



BEEF SYSTEMS INITIATIVE ANNUAL REPORT

November 30, 2018

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Beef Systems Initiative
First Annual Report
Center for Grassland Studies
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INTRODUCTION

Nebraska is often described as the epicenter for beef cattle production. The unique combination of forage and water supply, crop and ethanol production, and feeding and packing infrastructure make Nebraska a world-leader in beef production. However, there are critical opportunities to expand our cow/calf production capacity including: 1) efficient utilization of native rangeland as sources of feedstuff for beef cattle is less than its potential and 2) corn stover and cover crops are under-utilized.

Considering existing investments, opportunities for future investments, and the current momentum, The Agricultural Research Division and Nebraska Extension provided funds for a team-based integrated research and extension program for NE/US Beef Systems. Funding (\$1.5 million) in collaboration with IANR units (Schools, Centers and Departments) was provided over 5 years. Funding was designed to encourage strong collaborations (e.g., co-direction of students), address the research, teaching and extension missions of IANR, and fulfill two essential elements:

- Strategic integration and optimization of components of the IANR statewide system to impact specific issues of regional and national importance to Beef Systems, and
- Plans for leveraging this investment towards current and emerging external funding sources (public and private-sector).

A concerted statewide research and extension effort has been established to improve the utilization of rangeland, pastures, crop residues, annual forages, ethanol co-products, and cover crops to optimize Nebraska beef production in an economically and environmentally sustainable manner.

The goal of the Beef Systems Initiative, approved in November 2016, is to develop and support implementation of beef production systems that optimize feed resource use, natural resource conservation, and producer success in Nebraska through improved management of perennial grasslands and systems of integrated crop-beef cattle production.

To identify management practices that achieve optimal harvest efficiency and utilization of perennial grasslands, the initiative will utilize a case study approach. This plan involves a comparison of grassland and beef production systems of ranches in Nebraska that utilize various management and grazing strategies. The cattle grazing distribution, grassland and beef production, range condition/health, alternative feed resources, and harvest efficiency of ranches in Nebraska will be quantified and key factors that impact harvest efficiency and productivity will be determined.

The Beef Systems Initiative comprises 6 projects that are reporting in the first year:

- Enhancing Protein Production through Crops and Cattle
- Production Efficiency of Perennial Grassland Systems
- Outcomes of Integrating Cattle into Cropping Systems

- Utilization of Annual Forages and Crop Residues in Developing a Year-round Grazing System
- Predicting Consequences of Changing Systems: Economic and Production Parameters
- Producer and Community Outreach through Extension

The initiative is housed in the Center for Grassland Studies and engages many faculty from University of Nebraska-Lincoln units; as well as other institutions of higher education, state, federal and private collaborators. The first annual report documents progress on specific objectives during the first year of funding (August 1, 2017 - July 31, 2018) for each project.

BEEF SYSTEMS INITIATIVE PROJECTS

Project 1: Enhancing Protein Production through Crops and Cattle

Lead Project Investigator: James MacDonald, Associate Professor, Department of Animal Science, University of Nebraska-Lincoln.

Justification: There are three realities that will affect future beef production systems:

- Rapidly expanding population will require us to feed 9 – 10 billion people with the land base we currently have,
- Traditional perennial grasslands are declining and will continue to do so, thereby reducing the availability of traditional forage resources for beef production, and
- It is difficult for young people to have the capital to invest into land resources to enter into agriculture.

The project will develop a cow/calf system without perennial forage that utilizes crop residues and annual forages following cereal grain production as forage resources for cows.

Objective 1. Evaluate the effects of traditional and integrated forage production systems on cow/calf production.

Two cow/calf systems have been initiated at the Eastern Nebraska Research and Extension Center near Mead, NE. In each system 80 cows are enrolled. Cows were blocked by age into four blocks allowing for a randomized complete block design. Cows were bred to calve at the planned time for each system (Mid-April to Early-June for the traditional system and Mid-July to Early-September for the alternate system). The cows in the traditional system have calved and we observed a 95% pregnancy rate, and a 92.5% calving rate in this system. The cows in the alternate system will begin calving in July. We have observed a 98.75% pregnancy rate in the alternate system. We have met all of our goals in initiating these two cow/calf systems in the first year.



Objective 2: Quantify GHG emissions and water budgets from replicated production-scale systems utilized in Objective 1.

