Understanding the operations and decision-making of cow-calf farmers in Northwest Arkansas

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Clayton Weyl

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Abstract

Societal pressure on farmers has become a more central part of the rhetoric surrounding livestock production. This study includes farmers in the discourse on the rhetoric surrounding climate change via interviews and simulations tailored to their operation. Previous research has addressed regenerative agricultural practices and conditions that influence farmer decision-making, but little research has analyzed decision-making in tandem with environmental practices. The literature reveals that cow-calf producer decision-making is influenced by their reliance on cattle as an income source, and farmers overall choose climate-friendly practices based on their perceptions about climate change. The goal of this research was to gather data from farmers about their decision-making and operations; and analyze that data through a decision-aid software to find factors that may help them choose both economic and environmentally sustainable production practices. Data were gathered using a semi-structured open-ended interview of five cow-calf producers in the Northwest Arkansas area and analyzed using the Forage and Cattle Planner (FORCAP) decision-aid software. The researcher found research-based grazing management practices such as rotational grazing, strip grazing, and stockpiling forage to have profound, but varied, impacts on FORCAP estimates of net returns and net greenhouse gas (GHG) emissions. Each producer makes decisions based in some capacity on economics -- be it farm financial stability or the ability of the farm’s capital to support implementation of a practice. No producer ranked GHG emissions as a crucial factor influencing their decisions. Findings indicate that choosing optimal practices for GHG emissions can be highly profitable, but the impact of implementation will be variable depending on the scale and existing management practices of each individual operation. Policy aimed at
encouraging emissions reduction by cow-calf producers will have to include financial incentives, but policymakers must be careful to include incentives in a way that reduces net GHG emissions.

**Definitions**

*Sustainability* – the ability to maintain productive human, capital and land resources using production practices that are profitable while minimizing their negative environmental effects.

*GHG Emissions* – Blanket term to describe gaseous emissions from cow-calf operations, usually derived from carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), that are converted to CO₂ equivalents as a metric for measuring global climate change impact.

FORCAP – A spreadsheet model developed by Dr. Michael Popp, Dr. Coffey, Dr. West, Dr. Brye, and graduate students to help producers and extension agents analyze beef cow-calf operations by tracking both projected net returns and GHG emissions as a result of modifying beef cattle production parameters involving calving season, weaning age & weight, cow weight and reproductive performance, supplemental feed, forage species composition on pasture and hay land on a monthly time step, grazing method, fertilizer use, and specification of input/output prices.

*Interview* – Where relevant, the researcher conducted in-person interviews with NWA cow-calf operators to enter production parameters as best as possible into FORCAP and showcase potential production parameter changes to discuss impact and potential for adoption of modified production practices.
Introduction

While perceptions have improved in recent years, there has been a rhetoric that places the environment in contest with livestock production: especially intensive beef cattle agriculture. Many believe that beef cattle production must be reduced or completely eliminated to meet increasing demands for GHG emissions reductions to mitigate climate change (Levitt, 2021; Vetter, 2021; Carroll, 2019). Where certain beef production practices have been scientifically proven to be beneficial to the environment, (Hristov et al., 2013), we find the agriculture sector is slow to adopt new practices (Gomes & Reidsma, 2021).

With socially increasing demands being placed on farmers, and producer time often critical for adjusting practices to new standards (Gomes & Reidsma 2021), farmers ought to be a part of the very discussion about them. However, the inclusion of farmers in the discourse surrounding climate change leaves much room for improvement (Soubry, Sherren, & Thornton, 2019).

Previous research has identified a myriad of regenerative practices that can reduce beef cattle producers’ carbon footprints, yet adoption of such practices remains slim. Furthermore, there is a lack of research about farmers’ perceptions, views, knowledge, and understanding at a local level. While some research on the perceptions of farmers exists, it was most often conducted outside of the United States and goes into little depth. This research is also taking responses out of context especially with regard to discussion about climate adaptation (Soubry, Sherren,& Thornton, 2019). Therefore, local agricultural researchers need to conduct more anthropological research to better understand the condition of farmers of all kinds. Research that does so will be able to help future researchers and policy makers.
To answer the need for qualitative research about farmers and their operations regarding climate change, the purpose of this research was to gather information about cow-calf operations in the Northwest Arkansas region. We utilized the Forage and Cattle Planner (FORCAP) spreadsheet model to add structure to data gathered from on farm operations and conduct interviews with the owner(s) to determine what factors drive owner-operator’s decision-making.

The following research questions thus guided this study:

1. How do select cow-calf operations in NWA function as businesses?
2. How do NWA owner-operators of cow-calf operations make decisions regarding their operations?
3. If current practices are unprofitable or inefficient, what barriers stop them from changing their practices?
4. Can the FORCAP model be used region-wide to aid in economic and environmental decision-making, and further, what improvements are needed?

The researcher concedes that the data will be nuanced, and as such will not have an easily identifiable answer to any one question. Nonetheless the open-ended nature of this research should lend new insights into the operations of local cow-calf producers. Further, the small sample size of operations queried means that the quantitative analysis of their operations cannot provide a generalizable guideline for all cow-calf producers.

**Literature Review**

First, the researcher investigated agricultural cow-calf GHG mitigation practices in the United States. Second, the researcher sought research that confirmed or denied the cost-effectiveness of the various proposed GHG mitigation techniques that were discovered. Finally,
the researcher investigated the body of literature on cow-calf producer decision-making regarding adoption of new practices aimed at mitigating climate change.

*Practices Affecting GHG Emissions*

A massive international literature review of over 900 papers compiled a list of management practices that have proven to reduce agricultural GHG emissions. With plenty of inclusion for cow-calf management, several useful data were found. The substitution of silages for hay into ruminant nutrition programs showed reduced CH₄ emissions. (Hristov et al., 2013). One may assume that grass fed beef is better for the environment, but in truth, both conventional grain-fed beef and grass-fed beef each present environmental and economic trade-offs to the industry (Klopatek et al., 2021). In support of grain-fed systems, low doses of concentrate feeds in the diet increase feed conversion efficiency which reduces emissions given lesser cellulose content in the diet that, in turn decreases enteric fermentation products leading to greater average daily gain that ultimately lessens lifetime emissions (Hristov et al., 2013). However, a different paper found, at least in the UK, that concentrate feeding was a highly cost-ineffective abatement solution (Moran et al., 2010). Other natural compounds such as tannins can reduce CH₄ emissions. Further research is needed to confirm the effect of tannins on GHG emissions, as their inclusion in a diet could lead to reduced dry matter intake (DMI) and/or other productivity issues because of their poor palatability (Hristov et al., 2013).

In previous research using the FORCAP model, Smith et al. (2016) investigated the relationship between GHG emissions, profitability, and a selection of practices. The researchers tested 18 different scenarios, finding that fertilizer application was always unprofitable. They also found that for continuously grazed farms of large and medium sizes, that the most profitable model was also the one with the lowest GHG emissions. In their Arkansas example, that was a
farm with a fall-calving season with no fertilizer application. Manure is a high emitter of greenhouse gases, due to anaerobic bacterial production of CH$_4$ (Johnson et al., 2007). This is not as important for most cow-calf operations however, because manure CH$_4$ emissions are low for ruminants that graze on pasture, (Hristov et al., 2013). However, waste management is still a relevant practice because urine can contain urea (CH$_4$N$_2$O) in high concentrations, which can be rapidly hydrolyzed into ammonium ions (NH$_4^+$) and ultimately converted to N$_2$O. (Hristov et al., 2013). To that end, being proactive about feeding animals close to their protein requirements and prioritizing high sugar forages serves to mitigate N$_2$O and ammonia emissions from waste (Hristov et al., 2013).

