LOGISTICS OF NORTH DAKOTA STATE LOCAL FOOD SYSTEM: AN EMPIRICAL STUDY TO MEASURE LOCAL FOOD SUPPLY AND DEMAND FOR REGIONAL FOOD HUB FEASIBILITY STUDY

A Dissertation
Submitted to the Graduate Faculty
of the
North Dakota State University
of Agriculture and Applied Science

By

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In Partial Fulfillment of the Requirements
for the Degree of
DOCTOR OF PHILOSOPHY

Major Program:
Transportation and Logistics

July 2021

Fargo, North Dakota

North Dakota State University
Graduate School

Title

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DOCTOR OF PHILOSOPHY

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ABSTRACT

Because North Dakota (ND) is one of only four states that do not have a food hub, there is a significant need to estimate the supply and demand for local food. The food hubs concept is widely distributed among U.S. states to solve several local food issues. Food hubs cover the gap between farmers and markets and add value to the food supply chain infrastructure. Hence, this study's main exploratory research question was ***Does the ND local food system need a regional food hub?*** Furthermore, the author of this research found no comprehensive literature review concentrating solely on the local food system in ND. For that, a regional food hub feasibility study was conducted. In addition, this is the first study to our knowledge to investigate the digital marketing and social media platforms for local food marketing.

The ND regional food hub feasibility was divided into two independent cross-sectional surveys. Part-A (the supply-side) and part-B (the demand-side), each survey had 51 questions, including qualitative and quantitative factors. Both surveys were analyzed by the variable screening methods. Our findings indicated that ND food producers and customers defined local food as all food produced or grown in ND. Additionally, we found that the regional ND food hub project was feasible. Our findings indicated there are enough supply and demand for the local food in ND to establish a ND food hub. The suggested best model for the ND regional food hub was a cooperative legal structure and a hybrid business structure that can work for-profit at both the state and national levels.

ACKNOWLEDGMENTS

First and foremost, I thank almighty God for giving me the power and persistence to achieve my dream.

I would like to extend my sincere thanks to my esteemed committee chair, Professor. Joseph Szmerekovsky for his assistance at every stage of my Ph.D. journey. Without his patience and support, I could not have completed this dissertation. I am deeply grateful for his unwavering support and belief in me. He is an extraordinary mentor and adviser; he revealed his excellent, caring, tutoring, and mentoring from the orientation day to the graduation day. I am so thankful for his flexibility during my Ph.D., especially when I was writing my dissertation. Professor. Joe, your continued encouragement provided the fuel for my motivation which allowed me to finish this degree. I would also like to express my great appreciation to my committee members Professor. Joseph Jones, Professor. Frayne Olson, and Professor. Saleem Shaik for their insightful comments and suggestions.

I want to extend my sincere thanks to Professor Denver Tolliver, the Upper Great Plains Transportation Institute (UGPTI) director. And Professor. Jill Hough, the Small Urban and Rural Center on Mobility (SURCOM) director, for their unwavering support and belief in me. From the bottom of my heart, I would like to thank you for the unending financial and non-financial support I received from both of you. I sincerely appreciate all that you did for me, and I will stay forever grateful for both of you.

This dissertation could not have been completed if not for the assistance of many individuals and departments at NDSU. I want to offer my special thanks to Jody Baldock, the UGPTI department manager and academic coordinator, and Dr. Alan Dybing for their support, guidance, especially during difficult times. I also acknowledge the support from the entire UGPTI staff with gratitude, which made my stay in the Ph.D. program such a pleasant experience.

I would like to express my sincere gratitude to Professor. Curt Doetkott who kindly and selflessly offered me his knowledge and experience throughout the SAS programming class. Thank you, Professor, for making my Statistical Certificate meaningful. I would like to thank Linda Gunderson, technology coordinator at Group Decision Center, for her technical assistance.

I would like to offer my special thanks to Mr. Enrico Sassi, the center for writer's director, to offer a disquisition boot camp and develop several graduate writing courses. The center services allowed me to develop my writing style, which positively impacted my dissertation and personal life. I would like to extend my sincere thanks to Mrs. Kristina Caton, senior writing consultant, for the writing workshops she offered every semester. They were a valuable source for my dissertation. Also, I am deeply grateful to Mrs. Tammi Neville, graduate writing consultant, for sharing her personal experiences in local food and agriculture with me. Mrs. Kristina and Mrs. Tammi, thank you for the endless one-to-one consultation appointments that improved every chapter in this dissertation. I would like to thank Mr. Dan Nygard, the disquisition processor, for helping me with formatting this dissertation and making the approval process very smooth.

Finally, I would like to extend my appreciation to all NDSU. Being a student at this university feels like being a member of a lovely family.

DEDICATION

This work is dedicated to my beloved father, soul ***Qublan. Hamad. Al Qublan*** my first Professor and my life mentor.

May GOD grant him paradise.

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LIST OF ABBREVIATIONS

CSA..Community Supported Agriculture.

FRL ....Food-Related Lifestyle.

GAP..Good Agricultural Practices.

GHGs ....Greenhouse Gases Emissions

GHP..Good Handling Practices Audits.

HACCP ....Hazard Analysis and Critical Control Points.

LCA..Life Cycle Assessment.

ND..North Dakota.

NRA ....National Restaurant Association.

SFSC ....Short Food Supply Chain.

V. A. P..Value-Added Products.

VBSCs..Values-Based Supply Chains

WTPPP...Willingness to Pay a Price Premium.

WKKF..W.K. Kellogg Foundation.

1. INTRODUCTION

The 21st century has shifted American agriculture and rural life; the numbers of farms and populations in rural areas are dramatically decreasing. According to the USDA (Farming and Farm Income), there were 6.8 million farms in 1935 versus 2.05 million farms in 2017 (USDA-ERS 2021). This decrease was due to the merging of American agriculture that increased acres' average size. Farms currently in operation, on average, have about 444 acres compared to 155 acres in 1935 (USDA-ERS 2021). Having a few large, specialized farms instead of many small, diversified farms may harm the farming industry. McDean (1980,25) noticed that policymakers were encouraging the consolidation of farms into larger-sized units. MacDonald, Hoppe, and Newton (2018) noted that the U.S. moved to the consolidation of acreage in the last three decades. These three decades negatively affected the core of the U.S. local food system, and the small and mid-size farms were the most harmed from the merging of American agriculture.

The decreasing number of small and mid-size farms is an indicator of the risks and challenges facing farms, ranchers, and food producers. The concept of food hubs has become an increasingly popular response to these local agricultural problems. Barham et al. (2012) defined food hubs as active, financially viable businesses that develop infrastructure to manage the aggregation, distribution, and marketing of food products, primarily from local and regional producers. Furthermore, food hubs intervene in transactions to strengthen the producers' abilities to satisfy wholesale, retail, and institutional demand to gain entry into a new and additional market (Fischer et al. 2014). In addition, food hubs continue to attract diverse stakeholders who see food hubs as vectors for economic growth and social and environmental change (Hardy et al. 2016).

Many authors have observed the benefits associated with local food systems, such as the positive impact on local/regional food producers and farms, enhancements of community health, nutrition, and food security, the local/regional economic development, agriculture sustainability, and the environmental advantage related to short transportation. For example, Schmitt et al. (2017) said that local food systems provide ecological, health, and socio-economic benefits. And Barham et al. (2012) claimed that a food hub positively impacts the local economy, society, and environment and can be financially profitable. On the other hand, according to King, Hand, and Gómez(2014, 293), other observers who focus on extreme situations challenge these assessments and argue that the local food movement violates the comparative advantage. For example, Lusk and Norwood (2011) argue that North Dakota (ND) cannot produce everything, for example, pineapples.

These extreme scenarios faced ND before 1922 regarding elevators. The flour mills and grain exchange in Minneapolis were the primary wheat markets for ND farmers and elevators at that time, and ND farmers were receiving a low price for their wheat. To protect local farmers in ND from these unfair business practices and benefit them, the state government and Nonpartisan League launched the ND Mill and Elevator Association by the end of 1922. The project included seven milling units, a terminal elevator, and a packing warehouse to prepare bagged products for shipment. In addition to bread and pancake machine mixes, an organic wheat product was offered as well (North Dakota Mill, n.d.; State Historical Society of North Dakota, n.d.). The ND Mill and Elevator Association answer localizing control of the grain exchange and creating infrastructures to process that grain. And offered many opportunities for ND farmers and provided fair prices for their products (North Dakota Mill, n.d.). Likewise, the food hub project. A ND food hub can scale up local food production and offer reasonable prices to farmers and customers. And the benefits of food hubs can positively impact the local economy, environment, and community.

However, Martinez et al. (2010,1) said the “sparse literature is so far inconclusive about whether localization reduces energy use or greenhouse gas emissions”; in addtion food hubs are not a solution for all local food problems. Food hubs are not different from any other businesses; they have pros and cons. No literature recorded if there are any externalities of food hub projects. But, the fluctuation in the number of national food hubs over the past ten years is a sign of issues challenging food hubs’ success. Many case studies were conducted about food hubs to investigate if these issues are internal or external. For example, the USDA published four reports which examined these issues and challenges. The four reports (Running a Food Hub) were as follows:

- Running a food hub volume 1 addressed lessons learned from the field (Matson, Thayer, and Shaw 2015).
- Running a food hub volume 2 a business operations guide (Matson, Thayer, and Shaw 2015).
- Running a food hub volume 3 assessing financial viability (Matson, Thayer, and Shaw 2016).
- Running a food hub volume 4 learning from food hub closures (Feldstein and Barham 2017).

1.1. Background

1.1.1. Research area

ND the 19th largest state in the U.S. with a surface area of 70,700 square miles, is located along the U.S./Canadian border. As of 2021, the population size was 770,026 residents, with a 1.99% growth rate, which ranked it 2nd place in the nation for growth rate (World Population Review 2021). ND has four regions: northwest, northeast, southwest, and southeast. According to the 2017 Census of Agriculture of ND, 89% (39.3 million acres) of land in ND is occupied by farms and ranches (ND Census of Agriculture 2017). Tables 1 and 2 show farms by size and farms by the value of sales, respectively. The average farm size in 2017 was 441 acres (USDA-ERS 2020). From Table 1, we can see that 31% of the ND farms were less than the average size of U.S. farms and 17% less or equal to the average size. Furthermore, Table 2 shows that 30% of ND farms were earning $2500 or less.

Table 1. ND Farms by Size.

Farms by Size	Number	Percent of Total
1 to 9 acres	571	2
10 to 49 acres	2,514	10
50 to 179 acres	4,988	19
180 to 499 acres	4,549	17
500 to 999 acres	3,184	12
1,000 + acres	10,558	40

Source: Adapted from 2017 Census of Agriculture ND State Profile.
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/North_Dakota/cp99038.pdf

Table 2. ND Farms by Value of Sales.

Farms by Value of Sales	Number	Percent of Total
Less than $2,500	7,928	30
$2,500 to $4,999	888	3
$5,000 to $9,999	1,091	4
$10,000 to $24,999	1,606	6
$25,000 to $49,999	1,703	6
$50,000 to $99,999	1,889	7
$100,000 or more	11,259	43

Source: Adapted from 2017 Census of Agriculture ND State Profile.
https://www.nass.usda.gov/Publications/AgCensus/2017/Online_Resources/County_Profiles/North_Dakota/cp99038.pdf

1.1.2. Local food market in ND

According to Martinez et al. (2010), the local food market is divided into two parts based on transactions: direct-to-consumers and direct-to-retail/foodservice. However, many authors redefined (Martinez et al.'s 2010) classification of local food market into direct-to-consumer and intermediated marketing channels (King et al. 2010; Low and Vogel 2011; Low et al. 2015; Dimitri and Gardner 2019). Direct-to-consumer classifications include such entities as farmer's markets, U-pick, roadside stands, Community Supported Agriculture (CSA). Direct-to-retail/foodservice, or intermediated marketing channels, classifications include such entities as institutions, sales to schools and hospitals, grocery stores, restaurants, and food hubs.

According to ND Local Foods Directory (2017), ND has 54 on-farm sales, 49 farmer's markets, 25 CSA's, 20 wholesale markets, 11 roadside stands, and 11 U-picks. These direct-to-consumer and intermediated marketing channels are distributed throughout ND state counties (ND Local Food Directories 2017). This directory is an excellent resource for local foods; it lists local foods marketing channels' addresses and shows the seasonality for most of ND local foods. Figure 1 shows the local food marketing channels in ND; the legend on the left-hand side includes symbols for each type of local food channel identified in the map (Local Foods Directory Map n.d.).

However, the local food marketing channels list from the ND department of agriculture Local Foods Directory (2017) or the Local Foods Directory Map were not consonant with the USDA Local Food Directory (2021). The USDA Local Food Directory (2021) have less marketing channels numbers for all the categories. Only four farmer's markets were listed, and they were located in Bismarck, Bottineau, Minot, and Watford City. And one CSA in Bottineau and one on-farm market in Esmond. But no food hubs were listed in any of these local foods' directories.

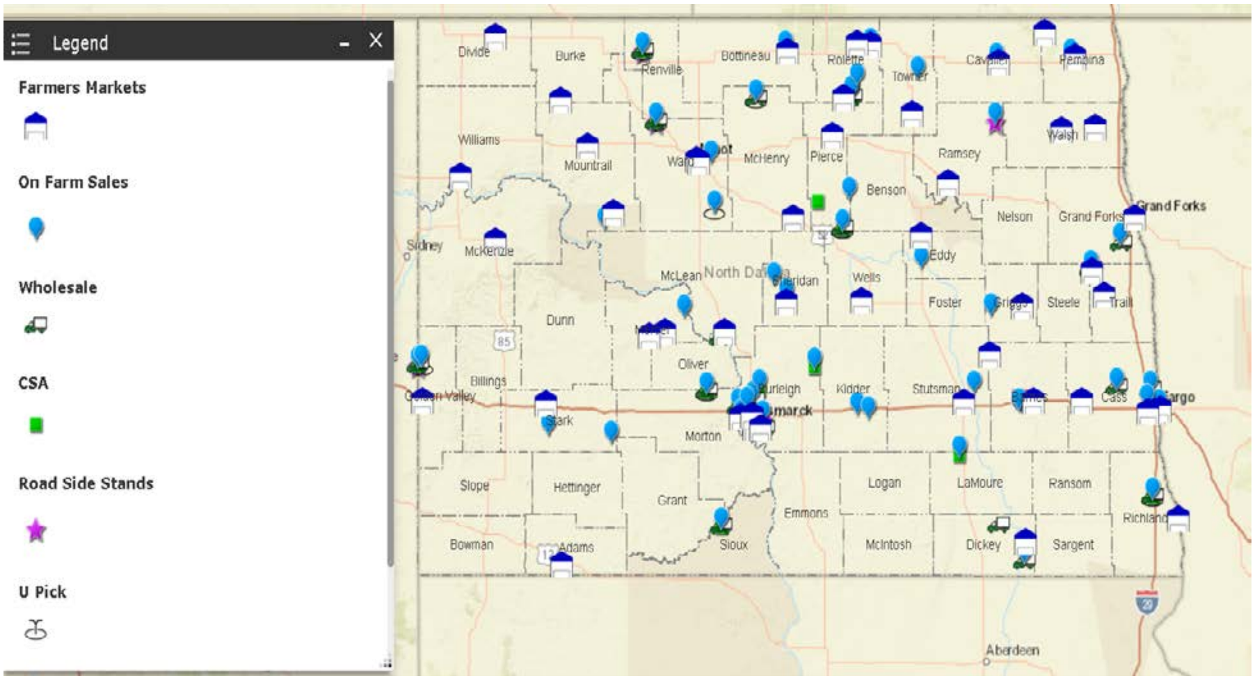

Figure 1. ND Local Foods Directory.
Source: Adapted from ND Department of Agriculture. Online Local Food Directory Map. https://ndda.maps.arcgis.com/apps/webappviewer/index.html?id=1ab2391e1d2c4405a081443cdec0a8e7

Furthermore, ND schools also participate in the Farm-to-Schools program. According to Farm-to-School's census (2015), 31% of ND school districts were participating in the farm-to-school program, which means 45 school districts and 70 ND schools participated in this program that served 6,444 students. The total money value spent on local foods was $1,009,200; in fact, ND schools that participated in this program spent 18% of their budget on local food. The money spent by ND schools on local foods were as follows: fruits (48%), vegetables (81%), milk (31%), and meat and poultry (14%). Furthermore, 31% of surveyed districts claimed they would increase their purchase amount in the future (Farm to School Census 2015).

1.2. Problem Statement and Personal Motivation

Food producers who own small and mid-sized farms usually do not have access to local or regional food supply chain systems to scale up their sales to wholesale food buyers. Furthermore, in most cases, these food producers financially are not able to own or lease an infrastructure for aggregation, distribution, and marketing to sell what they grow. Thus, the concept of food hubs has become an increasingly popular response to these agricultural problems. Food hubs cover the gap between farmers and markets and add value to the food supply chain systems. Food hubs may also increase access to fresh, healthy food for consumers, including underserved areas and food deserts (USDA-ERS 2021).

Unfortunately, ND is not excluded from agricultural problems in the U.S. local food system mentioned earlier. According to the ND Census of Agriculture (2017), the number of farms in 2017 decreased by 15% compared with 2012. According to the USDA Local Food Directories: At least one food hub business is present in all U.S. states except ND, New Jersey, Utah, and Wyoming (Food Hub Directory 2021). Since the food hub concept is widely distributed among U.S. states as a response to local food issues, ***we hypothesize*** that a food hub project is vital for each state and since the ND has no food hub, and we identify this as an issue in the ND local food system.

1.3. The Purpose Statement

Because ND is one of only four states that do not have a food hub, the purpose of the regional food hub feasibility study was to empirically evaluate whether the ND local food system needs a food hub from a supply and demand perspective. The lack of food hub infrastructures in ND was the motive for this research and led to the main research question: ***Does the ND local food system need a food hub?*** And due to the scarcity of studies investigating the local food system in ND, other local food aspects revealed many questions that also need to be examined.

Furthermore, to create a holistic view of the local food system potential in ND and cover the literature gap, the regional food hub feasibility study was divided into two independent cross-sectional surveys. The ND food hub feasibility part-A the supply-side included farmers, ranchers, and food producers. In this study, the supply-side refers to farmers, ranchers, and food producers; mentioning any of them in this study means ND food suppliers. Part-B (the demand-side) targeted the whole food buyers. We used customers in this report to represent institutions and differentiate between them and individual food consumers.

Both surveys were statistically analyzed descriptively and inferentially. Each survey had 51 questions, including qualitative and quantitative factors. Investigating both sides of the ND local food system led to a better comprehension of the research area, provided a complete understanding of the research problem, and filled a gap in the ND local food literature to provide answers for the study questions and hypotheses.

1.4. Research Questions and Objective

This study's primary goal was to find answers to the main exploratory research questions of this regional food hub feasibility study. The most crucial question that drove this research was:

1.4.1. Research question: Does the ND local food system need a regional food hub?

On the other hand, to provide some of the literature gaps were covered in the following objectives and questions that were included in this study.

- Find a definition for local food from the producers' and customers' perspectives. ***What local food means from the food supplier and customers' viewpoints?***
- Measure the level of familiarity of the ND food producers and customers with the food hub and their interest in joining the ND food hub project. In addition to their level of agreement with the food hub and sustainability statement. ***What does a Food Hub mean in ND from these three dependent variables?***

- Examine the variables that may affect their level of familiarity, interest, and opinion about a food hub. ***What are the independent variables that may affect the dependent variables of the study?***
- Measure the local food market capacity from the supply and demand sides. What is the status quo of the ND local food market? ***Does ND local food system have adequate supply and demand? Does the ND local food producers capable of scale-up the local food supply production? Can we find or create the need for scaled-up production?***
- Evaluate the internet and social media platforms as marketing tolls for ND local food. ***What is the level of importance for internet and social media platforms in local food marketing? What is the preferred type?***
- Discover the best food hub model for ND local food market. ***What is the best operational, tax designation, legal structure model for a regional food hub in ND from a food producers' perspective?***

Furthermore, each part of this regional food hub feasibility study had five hypotheses. The supply-side independent variables were as follows: operated farm or pasture size; the production of value-added products (V.A.P.); ND food producers' level of education; employment type; and years of experience. And the independent variables for the demand-side were as follows: limitation on the number of vendors for ND institutions; purchasing flexibility regarding local food quantity and seasonality; demand and need for local food products; type of institution; and gender. These independent variables were tested against the same three dependent variables for the supply-side. The independent variables and dependent variables for both surveys were analyzed by the variable screening methods (stepwise regression backward elimination technique). The independent variables for the supply and demand sides were tested against three dependent variables using the variable screening methods. The dependent variables that were tested for both sides of ND local food market were: level of familiarity with a food hub concept; level of agreement about a food hub project and sustainability; and level of interest of ND food producers in selling food products through a ND food hub and level of interest of ND customers buying local food from a ND food hub.

1.5. Dissertation Organization Structure

We started this dissertation with the introduction in Chapter 1, which provided background about the research area, local food market in ND, explained the research problem, motives, purpose, questions, and hypotheses. The remainder of this dissertation is organized as follows: Chapter 2 presents an extensive review of relevant literature on local food systems in the U.S. with a comparison to the European local food system. In this Chapter, we cover topics such as local food movements, definitions, and perceptions of local foods, demand for local food vs. demand for organic food, consumer demand for local food, the U.S. agriculture industry, local food marketing channels, benefits of the local food system, and local/regional agriculture and sustainability. The research approach, methodology, and development of the two independent cross-sectional surveys are detailed in Chapter 3. The results and data (descriptive and inferential statistics) analysis for the ND food hub feasibility study part-A (supply-side) is presented in Chapter 4. The results and data (descriptive and inferential statistics) analysis for the ND food hub feasibility study part-B (demand-side) is presented in Chapter 5. Discussion of the significant results are highlighted and discussed for the supply and demand sides are provided in Chapter 6. Finally, Chapter 7 presents concluding remarks on regional food hub feasibility (supply and demand sides), significant findings, limitations, and further directions of U.S. and ND local food research.

2. LITERATURE REVIEW

This section provides an overview of the local food system literature review. It presents an extensive review of relevant literature on local food systems in the U.S. with a comparison to the European systems. In this chapter, we cover topics such as local food movements, definitions, and perceptions of local foods, demand for local food vs. demand for organic food, consumer demand for local food, the U.S. agriculture industry, local food marketing channels, benefits of local food systems, and local/regional agriculture and sustainability.

2.1. Local Food Movements

The capability of feeding nine billion people and the availability of food in 2050 is a global concern because it threatens food security in many countries (Dani 2015). In response to the food security problem, there are many government initiatives in both developing and developed countries to improve local/regional food systems. In developing countries, the government initiatives focus on farmers in order to build and increase their capability. While in developed countries, government initiatives focus on locally produced food and how they can utilize local produce to create a local/regional supply chain system capable of enhancing the local/regional economy and providing sustainability for regional agriculture (Dani 2015). In addition to government institutions, the local food movement is supported by many private organizations and individuals.

Further, the number of people who support the local food movement is increasing in the U.S. and many other countries (Charney 2009). For instance, in Europe, particularly in Italy, the awareness and acceptance of the local food movement has grown dramatically in the last decade (Bazzani and Canavari 2017). (Brunori 2007,2) claims that the slow food movement that was “born in Italy about 20 years ago has expanded worldwide becoming an authoritative source of ideas and opinions on eating, food quality and agriculture and spearheading a wide variety of food relocalization initiatives".

In the U.S., the association between the local food movement and the term "good food," which was founded by the W.K. Kellogg Foundation (WKKF) in 1930, improved the movement in the past 25 years and increased its popularity. This popularity allowed the local food movement to be linked to many other movements that support a healthy lifestyle, food access, justice, the environment, sovereignty, and racial equity (Pirog et al. 2014). The four key elements used by the local food movement as common ground with other movements that support healthy food are healthy, green, fair, and affordable food. These four key elements create a bridge between a local food movement and other food movements such as food justice, environmental awareness, food access/health, food sovereignty, and racial equity (Pirog et al. 2014). These four attributes are common ground that allows the term good food to combine the heterogeneous set of actors that shares the same values for food (Sage 2003). There were many movements that contribute to efforts to expand local food and increase the attention and awareness for local agriculture (Guptill and Wilkins 2002). For example, healthy food is the key element and the link between the environmental movement and the local food movement. The local food supply chains provide food that travels a short distance and uses less greenhouse gas emissions, which is healthy for the environment. Also, the short distance associated with food freshness encourages people to consider geographic boundaries for their food choices (Kloppenburg, Hendrickson, and Stevenson 1996). Furthermore, the local food movement is associated with the community food-security movement (Gottlieb and Fisher 1996) and the anti-corporate activism movement (McMichael 2000).

The Adjustment Act (AAA), passed in 1933, is considered a milestone for the modern U.S. local food system. This federal law was intended to decrease the Great Depression's harmful effect on family farmers; the law was designed to boost agricultural prices by reducing surpluses (Breimyer 1983; Pirog et al. 2014). In addition, the AAA law allowed vertically integrated food manufacturing companies to purchase local food commodities such as corn, rice, soybeans, sugar, and wheat at low prices to be used in various value-added food products (Pirog et al.2014). However, over the last three decades' agricultural production in the U.S. has shifted to much larger farming operations; the consolidation of the acreage has led to an increased number of large farms and a decreased number of small and mid-sized farms from 1940 through 1970 (MacDonald, Hoppe and Newton 2018). Land and livestock shifted toward larger farms from the 1930s through the 1970s (Gardner 2009; Hart 2003).

In response to this issue and to remain in business, small and mid-sized farms started to sell their produce directly to consumers or through other marketing channels such as food co-ops and food service companies (Stevenson et al. 2011). For instance, the CSA concept, which is one of the local food marketing channels, appeared for the first time in Switzerland and Germany, and Japan, where it originated during the 1960s (Farnsworth et al. 1996). The idea of the CSA concept is to create an economic partnership to meet the demand for safe food and to provide stable markets for farmers (Groh and Steven McFadden. 1990). The first time the CSA concept appeared in the U.S. was in 1986. The concept was started in New England by two farmers, Temple Wilton Community Farm in New Hampshire and Indian Line Farm in Massachusetts (DeMuth 1993; Adam 2006; Prial 2020)

The USDA's defined the CSA concept as a group of people that consists of "individuals who pledge support to a farm operation so that the farmland becomes, either legally or spiritually, the community's farm, with the growers and consumers providing mutual support and sharing the risks and benefits of food production." (USDA-National Agricultural Library 2019). The number of CSA and other local food marketing channel concepts in the U.S. has increased over the years because of increased demand from consumers. In the U.S., from 1986 to 2015, the increased demand resulted in the growth of 7,398 farms that sold farm products through the CSA concept (Local Food Marketing Practices Survey 2015). The number of people who are motivated by their desire to know and understand the origin of their food is increasing. These types of food consumers are interested in local/regional food to support small local farms (Ilbery and Maye 2005; Pirog et al. 2014).

The local food movement was boosted again during President Obama's campaign that supported and assured the strength of local and regional food systems. The recent popularity of the local food movement and President Obama's campaign motivated the USDA'S to launch a local food program called "Know Your Farmer and Know Your Food (KYF2)". Furthermore, First Lady Michelle Obama announced the benefits of local foods when she arrived in Washington before the inaugural dinner (Burros, February 2009). In addition to her speeches, she used part of the South Lawn at the White House to plant a vegetable garden; this action had been absent since "Eleanor Roosevelt's victory garden during World War II." Mrs. Obama's hope was "that through children, they will begin to educate their families, and that will, in turn, begin to educate our communities" (Burros, March 2009).

In summary, the local/regional food movement is more than a spatial concept that describes the physical distance between producers and consumers (Boule et al. 2011). In fact, local food movements "typically value small, sole proprietorships over large, publicly-traded operations; organic over conventional production; fair labor practices over the current standards; and distribution through informal or open alternative channels as opposed to restrictive high volume supply chains" (Boule et al. 2011,27). The local food movement provides a place where farmers (food producers) and food consumers meet together to build a community that supports sustainable agriculture and recognizes the social relationships that create a connection to supports all regional small businesses (Kloppenburg, Hendrickson and Stevenson 1996).

2.2. Definitions and Perceptions of Local Foods

Before defining local foods, it is essential to distinguish the difference between local foods, “locality foods,” and “locavore”. The term “local” can have a variety of meanings depending on personal perception, past experiences, a belief in personal relevance, and how that individual decided to describe and express local/regional foods. The perception of the term local affects food consumers’ choices and depends on several important factors. These factors include a variety of cognitive biases, individual differences, such as age, education, and socioeconomic status. In summary, the simplest definition of the term local in regard to food should refer to the food grown/produced in close proximity to the consumer in the area where the foods were produced. In contrast, locality foods are more specifically defined by the traditional geographic location of the crop, or the food produced.

2.2.1. Locality

Locality is defined by Curry (2002) and Brurnori (2007) as knowing the venue of origin for food consumed by consumers who live far away from that venue. Locality refers to food produced in a recognized area and consumed in a different place (i.e., produced locally and exported to other parts of the world to be consumed). These food products are exported to many countries because the production area has distinctive features and qualities associated with that venue, including symbolic, relational, and physical criteria. For example, Kona coffee from Hawaii, Pu’erh tea from China, wild salmon from Alaska, cheese from France, and Wagyu beef from Japan. Therefore, the term “locality” is more firmly defined in food consumers’ minds than the term “local.”

2.2.2. Local

In contrast, because of the previously mentioned factors that influence food consumers’ decisions, there is disagreement on the term local and how food consumers define the term local. In addition, the literature documents that there is no standard or universally recognized definition for local foods. Authors such as Bellows and Hamm (2001); Edwards et al. (2008); Peters et al. (2009); Martinez et al. (2010); Padel and Zander (2010); Lev, Hand, and DiGiacomo (2014); Feldmann and Hamm (2015); Fernández-Ferrín, et al. (2018); and Meyerding, Trajer, and Lehberger (2019) claim that the term local can have a variety of meanings. Because of the variety of meanings that can be associated with the term local food, there is a need to look in-depth at the “relocalization” of food away from a global food system to one that is “relocalized” into the local community. This relocalization encompasses specific strategies, dimensions, and outcomes (Brurnori 2007). Relocalization comprises symbolic, physical, and/or relational aspects that are highly interrelated and flexible, which allows them to combine in many different ways to generate many different relocation strategies (Brurnori 2007). These relocalization strategies differentiate between local food and “localist food.” According to these relocalization strategies, local food systems are rooted in specific local communities and hold producers and consumers together as partners. They create the infrastructure that allows the local food to circulate short distances from first (producer) to second (consumer) partners. Local food is “chosen because it forms part of ordinary food habits” (Brurnori 2007,52). While “localist food, is not related to a traditional food habit, but may be deliberately chosen from among a set of products by consumers living in the same place”; local food, “localist food”, and “locality food” are three outcomes from relocalization strategies (Brurnori 2007). In fact, some proponents of sustainable agriculture argue that the outcomes of local food systems may cover many different forms of agriculture, encompassing a variety of consumer motivations and give rise to a wide range of politics (Winter 2003). Thus, these different interests use a variety of local food definitions that suit, serve, and market the purpose of that interest.

Authors such as Marsden, Banks, and Bristow (2000) and Martinez et al. (2010) define local foods based on many characteristics such as geographical, social, and supply chain. The geographical boundaries and the distance between local food production and consumption are concepts and tools that help to classify local food. Furthermore, many other approaches and concepts have been used to define local food (Thompson, Marie Harper, and Kraus 2008). For example, authors such as Marsden, Banks, and Bristow (2000) define local foods based on supply chain characteristics. They used the term “short food supply chain” (SFSC) to refer to local food and as a definition for a local food supply chain. In an SFSC, food consumers can connect with food producers by personal communication. In addition, in an SFSC, specific farm and farmer information is also placed on a package label. An SFSC provides food consumers with full information about the place of production, producer, and methods used to produce the food purchased (Marsden, Banks, and Bristow 2000). In contrast, production methods can be used as a way to define local food, and the local food definition may be expanded to include who produced the food with an emphasis on other factors that make up the story behind the food produced in that place (Thompson, Harper, and Kraus 2008). Many of the stories behind the food are about small farms that are already engaged with the community in social relationships and economic activity and help shape the local community’s definition of local food (Hughes et al. 2007).

However, the geographical distance between the farm where food is produced and food consumers can be used to define local food instead of production methods. This approach is widely adopted and accepted by many people. Peters et al. (2009) defined local foods as the food produced close to the point where it is consumed in relation to the modern or mainstream food system. Simultaneously, the U.S. Congress in the 2008 Food Conservation and Energy Act (2008, Farm Act) adopted a broader distance for the local food definition; they defined local/regional food as all food produced and consumed within the state or within 400 miles from its origin (Food, Conservation, and Energy Act 2008). In Italy, in contrast, people used the expression "Chilometro Zero" (Zero Kilometers) to refer to local foods (Bazzani and Canavari 2017).

Other authors, such as Darby et al. (2008), relied on food consumers to define local foods. Darby et al. (2008,1) claimed defining local foods by consumers "is one of the more vexing questions, it depends crucially on the consumers' perception of what qualifies as locally grown, a perception that is not well understood" and needs more research to reveal it. Simultaneously, Schmit (2008) relied on local food suppliers to define local food because local food suppliers and distributors had a broader view of describing local foods than food consumers.

As suggested by Forney and Häberli (2014), local foods can be defined based on "food networks" instead of relying on consumers' and customers' preferences and behavior. And Hinrichs (2000); Sage (2003) defined local foods based on the differences between local food systems and the global food system. They argue that social relationships and embeddedness create the sense of social connection and trust that is at the heart of local agricultural marketing channels and that distinguishes local food systems from global food systems (Hinrichs 2000; Sage 2003).

Furthermore, the local term may convey for other food consumers an ethical meaning or a sense of community, with an emphasis on how the food is produced and distributed (Pinchot 2014).

This ethical meaning or ethical sense noted in Pinchot's (2014) research may convey the trust feeling among food consumers for local/regional food is found in Hinrichs's (2000); Sage's (2003) studies. Trust may contribute a new way to define local food, explain the increase in its demand, and why food consumers are interested in and willing to pay for local foods. Jarosz (2000) claimed that the theory of understanding agri-food networks as social relations encourages stakeholders to strengthen the relationships based upon trust throughout the producer/consumer network. Trust will stimulate cooperation within the networks, such as resource sharing and apprenticeship programs, which, in turn, will enhance the agri-food networks' work and outcomes. For instance, that food producers in Southeast Michigan needed to develop trust-based relationships with their consumers in order to create better market access for local foods was one of the major implications of the findings in the (Abate-Kassa and Peterson 2011).

Trust is not only important for local food producers to gain their consumers' confidence but also for other local food systems' stakeholders. Block et al. (2008) suggested a "value web" to engage academics and non-academics in forming partnerships to take action to solve local food system issues in the U.S. through mutual understanding. Building trust among stakeholders and maintaining good quality work are essential attributes that must extend throughout value-added supply chain systems (Block et al. 2008).

According to Feenstra et al. (2011) building a strong relationship on trust was one of the essential findings and attributes. Trust is one of the most vital elements in the success of values-based supply chains that foster farm-to-institution programs in California. Focusing on information flow and building relationships that connect stakeholders in order to build trust will empower farm-to-institution programs (Feenstra et al. 2011). However, despite the necessary role that personal trust may play in building strong relationships among local food stakeholders, there still is a need to rely on commercial conventions. For example, wholesale produce distributors in rural and urban regions of Pennsylvania tended to give commercial conventions over social relationships, such as personal trust, which played an essential part in hybrid food value chains (Bloom and Hinrichs 2011).

Finally, the USDA defines the local food system as the food produced and distributed to consumers within a limited geographic area, either by direct or through intermediated marketing channels (Local Food Directories n.d.). The ND Department of Agriculture defines local food as all food products grown, produced, or processed and that reach end consumers in ND for consumption. This last definition will be used for the purposes of this research as the definition for local food to be consistent with the ND Department of Agriculture.

2.2.3. Locavore

While there is no universal agreement on the definition for local food, there is agreement on the definition that describes the people who consume it and are committed to support the local food movement. The year 2006 witnessed a popularity trend for using locally grown foods and ingredients, and one year later, the Oxford American Dictionary announced the term "locavore" as the word of 2007. As described by the Oxford Dictionary, "The locavore movement encourages consumers to buy from farmers' markets or even to grow or pick their food, arguing that fresh, local products are more nutritious and taste better." Locavores also shun supermarket offerings as an environmentally unfriendly measure since shipping food over long distances often requires more fuel for transportation (OUP-Blog 2007,1).

2.3. Demand for Local Food Vs. Demand Organic Food

In the U.S., before late 1990 and before the federal organic standards, the difference between local and organic food was not clear. At that time, "organic food was linked to small farms, animal welfare, deep sustainability, community support and many other factors that are not associated with most organic foods today." However, after the federal organic standards were put in place, consumer preferences in the U.S. shifted from organic toward local food (Adams and Salois 2010,1). Food consumer demand then started to shift toward local food from organic food after recognizing the benefits associated with local food and its broad implications for the environment and society (Adams and Salois 2010). Overall, these food consumers can be segmented into two segments: "origin lovers" and "method lovers" (Gracia, Barreiro-Hurlé, and Galán 2014). Origin lovers is the largest segment and value the origin of their food more than its production method. The method lovers segment value the production method over the origin of the food. In addition, food consumers usually associate local food with a short supply chain distance, whereas they link organic with food production without synthetic pesticides (Campbell, Mhlanga, and Lesschaeve 2013). Most of these food consumers value the local claim more than the organic claim (Gracia, Barreiro-Hurlé, and Galán 2014).

Local foods are often preferred because they embody either one or more of the attributes associated with trust, such as freshness, seasonality, naturalness, and territoriality because these attributes are usually not linked to organic food (Naspetti and Bodini 2008). Usually, local food consumers have a stronger value, beliefs, and norms for the community than organic food consumers (Zepeda and Deal 2009) and more interested in being part of sustainable food and agricultural system (Bean and Sharp 2011).

For example, in the U.S., New Englander's food preferences were studied in intensive research that included focus groups, individual interviews, and a mail survey for many food consumers and food systems specialists (Berlin, Lockeretz, and Bell 2009). This research aimed to identify the relationships between local, small-scale, and organic labels and the associated benefits with each label. Food consumers in New England area of the U.S. tended to have very positive associations with local and small-scale farming compared with organic (Berlin, Lockeretz and Bell 2009). Another national survey in the U.S. targeted adults and selected food consumers randomly from 48 contiguous states indicated that the 601 respondents valued the food products that were labeled either U.S. produced or local food more than the organic food label (Bellows, Alcaraz, and Hallman 2010). In addition, a statewide survey of Ohio revealed that respondents and members of a food cooperative and an environmental and social responsibility organization were increasingly interested in how to engage in practices that lead to more sustainable food and agriculture (Bean and Sharp 2011). The survey of the local and organic food attributes results revealed that consumers value the local attribute more than the organic attribute (Bean and Sharp 2011). Across the Mid-Atlantic states, the consumers' choices were varied regarding different strawberry labels: organic, natural, locally grown, and state brand (Onken, Bernard, and Pesek Jr 2011). The consumers' preference between local and state brand varied, while consumers in Maryland and Pennsylvania preferred local; in New Jersey, consumers preferred the state brand (Onken, Bernard, and Pesek Jr 2011). In Colorado, consumers preferred fresh apples labeled local over the organic label (Costanigro et al. 2011). This result also statistically correlated with social and public good consumer values, motivations to purchase local food (Costanigro et al. 2011).

In comparison, in most of the Europe countries, local food is dominating the food market, and food consumers prefers local label compared with other food labels such as organic label. For example, in Germany, "Due to growth and changing distribution channels for organic food in Germany, there is some concern that organic food will lose against local food in the competition for conscious consumers." claimed by (Roosen, Kottl, and Hasselbach 2012,1). Also, in Germany, food consumers preferred to purchase food labeled local more than organic label (Hempel and

Hamm 2016). Similar results regarding local apples label were found among Danish consumers who recognized the benefit of local food, and they tend to have a higher preference for local apples than organic label (Denver and Jensen 2014).

2.4. Consumer Demand for Local Food

2.4.1. Consumers preference and behavior toward local food

Many authors noticed the growth for local/regional food demand either in the U.S. or Europe. Authors such as Brown (2003); Schneider and Francis (2005); Darby et al. (2008); Conner et al. (2010); Bond, Thilmany, and Bond (2009); Brown, Dury, and Holdsworth (2009); Onozaka and McFadden (2011); Adalja et al. (2015); Aprile, Caputo, and Nayga Jr (2016); Bazzani et al. (2017); Jablonski, Sullins, and McFadden (2019) documented the dramatic interest for local/regional food among food consumers in the U.S. and Europe. However, Telligman, Worosz, and Bratcher (2017,1) claimed that "while there is a strong tradition of studying European consumers' quality perceptions, less is known about U.S. consumers." This study considered only the literature that investigated the U.S. local food consumer's performance for beef. Feldmann and Hamm (2015) reviewed 550 English articles that were published for the period between 2000 and 2014 on consumer perceptions and preferences for local foods. The majority of the 550 articles in the literature review examined consumer perceptions and preferences in North America, and just a few articles were conducted for food consumers in Europe.

For example, in the U.S., Telligman, Worosz, and Bratcher (2017) investigated local beef consumers' perceptions in the rural U.S. The local beef consumers were motivated by three factors: local beef has better quality, to support rural livelihoods, and food consumers valued their relationship and the trust they have for local farmers. The consumer's preferences in Southeast Missouri is another example of the U.S. consumer's preference and it was studied by Brown

(2003). The author claimed that quality and freshness were the two factors that motivated local food consumers in Southeast Missouri. The food consumers in Southeast Missouri believed that local food at farmers' markets has higher quality and competitive prices. Overall, results indicated that food consumers in Southeast Missouri prefer to define locally produced as growing in the surrounding region, even if it comes from outside their state (i.e., local food traveled fewer miles). Regardless of concerns about the origin of products, most consumers were unaware of the state's “Agri-Missouri promotion program.” which promotes Missouri local food and hand-made items to represent food and non-food products and improve agritourism and agricultural experience in Missouri (Brown 2003). Local food consumers in Washington County in Washington, U.S. is another example of U.S. consumer preferences. According to Schneider and Francis (2005), local food consumers in Washington, U.S. considered local food tasty, higher quality, and better. Indeed, they were committed to support environmentally friendly production and local farmers. These four factors motivated consumers in Washington County to purchase more local food. Furthermore, the high quality of local food products was the main reason for the increase in demand for local foods among Michigan residents in the past few years (Conner et al. 2010).

Furthermore, Shin and Hancer (2016,1) claimed that “attitude, subjective norm, perceived behavioral control, and moral norm were found to influence consumer local food purchase intention directly or indirectly.” based on a sample of 695 U.S. food consumers. However, according to the author, these findings cannot be generalized because of data limitations and the small sample size compared with the U.S. population. While Kumar and Smith (2018) claimed that there were three factors motivating U.S. food consumers: health consciousness, concern for the environment, and concern for local economies. These factors were significant indicators for frequent local food purchasing. And important attributes for consumer segmentation. The reveal of these motivating factors allowed Kumar and Smith (2018) to segment the U.S. local food consumers based on their food-related lifestyle (FRL) attributes into four segments:

- Impromptu Novelty Explorer,
- Uninvolved Connoisseur,
- Involved Information Seeker, and
- Apathetic Local Food Consumer (Kumar and Smith 2018).

Werner et al. (2019) used New England (New Hampshire, Maine, and Vermont) as a case study to explore the different components necessary for expanding the local agricultural industry. The food consumers in the Northeast purchase local food to support local farmland and the local economy.

In contrast, European consumers' perceptions and preferences were explored by Tregear and Ness (2005). According to the authors, in the UK, the upstream operators in the agri-food sector undertook more direct marketing of their products after Foot and Mouth Disease in the UK. The study aimed to reveal the factors that might influence a positive response for local foods since there is little information on consumer interest in Europe (Tregear and Ness 2005). The consumer interest in local food is strongly correlated with consumer concern for food supply chain issues and ethical/environmentally active consumers. For instance, the interest in local foods increased among consumers who were worried about competition between the global food system and the local food system. Based on the vulnerability of small farms and local shops (Tregear and Ness 2005).

In addition, the differences among local food consumers in England and France can be explained by socio-demographic factors (Brown, Dury, and Holdsworth 2009). The consumers in England are motivated by altruistic reasons to buy local foods (i.e., they believe local food traveled fewer miles than conventional food). The consumers in France purchased local food for pleasure and to treat themselves well (Brown, Dury, and Holdsworth 2009). Notwithstanding, local food consumers in England and France valued local food quality and were concerned about the environment. But the high prices for local food were a barrier to their full commitment to support local food sustainability (Brown, Dury, and Holdsworth 2009).

In Spain, consumer preferences for fresh lamb meat were examined by Gracia (2014). Gracia (2014) said the demand for local food segmented based on consumer preferences and was complex and heterogeneous. On the other hand, Fernández et al. (2018) claimed that Spanish food consumers were influenced by their ethnocentrism. The ethnocentrism was varied among categories of food products or for the same product within the same geographical scope and among different geographical areas. In Germany, Meyerding, Trajer, and Lehberger (2019) conducted a choice experiment to study consumer preference for local fresh and processed tomatoes. They found that consumers view non-labeled food as local if it is in its original state. Food consumers valued the local label for tomatoes regardless of whether they were processed or fresh (Meyerding, Trajer, and Lehberger 2019).

In Italy, the food consumer preferences for local food were examined by Aprile, Caputo, and Nayga Jr. (2016); Nicolosi, Pulina, and Laganà (2016); Menapace and Raffaelli (2017); Bazzani et al. (2017); Ferrazzi, et al. (2017). Aprile, Caputo, and Nayga Jr (2016) claim they found an explanation for consumer attitudes toward local food consumption. They identified factors that influenced local food consumers and classified Italian consumers into four clusters based on propensity to choose local food:

- Ethnocentric consumers: Consumers in this segment value the quality of local food; they believe it's healthier than foreign. They were motivated by supporting local farmers.

- Environmentalists consumers: This segment includes consumers who were motivated by social factors. They believe local food has a less negative impact on the environment and naturalness.
- Strict localists consumers: Consumers in this segment purchased only foods grown and manufactured in their region. This action was motivated to help sustain local farmland.
- Quality labeling-oriented consumers: Consumers in this segment were motivated by the traditional production methods, which makes local food have high quality than foreign (Aprile, Caputo, and Nayga Jr. 2016).

Nicolosi, Pulina, and Laganà (2016) investigated Capicollo Azze Grecanico Slow Food for meat products in Calabria, Italy. They found that consumers associate territory and product quality and link local food with food security. Also, the results for local food consumers were heterogenic with regard to personality traits, while the results endorsing food consumers. Menapace and Raffaelli (2017) found that females and young adults in the southern range of the Alps buy local ice cream more than other labels. They were motivated by reducing carbon emissions that resulted from shorter transportation distances. In addition to the social factors that influenced consumers toward locally grown products (Menapace and Raffaelli 2017). Ferrazzi et al. (2017) said when food consumers are forced to choose between multiple types of the same product, geographic identity, product certification, production, and supply chain information are positive discriminant when buying that food product and are essential attributes that have a positive influence on the choice of that product.

On the other hand, Bazzani et al. (2017,1) investigated the interaction between personality traits and consumers' preferences for local and organic food products. The authors believed that the “Big Five personality traits: openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism” affected consumers' preferences for local food purchases. For example, “caring personalities” have a higher probability of purchasing applesauce that labeled local. In addition, the heterogeneity in the consumers’ preferences for local and organic food can be partially explained by the personality traits.

There are many factors that can cause heterogeneity among food consumers’ preferences, such as type of education. As noted by Brown (2003); Tregear and Ness (2005), food consumers with higher education or who work at institutions related to environmental issues were more willing to purchase local and organic food. Yet, they were not ready to search for it. The interest in buying local food increased among food consumers who have farm or farming memories because they were raised there or have personal contact with family members who live on a farm. The authors said these groups of food consumers were more interested in local food and willing to purchase it regularly because of their sympathetic attitudes towards farmers (Brown 2003; Tregear and Ness 2005). The relationship between local food consumers' level of knowledge and the strength of their attitudes towards local food also was noted by Feldmann and Hamm (2015). According to the authors, food consumers who care about their food choices developed stronger attitudes towards local food and searched for it in addition to senior and wealthier people living in rural areas. Lancaster (1996) believed that food consumers make consumption decisions based on a product’s attributes rather than the product itself.

2.4.2. Willingness to pay a price premium (WTPPP) for local/regional food products

Typically, food consumers interested in local/regional food have the willingness to pay a price premium (WTPPP) because they value and know the benefit of local food products they are purchasing. Many researchers surveyed and documented consumers WTPPP for local/regional/organic food either in the U.S. or in Europe, such as Loureiro and Hine (2002); Brown (2003); Schneider and Francis (2005); Darby et al. (2008); Brown, Dury, and Holdsworth (2009), Hu et al. (2012); Onozaka and McFadden (2011); Bosworth, Bailey, and Curtis (2013); Gracia (2014); Forney and Häberli (2014); Adalja et al. (2015); Meas et al. (2015); Hempel and Hamm (2016); Gumirakiza, Curtis, and Bosworth (2017); Bazzani et al. (2017); Werner, et al. (2019). In the U.S., for example, in Colorado, WTPPP for "Colorado grown" (i.e., the local food brand for all food products grown or produced in Colorado) was more than that for organic and GMO-free labels (Loureiro and Hine 2002). Furthermore, Brown (2003) found there were two groups of local food consumers in southeast Missouri that were WTPPP for local food products. The first group was the people who were members of an organization concerned about environmental issues; their willingness was influenced by their higher education/income and their concern about the environment. The second group was the people who were influenced by their memories and emotions (i.e., people who grow up on a farm or have parents who live on a farm). In Washington County, Nebraska, food consumers WTPPP was because local food presents high quality and better taste for them (Schneider and Francis 2005). According to Darby et al. (2008), food consumers in Midwestern states were WTPPP for two reasons. The first reason was the values associated with local food products, such as freshness, and the second reason was sympathetic attitudes such as supporting small and mid-size farms. In addition, local food consumers in Kentucky and Ohio were WTPPP to support small family farms (Hu et al. 2012). Similarly, consumers in Kentucky and Ohio had a WTPPP for food products labeled local, specific geographical designations, and sub-state regions such as the Ohio Valley (Meas et al. 2015).

Furthermore, local food consumers in Utah had WTPPP for ice cream labeled local because of the quality they associated with that label. This allowed local ice creams brands to compete with private labels and national brands (Bosworth, Bailey, and Curtis 2013). Also, according to Gumirakiza, Curtis, and Bosworth (2017), local food consumers in Utah who buy their local food from farmers' markets have a WTPPP for fresh produce grown in their state compared to other products with unknown origin. In Maryland, consumers who bought food from a supermarket had a higher WTPPP for local ground beef than grass-fed ground beef. They valued local labels even without clear labeling rules, compared with food club consumers who were more aware of food labels but had lower WTPPP (Adalja et al. 2015). In contrast, Yue and Tong (2009) found that food consumers in Minnesota have the same WTPPP for local food and organic food. In general, the U.S. food consumers had a WTPPP for local food to support local farmers and to help reduce carbon footprints (Onozaka and McFadden 2011).

Similarly, in Europe, Italian consumers have the same WTPPP for local and organic food products (Bazzani et al. 2017). Farmers' organizations in Switzerland launched a new project to target consumers with a WTPPP for local dairy products as a marketing segment to offset the negative impact of the Swiss government's new policy regarding the national milk quota system (Forney and Häberli 2014). In Germany, urban consumers had a higher WTPPP for local foods than rural consumers (Hempel and Hamm 2016). Furthermore, in the UK, rural consumers were interested in local foods but less willing to pay, while urban consumers had a WTPPP for local food but with low interest to buy local food (Tregear and Ness 2005). In Spain, consumers had a WTPPP for locally grown food and preferred local lamb meat (Gracia 2014). Finally, Printezis, Grebitus and Hirsch (2019) applied meta-regression analysis to 35 studies on WTPPP. They found evidence indicating that there is selection bias among publications which favors larger and statistically significant results regarding WTPPP.

2.5. Local Food Supply Chain Vs. Conventional Food Supply Chain

The world food system is ever shifting and will continue to evolve; the human lifestyle consists of factors that affect the world food system, such as the appearance of cities and the way they grow, and the advancement of science and technology. Also included in these factors are colonization, politics, and war. All these factors and others influence global food systems from time to time (Mack et al. 2012,189). For example, the U.S. food system shifted to national and international food sources after World War II, while before the war, it was much more dependent on local sourcing (Martinez et al. 2010)

However, the global food system is now witnessing a new shift in the food marketplace. The system is shifting from a supply-driven economy, where the supplier decides what will be available to consumers, to a demand-driven economy, where consumers drive supplier decisions about what kind of produce is offered (Martinez et al. 2010; Lev, Hand, and DiGiacomo. 2014). The shift in the food marketplace and the dramatic increase in local food demand gave modern local food systems the ability to compete with industrialized global food systems with regard to production and marketing models (Schneider and Francis 2005). The transformation that pressures the food marketplace to shift to demand-driven created awareness and increased the demand for local food among food consumers and customers. According to the USDA, the farm-to-market projects across the U.S. increased in their number over years, including direct-to-consumers such as farmer's markets and CSA and direct-to-customer such as schools, institutions, and food hubs. These local/regional food projects are strong evidence for the intensely increasing demand for local food and a market response to balance the supply and demand for local food.

From the consumer's perspective, there are many factors associated with local food and the local supply chain that encourage the purchase of local food versus conventional food. The various advantages associated with local food can be divided into two categories. The first one is related to features of the food products themselves, such as flavor, taste, quality, freshness, and non-modified genetic diversity. The second type is related to values that are associated with food products, such as supporting and improving the local economy, increasing farmer income and scaling up farm production, decreasing food miles, protecting and restoring the environment, and building a sustainable food system. All these factors attract and motivate consumer interest in foods. While consumers may disagree on a strict definition, they seem to understand one of its purposes: supporting local farmers and economies. For example, as Bosworth, Bailey, and Curtis (2013) noted, local food consumers in Utah are fully aware of the "Utah's Own Program" and value that this program supports local farmers and the local economy. Yet, they do not know how this program functions.

The dramatically growing interest in local food by food consumers is observed and documented in current research such as Brown (2003); Schneider and Francis (2005); Tregear and Ness (2005); Darby et al. (2008); Bond, Thilmany, and Bond. (2009); Brown, Dury, and Holdsworth (2009); Conner et al. (2010); Onozaka and McFadden (2011); Adalja et al. (2015); Aprile, Caputo, and Nayga Jr. (2016); Bazzani et al. (2017). Simultaneously, other research reports consumers' willingness to pay for local food and found food consumers in the U.S. and Europe had a WTPPP for local food, see for example, Brown (2003); Schneider and Francis (2005); Darby et al. (2008); Brown, Dury, and Holdsworth 2009; Onozaka and McFadden (2011); Bosworth, Bailey, and Curtis (2013); Forney, Häberli (2014); Adalja et al. (2015); Meas et al. (2015).

Regardless of the features and values of local food systems, the food market demand shifts, and interest in local food compared to global food systems. What really distinguishes local food systems is the stability of the supply chain's flow. The 2020 COVID-19 pandemic was an excellent example that global food systems can be disrupted at any time, which increasing food insecurity.

2.6. The U.S. Agriculture Industry

2.6.1. Farm vs. point farm

As defined by USDA’s, a farm is a place (land) that can produce agricultural products worth $1,000 or more and can be sold during a given year. In contrast, if that place could not meet the required minimum sales amount ($1,000) in the year to qualify as a farm, USDA’s classified them as Point Farm (USDA-ERS 2020). This definition is consistent with the definition used for the U.S. census since 1974 (The U.S. census 2017).

2.6.2. Farm classification

The USDA-ERS classified U.S. farms to family farms and non- family farms. Most of the U.S. farms are family farms. In fact, in 2018, the family farms accounted for 90 % of the U.S. agricultural output (MacDonald, Hoppe, and Newton 2018). The ERS typology into three types. The ERS classification for U.S. family farms is based on gross cash farm income (GCFI). Small farms have a GCFI of less than $350,000 annually, midsized farms have GCFI between $350,000 and up to $1 million, and lastly, large family farms have more than $1 million GCFI (Hoppe and MacDonald 2013; MacDonald, Korb, and Hoppe 2013).

2.6.3. Agriculture products and value-added-products

There are three types of agriculture products: raising crops, livestock, and seafood; farmers adding value to these products to scale up production and increase farm income. Particular farming practices and processing strategies can be adopted by the farmer or by integrating with a third party to produce value-added products (V.A.P.). By enhancing the value of that food product through some extra process or combined with additional products to raise the product's overall value. A raw agricultural product should be modified or enhanced to have a higher market value or a longer shelf life to make a value-added product. Value-added food products are prevalent in agricultural markets. For example, raw strawberry can be changed to jam and changing fresh apples into cider. According to the USDA's definition, value-added products are a food product that has been intentionally changed its form or physical state. Furthermore, it categorized into three types:

- A raw agricultural product has been a change in the physical state or form, such as making strawberries into jam.
- Enhancing the raw agricultural product such as organic products.
- A physical segregation of an agricultural to enhance the value of that product, such as an identity-preserved marketing system (the University of Maryland Extension, n.d.).

2.6.4. Farmers/ranchers characteristics

According to the USDA definition, a beginning farmer is a farmer/rancher with less than ten years of experience in farming and agriculture practices (Martinez et al. 2010). Beginning farmers' numbers are varied regionally, and the national percentage is 24.3%, while the number will increase by high local food demand. The highest rate is concentrated in the West region. The West Coast has 48% beginning farmers of all food producers, while the Northeast has 28% beginning farmers of all food producers (Low and Vogel 2011). According to Ahearn (2011), farming like any other businesses, requires a start-up capital, which is usually related to two obstacles; the first one is the opportunity to buy or rent suitable land, the second one is how to scale up production to be profitable.

2.6.5. Scaling-up production

Scaling-up is the next hurdle facing the local food movement" (Mount 2012,1). The author claimed this issue's solution is to scale-up local food systems by reconnecting food producers and food consumers/customers and increasing the number of small and mid-sized farms to the system. However, barriers and obstacles such as logistics, structural, and regulatory are well known, but they are less understood. Roos, Terragni, and Torjusen (2007) said that local food systems created ethical binding between producers and consumers. According to Martinez et al. (2010), most farms that sell directly to consumers are small/mid-sized farms. Low and Vogel (2011) claimed that large farms dominated the intermediated marketing channels, while small and med-sized farms dominated the direct-to-consumer marketing channels. However, Krejci et al. (2015) said usually, small and mid-sized farms prefer to sell to intermediated marketing channels such as grocery stores, restaurants, schools either directly or through a distributor to avoid the challenges associated with direct-to-consumer marketing channels.

2.7. Local Food Marketing Channels

2.7.1. Local food market facts for all channels

"Marketing local products should stress quality, freshness, and price competitiveness, and appeal to environmentalists and those with a favorable attitude towards family farms" (Brown 2003,1). According to Diamond and Soto (2009), the top ten states for growth of direct-to-consumer food marketing from 1997 to 2007 were Oregon, Wyoming, Vermont, Alaska, South Dakota, Colorado, Mississippi, Kentucky, Montana, and Washington, respectively. According to Low and Vogel (2011,6), in 2008, the highest sales for local food were in metropolitan areas and concentrated in the Northeast and on the West Coast of the U.S. Local food commodities that sold through direct-to-consumer "were affected by climate and topography that favor fruit and vegetable production, proximity to farmers' markets and neighboring local food farms, and access to transportation and information networks." As noted by Lerman, Feenstra, and Visher (2012) there is incomplete information about the U.S. local food marketing channels and producers. Low et al. (2015, 8) said "we find growth in the number of intermediated markets. But the value of these sales is difficult to estimate given a lack of data".

2.7.1.1. Local food sales for all channels

Regardless of how small the local food market is compared to the U.S. agricultural market, this niche market is growing fast (Martinez et al. 2010). According to the 2007, Census of Agriculture, the local food sales through direct-to-consumer marketing channels reached $1.2 billion compared with $551 million in 1997 (Diamond and Soto 2009). In 2008, the gross of both direct-to-consumer and intermediated sales was $4.8 billion, which was four times higher than what was estimated for direct-to-consumer sales alone. Sales through intermediated channels were three times higher than sales through direct-to-consumer channels and two times higher than a combination of direct-to-consumer and intermediated channels; the total sales for intermediated channels in 2008 were $2.7 billion (Low and Vogel 2011).

