Animal Welfare and Environmental Stewardship Decision-Making Among U.S. Animal Producers: a Qualitative Analysis

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Abstract

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Animal agriculture remains an integral part of the U.S. food supply; as demand for animal products grows, it is essential to explore avenues for sustainable animal production across societal, environmental, and economic domains. Using Q-methodology and qualitative methods, this study examined the drivers and tradeoffs of priorities regarding animal wellbeing and environmental stewardship among 35 U.S. beef, pork, and broiler producers. The study found that each producer operated under a unique context of influences; key drivers of decision-making included *personal, operational viability, consumer, and regulatory*. *Operational viability* and *personal* drivers influenced tradeoffs to sustainability, however, some producers maximized multiple domains of sustainability by capitalizing on synergistic relationships between priorities. This study captures the subjective experiences of beef, pork, and broiler producers, highlighting the complexity of drivers and tradeoffs within and between domains of sustainability, predicts increased challenges to sustainability as demand for livestock products grows and offers potential leverage points among producers for effective policy interventions.

Table of Contents

1.0 INTRODUCTION

Livestock and poultry production operations in the United States produce affordable, nutrient-dense protein sources while providing income and employment to rural communities nationwide (Zhang et al., 2021). As demand for meat grows, it is essential to consider sustainability and its components (i.e. economic, environmental, and societal) in animal production. Meanwhile, consumers and industry players are placing increasing pressure on animal producers to improve their sustainability practices, forcing producers to navigate a complex decision-making landscape to remain economically viable (Cisneros-Saguilán et al., 2015; Mckendree et al., 2018). Specifically, as animal production systems strive to meet increasing consumer demand for meat and at affordable prices, coupled with increases in the costs of inputs such as animal feed and fertilizer, there may be greater tradeoffs for producers among components of sustainability such as animal wellbeing and environmental stewardship (Herrero et al., 2009). To move toward agricultural systems that can balance multiple dimensions of sustainability, it is essential to understand the current influences that drive how producers prioritize sustainability practices in their operations and make tradeoffs. This analysis employed qualitative methods to contextualize the complex animal producer decision-making space by identifying key drivers and tradeoffs regarding animal wellbeing and environmental stewardship.

1.1 Background

1.1.1 Patterns of Meat Consumption in the United States

By 2050, global demand for animal products is expected to double as economies grow and populations urbanize (Herrero et al., 2009). In the U.S., consumption of beef, pork, and chicken is among the highest in the world (Beale et al., 2023); the U.S. is the world's largest consumer of beef and poultry and the third-largest consumer of pork. In 2019, U.S. consumption of beef, pork, and broiler products averaged about 100 kg per capita (Raihan, 2023; USDA ERS, 2021). Additionally, consumption is widespread; a 2021 study of NHANES data on dietary recalls found that each day, 79% of U.S. residents consume red or processed meat. Most Americans purchase their meat from the grocery store, followed by fast-food outlets (Zeng et al., 2019).

Patterns of meat consumption in the U.S. are deeply connected to and driven by cultural traditions, foodways, and across ethnic groups and socioeconomic statuses, making meat a product with stable demand (Ellithorpe et al., 2022; Zeng et al., 2019). Between 1999 and 2016,

per capita consumption (by mass) of processed meat remained unchanged and consumption of unprocessed red meat declined (340 grams/week in 1999-2000 versus 282 grams/week in 2015-2016) (Zeng et al., 2019). Despite the consumption decrease, beef remains the most consumed category of red meat, followed by pork (Zeng et al., 2019). Consumption of red meat is largely being replaced by broilers, due to lower prices than red meat and rising consumer health concerns over red meat consumption (Frank et al., 2021); poultry consumption increased between 1999 and 2016 from 256 grams/week to 303 grams/week. According to 2016 NHANES data, total mean meat consumption (unprocessed red meat, processed meat, and total red and processed meat) in the U.S. was higher among men than women, low education (high school equivalent or lower) versus middle (trade or college certificate) or higher education (university degree or higher), and middle wealth versus high or low wealth (divided as tertiles of self-reported household income) (Frank et al., 2021). Such immense production and consumption of animal products in the U.S. requires high levels of resources and inputs, thus, the role of animal production in sustainability is a widely discussed topic in research and popular media.

1.1.2 Beef, Pork, and Chicken Production in the United States

The United States is a major global producer of animal products, including beef, pork, and poultry such as broiler chickens (USDA, 2023). Domestic production has risen steadily over time to meet demand; and, advances in production efficiency, traceability, and food safety certification standards have allowed meat products in the U.S. to remain safe, affordable, and nutritious sources of protein for consumers. U.S. farms, defined as operations intending to sell $1,000 or more of agricultural products in a year, totaled 2.1 million in 2012 and operated on 910 million acres of U.S. land (almost 37% of total U.S. land) (USDA, 2017). Of those operations, almost half (913,246) have cattle and calves, over 63,000 operations had hogs and pigs, and 164,099 (2017) had poultry and eggs. In 2021, production of beef, pork, and broilers generated over $132 billion USD in gross income, representing almost a third of all annual agricultural commodity cash receipts in the same year (USDA, n.d.).

1.2 Defining Sustainability in Animal Agriculture

Many definitions of sustainability have been conceptualized, varying by context and application (Smith and McDonald, 1998). In the U.S., the United States Department of Agriculture (USDA) offers a definition of sustainable agriculture as “an integrated system of plant and animal production practices having a site-specific application that will, over the long-term (A) satisfy human food and fiber needs; (B) enhance environmental quality and the natural resource base upon which the agriculture economy depends; (C) make the most efficient use of nonrenewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls; (D) sustain the economic viability of farm operations; and (E) enhance the quality of life for producers and society as a whole,” (7 U.S. Code § 3103 (2006)). Although no standard definition or metric for sustainability exists, sustainability in animal agriculture is largely accepted as emphasizing efficient production while achieving all three pillars of sustainability including social, environmental, and economic (Creemers et al., 2019; Smith and McDonald, 1998; Zhang et al., 2021).

The economic pillar of sustainability includes viability and resilience measures such as profitability, labor availability, risk aversion, and land access and succession planning (Smith and McDonald, 1998; Zhang et al., 2021). The social pillar of sustainability is related to human wellbeing, including such dimensions as rural quality of life, community engagement, or labor issues; food and health indicators such as food affordability, nutrition availability, and responsible antibiotic use; and animal wellbeing. Animal wellbeing can be conceptualized by Fraser's framework of animal welfare: animal health (freedom from disease and injury), expression of natural behavior (ability to lead reasonably natural lives), and experience of affective state and feelings (pain, distress, and pleasure) (Fraser, 2008; Smith and McDonald, 1998; Smyth and Dumanski, 1993; Zhang et al., 2021). The environmental pillar of sustainability is commonly defined as the development of a production process that is compatible with natural ecological processes. In the United States, environmental sustainability practices vary widely by operation location, size, and type of protein produced (Herrero, 2009). Many overlapping metrics for measuring sustainable agriculture have been proposed in the literature, and common environmental sustainability measurements include resource use such as water, energy, and nitrogen fertilizer, pollution metrics such as carbon emission or sequestration, water pollution, and air quality, and stewardship indicators such as soil health, land use, and biodiversity conservation (Smyth and Dumanski, 1993; Smith and McDonald, 1998; Zhang et al., 2021). Applications of sustainability as a framework vary by context, with some applying sustainability as an outcome or goal of agriculture, with others applying it as a framework or ideology guiding agricultural methods (Smith and McDonald, 1998; Zhang et al., 2021).

According to Zhang et al. (2021), the agricultural sector in the United States currently scores well in sustainability measures, overall operating in the "green", indicating a "safe operating space" regarding sustainability. Areas of the U.S. agricultural sector that need improvement include social dimensions such as food affordability, undernourishment, and gender equality, environmental indicators such as soil erosion, land use change, nitrogen surplus, and GHG emissions, and economic indicators such as price volatility and trade openness (Zhang et al., 2021).

1.2.1 Environmental Stewardship Challenges for Animal Producers

While production of animal products generates nutrient-rich food sources for human consumption, it requires considerable resources; the United States is the second-largest contributor to overall GHG emissions, emitting 7.7% of total global emissions in 2019 (World Bank).The agriculture sector accounted for 9.4% of total GHG emissions in the U.S. in 2021, the second largest emitting sector behind energy use (EPA, 2023). Nitrous oxide emissions accounted for 49.2% of sector emissions in 2021; the agricultural activities that contribute to the majority of nitrous oxide emissions are soil management related to fertilizer application and other activities that increase available soil nitrogen (EPA, 2023). Additionally, enteric fermentation related to the anaerobic digestion of carbohydrates by ruminant animals, such as beef cattle, produce the potent GHG methane. Compared to other domestic animal types, beef and dairy cattle were the largest producers of methane; beef were the largest contributors to methane emissions by enteric fermentation in 2021 (71%) (EPA, 2023). Other contributors to methane emissions come from management of liquid manure from pig operations, with greater

emissions coming from confinement-based operations (EPA, 2023). Though contributing less methane and nitrous oxide emissions from manure management overall than beef and dairy cattle, poultry and swine make up the third and fourth largest emitters of any animal type; beef and swine make up the highest and third highest emitters of methane due to enteric fermentation, respectively (EPA, 2023). Other environmental challenges to animal agriculture include water pollution from manure and fertilizer management, land use change and deforestation, and poor air quality.

Due to the size of their environmental footprint, animal producers are faced with new regulations or pressures to change their practices to fulfill environmental sustainability goals. However, environmental stewardship is an essential component of the management techniques of animal producers (Campbell and King, 2022). Practices exist that both improve production and preserve the natural environment, and producers are constantly improving. For example, genetic selection has improved feed efficiency in meat animals, decreasing finishing times while requiring less inputs; management-intensive rotational grazing allows animals ample space and preserves grassland ecosystems, cover cropping reduces feed costs and erosion, and managing manure provides an alternative to expensive fertilizer that might runoff into nearby waterways (Campbell and King, 2022). The U.S. agricultural sector has shown improvement to sustainability measures over time in areas such as phosphorus surplus–meaning less excess phosphorus is deposited into nearby waterways or soil, causing environmental damage such as algal blooms (Van Staden et al. 2022)–water use, and soil erosion. This indicates that producers are prioritizing sustainable practices on their operations (Zhang et al., 2021). Further, inputs per unit of beef production have decreased over time: producing an equivalent amount of beef in 2007 required 81% less feed and 67% less land than in 1977 (Schmiess and Lusk, 2022). Similarly, greenhouse gas (GHG) emissions per kilogram of live weight broilers produced decreased by 19% from 1981 to 2006 (Schmiess and Lusk, 2022). Modern confinement-based indoor pork production systems are notably less damaging to the soil than outdoor systems, although their use is debated in animal welfare discourses (Schmiess and Lusk, 2022).

1.2.2 Animal Wellbeing Challenges for Animal Producers

Even as production has increased and intensified over time, animal welfare has always been a priority of animal producers in the United States. However, consumers, policy makers, and producers struggle with consensus on a definition of animal welfare that fulfills both science-based approaches and personal values, both of which are not mutually exclusive (Fraser, 2008) For example, there are ongoing debates in the United States about the appropriateness of open sow housing, which allows pregnant sows space to socialize and move around, which may fulfill dimensions of animal welfare such as affective states and feelings (both positive and negative) and natural behavior, but may come with tradeoffs compared to single-sow gestation stalls that protect the animals from vice behaviors and violence (Fraser, 2008). These debates extend to broiler production (e.g., optimal stocking density, breed choice, or litter quality) (Bracke et al. 2019; Lusk, J. 2018) and beef production (e.g., raising animals in a paddock versus pasture) (McKendree et al., 2018).

Further, misalignment exists between consumers' vision of ideal animal production practices and practices that are effective and feasible for producers to adopt (McKendree et al., 2018; Vanhonacker et al., 2007). Both producers and consumers value animal welfare but it may be conceptualized differently; producers may tend to focus on Fraser's pillar of animal health, linking animal health with productivity or profitability while consumers may focus on pillars such as the affective states and natural behavior of the animal, though this varies widely by producer and consumer (Buddle et al., 2021; Creemers et al., 2009; Hansson et al., 2012; Velde et al., 2001).

Despite growing industry pressure for producers to change practices to accommodate en vogue sustainability goals, little is known about the influences behind the decision-making process U.S. animal producers employ to prioritize animal wellbeing, environmental stewardship, and balance the resulting tradeoffs (Creemers et al., 2019; McKendree et al., 2018).

1.3 Drivers Related to Animal Producer Decision-Making

Willock et al. (1999) highlighted that farming is a unique vocation, as farms are businesses where decisions are often made by a single person and yet more influenced by external factors, or drivers, than other jobs. Drivers in this analysis are defined as motivations or factorsthat influence producer decision-making. Producer decision-making has previously been conceptualized as a combination of behavioral (e.g. Theory of Planned Behavior (Despotovic et al. 2019)) and contextual factors (Farstad et al. 2022) that interact to generate action. For example, Darnhofer et al. (2010) and Farstad et al. (2022) write that producers must navigate between economic, social, and agro-ecological pressures, coupled with internal drivers such as personal preferences, values, and risk aversion in an attempt to sustain a viable income balanced with an adequate quality of life for themselves and their families. Individual farms contain social capital (e.g. abilities, knowledge, preferences, goals, relationships) and physical capital (e.g. land, animals, equipment) that impacts broader systems of sustainability (Darnhofer et al. 2010). Individual producers are ultimately the sole decider of their farm business priorities; thus, as drivers funnel through producers' mental interpretive frameworks, it is essential to understand the full context of the influences on decision-making when designing interventions that seek to improve sustainability on operations.

The drivers of interest in this analysis come from a review of the literature and include *economic, personal, regulatory, consumer, industry/buyer, and operation/brand* (see Appendix 6.5 for definitions of each driver). These drivers have been well documented (Castonguay et al., 2023; Buller et al. 2018; Pereira et al. 2016; Sabate and Sabate, 2019; Stringer et al., 2008, 2020) as relevant influences on decision-making, albeit with varying categorizations and combinations. For example, Stringer et al. (2020) conceptualized drivers (referred to as "imperatives") under the three pillars to sustainability (defined as environmental, socio-cultural, and economic profitability). Farstad et al. divided drivers of climate mitigation adoption among producers into "internal drivers" (e.g. personal motivations, climate consciousness), and "enabling contextual conditions" (e.g. farm continuation, economic, subsidy schemes, geography conditions, and available time).

1.3.2 Tradeoffs Related to Animal Producer Decision-Making

Influenced by competing drivers, the decision-making process for producers when prioritizing sustainable farming practices is complex and rife with tradeoffs. Defined as compromises made on an operation, tradeoffs occur in agriculture when land is managed with multiple objectives and goals, and particularly when resources are constrained. Tradeoffs can occur at all levels of agricultural systems, for example, where individual actors must balance short-term productivity with long-term sustainability (Klipwijk et al., 2014).

As demand for livestock products increases in conjunction with a changing climate, existing tradeoffs between or within the three domains of sustainability will likely increase. For example, land-management techniques of large-scale farms that capitalize on economies of scale efficiencies have been criticized for the environmental tradeoffs: heavy use of agrochemicals, machinery, and irrigation can degrade the soil, increase emissions, and harm human health and societal interests (Saguilan et al., 2015; Stringer et al., 2020). Castonguay et al. (2023) describe more complex tradeoffs: for example, economic costs can be minimized by raising cattle on marginal, low-value land (extensive grazing systems); however, these lands produce less and lower quality forage which increases emission intensity through animals consuming more roughage than with a higher quality feed (Herrero et al. 2013). Schmiess and Lusk (2022) describe tradeoffs between environmental stewardship and animal welfare; for example, practices that intensify production (gestation crates, feedlots, battery cages) reduce environmental impacts but come at the cost of animal welfare, illustrating that tradeoffs can occur both within agriculture systems and between larger environmental and social dimensions of sustainability (Klipwijk et al., 2014).

1.4 Significance - The Use of Q-Methodology to Explore producer Decision Making

The objective of this analysis is to apply rigorous qualitative methods to a Q-Sort analysis to enable a deeper understanding of drivers and tradeoffs within producer decision-making, specifically regarding animal wellbeing and environmental stewardship. While there is a large body of literature that utilizes quantitative methods to assess the impacts on sustainability of animal production, less is known about the subjective experiences of producers as they attempt to prioritize practices in their operations that optimize sustainability (Creemers, 2009; Kauppinen, 2010). The principal research questions behind this analysis include: *what are the drivers of animal wellbeing and environmental stewardship priorities among beef, pork, and broiler producers in the United States and how do they influence producer priorities? What are the tradeoffs when balancing these drivers?* Q-methodology allows for a comprehensive answer to these questions (see Damio, 2016); this analysis utilized qualitative methods to analyze 35 semi-structured interviews collected as part of a Q-methodology mixed methods study on sustainable animal agriculture practices in beef, pork, and chicken producers of diverse sizes (Janzing N. 2023).

2.0 METHODOLOGY

2.1 Recruitment of Participants

Recruitment of participants (n=42) took place in early 2023 as part of a larger Q-sort study. To maximize variation in opinions and perspectives, we aimed to recruit participants from broiler,

pork, and beef producers of very small, small, medium, large and very large scale and based in the United States (see Appendix 6.2 for definitions of operation scales). Purposive and snowball sampling were used to achieve a range of producer types. Participants were compensated $100 each. Of the 42 participants who were consented to participate, three participants were excluded due to working for the same operation and one participant was excluded due to not actively producing animals. The final analysis included 35 participant Q-sorts.

2.2 Q-Methodology

William Stepheson introduced Q-methodology in 1953, employing it as a novel mixed methods approach to capture subjectivity within a topic (Stephenson, 1953). Utilizing a combination of rank ordering exercises and Principal Component Analysis, Q-methodology identifies the consensus and disparities concerning discourses of interest, i.e., the worldviews and perspectives of individuals (McKeown & Thomas, 1988). Prior application of Q-methodology among producers showcases striking variation among the attitudes, values, and beliefs (Davies et al., 2007; Mann et al., 2019; Pereira et al. 2020), though none to our knowledge have focused on tradeoffs in sustainability.