Animal genetics are a valuable tool in production, as some heritable traits can improve an operation’s bottom line. Noteworthy for emissions mitigation is the “feed efficiency” trait with which the American Angus Association expresses in expected progeny differences (EPD$s$) as residual average daily gain (RADG) and calculates via the feed intake (SF) EPD. An animal can be expected to perform at a certain level when provided a specific quantity of feed. Animals with higher RADG produce fewer GHG emissions because an animal that retains more of the material it consumes releases less CH$_4$ or CO$_2$ (Hristov et al., 2013) over its lifetime. Changing animal genetics has a measurable, but small, impact on GHG emissions: it was found that out of 10 breeds that improved profitability only one lowered GHG emissions, the Tarentaise. The reduction in GHG emissions was less than 0.62% of the baseline (Keeton, Popp, and Smith, 2014). It should be noted that Keeton, Popp, & Smith (2014) only tested for three trait EPDs, which included birth weight (BW), weaning weight (WW), and yearling weight (YW) which drive animal weights at different life stages in the FORCAP model. Other traits are hypothesized to have a more significant impact on GHG emissions, like RADG.
Johnson et al. (2007) found that organic cattle producers generate greater \( \text{CH}_4 \) emissions per production unit because of their low-quality forage diet when compared to grain-fed systems. However, \( \text{CH}_4 \) emissions per unit area were less for organic systems than for grain-fed systems. In terms of grazing management, the mitigation potential is much more substantial; an analysis of grazing strategies conducted in the Southern Great Plain (SGP) region found that rotationally grazed range had potential to be net carbon sinks, or at least low carbon emitters (Wang et al., 2015). Results showed that if the quality of forage was higher than what was available on the SGP rangeland, that emissions would be further reduced by up to 30%. This suggests favorable mitigation potential in the NWA region, where pasture is more common than rangeland. Having a smaller herd, or lower pasture stocking rates, reduce \( \text{CH}_4 \) emissions per lb. of liveweight leaving the farm, because there are less animals producing GHGs and more pasture to sequester carbon (C), (Hristov et al., 2013). Researchers in Kansas used a model to simulate 1000 iterations of a 100 head herd operation, finding that reducing maintenance energy needs and improving forage yield and quality reduced emissions and improved returns. (Lancaster & Larson, 2021).

Conversion of hay pasture to dual-use switchgrass pastures was shown to reduce GHG emissions of cow-calf operations. The dual uses are for hay and for biomass, material which biorefineries convert to energy or other beneficial substances. To be specific, conversion resulted in a 3.4 and 3.6% reduction in GHG emissions for autumn and spring calving operations, respectively. (Popp, Ashworth, & West, 2021).

To summarize, a practice that could boost forage yield and quality would be the most efficient grazing management practice for an environmentally conscious cow-calf operation. A grazing management experiment with yearling Merino wethers compared many different grazing practices and found that fast, about 56 days of rest, rotational grazing with a high stocking rate to
be as productive as continuous grazing for animal productivity, estimated based on metabolizable energy intake, over a four-year period. They also found that a greater number of paddocks, 30 in this study, had reduced bare ground area compared to other systems with the same stocking rates. (Badgery et al., 2017). Furthermore, analysis shows “potential utilizable forage, quantified by incorporating the estimates of refused and nonutilized biomass, and relative forage quality were significantly greater under management-intensive rotational grazing when compared to the other treatments” (Oates et al., 2011, p. 892). This indicates that rotational grazing is an effective pasture management practice for GHG emissions.

Cost Effectiveness

A cow-calf operation which uses complementary winter annuals, employs rotational grazing, and has a high stocking rate returned the greatest dollars per hectare compared to other cow-calf operations (Beck et al., 2016). Over the course of a five-year period, a University of Arkansas discovery farm demonstrated that research-based management practices, such as rotational grazing, strip grazing stockpiled forages during winter, and a 60-d breeding season, resulted in a mean 316-day grazing season in Arkansas. In addition to reducing expenses for hay, this farm improved cow reproduction, calf performance, and economic return (Troxel et al., 2014).

Conversion of hay pasture to dual-use switchgrass pastures not only reduced GHG emissions but was also shown to be profitable. Profitability increased by 5-11% pending calving season or by roughly $1,500 when switchgrass was priced at $50 per metric ton regardless of the calving season on an average size cow-calf operation with 96 cows bred annually on 630 acres of pasture and hay land (Popp, Ashworth, & West, 2021)
An in-depth bottom-up analysis of UK agricultural marginal abatement cost curves for GHG emissions found, for the beef sector, that feeding ionophores to improve feed efficiency and improving genetic selection, were the only cost-effective forms of abatement. They concluded that other proposed abatement measures, such as feeding concentrates, were either cost-ineffective or had too small of an abatement potential (Moran et al., 2010). They did not test grazing management practices.

Carbon credit trading is a complicated process which can incentivize producers to adopt practices that reduce emissions. Put simply, a project developer for a carbon compliance market, who is a farmer or was hired by a farmer interested in selling carbon credits as a secondary source of income, enters an emissions reduction purchase agreement (ERPA) with an investor. For this explanation I will assume a farmer hired a project developer. The investor pays a project developer for the right to own carbon credits, which are generated by emissions reductions practices according to a registry. A registry outlines the methods it wants producers to use to generate carbon credits, then has a verifier check the efficacy of those methods. The project developer issues the methods to the farmer, who implements them. Then data collection follows, which can take years. Information from the farm is given to the project manager, and from the project manager to a verifier, and from the verifier to the registry. The registry delivers the carbon credits to the project developer, and the project developer delivers the carbon credits to the investor. The money which the investor paid at the beginning pays the project manager, the farmer, the verifier(s), and the registry (Plastina, 2022). Producers who opt to enroll in these carbon credit registries receive compensation when a buyer chooses to purchase any credits generated by the producer.
**Decision-Making Processes**

According to research, US farmers make practical decisions regarding climate change on their farms based on their perceptions about climate change. These perceptions are influenced by personal experience and anticipation of costs or regulations. Furthermore, the researchers found that only 65% of farmers in the US believe in climate change, and only 40% believe humans are influencing it. (Chatrchyan et al., 2017).

An example of difficult decision-making that is dependent on the farmer’s circumstances and operation is that of establishing a calving season. Doye, Popp, & West (2008) learned from modelling the benefits and expenses of establishing a controlled calving season that labor became increasingly intensive with a controlled calving season in comparison to a year-round calving season. For example, leaving a bull out year-round with the herd requires little additional management from the operator, but causes the herd to conceive at a slower rate or less consistently, when compared to a controlled breeding season. A dedicated spring-calving season thus requires greater management time from the operator; from managing the bull separate from the herd and intentionally providing additional nutrition for the freshly calved and now lactating animals. Operations that opted to use year-round calving often were small operations that couldn’t meet the labor requirements of a controlled calving season. This suggests that labor availability is a conditional factor that influences decision-making and will only be relevant on a case-by-case basis. Another study of cow-calf decision-making processes indicates three major factors which affected a cow-calf farmers likelihood to background their own cattle: profitability, risk, and ability of facilities to meet needs (Popp, Faminow, & Parsch, 1999). Additionally, human capital and farm size were not significantly influential in the decision-making process according to this paper. In contrast, a study of two groups of cow-calf farmers in Oklahoma,
categorized based on operation size and dependence on cattle as a source of income, found that the most important factors were related to the goal of reducing labor and reliance on farm income as well as the size of the farm operation and human capital available to the owner operator (Ward et al., 2008).