In 2012, the total local food sales were over $6.1 billion, and actual sales are more than that as the Agricultural Resource and Management Survey (ARMS) did not include all local food sales through intermediated marketing channels. According to the 2012 census of agriculture, farms that used direct-to-consumer marketing channels tended to experience increases in sales and were more able to survive and remain in business from 2007 to 2012 than farms that did not (Low et al. 2015). According to the USDA-ERS (2006), local food commodities that sold direct-to-consumer tented to have lower prices on average compared with prices at retail stores in all seasons. But at some locations, some products were priced higher than retail store prices (Low et al. 2015).

"Almost two-thirds of all local food producers reported that local food sales accounted for at least 75 percent of their total gross farm sales, while 22 percent of all local food sales farms reported that such sales accounted for less than 25 percent of their total gross farm sales. Higher local food sales shares suggest that local food sales farms are well integrated into existing direct-to-consumer and intermediated supply chains." (Low and Vogel 2011,10).

2.7.1.2. Classification

Martinez et al. (2010) claimed that defining types of local food markets channels may allow us to understand the local food market regardless of the lack of a universal local food definition. Martinez et al. (2010) divided the local food market into two parts based on transactions: direct-to-consumers and direct-to-retail/foodservice.

2.8. Direct-to-Consumer Marketing Channel Types

This type of local food market refers to transactions that are conducted directly between farmers and consumers. (e.g., farmers' markets, CSAs, farm stands/on-farm sales, roadside stands, and u-picks) (Martinez et al. 2010; Low et al. 2015). Other local food sources such as home gardening and sharing among neighbors, foraging/hunting, and gleaning programs are theoretically not market sources of local foods. They are typically difficult to measure or are unmeasured. However, these food sources increase food access and food consumer awareness about local food (Martinez et al. 2010).

2.8.1. Farmer's markets

A regular or common physical location where more than one farm vendor sells local food products directly to customers. According to Martinez et al. (2010,12), "A farmers' market is a common area where several farmers gather on a recurring basis to sell various fresh fruits, vegetables, and other farm products directly to consumers." The concept exists in many countries such as the U.S., Canada, and Britain (Feagan and Morris 2009). As noted by Shakow (1981), farmer's markets presence declined during the 1960s. They were once the core focal point for selling fresh products in Seattle's urban centers. Shakow (1981) identified the reason for this decline was growing cities. However, the number of farmer's markets has increased since 1998. According to USDA-AMS (2009), the number of farmers' markets increased to 5,274 markets in 2009, a 92% increase from 1998.

In 2016 there were 8,500 farmers' markets in the U.S., a 50% increase from 2011 (Farmers Market Talking Points 2016). The increase in farmer's markets may be due to the reasons found in Hughes et al. (2016)'s study. The authors claimed that farmer's markets enhanced the retention of local dollars and are an essential source of income for small and mid-size farms. Conner et al. (2010) noted that farmer's markets buyers in Michigan increased in the past few years, and the number is still growing; local food demand is driven by quality. Especially among Latinos, a high value is placed on the variety of products available (especially hormone-free animal products) and having access to information on how and where the food was produced. Yet, the lack of a welcoming atmosphere appears to be a major constraint (Conner et al. 2010).

Bond, Thilmany, and Bond (2009) suggested that producers may emphasize the availability of fresh, superior, vitamin-rich, and locally grown produce at market locations through booth displays, ads in magazines, radio spots, and electronic newsletters. The authors suggested using areas that are convenient to reach, showcasing a variety of colorful offerings, and working to enhance the overall aesthetic appeal of farmer's markets' locations to attract new customers. "Farmers' markets (FMs) in the U.S., Canada, and Britain are often held as one key response to the unsustainability of conventional food production systems, as they provide consumers with a potentially more comprehensive valuation venue for their food purchases" (Feagan and Morris 2009,1).

2.8.2. CSAs

The CSA concept appeared for the first time in Switzerland, Germany and Japan, where it originated during the 1960s (Farnsworth et al. 1996). Authors such as Adam (2006); Prial (2020) believe that the CSA concept appeared in the U.S. in 1986. The concept was started in New England by two farmers Temple Wilton Community Farm in New Hampshire and Indian Line Farm in Massachusetts. CSA is defined as a network of multiple farms collaborating to form a service that offered deliveries of locally-grown farm products during one or more harvest seasons on a membership basis.

The USDA local food directory defines CSA as "farm or network/association of multiple farms that offer consumers regular (usually weekly) deliveries of locally-grown farm products during one or more harvest season(s) on a subscription or membership basis. Customers have access to a selected share or range of farm products offered by a single farm or group of farmers based on partial or total advance payment of a subscription or membership fee." The ND local food directory defined CSA as "A community of individuals who pledge support to a farm operation with the growers and consumers providing mutual support and sharing the risks and benefits of food production. Members pledge in advance to cover the anticipated costs of the farm operation and farmer's salary. In return, they receive shares in the farm's bounty throughout the growing season" (Local Food Directories 2017,38).

According to Morgan et al. (2018), CSAs programs in New York, North Carolina, Vermont, and Washington were motivated by a range of personal, social, environmental, and economic objectives. In Colorado, farmers who incorporated CSA sales in their direct market portfolios usually have a smaller scale and utilize more diverse markets channels with lower average weekly sales than farmers who did not participate in a CSA (Jablonski, Sullins, and McFadden 2019). In 2005, there were 1,144 CSAs compared to 761 in 2001, an increase of 50 percent (Adam 2006).

2.8.3. Other types of direct-to-consumer marketing channels

There are two other types of direct-to-consumer marketing channels roadside, farm stands or on-farm stores, and pick-your-own or U-pick (Lawless et al. 1999).

2.8.3.1. Roadside, farm stands or on-farm stores

These are where a single farm sells agricultural and horticultural products directly to consumers from a location on the farm or at a place adjacent to that farm. They operate year-round from a permanent structure or during harvest periods from a truck, trailer, or tent (Lloyd, Tilley, and Nelson 1995).

2.8.3.2. Pick-your own or u-pick

This marketing channel was very popular during the depression and after World War II from 1930 to 1945. Farmers started this method because of the low prices that could not cover the harvesting cost and the shortage in agricultural labor (Lloyd, Tilley, and Nelson 1995). Berries, tomatoes, pumpkins, and Christmas trees are examples of popular commodities they offered at that time.

2.9. Direct-To-Retail/Foodservice and Intermediated Market Channels Types

2.9.1. Direct-to-retail/foodservice

This type of local food market channel refers to transactions between farmers and food buyers such as restaurants, retail stores, government entities, and non-government institutions, such as hospitals, schools, and universities/colleges who purchase large amounts of local food (Martinez et al. 2010). In addition, Martinez et al. (2010,12) said that local food "may also move through an intermediary marketing channels [sic], such as a wholesaler or the firm's distribution center, before reaching a retail outlet or consumer" (e.g., buying clubs).

However, many authors redefined Martinez et al. (2010) classification of the local food market into direct-to-consumer and intermediated marketing channels such as King et al. (2010); Low and Vogel (2011); Low et al. (2015); Dimitri and Gardner (2019). Low et al. (2015) defined "Intermediated marketing channels generally include all marketing opportunities in the local supply chain that are not farmer-to-consumer transactions, including farmers selling to grocers, restaurants, regional aggregators such as food hubs, and buying arrangements with the food service operations of schools, universities, hospitals, and other institutions" (Low et al. 2015,11).

For the purpose of this study, the farmer-to-consumer channel classification was used as it was defined in the literature review. But the name of intermediated marketing channels classification was modified to farmer-to-customers, which still includes all channels defined in the literature review.

In 2008, local food sales through intermediated marketing channels such as farmers' sales to local grocers, restaurants, hospitals, and schools accounted for the larger portion of all local food sales (Low and Vogel 2011). Low and Vogel (2011) claimed that intermediated marketing channels were dominated by large farms, while small and med-sized farms dominated direct-to-consumer marketing channels. Krejci et al. (2015) argued that many small and medium-scale food producers preferred to sell to larger-scale customers such as grocery stores, restaurants, and schools either directly or through a distributor such as a food hub to avoid the challenges associated with direct-to-consumer marketing channels.

According to Krejci et al. (2015), the increase in demand for local/regional food has resulted in a need for more efficient distribution methods. The local food market responded to this need by developing an intermediated regional food supply network that connects regional food producers and consumers. However, the authors in this study investigated only one type of intermediated marketing channel, which was a food hub. According to Dimitri and Gardner (2019,1), "the intermediated markets are relatively new market channels that have the potential to expand local and regional food systems while increasing the viability of small- and medium-sized farms."

2.9.2. Farm to grocery stores and retailers

Lawless et al. (1999) conducted a field experiment for 38 grocery stores in Wisconsin and neighboring areas. They found that fresh produce (fruits and vegetables) were the most popular local food items and dairy and eggs were in second place. In addition, these grocery stores used labels to identify the source of the produce. For example, Wisconsin-grown or photographs of farm suppliers Lawless et al. (1999). After the study of Lawless et al. (1999), the grocery industry in New York was investigated by Guptill and Wilkens (2002). The authors used open-ended interviews with seven owners and managers of different types of grocery stores. They found that "viable markets for local food are not based on niches that a business can "occupy" but rather a network of supply and selling relationships that retailers and producers alike must construct and continuously recreate" Guptill and Wilkens (2002,12). According to Martinez et al. (2010), many leading retailers such as Wal-Mart, Kroger, Safeway, Ahold, Delhaize America, H.E. Butt, and Meijer showed initiative in supporting local food systems through their websites.

Many U.S. food retailers and supermarkets launched programs to support local food systems and help local food producers. For example, Safeway launched a local food campaign to support locally grown produce. Publix started to support the "Fresh from Florida" brand in its southeastern stores, and Meijer had a program called "Home Grown" that supported 65 local producers in Grand Rapids, Michigan. Through its stores in almost all U.S. states, Wal-Mart is willing to provide fruits and vegetables to keep produce prices down. In Pennsylvania, Maryland, New York, New Jersey, and West Virginia, Sudbury launched a campaign called "Local and Proud of It." In addition, many consumer-owned retail food cooperatives (co-ops) promoted social and environmental values to support local farming and farmers (Martinez et al. 2010,18).

2.9.3. Farm to restaurants

According to National Restaurant Association (2019), "hyper-local foods made from produce grown in restaurant gardens, or house-made items, were popular with 67 percent of chefs" (National Restaurant Association 2019). Further, some restaurants with consumers who are highly supportive of the local food movement were serving only locally grown foods and limited their food menu to offer in-season products linked with their buyers' preferences (Martinez et al. 2010). Martinez et al. (2010) also documented that in 2006 fine dining and family dining/casual dining restaurants in the U.S. that serviced food made from local food ingredients were 87% and 75%, respectively.

Based on Martinez et al. (2010), the National Restaurant Association (NRA) surveys in 2006 found that 88% of chefs believed that local produce is a hot trend and local meat and seafood were on the top of the list for local food. In addition, NRA surveys found that restaurants' interest in local food increased significantly.

2.9.4. Farm to hospitals

Calverley (2007) claimed that if hospitals in England relied on local foods, they would be more cost-effective and increase patient satisfaction. According to Sachs and Feenstra (2008), incorporating local food into healthcare foodservice can improve patients' health, especially those with chronic diseases such as obesity, diabetes, and cardiovascular diseases. Furthermore, it can motivate other patients, staff, and visitors to develop a habit of eating healthy food and have a better lifestyle. Hospitals in California started serving local food in cafeterias, food-courts, and patient meals, which suits hospitals' mission to promote and protect all peoples' health (Sachs and Feenstra 2008). According to Martinez et al. (2010), the company Health Care Without Harm is working with many hospitals in many countries to develop a program to link social values, environmental values, and a healthy diet with local food. The program got the attention of many private hospitals, and in 2009 there 284 hospitals joined the project.

As noted by Klein (2015,1), "in alignment with stated social, health, and environmental values, hundreds of hospitals in the U.S. are purchasing local, and organic foods." (Klein 2015,1). Perline (2015). investigated farm-to-hospital programs. The authors conducted interviews with staff responsible for food purchasing, local food producers, and distributors in Montana to study the barriers, opportunities, and capacity-building strategies specific to the farm-to-hospital program. The study found that farm-to-hospital programs can create many opportunities, such as serving high-quality food in hospitals and building positive relationships with leaders in the local food system movement. However, local food prices, product availability, and quantity were barriers to use local foods. Yet, the development of cooperative distribution for local foods can reduce obstacles. The cooperative can work as a third party with hospital staff to formalize working-relationship contracts with local producers (Perline 2015). In addition, on-site food production at healthcare facilities may offer healing spaces and a better connection between the healthcare facilities and their communities (Knezevic, Mount, and Clement 2016).

2.9.5. Farm to schools

According to Dimitri and Gardner (2019), the main intermediated channels include direct to institutions, such as schools and hospitals, food hubs, and direct to retail. Low et al. (2015) noticed that in 2012, the ERS analysis of the USDA'S Farm to School Census reported that farm-to-school programs existed in 4 out of 10 school districts nationally. The farm-to-school program was started in the U.S. in 1997 by the USDA'S. The program was created from a desire to support communities, local food systems, and family farms, as well as to improve student health by reducing childhood obesity. According to Martinez et al. (2010,21), "farm to school programs represent an important component of the institutional market for locally grown produce."

The farm-to-school program encourages schools to purchase local foods directly from local farmers or through a third-party agent. Schools buy some or all of their food in the form of fresh produce such as dairy, fruits and vegetables, eggs, honey, meat, and beans (Joshi, Misako Azuma, and Feenstra 2008). In contrast, there are two forms of farm-to-school program. The first one is when a school turn part of its land into a small farm project (on-site food production) for education purposes. The second is arranging regular field visits for local farms as part of the school nutrition education curriculum (Martinez et al. 2010).

According to Joshi, Misako Azuma, and Feenstra (2008), the number of schools participating in the farm-to-school program increased. The program attracted many schools in the U.S. However, because of a lack of peer-reviewed research, the impact of this program is fully understood. Joshi, Misako Azuma, and Feenstra (2008) also found that the farm-to-school program positively impacted the lifestyle of students, teachers, staff, and parents. For example, parents noticed positive changes in their children's behavior, such as improved social skills, selfesteem, and work ethic. The positive outcomes also included local farmers who participated in the program; they increased their sales (Joshi, Misako Azuma, and Feenstra 2008).

Izumi, Alaimo, and Hamm (2010) identified three motivates in the Upper Midwest and Northeast regions in the U.S. to purchase local food and participate in the farm-to-school program. First, the desire to help and support local farmers, second fair prices for local produce food. Third, higher quality. A pilot study to connect children's education with local food was done by the "Plant the Seed program," a garden-based nutrition education program by Lee, Bai, and Wunderlich. (2016). The study aimed to educate children about the benefits of locally grown food, the food environment, and eating seasonal foods. The study "results demonstrate how a methodically designed program had a positive impact on theory mediators that can lead to the increased consumption of locally grown foods." (Lee, Bai, and Wunderlich 2016,4). According to the farm-to-school census (2015), there were 39,000 schools involved in the program, these schools served 24.1 million children. In addition, more than 5200 farms participated in the program. "The farm-to-school program are intended, in part, to increase market access and therefore the viability of farms and ranches." (Christensen, Jablonski, and O'Hara. 2019,1).

2.9.6. The food hub concept

From the literature, it is obvious that the dominant type of intermediated marketing channel is the food hub. "Food hubs are an essential component of scaling up local food systems and a flagship model of socially conscious business" (Colasanti et al. 2018,11). Koch and Hamm (2015,1) said, "there has been rapid growth of interest in planning and operationalizing food hub enterprises across the country." Studies that investigated food hubs are numerous. For example, the National Food Hub Survey was a periodic survey every two years from 2013 to 2017. The

National Food Hub Surveys are collaborative studies led by the Center for Regional Food Systems at Michigan State University (Fischer et al. 2014; Hardy et al. 2016; Colasanti et al. 2018).

The concept food hub acquired the interest of local foods stakeholders, and USDA funding support and other financial institutions made the concept very common in each state and county. However, not all food hubs were able to survive after funding runout; hence, it is not surprising that the number of food hubs is constantly changing. With the number of food hubs growing, it was necessary to create guidelines on how to plan, build, and run a food hub. For example, the USDA published four reports called "Running A FOOD HUB." Matson, Thayer, and Shaw (2015) (Vol.1); Matson, Thayer, and Shaw (2015) (Vol.2); Matson, Thayer, and Shaw (2016) (Vol.3); and Feldstein and Barham (2017) (Vol.4) addressed lessons learned from the field, a business operations guide, assessing financial viability; learning from food hub closures.

Feldstein and Barham (2017,13) tracked national food hubs for five years from 2005 to 2011, which means a food hub that started in 2005 tracked until 2012. The authors believed that food hubs had "remarkably high survival rates." The survival rates for these food hubs were as follow:

- In 2005, the survival rate was 93%,
- In 2006, the survival rate was 89%,
- In 2007, the survival rate was 79%,
- In 2008, the survival rate was 88%,
- In 2009, the survival rate was 84%,
- In 2010 the survival rate was 83%,
- In 2011 the survival rate was 96%, and
- In 2012, the survival rate was 95%.

2.9.6.1. Definitions for a food hub

As evident from the literature review, there are various ideas of what considers a food hub, leading scholars and authors to create different definitions for a food hub. According to Morley, Morgan, and Morga (2008,4), “The Food Hub concept is shot through with definitional issues that have to be addressed in order to come to a clear view of what Food Hubs may represent and how they may be developed. The definitions that are decided upon in part also depend on what purpose is conceived for a Food Hub. These may range from narrow market-efficiency functions to those related to visions of building a diversified food culture that may support small scale producers and deliver environmental, economic, and social sustainability to the producing sector together with health and cultural objectives among consumers”. In contrast, Horst et al. (2011) believed that the definition of a food hub in North America came from many sources. The authors contribute Salle, Janine, and Holland through their book Agricultural Urbanism as one of these sources in addition to the USDA’S, the nonprofit organization Wholesome Wave, and landscape designers (Salle, Janine and Holland 2010). Barham et al.'s (2012) definition for a food hub is the most commonly cited.

Barham et al. (2012,10) define a regional food hub as “a business or organization that actively manages the aggregation, distribution, and marketing of source-identified food products primarily from local and regional producers to strengthen their ability to satisfy wholesale, retail, and institutional demand.” This definition was the first that recognize this concept. Fischer, Pirog, and Hamm (2015) claimed that the existing food hub definitions were to broad and did not address the issue of properly articulating the benefits of food hubs. The authors suggest a new succinct description for a food hub that recognizes the core operations and is broad enough to include self-identified food hub structures. The authors' new definition for a food hub was “food hubs are, or intend to be, financially viable businesses that demonstrate a significant commitment to place through aggregation and marketing of regional food" (Fischer, Pirog, and Hamm 2015,97) and Hardy et al. (2016) claimed that stakeholders' must be added to Fischer, Pirog, and Hamm (2015) is definition because stakeholders' expectations change as food hubs mature and evolve.

2.9.6.2. Classification

Barham et al. (2012) identified two methods to classify food hubs. The first method is by food hub structure (legal business), which includes: nonprofit organizations, privately held food hubs, cooperatives, and publicly held food hubs. Barham et al. (2012) believed that the first method usually influences the second classification method, which is the food hub function. A food hub has three possible functions:

- Farm-to-business/institution model.
- Farm-to-consumer model.
- Hybrid model, which is a combination of the previous two functions Barham et al. (2012).

Horst et al. (2011) claimed that their typology for food hubs would contribute to a better collective understanding of food hubs. The authors said their nine typologies discussed a food hub purpose, design, and scale: Boutique/Ethnic/Artisanal Food Hub, Consumer-Cooperative Model, Destination Food Hub, Neighborhood-Based Food Hub, Education, and Human Service–Focused Food Hub, Online Food Hub Network, Rural Town Food Hub, Regional Aggregation Food Hub, and Hybrid Food Hub.

According to Matson, Thayer, and Shaw (2015,10) (Vol.2), a food hub is just like any other business in that it can be classified "into three broad categories: tax designation, legal structure, and operational model." Morganti and Gonzalez-Feliu (2015) did a case study in the city of Parma, Italy, for an urban food hub, they said based on Barham et al. (2012), they identified four types of food hubs:

- Cooperatives of producers' food hub.
- Farmers' markets food hub.
- Warehouse produce markets (WPMs), food hub, and
- Terminal markets food hub.

2.9.6.3. Types of products sold at food hubs

According to Fischer et al. (2014); Hardy et al. (2015); Colasanti et al. (2018), the authors of national food hubs surveys 2013, 2015, and 2017, there are 12 food product categories sold at food hubs all over the U.S. However, Alcohol was only on the 2017 list, and only 3% of the food hubs sold it. The 12 food product categories are as follows:

- Alcohol, (Colasanti et al. 2018)
- Baked goods/bread
- Coffee/Tea
- Eggs
- Fish and seafood
- Fresh produce and herbs
- Grains, beans, flours
- Meat and poultry
- Milk and other dairy products
- Non-food items
- Other processed or value-added products
- Processed produce.

2.9.6.4. Benefits of food hubs

Regional food hubs provide many benefits to local/regional agricultural producers, local food systems, the economy, and the community. A regional food hub offers new opportunities for food producers by expanding the market for them. In addition to the benefits to the local/regional economy by providing new jobs in rural and urban areas, food hubs reduce food deserts and increase access to fresh, healthy foods (Barham et al. 2012). Regional food hubs provide new opportunities for local agricultural producers, especially farmers, who operate small and mid-size farms. Food hubs offer local producers better prices for their food products by expanding market options for them, which increases their sales (Flaccavento 2009; Clancy and Ruhf 2010; Damon and Nicola 2014). Regional food hubs can help beginner farmers by scaling up their production (Bregendahl and Flora 2006).

According to Ahearn (2011), farming, like any business, requires start-up capital which is usually related to two obstacles. The first one is the opportunity to buy or rent suitable land. The second one is how to scale up production to be profitable. Bregendahl and Flora (2006) noted that a regional food hub can support farmers, especially beginner farmers, by providing professional market advice and educational knowledge such as marketing skills and practical information and data. According to Flora, Flora, and Gasteyer (2016), most national food hubs offered services to small and mid-sized farms that are usually operated by beginner farms. These services included continuing education and facilitating communication to build human and social capital in local food systems.

2.10. Benefits of Local Food Systems

Local/regional food systems are linked to many benefits, such as food consumers, producers, and other local/regional food system stakeholders. Authors who believe in local/regional food systems' benefits claim that local food systems are better than conventional national/global food systems. These benefits include better access to food for communities, healthier nutritious food for consumers, and better quality, environmental benefits since small and mid-size farms use little or no chemicals and fewer miles for transportation which means less energy use (greenhouse/gas emissions). According to Schmitt et al. (2017), Local food systems provide ecological, health, and socio-economic benefits. A food hub positively impacts the local economy, society, and environment, and it can be financially profitable (Barham et al. 2012).

2.10.1. Positive impact on local/regional food producers and farms

Local/regional food systems allow farmers to differentiate their food products in financially viable markets, particularly V.A.P. (Bendfeldt et al. 2008; Diamond and Barham. 2011). Food hubs provide product differentiation strategies, ensuring better prices for local food producers and food hub products. (Barham et al. 2012). As noted by Bregendahl and Flora (2006), farmers can strengthen their personal and professional communities and gain new knowledge of farming practices and marketing by participation in value-added supply chains. According to Bauman, McFadden, and Jablonski (2018), farms from any scale of sales volume, mainly small and mid-size farms, can be financially viable by participation in direct and intermediated market channels; and decrease future uncertainty about economic viability due to participant's relationships to each other (Hand 2010).

Food hubs help local/regional food producers by providing technical assistance and finding partners to offer this technical assistance. In addition, food hubs mainly support small and mid-sized farms that have small-scale production to scale-up farm operations (Barham et al. 2012). According to (Barham et al. 2012), food hubs treat producers as valued business partners, not as suppliers, and continuously commit to purchase from local small to mid-sized producers whenever possible.

2.10.1.1. Community health, nutrition, and food security

Conner and Levine (2007); Thompson, Harper, and Kraus (2008) noticed the benefits of supporting and consuming local/regional foods on community health. In addition, Morland, Wing and Roux (2002); Moore et al. (2008) claimed the healthy dietary choices that local food provided increased and improved access to healthy foods because they directly relate to each other. Further, the farm-to-school and farm-to-hospital literature shows that local foods are correlated to people's health. Local food items such as meat, dairy, and fresh fruits and vegetables may improve food consumers' lifestyles and health. The benefits of eating local/regional food include improving nutrition and reducing the risk of some chronic diseases such as obesity, diabetes, and cardiovascular disease (Sachs and Feenstra 2008; Joshi, Azuma, and Feenstra 2008).

Nord, Andrews and Carlson (2008) defined food security as residents having access to healthy food that supplies enough energy for daily activity, which allows them to live a healthy life; in addition, that access must not be interrupted for a long time. According to Coleman-Jensen, et al. (2018,1), “11.8 percent of American households were food insecure at least sometime during the year in 2017” (Coleman-Jensen et al. 2018). As noted by Kantor (2001), local food systems increased community food access and reduced food insecurity by improving and linking rural and urban communities to each other. Some people are motivated by social factors other than financial factors, and they have a desire to support communities by participating in a food hub even if it is not financially profitable for them (Krejci et al. 2016). In addition, Gale (1997) said that marketing food products from small and mid-sized farms and preserving these farms can assist the development of rural communities.

2.10.1.2. Economic development

The claim that local/regional food can improve a local/regional economy came from the increase of food consumers' purchasing power, which increased farm sales and positively impacted the local economy. According to Hughes et al. (2016), the development of local/regional entrepreneurial projects may benefit both farmers and the local economy. While Low et al. (2015,6) believed "it is difficult to draw conclusions about the local economic impact of local foods systems because the existing literature has narrow geographic and market scope, making comparing studies complicated." Other authors such as Marsden et al. (2000); Ikerd (2005) believe that the local economy could be improved by expanding the local system and increasing the number of local food projects in rural areas.

Local food systems may "contribute to rural development and labor markets to promote local economies." (Roininen, Arvola and Lähteenmäki 2006,1). Martinez et al. (2010), Otto and Varner (2005) said that the Iowa economy improved because each full-time job provided by local foods added a half-time job in other sectors of the Iowa economy. According to Bregendahl and Enderton (2013), each $1 million from Iowa local food sales is creating 7.7 to 13 full-time jobs in the Iowa food industry.

2.10.1.3. Environmental advantage

According to Edwards et al. (2008), It is challenging to say that the local food supply chain has fewer greenhouse gases emissions (GHGs) compared with the global food supply chain due to the scarcity of studies that measure life cycle assessment (LCA) across the entire local food supply chains. For that, food miles could be a poor indicator of the environmental benefit of local food supply chains. However, "only through combining spatially explicit life cycle assessment with analysis of social issues can the benefits of local food be assessed." (Edwards-Jones et al. 2008,1).

In contrast, authors such as Pirog et al. (2001); Saunders and Hayes (2007); Tregear (2011) support the other side of the argument. They believe that local food supply chains reduce food miles (Shimizu and Desrochers 2008) and carbon emissions. In addition, Pirog et al. (2001); Saunders and Hayes (2007); Tregear (2011) claim that local food supply chains use fewer miles compared to conventional food supply chains, reducing the use of fossil fuels and GHGs emissions that harm the environment. This side of the argument was also supported by Brown (2003); Lea (2005); Selfa and Qazi (2005).

2.11. Local/Regional Agriculture and Sustainability

Authors such as Hinrichs (2003); Ilbery, Maye (2005); Peters et al. (2009); Cleveland, et al. (2014); Johnson, Fraser, and Hawkins (2016); Berti and Mulligan (2016); Schmitt et al. (2017); Mittal, Krejci and Craven (2018); Cornejo et al. (2020) linked local/regional food agricultural system practices and local/regional food supply chains with sustainability. According to Hinrichs (2003), The Leopold Center for Sustainable Agriculture was one of the first institutions to support and fund Iowa local food, to establish sustainable farming practices in Iowa.

Ilbery and Maye (2005) claim that companies operating in rural the Scottish support local food supply chains as it is more sustainable for the environment and economy and improves social terms. However, the study found that these companies' supply chains were usually similar to conventional supply chains; they emphasized economic benefits more than sustainability. Due to that, the authors warned local food stakeholders not to conflate terms such as local, alternative, and sustainable. Peters et al. (2009) said that local food systems can offset the high prices associated with global food systems. According to the authors, local food supply chains may provide lower costs and sustain the agriculture for the areas they serve.

According to Conner et al. (2010), focusing on local produce and marketing local food products through a direct-to-consumer marketing channel supports the agriculture sector and makes it more sustainable. Local food production is a solution to sustaining agricultural land that is declining and improving the negative net income that most farms are facing in Michigan.

Cleveland et al. (2014,1) claim the local food supply chain can offset the negative environmental and social externalities of the conventional supply chain. The challenge facing the local food supply chain is that the food market is controlled and dominated by the mainstream economy, which is focusing only on economic profit. The authors suggested, “scaling up from direct marketing rather than scaling down from mainstream distribution, and the actor’s motivations to prioritize social and environmental over economic goals.”.

According to Berti and Mulligan (2016), the only way to make small and mid-size family farms competitive is by re-constructing local food systems and aligning them with Kramer and Porter’s concept of a shared value strategy. Johnson, Fraser, and Hawkins (2016,1) claimed that “producers and consumers may simultaneously look for the sustainability benefits associated with “alternative food systems” without wanting to sacrifice any of the convenience found in conventional food systems.”.

Mittal, Krejci, and Craven (2018) claimed that the logistics, efficiency, and effectiveness of regional food supply chains can be improved by adopting the best practices of conventional supply chain logistics. Cornejo et al. (2020) said that small and mid-size farms could be more sustainable by adopting a value-added diversification strategy. According to Conner et al. (2010), the increasing consumer interest in local foods is due to their ability to enhance the food system's sustainability by reducing the carbon footprint and providing new market opportunities for local farms.

2.12. North Dakota

ND is the 19th largest state in the U.S., with a surface area of 70,700 square miles, located along the U.S. and Canadian border. As of 2020, the population size was 761,723 residents, with a 1.99% growth rate, which ranked as 2nd place in the nation. ND a has four regions: northwest, Northeast, southwest, and southeast. According to the 2017 Census of Agriculture, farms and ranches occupy 89% (39.3 million acres) of land in ND. In the southeast, Cass County is located the most populated county with 177,787 residents. Fargo is the largest city in Cass County and in the state, with a population size of 118,523 residents (World Population Review 2021).

3. METHODOLOGY FOR ND FOOD HUB FEASIBILITY STUDY

This chapter aims to show the research methodology, which included several steps to empirically evaluate whether the ND local food system needs a food hub from the supply and the demand perspectives.

3.1. Research Approach

This research depended on primary data collection due to the nature of the research problem. In most cases, scholars prefer to rely on primary data to search the local food system because the present data about this field is limited, with some not academically documented. Likewise, similarities and differences of producer, consumer, and customer preferences and perspectives for local food should be examined and reported for each particular region and county. For this kind of information, many scholars depend on primary data from the local food field.

The majority of research on local food systems has been done with either a qualitative, such as a case study or with a quantitative approach, such as a survey. Authors such as Darby et al. (2008); Brown, Dury, and Holdsworth (2009); Conner et al. (2010); Onozaka and McFadden (2011); Bosworth, Bailey, and Curtis (2013); Meas et al. (2015); Hempel and Hamm (2016) used survey methodology to investigate the consumer demand and preference for local food in the U.S. or Europe. Other scholars implemented survey methodology either qualitatively or quantitatively to study local food producers. For example, Jablonski (2014) conducted a case study on Kriemhild Dairy Farms profiles. Feenstra et al. (2019) surveyed specialty manufacturers and interviewed manufacturers and farmers in California, Minnesota, Wisconsin, Washington, and Oregon. And Cornejo et al. (2020) studied dairy farmers in Spain.

In a more comprehensive study, Schneider and Francis (2005) conducted two independent surveys in one study to ascertain consumer demand for local food and farmer willingness to meet the local food demand in Washington County, Nebraska. Whereas most local food system literature studied local/food consumer performance or attitude, few researchers studied farmers/local food producer's opinions and willingness to supply local foods. It is uncommon in the literature to find articles investigating supply and demand for local food systems parallel to each other in one research paper.

Like the Schneider and Francis (2005) study, this current research also uses two independent surveys to build a holistic view of the local food system potential in ND. This study focused on ND local food system logistics and supply chain under the food hub concept umbrella to enrich the literature concerning the ND local food system and fulfill the research objectives. This is the first research to investigate the supply and demand for the ND local food system to the best of my knowledge. This study is also considered one of the few studies that examined institutions and whole-food buyers' preferences as customers for local food products instead of local food consumers' preferences.

3.1.1. Non-experimental research design

Since this study investigates whether or not ND requires a food hub, this research question was broad and exploratory. Therefore, the non-experimental research design was the appropriate design to use, even necessary, for this study because the independent variable cannot be manipulated. Creswell and Creswell (2018) stated that the quantitative nonexperimental approach is an effective method to examine a research problem that was not investigated and documented in the literature, primarily when the researcher seeks to involve complex experiments with many variables and run a factorial design. The literature included scholars who chose a qualitative survey method (e.g., interviews, case studies, or observations). In contrast, others chose the quantitative survey (e.g., questionnaires) method to study the local food system or to evaluate the latest ideas and aspects in particular areas. However, in this research, we relied on a survey approach with both quantitative and qualitative questions. According to Creswell and Creswell (2018), this approach describes a population's trends, attitudes, and opinions. It allows us to test sample variables and define associations among them to be used for our population.

The lack of data and literature about the ND local food system requires this study to apply the exploratory approach method to identify opportunities, issues, obstacles, and challenges in ND local food system. Throughout the course of this investigation, the USDA's Local Food Directories did not have a business facility registered as a food hub in ND. Thus, because of the scant information and data about the ND local food system, a non-experimental design was the appropriate approach for this research.

3.1.2. Purpose of this study

This study's primary purpose was to empirically evaluate whether the ND local food system needs a food hub from a supply and demand perspective. Investigating both sides of the ND local food system led to a better comprehension of the research area and provided a complete understanding of the research problem. The survey questions in this study included quantitative and qualitative factors to fill the gap in the ND local food literature and provided answers for the study questions and hypotheses.

3.2. Survey Development for ND Food Hub Feasibility Study

Two independent cross-sectional surveys were created to accomplish this feasibility study. Both surveys were online surveys due to the low cost and flexibility of this method. They were written in Word documents and then entered into the NDSU Qualtrics online tools. Both surveys were inspired by many studies that investigated the food hub concept, such as the National Food Hub Survey, which was a periodic survey every two years from 2013 to 2017. The National Food

Hub Surveys are collaborative studies led by the Center for Regional Food Systems at Michigan State University (Fischer et al. 2013; Hardy et al. 2015; Colasanti et al. 2018). This study was also inspired by peer-reviewed articles about research based on a survey method to examine the local food supply and demand sides. The ND food hub feasibility study was divided into two parts: Part A was the farmers/ranchers and food producers survey, this questionnaire meant to measure the supply-side for local food in ND, and part B was the farm to institutions and whole-food buyer survey. This questionnaire measured the demand-side for local food in ND from institutions and the whole food buyer's perspective.

3.3. Survey's Analysis Methods and Results Interpretation

The two independent cross-sectional surveys, the ND food hub feasibility part-A (the supply-side) and part-B (the demand-side), were analyzed descriptively and inferentially. Results from each part were analyzed separately. The descriptive statistical analysis for the results was obtained from the Qualtrics results report. For the inferential statistics, we created five hypotheses for each part, and the hypotheses were evaluated by stepwise multiple regression (backward elimination) analysis by SAS 9.3 programming. The hypotheses and variables (independent and dependent) for both parts of the ND food hub feasibility study were discussed separately in the following sections. The SAS 9.3 programming revealed the relationships among variables and allowed us to identify the most significant independent variables in the multiple regression model. The reliability of rates and statistics reported for both analyses are highly dependent on the number of responses in each category.

Furthermore, the power analysis was used in the regression assessment as a significant finding for the sample size in case of an insignificant independent variable. The power analysis was used to detect the sample size need for the less insignificant independent variable using the R-squared (R2).

3.4. ND Food Hub Feasibility Study Part A

3.4.1. Purpose of the survey

This survey's primary purpose was to cover the supply-side part of the feasibility study for the ND food hub in order to evaluate the local food production capacity and local food producers' ability and willingness to participate in a ND food hub project.

3.4.2. Demographic of the study

This questionnaire is meant to investigate and measure the local food supply in ND. Therefore, the population for part A of this research was all ND farmers, ranchers, and food producers. According to the data from the U.S. Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS) 2017 Census of Agriculture, the total number of ND farms was 26,364. Of these, 96% are family farms, 79% have internet access, and only 1% of all ND farms sell directly to consumers. In addition, there were a total of 41,904 ND producers, of which 29,588 (71%) were male, and 12.316 (29%) were female. In addition, ND producers 35 years old and less totaled 4,644, from 35 to 64 years old totaled 24,849, and 65 and older totaled 1,241. Of the 41,904 producers, 41,389. White, 315 were American Indian/Alaska Native, 21 Asian, 8 Black or African American, and 164 with more than one race.

3.4.3. Survey sample size

This survey was a web-based survey due to the low cost and flexibility of this method. It was challenging to get farms' emails or distribute the survey through USDA. Therefore, this study applied the non-statistical voluntary sampling technique. See the distribution part of this section for sampling.

3.4.4. Supply-side survey development

The survey was submitted to IRB in January 2019 and was exempt from protocol #BA19145 (see Appendix A). The questionnaire was also reviewed by committee members and academic professors in the NDSU Statistics Department familiar with web-based survey technique and the study's goals. The survey has been examined by professional experts in local food systems, such as Ashley Honsberger, the executive director of the Food Hub Management Professional Certificates (FHMPC); Jeff Farbman, a Sr. Program Associate at Wallace Center at Winrock International; and Lucy Bardell, an assistant to the President at ND Farmers Union. The survey questions were entered into Qualtrics survey software. To ensure that all the survey questions were readable and accessible from any electronic device, the NDSU Group Decision Center tested its accessibility.

3.4.5. Questionnaire sections and questions

This survey targeted farmers, ranchers, and producers in ND. The survey started with a letter that explained the entire study and the objectives of the research and presented participant rights (see Appendix B). The ND Food Hub Feasibility Study Part A, which presents the supply-side of this study, was divided into three sections. All sections had 51 questions, and some questions had sub-questions (see Appendix C).

3.4.5.1. Section 1: The role and attractiveness of a ND food hub

In order to simplify the food hub concept for the participants because some were unfamiliar with the food hub term, the author provided his version of the food hub definition at the beginning of this section to introduce food hub functions to the participants. The information provided was as follows: A food hub is a business that aggregates, markets, and distributes products from several local/regional farms. Food hubs offer services that may include cooling, storage, marketing and distribution, washing, grading, sorting, packing or repacking, packaging and labeling, and branding.

The definition was followed by 18 questions; 12 questions were a 7-point Likert scale, four multiple-choice questions, one fill in the blank question, and one open-ended question. The 7-point Likert scale that assessed such topics as importance, agreement, and interests. According to Sullivan and Artino Jr (2013), 7-point Likert scales are known to be the most accurate of the Likert scales. For example, in order to measured respondents' familiarity with food hubs, the Likert scale offered 7 answer options ranging from one extreme to another. An answer of "1" represented the lowest level of familiarity, the midpoint "4" represented a neutral option, and "7" represented the highest level of familiarity. Option "8" represented the "Not Applicable" (NA) answer.

Also, this section included fill-in-the-blank, multiple-choice, and open-ended questions designed to evaluate the characteristics of the ND food hub from the farmer, rancher, and producer perspective. It had questions about their level of familiarity with and interest in joining a food hub project. In addition, this section included questions about services provided by the ND food hub such as operational type and ownership category, business structure type, tax designation type, and legal structure type. And other questions related to the ND food hub project included concern about selling, product to be sold, resource barriers, and the distance of the food hub from the farm.

3.4.5.2. Section 2: Farm characteristics

This was the second section in the supply-side questionnaire, it included 26 questions focused on ND farm characteristics and operation; 16 questions were multiple-choice, five were binary, three were fill in the blank, and two were 7-point Likert scales. Furthermore, the 7-point Likert scale questions were collapsed into a 3-point scale for the purpose of describing and summarizing the descriptive statistics analysis. The 3-point scale represented the perceptions of the respondent with respect to the resource barriers and usage of digital marketing for local food and were classified as low, neutral, and high. An answer of “1-3” on the 7-point Likert scale represented the lowest level of agreement, the midpoint “4” on the Likert scale represented a neutral option, and “5-7” on the Likert scale represented the highest level of agreement.

3.4.5.3. Section 3: Food producer demographics

This section included seven questions designed to gather demographic information. It included questions such as level of education, employment status, and years of experience in the farming field.

3.4.6. Distribution of the survey

The electronic version of the supply-side survey was online and available for distribution from 02/11/2019 to 01/31/2020. A voluntary sampling technique was used to distribute the survey and to ensure it reached as many ND farmers and ranchers as possible. The link for the survey was distributed either by email, hard copy with the link, hard copy, or via Facebook to the following nine groups:

- ND Farmer’s Union: The survey link was sent to the union by email to Lucy Bardell, the assistant to the president at ND Farmer’s Union. Bardell then printed and distributed hard copies of the survey among members during one of the monthly union meetings. She then mailed the completed hard copies to the researcher, who entered them into Qualtrics.
- ND Department of Agriculture: The Qualtrics survey link was sent to Jamie Good, the local foods specialist. Good posted the link on the ND Department of Agriculture Facebook page. The researcher sent a reminder email to Good in order to make sure the link was updated and at the top of the Facebook page.

- Food Hub Huddle Conference: The purpose of the study and the survey objectives were presented at this conference held by the ND Local Foods Development Alliance, Tuttle Rural Innovation Center, and Natural Resources Conservation on Tuesday, April 9, 2019. Hard copies of the survey with the printed Qualtrics link on the first page were distributed among the audiences. Completed surveys were collected at the end of the conference, and the researcher entered the data into Qualtrics.
- Fargo/Moorhead Farmer's Markets: Hard copies of the survey were printed with the Qualtrics link on the first page and distributed among farmers in many farmer's markets in the Fargo/Moorhead Farmer's Market. See (Appendix K) for a full list of all farmer's markets in the Fargo-Moorhead area. This list was obtained from the Convention and Visitor's Bureau website. The researcher met with each farmer or food producer individually for a short time to explain the study. The interviewee had the option to fill out the hard copy during the meeting or after the meeting using the electronic version of the survey through the survey link.
- DLN Consulting, INC: Aspen Lenning, a student intern at DLN Consulting, INC, posted the survey link on the company's Facebook page. She found the link on the ND Department of Agriculture Facebook page, contacted the researcher for permission to post an updated survey link for their members on the DLN Consulting, INC's Facebook page. DLN Consulting, INC created the "Local Food Finder List" as a database for ND farmers and consumers looking to sell or buy local food. Also, the company created an intensive toolkit on how to create a food hub.

- Natural Grocers: The survey link was sent to the Natural Grocers store general manager Sophia Yohannes, who sent it to the store's local vendors.
- Prairie Roots Food Co-Op: The survey link was sent to the Prairie Roots Food Co-Op general manager Trae Long, who sent it to the store's local vendors.
- Tochi Products: The survey link was sent to the Tochi Products store general manager Joe Hoglund, who sent it to the store's local vendors.

3.4.7. Supply-side research hypotheses

Table 3 presents the hypotheses and variables that were used for inferential statistics for the supply-side. We used SAS 9.3 Stepwise Multiple Regression (Backward Elimination analysis) to analyze the inferential statistics. SAS 9.3 Multiple linear regression is a traditional statistical tool that regresses p independent variables against a single dependent variable. The application of the Backward Elimination analysis allowed us to include all the independent variables (predictors) in the model. And at each step, we evaluated the independent variables which were in the model and eliminate the most insignificant independent variable. We repeated the evaluation and elimination step until we had the most significate independent variable against that single dependent variable we used at the beginning.

We had five independent variables: Q 21 Farm or pasture size operated by ND food producers, Q 31 Does ND food producers currently produce and market V.A.P., Q 47 Level of education of ND food producers, Q 49 Employment time, and Q 51 Years of experience. In addition, we had three dependent variables: Q 1 Level of familiarity with a food hub concept, Q 2 level of agreement with sustainability statement, and Q 3 Level of interest of ND food producers in selling food products through the ND food hub. The Backward Elimination analysis was used to test all the five independent variables against one of these dependent variables, and we repeated this process for all the three dependent variables.

Furthermore, the power analysis was used in the regression assessment as a significant finding for the sample size in case of an insignificant independent variable. The power analysis was used to detect the sample size using the R^2.

Table 3. Supply-Side Research Hypotheses and Variables.

Hypotheses	Dependent variables	Independent variables
Hypothesis 1: Farmers operating farms or pastures less than the average size are more likely to have a higher level of familiarity with a food hub concept. Hypothesis 2: Farmers that produce a VAP are more likely to have a higher level of familiarity with a food hub concept. Hypothesis 3: Farmers with less than ten years of farming experience are more likely to have a higher level of familiarity with a food hub concept. Hypothesis 4: Full-time farmers are more likely to have a higher level of familiarity with a food hub concept. Hypothesis 5: Farmers who have a bachelor's degree or higher education are more likely to have a level of familiarity with a food hub concept.	Q 1 Level of familiarity with a food hub concept.	Q 21 Farm or pasture size operated by ND food producers. Q 31 Does ND food producers currently produce and market V.A.P. Q 47 Level of education of ND food producers. Q 49 Employment time. Q 51 Years of experience.
Hypothesis 1: Farmers operating farms or pastures less than the average size are more likely to have a higher level of agreement with the sustainability statement. Hypothesis 2: Farmers that produce a VAP are more likely to have a higher level of agreement with sustainability statement. Hypothesis 3: Farmers with less than ten years of farming experience are more likely to have a higher level of agreement with sustainability statement. Hypothesis 4: Full-time farmers are more likely to have a higher level of agreement with sustainability statement. Hypothesis 5: Farmers who have bachelor's degree or higher education are more likely to have a level of agreement with the sustainability statement.	Q 2 level of agreement with sustainability statement.	Q 21 Farm or pasture size operated by ND food producers. Q 31 Does ND food producers currently produce and market V.A.P. Q 47 Level of education of ND food producers. Q 49 Employment time. Q 51 Years of experience.
Hypothesis 1: Farmers operating farms or pastures less than the average size are more likely to have a higher level of interest in joining the ND food hub. Hypothesis 2: Farmers that produce a VAP are more likely to have a higher level of interest to join the ND food hub. Hypothesis 3: Farmers with less than ten years of farming experience are more likely to have a higher level of interest in joining the ND food hub. Hypothesis 4: Full-time farmers are more likely to have a higher level of interest in joining the ND food hub. Hypothesis 5: Farmers who have a bachelor's degree or higher education are more likely to have a higher level of interest in joining the ND food hub.	Q 3 Level of interest of ND food producers in selling food products through the ND food hub.	Q 21 Farm or pasture size operated by ND food producers. Q 31 Does ND food producers currently produce and market V.A.P. Q 47 Level of education of ND food producers. Q 49 Employment time. Q 51 Years of experience.

3.5. ND Food Hub Feasibility Study Part B

3.5.1. Purpose of the survey

This survey's primary purpose was to cover the demand-side part of the feasibility study for the ND food hub. It evaluated the demand-side for local food in ND from institutions and whole-food buyers' perspectives. The survey measured the food purchasing power for ND institutions and their performance about local food. Also, their ability, willingness, and interest in joining the ND food hub project as food buyers.

3.5.2. Demographics of the study

This questionnaire was meant to investigate and measure the local food demand in ND. Therefore, the population for the feasibility study for the ND food hub part B of this research focused on food buyers, including schools, childcare facilities, universities, colleges, hospitals, wholesale food sellers, and restaurants.

3.5.2.1. Survey sample size

This survey was a web-based survey due to the low cost and flexibility of this method. It was challenging to get an email list of all food buyers. Therefore, this study applied the non-statistical voluntary sampling technique. However, the targeted population was as follows:

- Public Schools and Childcare: A list that contained 320 schools and 136 childcare was obtained from Linda Schloer, Director of Child Nutrition and Food Distribution Programs in the ND Department of Public Instruction.
- Colleges and Universities: The National Center for Education Statistics lists 28 colleges and universities. Excluding non-nonrelated colleges (for example, The Hair Academy) that do not have dining and do not purchase food). We developed

an emailing list contained 21 dining or purchasing directors using college and university websites.

- Hospitals: A list of 55 hospitals was obtained from the ND Department of Health. Fifteen emails were missed from that list and were obtained from the hospital's websites. Emails were sent to admission, and they been asked to directed to the person in charge of food purchasing.

  Wholesale food buyers: The National Grocers Association, The Independent Grocers Alliance (IGA), and The Independent Grocer Association (IGA) were contacted to distribute the survey. The survey was sent to 145 individuals representing 90 retail establishments in ND by Mr. John Dyste, the President of the ND Grocers Association.

- Restaurants: This category was excluded from the study. There are many marketing companies that offers an emailing list for restaurants. The prices for data range from $50 to $1000; it was either expensive or unreliable. For that, we restaurants were excluded from this research.

3.5.3. Demand-side survey development

The survey was submitted to IRB in December 2019 and did not require the IRB approval or certification of exempt status because it does not involving human subjects; see (Appendix F). The questionnaire was also reviewed by committee members and academic professors in the NDSU statistics department familiar with web-based survey technique and the study's goals. The survey has been examined by professional experts in local food systems such as Kristianna Siddens, manager of Dakota Fresh Food Hub. The survey questions were entered into the Qualtrics survey software. To ensure that the entire survey questions were readable and accessible from any electronic device, the Group Decision Center at NDSU did the last revised version of this survey.

3.5.4. Questionnaire sections and questions

This survey targeted food buyers in ND, such as educational institutions, hospitals, and grocery stores. The survey started with a letter that explained the entire study and the objectives of the research and presented participants' rights. See the survey cover letter (Appendix G). The ND food hub feasibility study part B, which present the demand-side of this study, was divided into four sections. All sections had 51 questions, and some questions had sub-questions (see Appendix H).

3.5.4.1. Section 1: Food purchasing behavior and requirements

This section of the questionnaire covered the food purchasing behavior requirements, and it included 21 questions. Six multiple-choice questions, six questions fill-in-the-blank, five questions 7-point Likert scale, and four binary questions. The purpose of this section was to understand the factors influencing ND institutions' decision to purchase food, such as the number of vendors, delivery methods, the average cost for delivery, label requirements, and packing standard and requirements.

3.5.4.2. Section 2: Local food concept from

This section of the questionnaire covered ND institution's opinions and conceptions about local food products. For example, how institutions defined local food by distance in miles, influencing factors for purchase local foods, purchasing flexibility regarding seasonality. The section included 14 questions: Four questions multiple-choice, four binaries, four open-ended questions, and two questions 7-point Likert scale.

3.5.4.3. Section 3: The role and attractiveness of a ND food hub

To simplify the food hub concept for the participants as some of them are unfamiliar with the food hub term. The author provided his version of the food hub definition at the beginning of this section to introduce food hub functions to the participants (A food hub is a business that aggregates, markets, and distributes products from several local/regional farms. Food hubs offer services that may include cooling, storage, marketing and distribution, washing, grading, sorting, packing, or repacking, packaging and labeling, and branding).

The definition was followed by 12 questions, included 12 questions, five questions 7-point Likert scale, four questions fill-in-the-blank, two open-ended questions, and one binary question. The 7-point Likert scales questions were with different types such as importance, agreement. According to Sullivan and Artino Jr (2013), 7-point Likert scales are known to be the most accurate of the Likert scales. For example, in order to measured respondents' interest in joining the ND food hubs, the Likert scale offered seven answer options ranging from one extreme to another. An answer of "1" represented the lowest level of interest, the midpoint "4" represented a neutral option, and "7" represented the highest level of interest. Option "8" represented the "Not Applicable" (NA) answer. This section was designed to evaluate the importance of the ND food hub from the buyers' perspective. It had questions about buyers' level of familiarity and level of interest to join the food hub project. In addition to the types and quantity of local food, they are willing to buy from the ND food hub.

3.5.4.4. Section 4: Demographic and institutions information

This section of the questionnaire included four questions, two binary questions, one multiple-choice question, and one fill-in-the-blank question. It was designed to gather the type of the food buyer, gender, and address information of the food buyer. And to evaluate their opinion about a dedicated distribution system for local food in ND.

3.5.5. Distribution of the survey

The electronic version of the demand-side survey was online and available for distribution from 02/24/2020 to 05/30/2020. The survey was suspended from 03/15/2020 to 04/14/2020 due to the COVID-19 pandemic. Stratified random sampling technique was used to distribute this survey. The link for the survey was distributed by email:

- Schools and Childcare: Initially, the survey was sent to the list that included 320 schools and 136 child cars. An automated reminder message was set in the Qualtrics to send a reminder email every week to all non-respondent or unfinished responses.
- Universities and colleges: Initially, the survey was sent to the list that included a 22. An automated reminder message was set in the Qualtrics to send a reminder email every week to all non-respondent or unfinished responses.
- Hospitals: Initially, the survey was sent to the list that included 52 hospitals. An automated reminder message was set in the Qualtrics to send a reminder email every week to all non-respondent or unfinished responses.
- ND Grocers Association: Initially, the survey link was sent to Mr. John Dyste, and he distribute it among his list of 90 retail establishments in ND. A reminder email was sent every week.

3.5.6. Demand-side research hypotheses and variables

Table 4 presents the hypotheses and variables that were used for inferential statistics for the demand-side. We used SAS 9.3 Stepwise Multiple Regression (Backward Elimination analysis) to analyze the inferential statistics. SAS Multiple linear regression is a traditional statistical tool that regresses independent variables against a single dependent variable. The application of the Backward Elimination analysis allowed us to include all the independent variables (predictors) in the model. And at each step, we evaluated the independent variables which were in the model and eliminate the most insignificant independent variable. We repeated the evaluation and elimination step until we had the most significate independent variable against that single dependent variable.

We had six independent variables as follow: Q 16 Limitation on the number of vendors, Q 27 Flexibility regarding local food quantity, Q 28 Flexibility regarding local food seasonality, Q 31 Increase in demand and need for more local food products, Q 48 Type of Institution or Business, and Q 49 Type of gender. In addition, we had three dependent variables: Q 36 Level of familiarity with a food hub concept, Q 37 level of agreement with sustainability statement, and Q 38 Level of interest of ND institutions in buying food products from the ND food hub. The Backward Elimination analysis was used to test all the six independent variables against one of these dependent variables, and we repeated this process for all the three dependent variables.

Furthermore, the power analysis was used in the regression assessment as a significant finding for the sample size in case of an insignificant independent variable. Detecting the sample needed to have the less insignificant independent variable by the R^2.

Table 4. Demand-Side Research Hypotheses and Variables.

Hypothesis	Dependent variables	Independent variables
Hypothesis 1: Institutions with restrictions on the number of vendors are more likely to have a lower higher level of familiarity with a food hub concept. Hypothesis 2: Institutions that are fixable purchasing local produce regarding a change in the amount of food and seasonality are more likely have a higher level of familiarity with a food hub concept. Hypothesis 3: Institutions that observed the increase in the demand for local food are more likely to have a higher level of familiarity with a food hub concept. Hypothesis 4: Educational and healthcare institutions are more likely to have a higher level of familiarity with a food hub concept. Hypothesis 5: Females are more likely to have a higher level of familiarity with a food hub concept.	Q 1 Level of familiarity with a food hub concept.	Q 16 Limitation on the number of vendors. Q 27 Flexibility regarding local food quantity. Q 28 Flexibility regarding local food seasonality. Q 31 Increase in demand and need for more local food products. Q 48 Type of Institution or Business. Q 49 Type of gender.
Hypothesis 1: Institutions with restrictions on the number of vendors are more likely to have a lower higher level of agreement with sustainability statement. Hypothesis 2: Institutions that are fixable purchasing local produce regarding a change in the amount of food and seasonality are more likely have a higher level of agreement with sustainability statement. Hypothesis 3: Institutions that observed the increase in the demand for local food are more likely to have a higher level of agreement with sustainability statement. Hypothesis 4: Educational and healthcare institutions are more likely to have a higher level of agreement with sustainability statement. Hypothesis 5: Females are more likely to have a higher level of agreement with sustainability statement.	Q 2 level of agreement with sustainability statement.	Q 16 Limitation on the number of vendors. Q 27 Flexibility regarding local food quantity. Q 28 Flexibility regarding local food seasonality. Q 31 Increase in demand and need for more local food products. Q 48 Type of Institution or Business. Q 49 Type of gender.
Hypothesis 1: Institutions with restrictions on the number of vendors are more likely to have a lower higher level of interest to join the ND food hub. Hypothesis 2: Institutions that are fixable purchasing local produce regarding a change in the amount of food and seasonality are more likely have a higher level of interest to join the ND food hub. Hypothesis 3: Institutions that observed the increase in the demand for local food are more likely to have a higher level of interest in joining the ND food hub. Hypothesis 4: Educational and healthcare institutions are more likely to have a higher level of interest in joining the ND food hub. Hypothesis 5: Females are more likely to have a higher level of interest in joining the ND food hub.	Q 3 Level of interest of ND food producers in selling food products through the ND food hub.	Q 16 Limitation on the number of vendors. Q 27 Flexibility regarding local food quantity. Q 28 Flexibility regarding local food seasonality. Q 31 Increase in demand and need for more local food products. Q 48 Type of Institution or Business. Q 49 Type of gender.

4. RESULTS AND DATA ANALYSIS FOR ND FOOD HUB FEASIBILITY STUDY

PART A: THE SUPPLY-SIDE

This chapter includes three sections: the first section covers the challenges faced while distributing the survey and during data collection. The second section presents the descriptive statistics analysis for the supply-side results obtained from the Qualtrics results report. Finally, the third section presents the inferential statistics for testing the hypotheses.

This cross-sectional survey was created to accomplish Part-A: The supply-side of the ND food hub feasibility study. This survey was an online questionnaire due to the low cost and flexibility of this method. This survey was inspired by many studies that investigated the food hub concept, such as the National Food Hub Survey, which is a periodic survey every two years from 2013 to 2017. The National Food Hub Surveys are collaborative studies led by the Center for Regional Food Systems at Michigan State University (Fischer et al. 2013; Hardy et al. 2015; Colasanti et al. 2018). This survey was built to be exclusive to fit the ND study area and to incorporate changes in internet use such as internet marketing and social media. Each question presented an issue or a challenge that usually exists in any local food system tailored for ND particularly.

Initially, the supply-side questionnaire survey results were analyzed as descriptive statistics obtained from the Qualtrics results report. Each question investigated a specific issue to determine ND food producers' ability to supply local food for a ND food hub. After analyzing and illustrating the three sections of that survey, the five hypotheses were analyzed using SAS 9.3 programing. SAS programming revealed the relationships among variables (see Table 3) and allowed for testing each hypothesis individually. Therefore, the reliability of rates and statistics reported for both analyses are highly dependent on the number of responses in each category.

4.1. Challenges

Since the literature review did not provide any data for the local food system in ND, it was necessary to create a new survey. Furthermore, time constraints made it difficult to send the survey as a hard copy to farmers/ranchers. Also, hard copies were costly, so the electronic version was an overall solution. Unfortunately, the internet access was limited, and not every farm had access to the internet; this may be one of the reasons for the low response rate. See Figure 2 for more detail about farms that had internet access in 2018. According to the USDA, the broadband infrastructure and services in rural areas are improving after the $600 million-dollar Congressional loan to the USDA in 2018.

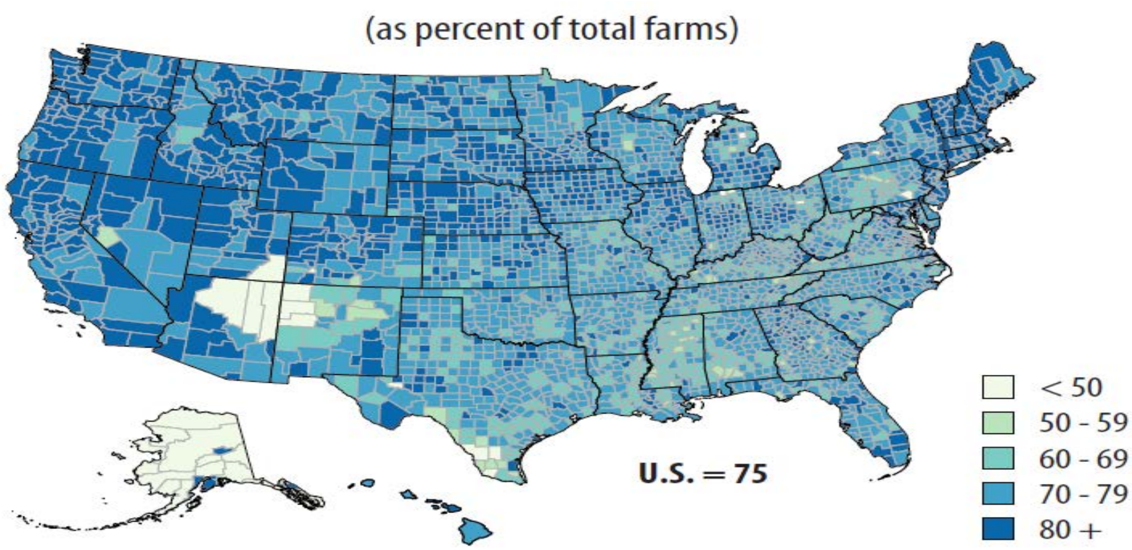

Figure 2. Farms with Internet Access, by County, 2017 (Adapted from National Agricultural Statistics 2017, USDA.
This figure was adopted from
(https://www.nass.usda.gov/Publications/Highlights/2019/2017Census_Farm_Economics.pdf).

