

Developing Strategies to Increase Prosperity for Small Farms through Sustainable Livestock Production, Processing and Marketing

Introduction

Project Goal and Objectives

The goal of this project is to conduct research to determine the optimum configuration of a livestock food system for small producers, including production, transportation, processing, and marketing and sales. This optimal configuration will maximize economic benefits to small producers and rural areas, and minimize environmental impacts by (1) increasing the profitability of small livestock operations, (2) increasing demand for small producer products, and (3) creating jobs and investment opportunities in rural communities. To address this goal, the project will complete the following objectives:

1. perform an economic impact analysis based on processing and selling beef products locally and regionally;
2. evaluate the effectiveness and producer willingness to participate in different producer co-op strategies;
3. conduct a life cycle analysis for potential changes in production, processing and marketing to compare environmental consequences;
4. complete a distribution system analysis for the current and proposed livestock food systems, which includes moving livestock from small farm to finishing, from finishing to processing, and from processing to market outlets.
5. complete a market research analysis to estimate the demand for locally-produced beef, assess consumers' attitudes, determine market size, quantify the market premium, and devise policies through market surveys, estimating beef demand functions, and ascertaining willingness to pay;
6. develop cost/benefit analyses of each available livestock system configuration;
7. and, develop a model for integrating economic and environmental benefits and impacts.

Substantiation of Project Need

While the business model for large-scale agriculture involves specialization, many small farms survive through diversification. Raising livestock is an important mainstay or supplement to small diversified farms. Unfortunately, the conventional livestock system includes pricing largely determined by the efficiencies and business models of the largest cattle producers. Increasingly concentrated, high volume animal agriculture is impacting the ability of small livestock producers to remain viable operations. This makes it difficult for small livestock operations to be sufficiently profitable to survive or to significantly supplement revenues.

Many consumers and small producers are dissatisfied with the industrial food system, resulting in a national resurgence of interest in local foods (Hinrichs & Welsh, 2003). Sales of locally-produced fruits, vegetables, and beef products are on the rise (Springer, Biermacher, Childs, Alkire, & Grooms, 2009). The resurgence of interest in farmers markets, community

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gardens, the growth of food co-ops, the recent explosion of media coverage of food issues, the inclusion of local foods in restaurant menus, and the pressure to include sourcing information in grocery stores all represent the marketing value, and the interest of consumers in local foods. This trend is reflected in Idaho as well. According to production notes from a documentary which will air on Idaho Public Television on July 15, 2010, “a growing number of Idahoans...are passionate about reversing the problems that have become inherent with the food system” (Tan, 2010).

The national demand for locally-produced beef products is expected to grow as consumers are exposed to advertising and educational messages about production practices and product attributes. This demand continues to grow in our region as well. According to financial data shared by the manager of the Moscow Food Co-Op, for example, year-over-year sales of local meat grew 78%, strongly fueled by demand for family pack lean burger, from June 2009 to June 2010. Local-beef producers in north Idaho and eastern Washington have indicated a desire to better understand consumers’ preferences and the demands of this niche market.

A key feature of consumer interest has manifested as a willingness to pay more for local foods. Consumers tend to buy more locally-grown food products because they value attributes such as freshness, organic, differentiated products, place of origin, supporting local producers, eco-friendly, animal welfare, and development of the local economy (Loureiro & Umberger, 2007). Because of these attributes, consumers pay premium prices for locally-grown products (Ernst & Darby, 2008). Restaurants have also increased their purchases of locally-grown products in response to consumer interest (National Restaurant Association, 2009).

Research also indicates an increasing interest by consumers in locally-grown food offered in multiple locations and through multiple channels, so creativity is needed to develop a sustainable local market system which goes beyond co-ops and seasonal farmer’s markets (Gasteyer, Hultine, Cooperbrand, & Curry, 2008). The rapidly growing interest in local foods represents a market niche which, when combined with the need to develop multiple market channels, has the potential to enable small producers to command a higher price for their meat, which will enable livestock production to play a greater role in generating small farm revenue. This in turn will increase incomes in rural areas.

Small-scale livestock producers in north Idaho and eastern Washington are limited in production and marketing of their value-added meat products due to lack of available USDA inspected processing facilities within a reasonable driving distance. This geographical area is similar to many other areas in the western United States, where livestock production occurs on a small scale and where no substantial local feedlot or commercial processing infrastructure exists (see Figure 1). Small ranchers in this area generally sell their livestock at auction, with few options for branding their products to participate in higher value markets. The main regional processing facilities in the Inland Northwest are spread around the Columbia Basin in Moses Lake, Walla Walla, Basin City, and Toppenish, which are all in Washington State, approximately 3-4 hours’ drive from Latah County and the University of Idaho. The only USDA-certified meat processing facilities in the Palouse region and north Idaho are university-based, or are small

companies which are licensed for specialty products such as sausage (FSIS Meat, Poultry and Egg Product Inspection Directory, 2010).