The anthropological data on farmers is limited as explained earlier, especially in the US. Therefore, the researcher utilized international research to gain a greater understanding of farmer perceptions about climate change and even just operation management decision-making. It should be noted that US farmers likely face different issues and challenges than those outside the US. A Dutch study found in their farmers that hesitation to change behavior was the most universal barrier to adoption of new practices. They also cite farmers’ difficulties in balancing the social demands placed on them as a barrier to adoption: “farmers are feeling without direction and criticized regardless of their efforts,” (Gomes & Reidsma, 2021, p. 4-5).

Additionally, changing practices takes time, especially for businesses not currently equipped to handle the change. The expectation that changes should happen quickly was a noteworthy barrier to adoption. Finally, some profit-maximizing firms expressed a desire for compensation for investment in the environment as a barrier to their own personal adoption of climate-friendly policy.

Methodology

This research followed a mixed-methods quantitative and qualitative approach, with an emphasis on qualitative research. The goal of qualitative research is to gather data and search for emerging patterns to give greater insight into human perspectives (Nassaji, 2015). The FORCAP modelling tool and input of operational data as collected from in-person interviews served as the quantitative portion of the research to analyze the farmers’ business model, their estimated farm
GHG emissions, and potential alternatives. The subsequent qualitative interview, delving into the farmers’ decision-making process, provided data that contributed to understanding cow-calf agriculture at a local level. The researcher intended the combination of FORCAP analysis and qualitative interviews to be a steppingstone for researchers investigating complex interventions in local cow-calf agriculture (Noyes et al., 2019).

**Instrumentation**

*Interview*

Questions developed by the researcher were reviewed by a committee to ensure validity. The questions were also approved by the IRB (IRB#2008276843) prior to the beginning of the interview process. Participants who gave consent had the interview recorded using an audio recording device for ease of interpretation. The researcher then transcribed the interviews to a written form, and then a summary of the data retrieved was produced for inclusion in this work. Participants had their responses returned to them after transcription, during the follow-up interview process, so that they could correct or add to anything they said. These corrections were retroactively added to the data.

*FORCAP*

The researcher employed the farmers’ tacit knowledge about their own operations to tailor the FORCAP model to their operation, allowing the farmer to see the cascade of changes from each input cell in the spreadsheet (the change in returns from using an input, for example). The researcher’s analysis of the current operation was compared to alternative scenarios. These alternative scenarios tested the effects of alternative practices, such as calving season, pasture, and grazing management.

*Population and Sampling*
The population consists of farmers who own cow-calf operations in NWA region. The researcher contacted an extension service agent in the NWA region to narrow down the search to a group of farmers that would be willing to sit down and be interviewed. The five farmers owned operations that differed in scale and operational goals. They were deemed representative of the diverse population of beef cattle operations in the NW Arkansas region as judged by the extension agent with 20+ years of beef cattle extension experience and producer contacts. This contributed to the researcher’s goal of finding a pattern which supports a wide variety of producers.

Data Collection

The FORCAP data for a specific operation was saved upon completion of the analysis. The data were scrutinized and tested for viable alternatives. By performing these tests and having the interview data about farmer decision-making, the researcher was expected to understand why farmers aren’t using the alternatives discovered in FORCAP.

Data Analysis

The researcher transcribed the information retrieved from the FORCAP analysis of cow-calf operations to compare alternatives and gain insight into how cow-calf operations in NWA make sustainable decisions. The interview portion was analyzed to understand NWA farmers’ decision-making. Together the data were used to identify barriers that hold farmers back from adopting new practices, and identify potential improvements to the FORCAP model, so it may be used more frequently outside of research contexts.
Results

Producer Characteristics and Perspectives

Table 1 summarizes salient features of cow-calf operations interviewed based on the local extension agent contacts provided. As shown, the operations interviewed varied greatly in land use, number of cows bred, how diversified the farm operations was and finally how much experience the producer had with cow/calf production. The market channel was mainly for commercial cattle but one producer had a purebred operation.

**Table 1.** Cow-calf operation characteristic of five producers in NW Arkansas.

<table>
<thead>
<tr>
<th>Producer</th>
<th># of cows</th>
<th># of pasture &amp; hay acres</th>
<th>Primary Enterprises</th>
<th>Years of Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>400</td>
<td>1,600</td>
<td>Commercial cow/calf, poultry, hay</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>15</td>
<td>35</td>
<td>Commercial cow/calf</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
<td>500</td>
<td>Commercial cow/calf and hay</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>260</td>
<td>Commercial cow/calf</td>
<td>43</td>
</tr>
<tr>
<td>5</td>
<td>27</td>
<td>40</td>
<td>Purebred &amp; commercial</td>
<td>5</td>
</tr>
</tbody>
</table>

In addition to the above general description of the producers interviewed, each producer provided information for input use as guided by the large array of input parameter choices a producer could entertain when modeling their farm operation using FORCAP. The list of questions that the researchers followed during the in-person interview is presented in the Appendix.

Producers were also asked a small set of qualitative questions concerning their decision-making for their farm operation. They were asked what factors influenced their choice of practice most and least, as well as what they value in inputs, and finally an assessment of their own strengths, weaknesses, opportunities, and threats (SWOT) analysis of their operation. Table
2 is an abbreviated summary of the information collected. Reliability, availability and quality appeared more important than cost for producer input choices. Production practice selection valued time savings and needed to fit existing operating conditions. Larger changes, requiring long-term financing, were deemed less viable especially among more experienced producers who may have a shorter investment horizon. Paying attention to GHG emissions was essentially non-evident but animal and soil health was a consideration. Full summaries are in the Appendix.

Table 2. Summary of producer responses about input use and practice selection factors and importance of GHG emissions in NW Arkansas.

<table>
<thead>
<tr>
<th>Producer</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>chooses inputs that are reliable and long-lasting and is willing to pay any price he can afford on purchases that he deems worthwhile; chooses practices with respect to how they will affect his revenues and economic sustainability. He conceded that his ongoing labor will always be an 80-hour workweek, so any practice to reduce labor is welcome; ranked GHG emissions concerns as the least important factor when deciding on practices.</td>
</tr>
<tr>
<td>2</td>
<td>chooses inputs which work as intended and are affordable; for the size of his operation, cost is a very important factor; selects practices that his facilities can support due to his small scale; did not specify the least important factor.</td>
</tr>
<tr>
<td>3</td>
<td>chooses inputs which are high quality and reliable over a long period; doesn’t rank cost highly when choosing inputs; cares highly about his soil and animal health as well as his own labor input; chooses practices which provide for his animal and pasture health while also limiting his own labor, as he considers the farm a hobby, not a full-time job; did not rank unimportant factors.</td>
</tr>
<tr>
<td>4</td>
<td>chooses inputs which are available in an emergency, and which work reliably; considers cost but deems it unimportant if there is only one available option; chooses practices which don’t require financing, and which improve their animal health; ranked GHG emissions as their lowest concern.</td>
</tr>
<tr>
<td>5</td>
<td>chooses inputs which are reliable and cost-effective; chooses practices which will improve his farm’s sustainability and which his facilities can accommodate; doesn’t mind borrowing money to accomplish a change; GHG emissions are not important to his decision-making.</td>
</tr>
</tbody>
</table>

Demonstrating FORCAP

The data retrieved from the interviews were transcribed from an audio form to written form. The written interviews were then referenced to make summaries which were then used to fill out all fields in the FORCAP spreadsheet model. It is important to note that this study took
place during the summer of 2022, when diesel prices were exceeding $5.00/gallon, when urea was $875/ton, and when poultry litter cost could have been as high as $80/ton.

