perspective of animal agricultural producers.

In summary, iterative revisions were made to the interview guide during the pilot process. The study consent language was moved into a document that would be delivered via email to each participant *before* the interview began, improving time efficiency in the interview process. Alterations to facilitator introductions and project background information were made, resulting in more concise language for both. The sorting exercise directions were modified to avoid confusion and misunderstanding noted by each pilot, with the introduction of the post-sorting exercise conversation being reorganized. In addition, visual components and language used in

the sorting exercise software were modified for clarity and readability. Lastly, further refinement of the Q set was conducted – based primarily on clarity, understandability, necessity, and the need for *singular* priorities (removing and/or editing compounded statements). The six pilots resulted in a final version of the interview guide, sorting software configuration, and Q set (n = 38, refer to Table 1 below).

**Table 1:** Final Q set.

| # | Statement | Sustainability Pillar |
|---|---|---|
| **1** | Navigating changing mandates and laws effectively. | Societal |
| **2** | Minimizing animal finishing times. | Societal |
| **3** | Reducing carbon emissions. | Environmental |
| **4** | Preventing animal illness. | Societal |
| **5** | Increasing production in resource-efficient ways. | Environmental |
| **6** | Providing affordable products to consumers. | Societal |
| **7** | Providing nutritious food to consumers. | Societal |
| **8** | Building trust with consumers. | Societal |
| **9** | Showing the public that production is safe and humane. | Societal |
| **10** | Maintaining traditions in farming practices. | Societal |
| **11** | Keeping a consistent, dependable, and efficient workforce. | Societal |
| **12** | Practicing the responsible use of vaccines and antibiotics. | Societal |
| **13** | Utilizing genetic selection. | Societal |
| **14** | Building or expanding local, direct-to-consumer markets. | Societal |
| **15** | Increasing energy efficiency. | Environmental |
| **16** | Diversifying market pathways. | Societal |
| **17** | Ensuring good air quality for animals, workers, and neighbors. | Environmental |
| **18** | Monitoring animal behavior. | Societal |
| **19** | Ensuring comfortable living environments for the animals. | Societal |
| **20** | Managing manure effectively and efficiently. | Environmental |
| **21** | Raising animals not in confinement. | Societal |
| **22** | Increasing renewable energy use. | Environmental |
| **23** | Minimizing water pollution. | Environmental |
| **24** | Giving animals more space. | Societal |

| | | |
|---|---|---|
| **25** | Training employees to prioritize proper animal handling. | Societal |
| **26** | Providing optimal rations to animals. | Societal |
| **27** | Preserving wildlife habitat. | Environmental |
| **28** | Ensuring animals are respected and happy. | Societal |
| **29** | Collecting data to track and improve sustainability practices. | Environmental |
| **30** | Improving sustainability by using new technologies. | Environmental |
| **31** | Increasing water use efficiency. | Environmental |
| **32** | Ensuring the health of animals. | Societal |
| **33** | Increasing consumer understanding of farming operations. | Societal |
| **34** | Stewarding the land and natural resources. | Environmental |
| **35** | Preventing farm land from being lost to development. | Environmental |
| **36** | Building on-farm resilience in preparation for disasters. | Environmental |
| **37** | Improving production and profitability by using new technologies. | Environmental |
| **38** | Maintaining the quality of soil. | Environmental |

### *2.6 P Set (the sample of interviewees)*

Selected participants (or the *P set*) were deliberately chosen to maximize the variation in opinions and perspectives across the beef, pork, and broiler industries from very small to very large scale operations (defined in Table 2, below). We asked for a list of potential participants from the project's advisory committee, the key informants (who participated in the KIIs previous to this study), the research team (between the University of Washington, Washington State University, and the University of Minnesota), network nodes (e.g., state veterinarians, industry stakeholders, etc.), species-specific industry organizations, and from other Q sort participants.

A total of 17 individual contacts were suggested from the project's advisory committee, the key informants, research team and other project partners. Network nodes and species-specific industry organizations were provided with supplemental recruitment language (see appendix A – 8.3 *Recruitment Language*) and these groups created 5 unique social media postings and/or network pushes which aided in participant recruitment. Within the recruitment language, a link was provided for interested participants to fill out a brief survey (Google Forms[3]) – to collect contact information and potential participant's operational details. The collection of these details allowed researchers to purposefully select participants to maximize variation in opinions and voices included in the study. Recruitment language was also posted to two email listservs – one being *sustag@lists.umn.edu* recommended by a member of the

[3] https://www.google.com/forms/

research team and the other being a private listserv maintained by the Washington State Department of Agriculture and reached through one of the project's network nodes. A total of 25 individuals responded to the recruitment survey. All interested participants, who were qualified (i.e., actively raised at least one of the three species of interest) and chosen to participate within this study, received further email correspondence. Included in the email correspondence was an introduction (or re-introduction) of the larger UW-led project, *how* we received their contact (whether through recommendation or survey completion), details on this specific study (and what was intended to be gathered by their participation), anticipated time commitment, and participant compensation. Lastly, a link to self-schedule a Q sort time slot using an online scheduling platform (Doodle[4]) was included. Finally, to achieve a full sample, targeted snowball sampling was used to gain participant recommendations from those who previously completed a Q sort. A total of 21 contacts were yielded from these requests, with email correspondence (identical to what was previously explained) being sent to all of those recommended. In total, 63 individual contacts were made across all recruitment strategies, where three directly declined to participate. Out of the remaining 60 contacted, a total of 18 did not respond to the request for study participation.

Each individual who scheduled to participate in a Q sort was sent a virtual invite for the meeting time chosen. A confirmatory email was sent to each, which included a greater description of the project and details of informed consent (see appendix A – 8.4 *Study Consent Language*) for the interview. The protocol and consent language was approved by the University of Washington's Instructional Review Board (UW IRB) for human subjects research. It was confirmed during the interview that each participant read and understood the consent language provided. If not, the interviewer discussed (in accordance with the UW IRB) voluntary participation, data use, and individual confidentiality (see appendix A – 8.2 *Q Sort Interview Guide*).

For this study, a total of 42 animal agricultural producers were interviewed, with participant characteristic information being reported in Table 3, below. In a Q methodology study, the participants are considered to be the variables and *not* the sample; thus, it is recommended that no more than 40 are included into each study (Damio, 2016). In previous studies, it was explained that meaningful conclusions can be derived from variable sizes ranging from 12 - 40 participants (e.g., Cairns, 2012; Nelson et al., 2022), with an average range being between 26 - 46 (Zabala et al., 2018). The inclusion of 42 variables resulted in researcher confidence of the study's validity, based on previously published research (as cited).

Categorizations for operation size across the three species were created using the Iowa Department of Natural Resources Animals to Animal Units Conversion sheet[5]. The number of live animals each producer reported was converted into a total number of animal units (AUs: i.e., unit of measurement that is the sum of multiplying the number of animals in a given species categorization by a predetermined factor) for each operation, and used to categorize the operation as either a very small, small, medium, large, or a very large operation.

[4] https://doodle.com/en/
[5] https://www.iowadnr.gov/Portals/idnr/uploads/forms/5420020.pdf

**Table 2:** Definitions for operation scale according to the number of animal units (AUs) and total number of animals for each species included in this study.

| | Scale | AU | Head Cattle | Head Hogs | Head Broilers |
|---|---|---|---|---|---|
| **A** | Very small | 1 - 9 | 1 - 9 | 1 - 24 | 1 - 999 |
| **B** | Small | 10 - 99 | 10 - 99 | 25 - 249 | 1,000 - 9,999 |
| **C** | Medium | 100 - 499 | 100 - 499 | 250 - 1,249 | 10,000 - 49,999 |
| **D** | Large | 500 - 999 | 500 - 999 | 1,250 - 2,499 | 50,000 - 99,999 |
| **E** | Very large | > 1,000 | > 1,000 | > 2,500 | > 100,000 |

One limitation of the P set was a lack of large and very large scale broiler operations. Repeated attempts to recruit large and very large broiler operations through a number of additional avenues, such as state veterinarians, state and national broiler organizations, direct contacts, and personal connections from members of the internal study team were unsuccessful. Conversations with industry representatives suggested that the vertically integrated model of large scale broiler production created challenges for participant recruitment. Thus, the results of this project may not be applicable to large scale broiler producers. Additionally, we were unsuccessful in recruiting very large scale beef operations for reasons unknown. However, according to the 2012 Census of Agriculture, operations with more than 1,000 head of cattle within the U.S. only contributed to 1.2 percent of all cattle operations (*USDA - National Agricultural Statistics Service - Census of Agriculture*, 2017). Refer to Table 3 for participant characteristic information.

| I.D. | Location (state) | Protein Focus | | | Market (primary) | Position | Exp. (yrs.) |
|---|---|---|---|---|---|---|---|
| | | *Beef* | *Pork* | *Broilers* | | | |
| Q01 | Washington | | | V. Small | Direct to consumers | Owner | 1.5 |
| Q02 | Iowa | Small | Medium | | Direct to consumers, wholesale | Owner | -- |
| Q03 | Washington | Small | Small | Small | Wholesale | Owner | 22 |
| Q04 | Washington | Small | Small | Small | Direct to consumers (incl. Ecommerce) | Owner | 7 |
| Q05 | Pennsylvania | Small | | | Direct to consumers | Owner | 4 |
| Q06 | Oregon | | Small | Small | Direct to consumers (incl. Ecommerce), wholesale | Owner | 8 |
| Q07 | Wisconsin | | V. Small | V. Small | Direct to consumers, wholesale | Owner | 3 |
| Q08 | Minnesota | Small | | V. Small | Direct to consumers (incl. Ecommerce) | Owner | 7 |
| Q09 | Washington | | | Medium | Direct to consumers, wholesale | Owner | 15 |
| Q10 | Minnesota | | Small | | Direct to consumers | Owner | 8 |
| Q11 | **Multiple locations* | | V. Large | | Wholesale | Owner | 12 |
| Q12 | Washington | Medium | | | Commodity | Owner | 25+ |
| Q13 | Washington | | Small | | Direct to consumers, wholesale | Owner | 8 |
| Q14 | Washington | Medium | V. Small | | Direct to consumers | Owner | 10 |
| Q15 | Minnesota | | | V. Small | Direct to consumers | Owner | 5 |
| Q16 | Colorado | Large | | | Commodity | Owner | 33 |
| Q17 | Washington | | V. Small | | Direct to consumers, wholesale | Owner | -- |
| Q18 | Minnesota | | V. Large | | Commodity | Owner | 25 |
| Q19 | Minnesota | | V. Large | | Commodity | Owner | -- |
| Q20 | Washington | Medium | Small | | Direct to consumers | Owner | 6 |
| Q21 | Washington | Medium | | | Direct to consumers, commodity | Owner | -- |
| Q22 | Washington | Large | | | Commodity | Owner | 50+ |
| Q23 | Texas | Small | | | Direct to consumers, wholesale | Owner | -- |
| Q24 | Minnesota | | | Small | Direct to consumers | Owner | 3 |
| Q25 | Washington | | Small | | Direct to consumers, wholesale | Owner | 15 |
| Q26 | Iowa | Medium | Medium | | Wholesale | Owner | 49 |
| Q27 | Minnesota | | | V. Small | Direct to consumers | Owner | 5 |
| Q28 | Washington | Small | | | Direct to consumers | Owner | 10 |
| Q29 | Iowa | | V. Small | | Direct to consumers | Employee | 2 |
| Q30 | North Carolina | Small | Small | Small | Direct to consumers (incl. Ecommerce) | Owner | 3 |
| Q31 | Wisconsin | V. Small | | V. Small | Direct to consumers, wholesale | Owner | 7 |
| Q32 | **Multiple locations* | | V. Large | | Wholesale | Dir. of Public Affairs | 49 |
| Q33 | Washington | Large | | | Direct to consumers, commodity | Ranch Manager | 11 |
| Q34 | North Carolina | Small | Small | | Direct to consumers (exclusively Ecommerce) | Owner | 4 |
| Q35 | Iowa | | V. Small | | Direct to consumers | Owner | 7 |
| Q36 | Iowa | | | | | Owner | 1.5 |
| Q37 | Iowa | | V. Small | | Direct to consumers | Employee | 6 |
| Q38 | Iowa | | V. Small | | Direct to consumers | Owner | 7 |
| Q39 | Texas | Small | V. Small | V. Small | Direct to consumers (incl. Ecommerce), wholesale | Owner | 9 |
| Q40 | Iowa | | Large | | Wholesale | Owner | 24 |
| Q41 | Iowa | | Small | | Direct to consumers | Owner | 7 |
| Q42 | Minnesota | Small | Small | Small | Direct to consumers | Owner | 5 |

**Tabel 3:** Participant characteristic information.

*Multiple locations of operation; to ensure participant confidentiality, specificity of location for each is not reported on.

## *2.7 Q Sort*

Each sorting exercise, known as a Q sort, was conducted using an online platform (Q Method Software[6]) and administered virtually via Zoom Video Conferencing by the same trained facilitator accompanied by a second member of the project team as notetaker. At the outset of each Q sort, the facilitator followed the interview guide, described above, to instruct the participant on how to perform the sort. The facilitator confirmed that the participant received,

[6] https://qmethodsoftware.com/

read, and understood the University of Washington Institutional Review Board (UW IRB) approved consent language previously sent to their email. The facilitator then asked the participant for approval to record the interview so that researchers could accurately capture explanations provided by each participant.