In this study, each participant completed a sorting exercise of 38 statements related to environmental and societal sustainability, including animal wellbeing. See Appendix 6.3 for list of statements. Each Q-sort interview was conducted via Zoom by one or two researchers.To describe variation among the sample, select demographic information and characteristics of producers' operations were collected in the pre-Q-sort interview including role on operation, experience farming in years, geographic location (state), number of species raised, and primary market outlet. Before the sorting exercise began, participants were prompted in the Zoom chat with a list of six potential drivers of their decision-making listed as, *"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), and economic (i.e., pertaining to the need to be financially stable, being viable)".* Drivers were compiled from various sources including key informant interview themes and a review of the literature (see Castonguay et al., 2023; Buller et al., 2018; Stringer et al., 2008, 2020). The list of drivers were noted by the interviewer as starting points for producers to think about, add to, or expand on when completing the Q-sort and interview. The six drivers were listed a second time on the Q-Software screen after the pre-sort exercise. Each participant sorted 38 statements from "higher" to "lower" priority on a grid, forcing the statements to be ranked against each other. The condition of instruction is as follows, *"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."*

2.2.1 Semi-Structured Interviews

Following the Q-Sort activity, a 4-question, post-sort interview was conducted. See Appendix 6.4 for an interview guide. Participants were asked open-ended questions about their experience sorting the Q-set, to expand on the drivers that influenced their sorting decisions, and to

consider how their prioritization would have changed without any constraints. Question 1 asked for an open-ended reply of initial reactions to the Q-sort exercise: *"So what did you think?"*. Question 2 reiterated the six drivers emphasized in the beginning of the interview and then asked explicitly what drives the higher prioritization of statements in their last four columns of the sort: *"Looking at these 4 columns, or your highest priorities, what drives this prioritization?"*. Question 3 asked for the influence of the same drivers on the lower prioritization of statements: *"Looking at these last four columns, or your lowest priorities, what drives this ordering?"*. Finally, Question 4 asked for producers to describe their hypothetical ideal prioritization of the Q-set in the absence of external 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?"*. If necessary, each question was followed by probes that asked for producers to describe drivers of their decision-making or additional reasons for their decisions not included in the provided list of six drivers. The semi-structured interview format allowed producers to openly share the influences and tradeoffs of their decision-making, allowing the interviewers to both explore emerging topics and probe for drivers. Producers were asked explicitly what drove their higher and lower priorities in the latter half of the interview; however, some drivers were implied by producers (see Appendix 6.6 for a distribution of drivers). Recorded interviews were de-identified and transcribed using Microsoft Word's transcription feature. Each Q-sort lasted between 50 and 90 minutes. Final transcripts were edited for readability, including inserting punctuation to reflect pauses in speech and removing duplicate words.

2.2.2 Quantitative Data Analysis

The 38 Q-sorts were analyzed quantitatively using R Software Package "Q-Method" and Principal Component Analysis (PCA) which mathematically grouped similar producer sorts into three groups, or factors. 35 loading significantly onto one of three "factors" or groupings of producers with similar Q-sorts. Three Q-sorts showed affinity for more than one factor and were excluded from further analysis. See below for the Q-board in which producers ranked each statement, and the resulting composite sorting grids for each factor.

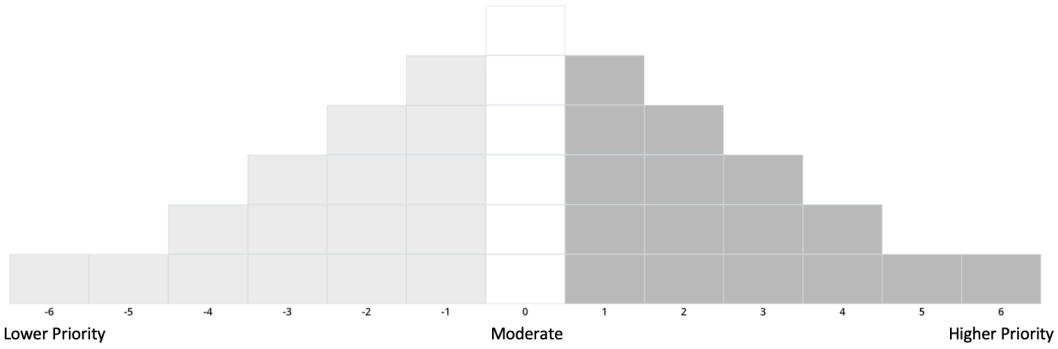


Figure 1: Example Q-sort grid

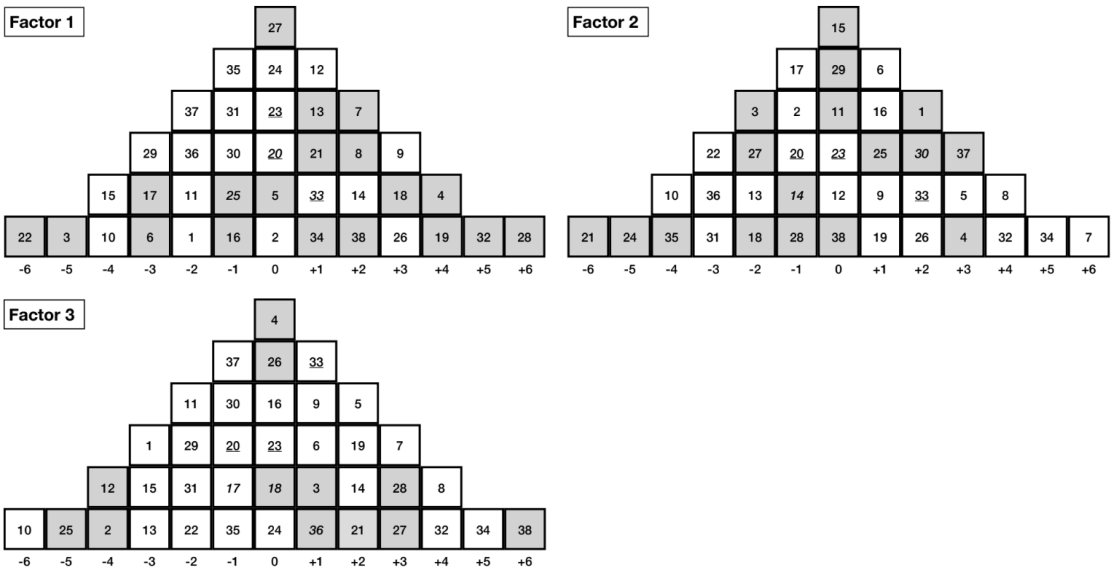


Figure 2: Composite Q-sorts for each factor
Grayed boxes represent *distinguishing* statements and those that are underlined represent *consensus* statements. Column +6 contains the statement that was the highest priority, while column -6 contains the statement that was ranked as the lowest priority. 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 represent the same factor score.

To interpret the discourse suggested by the composite ranking of statements for each factor, I employed qualitative methods to contextualize producers' sorting decisions within the content of the semi-structured interviews and identify the drivers that influenced their priorities.

2.3 Qualitative Analysis in Q-Methodology

There is no consistent nor detailed methodology for rigorous qualitative analysis of Q-sort interview data (Boom, 2021; Damio, 2016; Davies and Hodge, 2006; Periera, 2016). Qualitative data from the post-sort interviews in the form of text excerpts are often provided to support the groupings of participants into "factors" that represent shared worldviews. However, descriptions of qualitative methods, such as coding methods, theory, or thematic analysis are typically not included in published Q-Sorts. By utilizing qualitative methods to interpret the complexity of the decision-making space for animal producers regarding environmental stewardship and animal wellbeing in this Q-Sort, this analysis extends the capacity of Q-methodology by refining the application of these methods to Q-Sort data.

2.3.1 Rigor in Qualitative Analysis

Rigor is supported in qualitative analysis through transparency and reflexivity on behalf of the research team of the goals and processes in analytic decision-making and results (Grodal et al., 2021). As researchers sift through rich and layered qualitative data, decisions need to be made

to generate insights and overarching themes that may be merged, dropped or split. Several methods have been used to guide decision-making in qualitative analysis. In 1989, Guba and Lincoln outlined what are now widely accepted criteria for rigor in qualitative analysis including credibility, transferability, dependability, and confirmability.

Credibility is similar to internal validity in quantitative research, and can be defined as an expectation that results are accurate and true to participants and critical readers. In this analysis, credibility was achieved through triangulation of qualitative findings with the quantitative Q-sort findings (e.g. how do the results of qualitative analysis support or contradict the suggested discourses of the Q-Sort Factors regarding consensus and divergent priorities of animal wellbeing and environmental stewardship among producers?), peer debriefing among investigators about coding decisions and theme generation, detailed audits about analysis decisions, and reflexivity memos that confront researcher bias with the content of the qualitative data. *Transferability* is similar to generalizability, and can be defined as the ability to take the results derived from a specific population and apply them to a similar setting. This analysis is not intended to reveal universal truths, rather, transferability is the extent to which the results can be applied to other settings and contexts. In this analysis, facilitation of transferability consisted of rich descriptions of the time and context of the analysis in the form of an audit trail and detailed memos and descriptions of respondent characteristics (Appendix 6.1). *Dependability* is similar to reliability, and can be defined as an expectation that the methods and logic guiding analysis were consistent, stable, and clear. This was achieved by documenting the rationale and consistency for participant selection, data collection, and data analysis. An audit trail was kept in the form of field, coding, and analysis notes. Codes were developed so that coding decisions are the same between coders using any piece of text (Morse et al., 2015). To achieve this, double coding took place between two investigators in five transcripts, representing 13% of the sample. *Confirmability* is similar to objectivity, and is described as the ability to be confirmed by outside sources or participants. While member checking did not occur in this analysis, confirmability was supported through a detailed audit trail that outlines the steps of analysis and reflections by the research team (Williams and Kimmons, 2022).

2.3.3 Reflexivity Statement

This research project is based at the University of Washington in Seattle, Washington, and ultimately seeks to improve trust between animal producers and consumers by understanding the drivers and decision-making of animal producers. The author, MF, is oriented in the context of this study as an educated, white, cis-gender woman who grew up in a rural community in a northwestern state. MF has spent most of her adult life in Seattle. This is her first project working with animal producers.

2.3.4 Qualitative Coding

Though this was not a grounded theory analysis, the following steps of open and focused coding as a method to reduce qualitative data into themes aligns with methods used in grounded theory (Charmaz K., 2006). Coding began with a phase of open coding, followed by two phases of focused coding, and then a joint analysis that considered quantitative data from a study described elsewhere (Janzing N. 2023). With the aims of the analysis in mind, and based

on a review of the literature on the topic, an initial codebook was drafted with definitions and descriptions for each code based on existing conceptual frameworks of social and environmental sustainability, predefined drivers, and post-sort interview questions. Refer to Appendix 6.5 for the final codebook with code descriptions. Coding decisions and codebook changes were documented in detail in an audit trail and peer debriefed between two investigators. Each transcript was coded using Dedoose software. To achieve intercoder reliability, a subset of five interviews were co-coded by two investigators. After the codebook was refined, each transcript was fully read and coded in a first phase referred to as “open coding,” a common method employed in qualitative analysis (see Flick, 2021, pg. 153; Charmaz, 2006, pg. 47). During this phase, codes were split, added, merged, or refined inductively. For example, codes that emerged during open coding include, “general ethos”, “inapplicable”, “geography”, “Driver: Animal Wellbeing”, “Driver: Environmental Stewardship”, “operational resilience”, “Driver: Operational resilience”, and “Synergies.” Some initially emergent drivers were ultimately merged with one another or with other codes, see section 2.3.8.

When codes were changed or added, transcripts were re-coded to reflect the new codebook in its entirety. Applying codes allowed researchers to form connections between interviews regarding drivers of priorities on their operations, tradeoffs, as well as other salient themes. Detailed notes were taken during coding for each transcript. Periodically, notes and memos were created during open coding and after open coding was completed, providing a useful resource for identifying emerging themes, and referred to in other phases of analysis (Tolley et al., 2016).

2.3.5 Focused Coding, Phase One

After the open coding phase, I reread each transcript, taking new notes, adding codes to excerpts, and generating new themes using the constant comparison method (Glaser and Straus, 1967) where themes found in open coding were repeatedly cross-checked with the discourses suggested by the Q-sort factor groupings, distinguishing statements (Q-set statements sorted significantly differently between factor groups), and the body of literature related to the topic (e.g. antibiotic use or USDA processing regulations). Themes within each transcript were compared within and between the factor group they loaded onto as a way to refine the discourse suggested by the factor’s composite Q-sort, providing essential detail not available through quantitative data alone. For example, statements that were ranked as low priorities for a factor may not have been ranked low by all producers in that factor. Excerpts were pulled out throughout focused coding that illustrated overall themes found in each transcript into a data reduction matrix that grouped characteristics of interview by factor and was used to begin organizing and distilling coded excerpts, sorted by keywords and factor (see Tolley et al., page 206 for example). When necessary, the raw data (interview transcripts or audio recordings) were checked for accuracy.

2.3.6 Focused Coding, Phase Two

After the first phase of focused coding, coded excerpts for each transcript were pulled from Dedoose software into a data reduction matrix (one for each code) and analyzed for patterns

and themes between participants and factors. The themes and patterns revealed from the coded excerpts were then compared to (1) the initial themes found in open coding of the entire interview transcript, (2) the focused themes found in Phase One that consider the factor discourses and the entire interview transcript, and (3) the themes of each discourse as suggested by the quantitative analysis. This was accomplished using principles of constructivist grounded theory and constant comparison where MF distilled qualitative data into smaller and smaller buckets that reveal patterns, noting areas of convergence or divergence on a topic, to draw conclusions about the viewpoints of the producers in the sample. For example, each excerpt for a code was summarized into keywords that could be easily compared across interviews and factor groupings. This comparison revealed the drivers of priorities reflected by sorting decisions and tradeoffs between those priorities.

2.4 Mixed-Methods Analysis

2.4.1 Mixed Methods Integration

As used in typical Q-methodology, qualitative analysis allowed for the identification of illustrative quotes that support or refute the discourse suggested by each factor grouping (i.e. characterized by quantitative data such as distinguishing and consensus statement scores in each factor) (Damio, 2016; Davies and Hodge, 2007). Notably, the methodology suggested here expands upon the methods for qualitative analysis used in previous Q-methodology studies, utilizing the robust framework of qualitative methods to support and strengthen my conclusions about the subjective and complex discourses captured by Q-methodology (Boom et al., 2021; Damio SM, 2016; Davies and Hodge, 2006; Pereira et al., 2016). The results of the qualitative analysis were considered alongside the Q-Sort PCA to support and refine the conclusions of the Q-sort (achieving triangulation and complementarity) and clarify the findings (achieving expansion) (see Tolley et al., 2016).

2.4.2 Mixed Methods Analysis

During focused coding, excerpts were pulled that included statements, labeled as “S1”, “S2”, “S3”, and so on, that were ranked “high” and “low” statements (defined by factor score of +6 to +4 and -6 to -4, respectively; see Table 1), and any distinguishing or consensus statements within those high or low rankings. Additionally, all text coded with drivers codes, tradeoffs, and synergies were analyzed. Distinguishing statements in each factor’s composite Q-sort array are defined as those statements that were sorted similarly by most participants of one factor, but were sorted significantly different (p-value < 0.05) by the participants loaded onto the remaining factors, and thus considered to be particularly reflective of the discourse between each factor. Consensus statements are defined as statements sorted in similar positions across all three factors, and thus are considered shared opinions between the factor discourses.