We have built a greenhouse gas monitoring trailer capable of measuring methane, CO₂, and nitrous oxide. The trailer includes weather proof, well insulated boxes to house the analyzer (one box) and pump (second box). We are using a minisplit heat pump to cool and heat both boxes to maintain a constant temperature, which is necessary for accurate measurements. The trailer is capable of plugging into an existing power supply, or running from a diesel-powered generator with an emission pipe tall enough so that the generator emissions does not interfere with our monitoring. The system has been tested in multiple stages and is working. The hot weather has had minimal impact on internal temperatures. We are currently employing the system on the traditional cows while they are grazing perennial forage. The alternate system is currently in confinement pens. We are using our existing methane barn to monitor gestating cows, which has never been done, to our knowledge.



Project 2: Production Efficiency of Perennial Grassland Systems

Lead Project Investigator: Mitchell Stephenson, Assistant Professor, Panhandle Research & Extension Center, University of Nebraska

Justification: Cattle production in Nebraska is reliant on the perennial grassland forage resources that comprises about 46% of the state's land area. Grazing management strategies that increase the efficient use of perennial grasslands can help livestock producers become more sustainable and increase the level of production per land area. Increasing harvest efficiency, the amount of forage intake by cattle compared to the amount available, on grazing lands is significant from a beef production potential because small increases in harvest efficiency can result in considerable increases in carrying capacity of grazingland. This on-ranch project will evaluate the relationships between multiple grazing strategies and harvest efficiency, rangeland health and production, and plant species composition on Sandhills rangelands.

Collaborators: Walt Schacht, Professor, School of Natural Resources and Department of Agronomy & Horticulture, University of Nebraska-Lincoln; Jerry Volesky, Professor, West Central Research & Extension Center; Bethany Johnston, Extension Educator, Panhandle Research & Extension Center; Jack Arterburn, Extension Educator, Panhandle Research & Extension Center; Daren Redfearn, Associate Professor, Department of Agronomy & Horticulture, University of Nebraska-Lincoln; and Jay Parsons, Associate Professor, Department of Agricultural Economics, University of Nebraska-Lincoln.

Objective 1. Effect of grazing management strategies on rangeland health and livestock production.

The initial year of the project was focused on identifying a PhD graduate research assistant and selecting producers who would be willing to participate in the study. While much effort and advertisement were extended for the position, we did not find a suitable candidate for the PhD graduate assistantship. This limited our ability to move the project forward.

We currently have a potential Masters student who is interested in the project and has good experience working with livestock producers in a similar project. We have also identified and selected several producers who have indicated they would be willing to participate in the study. No funds were used in this year's budget, but it is expected that travel and student budget will begin in the next year. As this is a 3-year study within the 5-year period, we expect that the study will move forward in the next year and be accomplished in a timely manner.

Project 3: Outcomes of Integrating Cattle into Cropping Systems

Lead Project Investigator: Daren Redfearn, Associate Professor, Department of Agronomy & Horticulture, University of Nebraska-Lincoln

Justification: Crop producers and ranchers should embrace competition for land resources. Adoption of integrated crop-beef cattle systems will enhance the long-term resiliency of Nebraska's agricultural production systems. Our philosophy is that these diversified crop-forage-livestock systems are more productive, sustainable, and economically competitive with traditional cropping or livestock systems. This project will measure the effects of integrating forage cover crops and crop residues, cropping rotation, and cattle effects on crop agronomic performance and soil properties as indicators of soil health.

Collaborators: Humberto Blanco, Associate Professor, Department of Agronomy & Horticulture, University of Nebraska-Lincoln; Roger Elmore, Professor, Department of Agronomy & Horticulture, University of Nebraska-Lincoln; Robert Mitchell, Professor, Department of Agronomy & Horticulture, University of Nebraska-Lincoln, and Research Agronomist, USDA Agricultural Research Service

Objective 1. Replicated plots consisting of two cropping rotations (corn-soybean and corn-soybean-wheat) and five cropping sequences (corn-soybean, soybean-corn, corn-soybean-wheat, soybean-wheat-corn, and wheat-corn-soybean) were established in fall 2017. Locating this research project near UNL's East Campus will be useful to communicate project results with stakeholders attending on-campus events, as well as integration of crop-forage-livestock system components into academic courses with those learning outcomes.

Wheat ('Ruth') was planted into a 0.81 ha area on October 19, 2017. Because the later planting date, wheat seeding rate was increased to 100 kg seed ha⁻¹ (90 lbs. seed/acre) to increase the likelihood of a productive stand. The complete study area was sprayed with 2, 4-D (2, 4-Dichlorophenoxyacetic acid) in early April, 2018 to control broadleaf weeds.