A pre-sort interview was conducted with each participant, prior to completing the Q sort. The pre-sort interview consisted of background questions about the interviewee and their operation (see appendix A – 8.2 *Q Sort Interview Guide*). Following the pre-sort interview, an overview was given on the sorting exercise itself, as well as a preview of the post-sort interview. Participants were provided with a list of broad drivers that may influence their current decision-making when it comes to what they are able to prioritize on their operation and asked to touch on these as needed in describing their sorting prioritization. The list of six potential drivers were also intended to help facilitate the post-sort conversation, providing deeper context to reasons *why* they may have sorted one priority over another. The drivers were verbally described and listed in the Zoom chat for participant reference, as follows:

- REGULATORY (i.e., governmental mandates on manure storage)
- INDUSTRY/BUYER (i.e., customer purchase stipulations)
- CONSUMER/BUYER (i.e., general public demands)
- OPERATION/BRAND (i.e., values pertaining to the brand of the product, company pressures
- PERSONAL (i.e., values pertaining to the producer's personal perspectives)
- ECONOMIC (i.e., pertaining to the need to be financially stable)

Phase one of the sorting exercise, noted as a pre-sort, consisted of the individuals organizing their thoughts by reading each statement within the Q set and deciding if it was a "lower, moderate, or higher" priority within the comprehensive list of statements provided. Participants were encouraged to provide comments or ask questions as needed during this process. After the pre-sort, the sorting exercise commenced and was where the bulk of time for each interview was spent. Participants were asked to sort the statements, now grouped into the three categories (a lower, moderate, and higher priority category), by placing the statements into a predetermined Q board (Figure 3). The far right column of the grid represented the individual's highest priorities, while the lowest ranked items were placed in the far left column. Prior to beginning the sort, a condition of instruction was provided: "Go ahead and read each statement. When it comes to the **current** decisions you make on your operation, rank the statements appropriately to reflect your lowest, moderate, and highest priorities".

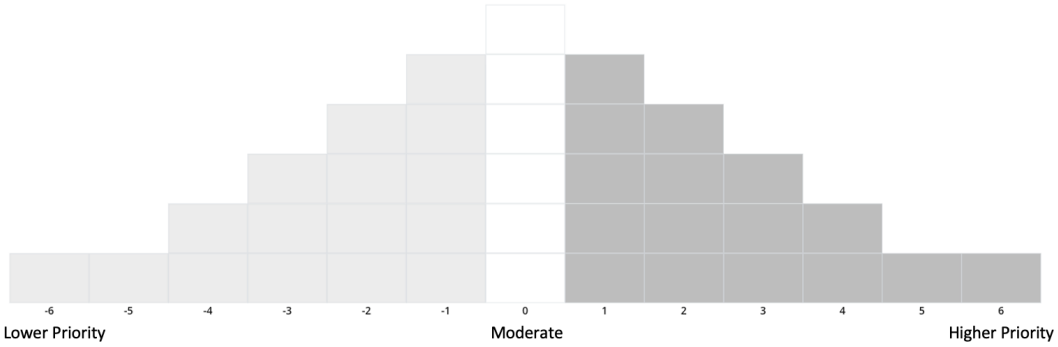


**Figure 3:** Predetermined Q Board Distribution.

The grid resembled a normal distribution shape, intended to illuminate the individual's highest and lowest priorities through the forced sorting exercise. Clarification to participants was made that although they may well consider each statement to be an operational priority, for the purposes of this exercise, not all priorities can receive the highest rank. It was explained that although a producer may personally value a priority, they were only instructed to rank a statement as a “higher priority” if it reflects their current ability to prioritize it on their operation. Once participants were comfortable with their sorting decisions, and that their grid reflected their current priorities as animal agricultural producers, the post-sort interview was initiated to explore the plausible influences to their decision-making. In the post-sort interview, each participant was asked the following three questions to facilitate the discussion in effort to elucidate the differing drivers and/or other factors to their current and ideal priorities.

1. Looking at these 4 columns, or your highest priorities, what drives this prioritization?
2. Looking at these last four columns, or your lowest priorities, what drives this ordering?
3. In an ideal world, and keeping within this grid, without any of these influences putting pressure on you, would you have sorted these priorities differently?

It was during this post-sort interview where participants were encouraged to elaborate on their sorting decisions, voicing any pressures they feel from external forces that dictate how they prioritize the decisions they make on their operation. The six potential drivers were reintroduced to the participant to facilitate the conversation. Once each participant answered the three questions, a chance was provided for each to elaborate on any component of their grid that wasn’t previously examined and/or any perspective they had on the topic of sustainable animal agriculture they wished to share. To facilitate factor interpretation (as explained in section 2.8 – *Statistical Analysis*) detailed field notes were taken during each Q sort. Both the facilitator and notetaker captured participant characteristic information, responses to each of the questions listed above, and all reasonings explained that suggest drivers to decision-making (see appendix A – 8.5 *Q Sort Note Template*).

## *2.8 Statistical Analysis*

Of the 42 that completed Q sortings, four were excluded from analysis due to participant characteristics. There were a total of four participants that belonged to the same operation (being recruited from a Q sort participant's recommendation) where three of the four were excluded – ensuring each sort that was included in the analysis represented a distinct operation. The first sort completed among these four was retained. Another participant was excluded because they were not currently producing meat. The remaining 38 participants were included in the analysis conducted using qmethodsoftware.com. Principal component analysis (PCA) was used to uncover consensus and divergent priorities among the participants and their ranking decisions, reducing the data into eight observable factors. Using varimax rotation, we retained three factors to allow for an explanation of the maximum variation among the study participants. Through this step of statistical analysis, 36 of the 38 participants were loaded onto one of the three factors significantly ($p < 0.05$).

Each factor is interpreted as a distinct perspective held within the variables included in the study. These perspectives, or discourses or common worldviews, were significantly different from one another and identified themes of statements that were prioritized higher (and lower) among each group – supporting the different tradeoffs made regarding environmental stewardship and animal wellbeing. In a Q methodology study, the number of factors to be extracted from the analysis is up to researcher interpretation and supported through several variables which aid in the facilitation of the decision – combining both qualitative and quantitative approaches (Herrington & Coogan, 2011). The core of Q methodology illustrates the fact that there is not one correct answer to the number of factors chosen within a given dataset, but rather dependent on and guided through examining a variety of these variables (Stephenson, 1980).

The ability to properly interpret the number of factors extracted, in an appropriate manner that is reflective and consequential to our topic of study, was paired with quantitative evaluation criteria. The derived factors that were included in the results and discussion of this study were formulated through the consideration of the percent of explained variance, Humphrey's Rule II (eigenvalues), number of defining variables loaded onto each factor, and correlations between factors. Literature suggested that the total percent of explained variance across retained factors in a Q methodology study is commonly between 40 and 70 percent (Zabala et al., 2018). The three factors retained in this study equates to 49 percent – supporting the choice to include the three factors for interpretation. Using qmethodsoftare.com, application of Humphrey's Rule II supported the retention of three factors – noting that factor retention is based on whether the two highest factor loadings' cross-product exceeds double of the standard error. With the inclusion of an additional factor, a trade off between obtaining a higher percent of explained variance is made with losing the amount of defining variables included in the interpretation. The choice to retain three factors, which included 36 defining variables, was made against retaining an additional factor where the loss of 5 variables would have been had. Through the use of a correlation matrix, the relationships between the three factors can suggest how distinguishing they are between one another – allowing for accurate factor interpretation.

All of these metrics were used in conjunction with the qualitative examination of the retained factors ensuring the interpretability and theoretical significance to the study population. To do so, both distinguishing (i.e., those statements that were placed significantly different in one factor then they were in the other two factors) and consensus (i.e., statements that all of the participants agreed on) statements were used, paired with the composite Q sorts for each factor (Figure 4) (Herrington & Coogan, 2011; Watts & Stenner, 2012). The inclusion of the three factors best represents the opinions and perspectives held among the studied participants.

Each factor is illustrated by an idealized, composite Q sort (produced by qmethodsoftware.com, see Figure 4 below) that represents a sorting distribution with a correlation coefficient of 1.0 for that given factor. Each of the three composite Q sorts is reflective of the individual Q sorts that loaded onto that factor. Each column on the distribution grid was denoted an integer between negative 6 and positive 6, being read left to right, and dictated the factor score for each statement sorted onto the grid. Each of the 38 statements received a factor score that was reflective of its position on the composite Q sort grid, and was done so for each factor. To quantify how much a producer's perspective agrees with the specific placement of a statement, each statement was provided with a z-score for each factor (Zabala, 2014). The z-score represents the relationship between statements and each factor, showcasing the level of agreement each composite Q sort has with the statement (Zabala, 2014). Next, both distinguishing and consensus statements are identified by the analysis. Those statements that were sorted similarly by all participants of one factor, but were sorted significantly different (p-value < 0.05) by the participants loaded onto the remaining factors, are defined to be distinguishing statements (Herrington & Coogan, 2011). Furthermore, statements to have similar factor scores, or those statements to be sorted in similar positions across all three factors, are noted as consensus statements and showcase shared opinions amongst the participants (Morea, 2022).

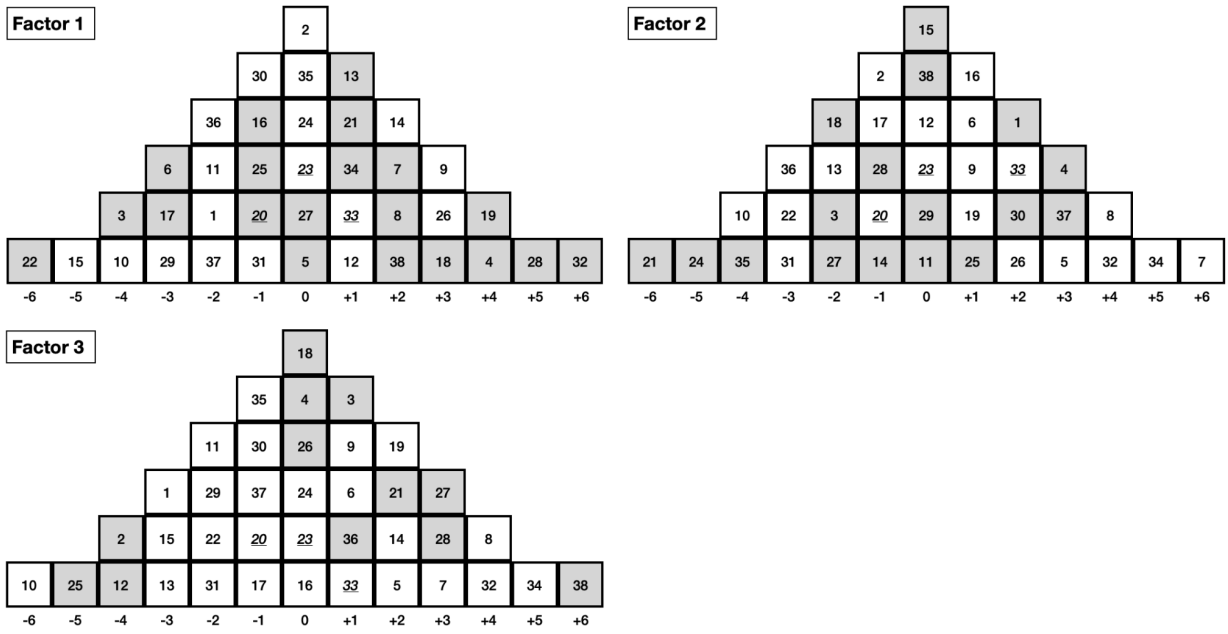

**Figure 4:** Composite Q sorts for each factor. Grayed boxes represent *distinguishing* statements and those that are italicized and underlined represent *consensus* statements. Column 6 contains the statement that was the highest priority, while column -6 contains the statement that was ranked as the lowest priority. For example, statement 22 in Factor 1 received a factor score of -6 and was also noted to be a distinguishing statement for that factor. There is no difference between those statements ranked above or below one another, within the same column, as they correlate to the same factor score.

In addition to using the order in which the priorities were ranked for each factor (i.e., composite Q sorts), paired with deciphering the placement and meaning of distinguishing and consensus statements for each factor, the factor scores for each priority (and across each factor) were examined. The *crib sheet system* was used to ensure that the factors retained were interpreted in a systematic and methodical manner. Developed by Simon Watts, this approach to factor interpretation allows for consistent examination across each factor while allowing the researcher to generate an accurate qualitative conclusion for each rendered discourse (Watts & Stenner, 2012).

The development of a crib sheet begins with looking at each statement within the Q set and the associated factor score for each factor (see Table 4 below). The first draft of the crib sheet (one crib sheet for each factor) includes four main categories: statements ranked as highest priorities (those with a factor score of +5 and +6); statements ranked higher than the same statement in the other two factor arrays; statements ranked lower than the same statement in the other two factor arrays; and statements ranked as lowest priorities (those with a factor score of -5 and -6). Statements that had the same factor score for two (or three) factors were not included in those factor's crib sheets. Throughout this process, of considering each statement for each factor, emergent themes began to develop from the observed crib sheets. A narrative for each factor developed as the process continued, and the viewpoints and the perspectives held by those who have loaded onto each factor increased in clarity – continuing to focus on the individual item (or priority) followed by questioning and considering the overall significance of its placement within the viewpoint (or factor) (Watts & Stenner, 2012).