Table 1: Q-sort statements analyzed in focused coding

Q-Sort Statements*	Factor 1 score, categorization	Factor 2 score, categorization	Factor 3 score, categorization
S28; Ensuring animals are respected and happy.	**+6†, high**	-1	3

S32; Ensuring the health of animals.	**+5†, high**	+4, high	+4, high
S4; Preventing animal illness.	**+4†, high**	+3	0
S19; Ensuring comfortable living environments for the animals.	**+4†, high**	+1	+2
S3; Reducing carbon emissions.	**-5†, low**	-2	+1
S22; Increasing renewable energy use.	**-6†, low**	-3	-2
S21; Raising animals not in confinement.	+1	**-6†, low**	+2
S24; Giving animals more space.	0	**-5†, low**	0
S35; Preventing farm land from being lost to development.	-1	**-4†, low**	-1
S38; Maintaining the quality of soil.	+2	0	**+6†, high**
S2; Minimizing animal finishing times.	0	-1	**-4†, low**
S12; Practicing the responsible use of vaccines and antibiotics.	+1	0	**-4†, low**
S25; Training employees to prioritize proper animal handling.	-1	+1	**-5†, low**
S7; Providing nutritious food to consumers.	+2	+6, high	+3
S34; Stewarding the land and natural resources.	+1	+5, high	+5, high
S8; Building trust with consumers.	+2	+4, high	+4, high
S33; Increasing consumer understanding of farming operations††	+1	+2	+1
S23; Minimizing water pollution††	0	0	0
S20; Managing manure effectively and efficiently††	0	-1	-1
S15; Increasing energy efficiency	-4	0	-3

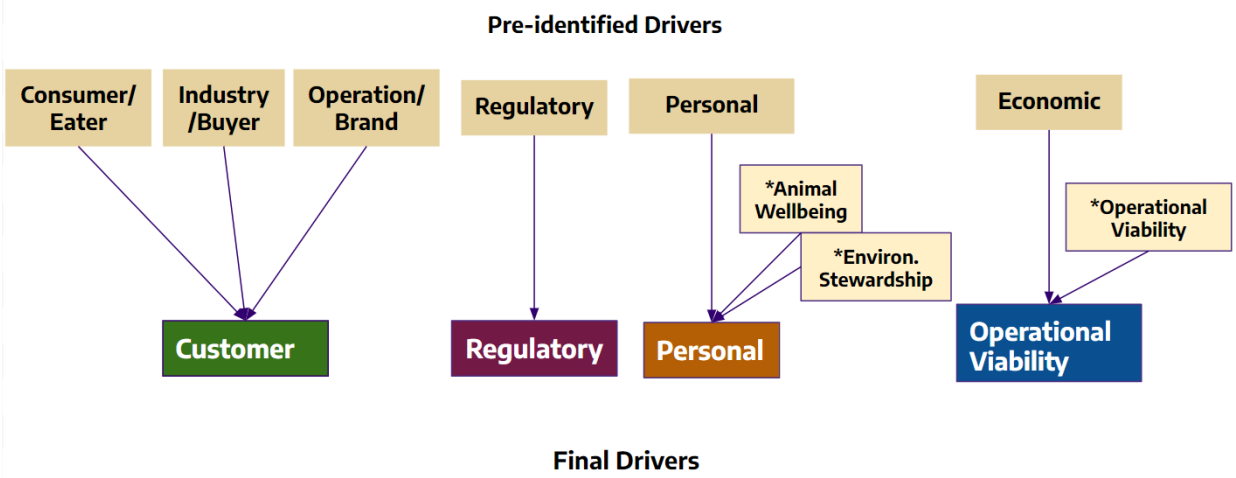
	low		
S10; Maintaining traditions in farming practices.	-4 low	-4 low	-6 low

Key: *"*"= Each q-sort statement served as a code in qualitative codebook "High"= statement ranked in top 3 columns of grid (factor score between +6 and +4); "Low"=statement ranked in lowest 3 columns of grid (factor score between -6 and -4); "†"= Distinguishing statements (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); "††"= Consensus statements (statements sorted in similar positions across all three factors, and thus are considered shared opinions between the factor discourses)*

2.4.3 Analysis of Drivers

The list of six predefined drivers–*economic, personal, industry/buyer, regulatory, operation/brand, consumer/eater*–were coded for as they emerged in the interview text. Some of the predefined drivers converged, meaning that their influences overlapped significantly. *Operational viability* emerged as a salient driver, providing an additional category of drivers of decision-making. Thus, all *economic* drivers were re-categorized as sub-drivers of *operational viability*. Additionally, *industry/buyer, consumer/eater*, and *operation/brand* drivers emerged as overlapping drivers and then re-categorized under a broader "*customer*" driver to encompass this overlap. Additional drivers called *animal wellbeing*, *environmental stewardship* were considered as additional influences of decision-making, however, these were ultimately merged with the *personal* driver upon further analysis. No other salient drivers emerged from the analysis, suggesting the predefined list was of high concordance to producers in this sample. Refer to Image 1 for a visual representation of how drivers merged.

Image 1: Pre-Identified Drivers to Final Drivers



** = Emergent drivers*

3.0 RESULTS

3.1 Description of Participants

35 beef, pork and broiler producer interviews were included in the qualitative analysis. Participants were located throughout the United States with a range of operation sizes and species. Operation sizes ranged from very small (1-9 AU) to very large (>1,000 AU). All were owners of their operation except for two who held managerial or director positions. Years of experience ranged from 1.5 years to over 50. See Appendix 6.1 for the full list of participant characteristics.

3.2 Summary of Factors

In a separate analysis described by Janzing (2023), each producers' Q-sort grid was quantitatively analyzed using the R software package "qmethod" and the research team retained three "factors," each representing a worldview shared by participants loading on that factor, that clustered similar grids together. All four very large producers, who all raised pork, in this sample loaded into Factor 2. In the results and discussion, operation scale or Factor grouping comparisons as relevant will be explicitly noted. Based on distinguishing statements and highest ranked statements for each factor that suggest their priorities, Factor 1 was titled, "Animal Husbandry, First and Foremost," Factor 2 was titled, "Business Sustainability: A Balancing Act," and Factor 3 was titled, "Environmental Stewardship, A Holistic Approach." See Table 2 for a summary of the Q-Sort Factors. "P" refers to the participants, each assigned a unique number identifier.

Table 2: Summary of Q-Sort Factors

Factor Name	Top 4 Prioritized Statements by Factor	Example Quotes
Factor 1: Animal Husbandry, First and Foremost (n=15)	1. Ensuring animals are respected and happy.	*"I'm always thinking about, especially in the winter, what could I do to make sure that they have plenty of space and get out of the mud and make sure they have enough food(...)like what can I do to maintain our brand and our morals and keep the animals happy?"* (P14, medium scale beef, very small scale pork)
	2. Ensuring the health of animals.	*"Our system is based around healthy animals. We need healthy animals for it to work right. If animals aren't healthy, then you're spending a lot of time on sick animals trying to get them healthy. You have to remove them from the group so that they don't get the other animals sick, they take extra care. So being preventative or being on top of it makes the system work and also saves money, right?"* (P06, small scale beef and broilers) *"I end up compromising my character if I place the health of my livestock below financial profit. And so for us as a family, we made a really big commitment to ourselves and*

		it's part of what has built such amazing trust with our consumers is that we're very transparent and honest, but we also are with ourselves(...) It's just not fair to watch my animals suffer just because my bottom line is going to suffer(...) I don't really feel like you should deserve to farm if your livestock's health isn't the number one priority." (P4, small scale beef, pork, broilers)
	3. Preventing animal illness.	*"I've seen a lot of animal illness in my time and when it does happen you kind of have to jump the gun and just get on top of it. From a calf that hits the ground to a calf that's 6 months old, You have to always be on top of it, or you could fail. And so it's top priority, no matter what."* (P21, medium scale beef)
	4. Ensuring comfortable living environments for the animals.	*"I just care very deeply on a psychic level, [I] connect with the pigs. We're very similar creatures and I really don't like to be uncomfortable."* (P10, small scale pork) *"[Ensuring comfortable living environments] is the reason I got into farming"* (P01, very small scale broilers).
Factor 2: Business sustainability; a balancing act (n=7)	1. Providing nutritious food to consumers.	"*Our mission is to provide nutritious food to a growing world. Pork is a very, very nutritious protein that has many of many nutrients that are not available elsewhere, So our mission is providing food."* (P11, very large scale pork).
	2. Stewarding the land and natural resources.	*"You better be a good steward, You better provide a nutritious product. You better build trust, otherwise you're not in the game. You're out of the game before you even do any of those other things."* (P19, very large scale pork) *"I put land stewardship and soil quality right up there in the very highest [priorities] (...)And land stewardship is just sort of the all encompassing thing we have to have(...) we don't have it obviously because we would have different behaviors if that was important. But I think about climate change now every single day. I didn't do that 10 years ago."* (P02, small scale beef, medium scale pork).
	3. Ensuring the health of animals.	"*[Ensuring the health of the animals] drives into a healthy product at the end of the day, it drives in to reduce antibiotic usage and it drives your overall viability to your business."* (P11, very large scale pork)
	4. Building trust with consumers.	*"I just think that generally the United States is missing integrity from its food system. When you go to any supermarket, but especially the "high end ones", [you are]*

		bombarded with an array of nonsense the moment you walk in the supermarket. These label claims that every package of meat or a package of anything looks like a NASCAR full of [advertisements](...)green circles that carry with them the connotation of wholesomeness and friendliness and it's utterly meaningless. (...)that's why it's so important to communicate your brand and your farm to your customers and they have to trust you as a creator of their food. Anyone doing anything remotely like I'm doing has to charge a lot more than the commodity food price to have a chance, and so for that to work, you need trust." (P40, large scale pork).
Factor 3: Environmental stewardship, a holistic approach (n=13)	1. Maintaining the quality of soil.	"*I put maintaining the quality of soil up at the I mean if there were an option here for improving the quality of soil that's what I would put at the very top because if we don't have good, vital, healthy soil we've got nothing."* (P31, very small scale beef and broilers)
	2. Stewarding the land and natural resources.	*"So I mean number one is the quality of the soil. I think there's nothing functions without healthy functioning soils so, it sort of is a nonstarter in my mind. There can't be any higher priority than that because there's no production without healthy soil and definitely not any profitable production on the scale that I'm at. I'm not going to compete on 5000 [acres] even if I wanted to, by just purchasing a bunch of inputs and juicing up things like that. So for me, it's just incredibly critical to have healthy soil, which, you know, buffers me on resilience and you know, weather patterns and things like that too. So to me, it's just where everything starts. So there's like that that was sort of a nonstarter for me. It was like it's immediately the top priority."* (P20, medium scale beef, small scale pork)
	3. Ensuring the health of animals.	*"Ensuring the health of my animals is definitely the highest priority because that is what the farm is there to do and to make sure that they're healthy and happy is the best outcome that I can get. I'm working to develop that goal as much as possible."* (P03, small scale beef, pork, broiler)
	4. Building trust with consumers.	*"I want people to trust what we're doing. It's that relationship with the customer. I do think that also has an effect on the farming decisions too, that if you have consumers that trust you then they're going to trust the decisions you make as farmers, too, so there can be less battles about that. So establishing that transparency is really important in the long term."*(P30, small scale beef,

		pork, broiler).

3.3 Summary of Drivers

When sorting their statements, all producers noted the value of animal wellbeing and environmental stewardship in efficient, sustainable animal production, but the drivers of these priorities varied immensely. A qualitative analysis of these sessions revealed four salient drivers of decision-making–*personal, operational viability, customer, and regulatory*–to be complex, interacting influences of operational priorities, illustrating that producers often arrive at the same priorities, or don't, due to varying contextual conditions on their operation. *Operational viability* and *personal* drivers emerged most often in the interviews, suggesting strong influence on decision-making; of the predefined drivers, *Industry/buyer* drivers appeared the least and in contexts that overlapped with consumer drivers, possibly due to several smaller scale producers in this sample who noted rarely interfacing with large scale intermediaries. The following subsections will explore each of these drivers in-depth, comparing their influence between operation scales and factors.

3.4 Personal Drivers

Personal drivers in this analysis referred to internal motivations, beliefs, goals, or values that influence the priorities of an operation. *Personal* drivers strongly influenced the priorities for most producers in Factors 1 and 3, and were a strong driver of active priorities for two producers in Factor 2. *Personal* drivers noted or alluded to in participant interviews included a deep desire for exemplary animal husbandry, land stewardship or the agrarian lifestyle offered by animal production, and a commitment to the sociocultural benefits of food production and consumer education. *Personal* drivers were informed by past experiences on animal operations, past careers outside of agriculture, or past educational experiences. Many producers considered their operations to be an outlet for achieving their personal philosophies for farming, in some cases willingly at the expense of profit or efficiency. For the four "very large" scale operations in Factor 2, *personal* drivers were notably less salient to their priorities than other operations in the sample.

P07, a very small scale pork and broiler producer in Factor 3, summarized the diversity and multifactorial nature of personal motivations that exist for farming animals, including raising animals with a high quality of life, high nutritional value, and low environmental impact, thereby creating a product that they personally want to consume, noting,

> *I raise food first and foremost because I'm raising food that I want to eat, and I'm raising meat animals not because I think that people should eat more meat, but I think that people should eat meat sparingly, and it should be of the very highest nutritional quality and the highest quality of life for the animal. Because that both seems like the morally correct thing to do, or the most humane thing to do, as well as the best thing to do for planetary health.* (P07; Factor 3; very small scale pork and broiler).

These personal "whys" for animal production were echoed by many producers in this analysis, showcasing how *personal* drivers can influence sustainability priorities.

3.4.1 Personal Drivers Influencing Exemplary Animal Husbandry

Animal health and wellbeing was a clear priority for producers in all factors, but was driven by varying influences; some producers viewed animal wellbeing as an avenue to achieve environmental stewardship priorities while others cared deeply about animal husbandry for its own sake, as a way to give meat animals the best possible life. Bolstering each of these views was the notion that animal wellbeing can help sustain operational viability as an outcome through ensuring a consistent, high quality product or fulfilling market or regulatory demands.

Many producers identified *personal* drivers for prioritizing exemplary animal husbandry, and for some this was the driver of their higher priorities such as *Ensuring animals are respected and happy* (S28), *Ensuring the health of the animals* (S32), *Preventing animal illness* (S4), and *Ensuring comfortable living environments for the animals* (S19). For Factor 1, animal wellbeing statements tended to be ranked higher relative to other statements than in Factor 2 or Factor 3, indicating a clear desire to care for their animals above all other priorities.
P01 described an interest in animal welfare as a driver to begin farming, as it was an outlet for their social advocacy goals,

> *I got into farming because of a very strong interest in animal welfare and specifically food animal welfare. I started out thinking I was going to be vegan and work for vegan advocacy, and then realized that actually the best way for me to get involved would be to raise animals myself and try and figure out how to do that in the most humane way possible.* (P01; Factor 1; very small scale broilers).

A goal for P28's small scale beef operation is to give the cattle a good life and a good death, stating, *"I do what I do because I love the cattle."* (P28; Factor 1; small scale beef)
When sorting the statement *Increasing production in resource efficient ways* (S5), P10 noted that their operation was driven by personal values of animal health, and they would not sacrifice these values for efficiency,

> *Efficiency is just not our top priority. It's like animal health and wellbeing, sustainability, customer happiness, farmer happiness. Of course, we don't want to be wasteful, but I just think the chase for efficiency, [the] chase for ever-increasing production with lower costs is how we got into this agricultural disaster in the first place, so I'm not willing to sacrifice my values on the altar of efficiency."* Later, P10 expands on their drivers of animal wellbeing on their operation, noting that *Providing optimal rations to animals* (S26) and ensuring animal comfort took up significant daily bandwidth, *"I just care very deeply like on a psychic level, I connect with the pigs, we're very similar(...) at the end of the day we are going to kill and eat these animals so they deserve to have the best possible life.* (P10; Factor 1; small scale pork).

When explaining why the statement *Ensuring animals are respected and happy* (S28) ranked as their number one priority, P34 pointed to personal preferences for respecting their animals. Absent of having a market to sell the meat, P34 would still raise animals, but notes that customer preferences also influence the need for respected animals,

> *The number one reason for that [ranking] is personal, and it's for me and my husband, but a close one that ties hand in hand is that my customers like that. The number one driver for that is that that's what my husband and I want. Even if we didn't have customers that were buying our meat, then we would still be doing this(...)We just like to*

have animals that are respected. (P34, Factor 1; small scale beef and pork).

P40 loaded into Factor 2 and ranked *Ensuring comfortable living environments for the animals* (S19) highly. They noted their personal connections to their animals' health,

> *I just feel like even though I think I'm [ensuring comfortable living environments] perfectly well, you can always be better. And taking care of the animals, if my pigs are not happy, then I'm not happy. I find that to be really true like consciously or subconsciously, if they're not happy, I'm not happy for one. If they're not happy, they're not healthy. I mean, it's just a raw economic reality.* (P40, Factor 2; large scale pork).

Later in their interview, P40 notes personal values for resisting supermarket pressure,

> *[C]apitalism tells us the free market has to decide everything. I think that's all backwards. I think the farmer has to know what kind of food they want to raise and that originates with your will. (...) I mean you have to have the will to do it right and, and for me, for some reason I have this vision out here of the way this farm should be, and I'm trying to communicate that to people who may share that vision and may want to taste it. So for me that's meat and that means animals, and that means we're going to treat these animals as though they are sacred and producing food for us and they're not just passive recipients in some economic formula.* (P40).

Particularly for producers in Factor 1, choosing a priority that would compromise their ability to pursue their definition of the highest standard of animal wellbeing, such as cost-cutting measures, would be a non-starter. For example, a small scale beef, pork, and broiler producer emphasized that animal husbandry was an integral factor on their operation and drove their willingness to pay the extra expenses of late-night veterinary visits,

> *I end up compromising my character if I place the health of my livestock below financial profit(…)it's not cheap to call your vet in the middle of the night. But I knew that if I waited, I could have some pretty major problems on my hands, and although it wouldn't financially sink me to have those problems it's just not fair to watch my animals suffer just because my bottom line is going to suffer(…)I don't really feel like you should deserve to get to farm if your livestock's health isn't the number one priority,* (P04; Factor 1; small scale beef, pork, broiler).

P17 also emphasized that their personal desire for animal wellbeing was the driver for pasturing their pork, allowing the animals to exhibit their natural behavior, and not due to the influence of consumer demand or the marketing benefit of "pastured" pork,

> *I think the most important part to me is that they get to live their life and be a pig, you know. My sows farrow on pasture. The babies are outside with them in the sunshine and grazing on grass and eating worms and grubs and digging in the dirt and, you know, just being pigs(...) I don't really care about the demand so much,* (P17; Factor 1; very small scale pork).

3.3.2 Personal Drivers Promoting Land Stewardship

Particularly in Factor 3, *personal* drivers influenced prioritizing statements such as *Maintaining the quality of soil (S38)* and *Stewarding the land and natural resources (S34)*. Some producers noted a profound personal desire to steward the land and limit their inputs (e.g. reduce the use of synthetic fertilizers through *Managing manure effectively and efficiently* (S20)) as a way to mitigate climate change, protect soil health, and preserve the entire ecosystem on their

operation. For example, when explaining why *Maintaining the quality of soil* (S38) was their highest ranked priority statement, P23 noted their strong personal belief in soil health as a foundational priority to animal production,

> *[The] quality of the soil, that's the most important thing of what we're doing. If we don't have healthy soil, we don't have healthy animals, we don't have water retention, we're not helping with preserving the natural wildlife out here. We tell everyone we are grass farmers. That's the most important thing because that's where it all starts. And with all of the erosion and degradation of soil happening around the world, we all really need to be more aware of soil and soil health.* (P23; Factor 3; small scale beef).