Within this larger area, individual plots for the 2018 corn and soybean cropping rotation were established by spraying the wheat with glyphosate (N-(phosphonomethyl)glycine) and no-till planting either corn or soybean in the appropriate plots of the design using field scale equipment. Plot size is 4.5 m x 40.5 m. Corn ('P1138AM', CRM 111) was planted on May 22, 2018 with soybean ('33T72R', RM 3.3) planted on May 29, 2018.

Wheat was harvested July 13, 2018 with a mean grain yield of 5347 kg ha⁻¹. Following wheat harvest, stubble was collected and weighed with a mean wheat stubble yield of 7882 kg ha⁻¹.

Oats ('Jerry') were planted 100 kg seed ha⁻¹ (90 lbs. seed/acre) on August 26, 2018. The grazing component is scheduled to begin near November 1 for the oats forage cover crop and early January for the corn residue.

Baseline soil samples were collected, but remain unanalyzed.

Project 4: Utilization of Annual Forages and Crop Residues in Developing a Year-round Grazing System

Lead Project Investigator: Harvey Freetly, Researcher, USDA MARC, and Adjunct Professor, Department of Animal Science, University of Nebraska-Lincoln.

Justification: Fall calving offers potential opportunities of integrating beef cattle production with farming systems. In the Midwest, fall calving helps to distribute the labor of the beef production and the farming enterprises across the year. The input/output relationships of these beef systems are poorly defined. Two management strategies are being examined. The first system is based on the premise that perennial summer forage is available. The system is designed to utilize perennial summer forage to support cows. Utilization of crop residue is incorporated into the system. The second system is based on utilization of harvested crop residue combined with the use of cover crops. This system is meant to integrate beef production into a farming system where perennial grass is not available.

Collaborators: Bob Cushman, Faculty, Department of Animal Science, University of Nebraska-Lincoln; Kristin Hales, Adjunct Professor, Department of Animal Science, University of Nebraska-Lincoln; Mary Drewnoski, Assistant Professor, Department of Animal Science, University of Nebraska-Lincoln; James MacDonald, Associate Professor, Department of Animal Science, University of Nebraska-Lincoln; Brian Vander Ley, Assistant Professor, Great Plains Vet Ed Center

Objective 1: The USMARC project was delayed one year due to a lack of labor to build the drylot facility. Site work has begun and I expect that we will begin the project in February 2019.

Project 5: Predicting Consequences of Changing Systems: Economic and Production Parameters

Lead Project Investigator: Jay Parsons, Associate Professor, Department of Agricultural Economics, University of Nebraska-Lincoln

Justification: Agricultural production systems are complex interactions between many biological, environmental, and human factors. A study of such systems, especially integrated crop-livestock production systems, is difficult and time consuming to complete using experimental trials. This project will leverage the data produced from experimental production system trials into computer simulated case study farms that will provide a foundation for testing the proposed systems for robustness and resiliency. The case study models will be used to identify key variables, assess various risk scenarios, and test proposed new systems that will guide future research.

Collaborators: Mary Drewnoski, Assistant Professor, Department of Animal Science, University of Nebraska-Lincoln; Daren Redfearn, Associate Professor, Department of Agronomy & Horticulture, University of Nebraska-Lincoln; James MacDonald, Associate Professor, Department of Animal Science, University of Nebraska-Lincoln; Mitchell Stephenson, Assistant Professor, Panhandle Research & Extension Center, University of Nebraska; and Matt Spangler, Associate Professor, Department of Animal Science, University of Nebraska-Lincoln

Objectives 3 and 4. Model factors that improve beef production efficiency on ranches and farms and simulate production system scenarios with data-driven models.

Development of the first computer simulated case study farm is well under way. The Knuth on-farm trial near Mead is being used as a model to build a simulation of a corn-soybean rotation farm incorporating spring grazing of winter rye by growing calves into their operation. The modeling efforts are being carried out using the systems modeling software AnyLogic (<http://www.anylogic.com>). AnyLogic brings together system dynamics and object oriented agent based modeling into an environment that is comprehensive and flexible enough to handle research into the number of different components involved in this type of integrated farming operation. Agricultural Economics M.S. graduate student Eric Coufal has been leading the charge in this modeling effort. He has finished up his course work and plans to defend his thesis in November and graduate in December. He presented a paper on his work titled “Modeling Crop-Livestock Production Systems Using Agent Based Principles/Techniques” at the Western Agricultural Economics Association Annual Meeting in Anchorage, AK on June 25, 2018.