4.2. Descriptive Statistics Analysis

4.2.1. Farmer/rancher and food producer demographics

The last section of the questionnaire included seven questions about the demographics of the ND farmers, ranchers, and food producers. It was designed to gather the demographic information from the targeted sample, such as level of education, employment status, and years of experience in the farming field. Table 5 summarizes the results percentage and responses count, and Table 6 shows the descriptive statistics for each question. Seventy-three percent of the participants were Farmers Union members, which indicates the importance of this union in agriculture. As was documented by the 2017 Census of Agriculture of ND, the male gender leads females in ND agriculture with 58% to 42%, respectively. In addition, the result of the questionnaire supports the finding in the ND 2017 Census of Agriculture regarding age. They reported that most of the food producers in ND were aged from 35-70. In our survey, 89% of respondents fell into this range.

The ND 2017 Census of Agriculture did not report education; however, the result of this questionnaire found that 88% percent of the participants had above high school education (again, see Table 6). Fifty percent of the respondents worked full-time as a food producer; also, 8% of food producers reported that they were planning to become full-time. There were 27% of respondents who worked as part-time with off-farm income, and 15% of respondents were retired, or enjoying farming as a lifestyle or as a hobby. Furthermore, 34% of ND food producers have less than ten years' experience, which corresponds closely with the group specified in the literature as beginning farms who indicated the most interest in and need for a food hub project.

Table 5. Demographic Characteristics Respondents Percentage and Count.

Demographic characteristics of the sample (sample size n = 36)	Response %	Count
Farmers Union membership		
Yes	73%	19
No	27%	7
Total	100%	26
Gender		
Male	58%	15
Female	42%	11
Non-binary persons	0%	0
Total	100%	26
Highest education degree		
No High school, diploma or equivalent (e.g., GED)	0%	0
High school graduate, diploma or equivalent (e.g., GED)	12%	3
Some college credit, no degree	15%	4
Bachelors or Associates, degree	42%	11
Graduate degree (e.g., MS., Ph.D.)	31%	8
Total	100%	26
Age group		
20 to 30	7%	2
31 to 40	27%	7
41 to 50	12%	3
51 to 60	23%	6
61 to 70	27%	7
Over 71	4%	1
Total	100%	26
Employment time		
Farm full time	50%	13
Part-time with a desire to become a full-time farm operator	8%	2
Farm part-time with off-farm income	23%	6
Retired, enjoy farming as a lifestyle, or as a hobby	15%	4
Other, please specify	4%	1
Years of Experience		
1-5 years	15%	4
6 -10 years	19%	5
11-20 years	19%	5
21-30 years	15%	4
30 + years	31%	8
Total	100%	26

Table 6. Demographic Characteristics Descriptive Statistics.

Demographic Characteristics Variables	Mean	Std. Deviation	Variance	Count
Farmers union membership	1.27	0.44	0.2	26
Gender	1.42	0.49	0.24	26
Education Degree	3.92	0.96	0.92	26
Age	3.46	1.42	2.02	26
Employment	2.15	1.29	1.67	26
Years of Experience	3.27	1.46	2.12	26

According to Roininen, Arvola, and Lähteenmäki (2006), local food systems have a positive impact on rural development and local economies since they can provide jobs and stimulate local labor markets. Table 7 shows the average number of workers and the type of employment who are hired by food producers. Food producers may hire more workers to help them grow and add value to more of their products if they can increase the number of opportunities to sell more products. Therefore, a ND food hub may have a positive impact on the number of workers and provide for jobs and training opportunities that will in turn, enhance the agriculture industry in ND.

Table 7. Average Number of Worker.

Employment Type	Average Number of Worker
Full-time	4
Part-time	5
Seasonal	3
Volunteers	1

Evidently, the demographic results of this questionnaire were compatible with the ND 2017 Census of Agriculture. Most of the ND food producers' respondents were highly educated and working full time to produce and market food. In addition, their businesses generate employment and help the retention of the local dollar in the local community.

4.2.2. The role and attractiveness of a ND food hub

The first section of the questionnaire included 18 questions focused on the role and attractiveness of a ND food hub; 12 questions were 7-point Likert scales, four were multiple-choice, one was fill in the blank, and one was open-ended. Furthermore, the 7-point Likert scale questions were collapsed into a 3-point scale for the purpose of describing and summarizing the descriptive statistics analysis. The 3-point scale represented the perceptions of the respondent with respect to the familiarity, sustainability, and interest to join the ND food hub and were classified as low, neutral, and high. An answer of “1-3” on the 7-point Likert scale represented the lowest level of familiarity, the midpoint “4” on the Likert scale represented a neutral option, and “5-7” on the Likert scale represented the highest level of familiarity. Option “8” represented the “Not Applicable” (NA) answer.

Tables 8 and 9 show the respondents’ level of familiarity with the idea of the food hub, their opinions about food hubs and local food sustainability, and the respondent's level of interest to join the ND food hub project. We cannot indicate if ND food producers were familiar with the food hub or not because the low and high points percentage were too close to each other. Also, the variance was high, which indicated there was a huge variation among respondents’ answers. However, 68% of the respondents agreed that a ND food hub can provide sustainability for ND local food. In addition, 76% of the respondents have a high level of interest in joining a ND food hub.

Therefore, regardless of the respondents’ level of familiarity with the food hub idea, the high percentage of their agreement about sustainability indicated their trust in such a project. Also, their level of interest in joining a ND food hub that can support business is an important sign for the need for a food hub. Obviously, these two percentages point to ND food producers' desire for a project such as a food hub that can both sustain the local food industry in ND and provide business sustainability to food producers.

Table 8. The Role and Attractiveness of a ND Food Hub Respondents Percentage and Count.

The Role and Attractiveness of a ND Food Hub	1-3 %	Count	Neutral	Count	5-7 %	Count
Level of familiarity with food hub	44%	14	13%	4	42%	13
Local food sustainability and food hub	13%	4	19%	6	68%	21
Level of interest to join a ND food hub	13%	4	11%	3	76%	21

Table 9. The Role and Attractiveness of a ND Food Hub Descriptive Statistics.

Descriptive Statistics of a ND Food Hub Role and Attractiveness	Mean	Std. Deviation	Variance	Count
Level of Familiarity with Food Hub Concept	3.81	2.05	4.22	31
Local food sustainability and food hub	5.13	1.62	2.63	31
Level of interest to join a food hub	5.36	1.52	2.3	28

In some cases, food producers have the capital and the ability to establish a food hub or offer a paid service for their local food hub either individually or collaboratively. Tables 10 and 11 below list some of the for-pay services that ND food producers may offer to a food hub. These options represented their business assets and if they were interested in using their privately owned infrastructure to assist the ND food hub operation for profit. Unfortunately, the respondent's level of interest and percentage for all categories (see Table 10 for the list of categories) were low. The notable exceptions to this lack of interest were service transportation and aggregation. Using the 3-point Likert scale, we found that nine respondents (32%) had the infrastructure to transport livestock to a USDA slaughter facility and 13 respondents (44%) had the capability to provide a drop-off and storage facility for nearby growers.

Table 10. Paid Services (Food Producers' Capital) Respondents Percentage and Count.

Paid Services (Food Producers' Capital)	Not Interested 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Interested 7	Count	Total Count
Cooling produce (to remove field heat) from nearby farms	33%	9	11%	3	11%	3	15%	4	11%	3	11%	3	7%	2	27
Transporting livestock to a USDA slaughter facility	39%	11	7%	2	7.%	2	14%	4	7%	2	11%	3	14%	4	28
Serving as a drop off/storage site for product collected from nearby growers	30%	8	4%	1	0%	0	22%	6	19%	5	22%	6	4%	1	27
Delivering product for other nearby farmers to the food hub	18%	5	7%	2	18%	5	18%	5	21%	6	11%	3	7%	2	28
Providing temperature-controlled cold storage on your property	26%	7	4%	1	4%	1	22%	6	26%	7	15%	4	4%	1	27
Sharing equipment with nearby farms	19%	5	7%	2	4%	1	33%	9	30%	8	4%	1	4%	1	27
Coordinating labor with nearby farms	19%	5	15%	4	7%	2	15%	4	30%	8	7%	2	7%	2	27
Providing processing services	23%	6	19%	5	4%	1	19%	5	23%	6	12%	3	0%	0	26
Serving as a drop off/storage site for supplies collectively purchased with surrounding growers	19%	5	11%	3	7%	2	22%	6	14%	4	19%	5	7%	2	27

Table 11. Paid Services (Food Producers' Capital) Descriptive Statistics.

Paid services (Food producers' capital)	Mean	Std. Deviation	Variance	Count
Cooling produce (to remove field heat) from nearby farms	3.22	2.04	4.17	27
Transporting livestock to a USDA slaughter facility	3.32	2.28	5.22	28
Serving as a drop off/storage site for product collected from nearby growers	3.78	2.04	4.17	27
Delivering product for other nearby farmers to the food hub	3.79	1.82	3.31	28
Providing temperature-controlled cold storage on your property	3.78	1.91	3.65	27
Sharing equipment with nearby farms	3.74	1.65	2.71	27
Coordinating labor with nearby farms	3.74	1.88	3.53	27
Providing processing services	3.35	1.77	3.15	26
Serving as a drop off/storage site for supplies collectively purchased with surrounding growers	3.89	1.93	3.73	27

Conversely, when food producers were asked about their willingness for ownership categories regarding conducting business with a food hub, the percentages were high for each category. For example, by using the 3-point Likert scale, we found there were 23 respondents (80%) who were interested in becoming members of a grower-owned cooperative and 15 respondents (56%) who were interested in becoming investors in a food hub (see Tables 12 and 13). These results show the importance of a food hub project to ND food producers. And show the high potential that ND food producers have and how they understand the risk associated with the local food market.

Table 12. Ownership Category Respondents Percentage.

Ownership Category	Not Interested 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Interested 7	Count	Total Count
Conduct business on a consignment or commission basis	18%	5	7%	2	7%	2	21%	6	25%	7	4%	1	18%	5	28
Conduct business on a direct purchase basis	7%	2	4%	1	4%	1	21%	6	18%	5	29%	8	18%	5	28
Set prices on a contract basis	15%	4	11%	3	11%	3	19%	5	15%	4	15%	4	15%	4	27
Price set based on a spot market	20%	5	12%	3	20%	5	20%	5	16%	4	12%	3	0%	0	25
Divide my product pricing some on contract and some on a spot market	22%	6	0%	0	11%	3	26%	7	30%	8	7%	2	4%	1	27
Become owner /or operator of the food hub	149%	4	15%	4	15%	4	21%	6	14%	4	14%	4	7%	2	28
Become an investor in the food hub	11%	3	0%	0	11%	3	22%	6	19%	5	26%	7	11%	3	27
Become a member of a grower-owned cooperative	4%	1	4%	1	10%	3	4%	1	31%	9	10%	3	38%	11	29
Be on the management team of the food hub	14%	4	7%	2	0%	0	29%	8	29%	8	7%	2	14%	4	28
Be part of the workforce for the food hub	30%	8	11%	3	11%	3	19%	5	11%	3	15%	4	4%	1	27
Provide services on a contractual basis for the food hub	25%	7	7%	2	4%	1	18%	5	36%	10	4%	1	7%	2	28

Table 13. Ownership Category Descriptive Statistics.

Ownership Category Interest level	Mean	Std. Deviation	Variance	Count
Conduct business on a consignment or commission basis	4.11	1.99	3.95	28
Conduct business on a direct purchase basis	4.96	1.68	2.82	28
Set prices on a contract basis	4.11	1.99	3.95	27
Price set based on a spot market	3.36	1.65	2.71	25
Divide my product pricing some on contract and some on a spot market	3.78	1.73	2.99	27
Become owner /or operator of the food hub	3.79	1.82	3.31	28
Become an investor in the food hub	4.59	1.73	2.98	27
Become a member of a grower-owned cooperative	5.38	1.67	2.79	29
Be on the management team of the food hub	4.29	1.83	3.35	28
Be part of the workforce for the food hub	3.3	1.94	3.76	27
Provide services on a contractual basis for the food hub	3.71	1.91	3.63	28

Tables 14 and 15 list some food hub services that can be provided to food producers. By using the 3-point Likert scale, we found there were 22 respondents (76%) that agreed that value-added product development is an important food hub service that a ND food hub should provide. Similarly, there 20 respondents (69%) believed that active linking to markets is an important service. The same number of respondents and percentage were agreed on the importance of maintaining producer-consumer connections.

Table 14. Food Hub Services Provided to Food Producer Respondents Percentage and Count.

Food Hub Services Provided to Food Producer	Not Important 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Important 7	Count	Total Count
Actively linking producers to markets	4%	1	7%	2	4%	1	17%	5	10%	3	17%	5	41%	12	29
Production and post-harvest handling training	11%	3	4%	1	7%	2	21%	6	14%	4	21%	6	21%	6	28
Business management services and guidance	11%	3	4%	1	11%	3	18%	5	25%	7	14%	4	18%	5	28
Branding and market development	7%	2	7%	2	4%	1	24%	7	17%	5	21%	6	21%	6	29
Maintaining producer-consumer connections	7%	2	4%	1	0%	0	21%	6	17%	5	27%	8	24%	7	29
Information sharing among regional food network	7%	2	4%	1	11%	3	18%	5	32%	9	11%	3	18%	5	28
Value-added product development	7%	2	0%	0	7%	2	10%	3	14%	4	38%	11	24%	7	29
Food safety training	4%	1	4%	1	11%	3	21%	6	11%	3	18%	5	32%	9	28

Table 15. Food Hub Services Provided to Food Producer Descriptive Statistics.

Food Hub Services Provided to Food Producer	Mean	Std. Deviation	Variance	Count
Actively linking producers to markets	5.41	1.77	3.14	29
Production and post-harvest handling training	4.75	1.88	3.54	28
Business management services and guidance	4.57	1.82	3.32	28
Branding and market development	4.83	1.76	3.11	29
Maintaining producer-consumer connections	5.17	1.68	2.83	29
Information sharing among regional food network	4.68	1.67	2.79	28
Value-added product development	5.34	1.65	2.71	29
Food safety training	5.14	1.73	2.98	28

Operational Services are considered as the primary and core service that a food hub can provide for most U.S. food hubs (Tables 16 and 17). In general, logistics of the delivery, product distribution is just an example of food producers' operational difficulties. We found by using the 3-point Likert scale there 21 respondents (78%) were agreed on the importance of delivery logistics., and 20 respondents (72%) were agreed that distribution is an important operational service that a ND food hub should provide. In addition, 18 respondents (67%) agreed about the importance of strategically linking them with an existing distributer or a food hub. With regard to marketing service, we found 19 respondents (71%) were agreed about the importance of using the digital marketing as one of the ND food hub operational services to market their products.

Table 16. Food Hub Operational Services Respondents Percentage and Count.

Food Hub Operational Services	Not Important 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Important 7	Count	Total Count
Aggregation	15%	4	8%	2	8%	2	15%	4	12%	3	23%	6	19%	5	26
Product storage	12%	3	4%	1	4%	1	15%	4	27%	7	31%	8	8%	2	26
Production planning	12%	3	8%	2	4%	1	23%	6	19%	5	31%	8	4%	1	26
Post-harvest handling and packing	12%	3	8%	2	4%	1	16%	4	20%	5	36%	9	4%	1	25
Season extension	8%	2	16%	4	4%	1	16%	4	36%	9	12%	3	8%	2	25
On-farm pick up	11%	3	7%	2	4%	1	11%	3	30%	8	22%	6	15%	4	27
Distribution	11%	3	4%	1	4%	1	11%	3	18%	5	36%	10	18%	5	28
Delivery logistics	11%	3	0%	0	4%	1	7%	2	26%	7	33%	9	19%	5	27
Offers pick up service	11%	3	4%	1	4%	1	11%	3	19%	5	33%	9	19%	5	27
Brokering	19%	5	7%	2	0%	0	22%	6	26%	7	19%	5	7%	2	27
Strategically linked to an existing distribution hub or service	15%	4	7%	2	0%	0	11%	3	26%	7	33%	9	7%	2	27
Handles sales and marketing so I can focus on production	11%	3	0%	0	0%	0	4%	1	19%	5	44%	12	22%	6	27
A web-based trading site	7%	2	0%	0	11%	3	7%	2	26%	7	37%	10	11%	3	27
Uses digital marketing (social media platforms)	7%	2	0%	0	7%	2	15%	4	33%	9	26%	7	11%	3	27
Packaging and repacking	19%	5	0%	0	7%	2	22%	6	26%	7	26%	7	0%	0	27
Light processing (trimming, cutting, freezing)	19%	5	0%	0	19%	5	26%	7	15%	4	19%	5	4%	1	27
Access to certified kitchen	12%	3	8%	2	4%	1	23%	6	4%	1	42%	11	8%	2	26
Food safety (e.g., to "Good Agricultural Practices (GAP) and Good Handling Practices Audits."	12%	3	4%	1	8%	2	8%	2	12%	3	23%	6	35%	9	26
Liability insurance	11%	3	4%	1	0%	0	22%	6	22%	6	19%	5	22%	6	27

Table 17. Food Hub Operational Services Descriptive Statistics.

Food Hub Operational Services	Mean	Std. Deviation	Variance	Count
Aggregation	4.46	2.08	4.33	26
Product storage	4.65	1.73	3	26
Production planning	4.38	1.73	3.01	26
Post-harvest handling and packing	4.48	1.79	3.21	25
Season extension	4.24	1.7	2.9	25
On-farm pick up	4.67	1.85	3.41	27
Distribution	5	1.83	3.36	28
Delivery logistics	5.11	1.75	3.06	27
Offers pick up service	4.96	1.86	3.44	27
Brokering	4.15	1.9	3.61	27
Strategically linked to an existing distribution hub or service	4.56	1.89	3.58	27
Handles sales and marketing so I can focus on production	5.41	1.73	2.98	27
A web-based trading site	5	1.59	2.52	27
Uses digital marketing (social media platforms)	4.89	1.52	2.32	27
Packaging and repacking	4.15	1.74	3.02	27
Light processing (trimming, cutting, freezing)	3.89	1.75	3.06	27
Access to certified kitchen	4.58	1.86	3.47	26
Food safety (e.g., GAP and GHP	5.12	2.04	4.18	26
Liability insurance	4.85	1.84	3.39	27

Community services are one of the aspects that differentiate a food hub from a regular grocery store (see Tables 18 and 19 list seven of most common of these services). All the seven community services that were listed were important to ND food producers. Furthermore, the two services that received a higher level of importance were "Buy Local" campaigns and Distributing food to food deserts. By using the 3-point Likert scale, we found there were 26 respondents (87%) who agreed on the buy local campaigns importance, and 23 respondents (77%) for the Distributing food to food deserts areas in ND.

Table 18. Food Hub Community Services Respondents Percentage and Count.

Food Hub Community Services	Not Important 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Important 7	Count	Total Count
"Buy Local" campaigns	0%	0	3%	1	3%	1	7%	2	13%	4	30%	9	43%	13	30
Distributing to food deserts	3%	1	3%	1	7%	2	10%	3	13%	4	27%	8	37%	11	30
Foodbank donations	0%	0	7%	2	13%	4	23%	7	13%	4	33%	10	10%	3	30
Healthy food demonstrations, cooking demonstrations	3%	1	0%	0	20%	6	10%	3	17%	5	23%	7	27%	8	30
Food stamp redemption	0%	0	3%	1	10%	3	20%	6	23%	7	13%	4	30%	9	30
Educational programs	3%	1	3%	1	3%	1	7%	2	23%	7	30%	9	30%	9	30
Youth and community employment opportunities	3%	1	0%	0	3%	1	17%	5	20%	6	27%	8	30%	9	30

Table 19. Food Hub Community Services Descriptive Statistics.

Food Hub Community Services	Mean	Std. Deviation	Variance	Count
Buy Local campaigns	5.93	1.29	1.66	30
Distributing to food deserts	5.53	1.63	2.65	30
Food bank donations	4.83	1.44	2.07	30
Healthy food demonstrations, cooking demonstrations	5.13	1.65	2.72	30
Food stamp redemption	5.23	1.48	2.18	30
Educational programs	5.53	1.5	2.25	30
Youth and community employment opportunities	5.5	1.43	2.05	30

The education services were appraised as another feature that differentiates a food hub from a regular grocery store. Educating food producers in marketing and other business management that can make food producers more efficient. Also, educating the community in methods of food preservation, healthy cooking, and proper food nutrition are examples of public education that have a significant impact on community health. Tables 20 and 21 list three educational services. By using the 3-point Likert scale, we found there were 19 respondents (68%) interested in receiving education on key business skills and activities in preservation, cooking, and nutrition. Also, there were 18 respondents (64%) who needed education on how to scale up their business.

Table 20. Food Hub Education Services Respondents Percentage and Count.

Food Hub education Services	Not Interested 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Interested 7	Count	Total Count
Marketing and financial management education	11%	3	0%	0	7%	2	14%	4	39%	11	11%	3	18%	5	28
Scale up business	11%	3	0%	0	7%	2	18%	5	25%	7	18%	5	21%	6	28
Cooking, and nutrition	11%	3	4%	1	4%	1	14%	4	39%	11	14%	4	14%	4	28

Table 21. Food Hub Education Services Descriptive Statistics.

Food Hub education Services	Mean	Std. Deviation	Variance	Count
Receive education on key business skills including marketing and financial management	4.75	1.7	2.9	28
Receive education on how to scale up my business	4.86	1.79	3.19	28
Educational activities in preserving, cooking, and nutrition	4.68	1.71	2.93	28

There are different reasons that prevent food producers from joining a food hub. Tables 22 and 23 list some of the concerns that may reduce the ND food producers' interest to join a food hub. The most important concern was fair or competitive pricing. By using the 3-point Likert scale, we found there were 26 out of 28 respondents (90%) who were worried about fair or competitive pricing for products sold to the ND food hub. Respondents worried about competitive prices; this trepidation can be minimized by the type of contract between a ND food hub and food producers, which was covered previously in the ownership category.

Table 22. Concerns Related to Selling to a Food Hub Respondents Percentage and Count.

Concerns related to selling to a food hub	Not Significant 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Significant 7	Count	Total Count
Fair or competitive pricing	0%	0	4%	1	4%	1	4%	1	17%	5	31%	9	41%	12	29
Losing independence by relying on a food hub for my sales	7%	2	7%	2	24%	7	21%	6	10%	3	21%	6	10%	3	29
Losing control over the end-to-end supply chain of my product	7%	2	21%	6	21%	6	21%	6	10%	3	17%	5	4%	1	29
Food hubs may compete with my farm in selling to my existing sales outlets	14%	4	21%	6	17%	5	10%	3	17%	5	17%	5	4%	1	29
Not having enough production for the food hub	4%	1	4%	1	14%	4	24%	7	14%	4	31%	9	10%	3	29
Increasing production without a guaranteed sales contract	7%	2	0%	0	14%	4	21%	6	18%	5	29%	8	11%	3	28
Financial risk	7%	2	4%	1	17%	5	21%	6	21%	6	10%	3	21%	6	29

Table 23. Concerns Related to Selling to a Food Hub Descriptive Statistics.

Concerns related to selling to a food hub	Mean	Std. Deviation	Variance	Count
Fair or competitive pricing	5.93	1.26	1.58	29
Losing independence by relying on a food hub for my sales	4.24	1.72	2.94	29
Losing control over the end-to-end supply chain of my product	3.72	1.64	2.68	29
Food hubs may compete with my farm in selling to my existing sales outlets	3.62	1.81	3.27	29
Not having enough production for the food hub	4.76	1.52	2.32	29
Increasing production without a guaranteed sales contract	4.71	1.6	2.56	28
Financial risk	4.59	1.75	3.07	29

In addition to ND food producers' concerns about fair or competitive pricing for products sold to the ND food hub, there are other barriers that can prevent food producers from selling food products to a food hub. Tables 24 and 25 cover ten barriers that usually prevent food producers from selling to a food hub. Using the 3-point Likert scale, we found 19 respondents (68%) concerned about the risk associated with not selling what they grow. Also, 18 respondents (64%) had concerns about fair pricing. In fact, all these concerns usually face food producers when they try to sell their products by themselves. The idea of a food hub is to help food producers to overcome these issues and provided a new and stable market for them.

Table 24. Barriers to Sell to a Food Hub Respondents Percentage and Count.

Barriers to sell to a food hub	Not Significant 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Significant 7	Count	Total Count
Risk barriers	11%	3	7%	2	4%	1	39%	11	0%	0	14%	4	25%	7	28
Knowledge of which crops/ livestock to grow	21%	6	7%	2	7%	2	11%	3	18%	5	18%	5	18%	5	28
Knowledge of how to grow crops/animals	18%	5	7%	2	4%	1	11%	3	25%	7	21%	6	14%	4	28
Knowledge of how to scale-up production	11%	3	7%	2	0%	0	22%	6	19%	5	30%	8	11%	3	27
Risk of not selling what I grow	11%	3	4%	1	0%	0	18%	5	21%	6	25%	7	21%	6	28
Knowledge of post-harvest handling (cooling, washing, grading, and packing)	19%	5	11%	3	7%	2	19%	5	22%	6	19%	5	4%	1	27
Difficulties finding/negotiating with buyers	11%	3	7%	2	4%	1	18%	5	21%	6	21%	6	18%	5	28
Lack of commitment from buyers	11%	3	11%	3	0%	0	18%	5	11%	3	29%	8	21%	6	28
Concerns about fair pricing	11%	3	7%	2	0%	0	18%	5	21%	6	21%	6	21%	6	28
Knowledge of required licenses and permits	11%	3	4%	1	7%	2	21%	6	21%	6	14%	4	21%	6	28

Table 25. Barriers to Sell to a Food Hub Descriptive Statistics.

Barriers to sell to a food hub	Mean	Std. Deviation	Variance	Count
Risk barriers	4.54	1.95	3.82	28
Knowledge of which crops/ livestock to grow	4.21	2.18	4.74	28
Knowledge of how to grow crops/animals	4.39	2.04	4.17	28
Knowledge of how to scale-up production	4.63	1.81	3.27	27
Risk of not selling what I grow	4.96	1.82	3.32	28
Knowledge of post-harvest handling (cooling, washing, grading, and packing)	3.85	1.86	3.46	27
Difficulties finding/negotiating with buyers	4.68	1.87	3.5	28
Lack of commitment from buyers	4.79	1.99	3.95	28
Concerns about fair pricing	4.82	1.89	3.58	28
Knowledge of required licenses and permits	4.68	1.85	3.43	28

Since the data revealing the extent of local food production in ND are not available, it was necessary that the survey had to cover many aspects. Types of produce in ND are a significant part of the ND local food supply study. The survey asked the farmer/rancher to list 5 of the food products that currently produce and 5 of future products that can be offered to sell to a ND food hub by respondents. A list of current and future food products that can be provided by ND food producers is mentioned below; these food products are just an example of what is offered since the survey was limited to list five products for each category.

Current product: Asparagus, barley, beef, bees, beetroot, canola, carrots, cherry, corn, cucumbers, cut flowers, eggs, flax, garlic, green beans, herbs, kale, lamb, lean beef, lettuce, melons, natural beef, navy beans, Non-GMO feeds (hull-less oats), okra, onions, orange, pasta, peas, peppers, potatoes, pumpkins, salad mix, soybeans, spring wheat, squash, string beans, sweet corn, tomatoes, wheat(flour), zucchini.

New product: apple, asparagus, beef, carrots, colored peppers, corn, dry cereal grains, eggs, flowers, food grade oats, garlic, green beans, herbs, kidney beans, lettuce, medicinal herbs, nurse trees, planting apple trees, pumpkins, soybeans, squash, sweet potatoes.

The effect of location on a food hub's success cannot be understated. The site of a food hub position is not only to attract a customer base but also to attract the right food producers to make that food hub successful. Correspondingly, a food hub location can help to create a brand image since there are parts of a city that carry a living status. Furthermore, the infrastructure and the operation services for a food hub located in a rural area are different from that found in an urban area. For example, a food hub located in a rural area might be better to focus on the food desert since there are a limited number of supermarkets.

In contrast, a food hub located in an urban area should make more effort toward buying local campaigns. The survey asked farmers/ranchers how far they would travel to deliver their products. Fifty-six percent of the respondents would drive between 50-100 miles one-way for their delivery (see Tables 26 and 27). Measuring the distances and matching with farm location by the zip code will assess future research to find the best site for a ND food hub and if more than one branch is needed.

Table 26. Distance to Deliver Product to the ND Food Respondents Percentage and Count.

Travel one way to deliver a product to a food hub	Percentage	Count
Less than 50 miles	37%	10
Between 50-100 miles	56%	15
More than 100 miles	7%	2

Table 27. Distance to Deliver Product to the ND Food Hub Descriptive Statistics.

Travel one way to deliver a product to a food hub	Mean	Std. Deviation	Variance	Count
	1.7	0.6	0.36	27

The location of a food hub is not the only feature determining the success of a food hub. There are four fundamental elements that impact any business operation's success and financial stability. These four fundamental factors are location, business structure, type of tax designation, and type of legal structure. A business structure is not less important than a location. How a food hub is structured to operate and serve its customers is a vital success factor for a food hub. This factor was covered (see Tables 28 and 29). Forty-seven percent of respondents considered a hybrid model as the appropriate model to run a ND food hub which matches the results of the national food hub surveys (Fischer et al. 2013; Hardy et al. 2015; Colasanti et al. 2018).

Table 28. Food Hub Business Structure Respondents Percentage and Count.

Food Hub Business Structure	Percentage	Count
Farm-to-Customer model	30%	9
Farm-to-Business/Institution/ Wholesale model	23%	7
Hybrid model	47%	14

Table 29. Food Hub Business Structure Descriptive Statistics.

Food Hub Business Structure	Mean	Std. Deviation	Variance	Count
	2.17	0.86	0.74	30

The third factor that contributes to the success of a business is the tax designation (see Tables 30 and 31). The tax designation will not only determine the financial stability of a business but also how the business interacts with government policies and the community that it serves. Forty-two percent of the respondents considered the profit tax designation model for the ND food hub at the state and national levels. While 27% of the respondents chose the non-profit tax designation model for the ND food hub at the state and national level. These results indicate that food producers at ND not only considered for-profit as a model for the type of tax designation but also, they favored to make a ND food hub operate at the national level.

Table 30. Type of Tax Designation Respondents Percentage and Count.

Type of Tax Designation	Percentage	Count
For-profit at the state level	12%	3
For-profit at both the state and national levels	42%	11
Non-profit at the state level	19%	5
Non-profit at both the state and national levels	27%	7

Table 31. Type of Tax Designation Descriptive Statistics.

Type of Tax Designation	Mean	Std. Deviation	Variance	Count
	2.62	1	1.01	26

The fourth factor that contributes to success for a business is the legal structure. Nearly 67% of the respondents considered a cooperative legal structure for a ND food hub. This legal structure model is the most common type for U.S. food hubs. Table 32 presents the percentage of respondents for each type of legal structure, and Table 33 shows the descriptive statistics of the type of legal structure model.

Table 32. Type of Legal Structure Respondents Percentage and Count.

Type of Legal Structure	Percentage	Count
B-Corporation	0%	0
C-Corporation	0%	0
S-Corporation	0%	0
Limited Liability Company (LCC)	15%	4
Cooperative	67%	18
Multi-stakeholder	4%	1
Subsidiary Food Hub	7%	2
Sole proprietorship	4%	1
Partnership	0%	0

Table 33. Type of Legal Structure Descriptive Statistics.

Type of Legal Structure	Mean	Std. Deviation	Variance	Count
	5.33	1.28	1.63	27

In addition to the factors that are considered important to business success, also information and data are essential components for business operations. They improve managers' understanding of the market and decrease uncertainty. Using the 3-point Likert scale, we found 24 respondents (83%) who believed that annual meetings and conferences are the most useful information source to improve their business. The second highest percentage was for informal networking with other food hubs 22 respondents (79%) chose this information resources. The third-highest percentage for information resources was for University and educational resources 22 respondents (72%), while non-profit's educational resources recorded 61% from 17 respondents. In addition, 17 respondents (61%) believed that the USDA or other federal department’s educational resources are useful resources to improve their business. Table 34 lists all the information resources covered by the survey and presents the percentage and count of respondents for each information resource type. Table 35 shows the descriptive statistics.

Table 34. Information Resources Respondents Percentage and Count.

Information resources	Not Useful 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Useful 7	Count	Total Count
A formal community of practice like a food hub network	4%	1	7%	2	7%	2	25%	7	32%	9	11%	3	14%	4	28
The USDA or other federal department's educational resources	7%	2	4%	1	11%	3	18%	5	25%	7	21%	6	14%	4	28
Informal networking with other food hubs	4%	1	0%	0	4%	1	14%	4	32%	9	32%	9	14%	4	28
Food policy councils	7%	2	0%	0	11%	3	29%	8	21%	6	21%	6	11%	3	28
State government educational resources	7%	2	0%	0	21%	6	10%	3	27%	8	17%	5	17%	5	29
Local government educational resources	7%	2	4%	1	14%	4	18%	5	21%	6	21%	6	14%	4	28
A university's educational resources	10%	3	0%	0	4%	1	14%	4	38%	11	14%	4	21%	6	29
A non-profit's educational resources	7%	2	4%	1	14%	4	14%	4	29%	8	18%	5	14%	4	28
Annual meetings or conferences	4%	1	0%	0	4%	1	10%	3	34%	10	24%	7	24%	7	29

Table 35. Information Resources Descriptive Statistics.

Information resources	Mean	Std. Deviation	Variance	Count
A formal community of practice like a food hub network	4.64	1.52	2.3	28
The USDA or other federal department's educational resources	4.71	1.67	2.78	28
Informal networking with other food hubs	5.25	1.3	1.69	28
Food policy councils	4.64	1.54	2.37	28
State government educational resources	4.72	1.68	2.82	29
Local government educational resources	4.64	1.69	2.87	28
A university's educational resources	4.93	1.7	2.89	29
A non-profit's educational resources	4.64	1.67	2.8	28
Annual meetings or conferences	5.41	1.35	1.83	29
Other, please specify	4.64	1.52	2.3	28

4.2.3. Farm characteristics

In addition to demographic characteristics and the role and attractiveness of a ND food hub, sections of the supply-side questionnaire had a third section that covered farm characteristics. This was the second section in the supply-side questionnaire, it included 26 questions focused on ND farm characteristics and operation; 16 questions were multiple-choice, five were binary, three were fill in the blank, and two were 7-point Likert scales. Furthermore, the 7-point Likert scale questions were collapsed into a 3-point scale for the purpose of describing and summarizing the descriptive statistics analysis. The 3-point scale represented the respondents' perceptions with respect to the resource barriers and usage of digital marketing for local food and was classified as low, neutral, and high. An answer of “1-3” on the 7-point Likert scale represented the lowest level of agreement, the midpoint “4” on the Likert scale represented a neutral option, and “5-7” on the Likert scale represented the highest level of agreement.

To build a robust local food system in ND and assist local food producers logistically, we must create a holistic view of the existing local food system supply chain. The survey covered the types of farms to evaluate the existing local food supply. Table 36 summarizes the percentage of respondents for types of farms. Thirty-four percent of the respondents produced grain, while 28% of them grew livestock. Thirty-one percent of the respondents produced special food products. In summary, from these results, it was clear the variety of ND farms. Also, the percentages were close to each other.

Table 36. Type of Farm Respondents Percentage and Count.

Type of Farm	Percentage	Count
Grain Farm	34%	12
Livestock Farm	29%	10
Specialty Products Farm	31%	11

Typically, small and mid-size farms are the most in need of food hub support. According to the NDSU Agriculture Communication website, the average farm size in ND was 1,937 crop acres or 490 pasture acres in 2017. This analysis involved 457 farms throughout ND and was reported by NDSU Agriculture Communication. We found in this study that 64% of respondents operated farms that are less than the average size (see Tables 37 and 38).

Table 37. Farm or Pasture Size Respondents Percentage and Count.

ND Farm or Pasture Size	Percentage	Count
Less than 1,937 crop acres or 490 pasture acres	64%	16
More than 1,937 crop acres or 490 pasture acres	36%	9

Table 38. Farm or Pasture Size Descriptive Statistics.

ND Farm or Pasture Size	Mean	Std. Deviation	Variance	Count
	1.36	0.48	0.23	25

Also, farms can be classified by gross cash farm income (GCFI) (Tables 39 and 40) list the results for this classification. Only 4% of the respondents operated farms that were considered large farms. Small, moderate, and mid-size farms made up more than 96% of the operated farms by respondents. The survey results demonstrate that a ND food hub might be an essential project to improve the local food system in ND since most of the food producers operated farms that require this type of business project.

Table 39. Farm Typology Measured by GCFI Respondents Percentage and Count.

ND Farm Typology Measured by Gross Cash Farm Income (GCFI)	Percentage	Count
Small size farms, the GCFI is less than $ 150,000	63%	15
Moderate size farms the GCFI is between $ 150,000 to $349,000	29%	7
A mid-size farms the GCFI is between $349,000 to $ 999,999	4%	1
A large size farms the GCFI is between $ 1,000,000 to $ 4,999,999	4%	1
A very lager size farms the GCFI is $ 5,000,000 and more	0%	0

Table 40. Farm Typology Measured by GCFI Descriptive Statistics.

ND Farm Typology Measured by Gross Cash Farm Income (GCFI)	Mean	Std. Deviation	Variance	Count
	1.5	0.76	0.58	24

Furthermore, a food hub not only improves the local economy by supporting small and mid-size farms but also supports family business since the majority of the U.S. farms are owned by a family, according to the 2017 U.S. Census of Agriculture. Eighty-nine percent of the respondents' farms were owned by a family (see Table 41 and 42).

Table 41. Family Farm Vs. Non-Family Farm Respondents Percentage and Count.

Family Farm vs. Non-Family Farm	Percentage	Count
Family farm	88%	23
Non-family farm	12%	3

Table 42. Family Farm Vs. Non-Family Farm Descriptive Statistics.

ND Farm Typology Measured by Gross Cash Farm Income (GCFI)	Mean	Std. Deviation	Variance	Count
	1.5	0.76	0.58	24

Furthermore, a food hub project can help food producers with operation strategies to expand their farms. We found that 44% of the respondents were planning to expand their farm business comparing with 36% of the respondents who were planning to operate their farm at the same capacity (see Tables 43 and 44).

Table 43. Operation Strategies Respondents Percentage and Count.

Operation Strategies	Percentage	Count
Planning to expand	44%	11
Planning to keep operating at approximately the same size	36%	9
Planning to reduce the size	0%	0
Planning to exit farming	12%	3
Planning to sell the farm in less than 3 years	0%	0

Table 44. Operation Strategies Descriptive Statistics.

Operation Strategies	Mean	Std. Deviation	Variance	Count
	2.12	1.48	2.19	25

Production practices are considered as one of the fundamental aspects that differentiate food producers from each other. It considers as a competitive advantage, which makes customers prefer one food product over another because production practices require effort to set up and manage. This effort usually translates to food consumers through food labels, and that what makes food producers proud of their food labels and try to make their brand name well-known. Therefore, food labels are important for consumers and food hub producers as well.

Thirty-nine percent of the respondents labeled their produce as conventional. The conventional farming relies on chemical intervention to fight pests and weeds and provide plant nutrition. Thirteen percent of the respondents labeled their products as certified organic, and 32% of the respondents labeled their produce as GAP or GHP. The 16% of the respondents who chose the other option, two of them specified their answers as regenerative farming and three as organic farming but not certified (see table 45).

Table 45. Production Practice Labels Respondents Percentage and Count.

Production Practice Labels	Percentage	Count
Conventional	39%	12
Certified organic	13%	4
Good Agricultural Practices (GAP) or Good Handling Practices Audits (GHP)	32%	10
Other	16%	5

There are two methods that allow food producers to sell their products. Food producers can sell their food products either through the direct-to-customer method or wholesale. Fifty-two percent of the respondents sold their produce as wholesale. Respondents who used directly to consumers were 34%, and that was for non-processed food products, while 10% of the respondents sold their processed food products directly to consumers. A food hub with a hybrid model can attract these three categories (see Table 46 for respondents' percentages and count).

Table 46. Selling Method to Consumers Respondents Percentage and Count.

Selling Method to Consumer	Percentage	Count
As a commodity (i.e., only wholesale)	52%	15
Direct to consumer non-processed products	34%	10
Direct to consumer processed products	10%	3

Table 47 lists all the current food products that are produced and sold by respondents. The food products produced in ND included both perishable food and V.A.P. Perishable food products can be fresh, such as fruits, vegetables, meat, poultry, eggs, or dairy, or processed, such as frozen or canned. However, some farmers, although they may process their food products to some extent in order to boost their sales, may not consider this as "adding value" and thus may not report their products as V.A.P; nevertheless, according to the USDA definition, any food product that has been intentionally changed in form or physical state, such as changing fresh apples into cider is a V.A.P.

Table 47. Food Products that are Currently Produced for Sale Respondents Percentage and Count.

Food Products that are Currently Produced for Sale	Percentage	Count
Canned	6%	3
Dairy	2%	1
Eggs	10%	5
Frozen	4%	2
Fruits	10%	5
Grains	21%	11
Meats/Poultry	17%	9
Value-added	4%	2
Vegetables	23%	12
Wines	0%	0

Seasonality is one of the main problems faced by the agriculture sector in many geographical areas. This seasonality can manifest in such issues as lack of labor or weather changes. Cold weather dominates ND's climate for most of the year, with few warm-hot summer months, making growing some products hard. A high or low tunnel and greenhouses are examples of strategies that allow farmers to extend the growing season and overcome seasonality. Twenty-seven percent of the respondents adopted tunnels, while only 4% implemented greenhouses. The reason for this percentage difference between these two methods is the cost since the greenhouse method is considered more costly compared to the tunnel’s method (Rimol blog). Also, the high cost for these technologies may be one of the reasons for the 62% of the respondents who did not adopt a strategy for season extension (Table 48). However, 52% of the respondents planned to apply season extension strategies in the future (Table 49).

Table 48. Current Strategies for Season Extension Technologies Respondents Percentage and Count.

Current Strategies to Extend the Growing Season	Percentage	Count
None	62%	16
Heated greenhouse	4%	1
High or low tunnels	27%	7

Table 49. Future Plans for Season Extension Technologies Respondents Percentage and Count.

Future Plans for Season Extension Technologies	Percentage	Count
Yes	52%	13
No	48%	12

Food producers in ND showed their willingness to join a ND food hub in the first section of the survey, and this willingness was confirmed by their preparedness to increase production to meet wholesale demands. Forty-six percent of the respondents were willing to increase production to meet wholesale demands, and 50% of the respondents were uncertain if they can increase production (see Tables 50 and 51).

Table 50. Increase Production to Meet the Demand for Wholesale Market Percentage and Count.

Increase Production to Meet the Demand for Wholesale Market	Percentage	Count
Yes	46%	11
Maybe	50%	12
No	4%	1

Table 51. Increase Production to Meet the Demand for Wholesale Market Descriptive Statistics.

Increase Production to Meet the Demand for Wholesale Market	Mean	Std. Deviation	Variance	Count
	1.58	0.57	0.33	24

As stated before, V.A.P. is defined as food products that are intentionally changed from their original or physical state (such as changing fresh apples into cider). Tables 52 and 53 show the respondents for ND food producers who produce V.A.P; 20% of them were producing V.A.P.

However, 76% of the respondents do not currently make V.A.P. This gap in the production of V.A.P may be due to the costs involved.

Table 52. Status Quo for Production and Marketing Value-Added Products Percentage and Count.

Status Quo for Production and Marketing Value-Added Products	Percentage	Count
Yes	20%	5
No	76%	19
Not now, maybe in the future	4%	1

Table 53. Status Quo for Production and Marketing Value-Added Products Descriptive Statistics.

Status Quo for Production and Marketing Value-Added Products	Mean	Std. Deviation	Variance	Count
	1.84	0.46	0.21	25

Table 54 shows the types of V.A.P production methods used by the ND food producers 25% of the respondents have a processing facility at their farm to make the V.A.P. Twenty-fife percent of the respondents rely on a third-party co-packer to make the V.A.P. Thirteen percent of the respondents make their V.A.P. at a shared-use commercial kitchen.

Table 54. Types of Value-Added Products Production Methods Percentage and Count.

Types of Value-Added Products Production	Percentage	Count
Produced at a farm at a processing facility	25%	2
Self-produced at a shared-use commercial kitchen.	13%	1
Produced by a third-party co-packer	25%	2
We currently co-pack for others	0%	0

Table 55 lists the V.A.P classification, nearly 38% of the respondents their V.A.P considered as processing (e.g., wash and cutting the vegetables). While 25% were considered as consumer packaging, and 13% for both kill-step process and bulk packing for V.A.P.

Table 55. Classification of Value-Added Processes Practice.

Classification of Value-Added Processes Practice	Percentage	Count
Processing (e.g., wash, cut, freeze)	38%	3
“Kill-step” processing (e.g., pasteurization)	13%	1
Packaging – bulk (e.g., cartons, crate, boxes)	13%	1
Packaging – consumer (e.g., 4 oz., 6 oz., 1 gal.)	25%	2
Produce sold to another farmer for resale as a value-added product	0%	0
Other, please specify	10%	4

Generally, food producers make V.A.P as a strategy to differentiate their food products to gain a competitive advantage. This strategy allows them to generate more revenue by pricing these food products higher than the original form of those products. In addition, it is a way to avoid competition by lowering the price of the original food product that may lead to customer loyalty if it is done right. There are four types of strategies to approach V.A.P, and they are Innovation, Industrial Innovation, Horizontal Coordination, and Vertical Coordination for full definitions. Tables 56 lists these strategies as the respondent’s percentages for each type. Fifty-two of the respondents believed the innovation strategy is the right strategy for them to produce V.A.P. Twenty-two percent preferred the horizontal coordination strategy, while 13% chose industrial innovation, and a similar percent of responders selected the vertical coordination strategy.

Table 56. Strategy to Approach Value-Added Product Percentage and Count.

Best Strategy to Approach Value-Added Product	Percentage	Count
Innovation	52%	12
Industrial Innovation	13%	3
Horizontal coordination	22%	5
Vertical coordination	13%	3

There are always barriers preventing farm businesses from increasing production (Table 57) lists these barriers. Using the 3-point Likert scale, we found three barriers were significant to the respondents: Availability of labor, cost of equipment, materials, and labor to increase production, and Marketing barriers. The percentage for these three barriers were 83%, 70%, and 70%, respectively. Table 58 shows the descriptive statistics for these barriers.

Table 57. Barriers Preventing Farm Businesses from Increasing Production.

Barriers Preventing Farm Businesses from Increasing Production	Not Significant 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Significant 7	Count	Total Count
Lack of protein processing facility /or access to USDA facility	17%	4	13%	3	17%	4	9%	2	17%	4	4%	1	22%	5	23
Availability of suitable land	9%	2	13%	3	13%	3	22%	5	13%	3	17%	4	13%	3	23
Affordability of land	8%	2	4%	1	21%	5	17%	4	21%	5	8%	2	21%	5	24
Availability of labor	4%	1	4%	1	4%	1	4%	1	38%	9	13%	3	33%	8	24
Availability of financing/ access to credit	9%	2	4%	1	9%	2	30%	7	13%	3	17%	4	17%	4	23
Cost of equipment, materials, and labor to increase production	0%	0	4%	1	4%	1	21%	5	8%	2	42%	10	21%	5	24
Management skills to run a larger operation	13%	3	13%	3	13%	3	8%	2	25%	6	21%	5	8%	2	24
Operational barriers	13%	3	4%	1	4%	1	25%	6	42%	10	4%	1	8%	2	24
Marketing barriers	8%	2	0%	0	4%	1	17%	4	29%	7	21%	5	21%	5	24
Transportation barriers	13%	3	4%	1	13%	3	21%	5	13%	3	17%	4	21%	5	24
Logistics barriers	9%	2	0%	0	9%	2	22%	5	30%	7	9%	2	22%	5	23

Table 58. Barriers Preventing Farm Businesses from Increasing Production Descriptive Statistics.

Barriers Preventing Farm Businesses from Increasing Production	Mean	Std. Deviation	Variance	Count
Lack of protein processing facility /or access to USDA facility	3.96	2.14	4.56	23
Availability of suitable land	4.22	1.84	3.39	23
Affordability of land	4.46	1.83	3.33	24
Availability of labor	5.38	1.6	2.57	24
Availability of financing/ access to credit	4.57	1.77	3.12	23
Cost of equipment, materials, and labor to increase production	5.42	1.35	1.83	24
Management skills to run a larger operation	4.17	1.89	3.56	24
Operational barriers	4.25	1.61	2.6	24
Marketing barriers	5.04	1.65	2.71	24
Transportation barriers	4.5	1.96	3.83	24
Logistics barriers	4.78	1.69	2.87	23

There are a variety of marketing channels where food producers can sell their products to customers (see Figure 3 for that lists 11 selling points). The respondents filled each category based on the percentage of food products sold in that category. The high percentage mean for other options could be due to two reasons. The first reason is participants were forced to put the total percentage for all food products sold, which is 100 percent, even if this percentage was for one category. Some respondents may not know the percentage for each category and chose to fill in the other category with 100 percent to move to the next question. The second reason for the high mean for the other category, which was nearly 22, maybe the choices did not cover all the marketing channels. The second highest mean was for elevators, which is logical since many ND farmers produce grain. Farmers' markets recorded the third-highest mean with 15, followed by direct-to-consumer, which was 14. The CSA mean was 10, while the remaining means were less than 10.

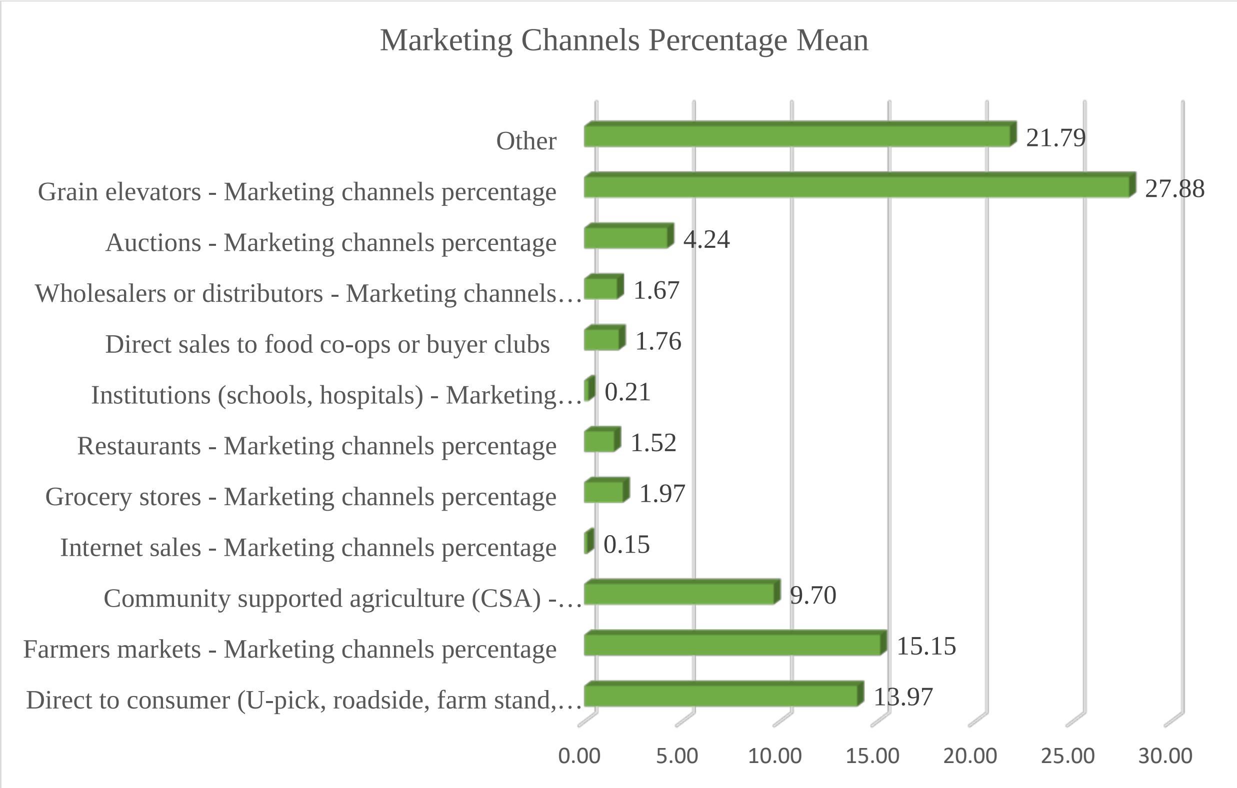

Figure 3. The Mean for Percentage of Marketing Channels.

The nature of a food hub encourages and assists farmers, especially beginning farmers, with developing practical agribusiness knowledge and marketing skills. Lack of marketing skills is one of the obstacles facing most farmers who run small and mid-size farms. As mentioned in the barriers, 70% of the respondents found marketing an obstacle preventing a farm business from increasing production. To better understand this issue, the survey included a question to examine how ND food producers feel when they deal with marketing responsibilities (Table 59 lists statements that represent food producers' attitudes toward marketing). And an open-ended question of how many hours on average does marketing task takes for them. Forty percent of the respondents needed help with marketing so they can focus on production and operation.

Table 59. Attitude Toward the Marketing Aspects

Attitude toward the marketing aspects	Percentage	Count
I can do marketing, but I do not like doing it	16%	4
I can do marketing, and I like it	16%	4
I need help with marketing, to spend more time on the production	40%	10
I cannot do it, and I do not like marketing	8%	2
No opinion	20%	5

The average hours spent on marketing was an open-ended question and the average hours spent on marketing for 33 respondents was five hours per week. Digital marketing is almost a free marketing tool compared with TV and radio advertisements and receives massive attention from consumers. Table 60 shows the respondents' opinions about digital marketing. Using the 3-point Likert scale, we found 19 respondents (83%) who agreed on the importance of digital marketing.

Table 60. Respondents Opinion Digital Marketing.

Importance of digital marketing (i.e., E-commerce) and social media	Percentage	Count
Strongly disagree 1	0%	0
2	0%	0
3	9%	2
4	9%	2
5	39%	9
6	35%	8
Strongly agree 7	9%	2
Total	100%	23

To better understand how ND food producers use digital marketing for marketing their produce (Table 61 lists five types of digital marketing platforms) that are commonly used. Nearly 35% of respondents used Facebook, while 25% used their own business website for marketing. Respondents who used Instagram were 13%; unfortunately, there were no respondents who used YouTube. And respondents who do not use digital marketing were 13 percent.

Table 61. Social Media Platforms.

Social media platforms	Percentage	Count
Website	25%	8
YouTube	0%	0
Facebook	34%	11
Twitter	6%	2
Instagram	13%	4
Other, please specify	0%	0
I do not use the Internet or social media platforms for marketing	22%	7

As mentioned before, the effect of location on a food hub's success cannot be understated. In addition, the location of the consumers is also an important factor for the local food systems' success. Table 62 shows the percentage of customers within 400-miles from ND food producers. Nearly 44% of the respondents have all their customers within 400-miles. Furthermore, the survey asked respondents about the shortest, average, and the longest distance they drive one-way for delivering their products to consumers. The average for these three distances was as follows:

- The average for the shortest distance to deliver food products to a customer was 21 miles.
- The average for the average distance to deliver food products to a customer was 189 miles.
- The average for the longest distance to deliver food products to a customer was 888 miles.

Table 62. Customers Within 400-miles.

Customers within 400-miles	Percentage	Count
All	43%	10
Not sure	26%	6
More than 75%	17%	4
less than 25%	4%	1
Between 26 -50%	4%	1
Between 51-75%	4%	1
Total	100%	23

Since there are different ways of conceptualizing and defining local food, it was essential to cover this issue in this study and define it from the perspective of the ND food producers. To better understand the local food concept, the survey asked ND food producers to share their points of view on this concept. (Tables 63) shows the local food definition results by point geographical area. Almost 43% of the respondents defined local food as what was produced on the state border, while 23% defined it as what was produced in their region.

Table 63. Statements Represent Local Definition.

Statements represent Local Definition	Percentage	Count
Produced or processed in my county	15%	4
Produced or processed in my state	42%	11
Produced or processed in my region	23%	6
Produced or processed in the US.	8%	2
Knowing the origin where my food produced or processed	8%	2

Furthermore, (Table 64) shows the local food definition results by miles from the point of sale. In consideration of the definition of local food from the distance of the point of sale, 39% of the respondents considered local food as food that is grown within 50 to 200 miles from where they live, and 23% of respondents chose the distance from 200 to 400 miles.

Table 64. Local Definition by Miles.

Local Definition by Miles	Percentage	Count
Produced within less than 10 miles of the point of sale	4%	1
Produced within less than 10-25 miles of the point of sale	15%	4
Produced within less than 50-100 miles of the point of sale	38%	10
Produced within less than 100-200 miles of the point of sale	23%	6
Produced within less than 200-400 miles of the point of sale	19%	5

4.3. Inferential Statistics

A variable screening method was used to find the most significant variable for the inferential statistics analysis part of this study. The Statistical Analysis System (SAS 9.3) was used to operate the stepwise multiple regression (backward elimination) analysis to evaluate and test the supply-side's five hypotheses. The five hypotheses included five independent variables: Q 21 Farm or pasture size operated by ND food producers, Q 31 V.A.P. Production, Q 47 level of education, Q 49 Employment type, and Q 51 Years of experience. In addition, the hypotheses contained three dependent variables: Q 1 level of familiarity with a food hub concept, Q 2 level of agreement with sustainability statement, and Q 3 level of interest of ND food producers in selling food products through the ND food hub.

The five independent variables were examined against each dependent variable. The backward elimination process requires including all the independent variables in the first model and eliminate the most non-significance variable one at a time. The elimination steps run until we find the most significant or the less non-significance variable. In the case of less non-significant variables, we did the power analysis to find the sample size needed for that variable to be significant. The SAS 9.3 program was coded to run three different backward elimination analyses for each dependent variable (see Appendix D).

4.3.1. The First backward elimination analysis model for the supply-side (Q 1)

The first backward elimination analysis included six steps as follow:

- Step 1: Backward elimination initially fits a model containing all the five independent variables (questions 21,31,47,49, and 51) k represents the independent variables) in the model.

$$E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$$

The variable with the smallest F-value or the largest p-value (> 0.05) for testing the model for $H_0\colon\ \beta_i = 0$ (see Figure 4). The most non-significance variable (question 51) was identified and dropped from the model.

Dependent Variable: Q1 familiar with food hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	12.83631714	2.56726343	0.72	0.6227
Error	11	39.28132992	3.57102999		
Corrected Total	16	52.11764706			

R-Square	Coeff Var	Root MSE	Q1 Mean
0.246295	52.66424	1.889717	3.588235

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	10.72921489	10.72921489	3.00	0.1109
Q21	1	2.86998587	2.86998587	0.80	0.3892
Q47	1	0.06596250	0.06596250	0.02	0.8943
Q49	1	0.27099566	0.27099566	0.08	0.7881
Q51	1	0.05200341	0.05200341	0.01	0.9061

Figure 4. Supply-Side First Backward Elimination Analysis Model 5 Step 1.

- Step 2: The model with the remaining (k − 1) independent variables (Q 21, Q 31, Q 47, and Q 49) was fit in the model and run again.

- Step 3: The variable associated with the smallest nonsignificant F-value or largest p-value (Q 47) was dropped from the model (see Figure 5). The model with the remaining (k − 1) independent variables (Q 21, Q 31, and Q 49) was fit in the model and run again.

Dependent Variable: Q1 familiar with food hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	12.78431373	3.19607843	0.98	0.4567
Error	12	39.33333333	3.27777778		
Corrected Total	16	52.11764706			

R-Square	Coeff Var	Root MSE	Q1 Mean
0.245297	50.45554	1.810463	3.588235

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	11.34883721	11.34883721	3.46	0.0875
Q47	1	0.15345912	0.15345912	0.05	0.8323
Q21	1	3.05000000	3.05000000	0.93	0.3538
Q49	1	0.25416667	0.25416667	0.08	0.7854

Figure 5. Supply-Side First Backward Elimination Analysis Model 4 Step 3.