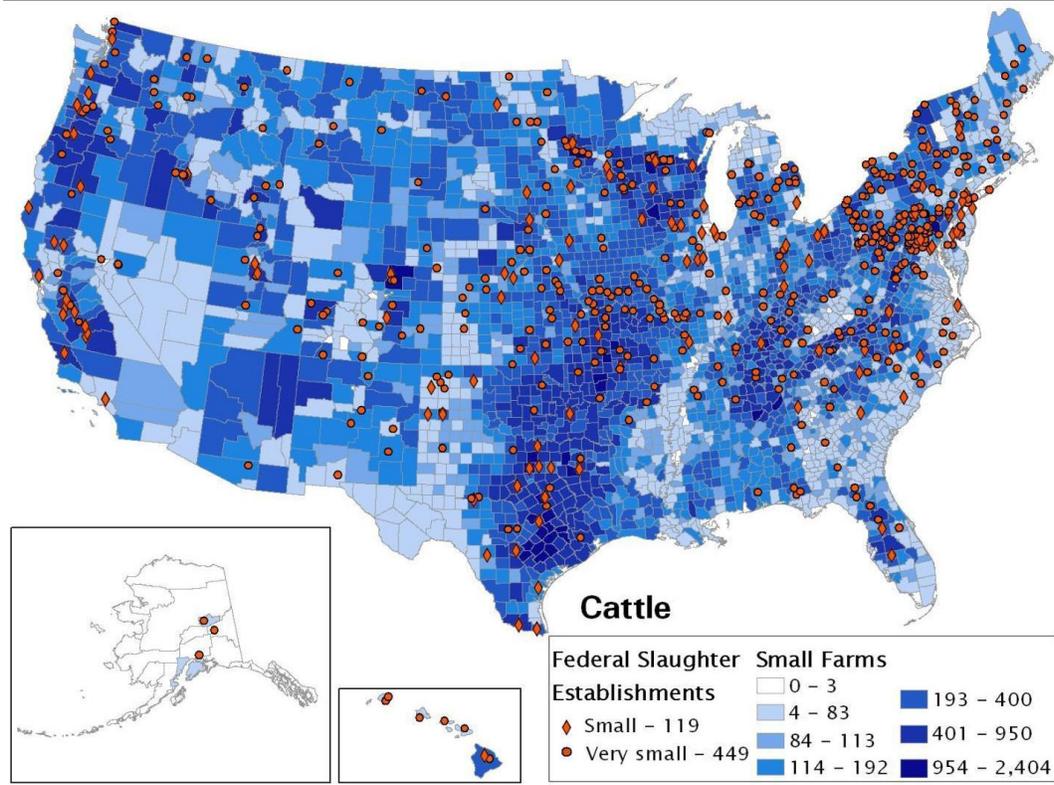


Figure 1 Slaughter availability for small livestock and poultry producers (USDA Food Safety and Inspection Service, 2010). The figure depicts the number of small farms in each county and slaughter establishments.

In 2003 and 2004, a local group of livestock producers, agency, university and non-profit partners held monthly planning and educational meetings in Moscow to address this issue. Many processing facility scenarios were discussed. The key recommendation from these discussions was the need for a feasibility study to include an assessment of current and potential producers, animal numbers and species to supply a facility, facility options, best location, associated costs of building, and associated volume needed to maintain a cost-effective business. A Rural Business Enterprise Grant proposal was submitted in the spring of 2004, but was not funded. The group lost steam and direction but the issue has not gone away. The need for local meat products has increased in the past six years. There is also potential for many of our small livestock producers to increase production if a processing facility is available within a reasonable driving distance.

In the spring of 2010, the UI Sustainability Center, UI Extension and Rural Roots (a regional food-system oriented nonprofit) organized the Farm-to -Table Conference focused on organizing local producers, identifying barriers to integrating small farm production into institutional food purchasing, and identifying barriers and strategies for strengthening the small producer portion of the food system. The conference was organized as a workshop in which participants

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discussed strategies for addressing identified problems. One outcome of the conference was the identification of continued strong interest by local producers in local meat processing. The need to organize producer co-ops to enable selling meat products to major food services and markets that require USDA-certified meat products was also identified as a necessary next step in supporting small producers in the area. Subsequent to the conference a number of small-scale livestock producers contacted the UI Sustainability Center, Latah Economic Development Council, UI Extension and UI faculty in the College of Business and the Agricultural Economics Department for support in developing local options for meat processing. As part of these discussions, the participants identified the need to analyze the economic and environmental feasibility and impacts of several livestock food system configurations.

Ongoing work relevant to the project

Darin Saul, UI Sustainability Director and Director of the UI Sustainability Center, has completed two GHG inventories for regional beef companies. These include a cow-calf operation, two feedlot operations and a beef processing facility (Saul & Nagawiecki, 2010; Saul & Nagawiecki, 2010; Saul, 2010; Saul & Griffith, 2010). He is also the primary author of the University of Idaho Greenhouse Gas Inventory (Saul & Nagawiecki, 2008) and the University of Idaho Climate Action Plan (Saul, 2010).

The UI Sustainability Center co-organized the March 2010 Farm-to-Table Conference at University of Idaho. The conference focused on organizing small producers, linking small producers with the food service market, and developing local food production and markets. UI Sustainability Center staff also includes a Food Systems Coordinator, who has been active in organizing efforts to increase integration of local foods into UI Campus Dining, addressing blocks in sourcing local foods, and in working with small producers to overcome institutional barriers to participating in local food systems.

Recent unpublished life cycle analysis (LCA) studies by the UI Sustainability Center on large feedlot and regional-scale cattle processing facilities in the Inland NW have identified transportation of cattle as a minor portion of the operational footprint of these companies. These studies also found that larger regional finishing and processing facilities were at a scale to enable access to food processing byproducts for feed, and had a better ability to control waste processes and develop secondary by-products than smaller operations, thereby reducing environmental impacts. These findings do not support the strong concern about “food miles” expressed by many supporters of local foods, at least within a regional context. Instead, these findings point towards a hybrid system of local production, regional finishing and processing, and then small producer co-op branding and marketing as the optimal environmentally friendly livestock production system. This project will build upon these efforts by including this scenario as one system configuration within project analyses.