**Table 4:** Each statement, and the associated factor score for each factor array.

| Statement Number | Statement | Factor 1 Score | Factor 2 Score | Factor 3 Score |
|---|---|---|---|---|
| **1** | Navigating changing mandates and laws effectively. | -2 | 2 | -3 |
| **2** | Minimizing animal finishing times. | 0 | -1 | -4 |
| **3** | Reducing carbon emissions. | -4 | -2 | 1 |
| **4** | Preventing animal illness. | 4 | 3 | 0 |
| **5** | Increasing production in resource-efficient ways. | 0 | 3 | 2 |
| **6** | Providing affordable products to consumers. | -3 | 1 | 1 |

| | | | | |
|---|---|---|---|---|
| **7** | Providing nutritious food to consumers. | 2 | 6 | 3 |
| **8** | Building trust with consumers. | 2 | 4 | 4 |
| **9** | Showing the public that production is safe and humane. | 3 | 1 | 1 |
| **10** | Maintaining traditions in farming practices. | -4 | -4 | -6 |
| **11** | Keeping a consistent, dependable, and efficient workforce. | -2 | 0 | -2 |
| **12** | Practicing the responsible use of vaccines and antibiotics. | 1 | 0 | -4 |
| **13** | Utilizing genetic selection. | 1 | -2 | -3 |
| **14** | Building or expanding local, direct-to-consumer markets. | 2 | -1 | 2 |
| **15** | Increasing energy efficiency. | -5 | 0 | -3 |
| **16** | Diversifying market pathways. | -1 | 1 | 0 |
| **17** | Ensuring good air quality for animals, workers, and neighbors. | -3 | -1 | -1 |
| **18** | Monitoring animal behavior. | 3 | -2 | 0 |
| **19** | Ensuring comfortable living environments for the animals. | 4 | 1 | 2 |
| **20** | Managing manure effectively and efficiently. | -1 | -1 | -1 |
| **21** | Raising animals not in confinement. | 1 | -6 | 2 |
| **22** | Increasing renewable energy use. | -6 | -3 | -2 |
| **23** | Minimizing water pollution. | 0 | 0 | 0 |
| **24** | Giving animals more space. | 0 | -5 | 0 |
| **25** | Training employees to prioritize proper animal handling. | -1 | 1 | -5 |
| **26** | Providing optimal rations to animals. | 3 | 2 | 0 |
| **27** | Preserving wildlife habitat. | 0 | -2 | 3 |
| **28** | Ensuring animals are respected and happy. | 5 | -1 | 3 |
| **29** | Collecting data to track and improve sustainability practices. | -3 | 0 | -2 |
| **30** | Improving sustainability by using new technologies. | -1 | 2 | -1 |
| **31** | Increasing water use efficiency. | -1 | -3 | -2 |
| **32** | Ensuring the health of animals. | 6 | 4 | 4 |
| **33** | Increasing consumer understanding of farming | 1 | 2 | 1 |

| | | | | |
|---|---|---|---|---|
| | operations. | | | |
| **34** | Stewarding the land and natural resources. | 1 | 5 | 5 |
| **35** | Preventing farm land from being lost to development. | 0 | -4 | -1 |
| **36** | Building on-farm resilience in preparation for disasters. | -2 | -3 | 1 |
| **37** | Improving production and profitability by using new technologies. | -2 | 3 | -1 |
| **38** | Maintaining the quality of soil. | 2 | 0 | 6 |

Once the three separate crib sheets were completed, and qualitative reasonings began to emerge, characteristics of the participants (collected during the pre-sort interview) were then explored. Intended to highlight patterns amongst those who loaded onto each factor, the following were used to aid in defining each grouping: size of operation; protein(s) of focus; diversified operations versus not (Table 5, below).

**Table 5:** Participants and factor loadings, with significance.

| I.D. | Role | Protein focus | Scale[1] | Factor 1[2] | Factor 2[2] | Factor 3[2] |
|---|---|---|---|---|---|---|
| **Q1** | Owner | Broiler | A | **0.71888** | 0.10529 | 0.18876 |
| **Q2** | Owner | Beef, pork | B, C | 0.05547 | 0.07177 | **0.72216** |
| **Q3** | Owner | Beef, pork, broiler | B. B, B | 0.35233 | **0.53765** | 0.19911 |
| **Q4** | Owner | Beef, pork, broiler | B, B, B | **0.60983** | 0.30367 | 0.18841 |
| **Q5** | Owner | Beef | B | **0.76824** | 0.20345 | 0.24175 |
| **Q6** | Owner | Pork, broiler | B, B | **0.50813** | 0.28431 | 0.3556 |
| **Q7** | Owner | Pork, broiler | A, A | 0.42231 | -0.30042 | **0.75042** |
| **Q8** | Owner | Beef, broiler | B, A | 0.01728 | -0.02673 | **0.67438** |
| **Q9** | Owner | Broiler | C | 0.13278 | 0.23413 | **0.4555** |
| **Q10** | Owner | Pork | B | **0.55134** | 0.32172 | 0.34517 |
| **Q11** | Owner | Pork | E | 0.22675 | **0.5224** | 0.11597 |
| **Q12** | Owner | Beef | C | **0.43136** | -0.3684 | 0.16298 |
| **Q13** | Owner | Pork | B | **0.48113** | 0.395 | 0.10994 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Q14** | Owner | Beef, pork | C, A | **0.34918** | 0.0878 | 0.25764 |
| **Q15** | Owner | Broiler | A | 0.54519 | -0.2064 | 0.52517 |
| **Q16** | Owner | Beef | D | **0.42286** | 0.42201 | 0.01804 |
| **Q17** | Owner | Pork | A | **0.63158** | -0.11321 | 0.3565 |
| **Q18** | Owner | Pork | E | -0.10035 | **0.72207** | -0.06064 |
| **Q19** | Owner | Pork | E | 0.13872 | **0.76875** | 0.37377 |
| **Q20** | Owner | Beef, pork | C, B | -0.15279 | 0.44473 | **0.56935** |
| **Q21** | Owner | Beef | C | **0.64003** | 0.2419 | 0.12065 |
| **Q22** | Owner | Beef | D | **0.76602** | 0.05244 | -0.1951 |
| **Q23** | Owner | Beef | B | 0.32887 | 0.19848 | **0.65562** |
| **Q24** | Owner | Broiler | B | 0.05914 | **0.41023** | 0.0243 |
| **Q25** | Owner | Pork | B | 0.32868 | 0.29174 | 0.32397 |
| **Q26** | Owner | Beef, pork | C, C | -0.2416 | 0.05807 | **0.33206** |
| **Q27** | Owner | Broiler | A | 0.51407 | 0.15054 | **0.60794** |
| **Q28** | Owner | Beef | B | **0.77572** | -0.07221 | 0.20605 |
| **Q30** | Owner | Beef, pork, broiler | B, B, B | 0.33559 | 0.1248 | **0.68067** |
| **Q31** | Owner | Beef, broiler | A, A | 0.33729 | 0.04228 | **0.71476** |
| **Q32** | Dir. of Public Affairs | Pork | E | 0.08525 | **0.54374** | -0.17826 |
| **Q33** | Ranch Manager | Beef | D | **0.4872** | 0.39226 | 0.05131 |
| **Q34** | Owner | Beef, pork | B, B | **0.78497** | 0.02428 | 0.15431 |
| **Q35** | Owner | Pork | A | 0.47892 | -0.05827 | **0.52789** |
| **Q39** | Owner | Beef, pork, broiler | B, A, A | 0.39103 | 0.00298 | **0.60299** |
| **Q40** | Owner | Pork | D | -0.10703 | **0.57175** | 0.3113 |
| **Q41** | Owner | Pork | B | **0.52199** | 0.0669 | 0.43825 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Q42** | Owner | Beef, pork, broiler | B, B, B | 0.2886 | 0.41706 | **0.58386** |

[1]Size of operate: A = very small, B = small, C = medium, D = large, E = very large

[2]**Significant z-scores** ($p < 0.05$), noting which participant loaded significantly onto each factor, requiring majority of common variance

Prior to interpreting the final factors, and exploring the results of the PCA and varimax rotation, an additional passthrough of the statements and factor loadings was made for each factor (and added onto the crib sheet – creating the second, and final, draft). This additional approach included examining each statement that was *not* included on each factor's first draft of the crib sheet (e.g., those statements neither ranked higher or lower for one factor in comparison to the other two factor arrays and those statements that received an equal factor score with one or two factor(s)). This allowed for the identification of additional statements that were useful items to support the defining features of each factor. Furthermore, the field notes were used to ensure accurate interpretation of the statements for each factor. Revisiting the statements in the first draft of the crib sheet, and those that were added during the second passthrough, contextual reasoning was provided to the statements for each factor (illuminating differences in reasonings or participant interpretation of each priority amongst the three separate factors). This process allowed for a holistic approach to factor interpretation, where each statement (associated with the appropriate interpretation for each factor), paired with participant characteristics, was examined and included in the qualitative analysis.

## 3.0 RESULTS

A total of 36 of the 38 total Q sorts included in the analysis loaded significantly ($p < 0.05$) onto one of the three factors (requiring majority of common variance – or ensuring that each Q sort significantly loaded onto only one of the three factors). Both Q15 and Q25 loaded significantly onto two of the three factors, defined to be confounded variables and excluded due to the majority of common variance requirement. The three rotated and retained factors represent three distinct discourses amongst our study participants, and are defined as follows: **Factor 1:** *Animal Husbandry: First and Foremost;* **Factor 2:** *Business Sustainability: A Balancing Act;* **Factor 3:** *Environmental Stewardship: A Holistic Approach*. In the succeeding paragraphs, each discourse is expanded in depth with corresponding factor characteristics for each (see appendix A – *General Factor Characteristics*). Using the factor scores (see Table 4 above), two separate Venn Diagrams were developed to showcase which priorities were ranked lower and higher in comparison amongst the three factor arrays. Additionally, general priority agreements are illustrated in Figure 5 (below) with the overlapping segments, noting which statements received the same factor scores.

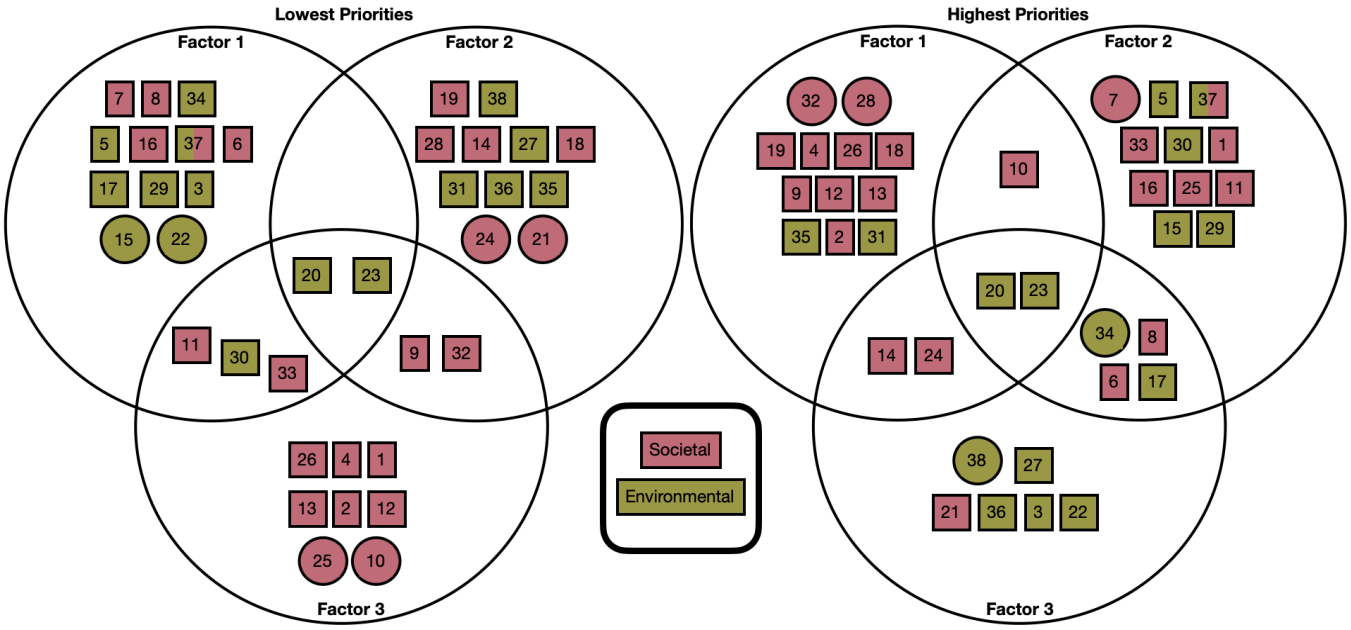


**Figure 5:** Using the factor scores, each factor's lowest (left) and highest (right) priorities (when compared to the other two factor arrays) is illustrated. Statements are ordered from highest factor score to lowest, within each factor. Pink colored statements are those corresponding to *societal* priorities, while those colored green are *environmental* priorities. Circled statements were ranked the lowest (-5 and -6) *or* highest (+5 and +6) priority for that factor(s).