- Step 4: The variable associated with the smallest nonsignificant F-value or largest p-value (Q 49) was dropped from the model (see Figure 6). The model with the remaining (k − 1) independent variables (Q 21, Q 31, and Q 49) was fit in the model and run again.

Dependent Variable: Q1 familiar with food hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	12.63085461	4.21028487	1.39	0.2910
Error	13	39.48679245	3.03744557		
Corrected Total	16	52.11764706			

R-Square	Coeff Var	Root MSE	Q1 Mean
0.242353	48.57059	1.742827	3.588235

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	11.94879037	11.94879037	3.93	0.0689
Q21	1	3.22250987	3.22250987	1.06	0.3218
Q49	1	0.31145316	0.31145316	0.10	0.7539

Figure 6. Supply-Side First Backward Elimination Analysis Model 3 Step 4.

- Step 5: After dropping the predictor variable (Q 49), as you see from (Figure 7), the predictor variable (Q 31) was significant, p-value < 0.05. However, the variable associated with the smallest nonsignificant F-value or largest p-value (Q 21) was dropped from the model.

Dependent Variable: Q1 familiar with food hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	42.1878261	21.0939130	7.53	0.0032
Error	22	61.6521739	2.8023715		
Corrected Total	24	103.8400000			

R-Square	Coeff Var	Root MSE	Q1 Mean
0.406277	42.70481	1.674029	3.920000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Q31	1	31.59000000	31.59000000	11.27	0.0028
Q21	1	10.59782609	10.59782609	3.78	0.0647

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	39.78532609	39.78532609	14.20	0.0011
Q21	1	10.59782609	10.59782609	3.78	0.0647

Figure 7. Supply-Side First Backward Elimination Analysis Model 2 Step 5.

- Step 6: We ran the model with the only variable left in the model (Q 31) and was the only significant predictor variable with p-value = 0.0043 < 0.05 level (Figure 8).

Dependent Variable: Q1 familiar with food hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	31.5900000	31.5900000	10.06	0.0043
Error	23	72.2500000	3.1413043		
Corrected Total	24	103.8400000			

R-Square	Coeff Var	Root MSE	Q1 Mean
0.304218	45.21358	1.772373	3.920000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Q31	1	31.59000000	31.59000000	10.06	0.0043

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	31.59000000	31.59000000	10.06	0.0043

Figure 8. Supply-Side First Backward Elimination Analysis Model 1 Step 6.

The first backward multiple regression for the supply-side was conducted to identify the most significant independent variables (farm or pasture size, V.A.P. production, level of education, employment type, and years of experience) for predicting the dependent variable (ND food producer level of familiarity with food hub concept). All models result for the first backward multiple regression for the supply-side are in (Appendix E). The model 2 with the most important predictors variables included only V.A.P. production (Q 31) and farm or pasture size (Q 21), F (7.53) = 0.0032, p <0.05, R^2 = 0.406 (Figure 7). This indicates that 40% of the variance of familiarity level can be explained by this model. The V.A.P. production (Q 31) was the only variable that statistically significant contributed to the final model (F = 10.06 = 0.0043, p < 0.05.

We run the power analysis for these two independent variables in model 2 at a 95% confidence level. We needed a sample size N = 78; the actual sample size was N = 31 (Figure 9).

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	2
Number of Test Predictors	1
R-square of Full Model	0.406277
Difference in R-square	0.102
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.802	48
2	0.85	0.855	55
3	0.90	0.904	64
4	0.95	0.951	78

Figure 9. Supply-Side First Backward Elimination Analysis Power Analysis for Model 2.

4.3.2. The second backward elimination analysis model for the supply-side (Q 2)

The second backward multiple regression supply-side was conducted to identify the most significant independent variables (farm or pasture size, V.A.P. production, level of education, employment type, and years of experience) for predicting the dependent variable (ND food producer level of agreement about food hub and sustainability). We repeated the six steps that were done for the first backward multiple regression for the second backward multiple regression supply-side; all models result for the second backward multiple regression for the supply-side listed in (Appendix E).

Model 2 with the most important predictors variables included only Employment type (Q 49) and Years of experience (Q 51), $F (3.31) = 0.0642$, $p > 0.05$, $R2 = 0.306$ (Figure 10). This indicates that 30% of the agreement variance can be explained by this model. Both variables were statistically not significant with the actual sample size N = 31. We run the power analysis for these two independent variables in model 2 at a 95% confidence level. We needed a sample size N = 39 (Figure 11)

Dependent Variable: Q2 Food Hub Provides Sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	12.41304348	6.20652174	3.31	0.0642
Error	15	28.08695652	1.87246377		
Corrected Total	17	40.50000000			

R-Square	Coeff Var	Root MSE	Q2 Mean
0.306495	28.31131	1.368380	4.833333

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q49	1	6.37732919	6.37732919	3.41	0.0848
Q51	1	7.51304348	7.51304348	4.01	0.0636

Figure 10. Supply-Side Second Backward Elimination Analysis Model 2.

dependent(Q2), most close to be significant variables are Q49 and Q51

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	2
Number of Test Predictors	2
R-square of Full Model	0.306495
Difference in R-square	0.306495
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.818	26
2	0.85	0.851	28
3	0.90	0.902	32
4	0.95	0.955	39

Figure 11. Supply-Side Second Backward Elimination Analysis Power Analysis for Model 2.

4.3.3. The third backward elimination analysis model for the supply-side (Q 3)

The third backward multiple regression supply-side was conducted to identify the most significant independent variables (farm or pasture size, V.A.P. production, level of education, employment type, and years of experience) for predicting the dependent variable (ND food producer level of interest in joining a ND food hub). We repeated the identical six steps in the first and second backward multiple regression for the third backward multiple regression supply-side; all models result for the third backward multiple regression for the supply-side (Appendix E).

Model 1 with the most important predictors variables included only Employment type (Q 49), F (0.82) = 0.3792, $p > 0.05$, R2 = 0.052 (Figure 12). This indicates that this model can explain only 5% of the variance of the level of interest in joining a ND food hub. The variables were statistically not significant with the actual sample size N = 31. We run the power analysis for this independent variable in model 1 at a 95% confidence level. We needed a sample size N = 240 (Figure 13).

Dependent Variable: Q3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.91736695	1.91736695	0.82	0.3792
Error	15	35.02380952	2.33492063		
Corrected Total	16	36.94117647			

R-Square	Coeff Var	Root MSE	Q3 Mean
0.051903	30.92471	1.528045	4.941176

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q49	1	1.91736695	1.91736695	0.82	0.3792

Figure 12. Supply-Side Third Backward Elimination Analysis for Model 1.

dependent(Q3), most close to be significant variables are Q49

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	1
Number of Test Predictors	1
R-square of Full Model	0.051903
Difference in R-square	0.051903
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.802	146
2	0.85	0.850	166
3	0.90	0.900	194
4	0.95	0.951	240

Figure 13. Supply-Side Third Backward Elimination Analysis Power Analysis for Model 1.

5. RESULTS AND DATA ANALYSIS FOR ND FOOD HUB FEASIBILITY STUDY PART-B THE DEMAND-SIDE

This section provides an overview of the ND local food demand-side survey results. The first section of this chapter covers the challenges faced during the data collection . The survey was inspired by many studies, such as the National Food Hub Surveys of 2013, 2015, and 2017. The National Food Hub Surveys are collaborative studies led by the Center for Regional Food Systems at Michigan State University. In addition, this study was inspired by articles conducting research based on survey or interview methods. However, this survey was built to be exclusive to fit the study area and to incorporate changes in internet use such as internet marketing and social media. Each question presents an issue or a challenge that usually occurs in any local food system but is tailored for ND. Initially, the survey results were statistically analyzed for each survey question to investigate the specific issue faced by food producers in ND. The reliability of rates and statistics reported are highly dependent on the number of responses in each category. After analyzing and illustrating the three sections of the survey statistically, the data was analyzed quantitatively using SAS 9.3. Analysis in SAS revealed the relationships among variables and allowed for testing the hypothesis.

5.1. Challenges

Since the literature review did not provide any data for demand for local food in ND, it was necessary to create a new survey. Furthermore, it was not possible to include all ND institutions and whole-food buyers. For example, as we mentioned earlier in the methodology, we excluded restaurants from this study because available email lists were either expensive or unreliable. We also had to suspend the survey for a month because of the COVID-19 pandemic.

5.2. Descriptive Statistics

5.2.1. Food buyers' information

The last section of the questionnaire included four questions about the food buyers (i.e., institutions and businesses). It was designed to gather the type of food buyer, gender, and address information of the food buyer. And one question to evaluate their opinion about a dedicated distribution system for locally produced. (Table 65) summarizes the percentage of the response and count. Most of the responses to this survey were females; the percentage was 75%. The highest percentage (63%) of the food buyers' respondents were from educational institutions; unfortunately, they did not specify the type of educational institution. The second-highest percentage of the survey responses were from hospitals, with 25%. Independent grocery stores were 6%, and nonprofit institutions were also 6%.

Table 65. Food Buyers Information Percentage and Count.

Food Buyers Information (sample size n = 16)		
Gender	Percentage	Count
Male	25%	4
Female	75%	12
Total	100%	16
Type of Business or Institution	Percentage	Count
Educational Institution, (e.g., school (K-12), university, college)	63%	10
Hospital	25%	4
National grocery store chain	0%	0
Independent grocery store	6%	1
Grocery-convenience, corner	0%	0
Broadline Distributor	0%	0
Specialty Distributor	0%	0
Cash and Carry Distributor	0%	0
Direct to consumer (e.g., CSA, online, home delivery, buyer's club)	0%	0
Nonprofit Institution (e.g., hunger relief, food security)	6%	1
Total	100%	16

At the end of this survey, we asked respondents about their opinion on the need for a dedicated distribution system for local food in ND (Table 66). Since the difference between agreed (47%) and disagreed (53%) responses were close to each other, the assessment of ND institutions' opinions was meaningless. A larger sample was needed to evaluate this since the difference between the two answers was only one response. Furthermore, the total sample number of this survey was low, as was mentioned in the challenging section.

Table 66. Food Buyers Information.

Do you believe ND requires a dedicated distribution system for locally food	Percentage	Count
Yes	47%	7
No	53%	8
Total	100%	15

5.2.2. Food purchasing behavior and requirements

This section of the questionnaire covered the food purchasing behavior requirements, and it included 21 questions. Eleven multiple-choice questions, five questions, 7-point Likert scale, three fill-in-the-blank, and two binary questions. The purpose of this section was to understand the factors influencing ND institutions' decision to purchase food, such as the number of vendors, delivery methods, the average cost for delivery, label requirements, and packing standard and requirements.

The demand seasonality is a vital factor that affects agricultural prices and other agricultural operations and production. The respondents' percentage was divided into two halves 50% of the ND institutions demanded food products year-round, and 50% demanded food products during the school year (Table 67). Also, the low variance value (Table 68) proves that the responses' results were close to each other.

Table 67. The Demand Seasonality for ND Institution Percentage and Count.

The demand seasonality for ND Institution	Percentage	Count
Year-round	50%	15
School year	50%	15
Summer Seasonal	0%	0
Winter Seasonal	0%	0
Total	100%	30

Table 68. The Demand Seasonality for ND Institution Descriptive Statistics.

The demand seasonality for ND Institution	Mean	Std. Deviation	Variance	Count
	1.6	0.8	0.64	30

The average number of vendors for institutions was five, where the maximum number of vendors was 20, and the minimum was one (see Figure 14). Respondents who had restrictions and limitations on the number of vendors that supply food to them were 43%, and 57% of the institutions reported they do not have restrictions or limitations, which means they can contract with new food suppliers as needed (see Tables 69 and 70).

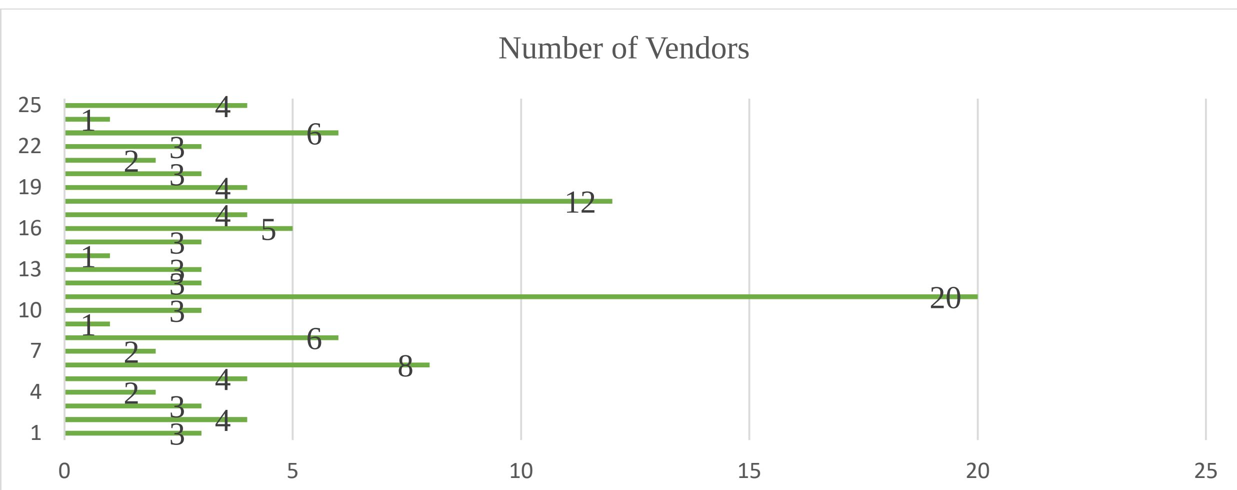

Figure 14. Number of Vendors

Table 69. Limitation on the Number of Vendors.

Limitation on the Number of Vendors	Percentage	Count
Yes	43%	13
No	57%	17
Total	100%	30

Table 70. Descriptive Statistics for the Number of Vendors Limitation.

Limitation on the Number of Vendors	Mean	Std Deviation	Variance	Count
	1.57	0.5	0.25	30

The average distance by miles for food purchased delivery from suppliers to customers was 118, where the maximum was 380, and the minimum was 1-mile (see Figure 15). Purchased food either delivered by the supplier or by picked by food buyer; 90% of the ND received their purchased food by the supplier (see Table 71). The average cost for shipping or delivery from suppliers to customers was $58 per order. However, this is a mathematical average was not representative because there were several responses excluded from the data. For example, some respondents were not sure about their shipping costs, other customers reported that the shipping cost was combined with their contract, and few respondents did not respond. The mathematical average results from one hospital that pays $1100 for daily food orders and other respondents who pay $10- $250 per order.

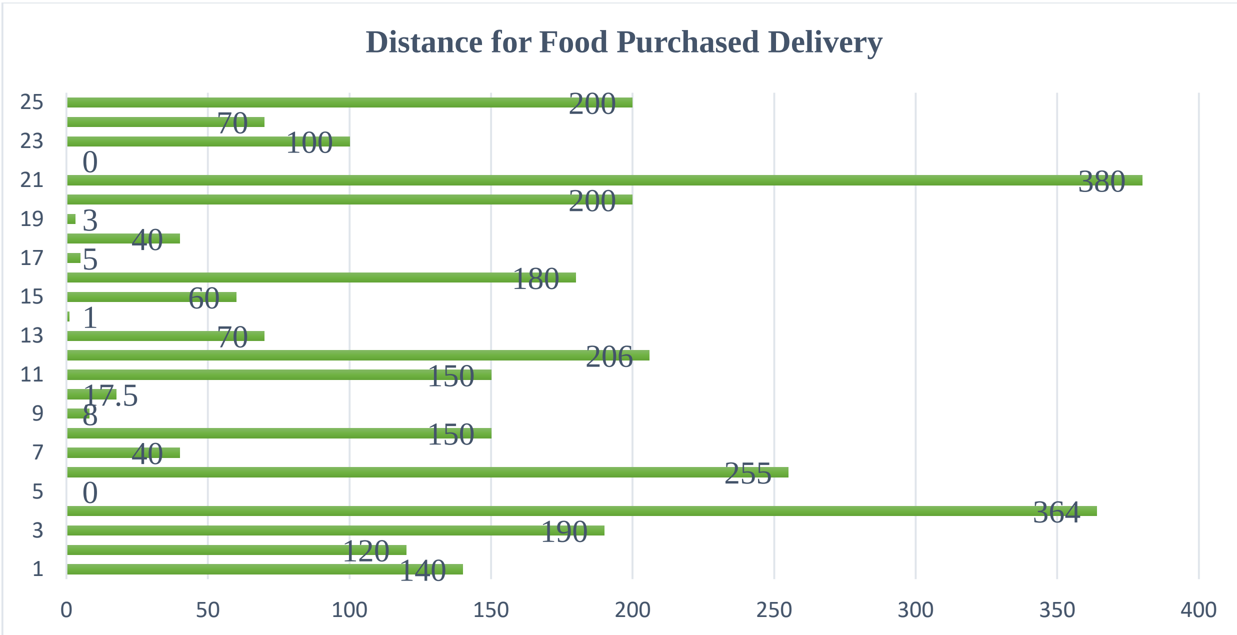

Figure 15. Distance for Food Purchased Delivery.

Table 71. Food Purchased Delivery Methods.

Food Purchased Delivery Methods	Percentage	Count
Supplier/s make the delivery to the institution	90%	27
We pick up our food from the supplier	10%	3
Total	100%	30

Table 72 lists the food purchasing requirements that ND institutions may be required from local food producers. These requirements are operational certificate that allows local food producers to be eligible to supply their food products to an institution. Respondents were able to choose all the requirements that apply to institutions, so the total count does not reflect the number of respondents. Ten respondents (24%) reported that their institutions do not have requirements for an operational certificate and similar results of the respondents required a USDA food safety plan certificate. Four institutions (10%) required traceability, and institutions required HACCP was three (7%). The seven respondents (17%) chose the other category. Three of the respondents specified requirements for a USDA inspection, another specified a price availability requirement, and a third respondent specified the ND public school requirements. The other two respondents determined the other category as either depending on vendor operational guidelines or did not use a standard or did not have an obligation.

Table 72. Requirements for Purchased Food Percentage and Count.

Requirements for Purchased Food	Percentage	Count
No requirements	24%	10
Must pass our on-farm audit	0%	0
Must have an on-farm food safety plan	2%	1
Must have implemented USDA certified food safety plan	24%	10
Must be GAP or GHP certified	0%	0
Must be HACCP certified	7%	3
Must offer traceability	10%	4
Must be organically certified	0%	0
Must be chemical-free	0%	0
Must be Halal certified	0%	0
We depend on suppliers' requirements	15%	6
Other	17%	7
Total	100%	41

Equally important to local food production requirements are the packaging requirements for purchased food (Table 73). These requirements varied from one institution to another. For example, 33% of the institutions required USDA grading standards, while 22% accepted industry standards. Other institutions that required local food suppliers to maintain cold chain standards were 13%. Institutions that have their own quality and packing standards were 15%. In addition, four percent of the institutions in our sample did not have packing requirements, and 7% depended on the distributor's standards.

Table 73. Packing Standards Requirement Percentage and Count.

Requirements in Term of Packing Standards	Percentage	Count
None	4%	3
Must follow USDA grading standards	33%	23
Expect industry packing standards	22%	15
Must maintain a cold chain	13%	9
Must meet our packing standards	4%	3
Must match our quality standards	14%	10
Must be recyclable or reusable packaging	1%	1
We depend on distributors' standards	7%	5
Must provide refrigerated, not frozen meats	0%	0
Other	0%	0
Total	100%	69

The institutions that depended on distributors in terms of liability insurance were 79%. Only 7% of the intuitions did not require food suppliers to provide any liability insurance. The institutions that had a minimum liability insurance requirement were 14% (see Table 74).

Table 74. Liability Insurance Requirements for Food Supplier Percentage and Count.

Food Supplier Liability Insurance Requirement	Percentage	Count
Not required	7%	2
We depend on distributors' requirements	79%	23
Required, minimum coverage amount	14%	4
Total	100%	29

Customers are usually preferred local food higher than organic. The respondents who chose conventional labels were 90% compared with zero percent for organic. Ten percent of the respondents chose the other option. Of these respondents, one specified conventional but under state guidelines for schools, another one specified choice was dependent on price and quality, and the last one was a combination of conventional and organic food (see Table 75) for results.

Table 75. Label Requirements Describing Purchasing Practice.

Label Requirements Describing Purchasing Practice	Percentage	Count
Conventional	90%	27
Certified organic	0%	0
Other	10%	3
Total	100%	30

Table 76 lists purchased food that originated in ND; The percentage of respondents who buy local food was 93% of the sample. The highest percentage for the food category that originated in ND purchased by institutions was for dairy products with 23%. The vegetable category was the second-highest percentage with 19%. Eggs, meat, fruits, and honey were 10%, 9%, 9%, and 7%, respectively. The seven respondents (10%) who chose other specified their answers are as follows:

- One institution purchased hot dogs.
- One institution was dependent on price and quality regardless of the origin of the food products.
- Three institutions specified that they do not know, and they depend on the suppliers.
- Two institutions responded they are interested in buying local food, but they do not have time to investigate where to buy food products that originate in ND.

Table 76. List of Purchased Food that Originates in ND.

List of Purchased Food that Originates from ND	Percentage	Count
Fruits	9%	6
Vegetables	19%	13
Meat	9%	6
Poultry	3%	2
Dairy products	23%	16
Honey	7%	5
Processed food (e.g., jam)	4%	3
Eggs	10%	7
We do not buy food sourced from ND	7%	5
Other	10%	7
Total	100%	70

In contrast, (Table 77) lists food product categories that originated in ND and institutions' interest toward purchasing. It was noticeable that the percentage increased for each food product category. For example, in the previous table, six institutions (9%) bought fruits sourced from ND. In comparison, the number of interesting institutions in purchasing fruits that originated in ND increased to 24 respondents (14%). Similarly, institutions interested in purchasing meat rose from six institutions (9%) to 24 respondents (14%). Furthermore, the percentage for the last two choices, “we do not buy food sourced from ND,” and other, decreased, which means institutions in ND are willing to buy local food products produced in ND.

Table 77. Interested Purchasing List for Food that Originates in ND.

Interested Purchasing List for Food that Originates in ND	Percentage	Count
Fruits	14%	24
Vegetables	15%	26
Meat	14%	24
Poultry	13%	23
Dairy products	13%	22
Honey	8%	14
Processed food (e.g., jam)	11%	19
Eggs	12%	21
We do not buy food sourced from ND	1%	2
Other	0.5%	1
Total	100%	176

Understanding the motivations behind local food buyers, why they buy local produce, and where they are in terms of their decision-making process is crucial for local food producers and distributors. For that, it was preferable to investigate the motives of institutions for attentiveness to improve the quality of service. (Table 78) lists 12 motivations that may drive institutions' interest in local food. Using the 3-point Likert scale, we found five motives had a high level of importance for the respondents: taste, quality, freshness, support of local farmers, and support of the local economy. Respondents' percentage were for these five motives 96%,93%,93%,90%, and 90%, respectively.

The first three motivations presented local food respondent's presumptions. For respondents, local food symbolizes freshness, quality, and taste. According to Schneider and Francis (2005), consumers buy local food because it presents high quality and better taste for them. And Kloppenburg, Hendrickson, and Stevenson (1996) claimed that consumers usually associated short distances with food freshness, which motivated them to consider geographic boundaries for their food choices and one of the motives for local food purchase. Furthermore, Onozaka and Dawn

(2011) said the U.S. food consumers had a WTPPP for local food to support local farmers. Also, Werner et al. (2019) found that consumers in the Northeast were motivated to buy local food to support local farmland and the local economy.

Table 78. Motives to Buy Local Food.

Motives to buy local produce	Not important 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Important 7	Count	Total Count
Community Demand	15%	4	0%	0	0%	0	19%	5	12%	3	19%	5	35%	9	26
Freshness	4%	1	0%	0	0%	0	4%	1	7%	2	14%	4	71%	20	28
Know where/how product was grown	0%	0	0%	0	4%	1	12%	3	8%	2	42%	11	35%	9	26
Price	4%	1	0%	0	0%	0	7%	2	7%	2	21%	6	61%	17	28
Quality	4%	1	0%	0	0%	0	4%	1	4%	1	14%	4	75%	21	28
Reduce transportation impacts on the environment	4%	1	12 %	3	4%	1	36%	9	12%	3	16%	4	16%	4	25
Support local economy	4%	1	0%	0	0%	0	7%	2	10%	3	27%	8	52%	15	29
Support education efforts on where/how food is grown	4%	1	0%	0	0%	0	14%	4	17%	5	27%	8	38%	11	29
Support local farmers	4%	1	0%	0	0%	0	7%	2	10%	3	24%	7	55%	16	29
Taste	0%	0	0%	0	0%	0	4%	1	0%	0	21%	6	75%	21	28
Other, please specify	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	100%	1	1

Additionally, the survey covered eight factors that may influence institutions to purchase local food regardless of budget constraints (Table 79). Using the 3-point Likert scale, we found three factors that helped increase local food purchase: increased awareness of local products carried by a distributor, availability of local food from a distributor, and support connecting with local producers. Respondents' percentages to these three factors were 93%, 90%, and 81%, respectively. The first two factors suggested the importance of making local food available in the food market and promoted it through distributors. The third factor is directly referred to as a food hub since the regular food distributors do not local producers with each other or with buyers.

Table 79. Factors Influence to Buy Local Produce Without Budget Restrictions.

Factors Influence to Buy Local Produce Without Budget Restrictions	Not Helpful 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Helpful 7	Count	Total Count
Support connecting with local producers	4%	1	0%	0	4%	1	12%	3	0%	0	31%	8	50%	13	26
Increased awareness of local products carried by my distributor	4%	1	0%	0	4%	1	0%	0	4%	1	22%	6	67%	18	27
Greater local product availability from my distributor	7%	2	0%	0	0%	0	4%	1	4%	1	18%	5	68%	19	28
Increased/Improved Storage	13%	3	0%	0	8%	2	42%	10	8%	2	13%	3	17%	4	24
Equipment	14%	3	5%	1	14%	3	48%	10	0%	0	10%	2	10%	2	21
Technical Assistance	13%	3	0%	0	13%	3	39%	9	4%	1	13%	3	17%	4	23
Training of staff to use the products	14%	3	9%	2	5%	1	45%	10	14%	3	9%	2	5%	1	22
Hiring professional staff	27%	6	9%	2	5%	1	45%	10	9%	2	5%	1	0%	0	22
Other, please specify	100%	1	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	1

In contrast, some factors prevent institutions from purchasing local food. (Table 80). By using the 3-point Likert scale, we found two factors were close to 70%. Seasonality of local products was 69%, and the quality of products available was (68%). Respondents believed that seasonality and availability of local food products are vital factors that may prevent institutions from purchasing local food. These two factors are not associated with ND because of the cold weather. In fact, weather and consumers' desire to eat out of the season food were indicted as the main barrier that affected consumers' choices for local food in many studies. For example, Brown, Dury, and Holdsworth (2009) found that the desire to eat out-of-season food was the main reason that affected consumers' choices in England, which may negatively affect the demand for local food.

Table 80. Factors Preventing Local Food Purchasing.

Factors Preventing Local Food Purchasing	Not important 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Important 7	Count	Total Count
Equipment	25%	5	15%	3	20%	4	30%	6	0%	0	5.%	1	5%	1	20
Food Safety Assurances/Concerns	14%	3	10%	2	10%	2	19%	4	5%	1	14%	3	29%	6	21
Food Budget Constraints	0%	0	0%	0	13%	3	22%	5	4%	1	17%	4	43%	10	23
Labor/Food Prep Budget Constraints	4%	1	0%	0	9%	2	22%	5	17%	4	22%	5	26%	6	23
I have not been able to focus on this	5%	1	0%	0	0%	0	36%	8	14%	3	23%	5	23%	5	22
I lack the resources to receive deliveries from multiple farms	14%	3	0%	0	5%	1	41%	9	9%	2	14%	3	18%	4	22
I want to purchase local foods directly from a farm, but don't know-how	19%	4	10%	2	0%	0	19%	4	5%	1	10%	2	38%	8	21
I want to purchase local foods, but a local farmer does not deliver to my institution	19%	4	10%	2	0%	0	19%	4	10%	2	24%	5	19%	4	21
My distributor does not carry local food	8%	2	0%	0	0%	0	28%	7	20%	5	12%	3	32%	8	25
My distributor does not identify or highlight local products	9%	2	0%	0	0%	0	22%	5	17%	4	13%	3	39%	9	23
Products are not available in the form I need them	12%	3	0%	0	4%	1	28%	7	8%	2	16%	4	32%	8	25
Storage	17%	4	4%	1	9%	2	30%	7	17%	4	9%	2	13%	3	23
Finding suppliers with accredited food safety plans	17%	4	0%	0	4%	1	39%	9	9%	2	4%	1	26%	6	23
Finding suppliers that have product processed in USDA inspected facilities	17%	4	0%	0	4%	1	30%	7	9%	2	4%	1	35%	8	23
Traceability mechanism of local product	22%	5	4%	1	4%	1	35%	8	13%	3	0%	0	22%	5	23
Sourcing products desirable for resale	32%	7	9%	2	5%	1	36%	8	5%	1	5%	1	9%	2	22
Finding suppliers that can provide necessary quantities at desired times	12%	3	0%	0	4%	1	19%	5	4%	1	12%	3	50%	13	26
Finding a product at the required price	4%	1	0%	0	4%	1	28%	7	8%	2	20%	5	36%	9	25
Contracts with current suppliers prevent us from purchasing from suppliers with local products	30%	7	0%	0	13%	3	22%	5	4%	1	22%	5	9%	2	23
Limited ability of suppliers to meet my delivery requirements	13%	3	0%	0	4%	1	38%	9	17%	4	13%	3	17%	4	24
Complexity of dealing with multiple small suppliers	8%	2	0%	0	0%	0	28%	7	24%	6	12%	3	28%	7	25
Handling product received from local	13%	3	0%	0	9%	2	30%	7	22%	5	13%	3	13%	3	23
Quality of products available	8%	2	0%	0	4%	1	20%	5	20%	5	20%	5	28%	7	25
Seasonality of local product	12%	3	0%	0	0%	0	19%	5	12%	3	19%	5	38%	10	26
Diversity of local produce	14%	3	0%	0	0%	0	19%	4	14%	3	14%	3	38%	8	21
Local, state, and/or federal policies and legislation	17%	4	8%	2	0%	0	21%	5	4%	1	13%	3	38%	9	24
Distribution & logistics	12%	3	4%	1	0%	0	20%	5	32%	8	20%	5	12%	3	25

To increase the demand for local food in ND, the survey covered some of the marketing and promotional tools that could raise the awareness of local food (Table 81). Using the 3-point Likert scale, we found one factors percentage that was more than 80%. Approximately 90% of the respondents believed that marketing local food produce grown in ND and creating a state brand for ND food produce is the most effective marketing tool to be applied. Loureiro and Hine (2002) found the same results among consumers in Colorado. While Onken, Bernard, and Pesek, Jr (2011) found that consumers' choices in the Mid-Atlantic states were varied regarding different labels such as organic, natural, locally grown, and state brand.

Table 81. Promotional Tools to Promote Local Food.

Promotional Tools to Promote Local Food	Not Helpful 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Helpful 7	Count	Total Count
A story or narrative of the farm and farmers	4%	1	0%	0	8%	2	21%	5	13%	3	33%	8	21%	5	24
Farmer visits to the institution	4%	1	0%	0	8%	2	29%	7	17%	4	21%	5	21%	5	24
Field trips to the farm	4%	1	4%	1	4%	1	32%	8	12%	3	24%	6	20%	5	25
"Grown in ND" "STATE BRAND"	4%	1	0%	0	0%	0	7%	2	7%	2	18%	5	64%	18	28
Location of the farm	4%	1	8%	2	12%	3	35%	9	0%	0	15%	4	27%	7	26
Name of the farm and farmer	8%	2	8%	2	8%	2	38%	10	4%	1	12%	3	23%	6	26
Photos of the farm and/or farmer	4%	1	4%	1	16%	4	32%	8	12%	3	16%	4	16%	4	25

Regardless of the constraints that are facing local food producers and factors that may be seen as an impedance to reach local food, 34% of the respondents expected the demand for local food somewhat would increase in the next three years. Other respondents (55%) believed that the demand for local food would stay the same market, not to be affected for the next three years. The first expectation may be more reliable than the second one since it matches the USDA and local food market expert expectations (see Table 82).

Table 82. Expectation of the Local Food Market for the Next Three Years.

Expectation of the local food market for the next three years	Percentage	Count
Greatly decrease	4%	1
Somewhat decrease	7%	2
Stay the same	55%	16
Somewhat increase	34%	10
Greatly increase	0%	0
Total	100%	19

To access local food, there are numerous marketing channels where local food customers and consumers can satisfy their needs of domestic food production. (Table 83) lists the eight most essential marketing channels. An institution's response directly depended on its understanding of these selling points and was discussed in detail in conclusion. Using the 3-point Likert scale, we found that 76% of the respondents preferred to buy local food from a produce distributor and a similar percent of the respondents preferred the broad-line distributor. Respondents who preferred to purchase local food directly from a farmer were 56%. Only 32% of the respondents preferred the purchase through a food hub. This percentage reflected the respondents' unawareness of a food hub function, which was provided in the role and attractiveness of a ND food hub section of the survey when we introduced them to the definition. Interestingly, 23% of the respondents preferred to purchase their local food online, which can be one of the operational models for a ND food hub.

Table 83. Preferred Methods for Purchasing Local Food.

Preferred Methods for Purchasing Local Food	Not Preferred 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Preferred 7	Count	Total Count
Direct from a farmer	20%	5	0%	0	12%	3	12%	3	4%	1	20%	5	32%	8	25
From a produce distributor	4%	1	4%	1	4%	1	12%	3	8%	2	20%	5	48%	12	25
Through a broad-line distributor	12%	3	0%	0	4%	1	8%	2	12 %	3	8%	2	56%	14	25
Food Hub	32%	7	0%	0	14%	3	23%	5	9%	2	0%	0	23%	5	22
Farmers markets	41%	9	5%	1	9%	2	27%	6	0%	0	5%	1	14%	3	22
On-farm markets	41%	9	9%	2	5%	1	27%	6	5%	1	5%	1	9%	2	22
CSAs	50%	10	10%	2	5%	1	25%	5	5%	1	0%	0	5%	1	20
Online	41%	9	5%	1	5%	1	27%	6	9%	2	0%	0	14%	3	22

Figure 16 shows the total amount volume of six food categories purchased by ND. Almost all food types existed in each dollar amount category below $100,000. Except for fruits and vegetables, they were until $500,000, and no food type was purchased more than $1,000,000.

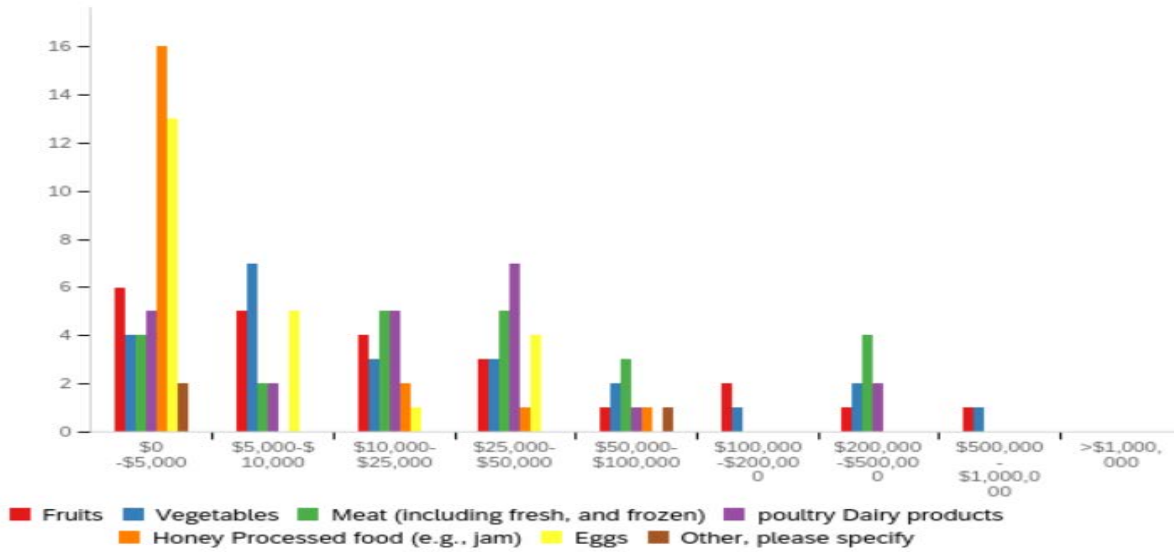

Figure 16. Total Purchased Amount for Six Food Categories.

Figure 17 shows the total amount volume of five processed fruit and vegetables purchased by ND. The x-axis presents the amount paid for fresh pack, wash pack, cut, canned, and frozen. The y-axis shows the number of responses for each type of processed food. Almost all types of processed food existed in each dollar amount category, except the amount between $100,000 to $200,000 had only two types, fresh pack and canned. The amount between $200,000 to $500,000 only had canned food.

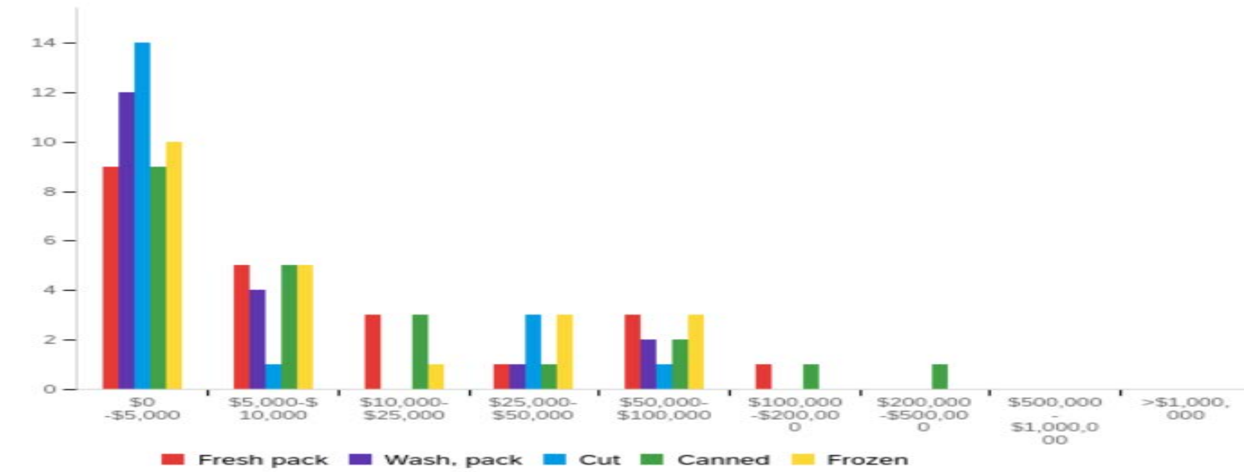

Figure 17. The Total Amount Volume of Five Processed Fruit and Vegetables Purchased by ND.

Figure 18 shows the percentage of local food that ND institutions were willing to buy from their total expenditures amount that was spent on food purchasing. The x-axis presents the percentage that institutions will substitute for local food from the total purchased amount for fruits, vegetables, meat, poultry, honey or any processed food, and eggs. The y-axis shows the number of responses for each food type. There were at least three responses willing to substitute 15 to 25 percent of their total purchase with local food.

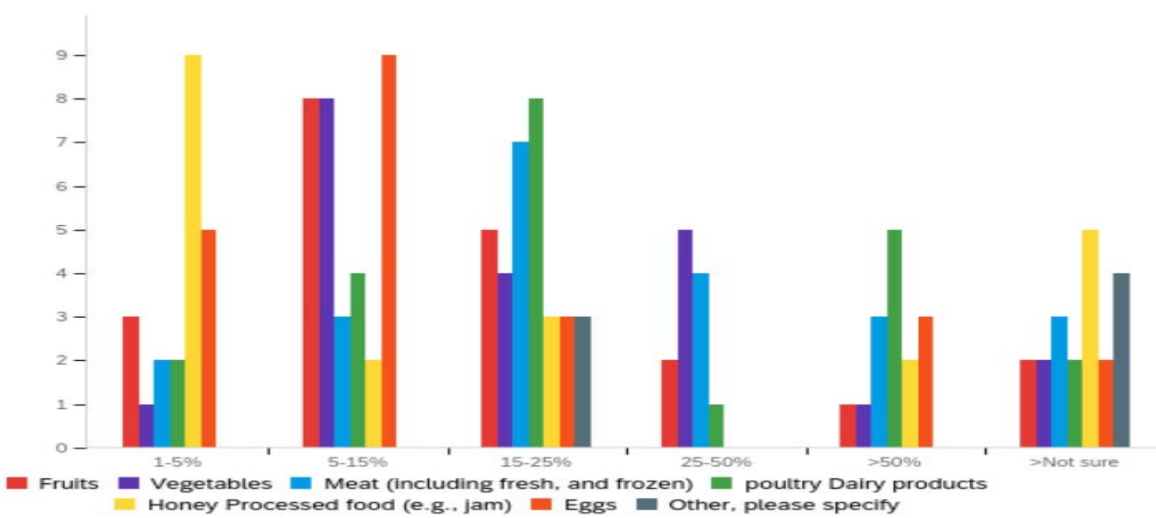

Figure 18. The Percentage of Local Food that ND Institutions Were Willing to Buy.

5.2.3. Local food concept

This section of the questionnaire covered ND institutions' opinions and conceptions about local food products. For example, how institutions defined local food by distance in miles, influencing factors for purchase local foods, purchasing flexibility regarding seasonality. The section included 14 questions: Five questions multiple-choice, four binaries, three fill-in-the-blanks, and two questions 7-point Likert scale.

There is no single definition of local food systems; local may have a variety of definitions based on peoples' interpretations. Therefore, it was essential to cover this issue in the survey. For a better understanding of the impression of local food, institutions were asked to share their perceptions of this concept by geographic area and by distance in miles. The holistic view of a respondent's perception about local food is necessary for our judgment of this concept, for that we asked them to provide a definition by a geographic area and by distance.

Tables 84 shows the respondents' point of view of local food definition based on geographical area. Fifty percent of the respondents interpreted local produce as food that was grown within their state, and 38% extended this description to the region where they live.

Table 84. Local Food by Geographic Area.

Local food by geographic area	Percentage	Count
Produced or processed in my county	4%	1
Produced or processed in my state	50%	12
Produced or processed in my region	38%	9
Produced or processed in the U.S.	0%	0
Knowing the origin where my food produced or processed	8%	2
Other	0%	0
Total	100%	24

Table 85 shows the respondents' point of view of local food definition based on distance in miles from point of sale. In consideration of the definition of local food from the distance of the point of sale, the highest percentage of the respondents (33%) chose the distance from 50 to 100 miles. The second highest percentage was 29% of the respondents who chose the distance from 200 to 400 miles. One respondent chose the other category and defined local food as food that is grown or processed in ND.

Table 85. Local Food by Distance in Miles.

Local food concept by distance in miles	Percentage	Count
Produced within less than 10 miles of the point of sale	0%	0
Produced within less than 10-25 miles of the point of sale	13%	3
Produced within less than 50-100 miles of the point of sale	33%	8
Produced within less than 100-200 miles of the point of sale	21%	5
Produced within less than 200-400 miles of the point of sale	29%	7
Other	4%	1
Total	100%	24

Customers have different concepts of local food; therefore, their purchasing behaviors are influenced by many factors that reflect their interpretation of the definition. Table 86 lists ten factors that influence local food purchase; interpreting local food as fresher food influenced 19% of the institutions, while 17% of the institutions purchased local food to support the local economy. Better taste and support of local farms each one obtained 12%.

Table 86. Factors that Influence Institutions to Purchase Local Produced Foods.

Factors that influence institutions to purchase local foods	Percentage	Count
Better taste	12%	13
Fresher food	19%	20
Higher quality	14%	15
Customer demand	5%	5
Marketing, 'good for business	8%	8
Costs less	5%	5
Food safety concerns	3%	3
Support local farms	11%	12
Support the local economy	16%	17
Environmental responsibility (food miles, etc.)	6%	6
Other	1%	1
Total	100%	105

In some cases, these factors are very powerful and are deeply embedded in an institution's norms and values, so they motivate their food suppliers to buy local food. Unfortunately, only 25% percent of the ND institutions influenced their food supplier to purchase local food compared with 75% who did not (see Table 87).

Table 87. Institutions Influence Suppliers to Buy Directly from ND Farms.

Institutions Influence their Suppliers to Buy Directly from ND Farms	Percentage	Count
Yes	25%	6
No	75%	18
Total	100%	24

Notwithstanding the fact that the percentage of institutions that influenced suppliers was only 25%, 61% of the ND institutions purchased and served local produce (Table 88). They bought and served local food such as apples, bread, buns, cabbage, carrots, cinnamon rolls, corn chips, cucumbers, dairy, lettuce, onions, potatoes, and vegetables. In contrast, 39% of the institutions did not purchase or serve local food, and they specified their answer for the following reasons:

- Part of the prison system, so we have budget constraints.

- Not sure what is available.
- Not convenient.
- Regulations, and need to meet federal regulations.

Table 88. Institution Purchased and Serve Locally Produced Food.

Does your institution purchase or serve locally produced foods	Percentage	Count
Yes	61%	14
No	39%	9
Total	100%	23

However, purchasing local produce requires commitment and planning. Institutions must be flexible with local food seasonality and variations in the quantity that may occur due to seasonality and other factors. Using the 3-point Likert scale, we found that 35% of ND institutions were very flexible with seasonality. In contrast, 33% of ND institutions were flexible with variation in quantity. Tables 89 and 90 show ND institutions' flexibility regarding seasonality and the variation of quantity of local produce.

Table 89. Institution's Purchasing Flexibility Regarding Seasonality of Local Produce.

Purchasing Flexibility Seasonality	Percentage	Count
Not Flexible 1	5%	1
2	5%	1
3	15%	3
Neutral 4	40%	8
5	5%	1
6	10%	2
Very Flexible 7	20%	4
Total	100%	20

Table 90. Institution’s Purchasing Flexibility Regarding the Amount of Local Produce.

Purchasing Flexibility Quantity	Percentage	Count
Not Flexible 1	10%	2
2	0%	0
3	14%	3
Neutral 4	43%	9
5	19%	4
6	10%	2
Very Flexible 7	5%	1
Total	100%	21

The ND institutions that were surveyed purchased locally grown produce seasonally whenever the local food product was available, and the percentage of these institutions was 48%. While 17% purchased local food monthly and only nine percent purchased local food weekly. Only two institutions (9%) never bought local-grown produce. For the two responses in the other category, one responder specified his answers once in a while. The second received donations from neighbor garden produce; refer to Table 91 for these results.

Table 91. Institution’s Frequency for Locally Grown Purchase.

Institution’s Frequency for Locally Grown Purchase	Percentage	Count
Daily	0%	0
Weekly	9%	2
Monthly	17%	4
Quarterly	4%	1
Seasonally	48%	11
Never	9%	2
Other	13%	3
Total	100%	23

Table 92 shows the ND institutions with customers that prefer local food and ask for it, which was 22%. In contrast, (Table 93) presents ND institutions that recorded an increase in demand for local food; 48% had an increase in the number of consumers that demanded local food.

Table 92. Institution's Consumer Demand for Locally Produced.

A consumer Demand Locally Produced Food	Percentage	Count
Yes	22%	5
No	78%	18
Total	100%	23

Table 93. Institution's Recoding Increase in Local Food Products Demand.

Institution's Forecasting about Local Food Products Demand	Percentage	Count
Yes	48%	11
No	52%	12
Total	100%	23

Table 94 shows how ND institutions and their food supplier's pricing of local food produce compared with non-local food. Sixty-eight percent were not sure how they price local food, and at the same time, 18 % priced local food higher than non-local food. In contrast, 9% priced local food lower than local food. As mentioned in the literature, many researchers surveyed and documented consumer's WTPPP for local/regional/organic food either in the U.S. or in Europe. For example, according to Darby et al. (2008), food consumers in Midwestern states were WTPPP for local food. Consumers were motivated to pay that price because of the values associated with local food products, such as freshness, and the sympathetic attitudes such as supporting small and mid-size farms.

Table 94. Institutions and Food Suppliers Pricing Strategy for Local Produce.

Institution's and Food Supplier's Pricing Strategy for Local Produce	Percentage	Count
Lower price	9%	2
Same price	0%	0
Higher price	18%	4
Mutually beneficial price	0%	0
Not sure	68%	15
Total	100%	22

In the last part of the local food concept section of the survey, respondents were provided a chance to show their complete knowledge, perception, and understanding of three features regarding local food trends over the past five years, institutions local food marketing campaign, and ND local produce purchasing challenges with open-ended questions. Over the past five years, consumers' awareness and concern about food have increased as now there are more people that want to know where their food is coming from and how it is being handled and processed, which pressures institutions to emphasize locally grown and sourced food supplies. The number of farmer's markets increased dramatically. In addition, the number of restaurants that serve fresh and locally grown products has increased to meet the increased demand by consumers.

Furthermore, grocery stores that offer a variety of locally grown products such as fruits and vegetables have increased. However, customers would rather buy from a hot, dusty parking lot in what they perceive as a farmer’s market than from grocery store coolers that offer the same products from the same source. In response to the increased demand for local produce, some institutions modified their mission, promotions, and customer education and information. In addition, some schools have gardens where kids can learn about farming and acquire the benefit of local produce, and taste fresh-grown products. Another institution has contracts with small farms where they can obtain local produce seasonally. In contrast, other institutions celebrate “Pride of North Dakota Day” where they purchase all locally grown food items to feature on their menu.

Purchasing local produce can sometimes be challenging, especially in ND, where the growing seasons are short for many local fresh food products, particularly for fruits and vegetables, and storage is costly and will not solve the problem. The high price for local produce and the availability of sufficient quantities limits institutions' ability to purchase local fresh food products.

Some institutions require massive quantities of food products daily, so it is often difficult to rely on local distributors. On the other hand, some local distributors may require a minimum purchase amount, which creates boundaries for smaller institutions. Although local food is available, some institutions do not have the time to search to find out who is offering it and what is available. This includes small schools that do not have local vendors. Another limitation may occur based on the institution's policy and regulation. For instance, healthcare and hospitals are very regulated about food distribution and preparation.

5.2.4. The role and attractiveness of a ND food hub by institutions

The section included 12 questions, five questions 7-point Likert scale, three questions fill-in-the-blank, two open-ended questions, one binary, and one multiple-choice question. To simplify the food hub concept for the participants as some of them are unfamiliar with the food hub term. The author provided his version of the food hub definition at the beginning of this section to introduce food hub functions to the participants (A food hub is a business that aggregates, markets, and distributes products from several local/regional farms. Food hubs offer services that may include cooling, storage, marketing and distribution, washing, grading, sorting, packing, repacking, packaging and labeling, and branding).

The first three questions of this section were combined in (Tables 95 and 96). The first question aimed to analyze ND institutions' awareness of food hubs and measure their familiarity level. Using the 3-point Likert scale, we found 67% of the respondents were unfamiliar with food hubs, compared with 20% of respondents who were familiar with the concept. This high percentage of respondents' unfamiliarity may explain why only 32% of respondents Preferred food hubs as purchasing methods (Table 83).

The second item inquired about the level of ND institutions agreement with the statement, “A food hub can provide sustainability to a local food economy, for that it may be important for each state to have at least one food hub to support producers and serve the public with local/regional/national food.” We did not record any disagreement from the respondents, and 77% agreed with this stamen.

The third item measured the level of interest of ND institutions in joining a food hub. We recorded zero percent for uninterested institutions; furthermore, 85% of the ND institutions were very interested in joining a food hub project. Institutions that were neutral in their interest were only 15%.

Table 95. The Role and Attractiveness of a ND Food Hub for Institutions.

The Role and Attractiveness of a ND Food Hub for Institutions	1-3 %	Count	Neutral	Count	5-7 %	Count
Level of familiarity with food hub concept	67%	10	13%	2	20%	3
Local food sustainability and food hub	0%	0	23%	3	77%	10
Level of interest to join a food hub	0%	0	15%	2	85%	11

Table 96. Descriptive Statistics of a ND Food Hub Role and Attractiveness for Institutions.

Descriptive Statistics of a ND Food Hub Role and Attractiveness for Institutions	Mean	Std. Deviation	Variance	Count
Level of Familiarity with Food Hub Concept	2.8	1.94	3.76	15
Local food sustainability and food hub	5.46	1.08	1.17	13
Level of interest to join a food hub	5.85	1.17	1.36	13

Table 97 shows the percentage of organic food required by ND institutions to purchase from the ND food hub. Almost all ND institutions that responded to this survey required zero percent organic food to be purchased for all food categories. Only one respondent either was not sure about the organic percentage or if the institution was needed to purchase organic food or not.

Table 97. Organic Percentage from the Total Purchase Amount.

Food Category	0%	Count	1-10%	11-20%	21-50%	>50%	Not Sure	Count
Fruits	86%	6	0%	0%	0%	0%	14%	1
Vegetables	86%	6	0%	0%	0%	0%	14%	1
Meat (including fresh, and frozen)	86%	6	0%	0%	0%	0%	14%	1
Poultry dairy products	86%	6	0%	0%	0%	0%	14%	1
Honey	86%	6	0%	0%	0%	0%	14%	1
Processed food (e.g., jam)	86%	6	0%	0%	0%	0%	14%	1
Eggs	86%	6	0%	0%	0%	0%	14%	1

Institutions may choose to not only purchase food from a food hub but also in some situations; they may play the role of a shareholder by offering infrastructure or the capital needed for launching a food hub. Table 98 shows that ND institutions currently were not willing to act as stakeholders.

Table 98. Institutions Interested in Offering paid Services through a Food Hub.

Institutions Interested to offer any Paid Services through a Food Hub	Percentage	Count
Yes	0%	0
No	100%	8

In addition, a specific paid service to support a food hub by interested institutions was listed in (Figure 19) to quantify ND institutions' willingness to be shareholders. However, institutions that responded to this survey were unwilling to provide any paid service.

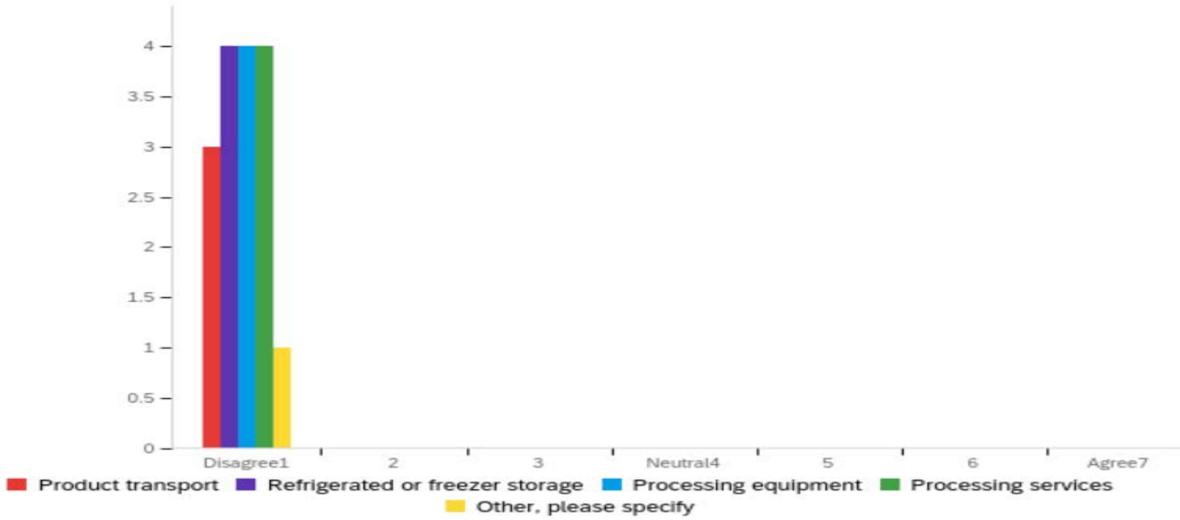

Figure 19. Specific Paid Services offered by ND Institutions.

In terms of ND institutions as local food buyers and their local food purchase requirements, (Table 99) lists 12 factors that may affect the institution's purchase of local produce from the ND food hub. Using the 3-point Likert scale, we found five respondents chose two factors regarding the price of the local produce, and both obtained (83%): set contracts on price and/or volume, and open market pricing structure for the product. Both of these factors were chosen by the ND food producers, which indicates that food buyers and producers are concerned about the local food price. Furthermore, we found four respondents (67%) chose three factors: pre-season product planning to pre-arrange products, quantities, packaging, and timing of deliveries, pre-purchase of a portion of forecasted demand, and offers farm-identified products. The first two factors refer to the local food quantity to ensure that the local food covers the demand. The third factor refers to the traceability and quality of local food. Interestingly, 100% of the respondents were not interested in being investors in a food hub.

Table 99. Factors Important for Institutions Purchasing.

Factors Important for Institutions Purchasing	Not important 1	Count	2	Count	3	Count	4	Count	5	Count	6	Count	Very Important 7	Count	Total Count
Pre-season product planning to pre-arrange products, quantities, packaging, and timing of deliveries	17%	1	0%	0	0%	0	17%	1	17%	1	0%	0	50%	3	6
Pre-purchase of a portion of forecasted demand	17%	1	0%	0	17%	1	0%	0	33%	2	0%	0	33%	2	6
Set contracts on price and/or volume	17%	1	0%	0	0%	0	0%	0	0%	0	17%	1	67%	4	6
Open market pricing structure for product	17%	1	0%	0	0%	0	0%	0	17%	1	17%	1	50%	3	6
Offers certified organic grown or produced products	67%	4	17%	1	0%	0	0%	0	17%	1	0%	0	0%	0	6
Offers chemical-free products	50%	3	0%	0	0%	0	17%	1	17%	1	17%	1	0%	0	6
Offers products with social values (food miles, etc.)	50%	3	17%	1	17%	1	0%	0	17%	1	0%	0	0%	0	6
Offers farm-identified products	17%	1	0%	0	0%	0	17%	1	33%	2	33%	2	0%	0	6
Has strong consumer-facing brand that stands for local/regional products	17%	1	0%	0	0%	0	50%	3	17%	1	17%	1	0%	0	6
Branding and market development for State food brand	17%	1	0%	0	0%	0	33%	2	33%	2	0%	0	17%	1	6
Value-added product development	17%	1	0%	0	0%	0	33%	2	17%	1	33%	2	0%	0	6
Become an investor of the food hub	100%	5	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	6

Table 100 has three columns. The first column lists the protein product types, the second one includes the quantity of each protein type, and the last column displays the purchasing frequency of that protein type. In view of the fact that product type was specified only for protein, it was expected to obtain a list such as beef as ground or chunk, chicken with various cut or specific parts, and eggs; meanwhile, the primary purpose was to quantify each product type and measure the regularity of each product. The tremendous quantity of local protein products demanded by respondents to be sourced from a ND food hub presented their commitment and willingness as local food buyers. In addition, most of the responses demanded the amount weekly to show commitment to providing fresher local food products to their food consumers. Similar results were found for types of fresh fruit and vegetables and dairy products as listed in (Table 101 and Table 102), respectively.

Table 100. Types of Protein Products (Meat, Poultry, Eggs) that Institutions Interested in Sourcing from a ND Food Hub.

Product Type	Quantity	Frequency
Beef	20 pounds	Weekly
Chicken	45 pounds	Weekly
Chicken breasts	20 pounds	Weekly
Chicken various cuts	6 pounds	Weekly
Eggs	45 dozen	Weekly
Eggs	10 cartons	Weekly
Eggs	30 dozen	Weekly
Eggs	25 dozen	Every two month
Eggs	12 dozen	Weekly
Ground beef	20 pounds	Weekly
Ground beef	10 pounds	Weekly
Ground beef	80 pounds	monthly
Ground beef	20 pounds	Weekly
Ground beef	20 pounds	Weekly
Meat	varies	Monthly
Meat	varies	Monthly
Poultry	varies	Monthly

Table 101. Types of Fresh Fruit and Vegetables that Institutions Interested in Sourcing from a ND Food Hub.

Product Type	Quantity	Frequency
Apples	varies	Every three months
Broccoli	1 carton	weekly
Carrots	varies	Every two months
Corn	varies	weekly
Cucumbers	5 pounds	weekly
Fruits	varies	weekly
Green beans	5 pounds	weekly
Melons	varies	Monthly
Romaine lettuce	15 pounds	weekly
Squash	varies	weekly
Tomato	5 pounds	weekly
Tomato	10 pounds	weekly
Vegetables	varies	Monthly
Vegetables	varies	weekly

Table 102. Types of Dairy Products that Institutions Interested in Sourcing from a ND Food Hub.