Steve Peterson has been a research economist and instructor with the UI since 1993, and in that time has conducted over 50 economic impact studies. A significant number of these studies involve natural resource and sustainability issues: these include the economics and economic impacts of salmon recovery; the effect of the decline in timber harvest on rural Idaho

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communities; wind energy; geothermal energy; small modular nuclear plants; sustainable information technology certification; free-range chicken production; agriculture production of wheat, livestock, and other products; the effects of urban growth on agricultural viability in Canyon County; and Idaho plant and seed nurseries. His report on the value of agriculture and agriculture-related products in Canyon County, Idaho, indicated that more than 85% of dollars related to local livestock production and processing remain within the county, resulting in increased prosperity for farmers and local communities (Peterson & Rodriguez, 2009). Mr. Peterson was recently a guest commentator on the program “Economic Trends 2010,” on Idaho Public Television’s *Dialogue* (2010). Mr. Peterson will lead the economic base assessment research for this project, and will evaluate the economic impact of regional and local livestock-based food systems.

Tracie Lee, a full-time Operations Management faculty member in the UI’s College of Business and Economics, has 13 years of industry experience in supply chain management and project management. Ms. Lee will develop a model to capture the economic and environmental costs and benefits of the livestock production, processing, and marketing options identified through project research. Ms. Lee also will lead the research on distribution channels for livestock and livestock products. Ms. Lee has taught Project Management as a service-learning course for the last 2 years at the University of Idaho, and has organized student teams to collaborate on multiple projects with Dr. Saul and the UI Sustainability Center. The results of their collaborations included a feasibility study to implement milk processing at the UI Dairy.

Stephen Devadoss, a professor in the Department of Agricultural Economics since 1992, has expertise in domestic and international marketing. He has extensive research experience in estimating demand for food items such as meat products, potatoes, wheat, corn, and rice. He has published numerous articles based on economic modeling and demand systems. His expertise in demand systems will be used in this project to develop a market assessment of demand for locally or regionally-produced livestock products.

Nick Sanyal, a professor of Conservation Social Sciences and Bioregional Planning, has 28 years of research experience in the human dimensions of conservation planning and in formulating conservation plans. He has worked for a variety of international, national, state and local governments and the private and non-profit sectors, helping them identify and solve problems, develop research, and understand public needs. Dr. Sanyal will co-lead the supplier assessment portion of the research, focusing on producer surveys. He teaches graduate and undergraduate classes that deal with conservation management and planning and social research methods and analysis.

Dev Shrestha is a professor of Bioenergy in the UI College of Agriculture and Life Sciences. His primary research area since 2004 is in LCA of bioenergy production systems. He has published a study which finds that the fossil energy ratio for soybean biodiesel is 4.56, which is now nationally used as a reference (Pradhan A. , et al., 2009). His prior work includes process evaluation and optimization, modeling and computer programming. This project will build upon his work with modeling to develop an LCA of livestock food system configurations.

Rationale and Significance

This project integrates economic and environmental research on local and regional livestock production, processing and consumer markets to determine optimal system configurations for increasing the economic and environmental sustainability of small farms. Growing interest in local and regional foods represents an opportunity for small producers to enter a higher profit market niche, thereby increasing farm revenues. Marketing to local markets also provides economic support for rural areas. Foltz, Jackson-Smith and Chen (2002) found that smaller, independent farms which are able to market their products directly to local communities support local businesses and stimulate economic activity. The benefits of producing and processing cattle in smaller volumes also can have environmental and social benefits, including avoidance of air and water pollution related to transportation to and finishing of livestock in large feedlots, and increased quality of life for farmers, their employees, livestock, and communities (Worosz, Knight, Harris, & Conner, 2008)

To take advantage of this opportunity much work needs to be done to identify the optimal strategies and configurations of the livestock production, processing and marketing system to maximize benefit for small producers while minimizing environmental impacts. While growing interest in local and regional livestock production, processing and marketing exists, the feasibility of establishing USDA-certified local processing in every local area is doubtful. For this reason, the feasibility of livestock food systems in a variety of configurations, including both local and regional options for finishing, processing and marketing, needs to be researched. The result of this research will determine which circumstances and conditions will most benefit small producers and rural communities economically, while offering the most significant environmental benefits.

Relationship to Program Area Priorities

This project directly addresses Program Area Priority area (iii) enhance sustainability of small and medium-sized farms and rural communities through appropriate entrepreneurship and small business development. This project promotes the sustainability of small farms and rural communities by researching and developing a model for optimizing livestock food systems to increase profit for small producers while balancing economic viability and environmental impacts. A number of system configurations will be evaluated to find the ones that produce the most income to small producers with the minimum of environmental impacts. Increased revenues will help revitalize rural communities, and under several scenarios, lead to new feeding and processing facilities that will add additional jobs to communities while increasing revenue for small producers.

This project also addresses additional Program Priority areas (i) increase the value of agricultural products sold per farm by small and medium-sized farms through the adoption of environmentally sustainable, economically viable best management practices, and (v) develop common methods and practices for decision making about optimal landscape design to promote sustainable rural development and in turn, reduce rural poverty. By determining market size, willingness to pay and other factors, through identifying appropriate producer co-ops models or

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other producer organizational strategies, and through identifying the most cost-effective business models for the livestock food system configuration, this project will develop the knowledge necessary to increase revenues to small producers through targeting higher value markets and sales. In addition, the project will develop a model that integrates economic and environmental benefits and impacts to support better decision making by small producers and rural community development efforts.

Finally, this project also addresses Program Priority area (iv) to enhance the efficiency and equity of public and private investment in agriculture and rural communities. As part of ongoing economic development work in the region, the project is meant to provide the feasibility work necessary to guide future public and private investment into local and regional food production systems that benefit small producers from rural communities. This model will be transferable to other areas of the West where similar conditions and markets exist.