The data were presented to producers in the sequence used by FORCAP (Figures 1-4). Each spreadsheet tab was walked through together, to ensure validity of data while asking for clarification or correction about input use.

![Figure 1. Prices of inputs and livestock in FORCAP.](image-url)
Figure 2. Forage and fertilizer customization screen.

Figure 3. Pasture page in FORCAP for changing the owner’s grazing management.
Figure 4. Cattle page in FORCAP, for data about the owner’s herd.

As the information was presented, the researcher walked producers through how input cells changed net GHG emissions on the farm or on a per lb. of animal weight sold basis as well as profitability estimates either in the short- or long-term. Short-term net cash returns account for direct, short-term cash expenses and revenues whereas long-term net returns include ownership charges. Then the researcher showed producers the alternative scenarios he had developed.

Alternative Scenario Simulations:

Alternative scenarios all changed grazing management from continuous to rotational grazing. Additionally, each scenario enabled strip grazing, and stockpiling forage. These practices were all chosen due to the evidence of improved economic sustainability and environmental impacts as found by Beck et al. (2016), Troxel et al. (2014), and Wang et al. (2015). All alternative farm scenarios, except for farmer #3, included planting a complementary...
winter annual. Farm 1’s alternative also reduced fertilizer use to a level that produced just enough hay for animals so as not to sell excess hay. All scenarios, except for Farm 1’s, switched to a fall-calving season for increased returns. The alternative scenarios offered greater returns to each producer and decreased GHG emissions:

The capital investment associated with rotational grazing was based on FORCAP’s calculation for cross-fencing needs. FORCAP performs a cross-fencing calculation based on number of pastures and acreage, yielding a length of fence needed to cross-fence pastures. Fences were comprised of T-posts with 30 feet between posts and pipe corners, with 2-strands of 14-gauge electric wire. Prices were 2022 averages. Cost of labor for installation was not calculated in FORCAP.

Producer 1’s alternative scenario consisted of adding the research-based grazing management practices – rotational grazing, planting a winter annual, and stockpiling some forage – as well as removing fertilizer completely from their grazing pasture, only keeping it on his hay ground. This resulted in a lower forage output on pasture, but a significant increase in grazing efficiency that made the loss in tonnage miniscule. He reduced the amount of excess hay that he produced, while maintaining enough to feed them well in the winter, as he likes to do. The greatest boost to his returns and reduction to his GHG emissions came from the substantial reduction in fertilizer application – lower emissions from the fertilizer and fossil energy needed during application. Most of producer 1’s fertilizer came from his poultry enterprise. Data were entered as though he were purchasing chicken litter from the enterprise to compare the effects of fertilization on farm economics. Producer 1’s returns rose by $224,749 and his GHG emissions were reduced by 8.06 lbs. CO₂/lb. of liveweight sold because of the proposed alternative
practices. Producer 1’s capital expenditure for fencing rose from $65,652 in a continuous grazing scenario to $73,327 in a rotational grazing scenario or a difference of $7,675.

Producer 2’s alternative scenario consisted of raising his stocking rate, introducing the research-based grazing management practices, and implementing a fall-calving season. These changes resulted in a boost to net returns of $2,656, and a reduction of GHG emissions by 0.44 lbs. CO₂/lb. of liveweight sold. Producer 2’s capital expenditure for fencing rose from $7,147 in a continuous grazing scenario to $7,815 or a difference of $668 reflecting investment in electric fence.

Figure 5. Producer 1’s current scenario compared to his alternative scenario.
Producer 3’s alternative scenario performed the research-based grazing management practices but did not plant a winter annual because he is content with the amount of cattle he raises. Thus, seeding the winter annuals on his property was unnecessary for providing nutrition to his small herd, and seeding them caused greater emissions than it reduced. Producer 3’s alternative scenario saw an increase in returns of $10,519 and increased his GHG emissions by 0.78 lbs. CO\textsubscript{2}/lb. of liveweight sold. This is a function of his lower stocking rate. Producer 3’s expected capital investment in fencing went from $22,779 in a continuous grazing scenario to $28,239 in a rotational grazing scenario or an additional expense of $5,460.

Producer 4 received the full treatment of alteration of their grazing management practices from continuous-conventional to a rotational system with stockpiling, strip-grazing, and planting of winter annuals. This alternative also switched to a controlled fall-calving season. This saw an increase in returns of $30,723 and a reduction in GHG emissions of 0.27 lbs. CO\textsubscript{2}/lb. of liveweight sold. Producer 4’s capital expenditure for fencing increased from $23,366 in a continuous grazing scenario to $27,757 requiring a $4,391 investment.

Producer 5 already controlled his calving season due to his use of artificial insemination for his purebred business. The best options for him to save money were to switch grazing situations, and it did significantly improve his returns and GHG. He increased his returns by $4,466 and reduced his GHG emissions by 7.51 lbs. CO\textsubscript{2}/lb. of liveweight sold. Producer 5’s capital expenditure increased from $7,701 in a continuous grazing scenario to $9,561 in a rotational grazing scenario and hence an investment of $1,860.
Producer Feedback:

Producers had some feedback to offer regarding the FORCAP software. All the producers except for Producer 1 expressed interest in using FORCAP in the future. Producer 1’s concern was related to the amount of time it would take to learn how to use the software. With their long workweek running three different enterprises they considered themselves too busy to try and learn a new system. Producer 2 commented that FORCAP may be more user-friendly if there was a software guidance system involved, interested in seeing it take on a sleeker design. No producer knew about FORCAP’s existence before the interviews. Producer 4 said they would be interested in learning the tool but admitted that they would need the help of an expert to teach them how to use it effectively.

Limitations:

Producers pointed out two limitations with the FORCAP software that were inconvenient. There is no way to simulate buying replacement heifers in FORCAP. In FORCAP, the only way to do that is to make the number of females sold negative, and you can only do that if the number of replacements you retain is higher than the number of females your farm produced. Producer 1 who buys replacement heifers rather than retaining female calves to breeding age said they would have wanted to see the comparison between raising their own replacement heifers and buying them. Figure 6 shows the area where one would enter replacement heifer decisions in FORCAP.
Figure 6: Screenshot of the replacement heifer issue in FORCAP

In FORCAP, animal feed requirements per month are calculated based on TDN requirements to maintain body condition score. Not every producer does this year-round.