Product Type	Quantity	Frequency
Butter	5 pounds	Weekly
Butter	3 pounds	Weekly
Cheese	10 pounds	Weekly
Cheese	10 pounds	Weekly
Cheese	15 pounds	Weekly
Cottage cheese	5 pounds	Weekly
Sour cream	25 pounds	Every 2 months
Whole Milk	30 gallons	Weekly
Whole Milk	40 gallons	Weekly
Whole milk	15 gallons	Weekly
Whole milk	5 gallons	Weekly
1% milk	20 gallons	Weekly
Yogurt	10 pounds	Weekly

Finally, from the last two open-ended questions of this section, respondents suggested that acquiring certificates, such as HACCP, may increase customer satisfaction if a ND food hub is implemented, along with a convenient location to offer local food access to most ND institutions. Another factor that may increase customer satisfaction is offering special contracts or discounts for schools and institutions that have a limited budget that provides food for students or individuals for free or for a symbolic charge in order to improve the health of students and the public.

5.3. Inferential Statistics

A variable screening method was used for the inferential statistics analysis part for the demand-side to find the most significant variable. The Statistical Analysis System (SAS 9.3) was used to operate the stepwise multiple regression (backward elimination) analysis to evaluate and test the demand side's five hypotheses. The five hypotheses included six independent variables: Q 16 limitation on the number of vendors, Q 27 flexibility regarding local food quantity, Q 28 flexibility regarding local food seasonality, Q 31 increase in demand and need for more local food products, Q 48 type of institution or business, and Q 49 type of gender. In addition, the hypotheses contained three dependent variables: Q 36 level of familiarity with a food hub concept, Q 37 level of agreement with sustainability statement, and Q 38 level of interest of ND food producers in selling food products through the ND food hub.

The six independent variables were examined against each dependent variable. The backward elimination process requires including all the independent variables in the first model and eliminate the most non-significance variable one at a time. The elimination steps run until we find the most significant or the less non-significance independent variable. In the case of less non-significant variables, we did the power analysis to find the sample size needed for that variable to be significant. The SAS 9.3 program was coded to run three different backward elimination analyses for each dependent variable (see Appendix I).

5.3.1. The first backward elimination analysis model for the demand-side (Q 36)

The first backward elimination analysis included seven steps as follow:

- Step 1: Backward elimination initially fits a model containing all the six independent variables (questions 16, 27, 28, 31, 48, and 49) k represents the independent variables) in the model.

$$E(y) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$$

The variable with the smallest F-value or the largest p-value (> 0.05) for testing the model for $H_0: \beta_i = 0$ (see Figure 20). The most non-significance variable (question 16) was identified and dropped from model 7.

Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	34.40224595	4.91460656	1.45	0.3793
Error	4	13.59775405	3.39943851		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.716713	61.45855	1.843757	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	18.93265657	9.46632829	2.78	0.1747
Q16	1	0.01279250	0.01279250	0.00	0.9540
Q31	1	1.27463469	1.27463469	0.37	0.5734
Q27	1	0.69281613	0.69281613	0.20	0.6751
Q28	1	16.81254495	16.81254495	4.95	0.0902
Q49	1	0.31387478	0.31387478	0.09	0.7764

Figure 20. Demand-Side First Backward Elimination Analysis Model 7 Step 1.

- Step 2: The model with the remaining (k − 1) independent variables (Q 27, Q 28, Q 31, Q 48, and Q 49) was fit into model 6 and run again.

- Step 3: The variable associated with the smallest nonsignificant F-value or largest p-value (Q 49) was dropped from model 6 (see Figure 21).

Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	34.38945345	5.73157557	2.11	0.2156
Error	5	13.61054655	2.72210931		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.716447	54.99605	1.649882	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	19.24117866	9.62058933	3.53	0.1105
Q31	1	1.26980795	1.26980795	0.47	0.5250
Q27	1	0.68858388	0.68858388	0.25	0.6364
Q28	1	16.96879854	16.96879854	6.23	0.0547
Q49	1	0.30777992	0.30777992	0.11	0.7503

Figure 21. Demand-Side First Backward Elimination Analysis Model 6 Step 3.

- Step 4: We repeated steps 2 and 3 for model 5 (Figure 22). The variable associated with the smallest nonsignificant F-value or largest p-value (Q 27) was dropped from model 5.

Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	34.08167353	6.81633471	2.94	0.1110
Error	6	13.91832647	2.31972108		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.710035	50.76877	1.523063	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	19.72145999	9.86072999	4.25	0.0708
Q31	1	3.03781388	3.03781388	1.31	0.2961
Q27	1	2.14167353	2.14167353	0.92	0.3737
Q28	1	20.45992947	20.45992947	8.82	0.0250

Figure 22. Demand-Side First Backward Elimination Analysis Model 5 Step 4.

- Step 5: We repeated steps 2 and 3 for model 4 (Figure 23). The variable associated with the smallest nonsignificant F-value or largest p-value (Q 31) was dropped from model 4.

Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	31.94000000	7.98500000	3.48	0.0721
Error	7	16.06000000	2.29428571		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.665417	50.48967	1.514690	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	19.72197674	9.86098837	4.30	0.0606
Q31	1	2.08035088	2.08035088	0.91	0.3727
Q28	1	19.64454545	19.64454545	8.56	0.0221

Figure 23. Demand-Side First Backward Elimination Analysis Model 4 Step 5.

- Step 6: We repeated steps 2 and 3 for model 3 (Figure 24). The variable associated with the smallest nonsignificant F-value or largest p-value (Q 48) was dropped from model 3.

Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	29.85964912	9.95321637	4.39	0.0419
Error	8	18.14035088	2.26754386		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.622076	50.19455	1.505837	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	17.96537600	8.98268800	3.96	0.0637
Q28	1	26.52631579	26.52631579	11.70	0.0091

Figure 24. Demand-Side First Backward Elimination Analysis Model 3 Step 6.

- Step 7: The last independent variable in the model (Q 28) was statistically non-significant (Figure 25).

Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	5.55496217	5.55496217	1.35	0.2675
Error	12	49.30218069	4.10851506		
Corrected Total	13	54.85714286			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.101262	74.67700	2.026947	2.714286

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q28	1	5.55496217	5.55496217	1.35	0.2675

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	0.7102803738	1.80659172	0.39	0.7011
Q28	0.4922118380	0.42330553	1.16	0.2675

Figure 25. Demand-Side First Backward Elimination Analysis Model 1 Step 7.

The first backward multiple regression for the demand-side was conducted to identify the most significant independent variables (Q 16 limitation on the number of vendors, Q 27 flexibility regarding local food quantity, Q 28 flexibility regarding local food seasonality, Q 31 increase in demand and need for more local food products, Q 48 type of institution or business, and Q 49 type of gender) for predicting the dependent variable (ND food producer level of familiarity with food hub concept). All models result for the first backward multiple regression for the demand-side are in (Appendix J). Model 1 with the most important predictors variables included only flexibility regarding local food seasonality (Q 28) and was statistically non-significant, F (1.35) = 0.2675, p > 0.05, R^2 = 0.101 (Figure 25). We run the power analysis for this independent variable in model 1 at a 95% confidence level; we needed sample size N = 118; the actual sample size was N = 30 (Figure 26).

dependent(Q36), most close to be significant variable is Q28

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	1
Number of Test Predictors	1
R-square of Full Model	0.101262
Difference in R-square	0.101262
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.802	72
2	0.85	0.852	82
3	0.90	0.902	96
4	0.95	0.951	118

Figure 26. Demand-Side First Backward Elimination Analysis Power Analysis for Model 1.

5.3.2. The second backward elimination analysis model for the demand-side (Q 37)

The second backward multiple regression demand-side was conducted to identify the most significant independent variables (Q 16 limitation on the number of vendors, Q 27 flexibility regarding local food quantity, Q 28 flexibility regarding local food seasonality, Q 31 increase in demand and need for more local food products, Q 48 type of institution or business, and Q 49 type of gender) for predicting the dependent variable (ND food producer level of agreement about food hub and sustainability). We repeated the seven steps that were done for the first backward multiple regression for the second backward multiple regression demand-side; all models result for the second backward multiple regression for the supply-side listed in (Appendix J).

Model 1 with the most important predictors variables included only flexibility regarding local food seasonality (Q 28), F (3.65) = 0.0823, $p > 0.05$, $R^2 = 0.25$ (Figure 27). This indicates that this model can explain 25% of the variance of the level of agreement. The independent variable was statistically non-significant, with the actual sample size N = 30. We run the power analysis for this independent variable in model 1 at a 95% confidence level; we needed a sample size N = 42 (Figure 28).

Dependent Variable: Q37 Importance of sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3.79814512	3.79814512	3.65	0.0823
Error	11	11.43262411	1.03932946		
Corrected Total	12	15.23076923			

R-Square	Coeff Var	Root MSE	Q37 Mean
0.249373	18.66645	1.019475	5.461538

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q28	1	3.79814512	3.79814512	3.65	0.0823

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	3.723404255	0.95218124	3.91	0.0024
Q28	0.418439716	0.21888890	1.91	0.0823

Figure 27. Demand-Side Second Backward Elimination Analysis Model 1 Step 7.

dependent(Q37), most close to be significant variable is Q28

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	1
Number of Test Predictors	1
R-square of Full Model	0.249373
Difference in R-square	0.249373
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.805	26
2	0.85	0.861	30
3	0.90	0.903	34
4	0.95	0.954	42

Figure 28. Demand-Side Second Backward Elimination Analysis Power Analysis for Model 1.

5.3.3. The third backward elimination analysis model for the demand-side (Q 38)

The second backward multiple regression demand-side was conducted to identify the most significant independent variables (Q 16 limitation on the number of vendors, Q 27 flexibility regarding local food quantity, Q 28 flexibility regarding local food seasonality, Q 31 increase in demand and need for more local food products, Q 48 type of institution or business, and Q 49 type of gender) for predicting the dependent variable (ND food producer level of interest in joining a ND food hub). We repeated the seven steps that were done for the first backward multiple regression for the second backward multiple regression demand-side; all models result for the second backward multiple regression for the supply-side listed in (Appendix J).

Model 1 with the most important predictors variables included only flexibility regarding local food quantity (Q 27), F (2.26) = 0.1613, $p > 0.05$, $R^2 = 0.3$ (Figure 29). This indicates that this model can explain 30% of the variance of the level of interest in joining a ND food hub. The independent variable was statistically non-significant, with the actual sample size N = 30. We run the power analysis for this independent variable in model 1 at a 95% confidence level; we needed a sample size N = 66 (Figure 30).

Dependent Variable: Q38 Join Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3.00989727	3.00989727	2.26	0.1613
Error	11	14.68241042	1.33476458		
Corrected Total	12	17.69230769			

R-Square	Coeff Var	Root MSE	Q38 Mean
0.170125	19.76205	1.155320	5.846154

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Q27	1	3.00989727	3.00989727	2.26	0.1613

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q27	1	3.00989727	3.00989727	2.26	0.1613

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.719869707	0.81560309	5.79	0.0001
Q27	0.252442997	0.16810856	1.50	0.1613

Figure 29. Demand-Side Third Backward Elimination Analysis Model 1 Step 7.

dependent(Q38), most close to be significant variable is Q27

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	1
Number of Test Predictors	1
R-square of Full Model	0.170125
Difference in R-square	0.170125
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.807	41
2	0.85	0.852	46
3	0.90	0.904	54
4	0.95	0.952	66

Figure 30. Demand-Side Third Backward Elimination Analysis Power Analysis for Model 1.

6. DISCUSSION

6.1. ND Regional Food Hub Feasibility Study Part A: Supply and Part B: Demand

The fact that ND is one of four states that do not have a food hub motivated this research and led to the main research question, *“Does the ND local food system need a food hub?”* Due to the scarcity of studies investigating the local food system in ND, this research was designed to be a feasibility study for a regional food hub in ND. The regional ND food hubs’ feasibility study was divided into two sections, A and B, to investigate and evaluate the supply and demand for the local food. Two independent cross-sectional surveys were used to accomplish the ND food hub feasibility study. Part-A, the supply-side, had a questionnaire with 51 questions that targeted food producers that included farmers and ranchers in ND. Part-B, the demand-side, had a questionnaire with 51 questions that targeted local food customers such as schools, hospitals, colleges and universities, local grocery stores, and other institutions or businesses. We used the variable screening methods to test five independent variables from the supply-side and six independent variables from the demand-side against three dependent variables that were duplicated in both surveys.

To create a holistic view of the local food system potential in ND and close the literature gap, this regional food hub feasibility study included objectives and questions that covered a wide range of topics. The first step was to ascertain a definition for local food from the producer and customer perspectives. The literature already showed differences in opinions about what defines local food, such as Bellows and Hamm (2001); Martinez et al. (2010); Feldmann and Hamm. (2015); Meyerding, Trajer, and Lehberger. (2019). Most notably, this was the first study to our knowledge to investigate the ND local food system in general and, in particular, the supply and demand for local food.

6.1.1. What local food means in ND

Schmit (2008) relied on local food suppliers' preferences to define local food because local food suppliers and distributors have a broader view of describing local foods than food consumers. Other authors, such as Darby et al. (2008), depended on food consumers' opinions to define local food. On the other hand, Martinez et al. (2010) defined local foods based on their geographic origin. In comparison, in 2008, the U.S. Congress defined local food based on distance and specified that local/regional foods are foods produced and consumed within a state or 400 miles from their origin.

In this study, we relied on both local food suppliers and customer preferences to define local. Thus, we defined local food from food suppliers and customers' preferences based on geographical area and distance. Based on the number of respondents of this study, we found that there were two groups based on geographical area and three groups based on distance, as follows:

- The first group based on geographical area included 43% of the suppliers and 50% of the customers who defined local as food produced in the state based on geographical area. The second group contained 23% of the suppliers and 38% of the customers who define local as food produced in their region.
- The first group based on mileage distance included 38% of the suppliers and 33% of the customers who defined local as food produced and consumed within 50 to 100 miles. The second group included 23% of the suppliers and 21% of the customers who defined local as food produced and consumed within 100 to 200 miles. The third group consisted of 19% of the suppliers and 29% of the customers who defined local as food produced and consumed within 200 to 400 miles.

Considering the huge geographical area for ND, we believe defining local based on the geographical area is best than mileage distance. Hence, we have concluded from our results that the ND food producers and customers define local food as food produced in ND. These results corroborated the U.S. Congress definition of local food as well as the ND department of agriculture.

According to Feldstein and Barham (2017), profitable food hubs usually start in small geographic areas and consider the food market's depth before expanding their services. Therefore, a ND food hub can start distributing food products labeled grown in ND within the state boundaries. Also, a ND food hub can take advantage of the Pride of Dakota brand since most suppliers and customers defined local food as food produced in ND. This brand name can help the ND food hub expand the future service to be regional. According to Olson (2021), the effort that the ND department of agriculture did for years to strengthen the Pride of Dakota brand may have cemented the local food definition in mind of ND food suppliers and customers.

6.1.2. Interest and willingness for the ND food project

After confirming the local food definition in ND, our next objective was to reveal what a food hub means in ND. We used three dependent variables: level of familiarity with a food hub, level of agreement about a food hub and sustainability, and if a food hub project was necessary for each state. The third dependent variable was ND food producers' willingness to sell to a ND food hub and ND customers' interest to buy local food from a ND food hub to gather and measure ND food producers' and customers' opinions about a food hub.

The three dependent variables were used in both surveys as a 7-point Likert scale. The respondents who recorded a high level on the 7-point Likert scale (from 5 to 7) for familiarity, agreement with sustainability statement, and interest in joining a ND food hub were 42%, 68%, and 76% of the ND food producers, respectively. And the results for the ND food customers were 20%, 77%, and 85% for familiarity, agreement, and interest, respectively. The results from the supply and the demand sides of the ND local food market indicated that ND food producers and customers were very interested in joining a ND food hub and believe this project is vital for ND and can provide a sustainable local economy.

This indication was not affected by their low level of unfamiliarity. And since people usually resist unfamiliar new ideas, these results were unbiased and reflected the absolute need for this project. Furthermore, we found that 73% of the ND food producers have at least Bachelor's degrees or higher degrees. Similarly, we found from the demand-side that 57% of the respondents were educational institutions, and 25% were hospitals. We believe that education is one of the reasons that increased the level of agreement and interest in the ND food hub project. This result corroborated previous studies such as Brown (2003) and Tregear and Ness (2005). They found that higher education is linked with more willingness to purchase local food because of sympathetic attitudes towards farmers.

In addition, we applied the variable screening method (stepwise regression backward elimination) to test the three dependent variables against the five independent variables from the supply-side (farm or pasture size, production of V.A.P., level of education, employment type, and years of experience). And the six independent variables that were used from the demand-side were: limitation on the number of vendors, flexibility regarding local food quantity and seasonality, increase in demand and need for more local food products, type of institution or business, and type of gender. The variable screening method results revealed three different models for each side.

6.1.2.1. Supply-side

- In the first model, we found that the level of familiarity was statistically significant with V.A.P. production. That means ND food producers who produce V.A.P. were more familiar with the food hub idea. Because V.A.P. is all about niche markets, we believe this finding was rational. In addition, the farm or pasture size was the least non-significant variable against familiarity.
- In the second model, we found the two least non-significant variables: employment type and years of experience. This means ND food producer who worked full time and had less than ten years' experience believed that a food hub is an important project for each state to have a sustainable local food system.
- The employment type was the least non-significant variable in the third model, which means the full-time producers showed a high level of interest to sell their product through a ND food hub.

6.1.2.2. Demand-side

- In the first model, we found that the flexibility regarding local food seasonality was the least non-significant independent variable. This means the ND institutions with a high level of familiarity are more flexible about the seasonality of local food.
- In the second model, we found again that the flexibility regarding local food seasonality was the least non-significant independent variable. That means the ND institutions that agreed that a food hub is a necessary project for each state to provide sustainability are more flexible about local food seasonality.
- In the third model, the flexibility regarding local food quantity was the least non-significant independent variable, which means the ND institutions with a high level

of interest in buying local food from food hubs are more flexible with the local food quantity that is supplied to them.

We believe the high level of interest in joining a ND food hub from both sides was remarkable and urged us to consider the ND food hub as a feasible project. The high level of interest came from food producers who produce V.A.P. and from customers who were very flexible reading the seasonality and quantity of local food products.

6.1.3. ND local food market capacity and scale-up opportunity

Food hubs have become an increasingly popular response to help and support food producers who own small and mid-sized farms by covering the gap between farmers and markets to add value to the food supply chain infrastructure. The challenges face beginner farmers/ranchers or food producers, particularly those who own small and mid-sized farms. This segment of the local food system usually does not have access to local or regional food supply chain systems. Because these food producers financially cannot own or lease an infrastructure for aggregation, distribution, and marketing. But they can grow their business to be regionally or even locally reach a level where they can sell their food products to the wholesale level. These obstacles and challenges create unfair competition between small and mid-sized farms and large farms, leading to a decreasing number of small and mid-sized (MacDonald, Hoppe, and Newton 2018). According, to the NDSU Agriculture Communication website, in 2017, the average farm size in ND was 1,937 crop acres or 490 pasture acres. The results of this research indicate that 64% of respondents operated farms or pastures that are less than the average size. We found that 50% of the respondents were working full-time as a food producer, which means the only income they receive were coming from farming. For that reason, they need a project that can help and support their business. Hughes et al. (2016) observed the development of local/regional entrepreneurial projects might benefit both farmers and the local economy.

Furthermore, food hubs can scale-up production by finding a new market and access to the whole food buyers, which are not accessible by individual food producers. According to Bregendahl and Flora (2006), a food hub can scale-up farm production and support farmers, especially beginner farmers, by providing professional market advice and educational knowledge such as marketing skills and practical information and data. We found that 34% of the respondents have less than ten years of experience; according to Ahearn (2011), a beginning farmer (with less than ten years of experience) needs help in scale up production to be profitable. We also found that 44% of the ND food producers were planning to expand their operation, and 52% of them planned to implement season extension technologies. On the other hand, 46% of the ND food producer were willing to increase production to meet wholesale demands.

On the other hand, we found that demand for food was divided into two halves 50% of the ND institutions demanded food products year-round, 50% demanded food products during the school year, and 34% expected the purchasing amount of food will increase in the next three years. Also, we found that 61% of respondents were purchasing local food, and 48% noticed a demand increase for local food. As claimed by Aprile et al. (2012); Campbell et al. (2013); Costanigro et al. (2014); Gracia (2014), consumers value the local food product more than the organic. We found that 90% of the ND institutions preferred conventional labels compared with zero percent for organic. According to Adams and Salois (2010), after the federal organic standards were put in place, consumer preferences in the U.S. shifted from organic toward local food. Naspetti and Bodini (2008) said local foods are often preferred because they embody either one or more of the attributes associated with trusts, such as freshness, seasonality, naturalness, and territoriality; these attributes are usually not linked to organic food. Motives that influence consumers to buy local food were documented in much literature and were consistent with our research results. Comparing customers' (whole food buyers) preferences with consumers' preferences, we found that they share the same attributes associated with local food. From 12 motives that may drive institutions' interest in buying local food, we found five motives with a high level of importance. Respondents recorded a high level on the 7-point Likert scale (from 5 to 7) for taste, quality, freshness, support local farmers, and support of the local economy. Respondents' percentage were for these five motives 96%,93%,93%,90%, and 90%, respectively.

Finally, our results measured the local food market capacity from the supply and demand sides. The status quo for local food products was evaluated by matching the food producers' local food products with needed food products from the demand-side. And our findings indicated that there are enough supply and demand for the local food in ND. Most of the products demanded from ND institutions were offered by the food producers, and ND local food supply commitments matched the demand commitment results of the ND institutions.

6.1.4. Marketing skills and digital marketing

One of this study's objectives was to evaluate the internet and social media platforms as marketing tools for ND local food and find the preferred digital marketing channel. Our results from the ND food producers found that 70% of the respondents found that marketing skills are one of the obstacles that prevented them from increasing production. The average number of hours spent on marketing was five hours, and 40% of the respondents indicated that they need help with marketing to focus more on the production. Eighty-three percent of the ND food producers' respondents highly agreed about the importance of digital marketing, and 25% had a business website for marketing. Other used social media platforms for marketing, such as 35% were using Facebook to market their products, and 13% used Instagram.

Most notably, this is the first study to our knowledge to investigate the digital marketing and social media platforms for local food marketing. We believe these marketing channels are able to increase the demand for local food for two reasons:

The first reason is trust: We believe using the internet and social media platforms are beneficial for local food marketing because they can increase the trust between the food producers and the consumers. According to Hinrichs (2000); Sage (2003), social relationships and embeddedness create a sense of social connection and trust at the heart of local agricultural marketing channels and distinguishes local food systems from global food systems. For example, a farmer who uses social media platforms such as YouTube can trust by showing them how their food was grown or harvested.

The second reason is linking*:*According to Feenstra and Hardesty (2016), the consumer's demand for local food that is linked with “farm to fork” and “values-based supply chains” (VBSCs) are increasing, and this type of consumers are willing to pay more for these types of food. We believe the internet and social media platforms is beneficial for local food marketing because it can support the idea of “farm to fork” which must directly increase the demand.

6.1.5. The best model for the regional ND food hub

We tested the supply and demand sides' ability to rent their infrastructure or provide paid service for a ND food hub, and the demand-side was not promising. However, the supply-side showed many interesting results. We found that 32% of the surveyed ND food producers had the infrastructure to transport livestock to a USDA slaughter facility, and 44% had the capability to provide a drop-off and storage facility for nearby growers. These results indicate that a ND food hub project collaborates with local food producers by renting their infrastructure to decrease the starting cost. Also, 79% of the surveyed ND food producers were interested in becoming a grower-owned cooperative member, and 56% wanted to become an investor in the ND food hub product.

In addition, we found that ND food producers who produce V.A.P. had a higher level of familiarity with food hub idea. This group of food producers must be the starting point for a ND food hub because the long shelf-life for V.A.P. comping with perishable food is affected by the short growing season associated with ND weather. Forney and Häberli (2014) noted that consumers who recognize the value of the added value food products were an important market segment that increased farmer income.

The concern about local food prices was documented in Feenstra et al. (2011) study and was not consistent with this research results. According to Feenstra et al. (2011), universities and colleges in California preferred local food that was sustainably produced but at a reasonable price. Comparing with our results, we found that local food price was one of ND institutions' motives to buy local food. Respondents who were recorded at the high level were 90%. However, when we asked the ND institution how their food suppliers price local food comparing with non-local food, 68% were not sure how they price local food, and 9% priced local food lower than non-local food. And 18 % thought that their food supplier’s priced local food higher than non-local food. Since most ND food customers were not sure about local food prices, there is a chance that they price local food lower than non-local, which may explain why 90% of them considered price as a motive to buy local food. Also, the results obtained from the open-ended question supported this conclusion since the price was one of the challenges faced by respondents for purchasing local food products sourced from ND farms. In addition to the 64% of the respondents chose “finding a product at the required price” as one of the factors preventing customers from purchasing local food. Furthermore, 84% of the ND food customers wanted to set contracts on price and volume, and 67% wanted pre-season product planning to prearrange products, quantities, and timing of deliveries. While 48% of the ND food producers wanted to price set based on a spot market, and 69% of them chose the risk of not selling what they grow as one of the barriers that may prevent sell to a ND food hub.

The food hub classification is an important factor for its success because it will structure how these worries and concerns were addressed and solved. Also, food type will affect how a food hub will interact with the food market and government policies. Therefore, it is important to plan for the type of food hub type that fits the local/region need in the initial phase. We tested ND food producers' performance about the food hub type they think will work best for a regional food hub in ND, and 47% of them believed that ND food hub should have a Hybrid model as a business structure. And 43% chose for-profit at both the state and national levels as a tax designation type, while 67% selected Cooperative as legal structure type for ND food hub.

Moreover, our analysis of the finding from the two cross-sectional surveys indicated that ND's local food system needs a food hub project (a logistical entity). Our evaluation of this study suggests that the food hub project is feasible if it started at an earlier stage, working and supporting food producers who produce V.A.P. The ND food hub project's initial capital can be reduced as well as the fixed cost by renting food producers' infrastructure. For example, the ND food hub project can simulate the Red Tomato food hub model. Red Tomato food hub logistically connects the region's farmers and rents farm spaces for aggregation. This model was able to reduce Red Tomato fixed cost and increase farmers' income. However, Red Tomato food hub is a non-profit organization.

7. CONCLUSIONS, LIMITATIONS AND FURTHER RESEARCH

7.1. Conclusions

This research aimed to discover if ND needs a food hub or not. Based on the quantitative and qualitative analysis from the two cross-sectional surveys explicitly created for the ND regional food hub feasibility study, it can be concluded that ND needs a food hub. Food producers who produce V.A.P.'s were more familiar with the food hub concept. A ND food hub can start operating by focusing on food producers who produce V.A.P.'s. because they were more familiar with the concept, which will smooth the establishment process. On the other hand, V.A.P.'s have a long shelf-life compared with perishable foods that are affected by short growing seasons associated with ND weather. They can better match ND institutions' food demand since the demand is year-round.

Lerman, Feenstra, and Visher (2012) noted that there is incomplete information about U.S. local food marketing channels and producers. Furthermore, the author of this research found no comprehensive literature concentrating solely on local food in ND. Hence, we covered this literature gap in this research. The results defined local food from ND food producers' and customers' perspectives as "all food products grown, produced, or processed in ND." Simultaneously, the research findings revealed obstacles and challenges that prevented food producers from selling food locally, such as lacking a logistics entity that helps to scale up production. Additionally, customers' preferences and motives toward local food in ND were recognized as taste, quality, freshness, support of local farmers, and support of the local economy.

While there is no current research that focuses on the disadvantages of food hubs, the fluctuation of the number of national food hubs over the past ten years is a sign of issues challenging the success of U.S. food hubs. However, organizations interested in the ND local food system and seeking to build a food hub in ND should study and learn from the success and failure of national food hubs. In particular, lessons need to be learned regarding logistics for both the supply and demand sides.

7.2. Limitations

This research has two limitations. One, the study's findings are specific to ND and cannot be generalized for other U.S. states' local food systems. Two, respondents' small sample sizes for the supply and demand sides limit the statistical significance of results for most statistical tests.

7.3. Further Research

7.3.1. Further research for ND

It is crucial to investigate the reasons that led to the inconsistencies between the USDA local food directory and the ND department of agricultural local food directory. This research offers only tentative direction to understanding the need for a food hub in ND. Furthermore, the food hub model that was presented was a suggestion based on the ND food producers' perspective. However, our results are encouraging and should be validated with a larger sample size. One hypothesis that deserves comment is the location and type of a ND food hub. To find the best regional food hub model tailored to the ND local food system, future studies should examine all local food stakeholders' opinions. This hypothesis is ripe for further research to investigate if ND needs one big urban food hub located in Fargo, or multiple small food hubs in rural areas. Future research should examine this issue more closely to better understand the needs of the ND local food system.

In addition, case studies should explore farmer's markets in the Fargo area and analyze their potential to establish an urban food hub. Focusing on food producers who produce VAPs and their ability to satisfy meat and dairy products demand. The ability of ND food producers to participate in the Bee Integrated Project (BIP)should also be explored.

7.3.2. Further research for the U.S.

Low et al. (2015) noticed the increase in the number of intermediate local food marketing channels; however, they could not record the value or sales because of lack of data. Future research should examine this issue more closely to study the ability to share information among all U.S. food hubs to create a big data source for local food systems. This big data source will help make a standard structure for building and launching local and regional food hubs based on local area needs.

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APPENDIX A. THE IRB APPROVAL LETTER FOR ND FOOD HUB FEASIBILITY STUDY PART-A

February 6, 2019

Dr. Joseph Szmerekovsky
Transportation, Logistics, and Finance

Re: IRB Determination of Exempt Human Subjects Research:
Protocol #BA19145, "North Dakota (ND) Food Hub Feasibility Study"

Co-investigator(s) and research team: Hamad Alqublan
Date of Exempt Determination: 2/6/2019 Expiration Date: 2/5/2022
Study site(s): online
Sponsor: n/a

The above referenced human subjects research project has been determined exempt (category #2(i)) in accordance with federal regulations (Code of Federal Regulations, Title 45, Part 46, Protection of Human Subjects). This determination is based on the original protocol submission (received 1/25/2019).

Please also note the following:
• If you wish to continue the research after the expiration, submit a request for recertification several weeks prior to the expiration.
• The study must be conducted as described in the approved protocol. Changes to this protocol must be approved prior to initiating, unless the changes are necessary to eliminate an immediate hazard to subjects.
• Notify the IRB promptly of any adverse events, complaints, or unanticipated problems involving risks to subjects or others related to this project.
• Report any significant new findings that may affect the risks and benefits to the participants and the IRB.

Research records may be subject to a random or directed audit at any time to verify compliance with IRB standard operating procedures.

Thank you for your cooperation with NDSU IRB procedures. Best wishes for a successful study.
Sincerely,

Kristy Shirley

Kristy Shirley, CIP, Research Compliance Administrator

APPENDIX B. ND FOOD HUB FEASIBILITY STUDY PART-A SURVEY COVER LETTER

North Dakota (ND) Food Hub Feasibility Study

Dear respondent,

My name is Hamad Al Qublan. I am a Ph.D. candidate in the Transportation, Logistics, and Finance program at North Dakota State University. I am conducting a survey to evaluate the feasibility of the establishment of a ND food hub as my doctoral dissertation. This research project is directed by Professors Joseph Szmerekovsky, Saleem Shaik, Frayne Olson, and Joseph Jones.

A food hub is a business which aggregates, markets, and distributes products from several local/regional farms. A food hub offers services which may include cooling, storage, marketing and distribution, washing, grading, sorting, packing or repacking, packaging and labeling, and branding. In addition, this study will gauge the interest and ownership expectations of ND food producers with respect to the establishment of the ND food hub.

The four main objectives of this survey are:
1- Evaluate food producer's preferences, attributes, adaptations, and attitudes toward ND local food supply chain systems.
2- Determine preferred ownership type, business structure, legal structure, and tax designation for a ND food hub.
3- Quantify the nature of food supply chain systems from interested ND food producers.
4- Classify obstacles to scaling-up production to supply a wholesale market that food producers may face.

I invite you to participate in this research study so that we may attempt to design a local food solution that best fits your needs. Participation involves you completing an online questionnaire with 51 questions. I estimate the time to complete this questionnaire to be 45-60 minutes. However, this survey has a "Save and Continue" option, so you can save your answers and return to finish the survey later. I do not anticipate any risks to you in participating in this study. The survey may benefit the food producers, consumers, and the state economy, but there is no compensation for completing the survey. Your participation is voluntary, and you may skip any question or withdraw from the study at any time without penalty. If you consent to participate, your answers will be anonymous and will be kept confidential to the fullest extent of the law. The information provided will be used solely for this research project, and only non-identifiable, aggregated results will be reported in reputable academic publications. No persons other than my supervisors and I will have access to the information you provide. This survey will be available online from, 02/11/2019 to,01/31/2020. If you have any questions regarding this project, feel free to contact me at 214-603-0237 or hamad.alqublan@ndsu.edu.

This project has been accepted by the Institutional Review Board (IRB) protocol # BA-19145. Should you have any concerns regarding the conduct of this research project, you are welcome to contact the researcher or the NDSU Human Research Protection Program at 701.231.8995, toll-free at 1-855-800-6717, by email at ndsu.irb@ndsu.edu, or by mail at NDSU HRPP Office, NDSU Dept. 4000, P.O. Box 6050, Fargo, ND 58108-6050.

Thank you for taking part in this research. If you wish to receive a copy of the results, please contact Hamad Al Qublan. I greatly value your participation. Thank you for your time and consideration!

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APPENDIX C. ND FOOD HUB FEASIBILITY STUDY PART-A SURVEY

Section 1: The Role and Attractiveness of a ND Food Hub A food hub is a business which aggregates, markets, and distributes products from several local/regional farms. Food hubs offer services which may include cooling, storage, marketing and distribution, washing, grading, sorting, packing or repacking, packaging and labeling, and branding.

Q 1 How familiar are you with the food hub concept, rate your level of familiarity with this statement?

	Unfamiliar 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Strongly Familiar 7 (7)	N/A (8)
Rate your level of familiarity (1)	O	O	O	O	O	O	O	O

Q 2 A food hub can provide sustainability to local food economy, for that it may be important for each state to have at least one food hub to support producers and serve the public with local/regional/national food. What is your opinion, rate your level of agreement with this statement?

	Strongly disagree 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Strongly agree 7 (7)	N/A (8)
Rate your level of agreement (1)	O	O	O	O	O	O	O	O

Q 3 If a local food hub, as described above, were reasonably accessible and offered a fair or competitive price for your products, rate your level of interest in selling your food products through the food hub?

	Not Interested 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Interested 7 (7)	N/A (8)
Rate your level of interest (1)	O	O	O	O	O	O	O	O

Q 4 How interested are you in offering any of the following **paid services** to support a regional food network such as food hub? (Rate your level of interest for each of the following statements)

	Not Interested 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Interested 7 (7)	N/A (8)
Cooling produce (to remove field heat) from nearby farms (1)	O	O	O	O	O	O	O	O
Transporting livestock to a USDA slaughter facility (2)	O	O	O	O	O	O	O	O
Serving as a drop off/storage site for product collected from nearby growers (3)	O	O	O	O	O	O	O	O
Delivering product for other nearby farmers to the food hub (4)	O	O	O	O	O	O	O	O
Providing temperature-controlled cold storage on your property (5)	O	O	O	O	O	O	O	O
Sharing equipment with nearby farms (6)	O	O	O	O	O	O	O	O
Coordinating labor with nearby farms (7)	O	O	O	O	O	O	O	O
Providing processing services (8)	O	O	O	O	O	O	O	O

Serving as a drop off/storage site for supplies collectively purchased with surrounding growers (9)	O	O	O	O	O	O	O	O
Other, please specify (10)	O	O	O	O	O	O	O	O

Q 5. If a food hub was to be located in an area accessible to you; what is your level of interest or willingness for each of the following <u>ownership categories</u> regarding conducting business with the food hub?

	Not Interested 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Interested 7 (7)	N/A (8)
Conduct business on a consignment or commission basis (1)	O	O	O	O	O	O	O	O
Conduct business on a direct purchase basis (2)	O	O	O	O	O	O	O	O
Set prices on a contract basis (3)	O	O	O	O	O	O	O	O
Price set based on a spot market (4)	O	O	O	O	O	O	O	O
Divide my product pricing some on contract and some on a spot market (5)	O	O	O	O	O	O	O	O

Become owner /or operator of the food hub (6)	O	O	O	O	O	O	O	O
Become an investor in the food hub (7)	O	O	O	O	O	O	O	O
Become a member of a grower-owned cooperative (8)	O	O	O	O	O	O	O	O
Be on the management team of the food hub (9)	O	O	O	O	O	O	O	O
Be part of the workforce for the food hub (10)	O	O	O	O	O	O	O	O
Provide services on a contractual basis for the food hub (11)	O	O	O	O	O	O	O	O
Other, please specify (12)	O	O	O	O	O	O	O	O

Q 6. Food hubs can provide many producer services, rate each service based on its importance to your farm business?

	Not Important 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Important 7 (7)	N/A (8)
Actively linking producers to markets (1)	O	O	O	O	O	O	O	O
Production and post-harvest handling training (2)	O	O	O	O	O	O	O	O

Business management services and guidance (3)	O	O	O	O	O	O	O	O
Branding and market development (4)	O	O	O	O	O	O	O	O
Maintaining producer-consumer connections (5)	O	O	O	O	O	O	O	O
Information sharing among regional food network (6)	O	O	O	O	O	O	O	O
Value-added product development (7)	O	O	O	O	O	O	O	O
Food safety training (8)	O	O	O	O	O	O	O	O
Other, please specify (9)	O	O	O	O	O	O	O	O

Q 7. Food hubs can provide many <u>operational services</u>, rate each service based on its importance to your farm business?

	Not Important 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Important 7 (7)	N/A (8)
Aggregation (1)	O	O	O	O	O	O	O	O
Product storage (2)	O	O	O	O	O	O	O	O
Production planning (3)	O	O	O	O	O	O	O	O
Post-harvest handling and packing (4)	O	O	O	O	O	O	O	O

Season extension (5)	O	O	O	O	O	O	O	O
On-farm pick up (6)	O	O	O	O	O	O	O	O
Distribution (7)	O	O	O	O	O	O	O	O
Delivery logistics (8)	O	O	O	O	O	O	O	O
Offers pick up service (9)	O	O	O	O	O	O	O	O
Brokering (10)	O	O	O	O	O	O	O	O
Strategically linked to an existing distribution hub or service (11)	O	O	O	O	O	O	O	O
Handles sales and marketing so I can focus on production (12)	O	O	O	O	O	O	O	O
A web-based trading site (13)	O	O	O	O	O	O	O	O
Uses digital marketing (social media platforms) (14)	O	O	O	O	O	O	O	O
Packaging and repacking (15)	O	O	O	O	O	O	O	O
Light processing (trimming, cutting, freezing) (16)	O	O	O	O	O	O	O	O

Access to certified kitchen (17)	O	O	O	O	O	O	O	O
Food safety (e.g., to "Good Agricultural Practices (GAP) and Good Handling Practices Audits." (18)	O	O	O	O	O	O	O	O
Liability insurance (19)	O	O	O	O	O	O	O	O
Other, please specify (20)	O	O	O	O	O	O	O	O

Q 8. Rate how important is each of the following food hubs service to your community.

	Not Important 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Important 7 (7)	N/A (8)
“Buy Local” campaigns (1)	O	O	O	O	O	O	O	O
Distributing to "food deserts." (2)	O	O	O	O	O	O	O	O
Food bank donations (3)	O	O	O	O	O	O	O	O
Healthy food demonstrations, cooking demonstrations (4)	O	O	O	O	O	O	O	O
Food stamp redemption (5)	O	O	O	O	O	O	O	O
Educational programs (6)	O	O	O	O	O	O	O	O

Youth and community employment opportunities (7)	O	O	O	O	O	O	O	O
Other, please specify (8)	O	O	O	O	O	O	O	O

Q 9. A food hub could offer a variety of other services to help growers improve their businesses, increase sales, or strengthen the local food system. Rate your level of interest in the following food hub services.

	Not Interested 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Interested 7 (7)	N/A (8)
Receive education on key business skills including marketing and financial management (1)	O	O	O	O	O	O	O	O
Receive education on how to scale up my business (2)	O	O	O	O	O	O	O	O
Educational activities in preserving, cooking, and nutrition (3)	O	O	O	O	O	O	O	O
Other, please specify (4)	O	O	O	O	O	O	O	O

Q 10. How significant are the following concerns related to selling to a food hub?

	Not Significant 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Significant 7 (7)	N/A (8)
Fair or competitive pricing (1)	O	O	O	O	O	O	O	O
Losing independence by relying on a food hub for my sales (2)	O	O	O	O	O	O	O	O

Losing control over the end-to-end supply chain of my product (3)	O	O	O	O	O	O	O	O
Food hubs may compete with my farm in selling to my existing sales outlets (4)	O	O	O	O	O	O	O	O
Not having enough production for the food hub (5)	O	O	O	O	O	O	O	O
Increasing production without a guaranteed sales contract (6)	O	O	O	O	O	O	O	O
Financial risk (7)	O	O	O	O	O	O	O	O
Other, please specify (8)	O	O	O	O	O	O	O	O

Q 11. If your pricing and other requirements were met, what products would you sell to a food hub in a location desirable to you? Please list existing and new crops, which you might add in the next three years.

	List of	List of
	Current Product (1)	New Product (1)
Product 1 (1)		

Product 2 (2)		
Product 3 (3)		
Product 4 (4)		
Product 5 (5)		
Product 6 (6)		
Product 7 (7)		

Q 12. If you chose to change or expand your product mix to sell to a food hub, how significant are the following resource barriers to you?

	Not Significant 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Significant 7 (7)	N/A (8)
Risk barriers (1)	O	O	O	O	O	O	O	O
Knowledge of which crops/ livestock to grow (2)	O	O	O	O	O	O	O	O
Knowledge of how to grow crops/animals (3)	O	O	O	O	O	O	O	O

Knowledge of how to scale-up production (4)	O	O	O	O	O	O	O	O
Risk of not selling what I grow (5)	O	O	O	O	O	O	O	O
Knowledge of post-harvest handling (cooling, washing, grading, and packing) (6)	O	O	O	O	O	O	O	O
Difficulties finding/negotiating with buyers (7)	O	O	O	O	O	O	O	O
Lack of commitment from buyers (8)	O	O	O	O	O	O	O	O
Concerns about fair pricing (9)	O	O	O	O	O	O	O	O
Knowledge of required licenses and permits (10)	O	O	O	O	O	O	O	O
Other, please specify (11)	O	O	O	O	O	O	O	O

Q 13. How far would you travel one way to deliver product to a food hub? (please select one option)

O A. Less than 50 miles (1)

O B. Between 50-100 miles (2)

O C. More than 100 miles (3)

Q 14. In your opinion, which business structure do you feel is right for a ND food hub? (please select one option)

O A. Farm-to-Customer model (1)

O B. Farm-to-Business/Institution/ Wholesale model (2)

O C. Hybrid model: serving both Businesses or Institutions, Wholesalers and Customers (3)

O D. Other, please specify (4)

Q 15. In your opinion, which type of tax designation do you feel is right for a ND food hub? (please select one option)

O A. For-profit at the state level (1)

O B. For-profit at both the state and national levels (2)

O C. Nonprofit at the state level (3)

O D. Nonprofit at both the state and national levels (4)

Q 16. In your opinion, which type of legal structure do you feel is right for a ND food hub? (please select one option)

O A. B-Corporation (1)

O B. C-Corporation (2)

O C. S-Corporation (3)

O D. Limited Liability Company (LCC) (4)

O E. Cooperative (5)

O F. Multi-stakeholder (6)

O G. Subsidiary Food Hub (formed as a subsidiary of an existing company with a broader mission) (7)

O H. Sole proprietorship (8)

O I. Partnership (9)

O K. Other, please specify (10)

Q 17. Rate each of the following information resources that are helpful for you.

	Not Useful 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Useful 7 (7)	N/A (8)
A formal community of practice like a food hub network (1)	O	O	O	O	O	O	O	O
The USDA or other federal department's educational resources (2)	O	O	O	O	O	O	O	O
Informal networking with other food hubs (3)	O	O	O	O	O	O	O	O
Food policy councils (4)	O	O	O	O	O	O	O	O
State government educational resources (5)	O	O	O	O	O	O	O	O
Local government educational resources (6)	O	O	O	O	O	O	O	O
A university's educational resources (7)	O	O	O	O	O	O	O	O
A non-profit's educational resources (8)	O	O	O	O	O	O	O	O
Annual meetings or conferences (9)	O	O	O	O	O	O	O	O
Other, please specify (10)	O	O	O	O	O	O	O	O

Q 18. What additional concerns or suggestions do you want to share that would assist with the development of a ND food hub that would best meet your needs (transportation, supply chain, marketing, logistics, production, etc.)?

Section 2: Farm Characteristics

Q 19. What type of farmer are you? (please select as many as apply to your business)

- ▢ A. Grain Farmer: (e.g., corn, soybeans, or wheat) (1)
- ▢ B. Livestock Farmer: (e.g., beef cattle, dairy cattle, hogs, chickens, or turkey) (2)
- ▢ C. Specialty Products Farmer: (e.g., citrus, or vegetables) (3)
- ▢ D. Other, please specify (4)

Q 20. Location of farm/majority of farms you operate. (please fill in the blank)

- O My farm business registration number is located at zip code # (1)

____

Q 21. What is your farm or pasture size?

- O A. Less than 1,937 crop acres or 490 pasture acres (1)
- O B. More than 1,937 crop acres or 490 pasture acres (2)

Q 22. ND farms are classified into 6 categories, farm typology measured by gross cash farm income (GCFI), which of these categories fits your business? (Please select one option)

- O A. Small size farms the GCFI is less than $ 150,000 (1)
- O B. Moderate size farms the GCFI is between $ 150,000 to $349,000 (2)
- O C. A mid-size farms the GCFI is between $349,000 to $ 999,999 (3)
- O D. A large size farms the GCFI is between $ 1,000,000 to $ 4,999,999 (4)
- O E. A very lager size farms the GCFI is $ 5,000,000 and more (5)

Q 23. Do you consider your business a family farm or non-family farm? (please select one option)

- A. Family farm: Family farm is a farm that is owned and operated by a family, especially one that has been handed down from one generation to another (1)
- B. Non-family farm: Is any farm for which the majority of the farm business is not owned by individuals related by blood, marriage, or adoption (2)

Q 24. Which statement best describes the stage of your farm at present? (please select one option)

- A. Planning to expand (1)
- B. Planning to keep operating at approximately the same size (2)
- C. Planning to reduce the size (3)
- D. Planning to exit farming (4)
- E. Planning to sell the farm in less than 3 years (5)
- D. Other, please specify (6)

Q 25. Which of the following labels best describes your production practices? (please select as many as apply to your business)

- [ ] A. Conventional (1)
- [ ] B. Certified organic (2)
- [ ] C. Good Agricultural Practices (GAP) or Good Handling Practices Audits (GHP) (3)
- [ ] C. Other, please specify (4)

Q 26. How do you sell your crops? (please select as many as apply to your business)

- ▢ A. As a commodity (i.e., sell everything at wholesale) (1)
- ▢ B. Direct to consumer non-processed products (e.g., vegetables at the farm gate) (2)
- ▢ C. Direct to consumer processed products (e.g., jams and jellies) (3)
- ▢ D. ther, please specify (4)

Q 27. Check the food products that you currently produce for sale: (Check as many as apply, at least one; regardless if it is produced on a regular basis or seasonally/occasionally:

- ▢ A. Canned (1)
- ▢ B. Dairy (2)
- ▢ C. Eggs (3)
- ▢ D. Frozen (4)
- ▢ E. Fruits (5)
- ▢ F. Grains (6)
- ▢ G. Meats/Poultry (7)
- ▢ H. Value-added (8)
- ▢ I. Vegetables (9)
- ▢ J. Wines (10)
- ▢ K. Other, please specify (11)

Q 28. Are you currently using strategies to extend the growing season? (please select as many as apply to your business)

- A. No (1)
- B. Heated greenhouse (2)
- C. High or low tunnels (3)
- D. Other, please specify (4)

Q 29. If there is money available to offset the cost of season extension technologies, would you consider employing season extension technologies in the future? (please select one option)

- A. Yes (1)
- B. No (2)

Q 30. If you had the opportunity to sell an additional product or increase production to meet the demand for the wholesale market, would you modify your production to meet the demand for that product or market? (please select one option)

- A. Yes (1)
- C. Maybe (2)
- B. No (3)

Q 31. Do you currently produce and market value-added products (V.A.P)? (i.e., V.A.P. is a change in the physical state or form of the product; e.g., milling wheat into flour or making strawberries into jam) (please select one option)

- A. Yes, what is the percentage of V.A.P from the total crop? Continue to the next question (1)
- B. No. Go to Question 16 (2)
- C. Not now, maybe in the future. Continue to the next question (3)

Q 32. How are these products produced? (please select as many as apply to your business)

- A. Produced on a farm in a processing facility (1)
- B. Self-produced at a shared-use commercial kitchen (2)
- C. Produced by a third-party co-packer (3)
- D. We currently co-pack for others (4)
- E. Other, please specify (5)

Q 33. Which of the following value-added processes do you practice? (please select as many as apply to your business)

- A. Processing (e.g., wash, cut, freeze) (1)
- B. "Kill-step" processing (e.g., pasteurization, pathogen-killing washes, irradiation) (2)
- C. Packaging – bulk (e.g., cartons, crate, boxes) (3)
- D. Packaging – consumer (e.g., 4 oz., 6 oz., 1 gal.) (4)
- E. Produce sold to another farmer for resale as a value-added product (5)
- F. Other, please specify (6)

Q 34. In my opinion, the best strategy to approach added-value product is through? (Please select one option)

- A. Innovation: Improving existing processes, procedures, products and services, or creating new ones (1)
- B. Industrial Innovation: Processing traditional crops into non-food end uses (2)
- C. Horizontal coordination: Pooling or consolidating individuals or companies from the same level of the food chain (3)

O D. Vertical coordination: Contracting, strategic alliances, licensing agreements (4)

Q 35. How significant are the following resource barriers in preventing your farm business from increasing production? (please rate your level of significance for each of the following resources barriers)

	Not Significant 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Very Significant 7 (7)	N/A (8)
Lack of protein processing facility /or access to USDA facility (1)	O	O	O	O	O	O	O	O
Availability of suitable land (2)	O	O	O	O	O	O	O	O
Affordability of land (3)	O	O	O	O	O	O	O	O
Availability of labor (4)	O	O	O	O	O	O	O	O
Availability of financing/ access to credit (5)	O	O	O	O	O	O	O	O
Cost of equipment, materials, and labor to increase production (6)	O	O	O	O	O	O	O	O
Management skills to run a larger operation (7)	O	O	O	O	O	O	O	O
Operational barriers (8)	O	O	O	O	O	O	O	O
Marketing barriers (9)	O	O	O	O	O	O	O	O
Transportation barriers (10)	O	O	O	O	O	O	O	O

Logistics barriers (11)	O	O	O	O	O	O	O	O
Other, please specify (12)	O	O	O	O	O	O	O	O

Q 36. What percentage of your farm produce is sold by you through the following marketing channels? (please fill in the blank). <u>Note: if you don't have the exact number you can put your estimation, your total must be 100.</u>

Marketing channels	Percentage
Direct to consumer (U-pick, roadside, farm stand, own store front,	
Farmers markets (2)	
Community supported agriculture (CSA) (3)	
Internet sales (4)	
Grocery stores (5)	
Restaurants (6)	
Institutions (schools, hospitals) (7)	

Direct sales to food co-ops or buyers’ clubs (8)	
Wholesalers or distributors (9)	
Auctions (10)	
Grain elevators (11)	
Other, please specify (12)	
Total	

Q 37. What phrase best describes your attitude toward the marketing aspects of your business? (please select one option)

- O A. I am good at marketing, and it's one of my favorite business parts (1)
- O B. I am not good at marketing, but I have no problems with doing it (2)
- O C. I wish someone could help me with marketing, to spend more time on producing (3)
- O D. I do not like marketing (4)
- O E. No opinion (5)

Q 38. On average, how many hours per week do you spend on marketing your product? (For example, total hours at a farm stand, farmers’ market, on the phone, over the Internet, etc.)

Q 39. Digital marketing through the internet (E-commerce) and social media platforms is an important marketing vehicle nowadays and can create more demand for local food, rate your level of agreement with this statement?

	Strongly disagree 1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	6 (6)	Strongly agree 7 (7)	N/A (8)
Rate your level of agreement (1)	O	O	O	O	O	O	O	O

Q 40. Which of the following social media platforms do you use to market your product? (please select as many as apply to your business)

▢A. Website (1)

▢B. YouTube (2)

▢C. Facebook (3)

▢D. Twitter (4)

▢E. Instagram (5)

▢F. Other, please specify (6)

▢G. I do not use the internet or social media platforms for marketing (7)

Q 41. What percent of your products are sold to customers within a 400-mile radius of your farm locations? (please select one option)

O A. less than 25% (1)

O B. Between 26 -50% (2)

O C. Between 51-75% (3)

O D. More than 75% (4)

O E. All (5)

O F. Not sure (6)

Q 42. What is the shortest, average, and longest distance you drive one way to make deliveries? (Please fill in the blanks).

O Shortest, miles one way (1)

O Average, miles one way (2)

O Longest, miles one way (3)

Q 43. Which of these statements represents "local" for you regarding food product? (Please select one option).

O A. Produced or processed in my county (1)

O B. Produced or processed in my state (2)

O C. Produced or processed in my region (3)

O D. Produced or processed in the U.S. (4)

O E. Knowing the origin where my food produced or processed (5)

O F. Other, please specify (6)

Q 44. Which of these statements represents "local" for you regarding food product? (Please select one option).

O A. Produced within less than 10 miles of the point of sale (1)

O B. Produced within less than 10-25 miles of the point of sale (2)

O C. Produced within less than 50-100 miles of the point of sale (3)

O D. Produced within less than 100-200 miles of the point of sale (4)

O E. Produced within less than 200-400 miles of the point of sale (5)

O F. Other, please specify (6)

Section 3: Food Producer's Demographics

Q 45. Are you a Farmer's Union member?

O A. Yes (1)

O B. No (2)

Q 46. What is your gender?

O A. Male (1)

O B. Female (2)

O C. Non-binary persons (3)

Q 47. What is the highest education degree you have thus far?

O A. No High school, diploma or equivalent (e.g., GED) (1)

O B. High school graduate, diploma or equivalent (e.g., GED) (2)

O C. Some college credit, no degree (3)

O D. Bachelors or Associates, degree (4)

O E. Graduate degree (e.g. MS., Ph.D.) (5)

Q 48. In which age group do you belong?

O A. 20 to 30 (1)

O B. 31 to 40 (2)

O C. 41 to 50 (3)

O D. 51 to 60 (4)

O E. 61 to 70 (5)

O F. Over 71 (6)

Q 49. How would you describe your role in the operation of your farm?

O A. Farm full time (1)

O B. Part-time with a desire to become a full-time farm operator (2)

O C. Farm part-time with off-farm income (3)

O D. Retired, enjoy farming as a lifestyle, or as a hobby (4)

O E. Other, please specify (5)

Q 50. How many staff are employed by your business and earns money for work on the farm operation? Including yourself, spouse, children, and hired workers? (please fill all that apply -_-to your business)

▢ Full-time (1)

▢ Part-time (2)

▢ Seasonal (3)

▢ Volunteers (4)

▢ Other, please specify (5)

Q 51. How many years have you been growing/producing on your farm for profit?