Long-Range Purpose and Priorities

This project will improve the long-term sustainability of the U.S. food system by increasing the economic and environmental sustainability of small livestock producers. This will help stabilize and grow the diversity of the livestock food system, and increase local and regional economic vitality. By optimizing the system configurations both economically and environmentally, the project will reduce the long-term risks and costs associated with environmental impacts.

This project is unique in its integration of economic and environment benefits through economic modeling, life cycle analysis, and cost/benefit analysis. It is also unique in its integration of social research focused on producer willingness to participate in different organizational strategies, recognizing that social factors may encourage or prohibit producers from participating in some strategies regardless of their economic or environmental benefits.

Approach

Proposed Activities

Our interdisciplinary project team will pursue seven lines of research concurrently. The first line of research is a supplier assessment. We will collect data on small livestock operations in the Palouse region and N. Idaho to determine available supply, types of livestock products offered, and current producer interaction with local and regional livestock food systems. This research will also investigate options for producer cooperatives and will explore producer interest and willingness to participate in local food system options. The second line of research is a distribution channel analysis. We will develop a process map of the distribution channels identified for the various system configurations. A third research thread will analyze local and regional options for finishing, processing, distribution, marketing and sales. A fourth research thread will develop an economic impact and base assessment to determine the local and regional economic benefits and impacts of different local and regional livestock system configurations. A fifth area will focus on market research to determine the potential of opportunities for increasing revenues through optimized strategies for branding, marketing and sales. A sixth research thread

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will be to evaluate the environmental benefits and impacts of the various food systems options and configurations through LCA. A final research activity will be to develop a synthesis model that integrates and balances economic and environmental benefits and impacts to determine optimal livestock system configurations based on particular conditions.

To develop this livestock system model and associated analyses, a number of research questions that reflect current information gaps need to be addressed:

1. Supply
 - a. How big is current supply?
 - b. What is potential supply if market and better prices become available?
 - c. What is the minimum size supply volume to make different finishing and processing options viable?
2. Finishing
 - a. How many producers are currently or willing to participate in finishing their cattle on farm?
 - b. How many producers are interested in more local feedlot access?
 - c. How many are interested in participating in a producer co-op that includes custom finishing at a regional feedlot?
3. Processing
 - a. What is the optimal configuration of processing economically and environmentally?
 - b. How many producers are interested in local meat processing?
 - c. How many producers are interested in participating in a producer co-op that includes processing at a regional facility?
 - d. What should the interface with the various processing options look like for small producers?
4. Markets
 - a. How big is the market for local meats and other branding options?
 - b. What is the willingness to pay more, if any, for these branding options?
 - c. What is the best marketing approach?
 - d. How many producers are interested in participating in a producer co-op for the purposes of branding and marketing?
5. Impacts
 - a. What are the economic impacts on rural economies of different livestock food system configurations optimized for smaller-scale producers?
 - b. What are the environmental impacts of different system configurations?
 - c. What are the best configurations, given certain conditions (density of livestock production in an area or region, availability of different transport (rail or truck), access to markets, and willingness to pay in local markets)?
6. Business models
 - a. How cost effective are different system options?

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- b. What conditions would be necessary for different system options to become optimal options?
- c. What are the risks associated with different system options?

Research Methods

Available supply and comparative analysis of producer organizational models

The first research area focuses on the supplier, or livestock producer, portion of the supply chain. This will include determining available supply, potential successful producer models, and producer interest and willingness to participate in various options. Information and data collection methods will include literature reviews, data mining of local, regional and national databases, surveys, interviews and focus groups.

At the local level we will work with the Latah Economic Development Council (LEDC), which has a database of local cattle producers, to determine total head of cattle, volume of beef to be processed, types of beef products offered, and to understand costs borne by local farmers in transporting their cattle to slaughter and processing outside the local area. Additional data will be collected on additional counties in north Idaho and eastern Washington from other data sources. Project staff will also gather data through group interviews as part of quarterly producer meetings in Latah County and the Palouse. UI Sustainability Center (UISC) will organize and facilitate the meetings in collaboration with UI Extension, LEDC and project researchers.

An additional research focus will be to collect comparative data from case studies, published reports and through visiting and interviewing those involved in various producer models to determine possible options for producer co-ops. Several models in the region include Country Natural Beef in NE Oregon and producer co-ops in Montana.

The producer meetings will be used to gather feedback, willingness-to-participate and obstacles to participation in various food system models and configurations. Additional data collection on supply and producer interests will include surveys of additional ranchers and small livestock producers through mail, personal interviews and other means. This research will include determining the representativeness of the local research findings of small producers from other regions, especially of the western US.

This work will be overseen by Darin Saul, Nick Sanyal and Tracie Lee. The work will involve UISC staff and UISC and CBE interns in gathering information and data, literature reviews and data collection. PASW software (formerly SPSS) will be used for data analysis (SPSS, Inc., 1997).

Comparative analysis of distribution channels for livestock food systems

This research area focuses on the costs and benefits of the distribution methods used in the various food system options identified through this project. We will use data collected through producer surveys, industry benchmarking and literature reviews to incorporate economic transaction costs, and data from the LCAs to incorporate environmental transaction costs in the model.

The majority of small farms in north Idaho and eastern Washington transport their yearling cattle to a nearby livestock auction for sale. The cattle are then transported to a feedlot, and from

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the feedlot to the processor. Processed beef is often transported hundreds or thousands of miles for eventual sale to a consumer. The drive to increase efficiencies and control costs, technological developments, and increasing consumer demand for beef worldwide have played significant roles in the consolidation and vertical integration of feedlots and meat processors. (Boehlje, Hofing, & Schroeder, 1999; Lowe & Gereffi, 2009). Research in the US has shown that vertically organized beef groups earn higher profit through economies of scale and increased access to niche markets (Raper, Black, Hogberg, & Hilker, 2005). Vertical integration and consolidation have reduced the market power of small farms, and have put downward pressure on auction prices. We will analyze distribution options including use of local producer co-ops for cattle finishing, local or regional meat processing, and increased sales of locally-produced meat products within rural communities, to determine whether a viable, sustainable distribution system for a regional livestock production system can be developed.