Typically, in the winter, some producers feed less than TDN requirements and allow the animals to lose a small amount of body condition score. The result is potentially a slightly smaller calf for sale in spring, but in some cases, this outweighs the cost of additional hay. Multiple producers noted that FORCAP said they should purchase hay when they don’t do so in real life. Notably, Producer 4 claimed that they would put up three hundred-fifty 800-lb. bales of hay this year when FORCAP said they’d only produce 150. There seems to be a discrepancy somewhere in this part of the tool. This discrepancy could contribute to the high effect of grazing management changes on returns, as the cost of hay is reduced tremendously. Figure 7 shows a screenshot in FORCAP where Producer 4 said they had issues with the amounts of hay.
Discussion

The alternative scenario simulations in FORCAP conform to results found in Beck et al. (2016). Each alternative farm scenario employed rotational grazing, and planted complementary winter annuals (except producer 3, because he didn’t want to increase his stocking rate), and returns were improved across the board. Findings reported by Troxel et al. (2014) were not completely reinforced by this study as we don’t know the effects of these grazing practices on cow reproduction and calf performance from FORCAP. We do confirm improvement in economic return because of the reduction in hay expense and greater animal production capability of each farm when employing more management-intensive grazing practices. Whilst testing alternatives, we also noticed an effect of reducing fertilization which we had not considered: the reduction of soil carbon sequestration (SCS). FORCAP measures SCS as a function of the amount of forage produced on the farm. Naturally, when fertilization is reduced, the amount of biomass produced is also reduced and therefore SCS is reduced. Because certain carbon credit registries issue credits based on SCS, such as the Soil and Water Outcomes Fund (Plastina & Wongpiyabvoron, 2022), project managers may increase fertilization to increase biomass production and SCS to claim carbon credits. However, net GHG emissions were far...
greater than they were in the scenario with no fertilizer, regardless of the offset generated by increased SCS.

Figure 8: Comparison of GHG and SCS before and after fertilization.

Farms in NWA never reached levels of GHG even close to net zero, and so we cannot agree with the conclusions of Wang et al. (2015) because the claims made there were vastly different than what FORCAP returned. A possible explanation lies in differences in math used between the model used by the researchers in that study and the FORCAP model. The researcher investigated this data more closely and determined a possible explanation. Wang et al. (2015) calculated net GHG emissions as total emissions minus SCS. In their study of SGP rangeland, stocking rates were 14 animal unit (AU) per 100 hectare (ha) and 27 AU per 100 ha for low and high stocking rates, respectively. The researcher calculated based on the herd sizes presented in
the study that the ranch sizes in the study were approximately 4,000 ha. This corresponds to nearly 10,000 acres (1 hectare = 2.47 acres). The stocking rates used in Wang et al.’s study were vastly lower compared to the stocking rates used in our study (e.g. producer 1 had 400 cows on 1600 acres or 62 AU per 100 ha). Therefore, SCS is able to vastly outperform animal GHG emissions and create a net carbon sink in the context of the SGP ranch system. In other words, the emissions reduction from switching grazing methods from a high stocking rate to a lower stocking rate or multi-paddock rotational systems is similar across the board. The difference is in scale: the biggest pasture we dealt with in NWA was 1/10 the size of the ranches studied in Wang et al. (2015), but stocking rates in this study are not proportional to this difference in size. We do, however, support findings of the Kansas researchers, Lancaster & Larson (2022) because the grazing strategies used in alternative scenarios increased available forage on the farm, therefore increasing returns and reducing emissions.

We were not able to confirm inferences drawn by Popp, Faminow, & Parsch (1999) or by Moran et al. (2010) due to the limits of our tools. While FORCAP does possess a genetic selection tab, it was not utilized for the purposes of this study. We do know from the Keeton, Popp, & Smith (2014) that certain breed genetics do result in GHG emissions reductions and profitability changes. Further research into genetic selection as a profitable abatement practice will either need to add more EPD values into FORCAP or employ a different methodology. Per the research by Smith et al. (2016), our study confirms the assertion that fertilizer is currently an unprofitable practice, and we assert that emissions reductions by reducing fertilization are highly efficient.
Regarding climate change, our findings appear consistent with the information shown by Chatrchyan et al. (2017). Farmer decision-making regarding climate change is primarily influenced by personal experience, and that belief in the anthropological effects on the climate was sparse. Some of the more experienced producers, Producers 1 and 4 told stories of extreme winter weather that caused producer stress and harmed calving rates, which led to them changing their breeding management to lower management requirements during the winter. These stories corroborate the results found by Doye, Popp, & West (2008). The producers who changed their calving seasons took on increased labor during the temperate parts of the year to reduce stressful labor in the winter months. In contrast, Producer 2 calves year-round, because he is the only labor on his farm, and doesn't have the facilities to support a bull pen year-round.

**Recommendations**

In future studies, researchers should specialize in either answering questions related to the FORCAP decision-support software or in gathering qualitative data on farmer decision-making. The split-focus nature of this study led the researcher to pay greater attention to the quantitative portion of the study, to the detriment of the quality of the qualitative data. Asking more questions, asking more detailed questions, and gathering data from a larger sample size, could have enabled the researcher to conduct more thorough data analysis to provide recommendations to future researchers, extension, and policymakers on reaching cow-calf producers. Repeating the same study with a cohort of researchers to gather data from more producers is also an option. Researchers interested in FORCAP should note the limitations of the tool as producers noted. Furthermore, if an alternative scenario reveals a more efficient practice than is currently being practiced by the producer; then the question, “What barrier stops you from using this practice?” should be asked. A blunt and honest answer would be most helpful for
deciphering farmer decision-making. Finally, a repeat study using FORCAP to analyze a cow-calf operation should be conducted as 2022 prices for inputs like fertilizer and fuel were particularly high.

**Conclusion**

Choosing grazing and forage management strategies other than continuous grazing almost always improved estimated environmental and economic sustainability, despite the initial investment in fence infrastructure. These results show that environmentally friendly practices can be good for both farm business owner-operators and activists concerned about the future of environmentally friendly animal agriculture. It is worth noting, however, that labor is not tracked in FORCAP. The increases in labor and the associated cost of time that are required by controlling calving season, switching to rotational strip grazing, seeding winter annuals, and planning pastures to stockpile may not make the addition in net returns a feasible alternative when labor bottlenecks exist. Nonetheless, observing cattle up close, and more frequently, is likely to lead to better health management practices on the operation as well.

Due to the producer rankings of GHG emissions, policy aimed at agricultural GHG emissions reduction will have to incentivize producers to adopt practices that meet their personal priorities, finances being number one. Current ecosystems markets reward SCS. The current markets may incentivize a producer to add fertilizer to increase SCS (due to increased root biomass growth) but result in a net increase in emissions per lb. of liveweight leaving the farm, for example, as added SCS may not offset the added emissions of fertilizer use.

As indicated by most producers, making the tool more accessible would be great. Since most alternatives scenarios shown dealt with improving pasture use efficiency, we anticipate
great interest in the summer annuals work and use of subsurface applied poultry litter associated
with SARE funding received for this work. Adding these forage and fertility management
options in an easy-to-use format is therefore expected to favorably impact sustainability for
cow/calf producers by enhancing economic performance while also lessening GHG emissions.
Adding voice over narrative to the FORCAP tool, as was done for a poster prepared for this
work, may well assist with lowering time required to learn how to use the tool.
References


Appendix

Appendix 1:

Open-interview Questions for Case Farm Study of Beef Cow-calf Operations to Investigate User-Friendliness of FORCAP

https://agribusiness.uark.edu/decision-support-software.php#forcap

1. How did you get started in farming this land? – looking for how long they have operated the farm, educational background, have they been growing/downsizing, is operation a hobby vs. for primary income.
2. How many acres are you using for your beef cow-calf operation?
3. How much of the land is in pasture vs. hay ground?
4. Is your pasture/hay ground fenced? How? – looking for use of electric fencing as well as practice of rotational grazing and use of hay ground for potential grazing in the fall. Water sources factor into this question. Pictures of watering sites and fencing methods without identifying the operation would be great.
5. How many people does it take to run the operation? – looking for use of hired help, owner labor, use of custom hire for specific task (hauling cattle, establishing pasture, fertilizer application etc.). Could quantify by thinking of full-time equivalent (FTE) job (40 hrs/week. year round so that 1 FTE = 2,000 hrs per year or 50 wk.*40 hrs/wk.
6. How many cows/first-calf heifers do you breed each year? – looking for information regarding stocking rate on pastures as well as number of cows per herd sire and/or use of artificial insemination/other.
7. Do you raise replacement heifers from your herd’s offspring, or do you typically buy breeding stock? – looking for breeding age, age of cows at time of culling, number of calves expected over the useful life of the cow, weaning age and weaning weight. Also, what does the ideal/average cow look like (mature weight, size, breed, temperament, etc.)
8. What kind/type of fertilizer(s) do you use on your operation during a normal year? – looking for information on type, quantity, and timing of application(s)
9. Do you control your calving season, or do you have cows calving year-round? – looking for typical calving months.
10. Do you creep feed your calves/use supplemental feed to bunk train calves/move cows?
11. How much/type of mineral additive do you feed? What is the cost of these additives per unit purchased as well as how often do you buy the material?
12. What is your vaccination program? – looking for responses to FORCAP options.
13. How do you control weeds on hay ground/pastures? Chemicals, mechanical, burning, spot weeding, etc.
14. How many cuttings of hay do you have in a typical year? What is the hay yield in lbs./acre? Bales/acre? Weight/bale.
15. What equipment do use for your cattle operation? New/used, hours used for cow/calf per year. Pictures and equipment age in hours, annual maintenance cost, would be great.
16. When evaluating different input choices (twine vs. net wrap, name brand vs. generic medicine, custom fertilizer/doing it yourself etc.) what drives your decision the most/least?
   a) Price
   b) Quality (does what it says)
   c) Reliability (lasts long without repair)
   d) Availability

17. When entertaining changes to production or marketing practices on your operation, what is/are the most important and least important factor(s)? Choose at most two of the most important factors and at most two of the least important factors. Writing in the boxes and the back of the sheet is perfectly fine to, in essence, prepare a mission statement for the cow-calf operation.
   a) No Financing required to invest in change
   b) One-time labor needs to invest in change is available
   c) On-going labor needs with the change are manageable
   d) How much extra profit it will generate
   e) Change needs to improve animal quality of life
   f) Change needs to improve soil health
   g) Change needs to lessen GHG emissions
   h) Change needs to lower risk of financial loss
   i) Equipment/facilities are available to perform change
   j) Other: _________________________

18. What strengths, weaknesses, opportunities, and threats do see for your operation?

For follow-up visit:

19. Would you use FORCAP, the on-line decision aid with response from the above questions entered to assist you with a decision? (Circle all that apply)
   I find the tool valuable   Too complex   Easy to use   Informative
   Only informative if used in conjunction with expert   Other: _________________________

20. Do you want to add/modify to your strengths, weaknesses, opportunities, or threats?

21. Do you think the frequency/severity of extreme weather events impacts your farm decisions? Has that changed in recent years?

22. When you face a difficult choice regarding your cow/calf operation, who do you consult
   a) Family
   b) Neighbors/other producers
   c) Extension agent/county office
   d) Attend conferences
   e) You Tube
   f) other internet
   g) Other _________________________
Appendix 2:

*Producer 1 FORCAP Interview Notes:*

**Farm:** Producer 1 owns approximately 1600 acres of land for his beef cow-calf enterprise. 600 of which is used exclusively for hay. Producer 1 fertilizes this land with 2000 tons of chicken litter which he purchases from his poultry enterprise, as well as 225 lbs. per acre of urea. Producer 1 estimates a forage balance of 15% clover, 25% Bermuda, and 60% fescue.

**Pasture:** In our interview, Producer 1 mentioned at least 8 distinct pastures on his farm, though it is probable that he has more, smaller, pastures than this. He practices continuous grazing by his herd on these. Producer 1 did not mention the amount of watering sites he had on his farm. Producer 1 fences his pastures off with 4 strands of barbed wire, 11 feet between posts. In the past Producer 1 planted winter wheat but does not anymore.

**Cattle:** Producer 1 breeds 400 cattle per year, and just recently purchased an entirely new, young herd. He sells an average of 360 cattle, losing a normal 10% to breeding failures and death losses.

**Haul, Feed, Vet, and Drug:** Producer 1 sells all his cattle at the Joplin June sale, so he has a few semis drive up and haul his cattle for him. He says that the prices that he gets at the sale are substantial enough to justify the mileage. Producer 1 feeds his cattle Purina Wind and Rain, as well as protein tubs in the winter. Moreover, he follows a strict vaccine regimen, based on veterinary recommendations, year to year. He did not specify veterinary expenses, so FORCAP’s estimations will be used.

**Capital:**

- Producer 1 has 5 current tractors
  - 165 HP
  - Two 115-125 HP
  - Two 50-75 HP
- He also owns 4 ancient pieces of equipment. 4 tractors that still run but have been used for so long that the hour meters have quit. It is for this reason that the researcher did not include them in capital expenditure.
- Producer 1 owns four stock trailers:
  - A 28’
  - A 20’
  - A 14’
  - And a 10’
- Producer 1 owns an arsenal of pasture management equipment, including a hay rake, baler, wagons, and a barn.
- He has both a disc and brush mower.
- Finally, Producer 1 has a myriad of miscellaneous items that he did not mention in the interview process. These are included as a minor expense.
 Qualitative Data:

Producer 1 said that when he is evaluating different input choices, it’s “flat out reliability and longevity.” Producer 1 will choose the inputs and capital that will work as advertised for a long period of time. He does not care about the price or is willing to spend a large amount of money to make sure that his purchases are worthwhile.

When discussing changes to the operation, Producer 1 said that he would weigh things primarily with concern of his revenues and his economic sustainability. They also said that they’d consider the ongoing labor needs, but it’s probably going to be equal to or less than the 80 hours a week they spend on the farm as is, so that’s not a great deal of importance to them. Surprising no one, they ranked GHG climate pollution as the lowest priority.

SWOT:

- Producer 1 identified the strength of their operation as having a reliable supply of fertilizer to feed their vast tracts of forage. Forage availability and nutrient content were strengths for him.
- Producer 1 said that she thought a small weakness of theirs pertained to their strength. Because of the size of their operation, they struggle with weeds.
- Producer 1 did not mention any kind of opportunity for change or improvement.
- Producer 1 identified government intervention as his operation’s primary threat. He said that it could be any number of policies or interventions: from animal welfare parties to Country-of-Origin Labelling. They also feel threatened by the influx of black-head buzzards that have moved into the county over the last ten years. Producer 1 said that there could be dozens of them getting a calf that has just hit the ground.

Follow-up Interview Answers:

Producer 1 said that they might use FORCAP, but they wagered that the time investment to learn the tool and to enter in all the data would be far too great for them to seriously consider it. They run many enterprises and must budget their time wisely to make it work.

Producer 1 did not want to alter their SWOT.

Producer 1 alters his operation for drought on a yearly basis, primarily through his management of forages and haying. His biggest challenge in drought is water availability. He has talked about going through a season-shift: he has noticed that weather patterns common in January are now occurring more often in February. He does think that in this seasonal climate alteration that things will naturally cycle back to the way they were before returning to how they are now.

Producer 1 will not consult any outside source if faced with a difficult decision on their farm operation.
Appendix 3:

Producer 2 FORCAP Interview Notes:

Farm: Producer 2 runs a small herd cow-calf operation. He owns 75 acres, using only 27 acres for pasture and 18 acres for hay. He has fertilized in the past but has not this year.