## 4.0 DISCOURSE ANALYSIS

### *4.1 Factor 1: Animal Husbandry: First and Foremost*

**Table 7:** Factor 1 characteristics.

| | | | | | | | Operation Scale[2] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Animal Husbandry:* | **Loading Q sorts** | **Eigenvalues** | **Explained variance %** | **Beef %[1]** | **Pork %[1]** | **Broilers %[1]** | **v. Small %** | **Small %** | **Medium %** | **Large %** | **v. Large %** |
| *First and Foremost* | 16 | 12.10666 | 31.85963 | 50 | 36.36 | 23.08 | 33.33 | 47.06 | 42.86 | 75 | 0 |
| **Top 4 priorities** | | | | | | | | | | | **Z-Scores** |
| †Ensuring the health of animals. | | | | | | | | | | | 2.0445 |
| †Ensuring animals are respected and happy. | | | | | | | | | | | 1.9828 |
| †Preventing animal illness. | | | | | | | | | | | 1.7529 |
| †Ensuring comfortable living environments for the animals. | | | | | | | | | | | 1.5433 |

[1]Percent of each species that loaded on to this factor (e.g., 50% of the 20 beef producers in the P set loaded on to Factor 1)
[2]Percent of operations at each scale that loaded on to this factor (e.g., 33.33% of the 9 very small scale producers in the P set loaded on to Factor 1)
†Distinguishing statement

The *Animal Husbandry: First and Foremost* discourse represents animal agricultural producers who prioritize, above all, the humane treatment and wellbeing of their animals. Within this perspective, “animal wellbeing” encompasses all three components of Fraser’s animal welfare model: natural living, effective state, and basic health and functioning (Fraser, 2008). These three components were prioritized above those priorities (included in the Q set) relating to environmental stewardship. The 16 participants that loaded onto this factor primarily raised one species (75%), with 18.75% raising two species of focus, and 6.25% raising three. In addition, most of the participants were the owner (or co-owner) of their operation, except for one participant who noted their role as a *Ranch Manager.* Out of all of the producers who raise beef (included in the P set), 50% loaded onto this factor. As for the size of operations, those categorized as very small scale to large scale farms/ranches are included in this factor – with no very large scale perspectives (Table 7). As noted by one participant, and reflective of this discourse, *how* these producers choose to practice is based (and followed in order) on three separate questions: “How do *I* want to farm/ranch that is parallel to my personal beliefs and morals?”; “Am I able to financially support these practices?”; “Am I able to build a successful brand/operation from these practices?”.

Statements that were associated with caring for the animal’s health, paired with those animal wellbeing statements that correlated to actions which could lead to (from the viewpoint of those who loaded onto this factor) an increase in the prevalence of healthy animals on their operation were the top priorities within this group. For example, it was explained by participants that for an animal to be *healthy* it must also be *happy and respected* and *comfortable*, simultaneously – with all encompassing statements being ranked higher (Table 7). These top priorities showcased the three pillars of the animal welfare framework as previously defined, noting the inclusion of the desire to want *productive* animals. This discourse is driven by personal morals and beliefs, commonly referencing the *need* for optimal animal wellbeing on animal agricultural operations. If these priorities are not met, producing the subsequent protein products was noted to not be worth the tradeoff of ill kept animals (regardless of the animal species). The *Animal Husbandry: First and Foremost* is represented by individuals who are eager to showcase their personal passion to focus, predominantly, on exemplary animal husbandry practices.

Although driven by their personal philosophies, these producers expressed the need to be financially viable as an operation (prioritizing animal productivity statements higher than Factor 2 and Factor 3 – S2, S13, S26). As the ability to remain profitable allows for these participants to continue raising their animals under optimal conditions. This allows for the fulfillment of their personal morals, while marketing to a consumer base that holds close to each producer’s aspiration to optimize best practices for animal handling. As consumers place value in those products that are associated with operations that prioritize animal wellbeing, the majority of these producers are able to market their animal husbandry practices – gaining an economic premium. These producers tend to have strong connections with their consumers, via direct to consumer sales, while others sell into a commodity market – emphasizing the personal influences which are to prioritize animal wellbeing (where additional economic value is no longer added nor marketed). The Animal Husbandry: First and Foremost producers are *not* driven by

consumer demands, but rather a market has developed and sought out producers who are animal wellbeing oriented.

Throughout analysis, it was noted the high ranking of a variety of societal statements, mainly pertaining to animal wellbeing priorities, that were placed above all others. These producers care immensely about their animals, commonly developing personal connections with their livestock and referring to farming/ranching as a lifestyle. However, it was explained that environmental stewardship was and is interwoven into how they operate. Frequently being supported by comments such as “environmental stewardship is just second-nature to us.”, it was determined that environmental stewardship was *not an active* priority and was sorted as such. It was the animal husbandry statements (S9, S18, and S26) that was noted as some of this factor's highest priorities in comparison to the other two factors. Furthermore, it was a commonality for these producers to not be large consumers of energy due to their practices of pasture raised farming/ranching. Many of these producers noted that they did not start farming in order to make significant money or maximize profitability. Because of this, many in this factor had limited resources and capital to allocate to implementing high cost, environmentally-focused practices (e.g., renewable energy). Both energy efficiency and renewable energy priorities were noted as important, but received the lowest factor scores for this discourse (-5 and -6, respectively).

With the tendency of being single species farmers/ranchers, these producers have personal connections with their animals and the lifestyle that encompasses animal agriculture. Prioritizing *how* they want to raise their animals drives the majority of their practice adoption, and supports markets they intended to breach. With a combination of pasture raised and grass fed operations, practices ensuring environmental health come as second nature (but never placed above the wellbeing of an animal). It is important for these producers to remain profitable (including maintaining their consumer relationships) to continue to produce high quality protein. By prioritizing animal wellbeing they are able to reap secondary benefits of having efficient and productive animals – increasing economic viability of their operation. Although economic viability and environmental health is important to Factor 1, animal wellbeing will always be prioritized first and foremost.

## *4.2 Factor 2: Business Sustainability: A Balancing Act*

**Table 8:** Factor 2 characteristics.

| | | | | | | | Operation Scale[2] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Business Sustainability:* | **Loading Q sorts** | **Eigenvalues** | **Explained variance %** | **Beef %[1]** | **Pork %[1]** | **Broilers %[1]** | **v. Small %** | **Small %** | **Medium %** | **Large %** | **v. Large %** |
| *A Balancing Act* | 7 | 3.54681 | 9.3337 | 5 | 27.27 | 15.38 | 0 | 11.76 | 0 | 25 | 100 |
| **Top 4 priorities** | | | | | | | | | | | **Z-Scores** |
| Providing nutritious food to consumers. | | | | | | | | | | | 1.5957 |
| Stewarding the land and natural resources. | | | | | | | | | | | 1.5308 |
| Ensuring the health of animals. | | | | | | | | | | | 1.4746 |
| Building trust with consumers. | | | | | | | | | | | 1.3185 |

[1]Percent of each species that loaded on to this factor (e.g., 5% of the 20 beef producers in the P set loaded on to Factor 1)
[2]Percent of operations at each scale that loaded on to this factor (e.g., 0% of the 9 very small scale producers in the P set loaded on to Factor 2)

The *Business Sustainability: A Balancing Act* discourse is represented by a total of 7 producers, whose operational practices are influenced by their desire to maximize profit and meet their business goals. It was a commonality amongst these participants to balance both environmental stewardship and societal themes – primarily prioritizing those statements that have the potential to influence business profitability higher than Factor 1 and Factor 3 (S5, S37, S30, S16, and S15). Six of the seven participants that loaded significantly onto this factor raised just one of the three proteins of interest. All but one individual noted to be an owner (or co-owner) of their operation, which encompassed primarily large and very large scale pork operations. Factor 2 holds 100% of the study's very large scale producers (Table 8). This discourse includes the incorporation of profitability and economic viability into their definition of operational sustainability. It was an overarching theme to prioritize the limitation of additional inputs to produce the same (if not more) meat products. With the top priorities noted to be *providing nutritious food to consumers* and *stewarding the land and natural resources*, an effort to balance high volume yet low cost food production with optimal environmental stewardship supports the defining feature of this discourse that low inputs *is* sustainable for all.

These producers are driven by the self-developed narrative of needing to produce enough protein for the growing population, while ensuring affordability of the products to consumers. The majority of these producers operate confinement production systems, focusing primarily on one species, allowing the ability to focus on driving efficiency and business profitability. Primarily seeking to market their products to wholesale entities, the priority of *building or expanding local, direct-to-consumer markets* was ranked lower within this discourse (compared to Factor 1 and Factor 3). These results suggest the greater opportunity for business growth within wholesale markets, in addition to less resources needing to be budgeted for direct consumer engagement. However, *diversifying market pathways* was noted as a higher ranked priority and explained as an opportunity to expand business ventures. Production practices were found to be influenced by their customers (usually larger entities, not individual consumers) and when demand was met, the ability to gain control over and increase the reliability of sales improved. Regulations (both governmental and those defined by specific brands and/or certifications) dictated operational decisions – while *navigating changing mandates and laws effectively* was ranked higher than the other factors.

Furthermore, it is important to characterize this group as ones that *care* about animal husbandry and optimal welfare practices – although this is defined differently in comparison to other factors. If an animal is efficient in production (regarding adequate utilization of operational inputs while producing, or aiding in producing, valuable meat products) *then* it was determined that the needs of the individual animal were met. Both *raising animals not in confinement* and *giving animals more space* were ranked as lower priorities (-6 and -5, respectively). It was a common practice to *not* prioritize these two statements, noting that confinement systems do not negatively affect animal welfare. For example, it was believed that allocating more space to animals that are raised in a confinement setting increases the likeness of vice behaviors. Animals were chosen to be raised in confinement for a variety of reasons; however, confinement operations are thought to prioritize the animals comfort (e.g., weather exposure) and health (e.g., disease exposure). Both prioritizing animal comfort and the health of the individual animal are important to increase productivity, and subsequently profitability, of the operation. While ensuring the animal's affective state and feelings was not seen to have a direct relationship to profitability; and thus, ranked lower by Factor 2.

Other statements ranked higher when compared to Factor 1 and Factor 3 include the following: *increasing energy efficiency; collecting data to track and improve sustainability practices; improving sustainability using new technologies; improving production and profitability by using new technologies*. These statements support the idea that the operations that are loaded onto this factor have the capability, capacity, and knowledge to prioritize these statements, noting the primary benefit to the environment. The ability to prioritize these statements is unique to those producers who loaded significantly onto this factor. These statements require initial and continued capital, time, and additional resources (e.g., workforce) to prioritize each which is rendered through maximizing business profitability and pushing for operation expansion. Furthermore, both workforce oriented statements received higher factor scores (when compared to Factor 1 and Factor 3) as these operations seek out and hire large sums of individuals to support operational related tasks. The need for an efficient workforce (who are adequately trained) is desired by the producers included into Factor 2.

Ensuring the use of limited inputs (e.g., less feed for the same, if not more, meat yield) allows for this discourse to effectively prioritize the balance of both environmental stewardship and *societal* (e.g., animal productivity, dependable workforce, etc.) related priorities. These producers can be identified as "business oriented", ensuring that their profit is maximized through the prioritization of statements that have the potential to generate an economic value (S5, S37, S30, S16, and S15) while preserving the environment they operate within. Often, these producers use specific production practices (e.g., *managing manure effectively*) to benefit both their environment *and* their bottom line (i.e., selling the waste of animals as a valuable by-product for fertilization). Noting these practices to be interwoven into how they operate (e.g., *managing manure effectively*), it was common for these producers to define these as "non-active priorities" and rank them lower. Societal statements pertaining to *trust* and *understanding* with consumers and the public were ranked high, illuminating the need to successfully have both in order to operate a viable business and allow for market expansion.

Many statements prioritized (or not prioritized) by Factor 2 were described by participants as being done to support the viability of their business, rather than being used as a leverage point to build direct relationships (and increasing acceptance) with consumers. The ranking of these statements supports the tradeoffs chosen to be made by the producers loading onto this factor to maximize profit, while secondary priorities (that may interest consumers) are required to be forgoed (S19, S28, S27, S24, amd S21 being ranked lower in comparison to Factor 1 and Factor 3) – supporting the *need* to expand markets, and produce highly nutritious and affordable food for the nation. These producers are business oriented, and although they make informed decisions regarding animal welfare and environmental stewardship, prioritization lies within those statements that allows for an efficient and profitable production.