The complexity and proliferation of value channel options makes distribution a particularly challenging area. We will first perform a literature review to determine the extent of the body of research on livestock supply chains, and will benchmark best practices of other regional and local food systems, such as US Premium Beef's value-added strategy (Katz & Boland, 2000) and alternative marketing agreements (Koontz & Lawrence, 2010). Next, working with producer and consumer survey data, LCA data, and economic base assessment data collected through this project, we will develop a process map for each potential livestock distribution channel (Olsen & Aschan, 2010). We will also investigate models for supply chain collaboration (Barrat, 2004).

Analyzing feasibility of livestock food system models

We will determine the feasibility of each livestock food system scenario using a cost/benefit analysis (CBA) to determine options to increase prosperity for small farms and rural communities. CBA is a method which converts all potential gains and losses for a scenario into monetary units and then determines whether the gains outweigh the losses, or in other words, whether the scenario results in a net benefit or net cost. CBA originated as a decision support tool for public policy decisions, to evaluate potential projects which have a societal and environmental impact (Nas, 1996).

Data from the economic impact and base assessment, life cycle analysis, market assessment and supplier assessment will be collated and analyzed to determine the overall economic and environmental cost and benefit of each livestock system configuration. UISC and CBE interns, managed by Darin Saul and Tracie Lee, will assist in data collection through interviews, research, and surveys.

The options to be analyzed include the following:

1. Finishing
 - a. on farm finishing,
 - b. local or nearby small feedlot finishing,
 - c. regional finishing
2. Processing

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- a. Public/private partnership, expand UI Vandal Meats' capacity to process local meats, determine feasible radius and headcount for required return on investment.
 - b. Private mobile slaughter and private cut and wrap, determine feasible radius and headcount for required return on investment.
 - c. Private stationary slaughter and private cut and wrap, expand local non-USDA facility into USDA-certified facility for cut and wrap, determine feasible radius and headcount for required return on investment.
 - d. Private regional slaughter and cut and wrap, local producer co-ops handle marketing and sales, whether cumulatively or for individual producer brands.
 - e. Maintain status quo, sell bulk of livestock at auction for market rate into national livestock food system, use non USDA certified private slaughter and cut and wrap for sale to family and friends.
3. Branding, marketing and sales
 - a. No cooperative efforts
 - b. Branding and marketing cooperatives
 - c. Local, small rancher, and other branding options

Variables needed to populate the feasibility analysis include the following: 1) capitalization costs; 2) operational costs; 3) transportation costs; 4) market demand; 5) available supply; 6) waste stream costs and potential byproduct revenues; and 7) required rate of return.

Economic impact and base assessment

This portion of the project will develop an economic impact and base assessment to determine the economic benefits and impacts of different local and regional livestock system configurations. The goals of this portion of the research are as follows: 1) create a detailed regional profile including economic, social, demographic, and historical trends; 2) create an economic base assessment of the regional economy which identifies causal factors of economic growth; 3) create a profile of agriculture and its role in the regional economy with a focus on livestock; 4) assess the economic impacts of increasing locally produced meats on the regional economy; 5) estimate the economic impacts of increasing regional consumption of locally produced meats on the regional economy. An economic profile of the regional economy reflects the actual sales, value-added, wages, jobs, unemployment, income distribution, and other measures of economic activity in each sector of the economy. This profile will also include other social, cultural, and demographic trends.

Profile measures of economic activity are widely reported and utilized by policy makers and the public. While being very useful they do not identify the causal factors that drive an economy. These factors include exports (i.e. any activities that bring new money to the region) and the backward linkages that create the multiplier effects. The larger the magnitude of the multipliers, the greater is the interdependency among the industrial sectors and less leakages through imports and savings.

A social accounting matrix (SAM) model will be developed using Minnesota IMPLAN Group's software and data package, IMPLAN (IMPLAN.com). The model will assess the

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contributions of different sectors in the economy. The economic base will be calculated using the ASAM model developed by Rodriguez, Watson, and Braak (2010). The base assessment will identify and report the actual drivers of the regional economy. (Miller & Blair, 2009)

This analysis will include a detailed assessment of agriculture's role in the economy (production and processing) and the economic impacts of expanding local production of meats, similar to Peterson and Rodriguez's (2009) report for stakeholders in Idaho's Canyon County. Agriculture's existing linkages to the other economic sectors will be identified along with how these linkages will change from an increase in locally produced meats. (Rodriguez, Taylor, Eborn, & Erikson, Spring 2010) Finally a simulation will be conducted to estimate the economic impacts of substituting regional consumption of locally produced meats for out-of-region produced meats.

The research discovery process will include identifying the appropriate geographical region for sustainable local meat production and processing. This may lead to the creation of multiple models over various defined geographical regions, depending on the needs of the analysis. The results will be a valuable tool for educating local decision makers about the role of local agriculture and processing in the local economy.

Market research

Two methods are typically used in the marketing research field to elicit and understand consumer wants and needs; namely, direct and indirect consumer survey methods (Smith & Albaum, 2004). The proposed project will utilize both methods.

The direct consumer survey method, which will be conducted first, will be used to provide an understanding of consumer perceptions of various product attributes. The survey instrument will include questions that will be used to (1) identify important product attributes based on values, attitudes, perceptions, and beliefs, (2) understand consumers' willingness to pay for the product, and (3) segment the market based on socio-demographic and perceptual characteristics.