Pasture: Producer 2 practices continuous grazing on one pasture and will “winter graze:” where he lets his cows graze the hay field late in November. He uses 5 strand barbed wire perimeter fencing. 3 ft between the posts. Two water sources: one pond, one trough. He does not plant winter annuals, stockpile, or strip graze.

Cattle: Producer 2 is currently stocking 13 cows and 1 bull to his land. Producer 2’s bull is 7/8 Angus + 1/8 Simmental. His herd is a mix of Black Angus and Hereford cows. His hay is stored out in the open, expect greater wastage. Producer 2 wants to buy replacements as needed because he likes his bull and, I think, would like to avoid inbreeding complications. 8 of his cows he has grown himself. He estimates that his cows weigh around 1200 lbs., although there are extremes at both ends. He breeds first-calf heifers at 15 months and weans calves at 7 months. Producer 2 does not control his calving season.

Haul, Feed, Vet, and Drug:

- The sale barn staff custom hauls cattle on a per trip basis, estimates $75 per trip.
- Cows get 7-Way Blackleg in the spring and dewormer twice a year. Bull calves are not castrated.
- He creep feeds his heifers with unspecified feed. He uses 12 mineral and salt blocks per year, at an unspecified price.
- Need data on vet visits

Capital:

- Producer 2 borrows hay equipment and cattle trailers from a family friend.
- Two four wheelers,

Qualitative Data:

Producer 2 wants inputs that are high quality and will work as intended. He does care about price, as for his size of an operation he cannot afford to “put steel pipe everywhere.”

Producer 2’s operation demands that his facilities be able to support whatever changes to his practices that he makes. That’s most important to him when it comes to changing practices.

SWOT:

Strength: Good recordkeeping
Weaknesses: Scale
Opportunities: Local supply, setting up rotational grazing
Threats: Drought

Feedback: Could be more user-friendly in a software format.

FOLLOW UP DATA: When asked if he would use the FORCAP decision support tool to assist him with a decision, Producer 2 said that he would potentially use it. He commented that his nature as a hobby farm means he doesn’t necessarily have to consider the minutia of economics. He also noted that the decisions he’s most interested in optimizing would be the adoption of rotational grazing and adjustment of his stocking rate.

He said the tool was informative, and that although it would require a bit of learning, he wouldn’t find it too difficult to use.

He did not alter his SWOT.

When asked about the frequency of extreme weather, Producer 2 claimed that he had previously not given it a lot of thought, saying that he has not been farming for a long enough time to notice whether extreme drought or cold or storms have been getting more frequent. He did however comment that he has elected to hold off buying more breeding-ready cows considering the drought this summer.

Producer 2 said that he would consult a family friend, who has been around all his life.

In his closing thoughts, Producer 2 brought up the idea of making the FORCAP system a software with a tour guide of sorts. Taking producers step by step through the process of farm analysis, and then giving them options to filter the results they want to see.
Appendix 4:

Producer 3 FORCAP Interview Notes:

Producer 3 was born and raised on a farm up north before moving to another operation in Texas. Sometime later he worked in oil and gas for several years before retiring and settling down on his new farming operation in Northwest Arkansas.

**Farm:** Producer 3 owns 400 acres of land, but only 300 is grass. The rest is forested or road. He exclusively hays 80 acres presently, and continuously grazes the remaining pasture with plans to install a cross-fencing system for rotational grazing. He has not fertilized and wants to focus on the soil health of his operation. He estimates currently that he has 20% Bermuda, 20% Clover, and 60% Fescue. He mentioned that he’d like to bring clover up to 1/3 of his pasture composition to take advantage of nitrogen fixation.

**Pasture:** Producer 3 has seven pastures on his property and tries to move them through each one in a semi-rotation. He has run into obstacles with this approach due to animal health issues: He does not have the alley infrastructure to easily move cattle to the barn to be treated. He has 7 ponds, 4 are consistently full and 3 require frequent filling of rain to remain full, considered as 5 ponds. No water troughs were mentioned. His land is all fenced with old, barbed wire. He didn’t mention any other specific grazing management practices.

**Cattle:** Producer 3 bought 50 Angus cows and lost only one calf when calving in February. All of them were bred for their first calving on his farm to Meat Magnitude (low BW high WW). Following this, Producer 3 acquired 3 South Poll bulls to breed his cows. His hay is net-wrapped and stored outside, estimate 15% hay loss.

**Haul, Feed, Vet, and Drug:**

- Feeds Purina Wind and Rain with fly control
- Vaccination program sounded standard. Will clarify any excluded treatments in follow-up.
- Some veterinary treatment has been required. Will gather empirical data in follow-up.

**Capital:** Producer 3 and his nephew work approximately one FTE and one Part time 20 hours per week.

- Skid Steer – Price and loading capacity unspecified (assumed $20,000)
- Tractor – Assumed Standard
- Barn
- Utility Terrain Vehicle

**Qualitative Questions:**

Producer 3 considers the farm a hobby. He doesn’t consider price too highly when deciding on inputs, and cares much more about the input working as intended and lasting for a long time.
Producer 3 highly values a return on time, he doesn’t want to be working 40 hours or more on the farm for the rest of his life. As such, he is selecting practices that provide efficiency for his labor. In other words, he ranks “On-going labor needs with the change are manageable” highly. Additionally, he highly values his soil and animal health. He did not rank unimportant factors.

**SWOT:**

- Strengths in terrain, water availability, and established forage base.
- Weaknesses in old, worn-out fencing and facilities.
- Opportunities in being a local beef supplier and entering rotational grazing niche.
- Threats in fescue toxicity.

**Follow-up data:**

Producer 3 asked for a copy of the FORCAP spreadsheet that he could play with. He likes spreadsheets and comments that even though FORCAP is a little intimidating with its complexity, that he would absolutely use it to help with a decision.

Producer 3 did not alter his SWOT

Producer 3 exclaimed that the drought this summer was causing him a great deal of stress. He was very worried about keeping his cattle cool and keeping them near water. He didn’t say that a decision had specifically been impacted but implied that it was a source of worry for him.

Producer 3 said he would reach out to the Agricultural Extension service for help with a difficult decision.
Appendix 5:

*Producer 4 FORCAP Interview Notes:*

Producer 4 started farming their land in 1979. The farm was a secondary source of income, as each worked a full-time job off the farm and provided approximately 40 hours of work per week to the farm.

**Farm:** The total volume of land for their enterprise is 259 acres: 195 owned, 64 rented. Of that land, 40 acres is dedicated hay ground, and the rest is pasture that is continuously grazed, but with periods of rest. Hay is harvested from pasture as well. They fertilize their land with 46-0-0 urea at 150 lbs. per acre, giving 1.5 applications to their hay ground. In the past they have applied poultry litter as well, but their supplier has gone out of business (and rising costs caused them to make cuts). Expect two cuttings per year, close to 500 bales total @800lbs/bale.

**Pasture:** The pastures are fenced in with 4 strands of barbed wire, with wood corners. A small proportion of the fence is an old rock wall, which was not factored in on FORCAP. Their farm has a combined 5 ponds (one is on leased land), and creek access on several pastures. Moreover, there are two watering troughs fed by well-water nearby to their working facilities in one pasture.