## *4.3 Factor 3: Environmental Stewardship: A Holistic Approach*

**Table 9:** Factor 3 characteristics.

| | | | | | | | Operation Scale[2] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Environmental Stewardship: A Holistic Approach* | **Loading Q sorts** | **Eigenvalues** | **Explained variance %** | **Beef %[1]** | **Pork %[1]** | **Broilers %[1]** | **v. Small %** | **Small %** | **Medium %** | **Large %** | **v. Large %** |
| | 13 | 3.01914 | 7.9451 | 45 | 36.36 | 61.54 | 66.67 | 41.18 | 57.14 | 0 | 0 |
| **Top 4 priorities** | | | | | | | | | | | **Z-Scores** |
| †Maintaining the quality of soil. | | | | | | | | | | | 1.9991 |
| Stewarding the land and natural resources. | | | | | | | | | | | 1.8777 |
| Ensuring the health of animals. | | | | | | | | | | | 1.6302 |
| Building trust with consumers. | | | | | | | | | | | 1.4017 |

[1]Percent of each species that loaded on to this factor (e.g., 45% of the 20 beef producers in the P set loaded on to Factor 1)
[2]Percent of operations at each scale that loaded on to this factor (e.g., 66.67% of the 9 very small scale producers in the P set loaded on to Factor 3)
†Distinguishing statement

A majority of the statements that the third discourse, labeled as *Environmental Stewardship: A Holistic Approach*, ranked higher than Factor 1 and Factor 2 are related to environmental sustainability. Commonly explaining that the ecosystem they operate within is essential to producing a high quality and healthy meat product. Approaching their farming practices from a holistic viewpoint, these producers note the importance livestock plays in ensuring the health of their environment and upholding the quality of their land. The animal species included within the producers' voices who loaded onto this factor stretched across all three proteins of focus (notably having a *more* equal distribution amongst the three species when compared to Factor 1 and Factor 2). The majority of diversified operations loaded onto Factor 3, with 69.23% of participants raising two or three of the livestock species of interest loading onto this factor. Being driven by personal values laced with the *need* to care for the surrounding ecosystem, these producers attempt to integrate their farm practices in a beneficial and sustainable manner.

Learned experiences and past education heavily influenced the decision-making of these producers. Each producer included within this perspective is the owner (or co-owner) of their operation, with all of the operation scales falling within either very small, small, or medium – highlighting the absence of large and very large scale producers (Table 9). The foundation of the practices chosen by these producers uses the symbiotic relationship between the

environment and animals to produce high quality end products while preserving (and improving) the integrity of the surrounding ecosystem.

This approach to farming/ranching includes a collaborative model of integrating their livestock operation *with* their land. This model supports and justifies the common belief (within this factor) that animal agriculture, when practiced holistically, can be used as a solution to environmental concerns commonly associated with protein production. This discourse's top priorities (*stewarding the land and natural resources* and *maintaining the quality of soil)* supports the commonly expressed understanding that these producers find soil health to be the key to a productive and healthy operation.

Additionally, those priorities that suggest a need for efficient animal production (e.g., *minimizing animal finishing times, utilizing genetic selection,* and *providing optimal rations to animals*) are ranked lower (when compared to Factor 1 and Factor 2). Producers are *not* driven by profitability, but rather the drive to produce high quality products while minimizing consumer cost to the best of their ability. Multiple producers, included in this factor, commonly noted the need to remain profitable to continue production rather than for the desire to expand as a business (in comparison to Factor 2). They understand that their choice of prioritizing animal efficiency lower, while positioning the environment's health first, drives input cost and increases the end cost for the consumer product. They are generally less concerned with expanding their consumer base, but rather attempt to maintain their existing consumer networks. Multiple producers explained the *want* to decrease the cost of their product, and increase access to high quality proteins, but still explained the need to cover on-farm and production costs.

It is integral to mention that Factor 3 cares about their animals immensely and advocates for the role they play in a healthy ecosystem. In terms of the three components of Fraser's animal welfare model, this factor finds all three important but explained the inapplicability of actively prioritizing each for their operation. The concept of maintaining the health of their animals is not driven by, nor inherently linked to, reasons for increased productivity. Furthermore, their operational practices of ensuring optimal environmental stewardship naturally reduces the risk and prevalence of animal disease. For example, it is thought that raising animals in a non-confinement operation, allowing animals to experience their natural environment, builds immunity and disease resiliency. Therefore, *preventing animal illnesses* and *practicing the responsible use of vaccines and antibiotics* were noted as lower priorities (when compared to Factor 1 and Factor 2).

While prioritizing environmental health, noting animals tend to be *less* sick than those raised in different production systems, there is an insufficient need to make animal health statements a key consideration within the decision-making landscape. Moreover, many of the animal wellbeing oriented priorities, as mentioned, have previously been prioritized by producers in Factor 3. For example, both *giving animals more space* and *raising animals not in confinement* were not included in these producers' highest priorities even though they exclusively practice a pasture-raised operation. This provides evidence to the unanimous

understanding that both statements are no longer an active priority as each are interwoven into the foundation of *how* animals are being raised on these operations.

Regarding lower priorities, *maintaining traditions in farming practices* was deemed the lowest priority (factor score of a -6) as it is thought that *some* traditions are harmful to the environment, and adopting newer practices would be initiated only if a benefit to the ecosystem could be rendered. Furthermore, being that these individuals are very small to medium scale operations and are commonly first generation producers, *training employees to prioritize proper animal handling* was ranked lower (factor score of -5) *not* due to the unimportance of the meaning behind the statement, but rather the majority of these farms do not employ additional help. Similarly, lower ranked statements (when compared to Factor 1 and Factor 2) such as *navigating changing mandates and laws effectively* were noted as a lesser concern to smaller-scale operations (while those in larger-scale operations must allocate specific resources to accomplish regulation navigation).

The *Environmental Stewardship: A Holistic Approach* discourse noted the great importance of their consumers while holding a “direct-to-consumer” marketing model. While having a higher cost end product, the need to be economically viable is not linked to the desire for business expansion, but rather to maintain production. Their holistic approach to farming is prioritized over profit and productivity, but some find it socio-politically difficult (although necessary) to price their products out of the budget of most. Others explained that they value their meat products, and deem the price appropriate, while mentioning potential alternatives to those consumers who are unable to afford what they are producing. Through the prioritization of integrating their livestock operations with the surrounding ecosystem, their actions are thought to subsequently produce a high-quality and healthy meat product. As a whole, these producers' holistic approach to protein production places ecological restoration and stewardship first – intending to protect and regenerate the environment.

### *4.4 Consensus Perspectives*

While much of the analysis was focused on characterizing divergent participant views, results also identified several areas where there were three non-distinguishing statements across the three factors. Measuring statistical significance at a p-value of 0.05, 3 of the 38 statements proved to have z-scores with no statistical difference between the discourses (i.e., generally, each producer sorted each of the three statements similarly). *Managing manure effectively and efficiently* (S20)*, minimizing water pollution* (S23)*,* and *increasing consumer understanding of farming operations* (S33) were sorted in the moderate priority range for each factor (Table 4). During the sorting exercise producers commented on, and explained their sorting decisions for, the listed statements. These explanations provide a further understanding for the *why* behind the placement of these moderately ranked statements across all participants.

S20 and S23 are both noted to be environmentally related statements, while S33 was predetermined as a societal themed statement. Both S20 and S23 had equal factor scores across the three factors, and were unanimously defined to *not* be a statement that consumes

producers' day-to-day decision-making (i.e., both statements are not an active priority). However, the reason for *why* both statements are not considered an active priority differ, and can be explained by two narratives. The first narrative, relating to S20, noted the previous prioritization of manure management which is now seamlessly built into each production system, and no longer an active (yet still moderate) priority (e.g., pasture raising animals to biologically disperse waste products, previously implementing manure collection infrastructure that limits the need for active decision-making of waste disposal, etc.). S23 can be explained by the second narrative, whereas this statement has never been considered an active priority. Rather, it is thought that through prioritizing other environmentally-related sustainability practices the concern of water pollution is minimized. Thus, water pollution remained as a lower concern and was prioritized (moderately) accordingly across all sorts.

S33 was identified as a consensus statement based on its moderate placement within each Q sort analyzed. However, the reasons for its placement differs amongst the three discourses. Factor 1 explained the reason to increase consumer understanding was to showcase, to individual consumers, their animal husbandry practices – commonly using their optimal animal handling practices to justify the economic premium of their products. Factor 2 noted the need to bring awareness to consumers (largely used synonymously with *the public* in this perspective) that animal agriculture allows for the production of nutritionally dense food products, incorporating affordability into the conversation. This provides justification for the need for consumer acceptance of the animal agricultural industry to support operation expansion. Factor 3 provided evidence to the cost of their meat products by creating consumer awareness of the amount of inputs needed to produce a high quality and *sustainable* end product. Although each discourse prioritized this statement moderately (with factor scores being 1, 2, 1 – respectively), it was a key component in understanding how each group of producers interacted with their consumers. Exploring where consensus lies (and why) within the industry, and across the three species, allows for a better understanding of the current alignment amongst animal agricultural producers.

In addition to the consensus statements as noted above, based on the statistical significance of each statement, there was a common conversation of worker fatigue amongst the study participants. Being this study explored the relative prioritization of both environmental stewardship and animal wellbeing, questioning of occupational-related hazards within animal agriculture was limited. S11, S17, S25 pertained to workforce-related priorities, but were commonly *already* prioritized among those producers who employed a workforce (and ranked moderately) or were ranked lower by those producers (mainly Factor 3) as they did not employ others (usually due to scale, with smaller-scaled operations commonly not employing others). Both narratives showcase the limited conversations had regarding worker health and safety as it relates to what is to be considered a high priority.

However, when probing for different pressures and drivers to decision-making, many producers noted the strain farming and ranching had on themselves (especially those without additional labor support) with underlying influences to the decisions they were able to prioritize. Commonly referencing a “seven-day work week”, many producers illustrated the struggle of time

availability in regards to the prioritization of both environmental stewardship and animal wellbeing. Furthermore, in order to be economically viable, the overexhaustion of personal labor and time created a higher possibility of burnout – with some producers noting this to be a reason why they *may* stop farming/ranching all together.

## 5.0 DISCUSSION

Livestock play an instrumental role in contributing to a sustainable food system; supporting the availability of nutritious food products while holding the opportunity to preserve and improve the surrounding ecosystem (*Moving Towards Sustainability*, 2022). According to the Food and Agriculture Organization (FAO) of the United Nations, 1.3 billion people rely on livestock production for food and nutritional security while bolstering their cultural livelihoods. Environmental stewardship and animal wellbeing are core elements in animal agriculture, where tradeoffs between the two are a common requirement – with decision-making being influenced by a multitude of internal and external pressures.

Challenges facing operations, with differences between smaller and larger-scale production models, include the insufficient availability of resources to adopt sustainable practices (e.g., financial capital, natural resources, farming knowledge, time, etc.), general consumer demands, environmental challenges (e.g., climate change), the constant need to navigate (and adopt practices to adhere to) changing governmental mandates and regulations (Eilola et al., 2014; Stringer et al., 2008), and the desire to align business practices with personal beliefs. Additionally, the need to be economically viable as an operation creates a challenge for those attempting to balance operational practices between environmental stewardship and animal wellbeing considerations with the need to yield a profit (Stringer et al., 2008; Ward et al., 2019). Due to this complexity interlaced into animal agricultural production, it is difficult to understand *what* producers are prioritizing and the *why* behind their current operational decisions – both being explored throughout this study. Using Q methodology, we investigated how 38 animal agricultural producers weighed environmental stewardship and animal wellbeing priorities against one another to better comprehend their relative prioritization preferences between the two topics. Exploration of the viewpoints held by each producer showcased the drivers and pressures which influenced their actions. The analysis resulted in the emergence of three factors, focused on (1) the need to place animal wellbeing first, (2) the desire to ensure business sustainability paired with profit maximization, and (3) supporting environmental health through a holistic approach to farming and ranching.

Production practices are commonly driven by internal influences, noting the role personal beliefs play into how one decides to operate their farm or ranch. It was found that a group of individuals indicated animal wellbeing as a high priority, while another defined environmental health as the cornerstone of a productive and healthy system. Others, those who aspire to expand their business, place efficiency and profitability first – while attempting to balance both environmental and societal themed statements. The notable distinctions between the three discourses lies within what statements were deemed higher priorities, supported by active decisions producers are currently able to make to maintain those priorities. This is to not

suggest statements ranked lower as unimportant, but provide an explanation to the ranking decisions. The challenge of balancing both environmental stewardship and animal wellbeing priorities, while also running a viable business, illuminates the complexities within animal agriculture. The outcome of placing either environmental stewardship or animal wellbeing first, resulted in repercussions being correlated to the amount of potential profit able to be gained, what resources (e.g., capital, time, money, workforce, etc.) is available to those producers to make sustainability-related changes in operational practices, and/or the cost of the end product for consumers.

These three independent viewpoints better explain what priority preferences, regarding environmental stewardship and animal wellbeing, are had by animal agricultural producers, why those priorities exist, and potential tradeoffs made. Those who place animal wellbeing first, driven by personal philosophies, choose to *not* meet consumer's demands or preferences. Another group of producers noted the priority to balance both animal welfare with environmental stewardship practices to ensure business viability. These producers commonly define animal welfare differently in comparison to other producers, noting that if their animals remain productive then all of their animals' needs are being met. This difference in *how* producers define animal wellbeing creates misalignment within the industry, and confusion amongst consumers. However, being able to prioritize an efficient business model allows this group of producers to produce a low cost, low input product – being driven by consumer demand. Others who noted environmental-forward practices as a high priority (in comparison to the other two groups of producers) commonly decreased the efficiency of their livestock operation and subsequently increased consumer cost. These tradeoffs showcase differences among the three factors extracted, and suggest different pressures that each production model is faced with. With these differences, paired with similar and dissimilar perspectives among same-specie producers, outlining differing needs for each discourse is recommended. Using the viewpoints rendered through this analysis, the allocation of resources can be more accurately applied to extend support to animal agricultural producers. Providing the support that reflects the relative priorities of the three factors will supply a higher probability for producers to adopt sustainability-related change on their operations.