P31 ranked S38 as their highest priority and *Stewarding the land and natural resources* (S34) as their second highest, referencing their strong personal motivation for land stewardship, "*This land was here long before I was born and it's going to be here long after I die and I just want to pass it on in better shape than I found it."* (P31; Factor 3; very small scale beef, broiler).

In the beginning of their interview, P30 explained that the origin of their operation was driven by a personal desire to carve out autonomy in the food system and steward the land,

> *So when my husband and I (...) were living in a community house(...) one of the things that kind of grew out of that(...) was this idea of helping people take care of themselves in a way that kind of worked outside of the restrictions of capitalism and so growing your own food, being able to feed yourself is kind of a natural idea in that(...)and then we bought this property a few years later and one of the reasons that we were primarily interested in livestock production is because we had always been really concerned about the food system. The more that we learned about the way that animals and plants work together, the more that we understood that we needed to help them work together in order to help restore the land and regenerate it, you know, kind of the principles of regenerative agriculture.* (P30, Factor 3; small scale beef, pork, broiler).

Personal values regarding soil health drove P40's choice to pursue Organic certification, over an animal welfare focused certification,

> *I'm Organic [certified], first and foremost I'm organic(...) Although it may be imperfect, it's a set of universal standards, and I like standards. It answers most of the questions that I want to answer(...) and the animal welfare component to me is important, but that's not the primary thing.The primary thing to me is healing the soil, and that sounds funny for someone who sells meat, to say that but I think if you heal the soil we are healing communities of various creatures, human and otherwise, of which we depend on and therefore we're fixing all sorts of stuff that we may not even know is broken.* (P40, Factor 2; large scale pork).

3.3.2.1 Environmental Stewardship as a Low Priority

Notably, other environmental stewardship priorities such as *Reducing carbon emissions (S3), Increasing renewable energy use (S22), Increasing energy efficiency (S15)* were ranked as low or moderate priorities by all factors. When asked to explain their thinking, producers said these statements as priorities are less relevant than others, noting they do not "hit their radar. Some producers claimed that their very small to medium operation sizes and/or rotational grazing practices allowed them to achieve these goals, making these statements less relevant than for a

larger operation. Additionally, *Minimizing water pollution (S23) and Managing manure effectively and efficiently (S20)* were ranked as moderate priorities by all three factors.

Regarding S20, producers in Factor 1 comment that pasturing animals allows for ample space to manage manure. Producers in Factor 3 agree. P09 noted that there was little more their operation could do to manage manure,

> "*Because [manure] is already managed, I really don't think it could be managed more effectively or efficiently. The birds drop it right in place and we move them every single day. So there's really no– aside from just ending domesticated food as we know it and just going to a strictly hunter gatherer diet. I don't think there's anything more we can do to improve upon it."* (P09, Factor 3; medium scale broilers).

Two producers in Factor 2 commented on the essential role of manure in generating carbon credits increasing the sustainability of their operations (e.g. reducing commercial fertilizer use). Regarding S23, many producers in Factors 1 and 2 were in consensus that water pollution is not a pressing issue on their smaller-scale, low-input operations. P11, a very large scale pork producer in Factor 2, notes that zero water pollution is a standard on their operation, and noted the ramifications if pollution were to occur, *"Well, minimizing water pollution, I mean that's your social license to operate and your legal license to operate. So if you're not doing that, you're not going to be in business."* (P11, Factor 2; very large scale pork).

3.3.3 Farming for the Agrarian Lifestyle

Many producers noted the lifestyle benefits of farming. For example, acknowledging that the vocation may not be highly profitable, P20 described that their motivation to pursue farming was for the lifestyle and had to include "regenerative" farming practices that utilized animals and did not rely on synthetic inputs, *"I think as my wife and I sort of settled in to decide if we were going to do this, we knew farming [was] not going to be easy and [was] not going to be a huge boon of wealth. So it's really for the lifestyle and if the lifestyle is making our family sick and our environment sick then it didn't really seem worth doing."* (P20; Factor 3; medium scale beef, small scale pork). P33 explained why *Ensuring comfortable living environments for the animals* (S19) was ranked highly, emphasizing the lifestyle benefits offered by raising livestock on pasture,

> *What I like about being a grass guy and doing what I'm doing is you're out in nature. Typically there's shade in every pasture, there's good water, they're moving cattle onto fresh grass all the time, there's something really, really comforting about it. I like to do everything horseback and I've got some border collie dogs, and so when you're out in the middle of nowhere and you're able to move a set of cattle with a nice backdrop and you know, here they put their heads down and you can actually hear them eating. It's not just that the living environment [is good] for the animals, [it] is also good for the human,* (P33; Factor 1; large scale beef).

P39 noted that their desire to produce high-quality food drove them to sell their previous business to fund a new farming operation,

> *[Farming] is something that I want to do. It's extremely hard. It's extremely frustrating. It's financially terrible. I don't see that getting much better over time, but it's something that I have a passion for now and it's how I want to live, you know, my life and my family, you*

know, our family is in agreement, and so we, you know, it's just something we've chosen to do and to stay in. Even though it's a pretty rough existence, you have to love it to be able to keep doing it at the scale that we are at and the size that we're at. (P39, Factor 3; small scale beef, very small scale pork and broilers).

3.3.4 The Desire for Nutritious, Affordable Products

Producers differed on whether their motivation to farm was driven by the desire to provide nutritious, affordable products to consumers. *Providing nutritious food to consumers* (S7) was the highest ranked statement for some producers. For other producers, the desire to provide high quality, affordable products or education to consumers was not a priority and was trumped by other personal influences such as the desire to steward the land or care for their animals. For example, P24 stated that they farm for reasons other than building relationships with their customers. To P24, selling to customers allows them to continue stewarding the land to combat climate change, *"I love my customers, but it's not why I farm. I didn't farm because I wanted to have relationships with customers. The customers are the "how" of the change I want to see in the world."* (P24, Factor 2; small scale broiler). Similarly, P28 noted that the nutritious product they produce is a byproduct of their priority to provide exemplary animal husbandry, "*I'm much more focused on the care and health of my animals than worrying about the people so much(...)I do what I do because of the animals and for the animals."* (P28, Factor 1; small scale beef). However, many producers noted feelings of personal responsibility to provide the public with a nutritious, affordable product, and take time and energy to interface with consumers to educate them on their practices. Some producers noted that the ability to feed people and provide a nutritious food source through their operations was deeply fulfilling. For example, P28, a small scale beef producer, noted that grass feeding their animals took longer than raising them on grain, but the product was more nutritious for the consumer and better for the animal, and therefore was worth the longer finishing time, *"I think [grass feeding is] worth that little bit of extra time to make sure that what you're providing for people is healthier and also it's healthier for the animal to be brought up that way."* (P28, Factor 1; small scale beef). P39 felt sure of their mission as a producer to provide nutritious food to consumers, over farming for the sake of traditions or fads,

> *I am 100% not one of these people that is like ohh well we this is how we did it, so let's keep doing it(...) I'm not necessarily stuck on 'I have to farm this way', because of tradition(...) I just know that my job is to produce as much nutritious food at a reasonable cost, where we can still make a profit and make a living and get as much as possible into the hands of the consumer (...) I'm working as hard as I can, and focused on [the] health of animals, [the] health of people making nutritious food, not(...) some fad that's here today,* (P39; Factor 3; very small scale pork and broiler, small scale beef).

P35, a very small pork producer, noted that they wish their products were affordable, but the current pricing systems are not in their control,

> *I just really wish that [my products] were affordable. I have a lot of feelings about my food being really expensive, I don't feel comfortable about it all the time, and I also recognize that I don't have any, It isn't really my job to make things affordable, because if I do then I go broke and then there's no good food coming from my farm so. Yeah, it feels like the parts of the system that make it expensive aren't in my control. It can't be*

> *my job to make it affordable, even though I really, really want it to be.* (P35, Factor 3; very small scale pork).

This desire was echoed by P30. Faced with the tension between providing affordable products and operational viability as an outcome, P30 noted spending extra time and energy educating their customers on more affordable animal products, like milk, eggs, or organ meats.

> *[P]roviding affordable products to consumers. So I think this is really tricky.(...) I think we're leaning more in the direction of farmers deserve to make a living wage and that we need to learn the real cost of food, but that's very difficult to balance with trying to serve people who have a limited budget and I think also the nature of inflation is that you don't necessarily have to have a limited budget to not be able to afford pasture-raised food. (...)We're not the farm that's saying, 'oh, I should really raise my prices, but I'm not going to do it because I love you so much.' I think that's just a disaster because you're not going to be able to stay in business. But I really want to find ways to make food more affordable to customers. So I mean, one way I do that is I try to do education on our more affordable cuts, so talking about why it's important just to incorporate eggs or milk if that's all you can afford or really amplifying organ meats. (*P30; Factor 3; small scale beef, pork, broiler).

3.5 Operational Viability Drivers

Referring to the need to be profitable enough to sustain farming operations, *operational viability* drivers were the most commonly referenced drivers among producers in this sample (see Appendix 6.6). Producers in all three factors noted the omnipresent influence of *operational viability* drivers on their operations; these drivers were noted by several producers to be their number one driver of decision-making or something always "top of mind." For example, P14 explained that the reason behind considering switching to GMO-free feed over their current Organic feed, while involving consumer preferences and personal values, was driven chiefly by *operational viability*, *"Thinking about trying to make this an economically sustainable operation in the long term, I am always trying to think about ways to maintain our practices and morals and increase financial stability."* (P14; Factor 1; medium scale beef, very small scale pork). P42, a small scale beef, pork, and broiler producer with a nascent operation pointed to economic considerations as the main driver of priorities, such as the need for customer sales. The need to maintain profitability drove their priorities over any other driver,

> *Finances is the number one driver of our current decision-making complex given where we are within our business life cycle. Our consumers are important because they're the ones that actually create the cash flow. If you don't have a good enough turnover rate and the cash flow, then you're not going to have a business.* (P42, Factor 3; small scale beef, pork, broiler).

When discussing if any of their priorities would change in the absence of current constraints, P11 explained that maintaining profitability in a large-scale pork commodity market was the number one consideration, *"We're in an extremely volatile business because we're in a commodity business, so maintaining sustainable profitability I mean that's first and foremost.*" (P11, Factor 2; very large scale pork). If profitability were a guarantee, P11 said they would shift their priorities to increasing their "social license to operate", highlighting that the demands of profitability can overshadow alternative influences. Another very large scale pork producer, P18,

pointed to profitability as a key driver on their operation, "*Economics is a high motivator of decisions and processes. Ultimately, if you aren't profitable, you're not in business…"* (P18, Factor 2; very large scale pork).

3.5.1 Operational Viability Influencing Animal Wellbeing

Priorities that maintained profitability also sometimes aligned well with *personal* drivers or goals such as animal wellbeing, supporting many producers' decision to adopt practices that support animal wellbeing. The operational viability benefit of healthy, productive animals was an added benefit for producers for whom personal drivers governed their operational prioritization, particularly for producers in Factor 1, but the benefits of animal wellbeing were noted by producers of all scales. A common example was that by *Preventing animal illness* (S4), *Ensuring the health of the animals* (S32), or *Monitoring animal behavior* (S18), producers would be able to use less expensive antibiotics, lose less animals to death or disease, and ultimately sell more animals, increasing profitability. For example, P05, a small scale beef producer noted how animal husbandry can meet both economic and personal goals,

> *The tie between personal and economic [drivers], I obviously want to [practice good husbandry] because I feel like that's right, but then also I think that good husband practices do lead to an economic benefit if you're taking care of your animals properly. Vaccines might cost money, but it prevents them from dying of pneumonia.* (P05, small scale beef).

This is echoed by P13, who noted that the driver of prioritizing animal health was partially the pragmatic economic benefits,

> *You've got to take care of your animals, that whole animal welfare component there and then there's the realistic financial component. If you're running animals under condition, or they're getting sick or whatever, it's just going to take longer for them to finish and that's just more money, right? More time and money, so that's the practical side.* (P13, Factor 1; small scale pork).

When asked why ensuring the health of the animals (S32) was sorted as a high priority, P11 notes, "*because [ensuring the health of the animals] drives into a healthy product at the end of the day, it drives in to reduce antibiotic usage and it drives your overall viability to your business"* (P11, Factor 1; very large scale pork). Or from P6,

> *Our system is based around healthy animals(...)If animals aren't healthy, then you're spending a lot of time on sick animals(...)that you have to remove them from the group so that they don't get the other animals sick. They take extra care so being preventative or being on top of it makes the system work and also saves money.* (P6, Factor 1; small scale pork and broilers).

3.5.2 Operational Viability Influencing Environmental Stewardship

Operational viability drivers influenced the prioritization of statements like *Stewarding the land and natural resources (S34)*, and *Maintaining the quality of soil (S38)* that were also influenced by *personal* drivers, particularly in Factor 3. For example, P20, a medium scale beef and small scale pork producer, explained that the reason for sorting S38 highest is that healthy soil is the key to a healthy ecosystem on their farm, which allows for continuous profitable production at their smaller scale,

> *[T]here can't be any higher priority than [maintaining the quality of soil] because there's no production without healthy soil and definitely not any profitable production on the scale that I'm at(...) if I want to be a profitable small-scale farmer, I have to be a steward. There's no other option.* (P20, Factor 3; medium scale beef, small scale pork).

3.5.3 Operational Viability as a Constraint

More than any other driver, *operational viability* drivers influenced producers to make tradeoffs between priorities that reflected their "ideal" operation and one that is economically sustainable. (See Table 4). For example, P24 noted they wanted to raise ruminants, which take longer to reach market weight than other species but are beneficial to soil health, but they were forced to make a tradeoff and raise chickens that reach market weight much faster, *"I believe that the best way to fight climate change and to actively reverse it is the intentional stewardship of ruminants(...)Chickens were an economic driver for me because you can convert a day-old chick into cash in as little as 56, 56 or 57 days."* Later in the interview, P24 expands on the influence of the *economic* driver of their priorities, noting, "*I'm not doing any good if my business fails, so business has to be financially profitable first. And that's just the nature of our world. It has to economically make sense,"* (P24, small scale broilers). In the absence of economic constraints, P24 stated that their "philosophical" approach to farming, driven by personal goals, would only intensify, "*So if money wasn't an issue for example? Oh yeah, [I] would be a whole lot more philosophic in my approach(...) it would all be the philosophical drivers to why I'm doing what I'm doing and not necessarily the economic ones that are of necessity."* Other producers echo this sentiment, describing a tension between *personal* and *operational viability* drivers and their desire to shift their priorities toward personal goals.

The desire to sustain their operations required producers to prioritize practices that allowed a consistent sale of animal products, such as *Diversifying market pathways* (S16) andB*uilding or expanding local, direct to consumer markets* (S14), sometimes reluctantly. For example, when asked if or what priorities would change in an "ideal" world, P04 noted, *"So building or expanding our direct to consumer markets [S14]. If I didn't have the economic pressure, that definitely would go way behind other things."* (P04; small scale beef, pork, broiler).
P28 noted that S14 was a high priority because it provides resilience in an unpredictable operating environment,

> *If you don't have multiple market channels for your end product and one of the few that you have gets cut off for some reason then you're going to be stuck with a bunch of animals or a bunch of beef that you can't market. And then your business isn't going forward and you can't make money to run your farm operation* (P28; small scale beef).

Balancing *operational viability* with *personal* drivers on an operation led to tradeoffs for producers in this sample. For example, P28, a small scale beef producer, explained that the need for USDA processing to sell their products requires a multi-hour drive, which is uncomfortable for the animals and undesirable for this producer's goals for animal wellbeing.

> *It took me a whole year to decide to go ahead and be OK with getting my animals USDA processed somewhere that's 3 1/2 hours from my farm. And I had to make that decision*

purely based on if I don't do that and I can't get animals USDA processed, I cannot continue my operation. I won't make enough money (P28, Factor 1; small scale beef).

The constant struggle to maintain profitability and operational viability as an outcome was not achieved for P12, who at the time of their interview had sold almost their entire cattle herd in the last year, noting an inability to compete with larger-scale operations, *"I just sold out last Thursday." (*P12, Factor 1; medium scale beef). In summary, *operational viability* drivers forced very small to large producers in this sample to balance profitability with other drivers and goals for their operations, often including tradeoffs.

3.6 Customer Drivers

Customer drivers refer to influences of the general public or customers that buy directly from the farm such as farmer's markets, E-commerce, retail outlets, or large scale intermediaries such as supermarkets or wholesale buyers. *Customer* drivers influenced producers to balance their personal aspirations with their perceived responsibility to their customers and with direct influences from customers on their operations. Priorities that were noted to be customer-driven in Factor 1 include the physical qualities of their meat products (e.g. fat marbling, fat quantity, cut size and shape), animal feed (e.g. grass-fed over grain, barley over corn), and breed selection (e.g. Heritage breeds such as Berkshire or Freedom Ranger, angus cattle). For very large scale producers in Factor 2, the need to maintain positive consumer perception to maintain operational viability as an outcome drove priorities of transparency, animal wellbeing, and environmental stewardship. *Customer* drivers also influenced the priorities of Factor 3, who emphasized a need for consumer trust and transparency on their operations.

P22, a large scale beef producer in Factor 1, explained that customers influence priorities such as transparency and responsible production because of their essential role in the public perception of the industry,

In much the same way that animal health drives my priorities the [customer] drives everything else because the day we forget why we're in the business and why we're doing what we're doing is the day we might as well quit and become street sweepers. The interactions that we have with the public as farmers are the some of the most important that we have because people want to know that they have A) a safe product, B) they want to know that the product is prepared in a responsible fashion and when our industry claims that we're stewards of the land we need to be able to back it up and and I think that's the key to everything we do. (P22, Factor 1; large scale beef).

However, P01, a very small scale broiler producer, noted the challenge of balancing customer demands with operational priorities,

It was challenging to sort the [statements] about consumers and customers with the animal welfare land stewardship part because that's always kind of the tension. My first day-to-day thought is always the farm, the health of the farm, the health of the animals. But it's not worth anything if I don't have customers and consumers. (P01, Factor 1; very small scale broiler).