A quantitative approach is proposed to permit statistically valid and reliable inferences to be made across regional market segments. A target of 200 completed questionnaires will be collected utilizing a stratified random sample of residents from each identified region (Hair et al., 2010). Stratification will be based on socio-demographic factors (e.g., household income, gender, age, education level). The sample frame, purchased from a provider such as Dun & Bradstreet, will include household telephone numbers and addresses, which will permit for nonresponse bias checks. A modified Dillman method will be implemented to ensure maximum participation (Dillman, Smyth, & Christian, 2009). An initial mailing will alert participants to the study and will include an email address where they can complete the questionnaire online (using Qualitrics™ software available to the research team). A reminder postcard will be sent 15 days after the initial mailing, followed by a second reminder postcard three weeks later.

Given declining participation to surveys over time, we expect a response rate of approximately 35 percent. To assess nonresponse bias, we will conduct a brief telephone interview with 40 randomly selected nonrespondents in each region (divided proportionately

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among the strata). The Armstrong and Overton wave method and t-tests will be used to assess the impact of nonresponse bias (Armstrong & Overton, 1977; Hair et al., 2010).

Individual consumer demand for products is strongly related to the attributes of the products being considered, both tangible and intangible, and the price of those products in the consumer's consideration set (Wedel & Kamakura, 2000). Hence, to estimate beef demand, it is important to understand the fundamental wants and needs of consumer segments (Myers, 1996).

Using the data from the above survey, we will estimate the total demand for beef products for this region. The demand specification is

$$Q = f(p, r, v, y, \mathbf{A}),$$

where Q is quantity demanded of local beef, p is price of locally produced beef, r is price of beef from other regions, v is price of substitute meat, y is per capita income, and \mathbf{A} is a vector of attributes (freshness, organic, differentiated products, eco-friendly, etc).

The indirect consumer survey will consist of a conjoint analysis study to assess relative attribute importance and consumer price sensitivities given various combinations of product attributes. Why conjoint analysis? Most consumers are incapable of accurately determining the relative importance that they place on product attributes, though they can often identify a set of attributes that affect their purchase decision (this set of attributes will be one output that will be derived from the direct consumer survey). To illustrate, often when consumers are asked which attributes are more important to their purchase decision, direct consumer survey results tend to indicate that all attributes are important. Additionally, *individual* product attributes are perceived differently than when they are assessed as *combinations* of attributes found in a product. In other words, consumers make tradeoffs when making a purchase decision based on a combination (bundle) of attributes embodied by the product (Green & Srinivasan, 1990).

Survey respondents tend to find it difficult to choose preferred combinations from a list of product attributes. The task is simplified when one is presented with combinations of product attributes that can be thought about as different product offerings. If all combinations of attributes are to be assessed, however, this task also becomes impractical since a very large number of possible combinations can exist.

Conjoint analysis is an analytical tool that allows for a practical and feasible subset of the possible combinations of product attributes (i.e., product offerings) to be used to identify the relative importance of each attribute in the consumer purchasing decision (Brocklebank, Hobbs, & Kerr, 2008; Orme, 2006). Furthermore, price sensitivity can be assessed for varying levels of each attribute. The method is indirect in the sense that study participants do not directly communicate the relative importance that they place on individual attributes or the value (in monetary terms) that they attach to various levels of attributes (Hair et al., 2010; SPSS, Inc., 1997). Rather, importance is derived via a simultaneous estimation method. Conjoint analysis is extensively used to assess the market for locally produced foods (Darby, Batte, Ernst, & Roe, 2008; Batte, Hu, Woods, & Ernst, 2010). Conjoint results are valuable in that they allow for an assessment of the appropriate combination of attributes to be offered to segments of the market at a price that consumers implicitly indicate that they are willing to pay. Hence, conjoint

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analysis is a powerful analytical tool when attempting to enter the market with the *right product* at the *right price* given consumer preferences.

The conjoint analysis for this project will be conducted after completion of the direct consumer survey. A prioritized list of attributes considered important by consumers will be output generated by the direct consumer survey; this output will then be used to establish which attributes to include in the conjoint analysis, as well as the appropriate levels that will comprise each attribute. The conjoint analysis sampling procedure will be nearly identical to that used for the direct survey, including the assessment of nonresponse bias.

Participants of the conjoint study will be presented with several products differing in their combinations of attributes (e.g., product origin, artificial hormones/hormone free, price) and asked to state their preference for each product combination using a rating scale; this particular methodology is referred to as adaptive choice conjoint (or ACA). The conjoint study will utilize an orthogonal fractional factorial design of four or five elements (i.e., attributes) with two to three levels for each element. The specific number of attributes and levels will be selected to maintain a manageable number of combinations for participants – approximately 15 or fewer. An orthogonal design reduces respondent burden by decreasing the total number of scenarios that a survey participant must evaluate (Hair et al., 2010; Orme, 2006).

Similar to the direct consumer survey, the conjoint study will use Qualtrics™ software for data collection and PASW software (formerly SPSS) will be used for data analysis (SPSS, Inc. 1997). The results of the conjoint analysis will be particularly useful in identifying target markets based on traditional segmentation variables (e.g., demographic segmentation), as well as by consumer price sensitivity (price segmentation).

Environmental Analysis

This portion of the project will quantify environmental impacts of different configurations of the livestock food system for comparison and context for the project's economic modeling. The assumption is that the best overall configuration of the livestock foods system will balance economic and environmental benefits and impacts. This will include developing an understanding of the best operational configurations from an environmental perspective.