**Cattle:** They have a herd of 100 cows, they tend to breed 10 first calf heifers. They raise their own replacement heifers, and cows typically have 8 calves, or a 10 year on farm life, before retiring (cull). They breed using natural service, and 5 bulls. 4 bulls to the 90 adult cows (1:22.5), and 1 to the 10 heifers. They estimate that they sell 80 calves, putting them at a 20% calf loss. They say they lose 4-5 calves each year, resulting in a 5% calf death loss. They calve in the spring, but because they expose cows to bulls for an extended period of time, they produce calves through the fall. They specifically remove bulls for a period to prevent winter births. Because they use net wrap and store their hay under a roof, we estimate a 12% hay loss.

**Haul, Feed, Vet, and Drug:**

- Producer 4 have their cattle hauled to the sale barn by the sale barn however they haul their own cull cows to the sale barn. Additionally, they haul their first-calf heifers to the vet’s office for a full vaccine program and checkup.
- They feed 100 sacks of Purina Wind and Rain with Sweet Mag Fly Control per year, totaling $1850. They feed 48 bloat blocks to prevent cow death by clover bloat in the spring, costing $1200. They creep feed replacement heifers when weaning. (Need feed information: nutrition facts, price per unit, number of units, etc.)
- Their calves get 7-way Blackleg and Pinkeye. Cows get Leptospirosis, IBR, and Pinkeye. All cows receive unspecified dewormer twice a year. They provide staircase GH implants for their steer calves. Additionally, they spray for flies twice a year, shoot fly balls at each cow every 6 weeks ($5 per ball), and deliver
injectable Draxxin via a dart gun ($500 per bottle of Draxxin). How much Draxxin needed?

- No data on Veterinary charges

**Capital:**

- 5100E, 2018 John Deere Tractor
- CX90, 2000 Casey International
- 4230, 1998 Casey International
- 685, 1995 Casey International
- Hay bind,
- Double Rake,
- 450 roll belt New Holland (Baler)
- 10’ brushhog
- 3-4 hay forks
- Track Hoe – John Deere Mini Excavator
- Cattle trailer
- Flatbed trailers
- 2 Unspecified Four Wheelers
- Unspecified Side-by-Side Utility Terrain Vehicle UTV
- Dodge Truck
- Disc, plow

**Qualitative Data:**

Producer 4 prefer to use inputs that are reliable and will spend the extra dollar to get long-lasting value out of them. They also say availability is important, because sometimes “you can’t get what you need.” Price matters some, but “when you really need something you don’t look at the price.”

Mrs. Producer 4 says that an important factor that she considers when changing the practices, they use on the farm is that the change needs to improve animal quality or health. Because the animals are her livelihood, she wants to make sure they’re well taken care of. She says that GHG emissions reduction is not important to her.

Mr. Producer 4 says that he seriously considers practices that don’t require him to borrow money. Most of the other factors we listed are “pretty important” as well.

**SWOT:**

- Strength – No loans against this farm, financially independent
- Weakness – Struggles with weed control
- Opportunity – Expand into local markets by selling beef “off the hoof” to community members interested in that kind of product.
- Threats – rising input prices, equipment, fertilizer, land, etc. Without cattle prices increasing appropriately.
Follow up Data:

Producer 4 said that they thought the tool was cool, and that they would use it if they could take some time with an expert to really learn to use the software.

Producer 4 had a small issue with the hay calculations, they would like to manually edit how much hay they are feeding and putting away, because they allow some body condition loss year-to-year, but FORCAP always assumes that hay will be fed to herd TDN requirements.

Producer 4 always ration their hay in anticipation of extreme weather. They prepare for droughts and long winters by storing extra hay and feeding a moderate amount of hay, so that they’ll have potentially more than necessary. They also feel that there has been an increase in the frequency of weather extremes, and that this year is the worst that they’ve had in a long while.

Producer 4 did not alter the SWOT

Producer 4 will consult their extension agent and other producers through the Cattleman’s association if they face a difficult decision that they cannot answer.

They were really impressed with the functionality of FORCAP.
Appendix 6:

Producer 5 FORCAP Interview Notes:

Producer 5 began farming his family farmland after returning home from his college education. He’s working to produce seedstock as a business, but for now it’s a hobby farm.

**Farm:** Producer 5 owns 300 acres; he devotes 40 acres to the cow-calf operation for pasture. He produces the hay for his cow-calf operation from a separate hay enterprise, 240-260 acres. Also recently acquired a Maysville farm that’s “cross-fenced really well.” Presently it’s a part of the hay enterprise but will be used for pasture eventually. In the past Producer 5 fertilized 168 lbs./acre of an unspecified fertilizer, but this year he has not.

**Pasture:** Producer 5 buys hay from his hay enterprise, he outsources cutting to an acquaintance who charges $25 a bale for his work. Producer 5 would sell bales from his hay enterprise at $45 a bale. The bales are 1300 lbs./bale. His pasture is fenced with barbed wire and cannot be cross-fenced due to extreme terrain.

**Cattle:** Producer 5 bought 27 mature cows this year to serve as surrogates for his donor embryos. Because he’s using embryo transfer, he has no herd sire. He also controls his calving season and expects to have 100% of the calves in March.

**Haul, Feed, Vet, and Drug:**

- The vet costs for embryo transfer were $70 a head, and with hormones the expense was $150 a head.
- He is going to creep feed his calves by working with a nutritionist through the co-op. Exact expenses are unknown. He also feeds mineral cubes and Purina Wind and Rain (33.99 per 50 lb. sack every 7-10 days – $1767 per year).
- Producer 5 follows a standard vaccination program; except he doesn’t vaccinate for Pinkeye and doesn’t use Growth Implants.
- Producer 5 hauls his own cattle as needed and can haul 11 cows per load in his 24’ stock trailer.

**Capital:** Producer 5 and his family work approximately 500 hours per year, or about 10 hours a week on the farm. Producer 5 owns a standard composition of farm equipment with his family.

**Qualitative Questions:**

Producer 5 ranks reliability and price highest for factors that affect his decision of inputs. He prefers things that are cost effective and pay for themselves in time.

Producer 5 chooses alternative practices that lower risk of financial loss (increase farm sustainability), and those that his farm equipment and labor resources can manage. He is willing to borrow money to invest in the change and does not consider the GHG emissions that the practice may produce.
SWOT:

- Producer 5’s herd has a strong genetic foundation, and he has personal relationships with industry leaders.
- Producer 5’s HQ land is very hilly and steep, and he lacks labor resources (he works full-time in real estate).
- Producer 5’s goal is to convert his small herd into producers of extremely high-value animals. Considers this an opportunity to become a supplier of seedstock to commercial industry.
- Producer 5’s operation is threatened by seedstock industry competition and the volatile nature of trends in cattle genetics (what is considered prime genetics, and breed association changing EPDs without warning).

Follow up data:

Producer 5 said that he has utilized decision-support software before, and that he’d use the FORCAP model just as well.

Though Producer 5’s situation as a seedstock operation is different than what FORCAP was normally used for, a few small adjustments to pricing brought things into perspective for him. He said he wouldn’t make any modifications to the tool because he wagered that “99%” of the producers who would use the tool would also be commercial cow-calf producers.

He did not modify his SWOT.

Producer 5 didn’t have any insight on the frequency or severity of extreme weather, but he did note that the drought this summer was altering the way he feeds his cattle. He is working with a nutritionist to purchase a feed supplement to cover the losses that this drought may have caused.

Producer 5 said that he most often contacts his local agricultural extension agent when he’s faced with difficult decisions and situations on his farm.