- O A. 1-5 years (1)
- O B. 6-10 years (2)
- O C. 11-20 years (3)
- O D. 21-30 years (4)
- O E. 30+ years (5)

APPENDIX D. SAS CODE FOR THE ND FOOD HUB FEASIBILITY STUDY PART-A

```
data supply;
infile "Suppy-side.csv" dsd firstobs=2 missover;
input Q1 Q2 Q3 Q4 Q21 Q22 Q31 Q47 Q49 Q51;
if Q1=8 then Q1=.;
if Q2=8 then Q2=.;
if Q3=8 then Q3=.;
if Q49=5 then Q49=.;
if Q31=3 then Q31=.;
run;

proc format;

value agree 1-3="Disagree"
             4="Natural"
            5-7="Agree";
value interest 1-3="Not Interested "
             4="Natural"
            5-7="Interested";
value fsize 1="Less than 1,937 crop acres"
            2="More than 1,937 crop acres ";
value yes_no 1="Yes"
             2="No";
value education 1="No High School Degree"
                2-5="High School and above";
value fp 1-2="Full time"
         3-4="Part time";
value exp 1-2="10 years or less"
          3-5="More than 10 years";
run;

ods rtf file="multiple linear regression stepwise ---supply Q1 .rtf";
proc glm data=supply plots=DIAGNOSTICS;
class Q31 Q21 Q47 Q49 Q51;
model Q1=Q31 Q21 Q47 Q49 Q51/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;
label Q21="Farm Size" Q31="Produce Value-added Products" Q47="Highest
Education " Q49="Role in Operation of Farm" Q51="Years in Farming"
Q1="familiar with food hub ";
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q31 Q21 Q47 Q49 ;
model Q1=Q31 Q47 Q21 Q49/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;
label Q21="Farm Size" Q31="Produce Value-added Products" Q47="Highest
Education " Q49="Role in Operation of Farm" Q51="Years in Farming"
Q1="familiar with food hub ";
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q31 Q21  Q49;
model Q1=Q31 Q21 Q49/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;
```

```
label Q21="Farm Size" Q31="Produce Value-added Products" Q47="Highest
Education " Q49="Role in Operation of Farm" Q51="Years in Farming"
Q1="familiar with food hub ";
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q31 Q21 ;
model Q1=Q31 Q21;
format Q31 yes_no. Q21 fsize.;
label Q21="Farm Size" Q31="Produce Value-added Products" Q1="familiar with
food hub ";
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q31  ;
model Q1=Q31;
format Q31 yes_no. Q21 fsize.;
label Q21="Farm Size" Q31="Produce Value-added Products" Q1="familiar with
food hub ";
run;

ods rtf close;

ods rtf file="multiple linear regression stepwise ---supply Q2 .rtf";
proc glm data=supply plots=DIAGNOSTICS;
class Q31 Q21 Q47 Q49 Q51;
model Q2=Q31 Q21 Q47 Q49 Q51/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;;
label Q2="Food Hub Provides Sustainability " Q21="Farm Size"  Q31="Produce
Value-added Products" Q47="Highest Education " Q49="Role in Operation of
Farm" Q51="Years in Farming" ;
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q47 Q21  Q49 Q51;
model Q2=Q47 Q21 Q49 Q51/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;;
label Q2="Food Hub Provides Sustainability " Q21="Farm Size"  Q31="Produce
Value-added Products" Q47="Highest Education " Q49="Role in Operation of
Farm" Q51="Years in Farming" ;
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q21  Q49 Q51;
model Q2= Q21 Q49 Q51/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;;
label Q2="Food Hub Provides Sustainability " Q21="Farm Size"  Q31="Produce
Value-added Products" Q47="Highest Education " Q49="Role in Operation of
Farm" Q51="Years in Farming" ;
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q49  Q51;
model Q2= Q49 Q51/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;;
```

```
label Q2="Food Hub Provides Sustainability " Q21="Farm Size"  Q31="Produce
Value-added Products" Q47="Highest Education " Q49="Role in Operation of
Farm" Q51="Years in Farming" ;
run;

proc glm data=supply plots=DIAGNOSTICS;
class  Q51;
model Q2=  Q51/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;;
label Q2="Food Hub Provides Sustainability " Q21="Farm Size"  Q31="Produce
Value-added Products" Q47="Highest Education " Q49="Role in Operation of
Farm" Q51="Years in Farming" ;
run;
ods rtf close;

ods rtf file="multiple linear regression stepwise ---supply Q3 .rtf";
proc glm data=supply plots=DIAGNOSTICS;
class Q31 Q21 Q47 Q49 Q51;
model Q3=Q31 Q21 Q47 Q49 Q51/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;
label  Q21="Farm Size" Q31="Produce Value-added Products" Q47="Highest
Education " Q49="Role in Operation of Farm" Q51="Years in Farming"
Q1="familiar with food hub ";
run;

proc glm data=supply plots=DIAGNOSTICS;
class  Q31 Q21 Q49 Q51;
model Q3=Q31 Q21 Q49 Q51/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;
label Q21="Farm Size" Q31="Produce Value-added Products" Q47="Highest
Education " Q49="Role in Operation of Farm" Q51="Years in Farming"
Q1="familiar with food hub ";
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q21 Q49 Q51;
model Q3=Q21 Q49 Q51/ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;
label Q21="Farm Size" Q31="Produce Value-added Products" Q47="Highest
Education " Q49="Role in Operation of Farm" Q51="Years in Farming"
Q1="familiar with food hub ";
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q21 Q49 ;
model Q3=Q21 Q49 /ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;
label Q21="Farm Size" Q31="Produce Value-added Products" Q47="Highest
Education " Q49="Role in Operation of Farm" Q51="Years in Farming"
Q1="familiar with food hub ";
run;

proc glm data=supply plots=DIAGNOSTICS;
class Q49 ;
model Q3=Q49 /ss3;
format Q31 yes_no. Q51 exp. Q49 fp. Q47 education. Q21 fsize.;
```

```
label Q21="Farm Size" Q31="Produce Value-added Products" Q47="Highest
Education " Q49="Role in Operation of Farm" Q51="Years in Farming" ;
run;

ods rtf close;
************Power Analysis****************;
1-Power Analysis for the first Backward Elimination.
ods rtf file="power analysis--supply.rtf";
proc power;
  multreg
  model = fixed
  nfullpredictors = 2
  ntestpredictors = 1
  rsquarefull = 0.406277
  rsquarediff = 0.102
  ntotal = .
  power = 0.8 to .95 by .05;
  title1 "dependent(Q1),Q31 is significant, most close to be significant
variable is Q21";
run;

2-Power Analysis for the second Backward Elimination.

proc power;
  multreg
  model = fixed
  nfullpredictors = 2
  ntestpredictors = 2
  rsquarefull = 0.306495
  rsquarediff = 0.306495
  ntotal = .
  power = 0.8 to .95 by .05;
  title1 "dependent(Q2), most close to be significant variables are Q49 and
Q51";
run;

3-Power Analysis for the third Backward Elimination.

proc power;
  multreg
  model = fixed
  nfullpredictors = 1
  ntestpredictors = 1
  rsquarefull = 0.051903
  rsquarediff = 0.051903
  ntotal = .
  power = 0.8 to .95 by .05;
  title1 "dependent(Q3), most close to be significant variables are Q49";
run;

ods rtf close;
```

APPENDIX E. SAS RESULTS OUTPUT FOR THE ND FOOD HUB FEASIBILITY STUDY PART-A

The SAS System

The GLM Procedure

Class Level Information		
Class	Levels	Values
Q31	2	No Yes
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q47	2	High School and above No High School Degree
Q49	2	Full time Part time
Q51	2	10 years or less More than 10 years

Number of Observations Read	33
Number of Observations Used	17

The SAS System

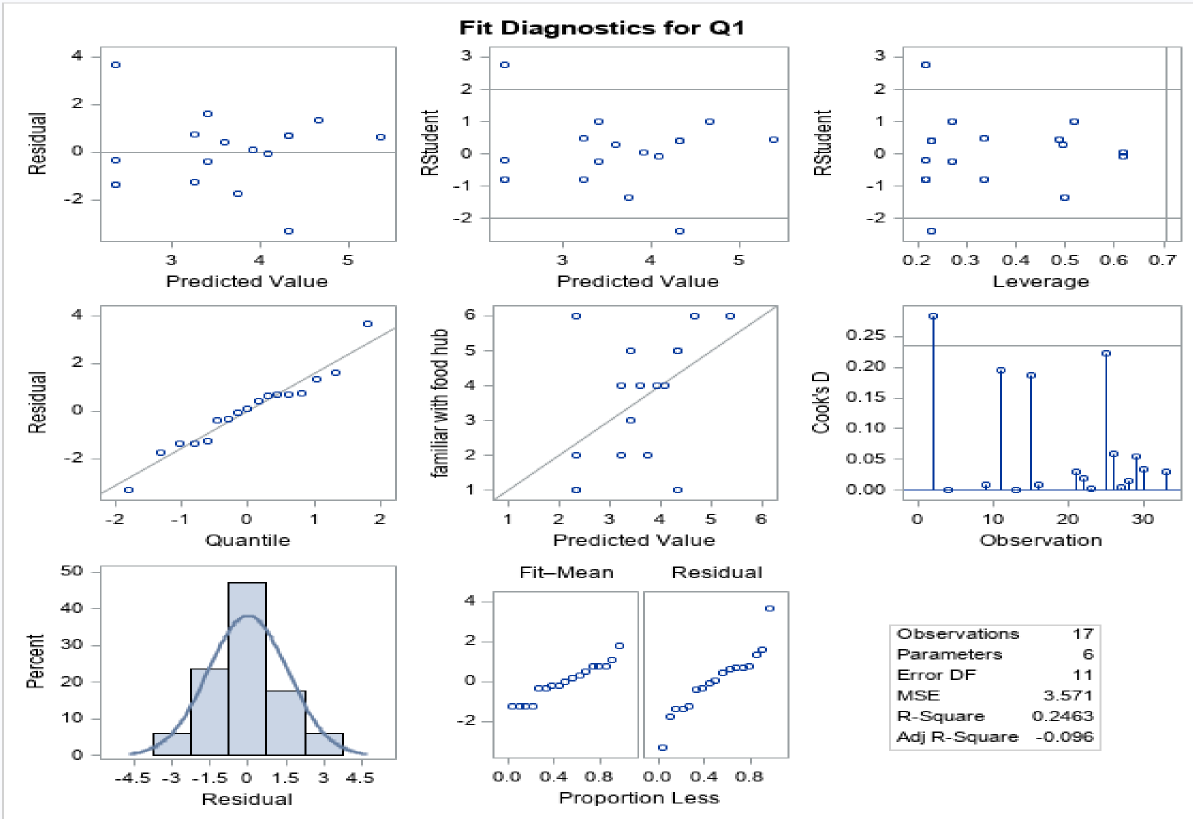
The GLM Procedure

Dependent Variable: Q1 familiar with food hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	12.83631714	2.56726343	0.72	0.6227
Error	11	39.28132992	3.57102999		
Corrected Total	16	52.11764706			

R-Square	Coeff Var	Root MSE	Q1 Mean
0.246295	52.66424	1.889717	3.588235

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	10.72921489	10.72921489	3.00	0.1109
Q21	1	2.86998587	2.86998587	0.80	0.3892
Q47	1	0.06596250	0.06596250	0.02	0.8943
Q49	1	0.27099566	0.27099566	0.08	0.7881
Q51	1	0.05200341	0.05200341	0.01	0.9061



The SAS System

The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
Q31	2	No Yes
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q47	2	High School and above No High School Degree
Q49	2	Full time Part time

Number of Observations Read	33
Number of Observations Used	17

The SAS System

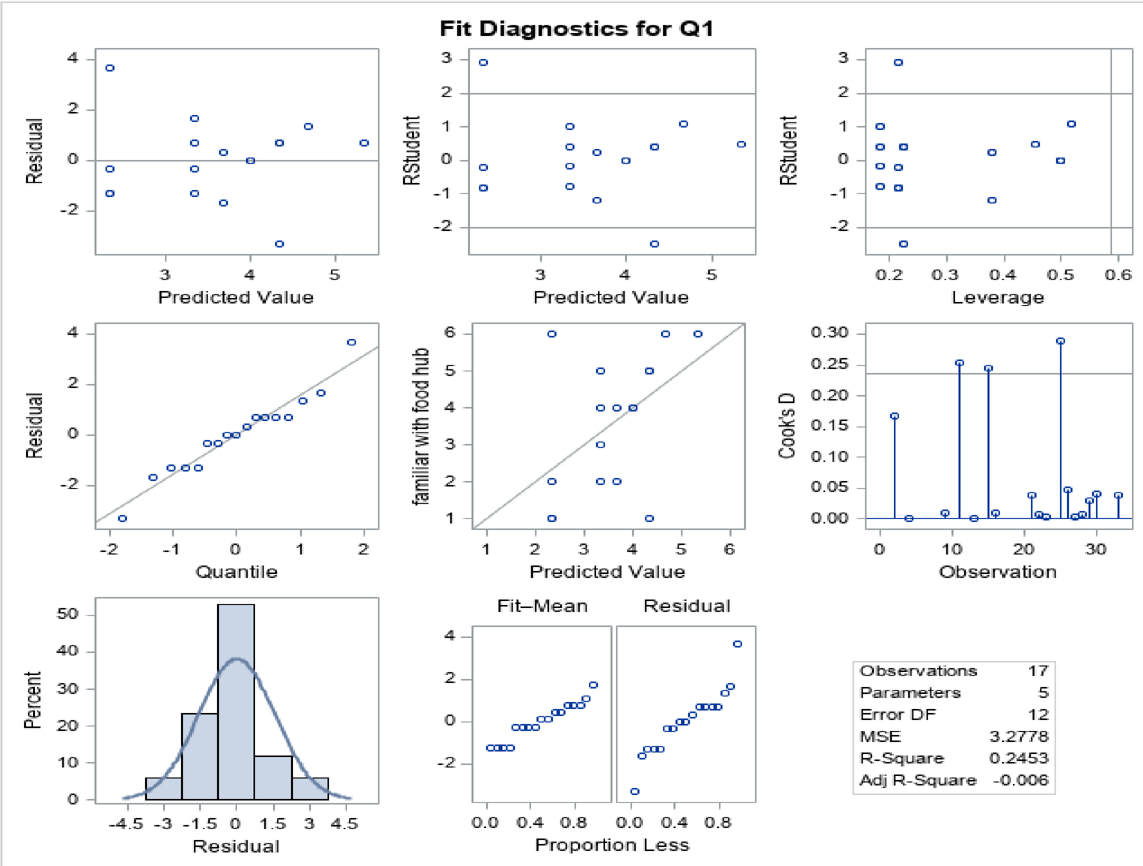
The GLM Procedure

Dependent Variable: Q1 familiar with food hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	12.78431373	3.19607843	0.98	0.4567
Error	12	39.33333333	3.27777778		
Corrected Total	16	52.11764706			

R-Square	Coeff Var	Root MSE	Q1 Mean
0.245297	50.45554	1.810463	3.588235

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	11.34883721	11.34883721	3.46	0.0875
Q47	1	0.15345912	0.15345912	0.05	0.8323
Q21	1	3.05000000	3.05000000	0.93	0.3538
Q49	1	0.25416667	0.25416667	0.08	0.7854



The SAS System

The GLM Procedure

Class Level Information		
Class	Levels	Values
Q31	2	No Yes
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q49	2	Full time Part time

Number of Observations Read	33
Number of Observations Used	17

The SAS System

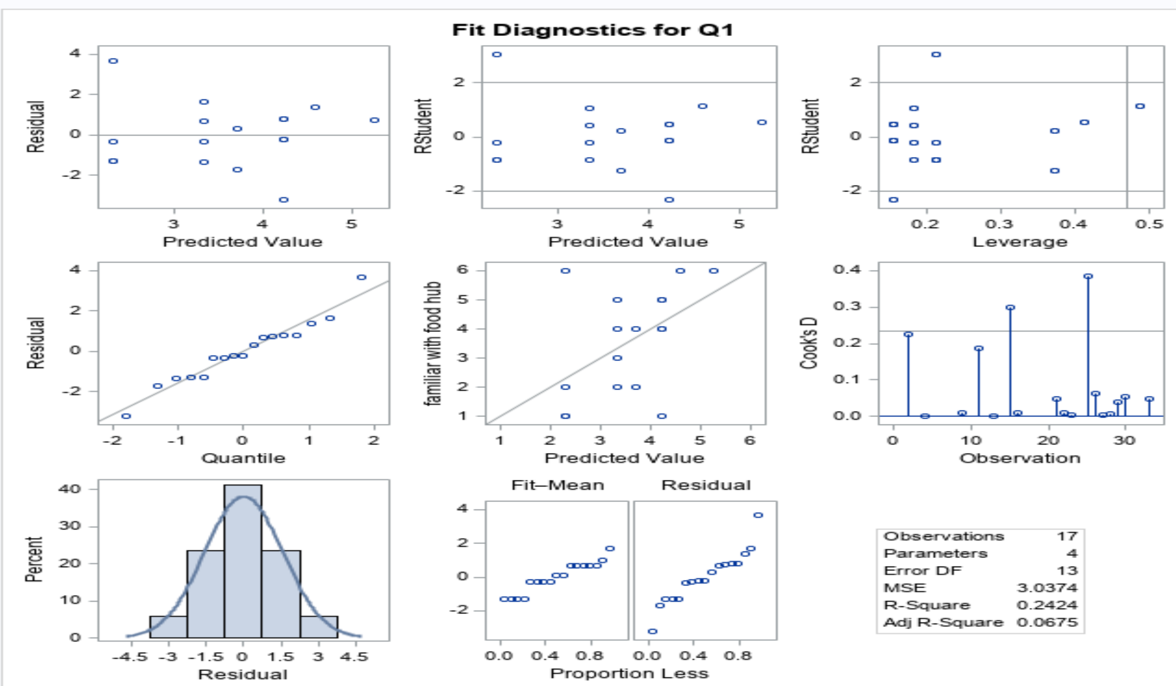
The GLM Procedure

Dependent Variable: Q1 familiar with food hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	12.63085461	4.21028487	1.39	0.2910
Error	13	39.48679245	3.03744557		
Corrected Total	16	52.11764706			

R-Square	Coeff Var	Root MSE	Q1 Mean
0.242353	48.57059	1.742827	3.588235

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	11.94879037	11.94879037	3.93	0.0689
Q21	1	3.22250987	3.22250987	1.06	0.3218
Q49	1	0.31145316	0.31145316	0.10	0.7539



The SAS System

The GLM Procedure

Class Level Information		
Class	Levels	Values
Q31	2	No Yes
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres

Number of Observations Read	33
Number of Observations Used	25

The SAS System

The GLM Procedure

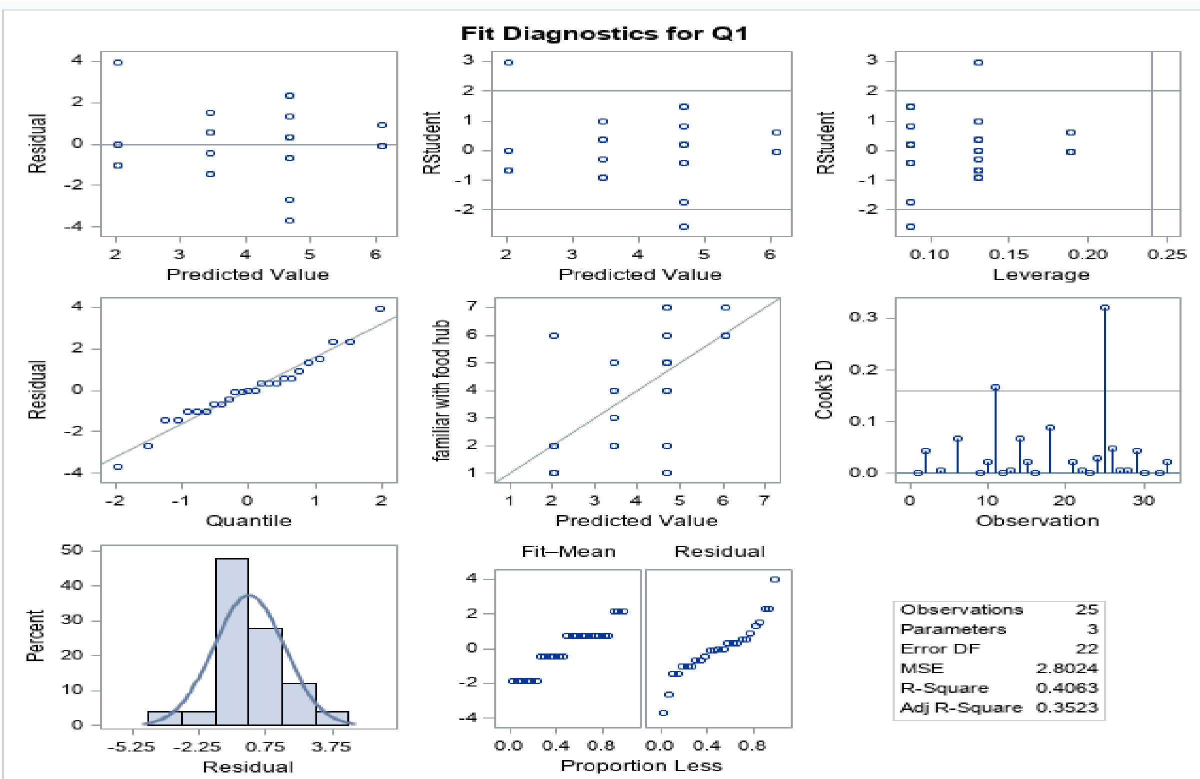
Dependent Variable: Q1 familiar with food hub

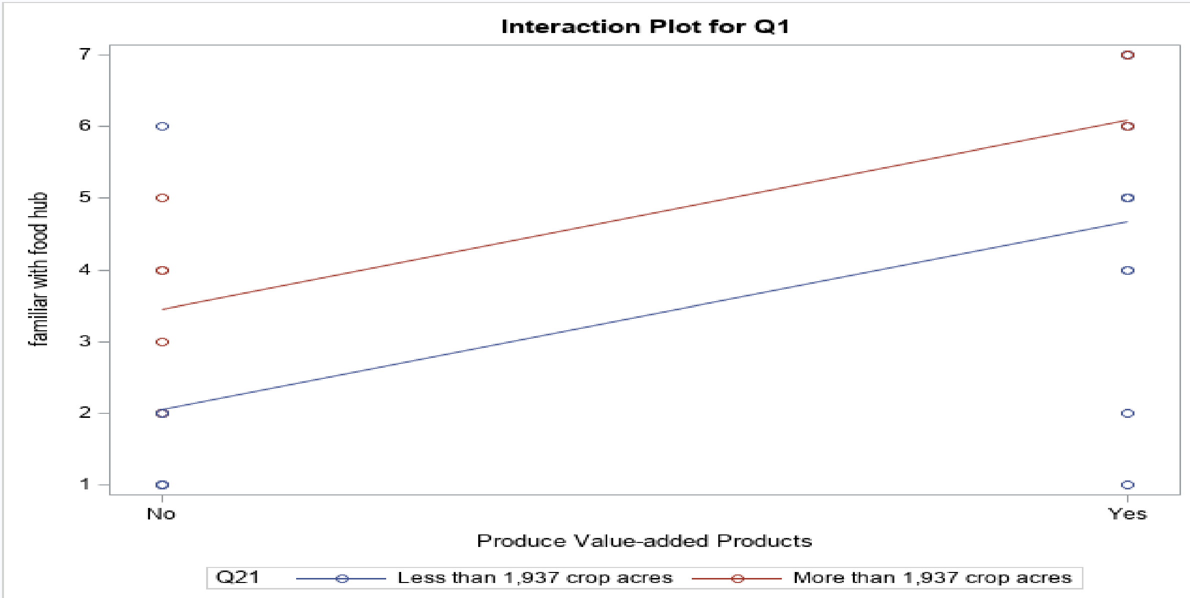
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	42.1878261	21.0939130	7.53	0.0032
Error	22	61.6521739	2.8023715		
Corrected Total	24	103.8400000			

R-Square	Coeff Var	Root MSE	Q1 Mean
0.406277	42.70481	1.674029	3.920000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Q31	1	31.59000000	31.59000000	11.27	0.0028
Q21	1	10.59782609	10.59782609	3.78	0.0647

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	39.78532609	39.78532609	14.20	0.0011
Q21	1	10.59782609	10.59782609	3.78	0.0647





The SAS System

The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
Q31	2	No Yes

Number of Observations Read	33
Number of Observations Used	25

The SAS System

The GLM Procedure

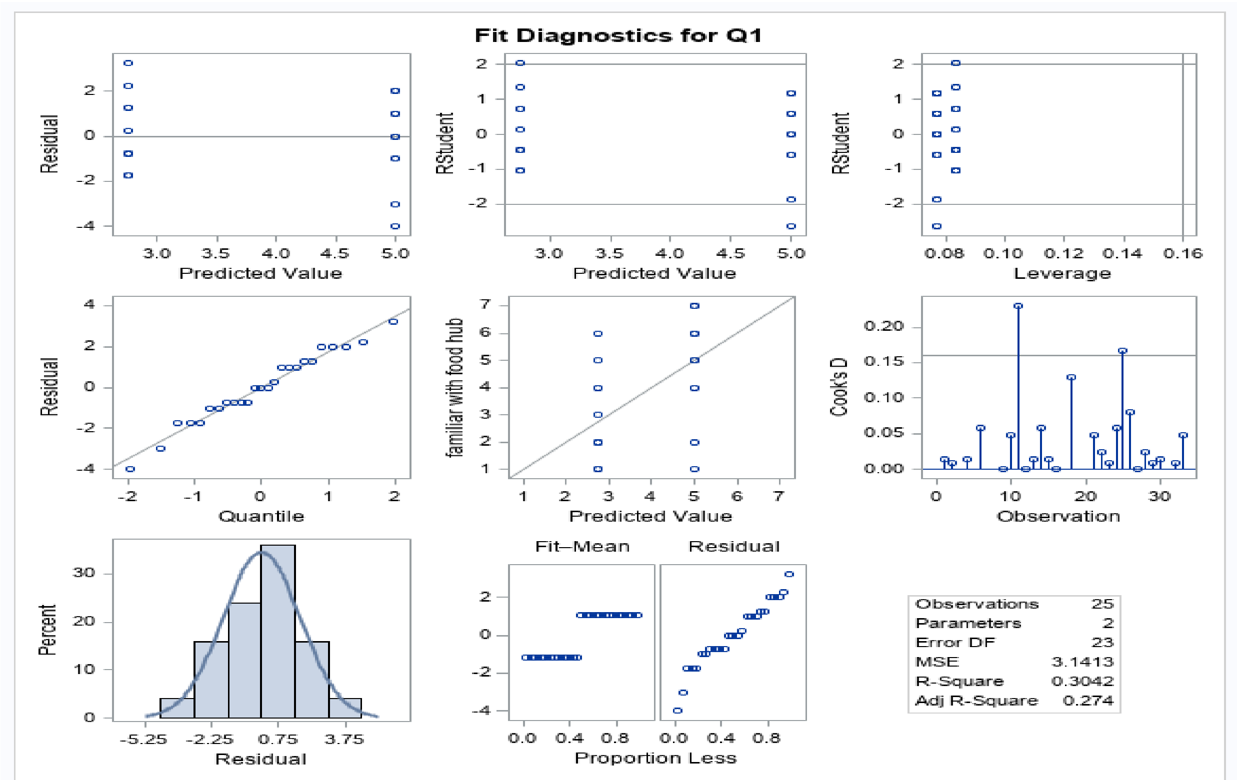
Dependent Variable: Q1 familiar with food hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	31.5900000	31.5900000	10.06	0.0043
Error	23	72.2500000	3.1413043		
Corrected Total	24	103.8400000			

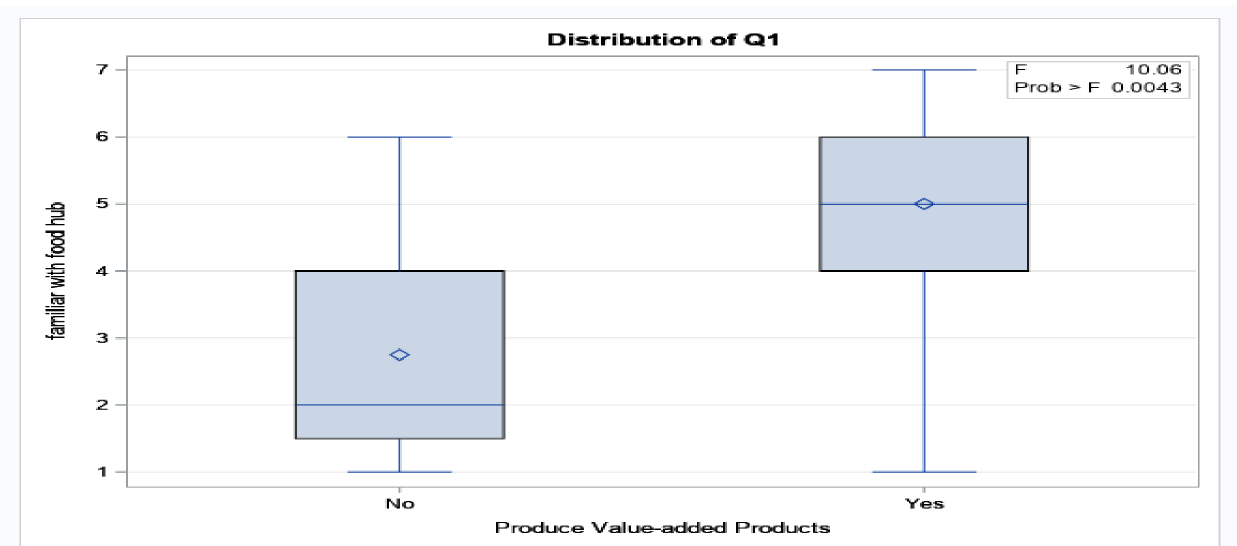
R-Square	Coeff Var	Root MSE	Q1 Mean
0.304218	45.21358	1.772373	3.920000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Q31	1	31.59000000	31.59000000	10.06	0.0043

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	31.59000000	31.59000000	10.06	0.0043



Fit Diagnostics for Q1
Residual
Predicted Value
RStudent
Leverage
Quantile
familiar with food hub
Cook's D
Observation
Percent
Fit–Mean
Residual
Proportion Less
Observations 25
Parameters 2
Error DF 23
MSE 3.1413
R-Square 0.3042
Adj R-Square 0.274



Distribution of Q1
F 10.06
Prob > F 0.0043
familiar with food hub
No
Yes
Produce Value-added Products

The SAS System

The GLM Procedure

Class Level Information		
Class	Levels	Values
Q31	2	No Yes
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q47	2	High School and above No High School Degree
Q49	2	Full time Part time
Q51	2	10 years or less More than 10 years

Number of Observations Read	33
Number of Observations Used	17

The SAS System

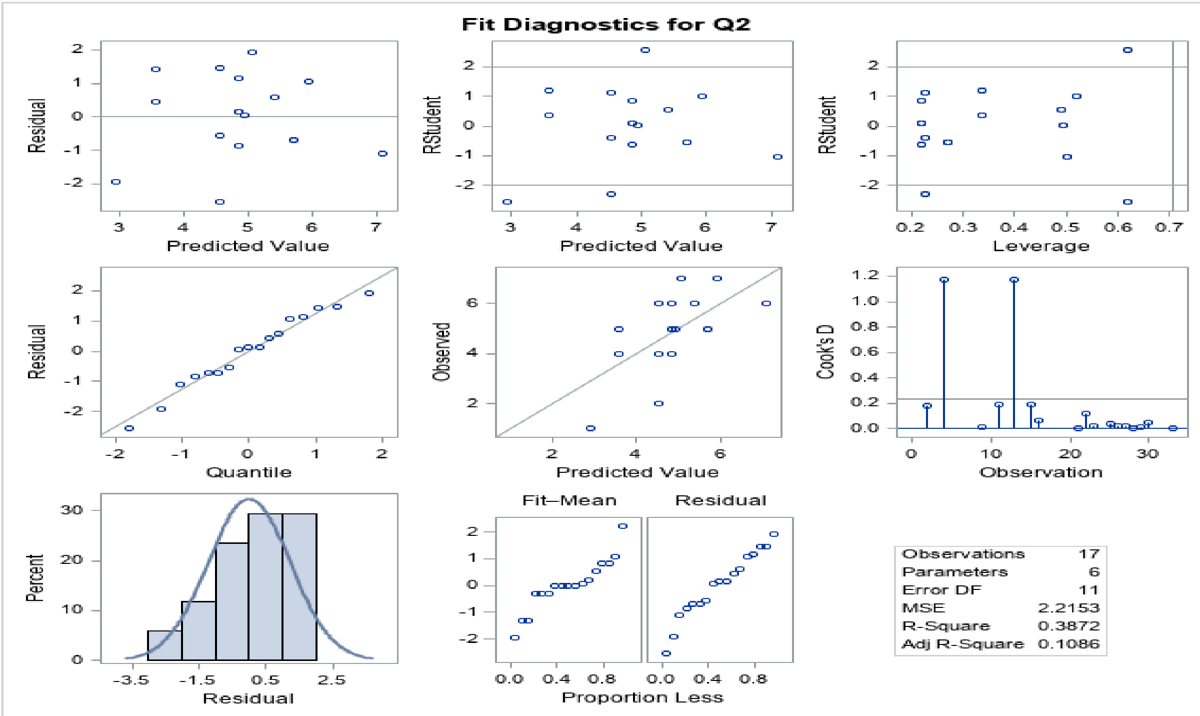
The GLM Procedure

Dependent Variable: Q2 Food Hub Provides Sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	15.39641944	3.07928389	1.39	0.3007
Error	11	24.36828645	2.21529877		
Corrected Total	16	39.76470588			

R-Square	Coeff Var	Root MSE	Q2 Mean
0.387188	30.48505	1.488388	4.882353

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	0.25034273	0.25034273	0.11	0.7431
Q21	1	1.88829250	1.88829250	0.85	0.3757
Q47	1	0.31041392	0.31041392	0.14	0.7153
Q49	1	4.41659728	4.41659728	1.99	0.1856
Q51	1	9.86122175	9.86122175	4.45	0.0586



The SAS System

The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
Q47	2	High School and above No High School Degree
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q49	2	Full time Part time
Q51	2	10 years or less More than 10 years

Number of Observations Read	33
Number of Observations Used	17

The SAS System

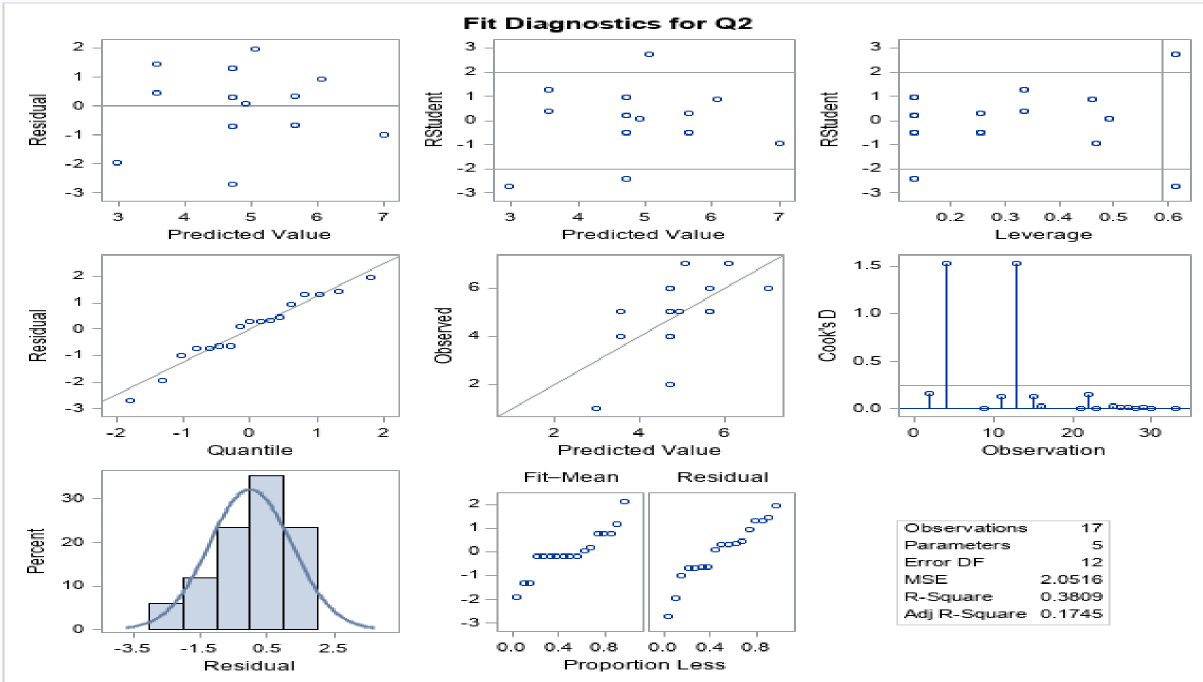
The GLM Procedure

Dependent Variable: Q2 Food Hub Provides Sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	15.14607671	3.78651918	1.85	0.1850
Error	12	24.61862917	2.05155243		
Corrected Total	16	39.76470588			

R-Square	Coeff Var	Root MSE	Q2 Mean
0.380892	29.33676	1.432324	4.882353

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q47	1	0.15367130	0.15367130	0.07	0.7890
Q21	1	2.48431200	2.48431200	1.21	0.2927
Q49	1	4.25637083	4.25637083	2.07	0.1753
Q51	1	9.61392897	9.61392897	4.69	0.0513



The SAS System

The GLM Procedure

Class Level Information		
Class	Levels	Values
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q49	2	Full time Part time
Q51	2	10 years or less More than 10 years

Number of Observations Read	33
Number of Observations Used	17

The SAS System

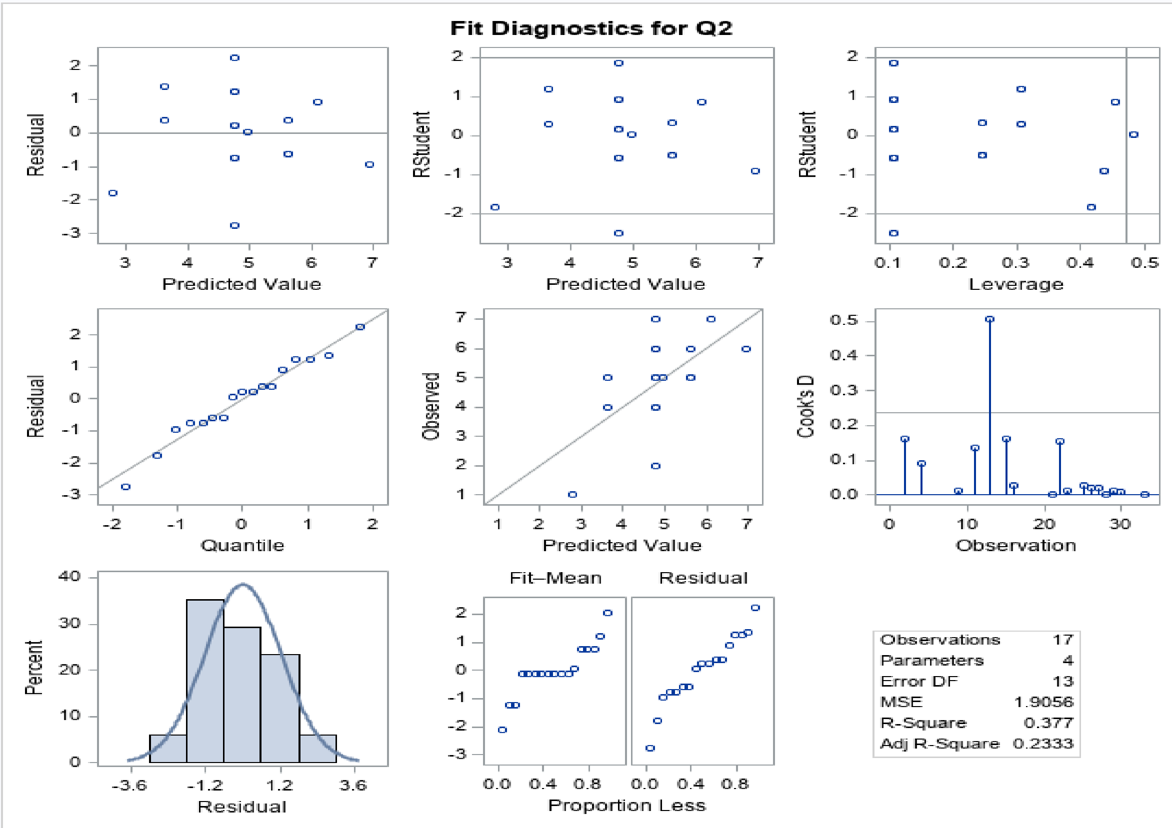
The GLM Procedure

Dependent Variable: Q2 Food Hub Provides Sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	14.99240541	4.99746847	2.62	0.0948
Error	13	24.77230047	1.90556157		
Corrected Total	16	39.76470588			

R-Square	Coeff Var	Root MSE	Q2 Mean
0.377028	28.27368	1.380421	4.882353

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q21	1	2.40880189	2.40880189	1.26	0.2812
Q49	1	4.12387439	4.12387439	2.16	0.1651
Q51	1	10.28291425	10.28291425	5.40	0.0370



The SAS System

The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
Q49	2	Full time Part time
Q51	2	10 years or less More than 10 years

Number of Observations Read	33
Number of Observations Used	18

The SAS System

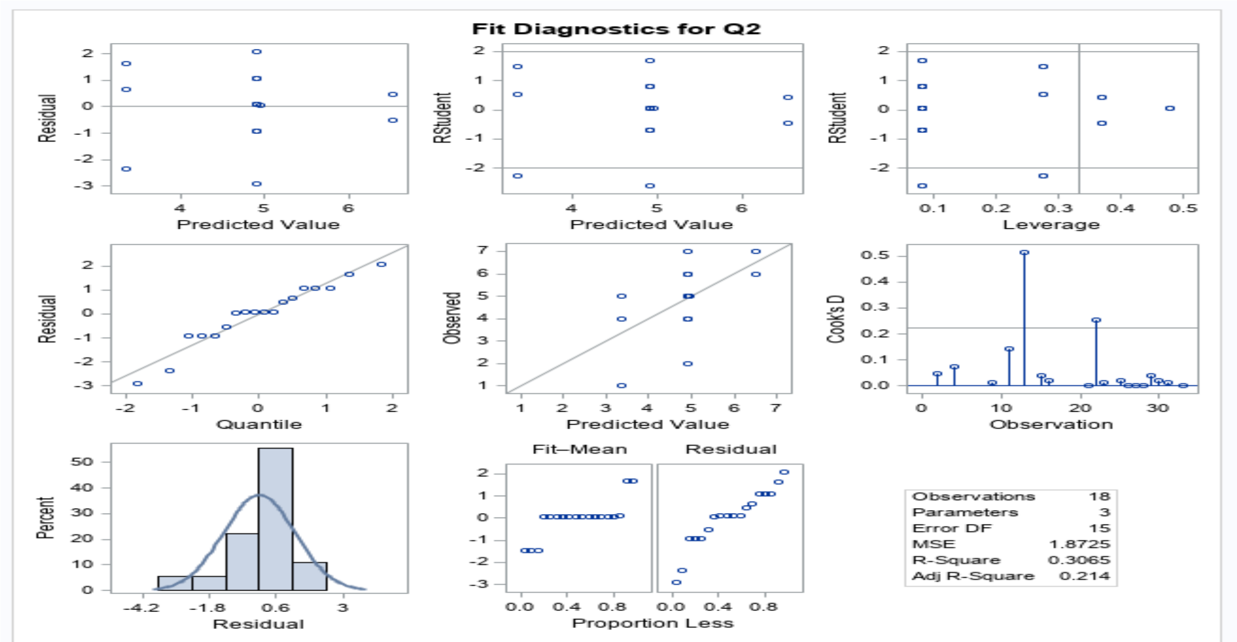
The GLM Procedure

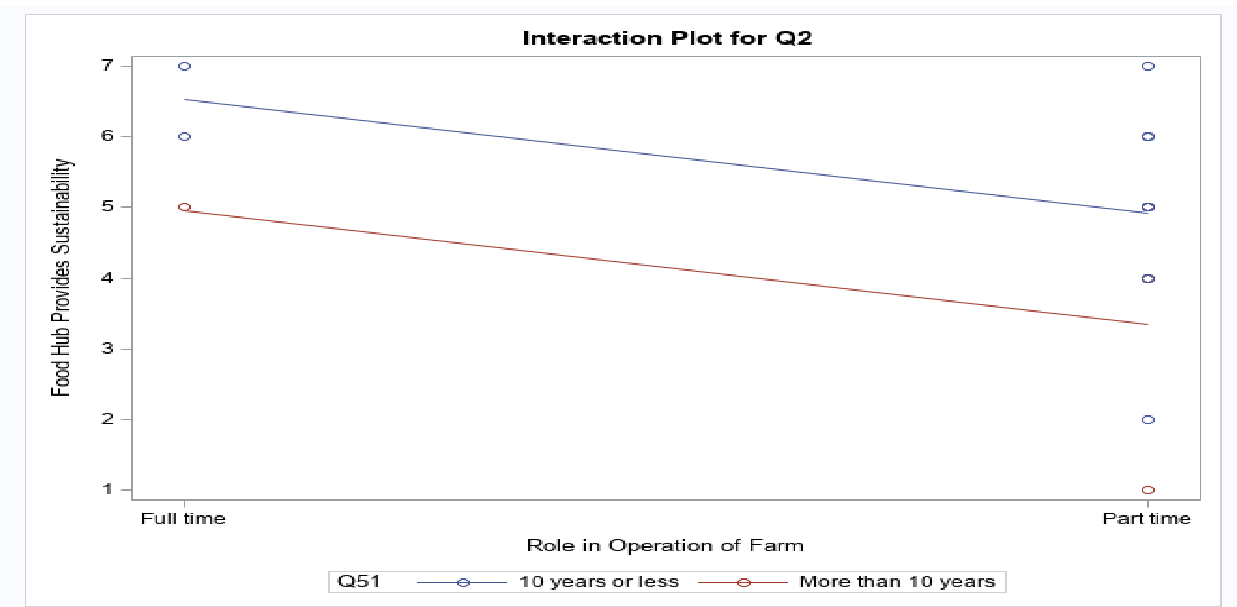
Dependent Variable: Q2 Food Hub Provides Sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	12.41304348	6.20652174	3.31	0.0642
Error	15	28.08695652	1.87246377		
Corrected Total	17	40.50000000			

R-Square	Coeff Var	Root MSE	Q2 Mean
0.306495	28.31131	1.368380	4.833333

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q49	1	6.37732919	6.37732919	3.41	0.0848
Q51	1	7.51304348	7.51304348	4.01	0.0636


Fit Diagnostics for Q2
Residual
Predicted Value
RStudent
Leverage
Quantile
Observed
Cook's D
Observation
Percent
Fit–Mean
Residual
Proportion Less
Observations 18
Parameters 3
Error DF 15
MSE 1.8725
R-Square 0.3065
Adj R-Square 0.214


Interaction Plot for Q2
Food Hub Provides Sustainability
Full time
Part time
Role in Operation of Farm
Q51
10 years or less
More than 10 years

The SAS System

The GLM Procedure

Class Level Information		
Class	Levels	Values
Q51	2	10 years or less More than 10 years

Number of Observations Read	33
Number of Observations Used	26

The SAS System

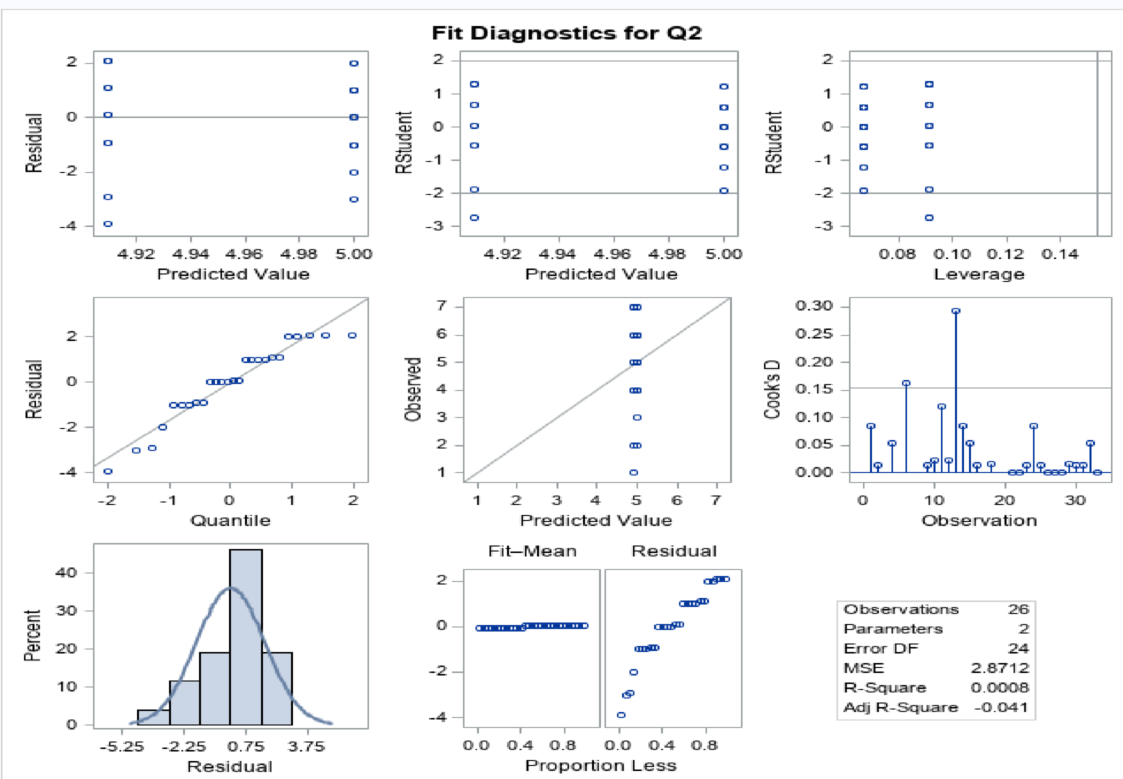
The GLM Procedure

Dependent Variable: Q2 Food Hub Provides Sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	0.05244755	0.05244755	0.02	0.8936
Error	24	68.90909091	2.87121212		
Corrected Total	25	68.96153846			

R-Square	Coeff Var	Root MSE	Q2 Mean
0.000761	34.15201	1.694465	4.961538

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q51	1	0.05244755	0.05244755	0.02	0.8936



The SAS System

The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
Q31	2	No Yes
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q47	2	High School and above No High School Degree
Q49	2	Full time Part time
Q51	2	10 years or less More than 10 years

Number of Observations Read	33
Number of Observations Used	16

The SAS System

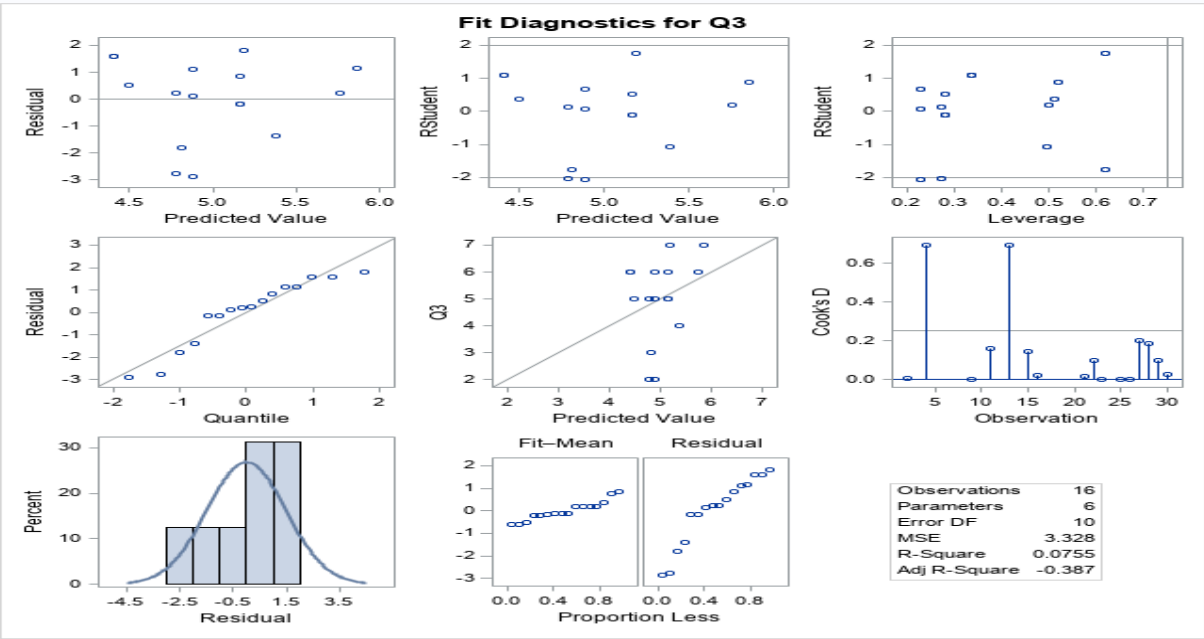
The GLM Procedure

Dependent Variable: Q3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	2.71954211	0.54390842	0.16	0.9705
Error	10	33.28045789	3.32804579		
Corrected Total	15	36.00000000			

R-Square	Coeff Var	Root MSE	Q3 Mean
0.075543	36.48586	1.824293	5.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	0.19929919	0.19929919	0.06	0.8116
Q21	1	0.35031134	0.35031134	0.11	0.7523
Q47	1	0.10607347	0.10607347	0.03	0.8619
Q49	1	2.16954211	2.16954211	0.65	0.4382
Q51	1	0.30142364	0.30142364	0.09	0.7696



The GLM Procedure

Class Level Information		
Class	Levels	Values
Q31	2	No Yes
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q49	2	Full time Part time
Q51	2	10 years or less More than 10 years

Number of Observations Read	33
Number of Observations Used	16

The SAS System

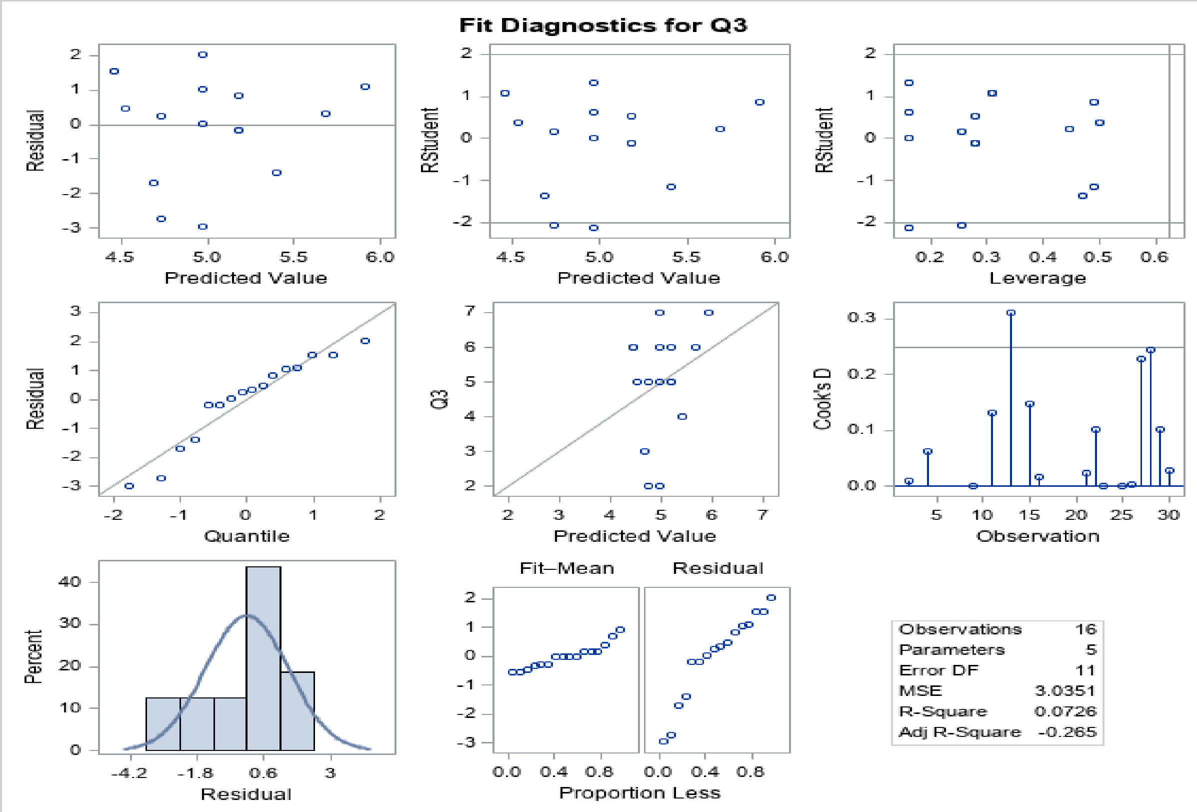
The GLM Procedure

Dependent Variable: Q3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	2.61346863	0.65336716	0.22	0.9244
Error	11	33.38653137	3.03513922		
Corrected Total	15	36.00000000			

R-Square	Coeff Var	Root MSE	Q3 Mean
0.072596	34.84330	1.742165	5.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	0.12399495	0.12399495	0.04	0.8435
Q21	1	0.48383901	0.48383901	0.16	0.6973
Q49	1	2.07500710	2.07500710	0.68	0.4259
Q51	1	0.20579477	0.20579477	0.07	0.7994



The SAS System

The GLM Procedure

Class Level Information		
Class	Levels	Values
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q49	2	Full time Part time
Q51	2	10 years or less More than 10 years

Number of Observations Read	33
Number of Observations Used	16

The SAS System

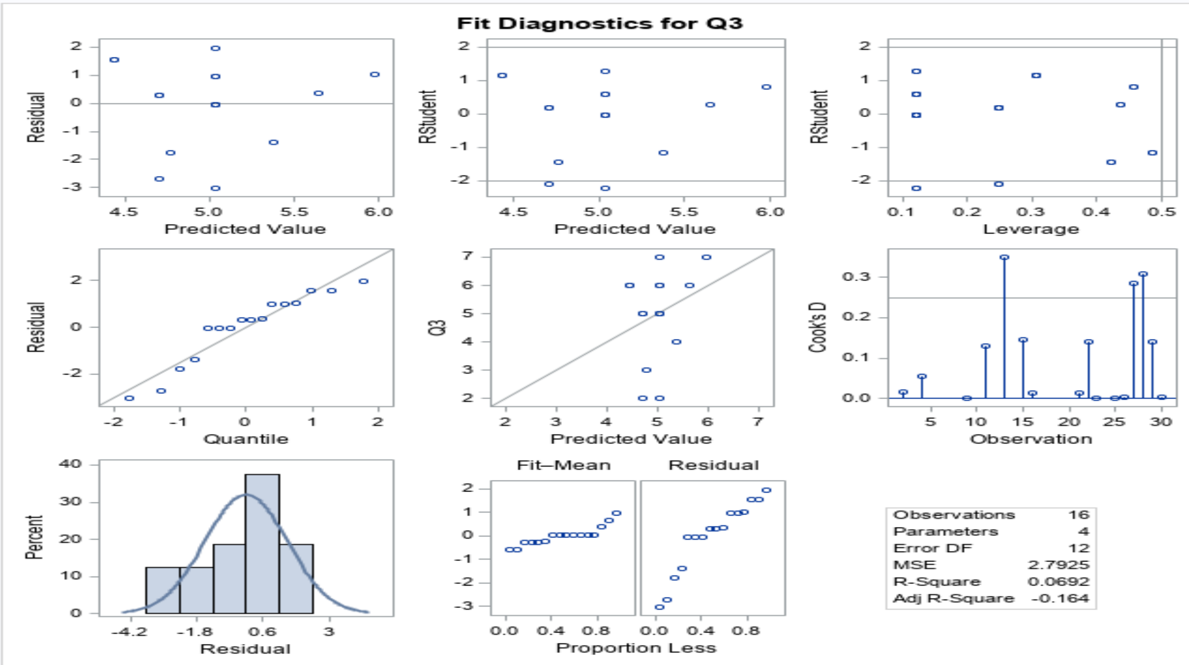
The GLM Procedure

Dependent Variable: Q3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	2.48947368	0.82982456	0.30	0.8268
Error	12	33.51052632	2.79254386		
Corrected Total	15	36.00000000			

R-Square	Coeff Var	Root MSE	Q3 Mean
0.069152	33.42181	1.671091	5.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q21	1	0.36016334	0.36016334	0.13	0.7257
Q49	1	2.05654685	2.05654685	0.74	0.4076
Q51	1	0.19495314	0.19495314	0.07	0.7961



The SAS System

The GLM Procedure

Class Level Information		
Class	Levels	Values
Q21	2	Less than 1,937 crop acres More than 1,937 crop acres
Q49	2	Full time Part time

Number of Observations Read	33
Number of Observations Used	16

The SAS System

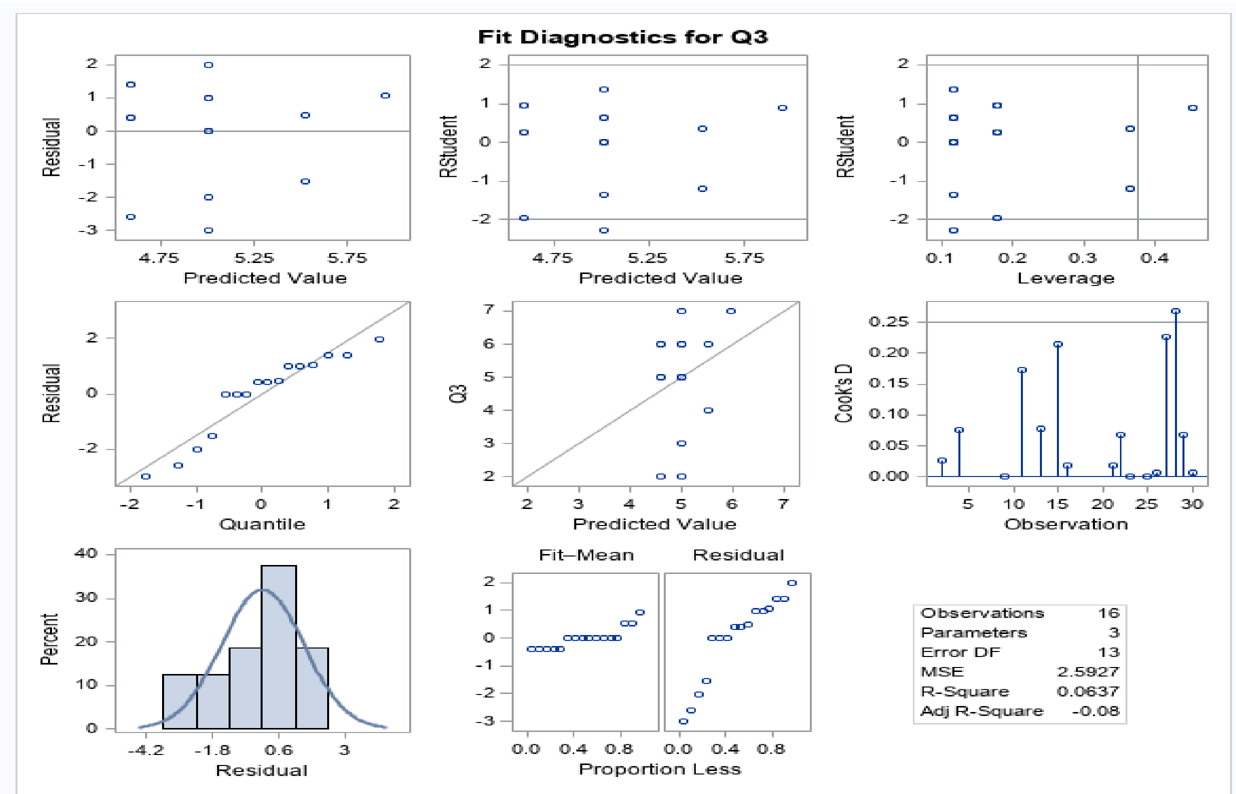
The GLM Procedure

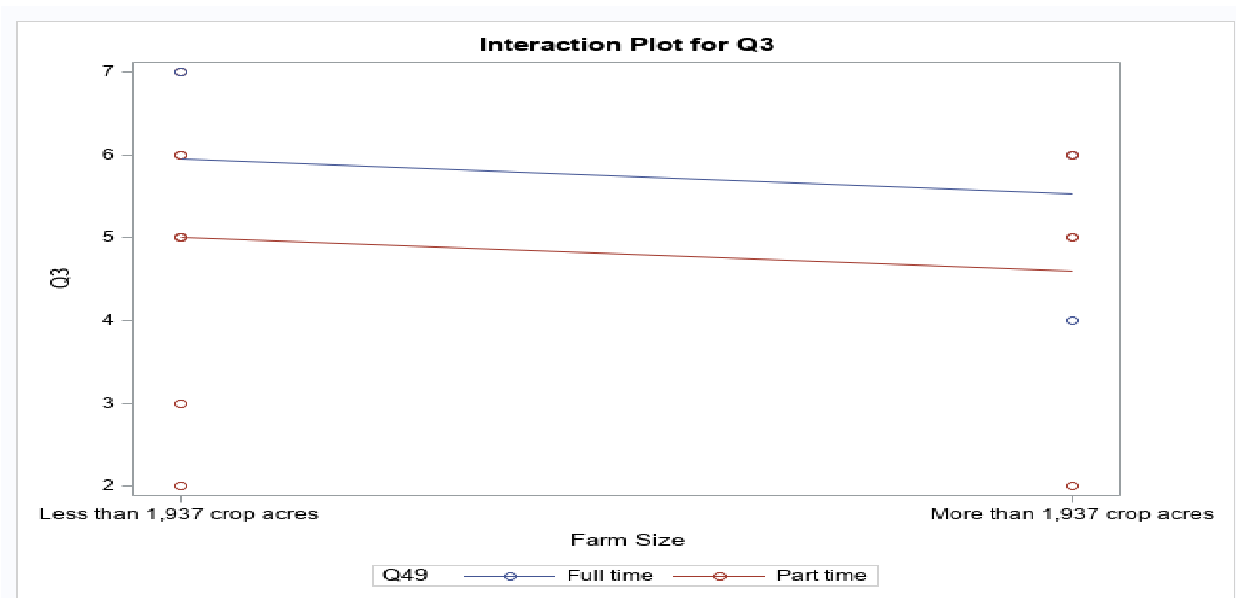
Dependent Variable: Q3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	2.29452055	1.14726027	0.44	0.6518
Error	13	33.70547945	2.59272919		
Corrected Total	15	36.00000000			

R-Square	Coeff Var	Root MSE	Q3 Mean
0.063737	32.20391	1.610195	5.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q21	1	0.65349491	0.65349491	0.25	0.6240
Q49	1	2.04055229	2.04055229	0.79	0.3911


Fit Diagnostics for Q3
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Q3
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 16
Parameters 3
Error DF 13
MSE 2.5927
R-Square 0.0637
Adj R-Square -0.08


Interaction Plot for Q3
Q3
Less than 1,937 crop acres
More than 1,937 crop acres
Farm Size
Q49
Full time
Part time

The SAS System

The GLM Procedure

Class Level Information		
Class	Levels	Values
Q49	2	Full time Part time

Number of Observations Read	33
Number of Observations Used	17

The SAS System

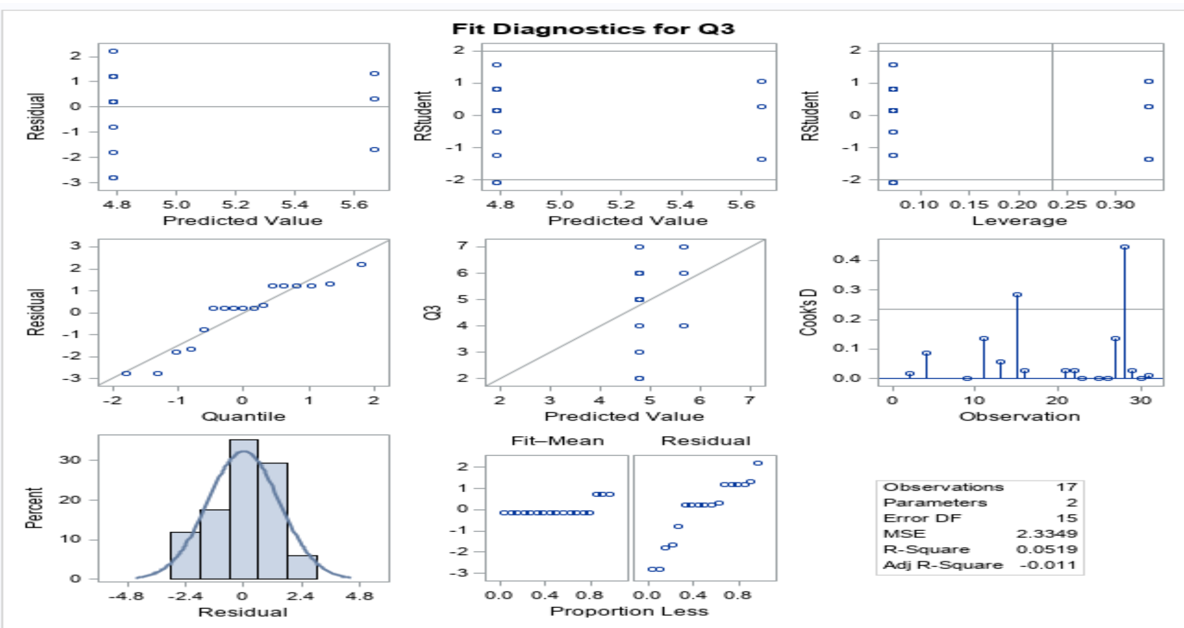
The GLM Procedure

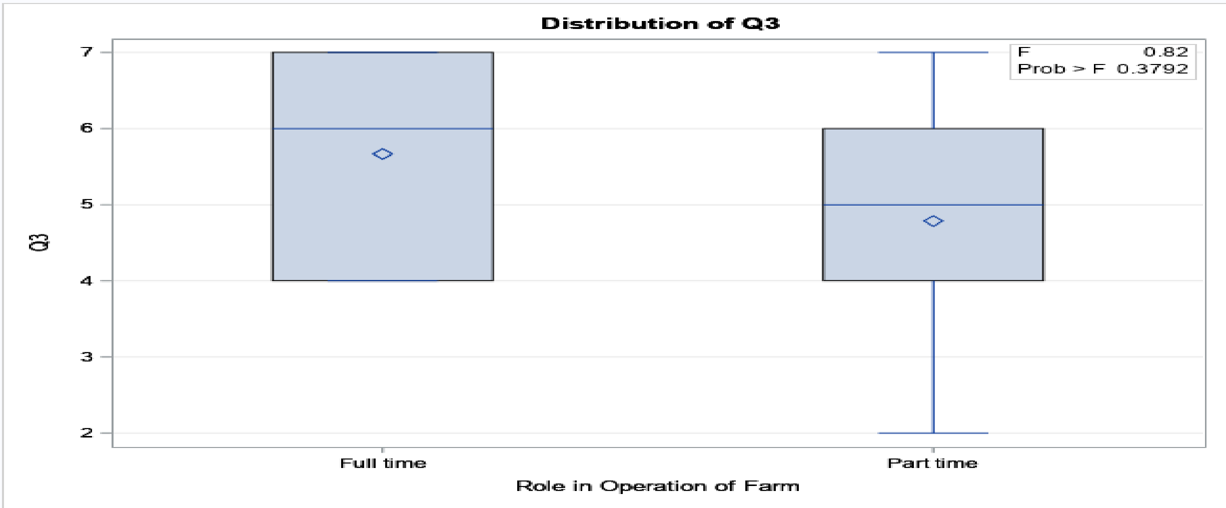
Dependent Variable: Q3

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.91736695	1.91736695	0.82	0.3792
Error	15	35.02380952	2.33492063		
Corrected Total	16	36.94117647			

R-Square	Coeff Var	Root MSE	Q3 Mean
0.051903	30.92471	1.528045	4.941176

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q49	1	1.91736695	1.91736695	0.82	0.3792





dependent(Q1),Q31 is significant, most close to be significant variable is Q21

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	2
Number of Test Predictors	1
R-square of Full Model	0.406277
Difference in R-square	0.102
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.802	48
2	0.85	0.855	55
3	0.90	0.904	64
4	0.95	0.951	78

dependent(Q2), most close to be significant variables are Q49 and Q51

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	2
Number of Test Predictors	2
R-square of Full Model	0.306495
Difference in R-square	0.306495
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.818	26
2	0.85	0.851	28
3	0.90	0.902	32
4	0.95	0.955	39

dependent(Q3), most close to be significant variables are Q49

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	1
Number of Test Predictors	1
R-square of Full Model	0.051903
Difference in R-square	0.051903
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.802	146
2	0.85	0.850	166
3	0.90	0.900	194
4	0.95	0.951	240

APPENDIX F. THE IRB APPROVAL LETTER FOR ND FOOD HUB FEASIBILITY STUDY PART-B

December 24, 2019

Dr. Joseph Szermekovsky
Transportation, Logistics, and Finance

Re: Your submission to the IRB: "North Dakota Food Hub Feasibility Study Part 2"

Co-Investigator(s) and Research Team: Hamad Alqublan, Dr. Saleem Shaik

Thank you for your inquiry regarding your project. At this time, the IRB office has determined that the above-referenced protocol does not require Institutional Review Board approval or certification of exempt status because it does not fit the regulatory definition of 'research involving human subjects'.