3.6.1 The Influence of Customer Preferences

Producers in all factors noted that their priorities were based in part on an array of consumer preferences for a nutritious, affordable, consistently high quality product, or a product that was raised with certain practices (e.g., pastured, Organic, corn-free feed), or breed selection. For some producers, consumer preferences drove certifications and thus husbandry practices (e.g. GAP certification, Organic, Animal Welfare Approved.) P34 noted the influence of customer demand on the decision to raise beef cattle over bulls for breeding,

> *We started the meat business probably four years ago because I think we realized there was more of an audience or more of a customer basis for beef than there was for example, high quality bulls. So it was just kind of a look at the market and see what the market around us wants and the market happens to be consumers.* (P34,Factor 1; small scale beef and pork).

Regarding animal feed, P34 was willing to make the tradeoff to feed barley over corn based on strong consumer preference for barley, even though it is more expensive (see Table 4). For P13, a small scale pork producer, the decision to seek AWA (Animal Welfare Approved) certification over Organic certification was driven by both *personal* and *customer* drivers.

> *We felt like the Animal Welfare Approved standards were more in line with our values around animal husbandry and set a higher bar than Organic and fit with where we were in our production and management, so as well as I guess you know, thinking about what catches the consumer's eye,* (P13, Factor 1; small scale pork).

Very large scale pork producers in this sample, such as P18, explained that their customers want an affordable, safe, and nutritious product, which their operation seeks to produce through *Ensuring the health of animals* (S32) and *Practicing the responsible use of vaccines and antibiotics* (S12).

3.6.2 The Desire for Customer Trust

Because of the importance of customer sales on business viability, producers of all operation sizes noted the exceptional value of *Building trust with consumers* (S8). When discussing S8 in the interviews, there was sometimes indiscernible overlap between *customer* and *operational viability* drivers. *Providing nutritious food to consumers* (S7) was the highest composite ranked statement for Factor 2. For the very large scale producers in Factor 2, the need to maintain positive consumer perception to maintain operational viability as an outcome drove priorities of transparency, animal wellbeing, and environmental stewardship, and *Building trust with consumers* (S8) was ranked highly by this factor. Additionally, the very large scale producers stressed the importance of upholding their operation *reputations* as capable of consistently producing safe, affordable, and nutritious protein sources for their customers, which drove their higher priorities such as *Ensuring the health of the animals* (S32), *Stewarding the land and natural resources* (S34), and justified placing some priorities, such as *Raising animals not in confinement* (S21) and *Giving animals more space* (S24), lower.

P40, a large scale pork producer in Factor 2, lamented that the barrage of labels on meat packages required them to build trust with their customers so that customers could filter through the labels,

> *It's so important to communicate your brand and your farm to your customers and they have to trust you as a creator of their food. Anyone doing anything remotely like what I'm doing has to charge a lot more than the commodity food price to have a chance, and so for that to work, you need trust.* (P40, Factor 2, large scale pork).

P11 ranked S8 highly, echoing the connection between trust and viability, "*at the end of the day, if we don't have a customer, we don't have a business so [chuckles] So it has to be right up there at the top."* (P11, Factor 2; very large scale pork). Similarly, P08 noted in their interview that customer trust increased operational viability as an outcome, "[*Building trust with consumers and providing an affordable product to consumers](...)that's important to us, because that's how we make our living, you know, making sure that we're trustworthy and people like our product."* (P08, Factor 3; small scale beef, very small scale broilers.) P19 also noted the essentiality of customer trust when explaining the reasons for their high-ranked priorities,

> *The [statements] that [I] ranked higher are foundational. You better be a good steward, you better provide a nutritious product, you better build trust, otherwise you're not in the game. You're out of the game before you even do any of those other things. If the consumer doesn't trust the ham then you can do all those other things, but all (...) those are foundational to farming. You're providing food, safe and efficient food.* (P19, Factor 2; very large scale pork).

P09 summarized how customer expectations and customer effort to purchase their products required that their operation maintains a standard of integrity and transparency, a point that was echoed by several other producers,

> *Without our customers, we are nothing, we have nothing. They're that significant to us. I just think about people who come to the farmers market and they have to work really hard to be there. It's something that they want to do, but like, you know, they have to fight in traffic. They have to look for parking. They have to walk around through hot crowds and carry this food with them. And ordering online through Amazon's way easier. It's way easier. So we're asking them to swim upstream, [to] find our product in a sea of all these other products. And we're charging a lot, we need to come to the table with strong values, propositions and this really sincere level of trust. Because that's the same amount of energy that people are bringing to us; they're trusting us, we better have some high integrity to back that up.* (P09, Factor 3; medium scale broiler).

3.6.3 Animal Wellbeing and a High Quality Product

Producers in all three factors agreed that prioritizing animal wellbeing created a higher quality end product. For the producers in this sample that did not attempt to compete with wholesale prices in a commodity market, but sold directly to consumers, it was necessary to differentiate their products to justify a higher price point. Thus, a high quality product was desired to clearly distinguish their operations from cheaper grocery store products.

Many producers agreed that prioritizing animal wellbeing created a higher quality end product, and therefore was prioritized. For example, *Ensuring the health of the animals* (S32) was a priority for all factors because it allowed producers to produce a high quality product and for smaller producers to showcase their exemplary animal husbandry practices. By raising an

“optimal” animal protein, producers fulfill their personal goals and meet consumer desires, allowing them to sustain operation. P17, a very small scale pork producer, explained how animal health was essential to their and intertwined with their personal goals for animal husbandry,

> *Keeping [the pigs] healthy is important. If they're not healthy, they're not gonna do well. They're not gonna Farrow well, they're not gonna have babies. They're not gonna make it to finish [slaughter]. If I ever have a piglet that is injured or just isn't thriving, there's no way I'm selling that. That's my reputation(...) I would never bring that animal to butcher because that’s representative of my farm and, you know, their health is so important to me but because that means they're happy and they're enjoying life and living it to their finest.* (P17, Factor 1; very small scale pork).

P04 noted the same benefits to prioritizing animal wellbeing, noting that by giving animals more space, their product quality increased, *“We just saw such a powerful impact in what we produced. So for example, the marbling on our pork is phenomenal,”* (P04, Factor 1; small scale beef, pork, broiler). P05 echoed the benefits of animal wellbeing when describing why animal wellbeing statements were ranked highly, “*If you're doing what's right for that animal, you are in turn ensuring that your quality and your meat is better, your product is better(...)all the things that are good husbandry also lead to better performance of your animals,"* (P05, small scale beef).

More than just the desire for high quality, producers referenced the need for a *distinguishable* product that reflects desired environmental and animal wellbeing practices. For example, when asked why *Ensuring the health of the animals* (S32) was a high priority, P30 replied that raising healthy animals is key to providing a distinctive product,

> *It means that you're not doing a very good job if you don't have healthy animals, but I think I would say that our customers are looking for a small farm because they're worried about what's in their food and so it's really important for us to maintain healthy animals because that's one of the most significant distinctions between us and what they can get at the store.* (P30, Factor 3; small scale beef, pork, broiler).

P01 explained that they distinguish their products by using practices such as rotational grazing and breed selection, thereby establishing a niche in the marketplace,

> *The thing that sets me apart is not only am I doing pastured chickens, not only are they being raised with rotational grazing, but I'm also choosing the most humane breed, and so if you want the best product, the most humane product, the most environmental product, all those things I'm the one who can offer it."* (P01, very small scale broiler).

P06, a small scale pork and beef producer, noted that longer finishing times were worth it for an exceptional product,

> *It's maybe a little bit longer [finishing times], but our pork is so much better than any grocery store pork including the nice grocery stores. And it's the 80 year old dudes who are like ‘this tastes like my mother's pork chop’. Yeah, it tastes really good. And it just feels right, you know, it looks right,* (P06, small scale pork and beef).

Some producers stressed the importance of communicating a brand that reflects the priorities of small producers. P07 summarized the drivers of their operation as *personal* first, then *operational viability*, and then the ability to communicate their practices to the public,

> *I will raise these creatures following my personal values for other people that also share those values and are able to pay for it in a way where I make some money." (...) I'm here to provide nutritious food to me and the consumers too, and I think my third highest [driver] is kind of the operation/brand, but not just for myself, not [only because] I need to have an effective brand and marketing strategy, but I want to make sure that what I'm communicating is reflective of small farmers in general. I want people to trust the local food system. I want people to look for their small local farmers. I want to really push those values very strongly on people that I interact with that living more sustainably means looking more locally for products.* (P07, very small scale pork and beef).

3.6.4 Customer Drivers Influencing Marketing

However, building relationships with consumers and building trust often required time and effort to be spent on managing marketing materials such as social media accounts, websites, or newsletters, which created a tension between the other operational goals (e.g. to prioritize animal wellbeing or land stewardship). Many producers noted marketing to be demanding and unpleasant and would prefer to spend time on the production priorities of their operation. The reverse was also noted to be true: some producers noted that the demands or priorities of their operation or the security of stable market outlets leave little time, energy or desire to devote to consumer concerns or preferences. For P14, *Building or expanding local, direct to consumer markets* (S14) was a high priority, noting that marketing to achieve operational viability as an outcome takes up immense bandwidth, *"I feel like I'm constantly thinking about marketing and am I going to sell everything. I just feel like that's pretty constantly on my mind to get it done because it's all me. Nobody else helps me with [marketing]*(...) *I really do not like social media*." (P14, Factor 1, medium scale beef, very small scale pork).

To add complexity, P01 noted the cost of marketing on their time and energy, but also understood its importance as a customer education tool, which was a personal priority. While discussing what priorities they like to change in their sort, P01 emphasized that *Increasing consumer understanding of farming operations* (S33) was burdensome but necessary and of personal value,

> *[In an ideal world] I would down-prioritize increasing consumer understanding of farmer operations just because it's so time consuming and it's risky because social media is a nightmare zone for inviting comments, it's a huge time and energy suck. However, a big personal priority is not just providing products but also helping people understand where their food comes from. So, I guess that was all just to say that that stays where it is, but there are some pros and cons to the time that's put into increasing consumer understanding of farm operations.* (P01; Factor 1; very small scale broiler).

Alternatively, P05, a small scale beef producer, explained that *Diversifying market pathways* (S16), was *not* an active priority because animal health took up greater bandwidth, suggesting that marketing as a customer driver exerted minimal influence on this producer,

> *I guess because you know the animals take up so much time the marketing comes second to me because you're busy taking care of them. So I end up marketing in the free time (...) you go home, you walk through the cows, you make sure there's no new*

babies(...) everybody's got eyes and ears and legs, and then maybe on the weekend I'll think about Inventory on the website or something. (P05, small scale beef).

3.6.5 Industry/Buyer Drivers Exert Minimal Influence

Industry/buyer drivers had minimal influence on producers in this sample. For example, P19 noted that large meat product companies have standards for an animal's live weight and quality, but in reality exert little pressure on their operation,

> *There's no pressure [from buyers]. So the recent pressure, for instance, would be they wanted a colored bore, which increases the meat quality from the standpoint of color and intramuscular fat. So will they pay you a premium for that? Slight, right. There's a slight premium there, so they'll incent you for good behavior and they'll punish bad behavior(...)So it's not like they dictate this is what you should do, no, no, you just get an economic advantage if you meet their standard.* (P19, very large scale pork).

Additionally, P40 noted that some large intermediaries that process their pork products required GAP (Global Animal Partnership) certification, forcing a shift in practices to comply, *"Some customers demanded it. Some of these ham producers said you have to have this because we're claiming that this is going into a Whole Foods Market, therefore it has to be GAP."* (P40, large scale pork). P40 later noted explicit pressure from supermarkets to change the amount of space provided to animals on their operation, for the sake of lowering the retail price of their products,

> *Even farms like mine are under pressure from supermarkets to make the animals more densely, more intensively housed. So that's a bit of a battle to undertake, even with supermarkets you'd recognize they have meat buyers saying, 'hey, we get it you love Organic, but just put another 50% animals in that building. Let's get the price down'. It's just unrelenting.* (P40, large scale pork).

3.7 Regulatory Drivers

Regulatory drivers in this analysis referred to local, state, or federal mandates, policies, or regulations that influence priorities. *Regulatory* drivers were noted less often than other drivers as exerting influence on priorities; rather, they tended to be viewed as significant constraints that drove tradeoffs for producers. Examples of *regulatory* influences included the desire to meet USDA processing standards, pursuing a certification such as Organic, AWA (Animal Welfare Approved), or GAP (Global Animal Partnership), or regulations on environmental practices such as water pollution.

3.7.1 Certifications

Meeting Organic or Animal Welfare Approved (AWA) certification requirements drove priorities for some producers such as *Giving animals more space* (S24), choice of feed (e.g. Organic vs. not Organic), or antibiotic use (e.g. antibiotic use is not permitted under Organic certification). Many producers opted *not* to pursue Organic certification, which commands a higher price for their products and offers a reputable label, because Organic inputs such as Organic feed were prohibitively expensive, or the Organic standards of animal husbandry were not in line with their personal goals. For example, Organic certification standards prohibit the use of antibiotics to treat sick animals, which was a tradeoff two producers (P05, P10) were not willing to make.

"*One of the main reasons why we're not certified organic is because sometimes pigs get an ear infection and the treatment for that is an antibiotic.*" (P10, small scale pork).

3.7.2 The Constraints of the Animal Processing Environment

Access to animal processing was a major theme discussed in the interviews; producers lamented the barriers to stable processing access, and the challenges and tradeoffs of meeting USDA certification.

After one of their processors suddenly canceled their slaughter appointment, P28 explained the resulting time and cost required to maintain USDA standards for processing,

> *Now what I have to do instead of having the same place to do the killing and the cutting and wrapping, I now have to haul my steers to [town name] to be killed and then I have to pay that place to then haul them back to [name] County to have a processor in [name] County do the cut and wrap for me just so I can get them done USDA.* (P28, small scale beef).

To gain more control in processing, P23 noted the reasons their operation pursued on-site processing, which also saves money and limits the stress of long transport times on their cattle,

> *We're [not] in control of what we're able to do using an offsite processing facility for our other animals(...) we're unable to get certain things that we want due to USDA regulations and so being able to process on site will just make it easier for us. And the nearest processor for our livestock is 80 miles away and transporting the animals, it causes so much stress we don't want to do that to the animals, there is a facility that's going to open closer to us so we'll move over to when it's open just to eliminate some of that stress with the animals go through the day of.* (P23, Factor 3, small scale beef).

3.7.3 The Minor Impact of Regulations on Animal Wellbeing and Environmental Stewardship

Environmental stewardship regulations were noted to be a minor driver of priorities for all but very large operations in this sample. Very large producers noted the influence of regulations on preventing water pollution, animal husbandry, and space requirements, although these producers also note that these would remain priorities in the absence of regulation. Very large scale pork producers lamented regulations, such as California's Proposition 12, that mandated an increase in available barn space per pig to sell pork in the state of California, forcing expensive barn renovations and higher heating costs. While explaining why environmental health would be sacrificed in the setting of unnecessary space regulations, P18 noted,

> *Why do I need to build a 25% larger barn? For no good reason. That ultimately will decrease the stocking density and cause me to use more heat. Just to keep the animal environment comfortable. But the very request of their ask is they want the sow to be comfortable by giving her more square footage. Well, she doesn't need more square footage.* (P18, very large scale pork).

When discussing their lower priorities, P26 noted the influence of regulations forced an expansion of their pork barns and thus has made *Giving animals more space* (S24) a lower priority, "*We had crowded facilities 30-40 years ago, but we have to meet the animal welfare standards and the Organic standards. And so that space is not a problem with the cattle anyway, the sheds are big,"* (P26, Factor 3, medium scale beef and pork).

3.8 Drivers and Tradeoffs

Operational viability drivers, *personal* drivers, and the animal processing environment were the largest drivers of tradeoffs. Tradeoffs were defined in this analysis as the elected or forced compromises on an operation. Tradeoffs were revealed in the interviews as producers discussed the compromises inherent to ranking their priorities on a fixed grid and when describing the complexity of balancing competing drivers. For example, all producers in this sample noted tradeoffs as either an explicit compromise made between two practices or a compromise made between two competing objectives of their operation such as profitability and personal values around animal wellbeing. Tradeoffs can also be conceptualized as between domains of sustainability, explored in the discussion.

3.8.1 Operational Viability Drove Tradeoffs

More than the other four drivers, *operational viability* drivers forced tradeoffs for producers between their "ideal" operations and ones that are economically sustainable. Remaining viable came with significant tradeoffs for some producers, who had to trade quality of life and personal values around animal wellbeing or environmental stewardship for economic stability. For example, P01 noted that the need to work a second job to be viable leads to a tradeoff in animal and environmental health, explaining that they would rotate their animals more often if they had the time,

> *In my perfect world, I would rotate the animals twice a day. I have to work an off-farm job because of financial issues, so I don't have the capacity to rotate them that often. They would certainly be healthier. The land would certainly be healthier if I could move them more often.* (P01, Factor 1; very small scale broilers).

3.8.1.1 Tradeoffs Related to Quality of Life

In many points in their interview, P14 lamented the significant tradeoffs of marketing on their quality of life. They would prefer to spend their time in the field rather than on marketing, which they find onerous. When talking about what their day-to-day might look like in the absence of marketing, they noted the insidious ways that operational viability takes up time and leads to burnout,

> *I think that not having to market [would] really help [with burnout] because it takes it's not just time like at the computer, it's time in the field taking pictures and writing notes and like all that and getting emails. In fact, I was at my [daughter's] equestrian team meet this weekend and I was sitting in the stands answering emails, and one of the other moms commented, she's like, 'you're always working'.* (P14, medium scale beef, very small scale pork).