It is important to understand economic impacts in the context of environmental benefits and impacts. One motivator for the establishment of local markets is the perceived reduction of environmental impacts associated with the national livestock system. To determine the environmental impacts, Life Cycle Analysis (LCA) will be conducted on each livestock production and processing scenario to document variations in environmental benefits and impacts based on different configurations of the livestock food system. LCA quantifies environmental impacts using a “cradle-to-grave” approach capable of identifying how different processes directly and indirectly impact important parameters such as greenhouse gases, carbon sequestration, land use (Searchinger, et al., 2008) and water quality (Zhang, Singh, & Bakshi, 2010; Wenzel, 2009). LCA will be used to identify areas in which the greatest life cycle benefits can be achieved.

Project Narrative

The scenarios developed in the livestock food system feasibility analysis and the economic impact analysis will also be analyzed using LCA. Each scenario will be broken down within its operational boundaries into component variables for analysis and comparison with other system configurations. The scenario configurations differ in regards to type and location of finishing, scale and location of facilities for processing, and distribution system to consumers. This will include, at a minimum, feed growth and transportation, utilities and stationary combustion, vehicle fuel use, manure management, transportation of animals, enteric fermentation, and transportation of processed meat and byproducts to consumers or point of use. Additional impacts such as use or disposal of byproducts will be included. Emissions associated with cows and bulls will also be included to complete the reproduction and rearing stages of production. Feed used at larger facilities in the NW includes a high percentage of byproducts, for example from potato processing and from biodiesel operations. Environmental benefits and impacts associated with byproduct use for feed will be included where appropriate.

LCA will be conducted according to guidelines provided by ISO 14040 and 14044 standards (International Standardization Organization, 2006a; International Standardization Organization, 2006b). Faculty involved in the project have ongoing research involving LCA and possess the necessary databases (Pradhan A. , Shrestha, Van Gerpen, & Duffield, 2008). Gabi4 from PE International, Simapro from PRé Consultants, and the Greenhouse gases, Regulated Emissions, and Energy use in Transportation (GREET) model will be used as appropriate to the option being analyzed. Most data for standard processes are available in the public domain from EPA, NASS, ERS, NIST, FAO, and DOE. Additional data can be purchased from companies: EcoInvent provides a database with LCA results of more than 4000 industrial processes; PE International provides specific data for biofuels; and PRé Consultants has additional data for cross validation. The UI possesses databases from all three major vendors plus databases available in the public domain. The composite database that we have assembled contains information on thousands of industrial processes. Previous experience has shown that LCA models need to be adapted to the specifics of cattle operations. Previous work with two regional cattle operations will provide a basis for model modification as necessary.

A portion of the project will include collecting data on production, feeding and processing operations in the Inland NW. Through previous LCA projects, we have data on two of the largest regional feedlot companies and a regional processing facility. Additional data will be collected on processes, feed mixes, manure management, residence time, average transportation distances, energy use, and other variables for different stages of the scenario configurations. This will include mapping out the processes from cradle-to-grave for a sample of small producers to determine key variables in each stage of the livestock food system as experienced by small producers. This will be done through analysis of existing data and reports, and through interviews and surveys of small producers.

Analysis of Results: Developing a Synthesis Model

To determine an optimal livestock food system configuration, the project team will evaluate the possible configurations using a weighted factor scoring model. This type of model is

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commonly used in project management and decision support (Cooper, Edgett, & Kleinschmidt, 2001; Hemphill, Berry, & McGreal, 2004; Kandel, Porter, Carr, & Zwinger, 2008; Shafer & Mantel, 1989). The project team will first agree on a set of criteria by which the potential livestock food system configurations may be evaluated. Criteria can be quantitative or qualitative, financial or non-financial. The criteria will be drawn from the results of each research area. For example, the LCAs will evaluate the carbon footprint for each meat processing option, and one criterion which may then be included in the scoring model is “size of carbon footprint.” A cost/benefit analysis (CBA) will be performed on all livestock food system configurations, therefore another criterion may be the “CBA ratio.” A scoring model provides an optimal vehicle to integrate economic and environmental data, as well as qualitative and quantitative data.

Once the criteria are developed, the project team will agree on the weight of each criterion. For example, the team may determine that CBA ratio should be weighted 25%. All criteria weights must add to one. Finally, the project team will rate each food system configuration against the common set of criteria. The configuration is rated from 1 to 5, with 1 meaning the configuration performs poorly in that criterion, and a 5 meaning the configuration performs extremely well in that criterion. See Table 1 for an example of a score card.

Once a configuration has been rated on each criterion, the rate is multiplied by the weight for all criteria. The results are summed, and the project is assigned a total configuration score. This formula will be used to determine a configuration score:

$$CS = \sum_i w_i r_i$$

where i are the criteria, w is the weight of each criterion, r is the rating assigned each criterion, and CS is the configuration’s total score. Weighted scoring models have 3 main benefits in that multiple organizational objectives can be included in deciding between projects, criteria can be quickly reweighted or reevaluated when business strategies change, and evaluation of projects is focused on longer term criteria than just short-run profitability (Verzuh, 2003, p. 82). Liberatore and Titus (1983) found that scoring models are particularly prevalent when the majority of research is funded through outside grants and contracts.

Criteria (i)	Weight (w) all weights sum to 1	Rate (r) On a scale of 1 to 5, where 1=poorly meets our needs and 5=best meets our needs	$w_i r_i$
Dollars per \$300 in sales, remaining in community			
Impact on environment (carbon footprint reduction)			
Results of Cost/Benefit Analysis			
		Total Project Score	

Table 1: Weighted Factor Scoring Model

Expected outcomes

This study will generate results to optimize strategies for small producers to increase revenues and minimize environmental impacts. The project will provide a roadmap for organizing next steps, whether to build local processing capacity, develop producer co-ops or educate producers on the how to maximize results from the current system. The synthesis model, and the individual research area outcomes, will provide a basis for developing strategies for use in similar circumstances across the US. The project will also result in a website (built into the UISC website), journal articles and conference presentations.