Dept. of Health & Human Services regulations governing human subjects research (45CFR46, Protection of Human Subjects), defines 'research' as "…a systematic investigation, research development, testing and evaluation, designed to contribute to generalizable knowledge." These regulations also define a 'human subject' as "a living individual about whom an investigator (whether professional or student) conducting research:
(i) Obtains information or biospecimens through intervention or interaction with the individual, and uses, studies, or analyzes the information or biospecimens; or
(ii) Obtains, uses, studies, analyzes, or generates identifiable private information or identifiable biospecimens."

It was determined that your project does not require IRB approval (or a determination of exemption) from NDSU. The data collected is not about the individual respondents, but business practices. Please remove the contact information for the IRB/HRPP office from your information letter.

We appreciate your intention to abide by NDSU IRB policies and procedures, and thank you for your patience as the IRB Office has reviewed your study. Best wishes for a successful project!

Sincerely,

Kristy Shirley

Kristy Shirley, CIP; Research Compliance Administrator

APPENDIX G. ND FOOD HUB FEASIBILITY STUDY PART-B SURVEY COVER LETTER

Dear respondent,

My name is Hamad Al Qublan. I am a Ph.D. candidate in the Transportation, Logistics, and Finance program at North Dakota State University. I am conducting a survey to evaluate the feasibility of the establishment of a ND food hub as my doctoral dissertation. The purpose of this study is to understand and evaluate the ND local food system from the demand-side. I am gathering the interest and expectations of wholesale and institutional buyers who are considered as local food buyers and ND food hub customers. Your input as wholesale and institutional food buyers is critical for the accuracy of the findings and the success of this study.

I invite you to participate in this research study so that we may attempt to design a local food solution that best fits your needs. Participation involves you completing an online questionnaire. I estimate the time to complete this questionnaire to be 15-20 minutes. However, this survey has a "Save and Continue" option, so you can save your answers and return to finish the survey later. I do not anticipate any risks to you in participating in this research. The study may benefit you as a food buyer, food producer, consumer, and member of the state economy, but there is no compensation for completing the survey.

Your participation is voluntary, and you may skip any question or withdraw from the study at any time without penalty. If you consent to participate, your answers will be anonymous and will be kept confidential to the fullest extent of the law. The information provided will be used solely for this research project, and only non-identifiable, aggregated results will be reported in reputable academic publications. No persons other than my supervisors and I will have access to the information you provide. This survey will be available online for a month, if you have any questions regarding this project, feel free to contact me.

Thank you for time, I greatly value your participation!

Hamad Al Qublan
Ph.D. Candidate, Transportation, Logistics, and Finance
North Dakota State University
Phone #: 214-603-0237. Email: hamad.alqublan@ndsu.edu

APPENDIX H. ND FOOD HUB FEASIBILITY STUDY PART-B SURVEY

PURCHASING BEHAVIOR AND REQUIREMENTS

Q 1 What is the seasonality of your institution (i.e., your top season for sale or service)?

O A. Year-round (1)

O B. School year (2)

O C. Summer Seasonal (3)

O D. Winter Seasonal (4)

O E. Other, please specify (5)

Q 2 How many vendors supply your institution with food?

Q 3 How is your food purchase delivered to you?

O A. Supplier/s make the delivery to the institution (1)

O B. We pick up our food from the supplier (2)

Q 4 On average, how many miles must your food purchase order travel from suppliers to your institution? Note: Either you answered A or B in the previous question, we still need you to answer this question.(Your answer must be in miles per one-way trip)

Q 5 On average, what is your shipping or delivery cost for a food purchase order to get your institution? Note: Either you answered A or B in the previous question, we still need you to answer this question. (your answer must be in $ …………cost per order)

Q 6 What are the requirements of local producers to sell or market to your business? Please check all that apply.

▢ A. No requirements (1)

▢ B. Must pass our on-farm audit (2)

▢ C. Must have an on-farm food safety plan (3)

- D. Must have implemented USDA certified food safety plan (4)
- E. Must be GAP or GHP certified (5)
- F. Must be HACCP certified (6)
- G. Must offer traceability (7)
- H. Must be organically certified (8)
- I. Must be chemical-free (9)
- J. Must be Halal certified (10)
- K. We depend on suppliers' requirements (11)
- L. Other, please specify (12)

Q 7 Which of the following labels describes your purchasing practices?

- A. Conventional (1)
- B. Certified organic (2)
- C. ther, please specify (3)

Q 8 What are your requirements in terms of packing standards? Please check all that apply.

- A. None (1)
- B. Must follow USDA grading standards (2)
- C. Expect industry packing standards (3)
- D. Must maintain a cold chain (4)

- E. Must meet our packing standards (5)
- F. Must match our quality standards (6)
- G. Must be recyclable or reusable packaging (7)
- H. We depend on distributors' standards (8)
- I. Must provide refrigerated, not frozen meats (9)
- J. ther, please specify (10)

Q 9 Do you purchase any of the following food that originates from North Dakota? Please check all that apply.

- A. Fruits (1)
- B. Vegetables (2)
- C. Meat (3)
- D. Poultry (4)
- E. Dairy products (5)
- F. Honey (6)
- G. Processed food (e.g., jam) (7)
- H. Eggs (8)
- J. We do not buy food sourced from ND (9)
- I. Other, please specify (10)

Q 10 Are you interested in purchasing any of the following food that originates from North Dakota? Please check all that apply.

- ▢ A. Fruit (1)
- ▢ B. Vegetables (2)
- ▢ C. Meat (3)
- ▢ D. Poultry (4)
- ▢ E. Dairy products (5)
- ▢ F. Honey (6)
- ▢ G. Processed food (e.g., jam) (7)
- ▢ H. Eggs (8)
- ▢ J. We do not buy food sourced from ND (9)
- ▢ I. Other, please specify (10)

Q 11 What motivates or would motivate you to buy local foods? Please check all that apply.

	Not important 1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Important7 (7)	N/A (0)
Community Demand (1)	O	O	O	O	O	O	O	O
Freshness (2)	O	O	O	O	O	O	O	O
Know where/how product was grown (3)	O	O	O	O	O	O	O	O

Price (4)	O	O	O	O	O	O	O	O
Quality (5)	O	O	O	O	O	O	O	O
Reduce transportation impacts on the environment (6)	O	O	O	O	O	O	O	O
Support local economy (7)	O	O	O	O	O	O	O	O
Support education efforts on where/how food is grown (8)	O	O	O	O	O	O	O	O
Support local farmers (9)	O	O	O	O	O	O	O	O
Taste (10)	O	O	O	O	O	O	O	O
Other, please specify (11)	O	O	O	O	O	O	O	O

Q 12 What factors are preventing you from purchasing, or purchasing more local foods? Please check all that apply.

	Not important1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Important7 (7)	N/A (0)
Equipment (1)	O	O	O	O	O	O	O	O
Food Safety Assurances/Concerns (2)	O	O	O	O	O	O	O	O
Food Budget Constraints (3)	O	O	O	O	O	O	O	O

Labor/Food Prep Budget Constraints (4)	O	O	O	O	O	O	O	O
I have not been able to focus on this (5)	O	O	O	O	O	O	O	O
I lack the resources to receive deliveries from multiple farms (6)	O	O	O	O	O	O	O	O
I want to purchase local foods directly from a farm, but don't know-how (7)	O	O	O	O	O	O	O	O
I want to purchase local foods, but a local farmer does not deliver to my institution (8)	O	O	O	O	O	O	O	O
My distributor does not carry local food (9)	O	O	O	O	O	O	O	O
My distributor does not identify or highlight local products (10)	O	O	O	O	O	O	O	O
Products are not available in the form I need them (11)	O	O	O	O	O	O	O	O
Storage (12)	O	O	O	O	O	O	O	O
Finding suppliers with accredited food safety plans (13)	O	O	O	O	O	O	O	O
Finding suppliers that have product processed in USDA inspected facilities (14)	O	O	O	O	O	O	O	O
Traceability mechanism of local product (15)	O	O	O	O	O	O	O	O
Sourcing products desirable for resale (16)	O	O	O	O	O	O	O	O

Finding suppliers that can provide necessary quantities at desired times (17)	O	O	O	O	O	O	O	O
Finding a product at the required price (18)	O	O	O	O	O	O	O	O
Contracts with current suppliers prevent us from purchasing from suppliers with local products (19)	O	O	O	O	O	O	O	O
Limited ability of suppliers to meet my delivery requirements (20)	O	O	O	O	O	O	O	O
Complexity of dealing with multiple small suppliers (21)	O	O	O	O	O	O	O	O
Handling product received from local (22)	O	O	O	O	O	O	O	O
Quality of products available (23)	O	O	O	O	O	O	O	O
Seasonality of local product (24)	O	O	O	O	O	O	O	O
Diversity of local produce (25)	O	O	O	O	O	O	O	O
Local, state, and/or federal policies and legislation (26)	O	O	O	O	O	O	O	O
Distribution & logistics (27)	O	O	O	O	O	O	O	O
Other, please specify (28)	O	O	O	O	O	O	O	O

Q 13 Other than removing budget restrictions, which of the following would help you begin purchasing or purchase more local food? Please check all that apply.

	Not Helpful 1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Very Helpful 7 (7)	N/A (8)
Support connecting with local producers (1)	O	O	O	O	O	O	O	O
Increased awareness of local products carried by my distributor (2)	O	O	O	O	O	O	O	O
Greater local product availability from my distributor (3)	O	O	O	O	O	O	O	O
Increased/Improved Storage (4)	O	O	O	O	O	O	O	O
Equipment (5)	O	O	O	O	O	O	O	O
Technical Assistance (6)	O	O	O	O	O	O	O	O
Training of staff to use the products (7)	O	O	O	O	O	O	O	O
Hiring professional staff (8)	O	O	O	O	O	O	O	O
Other, please specify (9)	O	O	O	O	O	O	O	O

Q 14 Which of the following promotional tools are, or would be, most helpful in promoting local foods? Please check all that apply.

	Not Helpful 1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Very Helpful7 (7)	N/A (0)
A story or narrative of the farm and farmers (1)	O	O	O	O	O	O	O	O

Farmer visits to the institution (2)	O	O	O	O	O	O	O	O
Field trips to the farm (3)	O	O	O	O	O	O	O	O
Identified as “Grown in ND” “STATE BRAND” (4)	O	O	O	O	O	O	O	O
Location of the farm (5)	O	O	O	O	O	O	O	O
Name of the farm and farmer (6)	O	O	O	O	O	O	O	O
Photos of the farm and/or farmer (7)	O	O	O	O	O	O	O	O
Other, please specify (8)	O	O	O	O	O	O	O	O

Q 15 What is, or would be, your preferred method of purchasing local food? Please check all that apply.

	Not preferred1 (1)	2 (2)	3 (3)	Natural 4 (4)	5 (5)	6 (6)	Preferred 7 (7)	N/A (0)
Direct from a farmer (1)	O	O	O	O	O	O	O	O
From a produce distributor (2)	O	O	O	O	O	O	O	O
Through a broad-line distributor (such as Sysco, US Foods, Reinhart) (3)	O	O	O	O	O	O	O	O

Food Hub (4)	O	O	O	O	O	O	O	O
Farmers markets (5)	O	O	O	O	O	O	O	O
On-farm markets (6)	O	O	O	O	O	O	O	O
CSAs (7)	O	O	O	O	O	O	O	O
Online (8)	O	O	O	O	O	O	O	O
Other, please specify (9)	O	O	O	O	O	O	O	O

Q 16 Do you have a limit on the number of vendors you like to deal with at any one time?

O A. Yes (1)

O B. No (2)

Q 17 What is your total purchased amount for each of the following food categories in thousands of dollars during your most recently completed fiscal year. Check the box for each category.

	$0 - $5,000 (1)	$5,000- $10,000 (2)	$10,000- $25,000 (3)	$25,000- $50,000 (4)	$50,000- $100,000 (5)	$100,000- $200,000 (6)	$200,000- $500,000 (7)	$500,000- $1,000,000 (8)	>$1,000,000 (9)	N/A (0)
Fruits (1)	C	O	O	O	O	O	O	O	O	
Vegetables (2)	C	O	O	O	O	O	O	O	O	
Meat (including fresh, and frozen) (3)	C	O	O	O	O	O	O	O	O	

poultry Dairy products (4)	O	O	O	O	O	O	O	O	O
Honey Processed food (e.g., jam) (5)	O	O	O	O	O	O	O	O	O
Eggs (6)	O	O	O	O	O	O	O	O	O
Other, please specify (7)	O	O	O	O	O	O	O	O	O

Q 18 What is your total annual purchased amount volume of processed fruit and vegetables? Fill the appropriate box in each column below. Check the box for each category.

	$0 - $5,000 (1)	$5,000- $10,000 (2)	$10,000- $25,000 (3)	$25,000- $50,000 (4)	$50,000- $100,000 (5)	$100,000- $200,000 (6)	$200,000- $500,000 (7)	$500,000- $1,000,000 (8)	>$1,000,000 (9)	N/A (0)
Fresh pack (1)	O	O	O	O	O	O	O	O	O	O
Wash, pack (2)	O	O	O	O	O	O	O	O	O	O
Cut (3)	O	O	O	O	O	O	O	O	O	O
Canned (4)	O	O	O	O	O	O	O	O	O	O
Frozen (5)	O	O	O	O	O	O	O	O	O	O

Q 19 Of your total expenditures amount? Please estimate what percent you are willing to spend on each of the following food categories that originate from ND? Check the box for each category.

	1-5% (1)	5-15% (2)	15-25% (3)	25-50% (4)	>50% (5)	>Not sure (6)
Fruits (1)	O	O	O	O	O	O
Vegetables (2)	O	O	O	O	O	O
Meat (including fresh, and frozen) (3)	O	O	O	O	O	O
poultry Dairy products (4)	O	O	O	O	O	O
Honey Processed food (e.g., jam) (5)	O	O	O	O	O	O
Eggs (6)	O	O	O	O	O	O
Other, please specify (7)	O	O	O	O	O	O

Q 20 What is your expectation about your total volume of food purchases amount for the coming 3 years?

O A. Greatly decrease (1)

O B. Somewhat decrease (2)

O C. Stay the same (3)

O D. Somewhat increase (4)

O E. Greatly increase (5)

Q 21 What are your requirements for food suppliers in terms of liability insurance?

- A. Not required (1)
- B. We depend on distributors' requirements (2)
- C. Required – what is the minimum coverage amount? (3)

LOCAL FOOD CONCEPT

Q 22 Which of these statements represents "local" for you regarding food products? Choose the description that best applies.

- A. Produced or processed in my county (1)
- B. Produced or processed in my state (2)
- C. Produced or processed in my region (3)
- D. Produced or processed in the U.S. (4)
- E. Knowing the origin where my food is produced or processed (5)
- F. Other, please specify (6)

Q 23 Which of these statements represents "local" for you regarding food products? Choose the description that best applies.

- A. Produced within less than 10 miles of the point of sale (1)
- B. Produced within less than 10-25 miles of the point of sale (2)
- C. Produced within less than 50-100 miles of the point of sale (3)
- D. Produced within less than 100-200 miles of the point of sale (4)
- E. Produced within less than 200-400 miles of the point of sale (5)
- F. Other, please specify (6)

Q 24 What influences you to purchase locally- produced foods? Please check all that apply.

- A. Better taste (1)
- B. Fresher food (2)
- C. Higher quality (3)
- D. Customer demand (4)
- E. Marketing, 'good for business (5)
- F. Costs less (6)
- G. Food safety concerns (7)
- H. Support local farms (8)
- I. Support the local economy (9)
- J. Environmental responsibility (food miles, etc.) (10)
- K. Other, please specify (11)

Q 25 Do you influence your suppliers to buy directly from ND farms?

- A. Yes (1)
- B. No (2)

Q 26 Is your business purchasing or serving locally produced foods?

- A. Yes. Please, list all local foods you buy or serve? (1)
- B. No.Why not? (2)

Q 27 What flexibility do you have when purchasing local produce? (i.e., change in the amount of food been purchased more or less)

	Not flexible1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Very flexible7 (7)	N/A (0)
Rate your answer (1)	O	O	O	O	O	O	O	O

Q 28 What flexibility regarding seasonality do you have when purchasing local produce?

	Not flexible1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Very flexible7 (7)	N/A (0)
Rate your answer (1)	O	O	O	O	O	O	O	O

Q 29 How often do you purchase locally grown/produced foods?

O A. Daily (1)

O B. Weekly (2)

O C. Monthly (3)

O D. Quarterly (4)

O E. Seasonally (5)

O F. Never (6)

O G. Other, please specify (7)

Q 30 Do you have customers asking for locally produced foods regardless of how often?

O A. Yes (1)

O B. No (2)

Q 31 Do you see increasing in demand and need for more local food products?

O A. Yes (1)

O B. No (2)

Q 32 In the past five years, what trends have you noticed in demand for local foods?

Q 33 Please describe your 'local' campaign efforts (e.g., importance to customers, mission-driven, promotion, and customer education and information)

Q 34 What is your or your supplier's approach to pricing products sourced from ND farms (labeled local produce)? (Check the one that best applies.)

O A. They tend to receive a lower price than other suppliers (1)

O B. They tend to receive the same price as other suppliers (2)

O C. They tend to receive a higher price than other suppliers (3)

O D. We work out a mutually beneficial price (4)

O E. Not sure (5)

O F. Other, please specify (6)

Q 35 List two or three of the challenges faced by your business when purchasing local food products sourced from ND farms.

FOOD HUB CONCEPT SECTION

A food hub is a business that aggregates, markets, and distributes products from several local/regional farms. Food hubs offer services which may include cooling, storage, marketing and distribution, washing, grading, sorting, packing or repacking, packaging and labeling, and branding.

THE ROLE AND ATTRACTIVENESS OF AND FOOD HUB

Q 36 How familiar are you with the food hub concept?

	Unfamiliar1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Familiar7 (7)	N/A (0)
Rate your answer (1)	O	O	O	O	O	O	O	O

Q 37 A food hub can provide sustainability to a local food economy, for that it may be important for each state to have at least one food hub to support producers and serve the public with local/regional/national food. Rate your level of agreement with this statement?

	Disagree1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Agree7 (7)	N/A (0)
Rate your answer (1)	O	O	O	O	O	O	O	O

Q 38 If a local food hub, as described above, <u>were reasonably accessible and offered a fair or competitive price for your products</u>, rate your level of interest in buying your food products through the food hub?

	Not Interested1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Interested7 (7)	N/A (0)
Rate your answer (1)	O	O	O	O	O	O	O	O

Q 39 What protein products (meat, poultry, eggs) are you most interested in sourcing from a ND food hub? List by the product desired, the quantity to be purchased, along with the frequency that it would be purchased. Please enter your answers as these two examples.

Product	Type	Quantity	Frequency
Example #1	Eggs (large)	10 cartons	Weekly
Example #2	Ground beef meat	50 ponds	2 times/week

	Type (1)	Quantity (2)	Frequency (3)

Product1 (1)			
Product2 (2)			
Product3 (3)			
Product4 (4)			
Product5 (5)			

Q 40 What fresh fruit and vegetables are you most interested in sourcing from local a ND food hub? List by-product desired, the quantity to be purchased, along with the frequency that it would be purchased. Please enter your answers as these two examples.

Product	Product Type	Quantity	Frequency
Example #1	Apple cider	50 gallons	Monthly
Example #2	Broccolic (organic)	1 carton	Weekly

	Product type (1)	Quantity (2)	Frequency (3)
Product1 (1)			

Product2 (2)			
Product3 (3)			
Product4 (4)			
Product5 (5)			

Q 41 What types of dairy products are you most interested in sourcing from a ND food hub? List by-product desired, the quantity to be purchased, along with the frequency that it would be purchased. The first two rows are just examples.

Product	Product Type	Quantity	Frequency
Milk	Whole w/cream line	50-half gal.	Weekly
Cheese	Aged cheddar	7.6 oz, 50 count	Weekly

	Product type (1)	Quantity (2)	Frequency (3)
Product1 (1)			
Product2 (2)			

Product3 (3)			
Product4 (4)			
Product5 (5)			

Q 42 What percent of the total purchase amount must be organic? Check the appropriate box.

	0% (1)	1-10% (2)	11-20% (3)	21-50% (4)	>50% (5)	Not Sure (6)
Fruits (1)	O	O	O	O	O	O
Vegetables (2)	O	O	O	O	O	O
Meat (including fresh, and frozen) (3)	O	O	O	O	O	O
Poultry dairy products (4)	O	O	O	O	O	O
Honey (5)	O	O	O	O	O	O
Processed food (e.g., jam) (6)	O	O	O	O	O	O
Eggs (7)	O	O	O	O	O	O
Other, please specify (8)	O	O	O	O	O	O

Q 43 Would you be interested to offer any **paid services and/or rent an infrastructure** to support a regional food network such as a food hub?

- O A. Yes (1)
- O B. No (2)

Q 44 Would you be interested in offering any of the following paid services to support a regional food hub? Please check all that apply.

	Disagree1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Agree7 (7)	N/A (0)
Product transport (1)	O	O	O	O	O	O	O	O
Refrigerated or freezer storage (2)	O	O	O	O	O	O	O	O
Processing equipment (3)	O	O	O	O	O	O	O	O
Processing services (4)	O	O	O	O	O	O	O	O
Other, please specify (5)	O	O	O	O	O	O	O	O

Q 45 As a local food buyer, please indicate the importance of the following related to purchasing and ownership of a food hub?

	Not important1 (1)	2 (2)	3 (3)	Neutral (4)	5 (5)	6 (6)	Important7 (7)	N/A (0)
Pre-season product planning to pre-arrange products, quantities, packaging, and timing of deliveries (1)	O	O	O	O	O	O	O	O

Pre-purchase of a portion of forecasted demand (2)	O	O	O	O	O	O	O	O
Set contracts on price and/or volume (3)	O	O	O	O	O	O	O	O
Open market pricing structure for product (4)	O	O	O	O	O	O	O	O
Offers certified organic grown or produced products (5)	O	O	O	O	O	O	O	O
Offers chemical-free products (6)	O	O	O	O	O	O	O	O
Offers products with social values (food miles, etc.) (7)	O	O	O	O	O	O	O	O
Offers farm-identified products (8)	O	O	O	O	O	O	O	O
Has strong consumer-facing brand that stands for local/regional products (9)	O	O	O	O	O	O	O	O
Branding and market development for State food brand (10)	O	O	O	O	O	O	O	O
Value-added product development (11)	O	O	O	O	O	O	O	O
Become an investor of the food hub (12)	O	O	O	O	O	O	O	O
Other, please specify (13)	O	O	O	O	O	O	O	O

Q 46 What are the critical services should the food hub provide for buyer satisfaction?

Q 47 What additional concerns or suggestions do you want to share that would assist with the development of a food hub that would best meet your needs?

BUSINESS INFORMATION SECTION

Q 48 This Business or Institution is a:

- A. Educational Institution, (e.g., school (K-12), university, college). Please, specify (1)
- B. Hospital (2)
- C. National grocery store chain (3)
- D. Independent grocery store (4)
- E. Grocery-convenience, corner (5)
- F. Broadline Distributor (6)
- G. Specialty Distributor (7)
- H. Cash and Carry Distributor (8)
- I. Direct to consumer (e.g., CSA, online, home delivery, buyer's club) (9)
- J. Nonprofit Institution (e.g., hunger relief, food security) (10)
- K. Other. Please, specify (11)

Q 49 What is your gender?

- A. Male (1)
- B. Female (2)
- C. Prefer not to answer (0)

Q 50 Given your responses throughout the survey, do you believe that ND requires a dedicated distribution system for locally produced food and agricultural products?

- A. Yes (1)
- B. No (2)

Q 51 Institution /Business infromation

- Business or Institution name (1)
- Physical Address (2)
- State, County, Town (3)
- ZIP Code (4)

APPENDIX I. SAS CODE FOR THE ND FOOD HUB FEASIBILITY STUDY PART-B

```
data demand;
infile "Demand-side.csv" dsd firstobs=2 missover;
input Q16 Q27 Q28 Q31 Q36 Q37 Q38 Q48 Q49;
if Q27=0 then Q27=.;
if Q28=0 then Q28=.;
if Q36=0 then Q36=.;
if Q37=0 then Q37=.;
if Q38=0 then Q38=.;
if Q48=11 then Q48=.;
if Q49=0 then Q49=.;
run;

proc format;
value yes_no 1="Yes"
             2="NO";
value gender 1="Male"
             2="Female";
value flexible 1-3="Not Flexible"
                4="Natural"
                        5-7="Flexible";
value familiar 1-3="Unfamiliar"
                4="Natural"
                        5-7="Familiar";
value interest 1-3="Not Interested"
                4="Natural"
                        5-7="Interested";
value business 1="Educational Institution"
               2="Hospital"
                     3-11="Private Store";
run;

ods rtf file="linear regression stepwise----demand Q36.rtf";
proc glm data=demand plots=diagnostics;
class Q48 Q16 Q31 Q49;
model Q36=Q48 Q16 Q31 Q27 Q28 Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q36="Familiarity with Food Hub" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class Q48 Q31 Q49;
model Q36=Q48 Q31 Q27 Q28 Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q36="Familiarity with Food Hub" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class Q48 Q31 ;
model Q36=Q48 Q31 Q27 Q28 /ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
```

```
label Q48="Business Type" Q36="Familiarity with Food Hub" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class Q48 Q31 ;
model Q36=Q48 Q31 Q28 /ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q36="Familiarity with Food Hub" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class Q48  ;
model Q36=Q48 Q28 /ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q36="Familiarity with Food Hub" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;

model Q36= Q28 /ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q36="Familiarity with Food Hub" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

ods rtf close;

ods rtf file="linear regression stepwise----demand Q37.rtf";
proc glm data=demand plots=diagnostics;
class Q48 Q16 Q31 Q49;
model Q37=Q48 Q16 Q31 Q27 Q28 Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q37="Importance of sustainability" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class Q48 Q31 Q49;
model Q37=Q48  Q31 Q27 Q28 Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q37="Importance of sustainability" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class Q48 Q31 Q49;
model Q37=Q48  Q31  Q28 Q49/ss3;
```

```
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q37="Importance of sustainability" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class  Q31 Q49;
model Q37= Q31  Q28 Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q37="Importance of sustainability" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class  Q31 ;
model Q37= Q31  Q28 /ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q37="Importance of sustainability" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;

model Q37= Q31  /ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q37="Importance of sustainability" Q16="Limited
Vendor" Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal
Purchase Flexibility" Q49="Gender" ;
run;

ods rtf close;

ods rtf file="linear regression stepwise----demand Q38.rtf";
proc glm data=demand plots=diagnostics;
class Q48 Q16 Q31 Q49;
model Q38=Q48 Q16 Q31 Q27 Q28 Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q38="Join Food Hub" Q16="Limited Vendor"
Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal Purchase
Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class Q48 Q16  Q49;
model Q38=Q48 Q16  Q27 Q28 Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q38="Join Food Hub" Q16="Limited Vendor"
Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal Purchase
Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class Q48   Q49;
```

```
model Q38=Q48   Q27 Q28 Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q38="Join Food Hub" Q16="Limited Vendor"
Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal Purchase
Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class   Q49;
model Q38= Q27 Q28 Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q38="Join Food Hub" Q16="Limited Vendor"
Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal Purchase
Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
class   Q49;
model Q38= Q27  Q49/ss3;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q38="Join Food Hub" Q16="Limited Vendor"
Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal Purchase
Flexibility" Q49="Gender" ;
run;

proc glm data=demand plots=diagnostics;
model Q38= Q27  ;
format Q48 business. Q16 yes_no. Q31 yes_no. Q49 gender.;
label Q48="Business Type" Q38="Join Food Hub" Q16="Limited Vendor"
Q31="Increase Demand" Q27="Purchase Flexibility" Q28="Seasonal Purchase
Flexibility" Q49="Gender" ;
run;

ods rtf close;

ods rtf file="power analysis---demand.rtf";

proc power;
  multreg
  model = fixed
  nfullpredictors = 1
  ntestpredictors = 1
  rsquarefull = 0.101262
  rsquarediff = 0.101262
  ntotal = .
  power = 0.8 to .95 by .05;
  title1 "dependent(Q36), most close to be significant variable is Q28";
run;

proc power;
  multreg
  model = fixed
  nfullpredictors = 1
  ntestpredictors = 1
  rsquarefull = 0.113636
  rsquarediff = 0.113636
  ntotal = .
```

```
  power = 0.8 to .95 by .05;
  title1 "dependent(Q37), most close to be significant variable is Q31";
run;

proc power;
  multreg
  model = fixed
  nfullpredictors = 1
  ntestpredictors = 1
  rsquarefull = 0.170125
  rsquarediff = 0.170125
  ntotal = .
  power = 0.8 to .95 by .05;
  title1 "dependent(Q38), most close to be significant variable is Q27";
run;
ods rtf close;
```

APPENDIX J. SAS RESULTS OUTPUT FOR THE ND FOOD HUB FEASIBILITY STUDY PART-B

Class Level Information		
Class	Levels	Values
Q48	3	Educational Institution Hospital Private Store
Q16	2	NO Yes
Q31	2	NO Yes
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	12

The SAS System

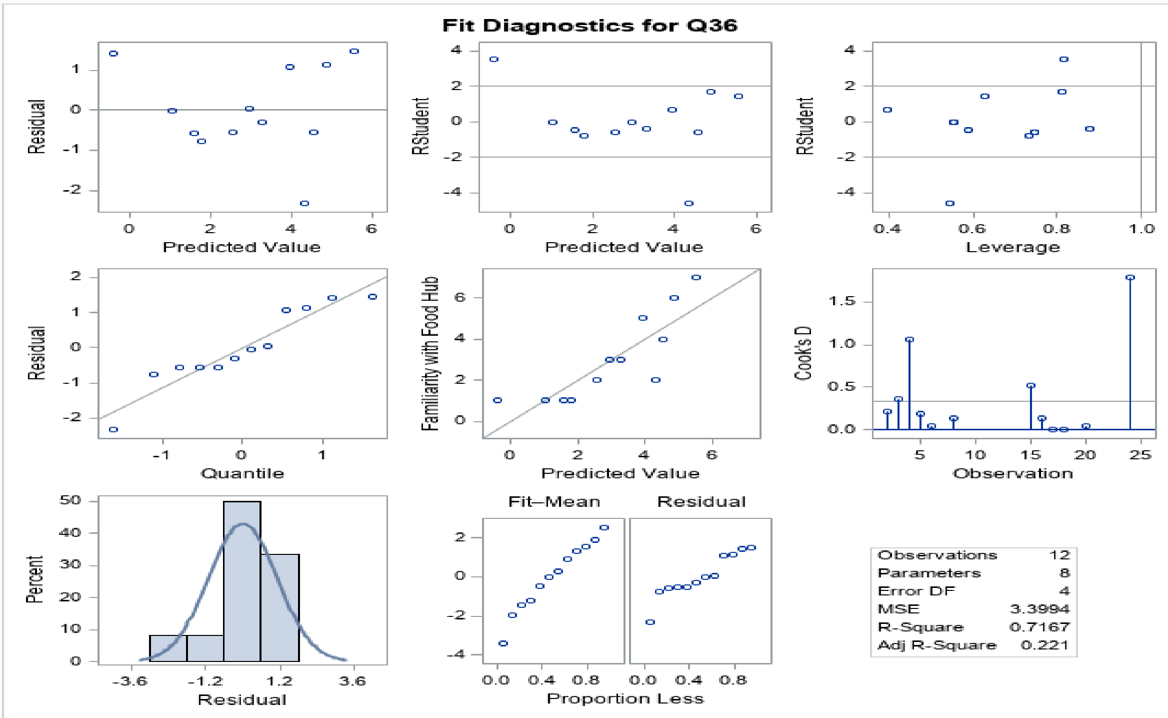
The GLM Procedure

Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	34.40224595	4.91460656	1.45	0.3793
Error	4	13.59775405	3.39943851		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.716713	61.45855	1.843757	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	18.93265657	9.46632829	2.78	0.1747
Q16	1	0.01279250	0.01279250	0.00	0.9540
Q31	1	1.27463469	1.27463469	0.37	0.5734
Q27	1	0.69281613	0.69281613	0.20	0.6751
Q28	1	16.81254495	16.81254495	4.95	0.0902
Q49	1	0.31387478	0.31387478	0.09	0.7764



Class Level Information		
Class	Levels	Values
Q48	3	Educational Institution Hospital Private Store
Q31	2	NO Yes
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	12

The SAS System

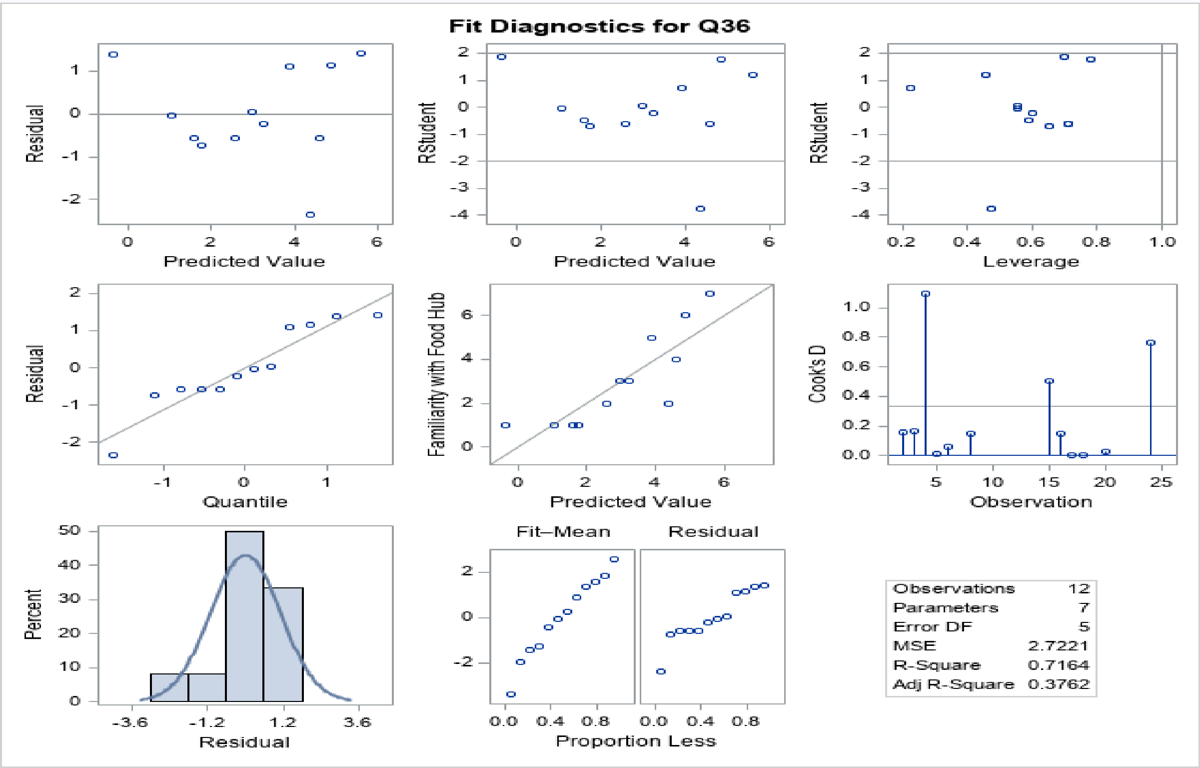
The GLM Procedure

Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	34.38945345	5.73157557	2.11	0.2156
Error	5	13.61054655	2.72210931		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.716447	54.99605	1.649882	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	19.24117866	9.62058933	3.53	0.1105
Q31	1	1.26980795	1.26980795	0.47	0.5250
Q27	1	0.68858388	0.68858388	0.25	0.6364
Q28	1	16.96879854	16.96879854	6.23	0.0547
Q49	1	0.30777992	0.30777992	0.11	0.7503



Class Level Information		
Class	**Levels**	**Values**
Q48	3	Educational Institution Hospital Private Store
Q31	2	NO Yes

Number of Observations Read	27
Number of Observations Used	12

The SAS System

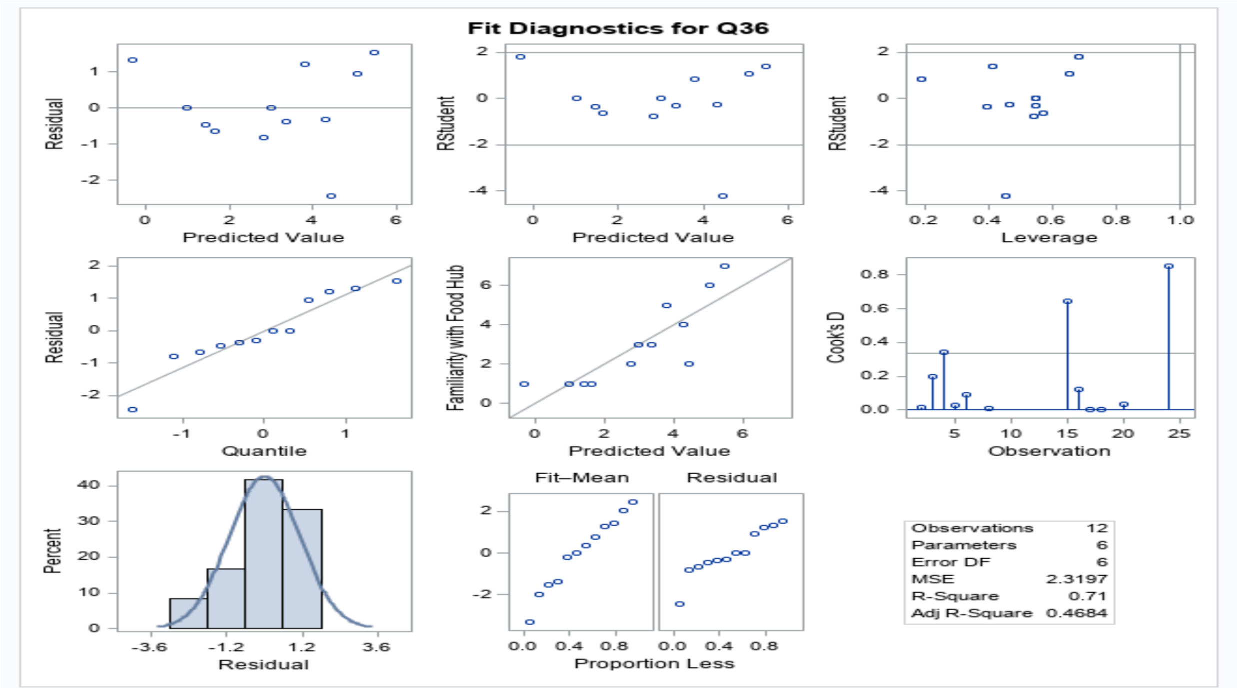
The GLM Procedure

Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	34.08167353	6.81633471	2.94	0.1110
Error	6	13.91832647	2.31972108		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.710035	50.76877	1.523063	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	19.72145999	9.86072999	4.25	0.0708
Q31	1	3.03781388	3.03781388	1.31	0.2961
Q27	1	2.14167353	2.14167353	0.92	0.3737
Q28	1	20.45992947	20.45992947	8.82	0.0250



Class Level Information		
Class	Levels	Values
Q48	3	Educational Institution Hospital Private Store
Q31	2	NO Yes

Number of Observations Read	27
Number of Observations Used	12

The SAS System

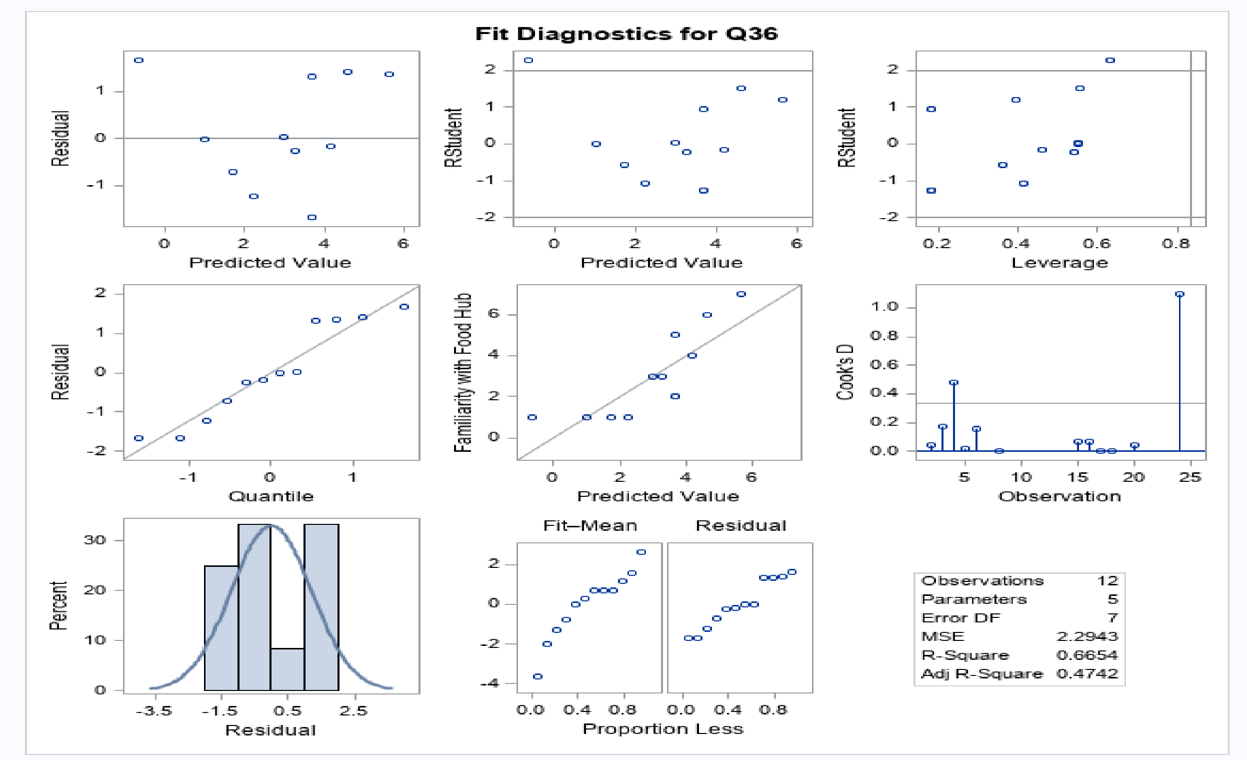
The GLM Procedure

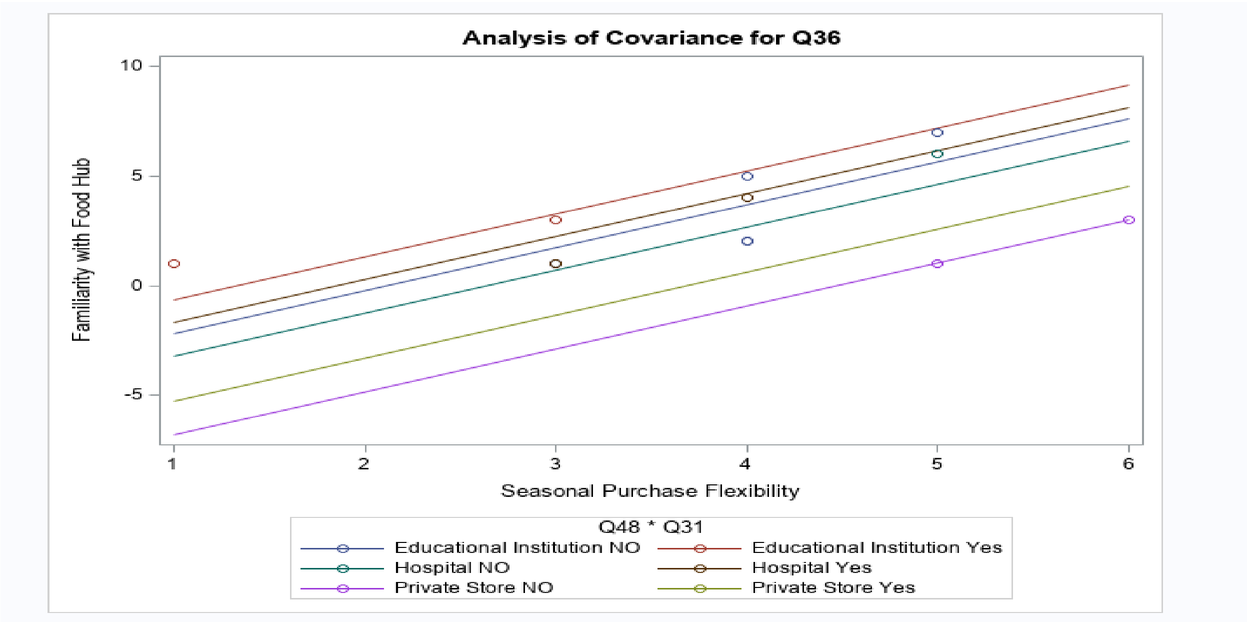
Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	31.94000000	7.98500000	3.48	0.0721
Error	7	16.06000000	2.29428571		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.665417	50.48967	1.514690	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	19.72197674	9.86098837	4.30	0.0606
Q31	1	2.08035088	2.08035088	0.91	0.3727
Q28	1	19.64454545	19.64454545	8.56	0.0221


Fit Diagnostics for Q36
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Familiarity with Food Hub
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 12
Parameters 5
Error DF 7
MSE 2.2943
R-Square 0.6654
Adj R-Square 0.4742


Analysis of Covariance for Q36
Familiarity with Food Hub
Seasonal Purchase Flexibility
Q48 * Q31
Educational Institution NO
Educational Institution Yes
Hospital NO
Hospital Yes
Private Store NO
Private Store Yes

Class Level Information		
Class	**Levels**	**Values**
Q48	3	Educational Institution Hospital Private Store

Number of Observations Read	27
Number of Observations Used	12

The SAS System

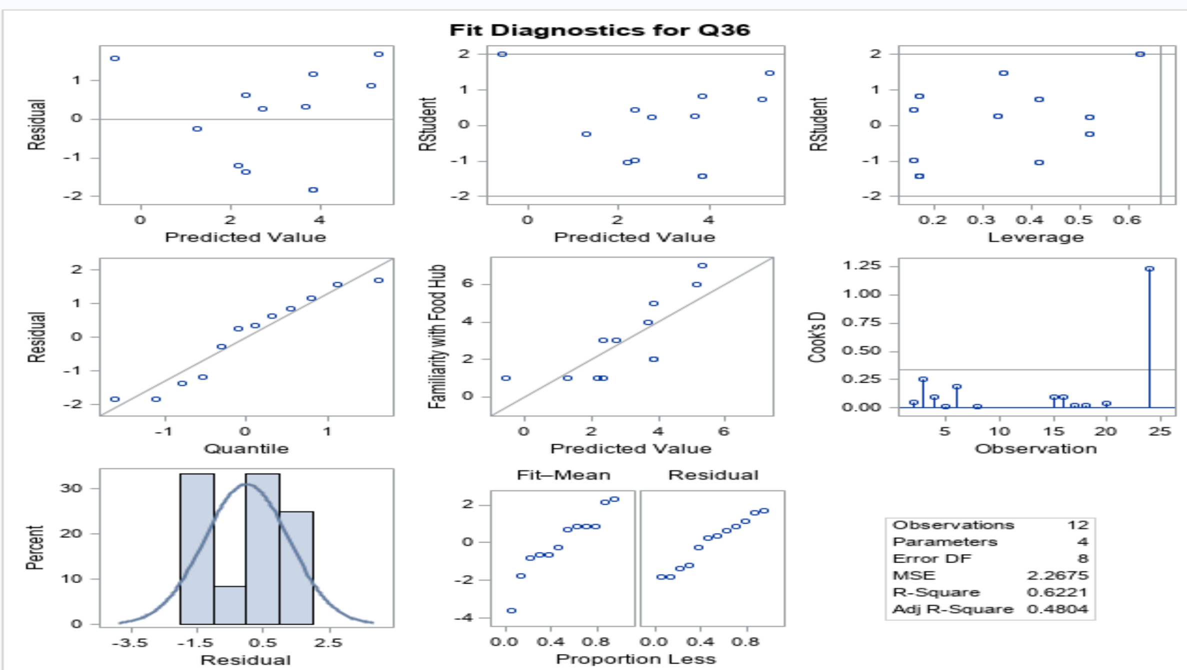
The GLM Procedure

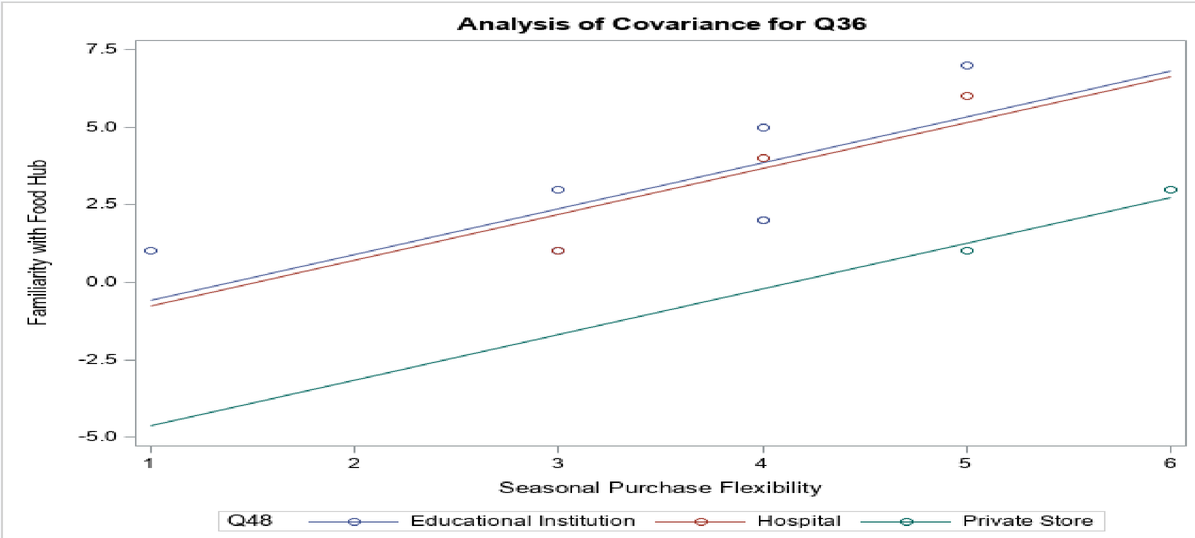
Dependent Variable: Q36 Familiarity with Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	29.85964912	9.95321637	4.39	0.0419
Error	8	18.14035088	2.26754386		
Corrected Total	11	48.00000000			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.622076	50.19455	1.505837	3.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	17.96537600	8.98268800	3.96	0.0637
Q28	1	26.52631579	26.52631579	11.70	0.0091





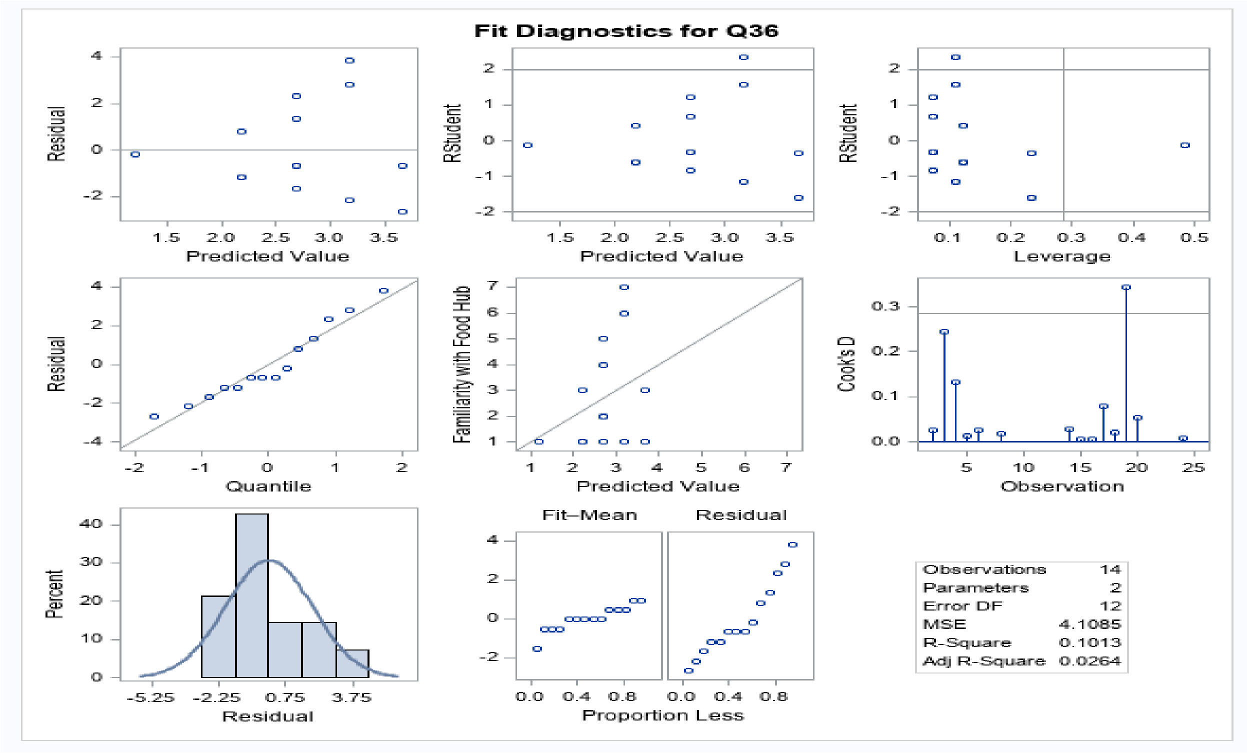
Dependent Variable: Q36 Familiarity with Food Hub