At the conclusion of their interview, P22 noted the tradeoffs between ranching and their relationships, noting the strain that the demands of animal production placed on his former marriage,

> *For a workaholic like me, it's(...) maybe a bittersweet part of the ranching. I like what I do and I like it so well that that's pretty much I'm happy doing that. That's probably one of the reasons I'm divorced is because I couldn't expect my wife to put up with my schedule and be on-call all the time and deal with the uncertainty(...) I don't care how much you*

> *like your job. You need to get away from it periodically(...) I know ranchers that are quite good at it but it needs to be in the front of your mind because cows need care every day, if not being fed at least being monitored. And yes, you can go off for two or three days, at different times of year and do something and have a neighbor check the water or a hired man, but it's gonna keep you close to the operation more than most other businesses. You can't just turn the key off and close the office for two weeks while you go to Cancun. I think it's a key component and it may be the most important thing regardless of what we do with the cows and everything. If you're spending your profits on alimony then really, what have you gained?* (P22, Factor 1; large scale beef).

P06 echoed a similar sentiment, noting the tradeoffs to quality of life forced by the time required to be an economically viable animal producer at a small scale, further compounded by an industry standard that normalizes busyness and burnout. Responding to a question about how their time would fill back up in the absence of the demands of marketing, they explained that they would spend that time not farming,

> *[My time] would not fill up. I would go on a hike. I'm so crystal clear that I want a nine to five job. I want farming to be a nine to five job (...)the burnout thing is so [messed] up and I didn't sign up to be poor and I didn't sign up to have no hobbies, and I am annoyed that people take pride in that or that people perpetuate that as a glorious thing. Like, no, I want to go take a watercolor class. I want to hike [a trail] and be gone for three days. I want to raise food as my job. It's my passion. I wouldn't choose anything else, and I also wouldn't necessarily do anything different in our choices that we've made. But I'm not trying to give everything. I'm sick of that.* (P06, Factor 1; small scale beef and broilers).

3.8.1.2 Tradeoffs Related to Personal Values

For P24, a small scale pork producer, the need for operational viability as an outcome overrode personal goals for their operation, noting that they would be more "philosophical" in their approach to farming if profitability was not of concern. P24 wanted to raise ruminants on their operation, which take longer to reach market weight than other species but are beneficial to soil health, but P24 was forced to make a choice between species and raise chickens that reach market weight much faster. P24 expanded on the influence of *economic* drivers on this decision, noting, "*I'm not doing any good if my business fails, so business has to be financially profitable first. And that's just the nature of our world. It has to economically make sense,"* (P24, small scale broilers). The high cost of farming sustainably also led to tradeoffs in personal values such as *Providing affordable products to consumers* (S6). "[*Ranking] that affordable products [statement] is a really tricky one (...) Because I want to provide affordable products, but the cost of farming is so high that it's hard to do that,"* (P01; Factor 1; very small scale broilers).

3.8.1.3 Tradeoffs Related to Environmental Stewardship

P09 noted a tension between environmental stewardship priorities and the demands of operational viability as an outcome, citing an example that planting a riparian zone, which benefits wildlife habitat and the surrounding environment, but would come with a tradeoff of profit for producers. When explaining why they ranked the statement *Showing the public that production is safe and humane* (S9) highly, they noted that consumer trust was important to alleviating this tension,

> *I think that [ranking S9 highly] stems from this growing tension between agriculture and conservation. There's this palpable tension between those two needs, you know, conservation is like, 'we* need *to plant that riparian zone' and farmers are like, 'check it out we* need *to farm that land that we own because we* need *to pay our bills' and both of them are true, they're both very true statements. So we're trying to ride that line between farming and conservation like in an ideal world, can't we do both at the same time?* (P09; Factor 3; medium scale broilers).

Finally, many producers lamented the prohibitively high cost of incorporating renewable energy sources or energy efficient technology. P23 noted that they desired solar panels but had to invest profits into areas of their farm that improved operational viability as an outcome,

> *It is hard because, especially with renewable energy, I would love for that to be a higher priority for us and it will eventually. Just right now if I had to choose, if we needed to invest that much money, I'm going to invest it into increasing our production and increasing our market reach, things like that as opposed to renewables.* (P23)

3.8.2 Personal Values Drove Tradeoffs

Alternatively, strong *personal* drivers led to tradeoffs for some producers. For example, P01 was willing to pay an extra expense for a breed of slower-growing broilers that could be raised more humanely than faster-growing breeds such as Cornish Crosses that have more musculoskeletal issues,

> *If I didn't have any regulatory or economic concerns, then minimizing animal finishing times would be one of my lowest priorities. I would prefer to raise animals that have slow finishing times. Broilers, you know, most people raise Cornish Cross because they're very, very fast growing and they're cheap to raise. I don't raise Cornish Cross and I make a financial sacrifice for that and I have to ask consumers to get on board and to understand my reasons for it and to be willing to pay more (...) for me it's an animal welfare issue. Cornish Cross is the most common breed that I see people using and they do it because they're a commercial breed, [but] they have some genetic musculoskeletal issues.* (P01, very small scale broilers).

P07 was willing to trade profits for the personal values of animal husbandry,

> *[P]rioritizing the animal's wellbeing is going to be more important than communicating that to the customer(...) when it comes down to it (...) [customers] can buy my food or not. I just want to know that I'm doing it the best, and that's why I'll just never be a super profitable farmer.* (P07, Factor 3; very small scale pork and broilers).

3.8.3 Tradeoffs Related to Environmental Stewardship

P32, a very large scale pork producer, noted that because animal comfort was a priority, that led to a tradeoff of efficient energy usage,

> *We aren't going to compromise animal welfare, if we need to use more energy to heat a barn in the winter, we're going to do that. We are going to use more water in the summer for our misters and our stir fans. We're going to use a little bit more energy for ventilating farms for that animal comfort.* (P32; Factor 2; very large scale pork).

P18 echoed this, explaining that by giving animals more space (i.e. decreasing stocking density) in response to new proposed regulations, that would force higher energy use to heat the barns,

> *With mandates and changes that are being brought from a legal perspective and regulatory perspective, there's lots of requests that are being made by activist groups to do certain things with livestock; they want a safe environment-friendly production system, but their requests [are] actually taking us backwards from an environmental footprint standpoint(...) the easy thing for me to explain is the pending case with California on Proposition 12. They require 24 square feet for that sow(...) She could do everything they ask her to do in 18 square feet. Why do I need to build a 25% larger barn?(...) That ultimately will decrease the stocking density and cause me to use more heat, just to keep the animal environment comfortable."* (P18, Factor 2; very large scale pork).

3.8.4 Animal Processing Capacity Drove Tradeoffs

Processing access varied by geography for producers in this sample. For producers that lived far from USDA processors, they had less flexibility with their animal finishing times, and less autonomy over packaging quality or animal welfare than those who lived near several processors or were members of a processing co-op. The need for certifications or to meet regulatory standards such as USDA processing or labeling of animal products, animal welfare certifications like GAP (Global Animal Partnership) or AWA (Animal Welfare Approved), or the Organic certification constrained operational flexibility and was a major driver of tradeoffs. For example, USDA-certified products cost more to process than non-USDA processing, but allowed producers to sell their products at retail outlets, and so producers elected to or felt forced to make this tradeoff. In addition to the extra cost, processing their animals under USDA certification required producers to give up autonomy or control of the timing of slaughter and packaging of their products, with many producers lamenting the poor quality of the final product and lack of flexibility. P06 noted, *"We're required to have a USDA inspected stamp on our product which limits the kind of processors that we can use and just makes us very, I want to say vulnerable or dependent on our processor."* (P06, small scale beef and pork). P28, a small scale beef producer, explained that the need for USDA processing to sell their products requires a multi-hour drive, which is uncomfortable for the animals and undesirable for this producer's goals for animal wellbeing.

> *It took me a whole year to decide to go ahead and be OK with getting my animals USDA processed somewhere that's 3 1/2 hours from my farm. And I had to make that decision purely based on if I don't do that and I can't get animals USDA processed, I cannot continue my operation. I won't make enough money"* (P28, small scale beef).

For producers that couldn't access USDA-certified processing or were unwilling to make the tradeoff of animal wellbeing for the sake of USDA certifications, they were then unable to sell their products retail or at producers' markets, instead being limited to selling their product in whole, halves, or quarter sizes that were exempt from the certification requirements. For producers that desired USDA certification to sell their products at farmer's markets or grocery stores, they lamented the far drives required to reach USDA-certified animal processing facilities and the requirement to book butcher dates up to a year in advance, limiting their flexibility with animal finishing times. For some producers, the lack of available processors led to them

initiating on-farm processing, which is allowed under USDA-custom exemption, but requires more labor and resources.

4.0 DISCUSSION

4.1 Summary

In this study, we analyzed transcripts from the semi-structured interview portion of Q-Sort sessions with beef, pork and broiler producers in order to contextualize the drivers of sustainability-related decision-making regarding animal wellbeing and environmental stewardship. Of all the drivers referenced by producers from the a priori list or from their own experience, four drivers were the most salient: *personal, economic, customer, and regulatory* along with tradeoffs between priorities and between domains of sustainability. By understanding what drives animal producers to make decisions or balance tradeoffs, key leverage points to improve sustainability are revealed, providing valuable insight for public service agencies and policymakers to effectively support producers in meeting sustainability goals (Hayden et al. 2021).

Stringer et al. (2020) argues the necessity of including producer voices in seeking to understand their motivations and drivers of decision-making. The results of this analysis emphasize the importance of including the voices of producers as qualitative data sources when exploring sustainability, in addition to using sustainability metrics and farm-level data alone. Additionally, the present analysis adds critical insight to the quantitative Q-Sort analysis by contextualizing sorting decisions, describing drivers, and identifying tradeoffs not able to be described via the quantitative Q-methodology applied to this sample. Overall, this study is unique in its scope and mixed-methods approach that allowed for a nuanced comparison of influences across species (beef, pork, and broilers), operation size (10 to > 1,000 AU), and geographic location within the United States.

4.2 Animal Producers Are Not Solely Profit-Driven

The salience of *personal, economic, consumer, and regulatory* drivers revealed in this analysis aligns with other research on this topic (Balzani et al. 2020; Brown et al. 2021; Farstad et al. 2022; Hayden et al. 2021; Stringer et al. 2020; Willock et al. 1999). A seminal study by Willock et al. (1999) categorized non-financial influences that may affect decision-making among producers as a mix of attitudes (e.g. stress, risk aversion, off-farm work), goals (e.g. quality of life, management goals) and behaviors (e.g. profit maximization, diversification), influences that were also found in the present analysis.

Stringer et al. (2020) analyzed adaptation and development pathways to environmental, socio-cultural, and economic sustainability for different farming scales and production focuses, exploring the salient drivers to improve overall sustainability for each producer type. Stringer et al. concluded that conventional large-scale, conventional small-scale, traditional extensive, and artisanal producers may each be driven by interventions that emphasize different domains of sustainability. For example, conventional large-scale producers were predicted to be more driven by an emphasis on economic over societal or environmental sustainability than other farm types. Other studies have also concluded that larger scale producers are more likely to be

driven by market access or economic viability considerations than smaller scale operations (Buddle et al. 2021). Using both a review of the literature between 2007 and 2019 and interviews with producers, Brown et al. (2021) found economic factors among the most common determinants of behavior adoption regarding environmental management. However, Brown et al. also noted the overemphasis by policymakers on the impact of economic factors on producer decision-making. While economic and operational viability were important drivers of producer priorities and a driver of tradeoffs in this analysis, priorities such as animal wellbeing can take precedence over profit. For example, consistent with Willock and other recent research (Balzani et al. 2020; Hayden et al. 2021), producers in this analysis were found to be driven by goals other than profit maximization; *economic* (included within *operational viability*) drivers are salient determinants of priorities, but that priority-setting is also strongly influenced by other drivers such as *personal* or *customer*. Priorities where producers willingly forego profit should be recognized in policy as potential leverage points for behavior change.

4.2.1 Animal Wellbeing is Prioritized for Personal Benefits

Animal wellbeing was a high priority for most producers, influenced by different drivers including *personal* or *operational viability*. Animal wellbeing is a well-studied priority among animal producers: a previous study by Buddle et al. (2021) described personal care for their animals as a strong theme among Australian livestock producers. Producers in the present analysis noted the deep personal connections they had with their animals and explicitly noted examples of willingly placing animal wellbeing over profit. Additionally, Balzani et al.(2020) and Hayden et al. (2021) note that animal producers are motivated to achieve animal wellbeing for reasons other than profit. Balzani et al. emphasized that producers with a perceived high “non-use value,” defined as a personal valuation of the economic value derived from animal welfare beyond direct use of the animal, on animal wellbeing are more likely to prioritize it in their practices. The concept of non-use values driving behavior is represented strongly in the present analysis. For example, producers in Factor 1 highly prioritized animal wellbeing priorities based on their perception of its inherent value outside of direct profit. This suggests that for some producers, leveraging their desires to achieve the highest standards of animal wellbeing might be advantageous over leveraging potential increases in profitability. In many cases, however, animal wellbeing and operational viability were noted to work in conjunction, representing a synergistic relationship rather than a tradeoff. This synergistic relationship is discussed in Section 4.4.

4.2.2 Other Proposed Drivers of Animal Wellbeing

While animal wellbeing was a high priority for most producers in this sample, it’s important to consider other factors not explored in this study that could impact priorities such as bonding and social desirability bias. In a semi-systematic review and thematic analysis, Balzani et al. (2020) explored factors that influenced producer’s views on animal welfare, finding that farming systems that supported more direct contact between producers and animals was a large determinant of animal welfare behaviors. Mediators to bonding included a smaller operation size that allowed for frequent and direct contact between producers and animals; operation scale; species, possibly due to differences in animal lifespan or temperament (e.g. producers tended to

feel closer to their cows than pigs or chickens); housing system and stocking density (e.g. intensive pork confinement reduced a producer's ability to bond with their animals versus a dairy milker who milked their cows daily); and stage of animal production (e.g. breeding stock producers had varying degrees of emotional attachment versus varying degrees of emotional detachment in producers who raised animals to slaughter) (Balzani et al. 2020). Additionally, Balzani points to social desirability bias as a salient influence of animal welfare practices, which was not explored in this analysis.

4.2.3 Q-Sort Factors Reveal Patterns in Producer Priorities Absent of Scale

The finding of this Q-sort study clustered producers into three groups, or "Factors" based on similarities between priorities. This is unique in the literature on this topic, as many mixed methods or qualitative analyses pre-sort producers by operation size, species, or location. Producers with similar priorities were clustered into three Q-sort factors; each factor was composed of diverse species types, scales, and operating regions, except for the four very-large scale producers in this sample, who all sorted into Factor 2, among a mix of other operation sizes. This highlights that somewhat irrespective of scale, species type, or operating region, producers can cluster around a similar set of priorities, which contradicts common assumptions about the influence of these three factors in other research (Stringer et al. 2020).

Balzani et al.(2020) concluded that smaller herd size on an operation positively influences producer perception of animal wellbeing, emotional attachment to their animals, and perception of animal health status. In this analysis, while very large scale producers were more likely to disregard the relevance of animal "happiness" as a relevant construct than smaller scale producers, both small and larger-scale producers emphasized the critical importance of animal health. This suggests that scale by and large is not an accurate predictor of animal wellbeing priorities regarding animal health specifically.

While very small producers were more likely than very large scale producers to identify *personal* drivers as influencing their priorities, the same drivers were represented across all operation scales (e.g. some small producers were heavily influenced by *operational viability* and some large scale producers were heavily influenced by *personal*). In summary, in all but the very-large scale operations, drivers of priorities are not necessarily consistent between similar operation types, which is suggested by Stringer et al (2020) and Balzani et al. (2020). While these individual exceptions do not disprove an aggregate trend in drivers by farm type, and while this analysis did not intend to analyze a representative sample of farm types, it is critical to highlight cases where producer drivers do not align with common paradigms. The heterogeneity of decision-making contexts among producers, as revealed in this analysis, emphasizes the need to understand the motivations behind agricultural priorities that influence sustainability (Stringer et al. 2020; Adolph et al. 2021).

4.3 Tradeoffs in Economic, Societal, and Environmental Sustainability

Given the constraints of limited time and resources and the binary nature of some farming practices (e.g. pastured vs. confinement systems; feed selection, species selection) in animal production, it is not possible to maximize all three domains of sustainability simultaneously,

inevitably leading to tradeoffs. Previous research uses an array of approaches to model or quantify tradeoffs in agriculture, seeking to optimize outcomes such as resource use at the micro-level to integrating multiple domains of sustainability at the macro scale (Adolph et al. 2020). Klapwijk et al. (2014) reviewed recent advances in tradeoff analysis in agricultural systems, concluding that tradeoff analysis has increased in importance for identifying interventions in diverse agricultural systems. As emphasized by Klapwijk et al. (2014), there is a need for participatory, qualitative data in tradeoff analyses to fill the gap in knowledge surrounding societal sustainability, which are less often quantified in tradeoff analyses (Latruffe et al. 2016).

As producers in the Q-sort ranked their priorities, tradeoffs were revealed among both priorities and sustainability domains. Adolph et al. and Klapwijk et al. (2014) summarize tradeoffs in agriculture as occurring between dimensions of sustainability, timescales (e.g. short- to long-term), spatial scales (e.g. farm to landscape scale), and between different types of producers; the tradeoffs that emerged in this analysis are consistent with that variety, occurring across several categorizations. Refer to Table 3 below for a summary of tradeoffs in this analysis. If a compromise was made in favor of one priority or objective over another, it is denoted by a “>” or “<” symbol, with a note of how many producers noted the same compromise (n); in the case of the decision between USDA vs. non-USDA processing, the compromise is denoted by a “-”, reflecting that producers varied on their decisions between the two.