It was unanimous across all producers included in this study that economic pressures, and the need to be running a viable business, created limitations to the amount of focus one can have on both animal wellbeing and environmental stewardship relative prioritization. However, some, who commonly had secondary income, had the flexibility to place animal wellbeing and/or environmental stewardship as a higher priority – noting operational profitability maximization being the tradeoff. Those who were not business oriented often struggled with allocating resources to implement sustainability-related change on their operation. Further supporting the proven hypothesis that the decision-making landscape is complex within animal agriculture, and the need for flexible support systems that (1) reflect the needs of all producers and (2) reflect the needs of individual groupings of producers that differ between one another, is highly recommended for the industry to adopt.

The concept of *food affordability* had received mixed opinions among most of the producers, with differing discussions commonly dispersed throughout each factor. Some noted that due to limited resources (or lack of desire) to increase production efficiency, they were unable to decrease consumer cost. The reliance on additional inputs in production settings with limited resources drives production cost, increasing the end cost for consumers. Others explained that in order to adequately prioritize the animal's wellbeing and/or the health of the integrated environment, low cost products were a tradeoff made. Two common themes emerged from both reasons: producers who believe that their products are worth the price when compared to lower-priced commodities (from a nutritional, health, and quality standpoint); those who were aware of the unfortunate reality of producing high-cost products, but were determined to not make tradeoffs relating to either animal wellbeing or environmental stewardship in place of affordability.

In order for an operation to be sustainable, the following must be met; business profitability throughout, providing broad based benefits to society, and the exclusion of negative environmental impacts in their production practices (FAO, 2021). To explain, the ability to be economically viable (as an operation) was a necessity needed to be met by most. This priority created difficulties for smaller-scale operations to be in-control of the cost of their end product, without making sacrifices to *how* these producers were operating. Others felt that food affordability was out of their control, as they were the "middle-player" in the food value chain they produced within (e.g., cow/calf producers selling live animals to feedlots, rather than producing and selling their own meat products).

It is common for larger-scale operations to prioritize the production of high yielding protein products to continue market expansion, while having the capability to allocate resources to ensure the business remains sustainable. In contrast, smaller-scale producers tend to market towards those outside of a subsistence lifestyle, as additional cost of production (paired with minimal efficiency) creates an unaffordable product for most consumers (Ward et al., 2019). The barriers preventing the ability for smaller-scale producers to operate in a more commercialized setting, while upholding all three pillars of sustainability, can be related to the resources available to them (e.g., start-up capital, processing access, infrastructure, workforce, etc.). Additionally, the tradeoffs needed to be made to either (or both) animal wellbeing and environmental stewardship does not coincide well with smaller-scale producers' personal defined obligations to produce meat products that prioritizes these concepts *over* profitability. The different incentives available to smaller-scale and larger-scale operations provides probable justification for different priorities amongst different scaled operations. The resources accessed by larger-scale operations (primarily those who practice a confinement production model) allows economics to be prioritized in conjunction with the remaining two pillars of sustainability (environmental and societal), while smaller-scale operations must deliver a higher cost product to avoid unintentional tradeoffs to both animal wellbeing and environmental stewardship.

## *5.1 Future Research*

This study explored producers' priorities between environmental stewardship and animal wellbeing, including many influences to these relative prioritization decisions. It is suggested for future studies to explore the role of land ownership as a potential influence to environmental-related decisions. It is thought that there may be differences that lie between those producers who own their land, and make decisions based on operational longevity, versus producers who rent their land and may have a minimal (or unknown) duration operating on their rented environment. According to the USDA, 39% of all U.S. farmland is under a rental agreement, and not owned by those operating on the land (Callahan, 2022). This may suggest additional barriers faced by those who rent their farmland, and why they may not prioritize environmental-specific statements (e.g., *stewarding the land and natural resources*) in contrast to those who own their land. Additionally, future studies should examine the repercussions of limited processing access – faced by all production models. Barriers, in relation to meat processing access, are thought to have the capability to dictate how many animals an operation is able to produce, the type of species that the producer is able to raise, and the cost of the end product. Paired with this exploration, a primary focus should be had on the barriers producers face (specially smaller-scaled operations) in which markets they are able to access (wholesale versus direct-to-consumers). This study alluded to the urge for those who were attempting to expand their operation to seek wholesale markets, while others attempting to sell higher priced products must seek direct-to-consumer sales. Exploring the different barriers faced in accessing both markets (and what role processing access plays) is suggested.

Lastly, future studies should explore the role occupational-related hazards play in the livelihoods of animal agricultural producers. As explained in previous sections (see 4.4 – *Consensus Perspectives*) the concept of “producer burn-out” seems to be interwoven into all production models – alluding to the physical and mental toll of producing sustainable meat products while retaining a viable business. Reasons behind this common feeling should be investigated to allow for the generation of support to minimize the burden felt by those producing animal protein within the U.S. Furthermore, it is suggested to explore the occupational-related health concerns, outside of the psycho-social context as previously defined, faced by this industry. Specially for smaller-scaled producers, noting that many serve as the sole workforce in their operation, it is suggested for future research to explore whether these individuals are adequately trained (and provided the necessary resources) to prevent occupational-related hazards from occurring.

## *5.2 Strengths and Limitations*

Using the findings of this study, the groupings of these producers support the reality that animal agriculture faces difficult decisions based on what producers can and cannot *actively* prioritize. Whether this be linked to personal beliefs or external forces, ability to or the incapability of, it is common for all to feel the pressure and economic restraints that farming is laced with. Each producer has noted that they have (or actively are) including components of animal wellbeing and environmental stewardship into their operation – with different levels of focus being the distinction between the three factors. The strengths of these findings correlate

to the identification of differing groups of producers – spread across, and within, the three species of interest. These conclusions render the recommendation for industry to adopt flexible support systems that reflect the needs across all animal agricultural producers, and within the differing production models and viewpoints. Allowing each producer to be provided with the resources to effectively balance both animal wellbeing and environmental stewardship, while remaining economically viable, will subsequently drive adoption of sustainability-related decisions on each operation.

Limitations of this study, and the rendered conclusions, include both large and very large scale broiler operations being unsuccessfully recruited as participants within this study (as previously described, see section 2.6 – P Set *(the sample of interviewees)*). The three factors discussed in this study are not to be reported as encompassing all types of animal agricultural producers, including other protein producers that were not one of the three proteins of focus within this study (e.g., lamb, laying hens, etc.) Furthermore, the nature of Q methodology regards the systematic approach to choosing the P set (versus randomization) to maximize variation to diversify the perspectives included in the study. The distribution of the participants across the three factors does not accurately reflect the reality of the distribution across all animal agricultural producers within the U.S. When applying these perspectives to better understand how decisions are made within the industry, and where support can be provided, consideration should be made of these listed limitations.

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# 7.0 APPENDIX A

## *7.1 Key Informant Interview Guide*

**INTRO SCRIPT**

**[What to expect]** Does this time still work for us to talk, for about an hour? And are you in a place that works for this interview?

**[Interviewer introduction]** My name is…. [add your own introduction].

- *[If there are more interviewers on the call]* I also have a colleague on the call today who is here to help me take notes, and will mostly have their video off but might chime in during the interview. [Second interviewer to introduce themselves]

**[Project background]** Before we get into the interview, I want to share some background about the project:

- Our team includes researchers from the University of Washington, Washington State University, the University of Minnesota, and the Agriculture & Food Systems Institute.
- For the next two years, we're working on a project funded by the USDA to study the complexity of decision-making that goes on in livestock and poultry production, and to identify places where improved understanding of that complexity among consumers could be helpful for advancing trust and alignment.
- To understand the project, we want to share a simple narrative through which we are approaching it. And, that is: There is a big public debate going on right now about whether meat is a component of a sustainable diet and which meat sources are better. We believe meat can be a part of a sustainable diet and that some of the current debates (for example, "meat or no meat," or solely focusing on greenhouse gas emissions) are not helpful for supporting producers in making meat production more sustainable. We aim to help, by engaging in a multi-phase project that first identifies what farmers and ranchers are already doing and want to do better, and how consumer demands, opinions, and misconceptions might get in the way of that. Then, we'll examine how to better align consumer demand and opinion with what would actually help producers.
- I'm interviewing you today as part of the first phase of the project, which is to understand more about farmer and rancher priorities related to environmental impact and animal wellbeing. We are focusing on these two areas because we think they are important for building trust between producers and consumers.
- In particular, this interview will help us make sure we have the best information for our next phase which is to ask farmers and ranchers to rank their priorities and needs related to environmental impact and animal wellbeing and then provide insights into these rankings.
- As we go through this interview, we know there are many other considerations beyond what we will specifically ask about that are central to production. Feel free to bring up economic factors as well as other intersecting factors you face, especially as we get into talking about tradeoffs.
- Do you have any questions about this interview and what we need from you?

**[Informed consent]** The last bit of background information is about how we plan to use the information from this interview and protect your privacy and confidentiality.

- Your participation in this interview is voluntary — you are welcome to skip any of the questions I ask, and we can stop the interview at any time.
- Any information you share will be anonymous and confidential. The ideas you share with us will help inform the next stages of our study, but we will not share with anyone that you were a participant.
- If it's okay with you, I'll record the interview. This will help make sure I don't miss anything, since I can't write as fast as you talk!
- The transcript from the interview will not contain your name, the name of your organization, or any potentially identifying information about you.
- If you're interested in the results of the study when it is completed, let us know and we can get back in touch with you.
- Do you have any questions?

Is it okay if I record this? **[If yes, second interviewer to start recording]**

**INTERVIEW QUESTIONS**

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| Q1. To begin, can you tell me about **your organization, and your role within that organization?** | *Tailoring, for **producers**:*<br>- Rather than "your organization," ask about "your farm or ranch," and probe for which livestock species.<br>- Alternatively, ask about "where you work, and what you do"<br><br>*Probes, if the response is **very short**:*<br>- Could you describe what this might look like on a day-to-day basis? |
| Q2. One of the goals of this conversation is that in a few weeks, we'll be conducting exercises with livestock and poultry producers where we ask them to rank the importance of different priorities related to environmental impact and animal wellbeing. We want to make sure we have a comprehensive list of priorities in these areas, and so I'm going to ask you about environmental impact issues, and then we'll talk about animal wellbeing issues after. And throughout all of this, you're welcome to bring up other considerations like economic, social, or other factors that you think are relevant.<br><br>To start with, when you think about environmental impact issues related to [beef/pork/broiler] production, **what do you think are the top issues or priorities within the industry overall?** (We will ask about priorities for producers next)<br>● *Clarification, if needed:* When we say priorities "within the industry," this could span the entire value chain, from feed and other inputs to waste reduction. And this could include priorities held by groups that represent farmers and ranchers, or any other influential groups in this space.<br><br>*Follow-up questions for everyone (can skip if they are already covered):* | *General probes that apply to all of these questions:*<br><br>*Probe, **if they are listing practices rather than priorities/issues:***<br>- What kind of environmental impact goals or outcomes do you think that accomplishes?<br><br>*Probe, **if they are listing priorities/issues and we want to learn about the practices:***<br>- How might producers address that in their operations? What are some of the on-farm practices?<br>- What are the most common on-farm practices people are using to address this priority?<br><br>*Probe, **if there's a good opportunity to ask about cause-and-effect relationships:*** |

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| ● When you think about environmental impact issues related to [beef/pork/broiler] production, **what do you think are the top priorities for farmers and ranchers in general?**<br>○ *Clarification, if needed:* These might be shared with the industry-wide priorities you just mentioned, or they might be different<br><br>● When you think about **[beef/pork/broiler] producers that are leading the way** in terms of reducing environmental impact, what kind of things are they prioritizing?<br><br>● When you think about changes that farmers and ranchers are making to reduce their environmental impact, **what is getting in the way — what big tradeoffs are they facing?**<br>○ *Probe:* Ask about economic trade-offs, if not mentioned<br><br>● What things are producers doing to reduce environmental impact that you **wish consumers were more aware of** (or would demand more of)?<br>○ *Alternative wording, if needed:* … or things you wish consumers would demand more of?<br><br>*For KII+ conversations with AC members:*<br>● We noticed that very few interview participants mentioned [ ] — does this issue tend to come up in your circles? (Why or why not?)<br>● Where do you get your information about best practices for (or innovations for improvement in) environmental impact — are there any reports or guidelines that you rely on?<br>● Future Visioning Question: Looking ahead 10 years, what is different about meat production in terms of how we're reducing environmental impact? | - If that happened, what kind of consequences (or effects) would that lead to?<br>- Why do you think that happens?<br>- What do you think is driving that?<br><br>*Probe, **to learn about terminology:***<br>- I've heard people talk about ___, but is that how producers actually talk about it? |