Use of Results

This project will disseminate results at two levels. Locally the quarterly producer meetings will involve local producers in providing information for the project and in understanding project results. Project results will be shared with small livestock producers through a report and website, and will be shared with local producers through direct communication. One important use of these results will be to educate local decision makers about the impacts of the livestock food system on the local economy. Project results can also be used to build public support and “buy-in” for producing and processing local meats.

Results will also be disseminated nationally through journal articles, the UISC website and publications designed for the small producer audience. It is hoped that this multidisciplinary research will result in a transferable livestock food system model. Co-PIs will collaborate on peer-reviewed articles targeting agricultural economics, LCA and rural economic development audiences. Graduate students and Co-PIs will also present project results at appropriate conferences as part of their regular career activities.

Limitations to proposed procedures

Market surveys and willingness-to-pay research include an inherent assumption that consumers’ behavior will match stated intentions. To mitigate the differences between consumers’ actual practices and answers to the questions, the survey questions will include several options to gauge consumers’ intentions.

Hazardous Activities

No Hazardous activities are planned as part of this project.

Potential Pitfalls

While interest has been strongly expressed by small producers in the local area, we may have difficulty getting consistent participation through the life of the project because of conflicting demands upon their time.

Timeline

Figure 2 is a timeline for the project, with tasks beginning February 2011, and finishing January 2013. Common tasks are indicated in the “Additional Project Activities” section, including preparation of journal articles, quarterly Co-PI meetings, and report submission in the 3rd quarter 2012. A website will be developed to solicit input from, disseminate results to, and provide a forum for project stakeholders, including producers and community partners.

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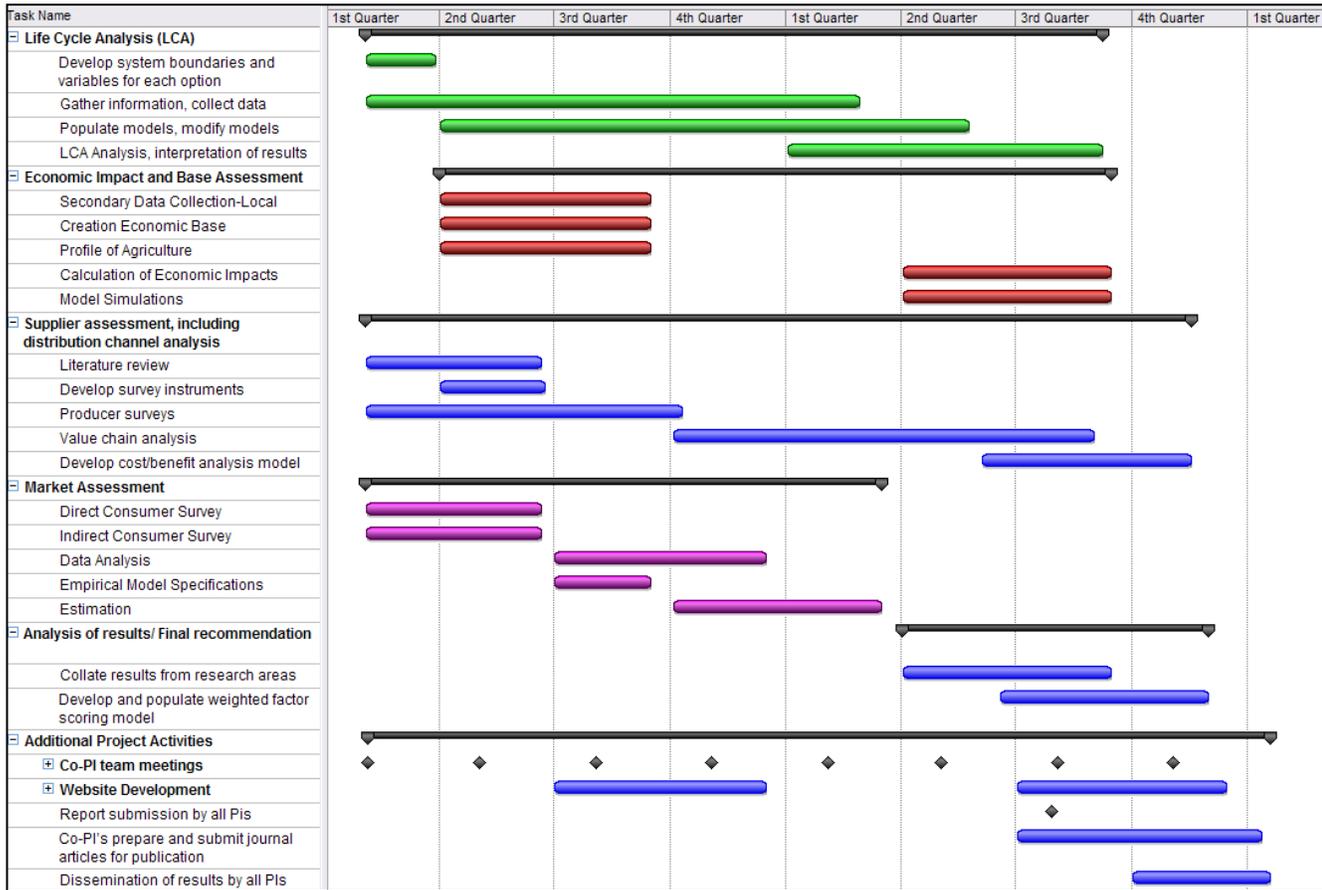


Figure 2: Timeline