The goal is to build six simulated case study farms over the life of the five-year project. In conjunction with the Extension component of the project, five focus group meetings were held in July and August 2018 with innovative cattle producers in five locations spread throughout the state (Lincoln, Norfolk, Holdrege, Broken Bow, and Scottsbluff). As a part of those meetings, discussions were completed on what a ‘typical’ cattle operation in their area would look like and what sort of numbers would go into populating a budget for such an operation. Each location had 2-3 ideas about what typical might look like in their area but the result was a great start on building more case study farms representative of cattle operations across the state that will form the basis of future simulation models. The Department of Agricultural Economics is in the process of building more user friendly livestock budgeting tools and educational materials that will create synergies in the outreach component of this project.

As far as setbacks go, the main concern is the recruitment of graduate students. The student recruited to start this fall backed out in August. Another applicant that would have been a good fit accepted a position in Australia during the recruiting process. The plan was to have two graduate students on the project for years 2, 3, and 4 that would be focused on modeling. It is not a setback yet but it is a concern that we seem to be working with a small pool of qualified potential graduate students and the recruitment of them is going to be important.

Project 6: Producer and Community Outreach through Extension

Lead Project Investigator: Mary Drewnoski, Assistant Professor, Department of Animal Science, University of Nebraska-Lincoln

Decision making in farming and ranching is extremely complex as it often involves several interacting factors such as impacts on the soil, plants, animals, economics as well as social aspects. In addition to using the information produced as a part of the research component of this project, extension personnel will work with producers currently using management practices being examined and those interested in adopting new practices to serve as case studies/ demonstration sites. The team will develop and deliver information, and conduct educational activities that will enhance stakeholder understanding of:

- Grazing management effects on harvest efficiency and long-term productivity of perennial grassland,
- Avenues for developing new or expanding existing beef enterprises by incorporating cattle into cropping systems, and
- Beef cattle impacts on ecosystem services.

Objective 5. Deliver gathered information to Nebraska producers using innovative extension and outreach programs to enhance economic vitality of stakeholders.

Two on-farm research projects (one near Mead, NE and the other in Lawrence, NE) evaluating the incorporation of double cropped annual forages into cropping systems are underway. These studies are looking at the effects on the whole system including the soil and water use, forage and cash crop production as well as whole system economics.

A field day that showcased the research from the Integrated Beef Systems Initiative at ENREC was attended by 25 producers. Of participants taking the survey, 63% said they were likely or very likely to increase their use of cover crop forages and 45% said they likely or very likely to reduce their feed costs.

Five focus groups with 43 innovative cattle producers were held in Lincoln, Norfolk, Holdrege, Broken Bow, and Scottsbluff. These producers were asked to discuss opportunities, barriers, and research needs regarding integrated cow/calf and cropping systems. They also provided information to begin development of regional beef cattle budgets.

Five common items were identified as either an education or research gap by each focus group:

1. Evaluate each integrated system as a whole system in terms of economics, risk, and adaptability to markets and weather
2. Explore options to extend the grazing season for early spring and late fall forage deficiencies
3. Develop management practices that reduce disease incidences in young calves
4. Refine the energy requirements of drylot cows
5. Investigate variability of cattle response when grazing corn residue

SUMMARY OF EXPENDITURES FOR YEAR 1 OF THE BEEF SYSTEMS INITIATIVE

WBS	Description	Revenue Received	Expended		Commitments		Available Revenue	Notes
			Personnel	Non-Pers	Pers	Non-P		
26-6261-0012	Beef Systems Initiative							
26-6261-0012-001	BSI - Overall	11,670	-	(11,670)	-	-	-	
26-6261-0012-002	BSI - MacDonald	63,655	(53,306)	(8,466)	-	-	1,883	
26-6261-0012-003	BSI - Drewnoski	45,620	-	(9,425)	-	-	36,195	<i>Year 1 funding loaded</i>
26-6261-0012-004	BSI - Redfearn	60,082	(55,024)	-	-	-	5,058	
26-6261-0012-005	BSI - Parsons	44,307	(26,539)	(1,630)	-	-	16,138	
26-6261-0012-006	BSI - Stephenson	75,095	(1,648)	-	-	-	73,447	
26-6261-0012	Total BSI	300,429	(136,517)	(31,190)	-	-	132,722	