Table 3: Tradeoffs in Sustainability Domains Discussed in Q-Sort Interviews

Sustainability Domain(s)	**Tradeoffs Between Outcomes** *(denoted as outcome chosen > outcome not chosen)*
Economic > Societal	Operational viability > Quality of life (QOL) (n=7) Operational viability > Providing affordable products to consumers (n=3) Operational viability > Animal wellbeing (n=3) Operational viability > Personal values (e.g. personal reservations with selling beef at a sale yard or freedom to market their product as desired) (n=2) Operational viability > Operational resilience (n=1) Profit > Animal wellbeing and QOL (n=1) Not raising pigs > Finding markets to sell pigs and arduous labor of moving their pens (n=1) Operation scale limitations > Raising chickens at all (n=1) Selling wholesale > Diluting individual brand (n=1)

	Complying with consumer preferences about smell (by moving away from population centers) > losing workforce access (n=1)
Societal > Economic	Animal wellbeing > profit (n=8) Convenience and processing control (+regulatory constraints) > Ability to sell meat retail (n=2) Processing control (+high labor costs) > Profitability (n=2) Investing in long term resilience > Short term profits (n=1) Paying employees well > Paying self well and profitability (n=1) Long-term operational viability (raising beef) > Short term viability (raising chickens (n=1)
Economic > Environmental	Profit > Installing solar or new technology (n=1) Profit > Raising animals on the land (n=1) Chickens (i.e. animal that reach market weight quickly) > Ruminants (i.e. an animal that aligns better with environmental stewardship goals) (n=1) Profit > Planting riparian zone (n=1)
Economic – Economic	USDA processing – Non USDA processing (n=3) Operational viability > Cost of Organic certification (n=3) Consolidated livestock season (profit) > choice of geography (location) (n=1) Profitability > Animal finishing times (efficiency) (n=1) Operational viability > Access to more market pathways (n=1)
Societal > Environmental	(Due to lack of land ownership) Animal wellbeing > environmental stewardship (n=1) Heating barn for animal comfort > Energy efficiency (n=1)
Societal – Societal	Farming as a vocation > QOL (n=1) Time demands of farming > Educating the public (n=1) Hiring employees > Available time (n=1)

	Access to consumer base (via operation location) > Maximum operation size (n=1) Consumer demands about air quality > Access to workforce (n=1)
Environmental > Economic	Regenerative practices > Organic certification (n=1) Pastured > Minimizing finishing times (n=1) Protecting wildlife habitat > operational viability (n=1) Buying Organic, farther away feed > Buying cheaper local conventional feed (n=1)
Environmental > Societal	Ecology (i.e. via manure management) > Non-confinement systems (n=1)
Environmental – Environmental	*None noted*

">" indicates the directionality of a tradeoff between domain or priority
"–" indicates a tradeoff within the same domain or priority
(roman numerals) indicate the number of producers who discussed this tradeoff

4.3.1 Tradeoffs Between Operational Viability and Animal Wellbeing - A Barrier to Societal Sustainability

Animal wellbeing-related statements were often the highest priority out of the Q-set for many producers. However, prioritizing animal wellbeing came with tradeoffs. Balzani et al. (2020) noted in their literature review that conflict existed between productivity and giving animals a "good life." This is also supported in the present analysis; a commonly noted tradeoff was between decreasing animal finishing times or raising animals on pasture. In this example, many producers chose to maintain pastured production, highlighting a common theme in this analysis that while the burden of needing to remain *viable* was a strong driver for some producers, they were noted to make tradeoffs in the name of animal wellbeing. For example, producers willingly sacrificed operational viability as an outcome due the strength of their *personal* convictions about animal wellbeing. Some producers that prioritized animal wellbeing were willing to pay more for feed, slower-growing breeds, longer finishing times, spend less time marketing, and generally accept less efficiency in the name of exemplary animal welfare. There were cases where operational viability prevailed, however. Primarily, this was due to the lack of available animal processors forcing producers to truck their animals long distances for processing, which violated their standards of animal welfare.

Notably, producers who chose to make a tradeoff between two sustainability domains didn't necessarily make a tradeoff between those domains when faced with other choices. For example, P01 noted the tradeoff between providing affordable products to consumers (societal sustainability domain) and maintaining economic viability (economic sustainability domain), choosing to forego providing affordable products. However, P01 later noted choosing societal

over economic sustainability by raising a more humane breed of broiler that takes longer to finish, lowering profitability through lost efficiency. While producers do not necessarily consciously consider tradeoffs *between domains of sustainability* when making decisions, the findings here suggest that granularity exists within sustainability domains, and, thus, producer types cannot be expected to prioritize a single domain. Therefore, granularity within sustainability domains should be considered in interventions that seek to improve sustainability in a heterogenous (i.e. varying species or scale) farm population. To do so, it may be advantageous for policymakers to first cluster their target population by their relevant drivers of behavior to improve their chances of success.

4.3.2 Synergies Between Animal Wellbeing and Operation Viability

Grzelak et al. (2022) quantified tradeoffs on Polish farms to explore the existence of relationships between sustainability dimensions, finding a strong positive relationship between economic and environmental domains, and other significant positive relationships between economic, social, and environmental domains. In this analysis, the strongest synergistic relationship was found between societal (e.g. animal wellbeing) and economic (e.g. operational viability) domains of sustainability. Specifically, many producers noted the synergistic relationship between animal husbandry and profitability, bolstering their desire to prioritize animal wellbeing on their operations. This relationship has been found in previous research; Latruffe et al. (2016) compared farm level indicators of all three pillars of sustainability and concluded that high social sustainability was linked to high economic performance for grazing livestock farms and mixed crops-livestock farms. Additionally, Buddle et al. (2021) noted the relationship between animal welfare and operational viability, highlighting that drivers rarely act in isolation. These findings suggest that economic and social sustainability can be complementary.

4.3.3 Farming as a Viable Vocation - Tradeoffs in Societal Sustainability

Farming in itself is recognized as a vocation with inherent value and source of personal identity, supporting rural communities and a strong connection to land and place (Stringer et al. 2020; Willock et al. 1999). Two main indicators for societal sustainability commonly accepted in the literature include the farm community (e.g. producer quality of life and working conditions) and broader society (e.g. contributions to employment and rural livelihoods) (Sidhoum et al. 2022). There is a disproportionate focus on environmental and economic sustainability in the literature (Sidhoum et al. 2022) and this analysis provides a valuable addition to current understandings of the societal domain as it compares to the economic and environmental domains.

The results of this analysis reveal a tension between the burden of operational viability and societal sustainability among producers of all scales; many producers reported tradeoffs between components of societal sustainability (see Table 5). Consistent with this analysis, Stringer et al. (2020) note that small farms are less likely to be financially viable; many producers in this sample note having an income source separate from the farm, which acted as a “safety net” or source of economic resilience and viability, with one producer (P12) about to exit farming altogether. Implied here is the need for an agricultural system that allows animal

producers a secure, livable wage forgoes the need for additional income and allows producers to operate in relative balance between all three domains of sustainability.

For smaller scale producers in this sample, an additional tradeoff existed between their ability to remain economically viable and provide affordable products to consumers. Smaller scale producers do not benefit from the same economies of scale available to larger producers, and as a result must price their products out of the range of affordability for many consumers (Stringer et al. 2020). Systematic changes in agricultural systems, such as policy support or infrastructure development (i.e. expanding animal processing systems) are needed to support the operational viability of animal producers' without compromising their ability to enjoy a high quality of life while contributing to their communities.

4.4 Strengths and Limitations

Q-methodology seeks to include participants with diverse worldviews rather than recruiting for a representative sample, thus, the views expressed by one species or operation size can not be concluded to represent that farming group as a whole. It is understood that the exploratory nature of this study did not seek to comprehensively describe the perceptions of all types of livestock producers, however, the qualitative methods employed here would have benefited from the ability to interview a larger number of producers with certain characteristics (i.e. operation size or species raised) to reach data saturation on specific themes.

This analysis is strengthened by the application of qualitative methods that includes the subjective viewpoints of producers over other research that used statistical modeling to identify tradeoffs (Pang et al. 2022, Ssebunya et al. 2019, Latruffe et al. 2016, Sidhoum et al. 2022). Additionally, this analysis is strengthened by the significant heterogeneity achieved in the scale, operating region, and species type of the sample, allowing for a breadth of data on producer decision-making regarding the same animal wellbeing and environmental stewardship priorities. As a research team, we were unable to verify if the priorities expressed in this analysis, possibly influenced by social desirability bias, translated to their practices, however, there is evidence that producer attitudes towards sustainability impacts their intent to change their practices (Creemers et al., 2019).

4.5 Future Research

Future research should continue to apply qualitative methods to sustainability research among livestock producers to ensure that interventions and policies are relevant to this population (Balzani et al. 2020; Klapwijk et al. 2014), with larger sample sizes recommended. Research should explore methodological best practices for Q-Sorts that utilize robust qualitative methods in their analyses. Finally , further exploration is necessary into how producer priorities are effectively translated into practices over time, and how priorities compare to farm-level indicators of sustainability (e.g. water consumption per hectare, farm output per hectare, quality of life measures) (Latruffe et al. 2016).

4.6 Recommendations

Table 4: Recommendations for Policymakers and Public Service Agencies Serving Animal Producers

1. Incorporate the perspectives of animal producers and other stakeholders into sustainability research.

2. Recognize that animal producers are motivated by drivers beyond rational profit-maximization. When aiming to change behavior, consider the impact of personal values, keeping in mind the diverse motivations within the industry.

3. Animal producers already prioritize animal wellbeing and environmental stewardship. Harness their current priorities to bolster sustainability efforts by integrating these values into strategies and initiatives to garner support for more effective and widely accepted sustainable practices in animal agriculture.

4. Acknowledge the complexity of producer decision-making, the diverse priorities among producers, and the lack of predictability among farm types and scales. Move away from one-size-fits-all approaches to better address the unique needs of different agricultural contexts.

4.7 CONCLUSION

Animal agriculture remains an integral part of the U.S. food supply, and as demand for animal products grows in a warming climate, it is essential to explore avenues for producers to continue operating sustainably. However, moving toward animal production systems that balance all domains of sustainability without excessive tradeoffs will require identifying the current priorities and relevant drivers of behaviors of animal producers. Policymakers and public service agencies are encouraged to tailor their approaches to sustainable animal production considering heterogeneity in drivers and outcomes for animal producers.

Across diverse scales and practices, the animal producers included in this study were both savvy business owners and holistic players in sustainable animal production. Their main drivers of priorities include *personal, operational viability, customer, and regulatory*, and each producer operated under a unique context of influences. The findings of this study highlight that if given favorable operating conditions such as accessible animal processing systems and consistent market pathways, then producers might make fewer tradeoffs. Additionally, these findings show that some producers are already maximizing multiple domains of sustainability on their operations, such as societal and economic, by capitalizing on synergistic relationships between practices. If these existing relationships can be supported by policy and public service agencies, a more sustainable animal production system is in our reach.

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6.0 APPENDIX

Appendix 6.1 Participant Characteristics

		Protein Focus					
I.D.	**Location (region)**	***Beef***	***Pork***	***Broilers***	**Market (primary)**	**Position**	**Exp. (yrs.)**
P01	Northwest			V. Small	Direct to consumers	Owner	1.5
P02	Midwest	Small	Medium		Direct to consumers, wholesale	Owner	--
P03	Northwest	Small	Small	Small	Wholesale	Owner	22
P04	Northwest	Small	Small	Small	Direct to consumers (incl. Ecommerce)	Owner	7
P05	Northeast	Small			Direct to consumers	Owner	4
P06	Northwest		Small	Small	Direct to consumers (incl. Ecommerce), wholesale	Owner	8
P07	Midwest		V. Small	V. Small	Direct to consumers, wholesale	Owner	3
P08	Midwest	Small		V. Small	Direct to consumers (incl. Ecommerce)	Owner	7
P09	Northwest			Medium	Direct to consumers, wholesale	Owner	15
P10	Midwest		Small		Direct to consumers	Owner	8
P11	**Multiple locations*		V. Large		Wholesale	Owner	12
P12	Northwest	Medium			Commodity	Owner	25+
P13	Northwest		Small		Direct to consumers, wholesale	Owner	8

P01	Northwest			V. Small	Direct to consumers	Owner	1.5
P02	Midwest	Small	Medium		Direct to consumers, wholesale	Owner	--
P03	Northwest	Small	Small	Small	Wholesale	Owner	22
P14	Northwest	Medium	V. Small		Direct to consumers	Owner	10
P15	Midwest			V. Small	Direct to consumers	Owner	5
P16	Southwest	Large			Commodity	Owner	33
P17	Northwest		V. Small		Direct to consumers, wholesale	Owner	--
P18	Midwest		V. Large		Commodity	Owner	25
P19	Midwest		V. Large		Commodity	Owner	--
P20	Northwest	Medium	Small		Direct to consumers	Owner	6
P21	Northwest	Medium			Direct to consumers, commodity	Owner	--
P22	Northwest	Large			Commodity	Owner	50+
P23	Southwest	Small			Direct to consumers, wholesale	Owner	--
P24	Midwest			Small	Direct to consumers	Owner	3
P25	Northwest		Small		Direct to consumers, wholesale	Owner	15
P26	Midwest	Medium	Medium		Wholesale	Owner	49
P27	Midwest			V. Small	Direct to consumers	Owner	5
P28	Northwest	Small			Direct to consumers	Owner	10
P29	Midwest		V. Small		Direct to consumers	Employee	2
P30	Southeast	Small	Small	Small	Direct to consumers (incl. Ecommerce)	Owner	3
P31	Midwest	V. Small		V. Small	Direct to consumers, wholesale	Owner	7

P01	Northwest			V. Small	Direct to consumers	Owner	1.5
P02	Midwest	Small	Medium		Direct to consumers, wholesale	Owner	--
P03	Northwest	Small	Small	Small	Wholesale	Owner	22
P32	**Multiple locations*		V. Large		Wholesale	Dir. of Public Affairs	49
P33	Northwest	Large			Direct to consumers, commodity	Ranch Manager	11
P34	Southeast	Small	Small		Direct to consumers (exclusively Ecommerce)	Owner	4
P35	Midwest		V. Small		Direct to consumers	Owner	7
P36	Midwest					Owner	1.5
P37	Midwest		V. Small		Direct to consumers	Employee	6
P38	Midwest		V. Small		Direct to consumers	Owner	7
P39	Southwest	Small	V. Small	V. Small	Direct to consumers (incl. Ecommerce), wholesale	Owner	9
P40	Midwest		Large		Wholesale	Owner	24
P41	Midwest		Small		Direct to consumers	Owner	7
P42	Midwest	Small	Small	Small	Direct to consumers	Owner	5

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

Appendix 6.2 Definitions for operation scale according to the number of animal units (AUs) and total number of animals for each species included in this study. Adapted from Janzing, N. (2023)

	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

Appendix 6.3 List of Q-statements with factor scores

#	Statement	Sustainability Pillar	Factor 1 Score	Factor 2 Score	Factor 3 Score
1	Navigating changing mandates and laws effectively.	Societal	**-2**	**2**	**-3**
2	Minimizing animal finishing times.	Societal	**0**	**-1**	**-4**
3	Reducing carbon emissions.	Environmental	**-5**	**-2**	**1**
4	Preventing animal illness.	Societal	**4**	**3**	**0**
5	Increasing production in resource-efficient ways.	Environmental	**0**	**3**	**2**
6	Providing affordable products to consumers.	Societal	**-3**	**1**	**1**
7	Providing nutritious food to consumers.	Societal	**2**	**6**	**3**
8	Building trust with consumers.	Societal	**2**	**4**	**4**
9	Showing the public that production is safe and humane.	Societal	**3**	**1**	**1**
10	Maintaining traditions in farming practices.	Societal	**-4**	**-4**	**-6**
11	Keeping a consistent, dependable, and efficient workforce.	Societal	**-2**	**0**	**-2**
12	Practicing the responsible use of vaccines and antibiotics.	Societal	**1**	**0**	**-4**
13	Utilizing genetic selection.	Societal	**1**	**-2**	**-3**
14	Building or expanding local, direct-to-consumer markets.	Societal	**2**	**-1**	**2**
15	Increasing energy efficiency.	Environmental	**-4**	**0**	**-3**
16	Diversifying market pathways.	Societal	**-1**	**1**	**0**

17	Ensuring good air quality for animals, workers, and neighbors.	Environmental	**-3**	**-1**	**-1**
18	Monitoring animal behavior.	Societal	**3**	**-2**	**0**
19	Ensuring comfortable living environments for the animals.	Societal	**4**	**1**	**2**
20	Managing manure effectively and efficiently.	Environmental	**0**	**-1**	**-1**
21	Raising animals not in confinement.	Societal	**1**	**-6**	**2**
22	Increasing renewable energy use.	Environmental	**-6**	**-3**	**-2**
23	Minimizing water pollution.	Environmental	**0**	**0**	**0**
24	Giving animals more space.	Societal	**0**	**-5**	**0**
25	Training employees to prioritize proper animal handling.	Societal	**-1**	**1**	**-5**
26	Providing optimal rations to animals.	Societal	**3**	**2**	**0**
27	Preserving wildlife habitat.	Environmental	**0**	**-2**	**3**
28	Ensuring animals are respected and happy.	Societal	**6**	**-1**	**3**
29	Collecting data to track and improve sustainability practices.	Environmental	**-3**	**0**	**-2**
30	Improving sustainability by using new technologies.	Environmental	**-1**	**2**	**-1**
31	Increasing water use efficiency.	Environmental	**-1**	**-3**	**-2**
32	Ensuring the health of animals.	Societal	**5**	**4**	**4**
33	Increasing consumer understanding of farming operations.	Societal	**1**	**2**	**1**
34	Stewarding the land and natural resources.	Environmental	**1**	**5**	**5**
35	Preventing farm land from being lost to development.	Environmental	**-1**	**-4**	**-1**
36	Building on-farm resilience in preparation for disasters.	Environmental	**-2**	**-3**	**1**
37	Improving production and profitability by using new technologies.	Environmental	**-2**	**3**	**-1**
38	Maintaining the quality of soil.	Environmental	**2**	**0**	**6**

Appendix 6.4 Interview Guide*

Interview Guide	
P1. So what did you think?!	*Initial reaction…*

P2. **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*
	- ***Drivers/pressures*** *(see below)*
	  o *If they are silent, go one by one.*
	  ▪ *"Can you walk us through your thinking?"*
	  ▪ *"What kind of things were you thinking about as you ranked these items?"*
	  o *If they mention multiple drivers, and leave one or two out, revisit the ones missing.*
	- ***Additional reasons*** *for decision-making (not included in the 6 drivers)*
	- *Facilitators of current priorities*

P3. **Looking at these last four columns**, or your lowest priorities, what drives this ordering?	Probes
	- ***Drivers/pressures*** *(see below)*
	  o *If they are silent, go one by one.*
	  o *If they mention multiple drivers, and leave one or two out, revisit the ones missing.*
	- ***Additional reasons*** *for decision-making (not included in the 6 drivers)*
	  o *Didn't make sense, never thought about, not applicable to your operation…*
	  o *Not aware of what's out there (e.g., possible technology), solely for large scale operations, not of value…*
	- *Facilitators of current priorities*

P4. 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* - Are there any specific priorities that you would have ranked higher or lower, without these pressures at play? - **Why?** o **Motivators** behind why they are seeking a change, if possible o **What influences** are preventing your ideal changes?