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| Q3. **Of the environmental impact priorities you mentioned, which, if any, would you say are influenced by consumer preferences?**<br>- *Clarification / alternative wording (if needed):*<br>  - Are there any environmental impact issues that have become a priority for producers *because of* consumer preferences?<br>  - "Consumer preferences" could include consumer trends or market pressures<br><br>*Follow-up questions for everyone (can skip if they are already covered):*<br><br>● What do you think are **consumers' top priorities** related to environmental impact?<br>  ○ *Probe:* What sources of information do you depend on to understand consumer trends and preferences?<br><br>● Do you have any examples of issues where farmers/ranchers and consumers ***are* in alignment?**<br>  ○ *Probe:* What do you think contributed to this alignment?<br><br>● We talked about alignment between producer and consumer priorities related to environmental impact, but **what about misalignment**… can you think of issues where consumers act on a lack of information, or different information than producers, or even mis-information, in ways that make it more difficult for farmers and ranchers to reduce environmental impact? | <u>*General probes that apply to all of these questions:*</u><br><br>- How do you think consumers are developing these preferences?<br><br>- Where do you get your information about consumer preferences (or consumer demand, market trends)?<br><br>- Do you think consumers are setting priorities and the industry follows, or is it the other way around?<br><br>- Is there a mismatch between producer and consumer priorities around the environment impact, with the producer/ consumer prioritizing an issue more than the other ? What are some examples?<br><br>- Are there certain issues that consumers perceive as worse (or more severe) than they actually are?<br><br>- What difficulties do producers face that you wished consumers understood/ knew about? |
| Q4. Thank you for helping us to think through priorities related to environmental impact. I'd like us to do the same thing for issues or priorities related to animal wellbeing, recognizing that again, this is just one of the many factors relevant to sustainable meat production. | <u>*General probes that apply to all of these questions:*</u> |

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| **When you think about [beef/pork/broiler] production, what are the top issues or priorities related to animal wellbeing within the <u>industry</u> overall?** (We will ask about priorities for producers next)?<br><br>● *Clarification, if needed:* When we say priorities "within the industry," this could span the entire value chain, from feed and other inputs to waste reduction. And this could include priorities held by groups that represent farmers and ranchers, or any other influential groups in this space.<br><br>*Follow-up questions for everyone (can skip if they are already covered):*<br><br>● When you think about animal wellbeing issues related to [beef/pork/broiler] production, **what do you think are the top priorities for farmers and ranchers in general?**<br>○ *Clarification, if needed:* These might be shared with the industry-wide priorities you just mentioned, or they might be different<br><br>● When you think about **[beef/pork/broiler] producers that are leading the way** in terms of improving animal wellbeing, what kind of things are they prioritizing?<br><br>● When you think about changes that farmers and ranchers are making to improve animal wellbeing, **what is getting in the way — what big tradeoffs are they facing?**<br>○ *Probe:* Ask about economic trade-offs, if not mentioned<br><br>● What things are farmers and ranchers doing to improve animal wellbeing that you **wish consumers were more aware of** (or would demand more of)? | *Probe, **if they are listing practices rather than priorities/issues:***<br>- What kind of animal wellbeing goals or outcomes do you think that accomplishes?<br><br>*Probe, **if they are listing priorities/issues and we want to learn about the practices:***<br>- How might farmers and ranchers address that in their operations? What are some of the on-farm practices?<br>- What are the most common on-farm practices people are using to address this priority?<br><br>*Probe, **if there's a good opportunity to ask about cause-and-effect relationships:***<br>- If that happened, what kind of consequences (or effects) would that lead to?<br>- Why do you think that happens?<br>- What do you think is driving that?<br><br>*Probe, **to learn about terminology:***<br>- I've heard people talk about ___, but is that how producers actually talk about it? |

| | |
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| ○ *Alternative wording, if needed:* … or things you wish consumers would demand more of?<br><br>*For KII+ conversations with AC members:*<br>● We noticed that very few interview participants mentioned [ ] — does this issue tend to come up in your circles? (Why or why not?)<br>● Where do you get your information about best practices for (or innovations for improvement in) animal wellbeing — are there any reports or guidelines that you rely on?<br>● Future Visioning Question: Looking ahead 10 years, what is different about meat production in terms of how we're improving animal wellbeing? | |
| Q5. **Of the animal wellbeing priorities you mentioned, which, if any, would you say are influenced by consumer preferences?**<br><br>*Follow-up questions for everyone (can skip if they are already covered):*<br><br>● What do you think are **consumers' top priorities** related to animal wellbeing?<br>○ *Probe:* What sources of information do you depend on to understand consumer trends and preferences?<br><br>● Do you have any examples of issues where farmers/ranchers and consumers ***are*** **in alignment?**<br>○ *Probe:* What do you think contributed to this alignment?<br><br>● We talked about alignment between producer and consumer priorities related to environmental impact, but **what about misalignment**… can you think of issues where consumers act on a lack of information, or different information than producers, or even mis-information, in ways that | <u>*General probes that apply to all of these questions:*</u><br><br>- How do you think consumers are developing these preferences?<br><br>- Where do you get your information about consumer preferences (or consumer demand, market trends)?<br><br>- Do you think consumers are setting priorities and the industry follows, or is it the other way around?<br><br>- Is there a mismatch between producer and consumer priorities around the animal wellbeing, with the producer/ consumer prioritizing an issue more |

| | |
|---|---|
| make it more difficult for farmers and ranchers to improve animal wellbeing? | than the other? What are some examples?<br><br>- Are there certain issues that consumers perceive as worse (or more severe) than they actually are?<br><br>- What difficulties do producers face that you wished consumers understood/ knew about? |
| Q6. If you had to characterize the relationship between [livestock/poultry] producers and consumers, would you say that on the whole there is more **trust, or mistrust**?<br>● *Probe:* What makes you say that?<br>● *Probe (for trust):* What do you think helped to build this trust?<br>● *Probe (if they say mistrust):* What do you think could help to build trust between producers and consumers? Is there anything related to areas that we haven't discussed yet today?<br>● | (If "yes," please elaborate) |
| Q7. That was my final planned question — **is there anything you wish I had asked about, or anything you want me to know?** | |

**EXIT SCRIPT**

- Thank you so much for your time today.
- Our next step is to use what we learn from these conversations to inform our next phase. The priorities that you helped us to identify — we're going to ask farmers and ranchers to actually rank these, through a research method known as Q sort, so we can understand how they're making decisions and thinking about trade-offs.
- **[Snowball sampling]** We'll be recruiting participants for these Q sort sessions starting in January, and we also hope to find more people to participate in interviews just like the one we did today. I wanted to ask if you know any farmers or ranchers, or other people with expertise in animal agriculture,who might be willing to participate. Would it be okay if

I emailed you with a brief description of what we're looking for, in case you know of any potential participants?

- You'll hear from us over email with that follow-up. If you have any questions please don't hesitate to be in touch, and thank you again for your time today.

### *7.2 Q Sort Interview Guide*

**INTRO SCRIPT**

**[What to expect]** Does this time still work for us to talk, for about an hour and a half? You will need access to a computer, are you in a place that works for this interview?

- We'll jump into introductions in a minute, but first to give you a quick overview of the process today (1) we will introduce ourselves and the project, (2) ask some preliminary questions and give you a chance to introduce yourself, (3) the bulk of our time will be spent completing a sorting exercise with on-farm/ranch priorities (4) and conclude with a conversation regarding the sorting exercise.

**[Interview introduction]** My name is…. [add your own introduction].

- [If there are more interviewers on the call] **I also have a colleague** on the call today who is here to help me take notes, and will mostly have their video off but might chime in during our conversation. [Second interviewer to introduce themselves]
    - [Second interviewer, after introduction]: "...and we're actually going to ask you to hold on just a second to introduce YOURSELF because we have a spot for it at the beginning of our interview process."

**[Project background]** Before we get into our conversation, I want to share some background about the project:

- As we briefly explained in our email, this is part of a multi-year project funded by the USDA looking at complexities and tradeoffs in animal agriculture. Specifically we're focusing on complexities surrounding sustainability and animal wellbeing. **Our aim is to help build trust between producers and consumers**, and to better understand the full extent of what producers are up against as they make decisions related to these topics.
- **Ultimately**, we are focused on better aligning consumer understanding, demand, and opinion with the reality that producers face.
- We've spent the last couple of months interviewing industry members and value chain stakeholders about on-farm and ranch priorities regarding these topics. Today, we are after your thoughts on the priorities that came out of these interviews.
- We'll be doing a sorting exercise based on these priorities. Essentially, we'll be having you look at a bunch of simply worded statements having to do with operational priorities, and we'll be asking you to rank them in line with how you prioritize each of them on your farm/ranch.

  *If asked…*
    - ***[Project partners]:*** *University of Washington, Washington State University, the University of Minnesota, and the Agriculture & Food Systems Institute*

- **Do you have any questions about this exercise and what we need from you?**

**[Informed consent]** We sent some consent language to you in our last email — did you have a chance to look that over? (Y)

- **[Yes]** Did you have any questions or concerns, or would you like to run through it together?
    - **And you're okay with us recording today?**
- **[No]** Let's run through it together.

*Note: No action was necessary, there was nothing you needed to sign or anything. By participating in this interview you're giving consent, we just want to make sure you're clear on what that means before moving forward.*

***[IF NEEDED]***

**[Consent Language]** The last bit of background information is about how we plan to use the information from this exercise to protect your privacy and confidentiality.

- Your participation in this conversation is completely voluntary — you are welcome to skip any questions I or *second interviewer* asks.
- Any information you share will be anonymous and confidential. The ideas you share with us will help inform the next stages of our study, but we will not share with anyone that you were a participant and data from this phase of the project will only be shared in the aggregate.
- The final transcript and data from the interview will not contain your name, the name of your organization, or any potentially identifying information about you.
- I will guide you through the sorting exercise, and when it's time, I'll ask you to share your screen with me.
- If it's okay with you, we'd like to record this interview. This will help make sure we capture all of your thinking accurately since we can't write as fast as you can talk! The recording will be audio only, and will under no circumstances be shared or used outside of the immediate study team. It's just to make sure we don't miss anything!
- **Are you okay with us recording today?**
- Do you have any **questions** for me or second interviewer?

*Note: Recording won't be kept any longer then they will need to be. Once a transcription is completed, including the removal of all identifiable information, the recording will be…*

a. *Deleted.*
b. *Moved into a secure folder that has very minimal access until the completion of the project.*

With that, we'll start recording and move along. **[If there is no objection, second interviewer to start recording]**

**PRE-SORT DEMOGRAPHIC QUESTIONS**

| | |
|---|---|
| Q1. To begin, can you tell me briefly **about yourself and your operation?** | *Probes*<br>- Where is your farm/ranch **located**?<br>- How would you describe your **role/relationship with the operation** |

| | |
|---|---|
| | (e.g., farm owner, operator, manager)?<br>- Which **livestock specie(s)** do you primarily raise?<br>- How would you describe your **primary customer**?<br>- **How long** have you been XX producer for XX primary customer?<br>- What is the **size** of your operation?<br>o Probe for number of head/AU<br>o "If you would prefer, I can list ranges of head for you to choose where your operation falls into?" |

**[Transition to Q Sort]** Thank you for answering those questions, it helps us better understand your perspective! We will head into the sorting exercise.

## Q-SORT OVERVIEW

**[Introduce Q-Sort]** The majority of our time today will be completing the sorting exercise, broken into two phases,. After, we will end with a loosely structured discussion to understand your thinking and the way you sorted the priorities that we have for you today.

- As I mentioned earlier, we have a list of priorities that pertain to environmental stewardship and animal welfare.
- First, we will introduce you to each statement to allow you to organize your thoughts. Followed by the bulk of the sorting exercise which we will use in our analysis. And then conclude with a discussion.

**[Introduction to the drivers/pressures] In our closing discussion** I will ask you what drove you to rank your top priorities and bottom priorities as such. To help give context, we have a short list of potential influences that may affect your decision-making. We'll drop them in the chat now and see if you have any questions about them that we can answer. These are the broad, important, impacts that came to our minds, but if others occur to you **we'd love to hear about that in the post-sort conversation.** As you read each statement, and throughout the sorting process, try to keep these influencers in the back of your head so that you'll be able to best explain your ranking decisions:

- REGULATORY (i.e., governmental mandates on manure storage)
- INDUSTRY/BUYER (i.e., customer purchase stipulations)
- CONSUMER/EATER (i.e., general public demands)
- OPERATION/BRAND (i.e., values pertaining to the brand of the product, company pressures)
- PERSONAL (i.e., values pertaining to the producer's personal perspectives, generational viability)
- ECONOMIC (i.e., pertaining to the need to be financially stable, being viable)

**Do you have any questions before we jump into sorting?**

**PRE-SORT DIRECTIONS**

**[Send link]** You should've received a link in the Zoom chat, please open that link. Once you have opened that link, you should see "Exploring the Complexities within Animal Agriculture". **Did that link work for you?**

- **[If yes]** Choose "Yes" to the statement "Select if you have a participation code". The participation code should populate automatically, **if it did** choose "SUBMIT".
    - *If the participation code doesn't populate automatically, it is the last 4 letters/numbers of the URL.*
- **[If no]** [Second interviewer] will send you an additional link. **Did that link work for you?**

*Note:*

- *If asked, we are using participation codes as a way to keep track of all 40 interviews.*

**[Participant to screen record]** You should now see a "Consent" page, is that correct?

- **[If no]** *Repeat process with a new link*. *Second interviewer* will send you an additional link. **Did that link work for you?** You should now see a "Consent" page, is that correct?
    - **[If yes]** *Refer to consent on screen sharing below.*
- **[If yes]** Great! This will be a good time to share your screen with us, so I am able to help guide you through the process. It also allows us to better understand your sorting pattern. Are you willing to share your screen with us?
    - **[If clarification seems necessary]** As a reminder, the audio of our conversation is being recorded, but we are not recording any video or shared screens. This is just to streamline the process and make sure we can give any technical assistance needed.
- **[If yes]** Thank you. Go ahead and navigate back to your Zoom screen, and share the screen that has the Q Method Software loaded. **[*Confirm that screen sharing is working/sharing the correct screen.*]** I can now see your screen. This consent language is the same as we discussed earlier in our call today. If it all looks okay to you, go ahead and **choose "I agree" to the prompt.**
- **[If no]** That is okay, I will verbally walk you through each step and share my screen once you have submitted the sort to facilitate our discussion at the end. **Choose "I agree" to the consent prompt** to move forward**. [To clarify] I do not see your screen.**

**[Introduction of the pre-sort]** We will begin with the first phase of the exercise. You *should be seeing* all **38** statements. At the bottom of each statement's "card", you will see a down arrow, circle, and up arrow - representing a lower, moderate, or higher priority. This phase is to introduce you to each priority, and allow you to organize your thoughts.