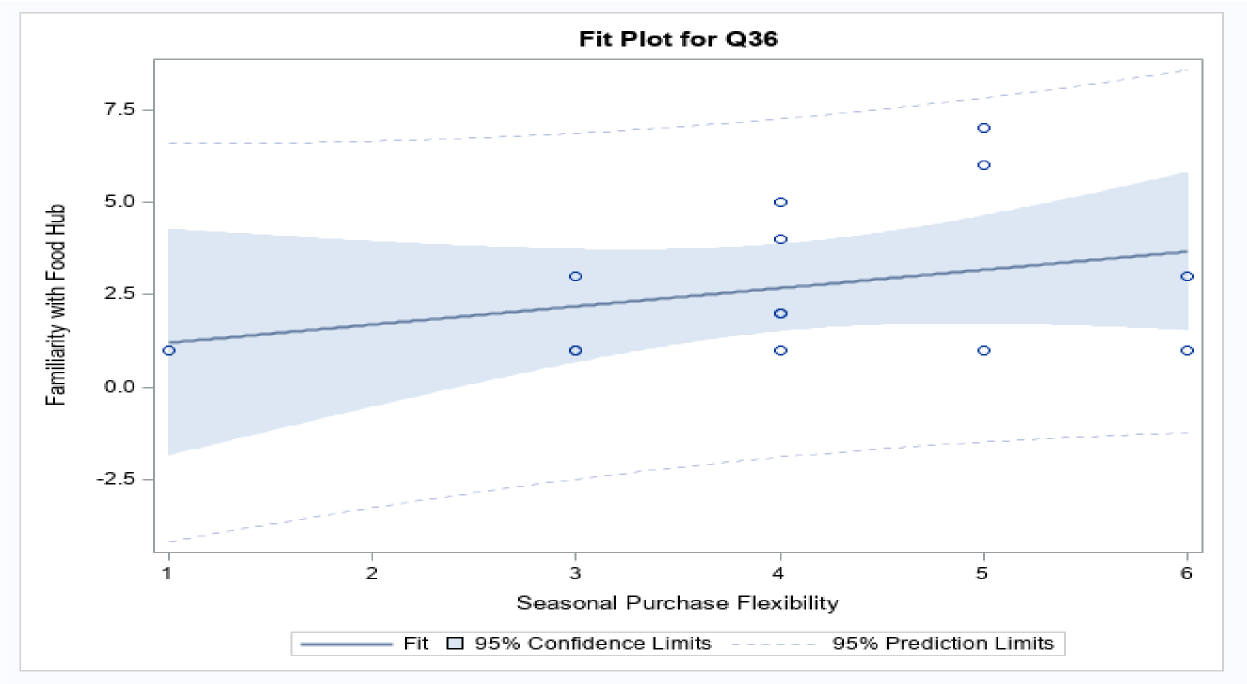
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	5.55496217	5.55496217	1.35	0.2675
Error	12	49.30218069	4.10851506		
Corrected Total	13	54.85714286			

R-Square	Coeff Var	Root MSE	Q36 Mean
0.101262	74.67700	2.026947	2.714286

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q28	1	5.55496217	5.55496217	1.35	0.2675

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	0.7102803738	1.80659172	0.39	0.7011
Q28	0.4922118380	0.42330553	1.16	0.2675


Fit Diagnostics for Q36
Residual
Predicted Value
RStudent
Leverage
Quantile
Familiarity with Food Hub
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 14
Parameters 2
Error DF 12
MSE 4.1085
R-Square 0.1013
Adj R-Square 0.0264


Fit Plot for Q36
Familiarity with Food Hub
Seasonal Purchase Flexibility
Fit
95% Confidence Limits
95% Prediction Limits

Class Level Information		
Class	Levels	Values
Q48	3	Educational Institution Hospital Private Store
Q16	2	NO Yes
Q31	2	NO Yes
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	11

The SAS System

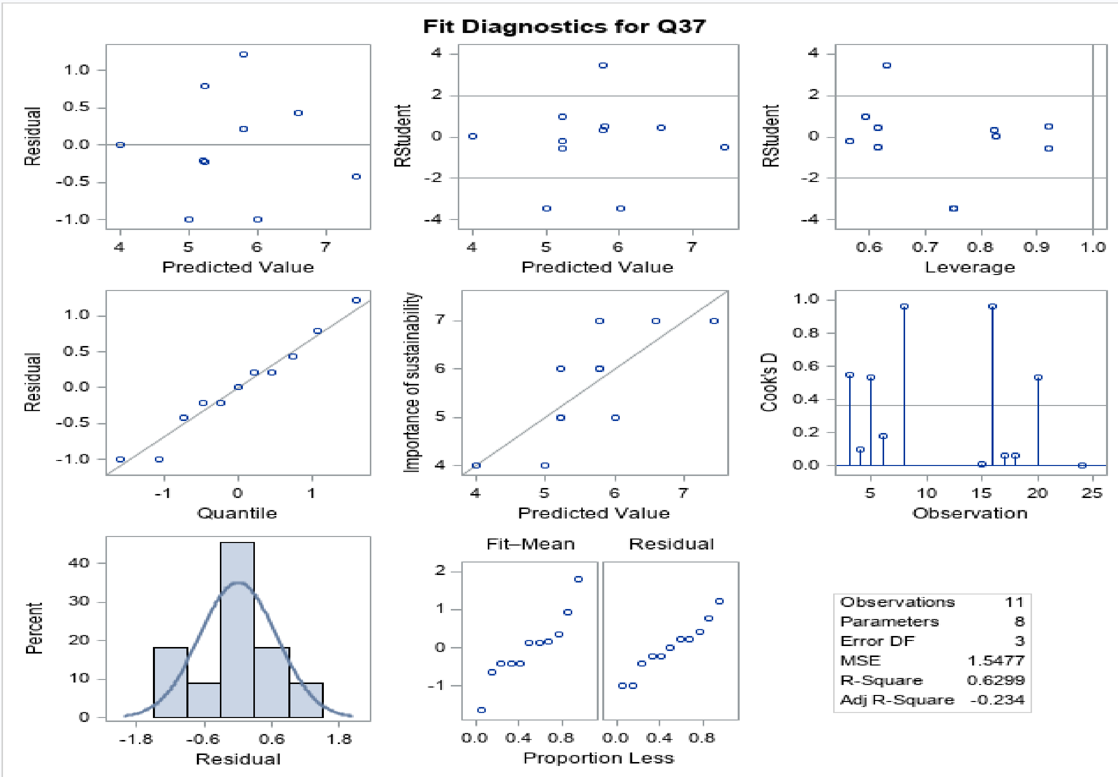
The GLM Procedure

Dependent Variable: Q37 Importance of sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	7.90249922	1.12892846	0.73	0.6720
Error	3	4.64295533	1.54765178		
Corrected Total	10	12.54545455			

R-Square	Coeff Var	Root MSE	Q37 Mean
0.629909	22.07179	1.244047	5.636364

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	2.21389222	1.10694611	0.72	0.5572
Q16	1	0.03922133	0.03922133	0.03	0.8836
Q31	1	0.51868344	0.51868344	0.34	0.6033
Q27	1	0.07249183	0.07249183	0.05	0.8425
Q28	1	1.59118365	1.59118365	1.03	0.3853
Q49	1	0.37084006	0.37084006	0.24	0.6580



Class Level Information		
Class	Levels	Values
Q48	3	Educational Institution Hospital Private Store
Q31	2	NO Yes
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	11

The SAS System

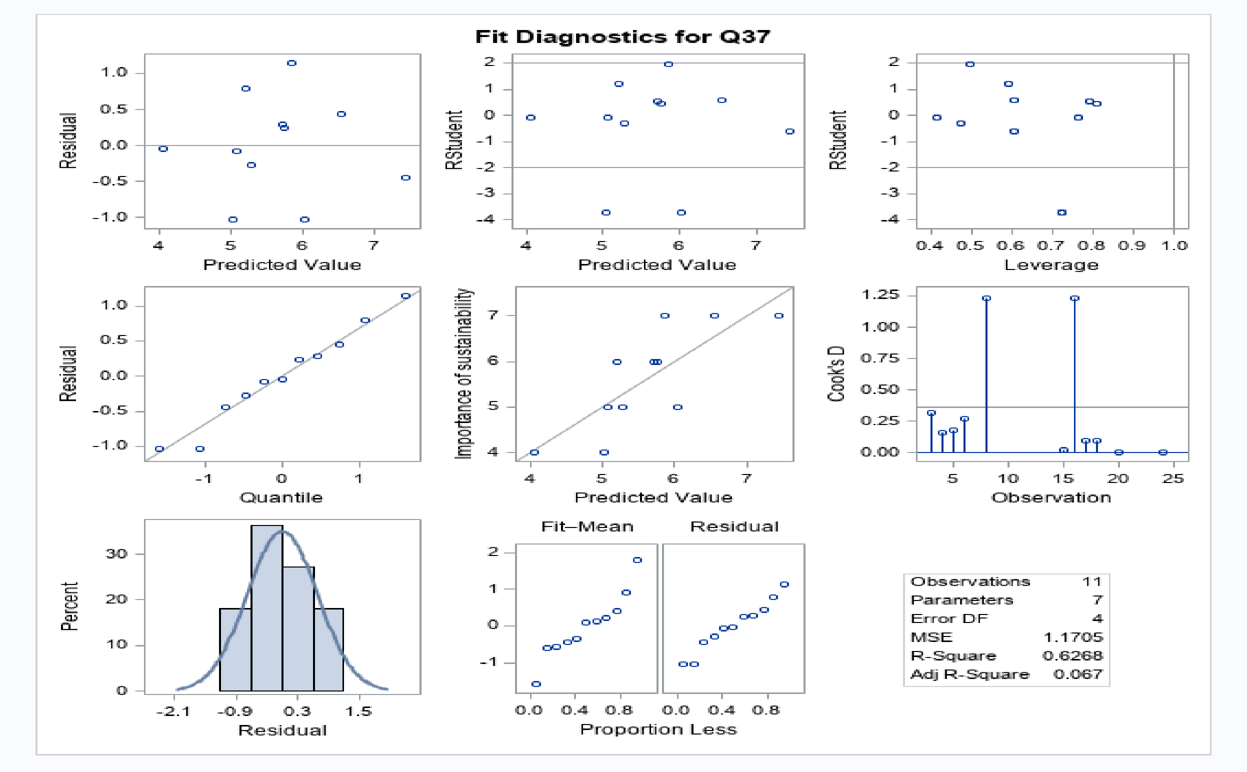
The GLM Procedure

Dependent Variable: Q37 Importance of sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	7.86327789	1.31054631	1.12	0.4781
Error	4	4.68217666	1.17054416		
Corrected Total	10	12.54545455			

R-Square	Coeff Var	Root MSE	Q37 Mean
0.626783	19.19530	1.081917	5.636364

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	2.25451509	1.12725754	0.96	0.4556
Q31	1	0.64514293	0.64514293	0.55	0.4991
Q27	1	0.08511894	0.08511894	0.07	0.8008
Q28	1	1.85886812	1.85886812	1.59	0.2761
Q49	1	0.74869976	0.74869976	0.64	0.4687


Fit Diagnostics for Q37
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Importance of sustainability
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 11
Parameters 7
Error DF 4
MSE 1.1705
R-Square 0.6268
Adj R-Square 0.067

Class Level Information		
Class	Levels	Values
Q48	3	Educational Institution Hospital Private Store
Q31	2	NO Yes
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	11

The SAS System

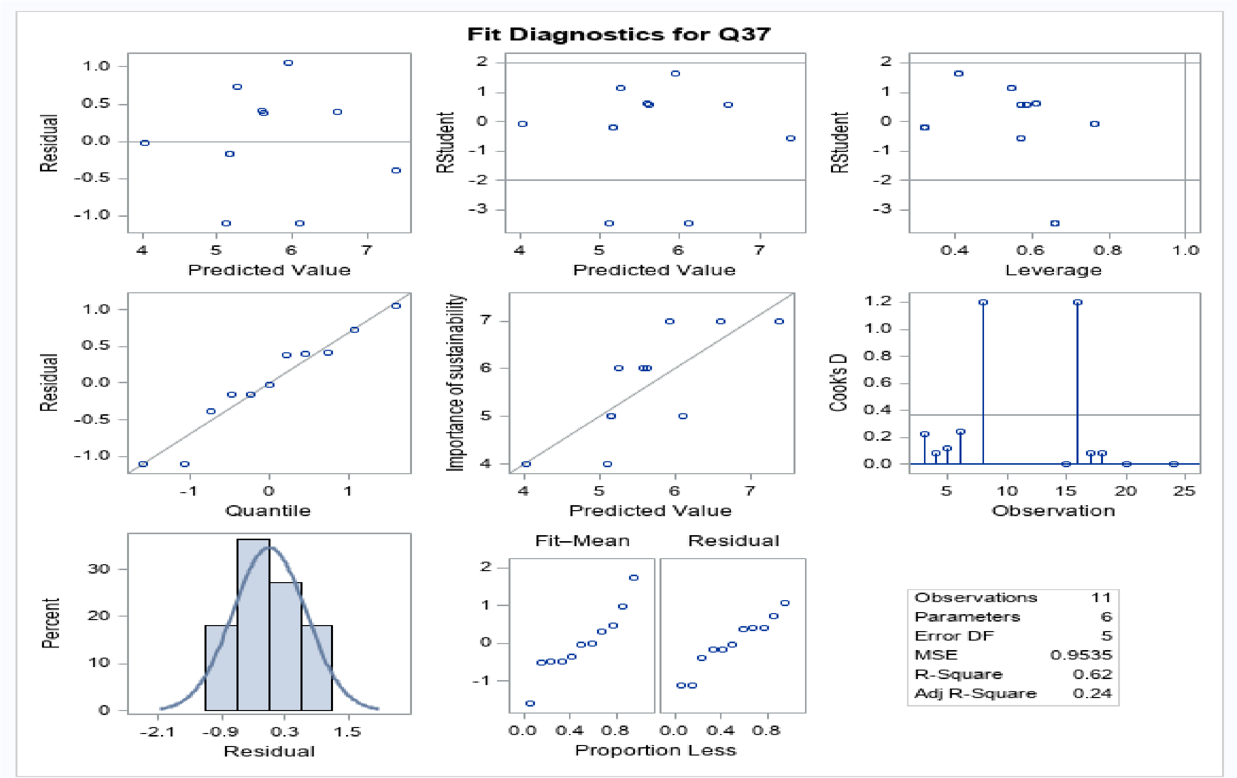
The GLM Procedure

Dependent Variable: Q37 Importance of sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	7.77815895	1.55563179	1.63	0.3021
Error	5	4.76729560	0.95345912		
Corrected Total	10	12.54545455			

R-Square	Coeff Var	Root MSE	Q37 Mean
0.619998	17.32415	0.976452	5.636364

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	2.17045541	1.08522770	1.14	0.3914
Q31	1	0.72566215	0.72566215	0.76	0.4229
Q28	1	2.10226962	2.10226962	2.20	0.1977
Q49	1	0.98270440	0.98270440	1.03	0.3566



Class Level Information		
Class	**Levels**	**Values**
Q31	2	NO Yes
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	12

The SAS System

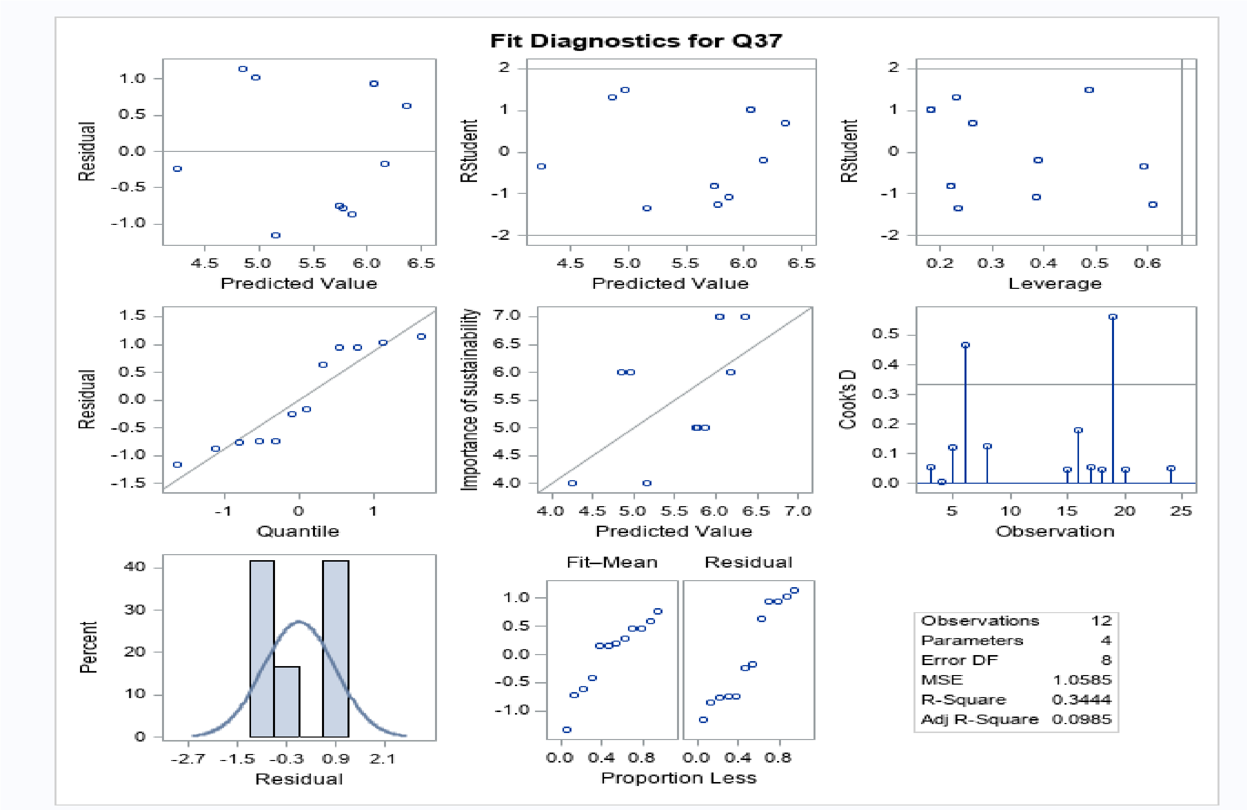
The GLM Procedure

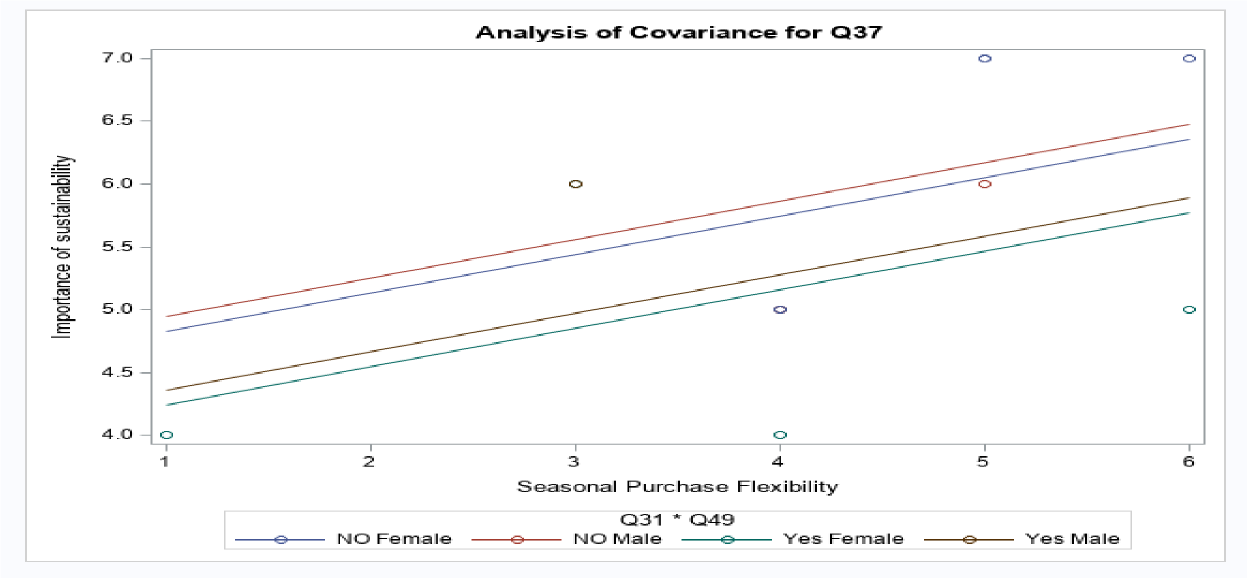
Dependent Variable: Q37 Importance of sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	4.44848128	1.48282709	1.40	0.3117
Error	8	8.46818539	1.05852317		
Corrected Total	11	12.91666667			

R-Square	Coeff Var	Root MSE	Q37 Mean
0.344399	18.42708	1.028846	5.583333

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	0.75518231	0.75518231	0.71	0.4228
Q28	1	1.53181461	1.53181461	1.45	0.2634
Q49	1	0.02837819	0.02837819	0.03	0.8740


Fit Diagnostics for Q37
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Importance of sustainability
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 12
Parameters 4
Error DF 8
MSE 1.0585
R-Square 0.3444
Adj R-Square 0.0985


Analysis of Covariance for Q37
Importance of sustainability
Seasonal Purchase Flexibility
Q31 * Q49
NO Female
NO Male
Yes Female
Yes Male

Class Level Information		
Class	Levels	Values
Q31	2	NO Yes

Number of Observations Read	27
Number of Observations Used	13

The SAS System

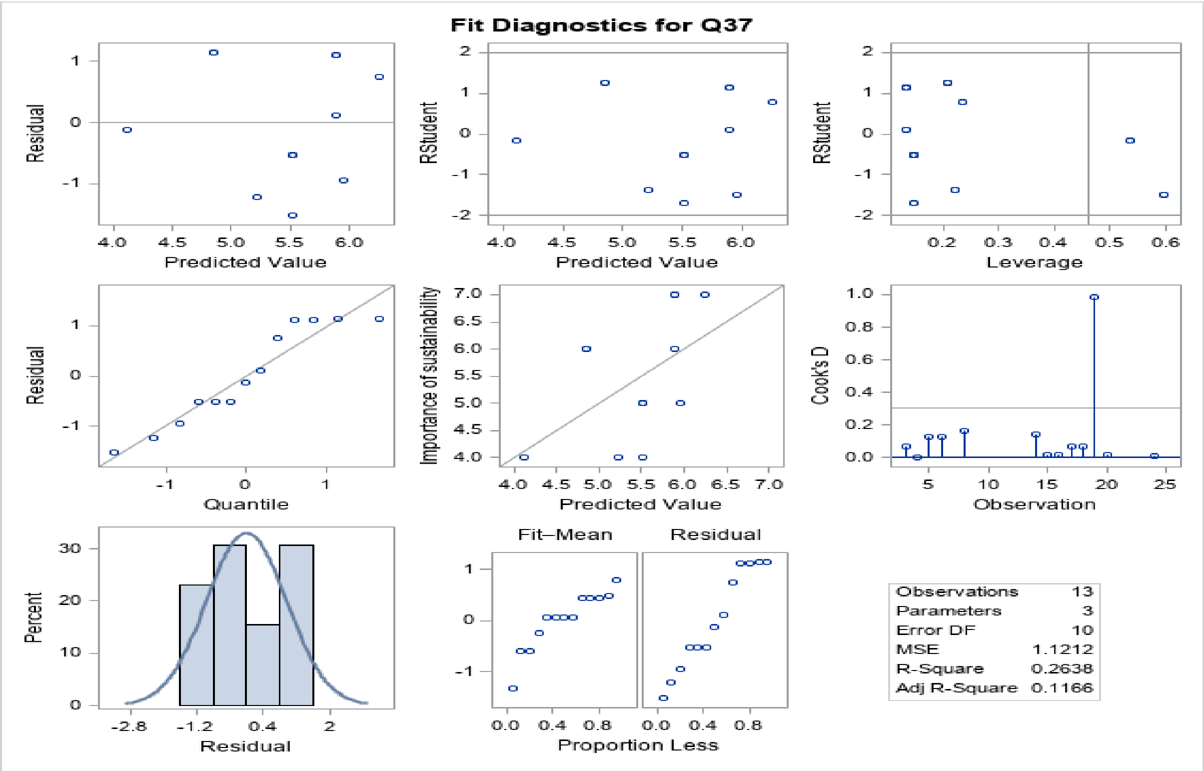
The GLM Procedure

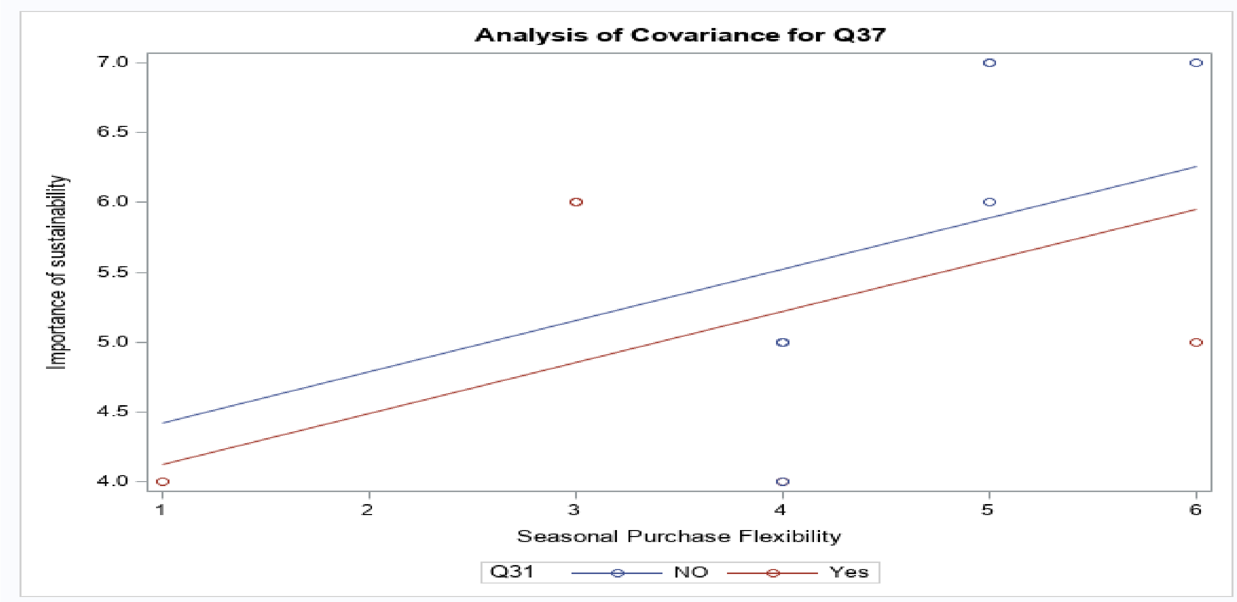
Dependent Variable: Q37 Importance of sustainability

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	4.01847055	2.00923527	1.79	0.2162
Error	10	11.21229868	1.12122987		
Corrected Total	12	15.23076923			

R-Square	Coeff Var	Root MSE	Q37 Mean
0.263839	19.38797	1.058881	5.461538

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	0.22032543	0.22032543	0.20	0.6670
Q28	1	2.28770132	2.28770132	2.04	0.1837





Number of Observations Read	27
Number of Observations Used	13

The SAS System

The GLM Procedure

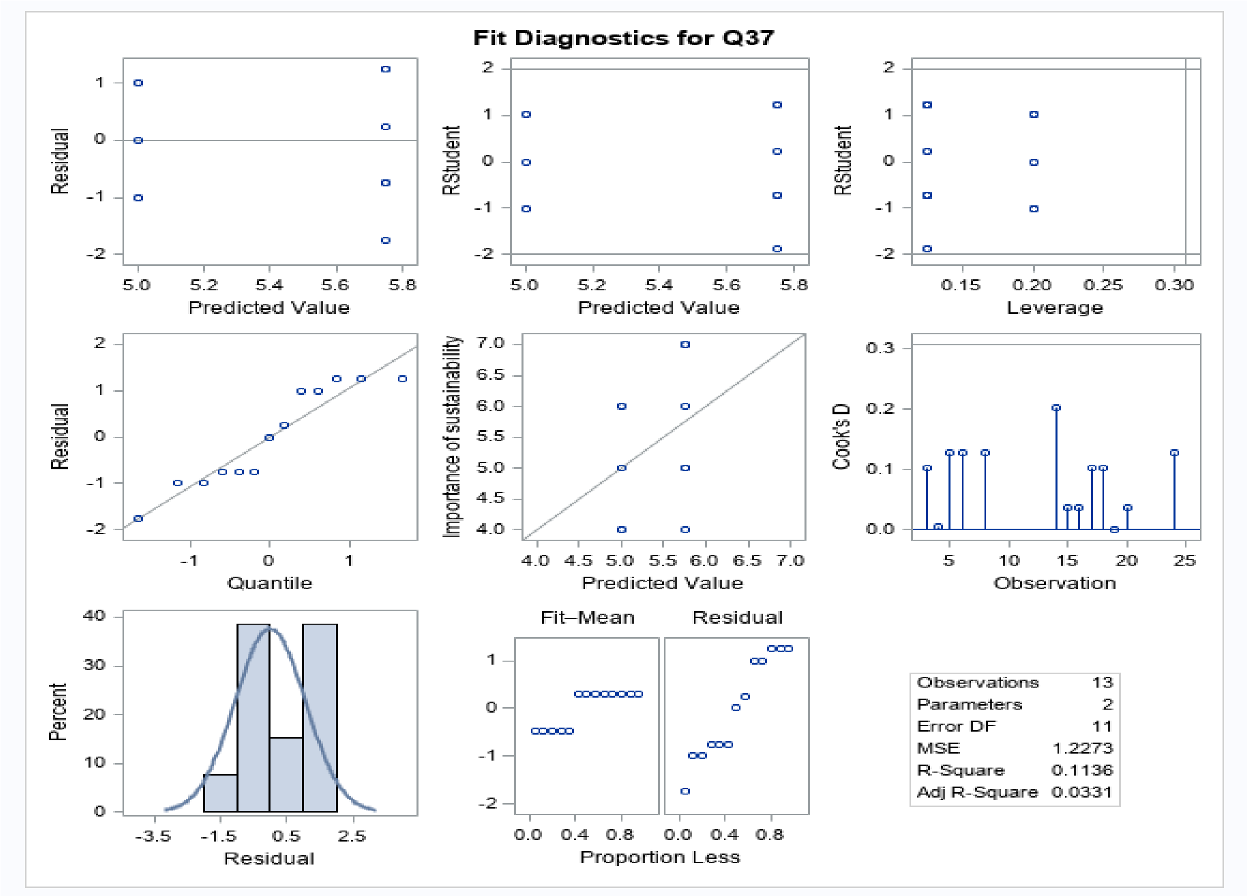
Dependent Variable: Q37 Importance of sustainability

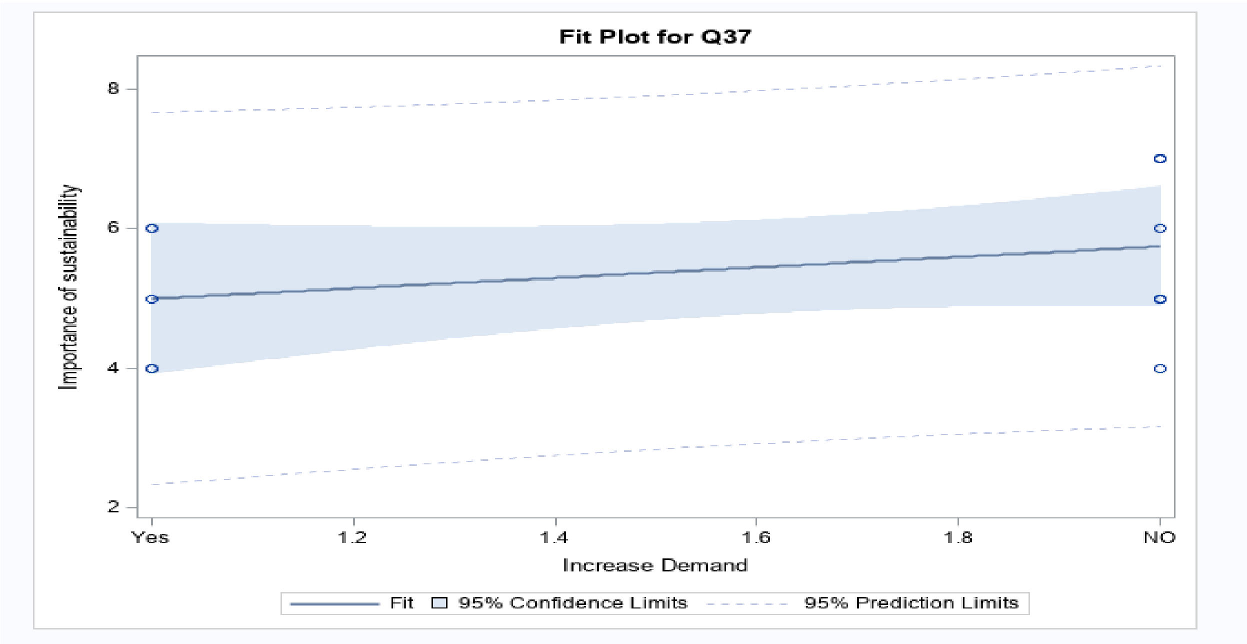
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1.73076923	1.73076923	1.41	0.2600
Error	11	13.50000000	1.22727273		
Corrected Total	12	15.23076923			

R-Square	Coeff Var	Root MSE	Q37 Mean
0.113636	20.28409	1.107823	5.461538

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q31	1	1.73076923	1.73076923	1.41	0.2600

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.250000000	1.06547045	3.99	0.0021
Q31	0.750000000	0.63155652	1.19	0.2600


Fit Diagnostics for Q37
Residual
Predicted Value
RStudent
Leverage
Quantile
Importance of sustainability
Cook's D
Observation
Percent
Fit–Mean
Residual
Proportion Less
Observations 13
Parameters 2
Error DF 11
MSE 1.2273
R-Square 0.1136
Adj R-Square 0.0331


Fit Plot for Q37
Importance of sustainability
Yes
1.2
1.4
1.6
1.8
NO
Increase Demand
Fit
95% Confidence Limits
95% Prediction Limits

The SAS System

The GLM Procedure

Class Level Information		
Class	**Levels**	**Values**
Q48	3	Educational Institution Hospital Private Store
Q16	2	NO Yes
Q31	2	NO Yes
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	11

The SAS System

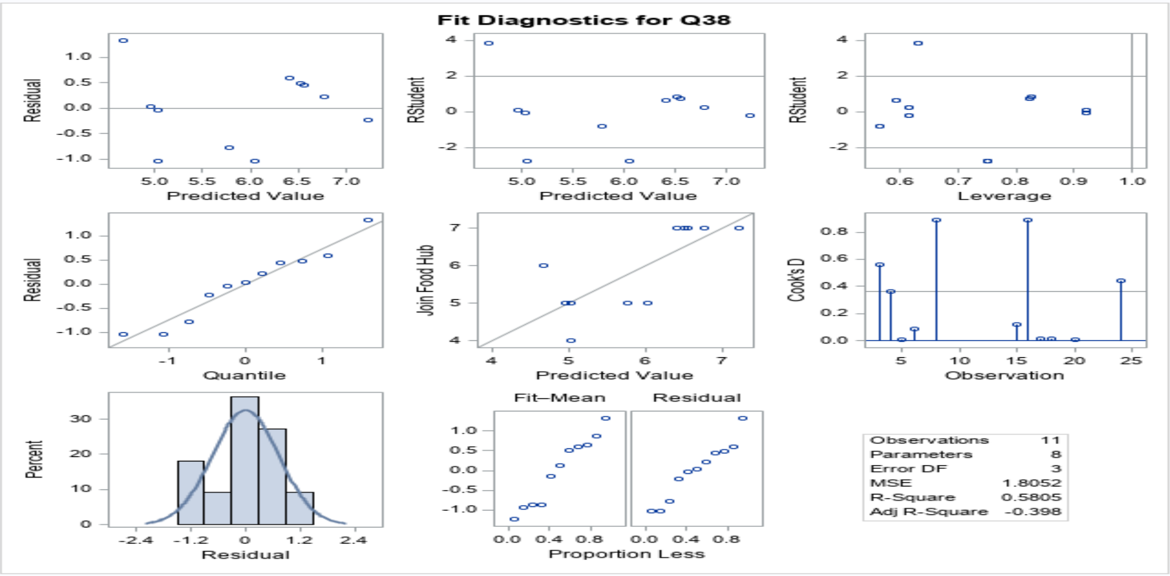
The GLM Procedure

Dependent Variable: Q38 Join Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	7.49362699	1.07051814	0.59	0.7441
Error	3	5.41546392	1.80515464		
Corrected Total	10	12.90909091			

R-Square	Coeff Var	Root MSE	Q38 Mean
0.580492	22.73718	1.343560	5.909091

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	2.32510456	1.16255228	0.64	0.5852
Q16	1	0.15630264	0.15630264	0.09	0.7877
Q31	1	0.00633996	0.00633996	0.00	0.9565
Q27	1	0.37315397	0.37315397	0.21	0.6802
Q28	1	0.44405270	0.44405270	0.25	0.6540
Q49	1	0.95535608	0.95535608	0.53	0.5196



Class Level Information		
Class	Levels	Values
Q48	3	Educational Institution Hospital Private Store
Q16	2	NO Yes
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	11

The SAS System

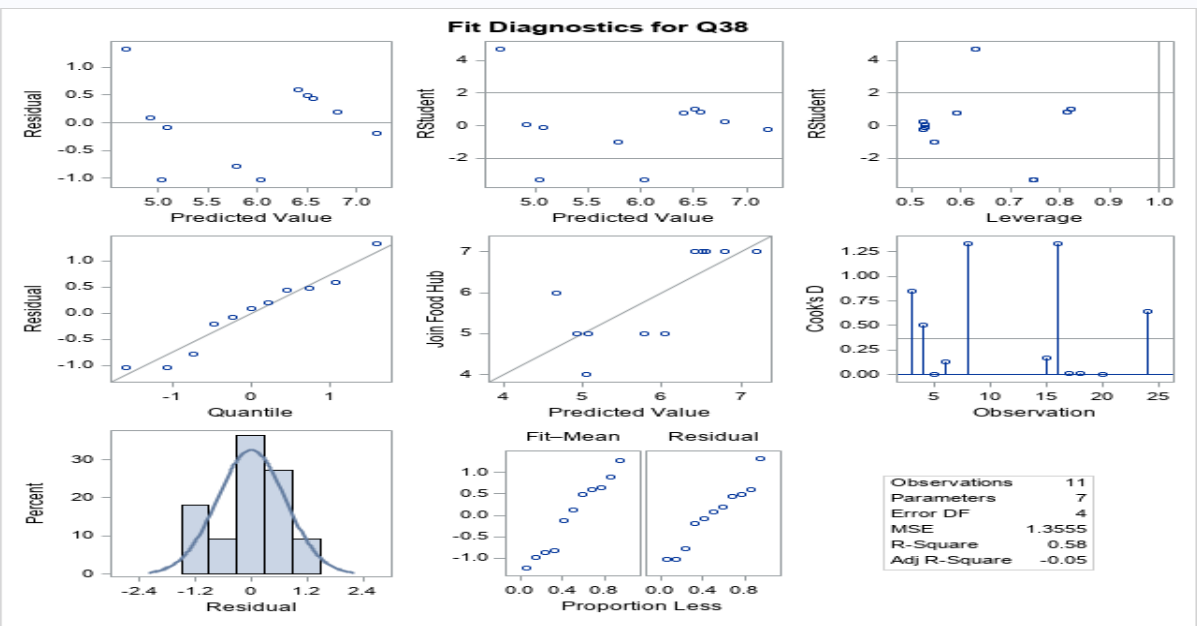
The GLM Procedure

Dependent Variable: Q38 Join Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	7.48728704	1.24788117	0.92	0.5590
Error	4	5.42180387	1.35545097		
Corrected Total	10	12.90909091			

R-Square	Coeff Var	Root MSE	Q38 Mean
0.580001	19.70250	1.164238	5.909091

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	2.32556455	1.16278227	0.86	0.4898
Q16	1	0.18730266	0.18730266	0.14	0.7289
Q27	1	0.91152946	0.91152946	0.67	0.4582
Q28	1	1.79678477	1.79678477	1.33	0.3137
Q49	1	2.63558806	2.63558806	1.94	0.2356



Class Level Information		
Class	Levels	Values
Q48	3	Educational Institution Hospital Private Store
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	11

The SAS System

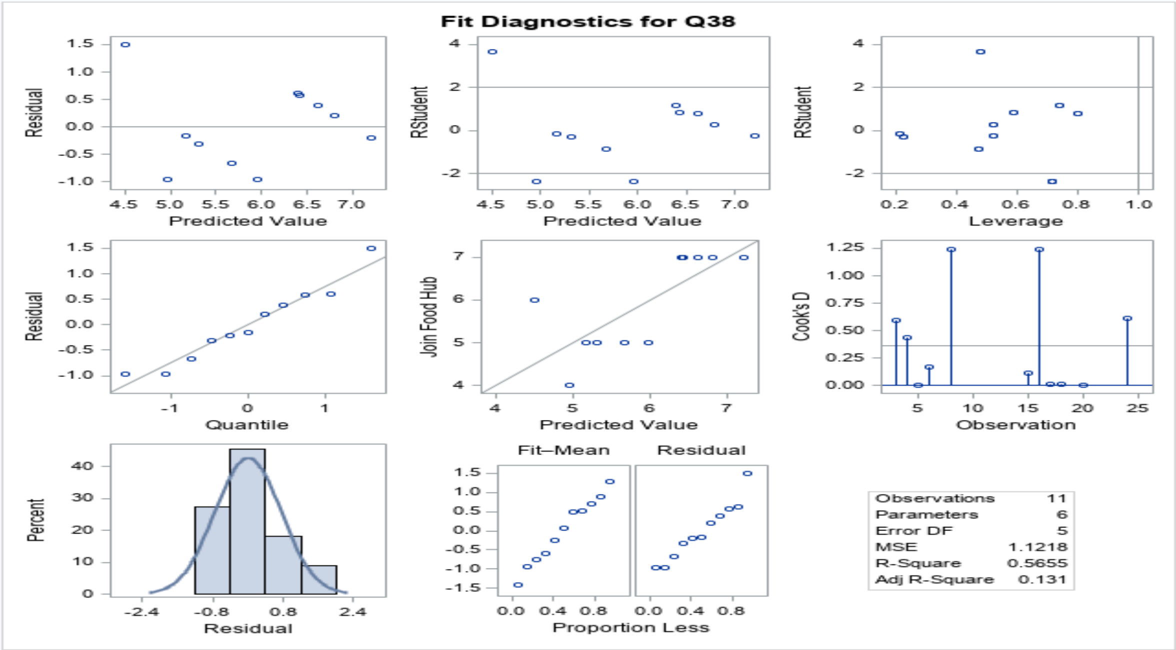
The GLM Procedure

Dependent Variable: Q38 Join Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	7.29998438	1.45999688	1.30	0.3898
Error	5	5.60910653	1.12182131		
Corrected Total	10	12.90909091			

R-Square	Coeff Var	Root MSE	Q38 Mean
0.565492	17.92426	1.059161	5.909091

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q48	2	2.53682281	1.26841141	1.13	0.3934
Q27	1	1.03878079	1.03878079	0.93	0.3801
Q28	1	1.87166270	1.87166270	1.67	0.2530
Q49	1	2.79804342	2.79804342	2.49	0.1751



Class Level Information		
Class	Levels	Values
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	12

The SAS System

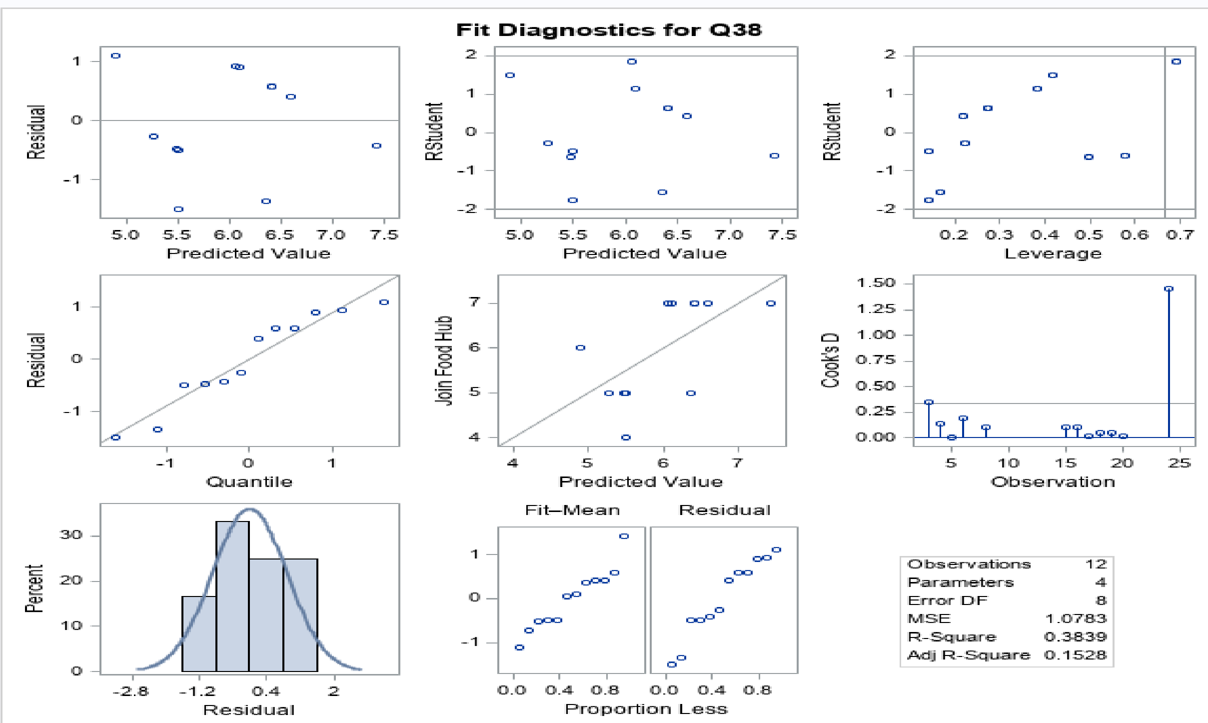
The GLM Procedure

Dependent Variable: Q38 Join Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	5.37399567	1.79133189	1.66	0.2514
Error	8	8.62600433	1.07825054		
Corrected Total	11	14.00000000			

R-Square	Coeff Var	Root MSE	Q38 Mean
0.383857	17.30647	1.038388	6.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q27	1	4.44787883	4.44787883	4.13	0.0767
Q28	1	0.48218280	0.48218280	0.45	0.5225
Q49	1	2.69996782	2.69996782	2.50	0.1522



Class Level Information		
Class	Levels	Values
Q49	2	Female Male

Number of Observations Read	27
Number of Observations Used	12

The SAS System

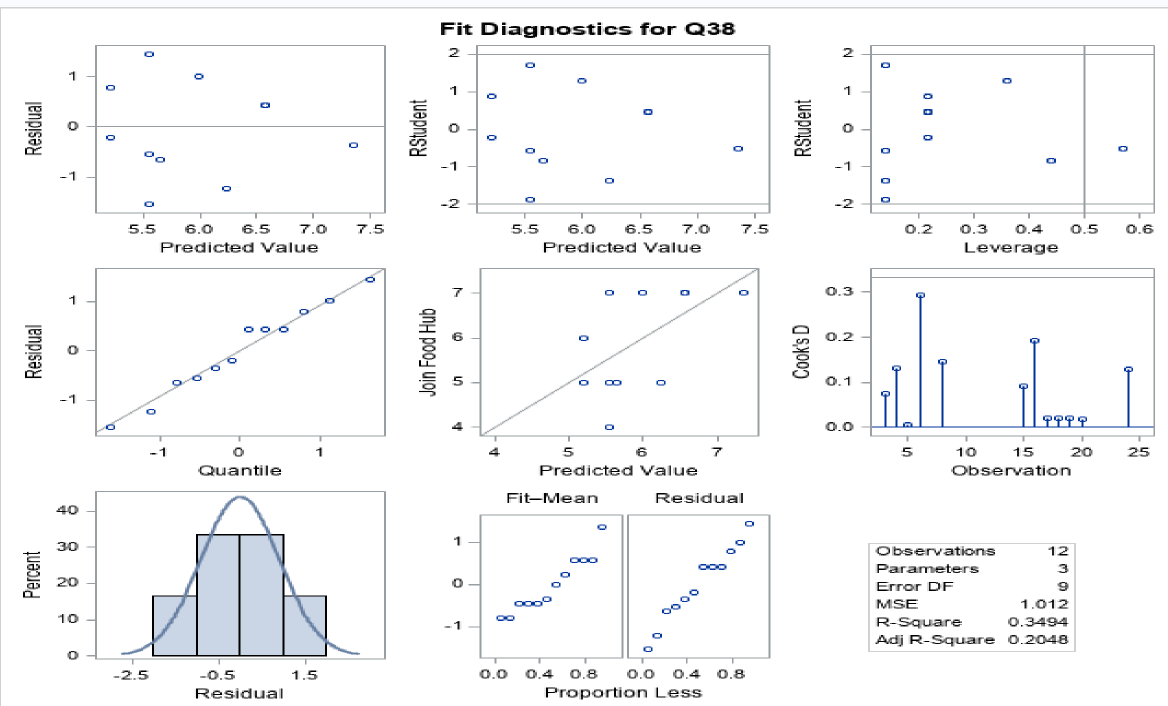
The GLM Procedure

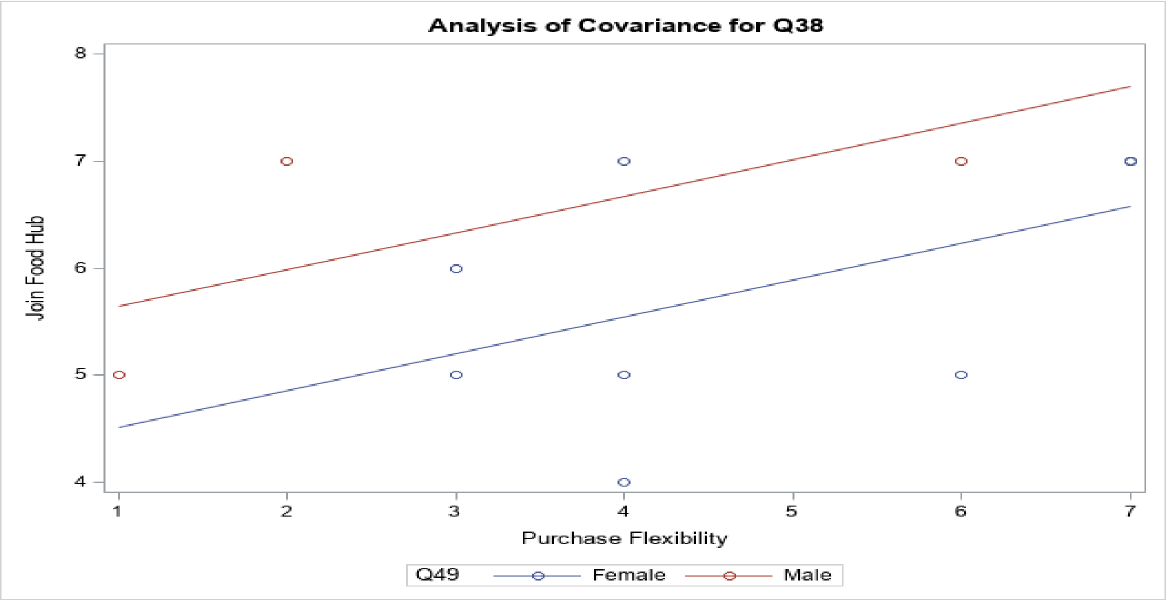
Dependent Variable: Q38 Join Food Hub

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	4.89181287	2.44590643	2.42	0.1445
Error	9	9.10818713	1.01202079		
Corrected Total	11	14.00000000			

R-Square	Coeff Var	Root MSE	Q38 Mean
0.349415	16.76654	1.005992	6.000000

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q27	1	4.44736842	4.44736842	4.39	0.0655
Q49	1	2.31734478	2.31734478	2.29	0.1645





Number of Observations Read	27
Number of Observations Used	13

The SAS System

The GLM Procedure

Dependent Variable: Q38 Join Food Hub

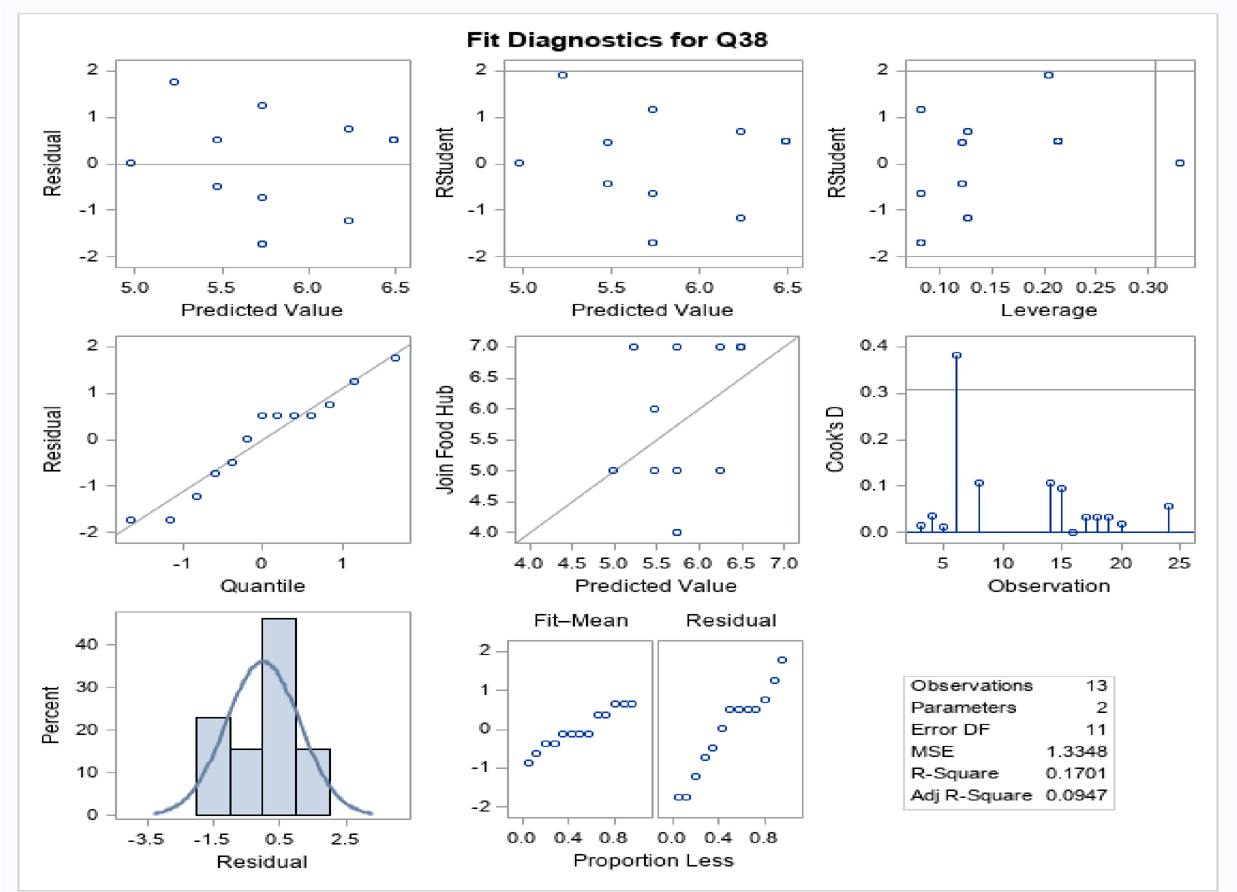
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	3.00989727	3.00989727	2.26	0.1613
Error	11	14.68241042	1.33476458		
Corrected Total	12	17.69230769			

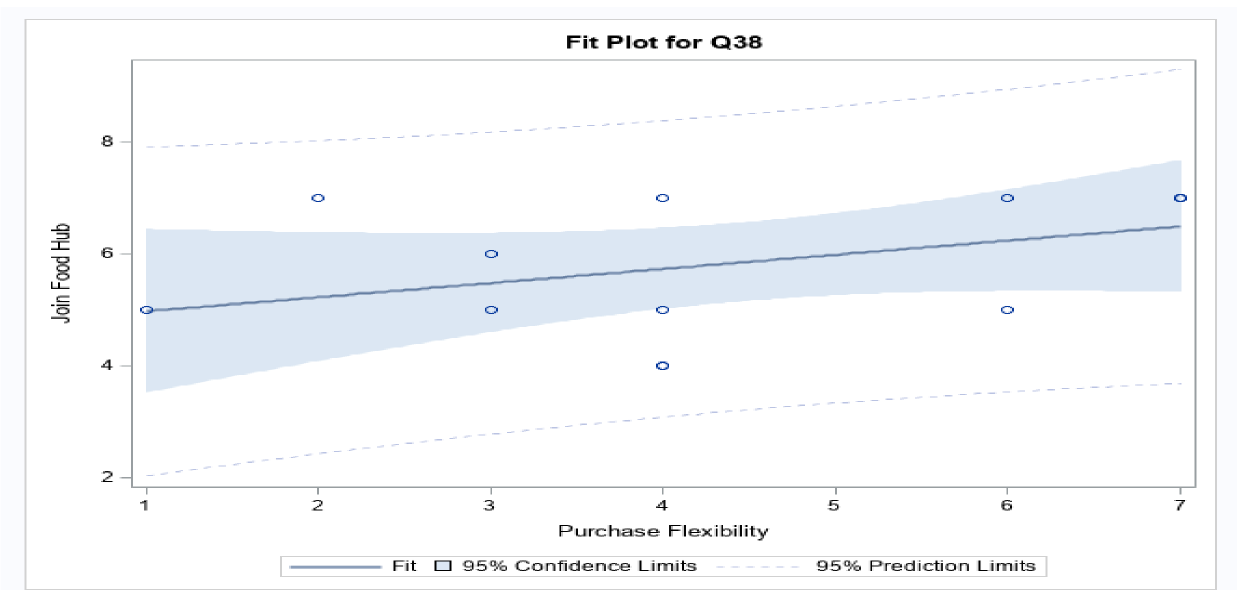
R-Square	Coeff Var	Root MSE	Q38 Mean
0.170125	19.76205	1.155320	5.846154

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Q27	1	3.00989727	3.00989727	2.26	0.1613

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Q27	1	3.00989727	3.00989727	2.26	0.1613

Parameter	Estimate	Standard Error	t Value	Pr > |t|
Intercept	4.719869707	0.81560309	5.79	0.0001
Q27	0.252442997	0.16810856	1.50	0.1613


Fit Diagnostics for Q38
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Join Food Hub
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 13
Parameters 2
Error DF 11
MSE 1.3348
R-Square 0.1701
Adj R-Square 0.0947


Fit Plot for Q38
Join Food Hub
Purchase Flexibility
Fit
95% Confidence Limits
95% Prediction Limits

dependent(Q36), most close to be significant variable is Q28

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	1
Number of Test Predictors	1
R-square of Full Model	0.101262
Difference in R-square	0.101262
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.802	72
2	0.85	0.852	82
3	0.90	0.902	96
4	0.95	0.951	118

dependent(Q37), most close to be significant variable is Q31

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	1
Number of Test Predictors	1
R-square of Full Model	0.113636
Difference in R-square	0.113636
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.805	64
2	0.85	0.855	73
3	0.90	0.900	84
4	0.95	0.951	104

dependent(Q38), most close to be significant variable is Q27

The POWER Procedure
Type III F Test in Multiple Regression

Fixed Scenario Elements	
Method	Exact
Model	Fixed X
Number of Predictors in Full Model	1
Number of Test Predictors	1
R-square of Full Model	0.170125
Difference in R-square	0.170125
Alpha	0.05

Computed N Total			
Index	Nominal Power	Actual Power	N Total
1	0.80	0.807	41
2	0.85	0.852	46
3	0.90	0.904	54
4	0.95	0.952	66

APPENDIX K. LIST OF FARMER'S MARKETS IN FARGO-MOORHEAD AREA

	Farmers' markets Name	Duration
1	Red River Market	July 13 – October 26
2	The Market at West Acres	June 25 – October
3	Ladybug Acres (Red Barn) Produce Stand	July 1 – October 31
4	Hildebrant's Farm	Depend on the season
5	Farmers Market & Beyond	July 22 – October 3
6	Moorhead Farmers Market	June 18 – September 24
7	Dilworth Farmers Market	Depend on the season