**Interview questions preceded by Q-sort exercise reported in separate manuscript as part of the overall Q-Sort Analysis. Guide created collaboratively by the research team and used with permission for the purposes of this analysis.*

Appendix 6.5 Qualitative Codebook

Code	Code Definition	Notes
Regulatory	Statements reflecting governmental mandates, policies, regulations.	Use for statements such as (P7): "*P: Well, don't tell anybody, but apparently we were supposed to have a wholesale distribution license to be selling to the restaurant but they didn't ask for that. And everybody's fine, and there was [specific inspector] inspected and it's not like, you know we're going to have any backlash from that. But I'm like oh, whoops! I guess they should have had a license for that."*
Child Code DRIVER: regulatory	Statements reflecting regulations that influence decision-making that are noted to drive behavior or priorities.	Use for statements that clearly describe regulations that influence behavior. For example, (P5): *"I1: Are there any parts of your business that are really influenced by different regulations or is it just something that you it doesn't really affect you as a whole?* *P: No, like, commodity prices don't affect us. We're required to have USDA inspected Stamp on our product which limits our the kind of processors that we can use and just Makes us very I want to say like vulnerable or dependent on our processor. So during COVID that was pretty scary. Where it's a small processor, And they made a lot of changes and a lot of people were no longer able to bring their animals*

		there But we were at a scale processing 8 every other week that they kept us because it was like one touch for we were big enough account for them. But that also feels like it was kind of just luck. It made us rethink How dependent we are on them."
Processing	Statements referring to meat processing and related barriers, regulations, challenges, and successes.	Use this code for statements about USDA-regulated processing or other processing methods, or booking butcher dates. Do not use this code for statements about regulations related to pricing, packaging, labeling, transportation, or distribution. Use code DRIVER: REGULATORY
Industry/Buyer	Statements about customer purchase stipulations, industry "standards", and commercial purchasing standards	Examples include wholesale or commercial buyers.
Child Code DRIVER: industry/buyer	Statements referring to industry or buyer standards that influence producer behavior or priorities.	Use for statements such as (P19) *"I2: I'd love to hear you talk about the kind of generational change and, you know, even even just literally the animals that you've been raising, how much of that change and I guess how often is that dictated by the major intermediaries you sell to, like [large meat companies] and [large meat company]? I mean, are are they, do they have a heavy hand? And kind of You know which stocks you choose and which animals you raise.* *P: Ah, they they want the parameters. You sell the pig to live has to meet a certain weight and a certain yield standard. And then the meat a certain there's a there's a quality standard there of the, From a safety standpoint, but it's basically weight. And there there's no There's no pressure. Let's say it's so the recent pressure, for instance, would be they wanted a colored bore, which increases the meat quality from the standpoint of color and intramuscular fat. So will they pay you a premium for that? slight Right. There's a slight premium there, so then they'll incent you to good behavior and they'll punish bad behavior. That's probably their influence, which is that's how all of us, my children and grandchildren,*

		right, you want to reward good behavior and punish bad. So it's not like they dictate this is what you should. You should do. No, no, you just get, uh, an economic advantage if you meet their standard."
Consumer	Statements about general public demands, consumer preferences, or consumer misconceptions about operation practices or products.	Examples include demands or preferences of customers at producers markets and direct-to-consumer. Do not use this code for wholesale buyers, use code INDUSTRY/BUYER
Child code DRIVER: Consumer	Statements about consumer preferences, impressions, or demands that influence producer behavior or priorities.	Use this code for statements that describe how producers' behavior on their operation or in their marketing is influenced by consumers. For example, (P6), *"P: Yeah, that would be cool. So for example, we our slaughterhouse got a grant for an RFID program. And we had a livestock-- and we were part of that. So we started ear tagging all of our pigs. And I want to figure out like, which sows are giving me fatty bacon. And I know that that is a like it's a genetic thing. It's a, you know Growing them a little bit too big, but there's still somebody out there has given me fatty Bacon and customer are afraid of fat because the 90s were really detrimental to that. And so then that's really hard for me to sell So I want to use those RFID tags to figure those out out, cull them, replace them, but we don't have the bandwidth for that and we don't have the money to continue paying our livestock producer."*
Child code: Product Affordability	Statements about the affordability of products for consumers.	Use this code for statements about providing "affordable" products to consumers. Use this code for statements about a producer's opinion or actions to provide affordable meat to consumers. If a producer talks about a personal responsibility to provide affordable meat, double code with DRIVER: PERSONAL.
Child code: Consumer education	Statements referring to actions taken or priorities held by producers to intentionally educate consumers on an operation's practices.	Examples include interfacing between producers and consumers at producers markets, over email, social media, newsletters, or word of mouth to inform consumers about decisions around operation practices (i.e. choosing not to certify as organic

		because of the cost). OR operation practices that make a product marketable as “superior”, worth the price point, “ethical”, or “sustainable”. (i.e. grass fed).
Child code: Consumer Marketing	Statements referring to behaviors or priorities of producers to market to consumers	Examples of marketing outlets include social media marketing, newsletters, branding, online presence, or word of mouth.
Operation/Brand	Statements about values pertaining to the brand of the product or company-specific pressures.	Do not use this code for personal values about animal welfare or environmental stewardship, use code PERSONAL
Child code DRIVER: operation/brand	Statements about operation or brand standards that influence operational behavior or priorities.	Use this code for statements that refer to improving or maintaining a brand or operational tradition for ANY purpose (marketing, profit, personal values, operational sustainability, etc.)
Personal	Statements about values pertaining to the producer’s personal perspectives or generational viability.	Use code for statements like, “I farm because I care about animal welfare”or (P6)*“P: And you know, like we also really like the mill that we've worked with and they've been around since the 1870s and they're 5 miles away and they're not organic because they do a lot of conventional feed as well…Because we're so polarized right now, right, Whether it's political polarization or conventional organic polarization like, I like working with these ladies down at the mill. They're all super conservative and they don't do organic and there's something that feels a little bit Punk rock and collaborative, that is like, hey, we can get along. It's not that important like these concepts, What is more important is, Building our community and keeping each other in business.”*
Child code DRIVER: Personal	Statements about how personal values, opinions, or experiences influence behavior or priorities on an operation.	A “personal” value or driver need not necessarily be explicitly stated when applying this code.

Economic	Statements about the need to be financially stable and remaining viable.	Use this code for statements referring to profit, profit margins, product pricing, equipment and input cost, and operation scaling. Do not use this code for consumer demands (e.g. at producers markets) use code CONSUMER.
Child code DRIVER: Economic	Statements about how economic factors influence behavior or priorities on an operation.	Use this code for statements that refer to economic factors such as profit, greater marketability, or desire for operation expansion that drive behavior or priorities. Economic factors need not be explicitly noted in the excerpt. For example, statements referring to operating as a grass-fed business in order to sell products at a higher price could be coded as DRIVER: ECONOMIC. Similarly, statements referring to operating as a grain-fed business in order to save money on feed costs could be coded as DRIVER: ECONOMIC.
tradeoffs	Statements referring to having to prioritize or choose one decision/behavior over another on an operation. The tradeoff could be between domains of sustainability (economic, social, environmental) OR between drivers (e.g. economic drivers overrule personal drivers). Statements that use this code can either explicitly mention tradeoffs or allude to them.	For example, for statements like (P5): *"actually minimizing the animal finishing time like that would be nice, except like one of the problems we've had is trying to Match our like The rate that we're going through cattle with like trying to match everything up like to get a butcher date like we started it in May of 2019. So then in February of 2020, it was COVID and all of a sudden you couldn't get any butcher dates. So then we had, like, no meat, no butcher dates. Like, I didn't know how many animals. For the last 2 1/2 years I all I know is that I could sell everything we had that we could butcher. So now we're trying to like build it up, then this past year I've had like too many butcher dates and had to give some of them back because it didn't have like we Weren't selling as much product like I was Like hoarding, butcher dates and. So like just trying to so some of our animals have been on feed probably longer than they needed to be because that I didn't have either have didn't have a date or didn't have room in the freezer."*
Inapplicable	Statements referring to practices, problems, drivers, or other factors that producers	Use this code for statements referring to geography either explicitly or implicitly. For example, use this code for statements about weather in the midwest,

	claim do not apply to them or their operation for any reason.	OR about how the presence of neighboring operations support the participants operation.
Land ownership	Statements about how owning or not owning land impacts animal welfare or environmental stewardship practices.	Use this code for statements about land ownership, do not use this code for regulations around water or land use, use code REGULATORY.
Geography (added 6/7)	Use this code for statements that refer to geographic factors that influence resource availability, disaster preparedness and risk, farm neighbors, and community or regional infrastructure that influence an operation.	Use this code for statements that explicitly mention geographic terms like state or biome of residence, AND/OR statements that imply geographic significance such as neighboring farms, location of feed mills or processors, or demographics of customer base (poor or affluent).
Antibiotic/vaccine use	Use this code for statements related to antibiotic or vaccine use on an operation.	If applicable, double code statements referring to Q statement “Practicing the responsible use of vaccines and antibiotics.”
Animal wellbeing (added 6/5)	Use this code for statements related to animal husbandry, animal handling, general ethos regarding animal wellbeing, and animal efficiency and productivity.	This code should be a general bucket for statements about animal wellbeing. For statements referring to a Q-statement, co-code with the appropriate Q-statement code.
Child code DRIVER: Animal Wellbeing (added 7/27)	Statements about animal husbandry, animal handling, general ethos regarding animal wellbeing, goals, and animal efficiency and productivity that influence behavior or priorities on an operation.	
Environmental stewardship (added 6/5)	Use this code for statements related to behaviors or values that impact the environment.	For example, use this code for statements referring to pasture management, crop rotation, or streambank and fencing maintenance. This code should be a general bucket for statements about environmental stewardship. For statements referring to a Q-statement, co-code with the appropriate Q-statement code.

Child code DRIVER: Environmental stewardship (added 7/26)	Statements about environmental stewardship behaviors, priorities, or goals that influence behavior or priorities on an operation.	
General ethos	Use this code for statements that refer to a producer's overarching or characteristic approach to agriculture.	Use this code for statements about practices that are not exclusively animal wellbeing or environmental stewardship. For example (P19): "*See, so a good pig farmer just knows those things, They know that they should provide good, I mean, without good air quality, My pigs aren't healthy. My pigs don't grow. That's not a priority. That's just a necessary thing. You should do. And the same with collecting data that you should just you if you're If you're a 16 and see I can we're 4 generations in America, We're 16 generations back to Europe. If you've been in agriculture for 16 generations, I'm not sure about the definition of sustainability, but I think that's sustainable. And this is just those are just the things we do*"
Cause and Effect (added 7/24)	Use this code for statements that	
Synergies (added 7/21)	Use this code for statements that refer to a behavior or priority on an operation that confers multiple benefits to the operation, producer, environment, industry, or other players.	For example, use this code for statements referring to animal husbandry practices (i.e. raising animals not in confinement) that confers the three benefits of reducing animal illness, meeting personal, regulatory, or consumer animal husbandry standards, and reducing costs for the producer.
Operational viability (added 7/21)	Use this code for statements that refer to the operational remaining function or in business over time.	Can use this code for statements referring to profitability, longevity, viability, sustainability or other terms that refer to the operation remaining functional over time.
Child Code: DRIVER Operational viability	Statements about operational viability goals or priorities that influence behavior or priorities on an operation.	
Q Statement: Navigating	Use these codes for statements that refer to a	Use these codes ONLY when the producer or interviewer is referring to or explaining the Q

changing mandates and laws effectively.	Q-sort statement in ANY part of the interview. Code statements that name the Q-statement explicitly OR are statements in response/reference to a previous mention of the statement.	statement as an element of the Q-sort. Do not use these codes for statements not tied to a Q-statement and do not use these codes when the statement is read but not expanded upon. When appropriate, double code these statements with respective drivers and tradeoffs.
Q Statement: Minimizing animal finishing times.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Reducing carbon emissions.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Preventing animal illness.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Increasing production in resource-efficient ways.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Providing affordable products to consumers.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Providing nutritious food to consumers.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Building trust with consumers.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Showing the public that production is safe and humane.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Maintaining traditions in farming practices.	See above definition for all Q-statements.	See above notes for all Q-statements.

Q Statement: Keeping a consistent, dependable, and efficient workforce.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Practicing the responsible use of vaccines and antibiotics.	See above definition for all Q-statements.	See above notes for all Q-statements.See above notes for all Q-statements.
Q Statement: Utilizing genetic selection.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Building or expanding local, direct-to-consumer markets.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Increasing energy efficiency.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Diversifying market pathways.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Ensuring good air quality for animals, workers, and neighbors.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Monitoring animal behavior.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Ensuring comfortable living environments for the animals.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Managing manure effectively and	See above definition for all Q-statements.	See above notes for all Q-statements.

efficiently.		
Q Statement: Raising animals not in confinement.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Increasing renewable energy use.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Minimizing water pollution.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Giving animals more space.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Training employees to prioritize proper animal handling.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Providing optimal rations to animals.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Preserving wildlife habitat.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Ensuring animals are respected and happy.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Collecting data to track and improve sustainability practices.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Improving sustainability by using new technologies.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Increasing water	See above definition for all	See above notes for all Q-statements.

use efficiency.	Q-statements.	
Q Statement: Ensuring the health of animals.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Increasing consumer understanding of farming operations.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Stewarding the land and natural resources.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Preventing farm land from being lost to development.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Building on-farm resilience in preparation for disasters.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Improving production and profitability by using new technologies.	See above definition for all Q-statements.	See above notes for all Q-statements.
Q Statement: Maintaining the quality of soil.	See above definition for all Q-statements.	See above notes for all Q-statements.

Appendix 6.6: Count of Drivers Coded in Q-Sort Interviews

Key (color classification added to largest scale species)	
Scale Very small Small Medium Large Very Large	**Factor** Factor 1 Factor 2 Factor 3

	Species			Count of Times Driver Coded			
ID	Beef	Pork	Broilers	Personal*	Operational Viability**	Customer***	Regulatory
P01			V. Small	10	4	2	0
P17		V. Small		7	2	2	0
P07		V. Small	V. Small	8	4	3	0
P27			V. Small	10	2	2	1
P31	V. Small		V. Small	11	4	5	0
P35		V. Small		8	5	2	1
P04	Small	Small	Small	7	8	4	2
P05	Small			4	3	6	0
P06		Small	Small	6	4	12	1
P10		Small		12	2	6	0
P13		Small		5	3	3	3
P28	Small			5	8	5	5
P34	Small	Small		8	6	12	0
P41		Small		3	2	10	0
P24			Small	10	15	5	1
P03	Small	Small	Small	0	1	2	0
P23	Small			0	2	3	2
P08	Small		V. Small	0	3	2	0
P30	Small	Small	Small	3	3	5	0
P39	Small	V. Small	V. Small	9	5	5	0
P42	Small	Small	Small	1	7	2	1
P12	Medium			0	1	2	2
P14	Medium	V. Small		4	4	3	2
P21	Medium			1	4	0	0
P02	Small	Medium		1	3	1	2
P09			Medium	3	4	3	4
P20	Medium	Small		1	10	2	0
P26	Medium	Medium		3	2	0	1
P22	Large			1	4	5	2

P33	Large			4	6	2	0
P40		Large		7	4	6	1
P11		V. Large		1	6	3	4
P18		V. Large		1	4	4	3
P19		V. Large		1	3	4	0
P32		V. Large		7	2	4	4

**Personal driver composed of codes Driver: Personal; Driver: Animal Wellbeing; Driver: Environmental Stewardship*
***Operational Viability driver composed of codes Driver: Operational Viability; Driver: Economic*
****Customer driver composed of codes Driver: Consumer; Driver: Operation/Brand; Driver: Industry/Buyer*

Appendix 6.7: Summary of Q-Sort Factors

	% of Producers in Factor Grouping (n total)			
Operation species or scale	**Factor 1 (n=15)**	**Factor 2 (n=7)**	**Factor 3 (n=13)**	**Total (%)**
Beef	(47.36)	(5.26)	(47)	100
Pork	(36.36)	(27.27)	(36.36)	100
Broiler	(15.38)	(15.38)	(61.54)	100
Very small scale	(33.33)	0 (0)	(66.67)	100
Small scale	(47.06)	(11.76)	(41.18)	100
Medium scale	(42.86)	0 (0)	(57.14)	100
Large scale	(66.66)	(33.33)	0 (0)	100
Very Large scale	0 (0)	100	0 (0)	100