- For each statement, read the statement entirely and decide which "bucket" you initially feel it falls in by choosing one of the three symbols. **If you have any questions about the meaning of a statement, or just want to think out loud and speak as you sort, you're absolutely welcome to.**
- We recognize that all of the statements are priorities, and that it may be difficult to choose which ones are the highest or lowest. We won't assume that those statements ranked lowest are things that you don't think about, rather, we will understand that there are other priorities that you deem more important. **Our goal here is to understand how you make tough calls and prioritize when everything is potentially a priority.**
- We're really interested in knowing how you currently operate, NOT how you wish to operate or have operated in the past. Sort these to reflect your current priorities.

- I will give you some time to read each statement and bucket them appropriately.

*Once all statements are pre-sorted, the software will automatically progress to the Instructions slide - see below.*

**FINAL-SORT DIRECTIONS**

**[Final Q-sort instructions]** You should now see page 3, "Instructions", is that correct?

- **[If yes]** As a reminder, keep **those 6 pressures** at the back of your mind as you decide which priorities boil to the top, and which fall into the "lower priority" category.

*If asked to be reminded of the pressures…*

1. *REGULATORY* (i.e., governmental mandates on manure storage)
2. INDUSTRY/BUYER (i.e., customer purchase stipulations)
3. CONSUMER/BUYER (i.e., general public demands)
4. OPERATION/BRAND (i.e., values pertaining to the brand of the product, company pressures
5. PERSONAL (i.e., values pertaining to the producer's personal perspectives)
6. ECONOMIC (i.e., pertaining to the need to be financially stable)

**[Click the "Begin" button]** I will explain details of the sort once you choose "Begin".

**[Final Q-Sort]** This page will show you the same priorities, three at a time, in the three separate groups you previously sorted them in.

- For each statement, drag and place each into the grid below. The statements placed on the far left will be statements you find to be the lowest priorities, with the highest priorities being sorted on the far right. **The columns are distinct from one another**, with statements placed below/above one another having equal weight. **You are able to freely move the statements around after first placing them.**
- We're really interested in knowing how you currently operate, NOT how you wish to operate or have operated in the past. Sort these to reflect your current priorities.
- I will give you time to sort, please feel free to talk aloud about what pressures are driving your decisions or stay silent during the sorting process - whatever you prefer! Either way, **we will revisit your final sort and have our closing discussion after submission.**
- Do you have **any questions** about this exercise and what we need from you before we begin?

**[Condition of Instruction]** Go ahead and read each statement. When it comes to the **current** decisions you make on your operation, rank the statements appropriately to reflect your lowest, moderate, and highest priorities.

**Tips**

- *Participants can zoom in and out using the "+" and "-" buttons on the left hand side of their screen, using their mouse to click and drag to navigate the screen.*
- *If they decide to place a statement on the grid, over a pre-placed statement, that pre-placed statement will swap spots with the new statement. Example: if a statement has been placed in the highest priority grid spot, and the participant decides to drag a pre-sorted low priority statement into that same grid box, the statement that was previously in the highest priority grid box will be automatically placed in the pre-sorted low priority group (swapping places with the new statement).*

**[Confirm Q-Sort]** Are you comfortable that the grid reflects your priorities? Please feel free to look it over once more.

**[Gratitude]** Don't submit just yet, we will move into the final discussion. Thank you for completing the sorting exercise [**see Q1 below**].

**POST-SORT DRIVERS/PRESSURES QUESTIONS**

| | |
|---|---|
| Q1. So what did you think?! | *Initial reaction…* |
| Q2. **Looking at these 4 columns**, or your highest priorities, what drives this prioritization? [*Potentially drop the 6 drivers in the chat again here for reference*] | *Probes*<br>- ***Drivers/pressures*** *(see below)*<br>  o *If they are silent, go one by one.*<br>  ▪ *"Can you walk us through your thinking?"*<br>  ▪ *"What kind of things were you thinking about as you ranked these items?"*<br>  o *If they mention multiple drivers, and leave one or two out, revisit the ones missing.*<br>- ***Additional reasons*** *for decision making (not included in the 6 drivers)*<br>- *Facilitators of current priorities* |
| Q3. **Looking at these last four columns**, or your lowest priorities, what drives this ordering? | Probes<br>- ***Drivers/pressures*** *(see below)*<br>  o *If they are silent, go one by one.*<br>  o *If they mention multiple drivers, and leave one or two out, revisit the ones missing.*<br>- ***Additional reasons*** *for decision making (not included in the 6 drivers)*<br>  o *Didn't make sense, never thought about, not applicable to your operation…*<br>  o *Not aware of what's out there (e.g., possible technology), solely for large scale operations, not of value…*<br>- *Facilitators of current priorities* |

| | |
|---|---|
| Q4. In an ideal world, and keeping within this grid, **without any of these influences putting pressure on you**, would you have sorted these priorities differently? | *Probes*<br>- Are there any specific priorities that you would have ranked higher or lower, without these pressures at play?<br>- **Why?**<br>o **Motivators** behind why they are seeking a change, if possible<br>o **What influences** are preventing your ideal changes? |

**[Submit Q-sort]** Please go ahead and submit your Q-sort, using the bottom-right button, and stop screen sharing. Thank you.

**[Discussion wrap-up]** Is there anything else you would like to share before we wrap up today?

**[End Recording]**

**EXIT SCRIPT**

**[Gratitude and next steps]** Thank you again for your time today.

- ***(Person responsible)*** will follow-up with you about a thank you gift card for your time, and also about keeping you looped in on the project as it progresses.

- Before we conclude, do you have any lingering questions?
    - **[If not]** Thanks again for your time, we will be in-touch. Take care.

## *7.3 Recruitment Language*

**A University of Washington-led study examining complexity and tradeoffs in animal agriculture is looking for meat producers to participate in interviews.** This USDA-funded work is being conducted in partnership with Washington State University, the University of Minnesota, and the Agriculture & Food Systems Institute, with a goal of building awareness and trust between producers and consumers.

The research team is looking to have conversations with a wide variety of **beef, pork, and broiler** producers, discussing how issues that get a lot of consumer attention are prioritized in an environment where **everything** is a priority. The goal is to help better understand how producers make complex decisions and weigh tradeoffs related to topics that receive consumer attention, such as environmental impact and animal wellbeing.

Time commitment for each participant will total roughly 1.5 hours, and will include an interview component and an interactive sorting exercise. Discussions will be held over Zoom, and each participant will be offered a $100 gift card for their time. **Are you interested in participating? If**

**so, please fill out this brief form (*insert link to study survey*) and the study team will get in touch with you!** Alternatively, feel free to get in touch with study coordinator (*insert study coordinator contact information)* for more information.

## *7.4 Study Consent Language*

PURPOSE OF THE STUDY

This study examines complexity and tradeoffs in animal agriculture. This USDA-funded work is being led by the University of Washington, and is being conducted in partnership with Washington State University, the University of Minnesota, and the Agriculture & Food Systems Institute, with a goal of building awareness and trust between producers and consumers. The research team will have conversations with a wide variety of beef, pork, and broiler producers, discussing how sustainability and animal wellbeing matters are prioritized in an environment where everything is a priority. The hope is to help better understand how producers make complex decisions and weigh tradeoffs related to topics that receive consumer attention, such as environmental impact and animal wellbeing.

PROCEDURES

We are asking you to participate in a semi-structured interview and facilitated sorting exercise that will help to build understandings of how farmers and ranchers are prioritizing various issues and practices. The interview will be facilitated by members of our research team. Detailed notes will be taken, and will be used to inform both the study findings and future steps of the project. The interview will be approximately one and a half hours in length, and, with your permission, will be recorded. Recordings will be audio-only, and will not be shared outside of the immediate study team. They will be deleted once final transcripts are completed. The only purpose of recording is to ensure that we do not miss or inaccurately represent your views as we finalize the interview transcript.

COMPENSATION

After the interview you will have the option of accepting a $100 Visa gift card as a thank you for your time and expertise. Gift cards can be sent physically to an address of your choosing (except for PO boxes) or electronically via email. Accepting the gift card is optional and you do not have to provide extra contact information if you do not want to.

WHAT ARE THE RISKS?

Taking part in this study is voluntary. All information you provide will be kept confidential and only used internally amongst the research team. The ideas you share with us will help inform the next stages of our study, but we will not share with anyone that you were a participant, and data from this phase of the project will only be shared in the aggregate. You will have the choice

of not answering any questions and you can stop the interview at any time. The final transcript and data from the interview will not contain your name, the name of your organization, or any potentially identifying information about you. Your email will only be used to keep you informed on progress and findings of the study, should you want to stay updated, and to send you a gift card should you opt to receive one electronically. Providing a mailing address is only required if you would like a physical gift card, and if provided, your physical address will only be used to distribute the gift card.

WHAT ARE THE BENEFITS?

We hope the results of this study will help to identify areas of alignment between producers and consumers, as well as to showcase the complexities and difficulties that producers navigate every day. Ultimately we hope to help build trust between producers and consumers, and grow public understandings surrounding animal agriculture.

## *7.5 Q Sort Note Template*

**NOTES — INTERVIEWER 1 or INTERVIEWER 2** [Each interviewer should fill this in as soon as possible after the interview. If there are two interviewers, fill in your own post-interview notes separately, and then add them here.]

**Chronological notes**

- **Demographics and operation information – "can you tell me briefly about yourself and your operation?"** ***Operation details such as size, geography, species, age, primary customers, etc.***
    - [Add notes here]

- **Pre-sort notes –** ***particular attention given to conversation of drivers and other important reactions to Q statements***
    - [Add notes here]

- **Q sort notes –** ***particular attention given to conversation of drivers and other important reactions to Q statements***
    - [Add notes here]

- **Post-sort notes; general reflection – "what did you think?"**
    - [Add notes here]

- **Post-sort notes; highest priorities – "Looking at these 4 columns, or your highest priorities, what drives this prioritization?"**
    - [Add notes here]

- **Post-sort notes; lowest priorities – "Looking at these last four columns, or your lowest priorities, what drives this ordering?"**

    - [Add notes here]

- **Post-sort notes; removing drivers – "In an ideal world, and keeping within this grid, without any of these influences putting pressure on you, would you have sorted these priorities differently?**
    - [Add notes here]

- **Wrap up notes – " Is there anything else you would like to share before we wrap up today?"**
    - [Add notes here]

**Operational notes**

- **What worked or did not work in this interview?**
    - [Add notes here, can be in paragraph form or bullet points. Does not need to be extensive, but make sure all notes are descriptive enough that others can interpret on their own.]

- **Do we need to make any changes to the interview guide, interview techniques, or terminology?**
    - [Add notes here]

**Analytic notes**

- **Drivers – thoughts on/synthesis of drivers discussed during the interview.**
    -

- **Anything else? (Thoughts on how this participant might be similar or different from the rest? Compelling quotes, or new terminology? Anything surprising? Any insights that connect to other parts of the project? Anything you want to draw the team's attention to at the next debriefing?)**
    - [Add notes here]

## *7.6 General Factor Characteristics*

| | No. of Defining Variables[1] | Avg. Rel. Coef.[2] | Composite Reliability[3] | S.E. of Factor Z-Scores | Eigenvalues | Explained Variance (%) |
|---|---|---|---|---|---|---|
| **Factor 1** | 16 | 0.8 | 0.98462 | 0.12403 | 12.10666 | 32 |
| **Factor 2** | 7 | 0.8 | 0.96552 | 0.1857 | 3.54681 | 9 |
| **Factor 3** | 13 | 0.8 | 0.98113 | 0.13736 | 3.01914 | 8 |

[1]Number of Q sorts that significantly loaded ($p < 0.05$) onto each factor
[2]Measure of accuracy
[3]Measure of internal consistency