SUSTAINABLE FARMER INNOVATIONS IN EMERGING LOCAL FOOD SYSTEMS:

LOOKING BEYOND ADOPTION

TO ADAPTATION AND DEVELOPMENT OF INNOVATIONS

By

JUSTIN SINCLAIR ELLIS

(Under the direction of Carl F. Jordan)

ABSTRACT

The view of what constitutes agricultural innovations has evolved from the productionist era, which began in the 1930s, to today's emerging interests in sustainable agriculture and the development of local food systems. Agricultural innovations have historically been assumed to be science and technology focused, address yields, profits and production challenges and arise from research science and private firms before being diffused to farmers who are the adopters. Sustainable agriculture has developed by a somewhat different path by which innovations often originate from practitioners as opposed to research science, utilize tools beyond the production environment to achieve social and economic benefits, attempt to address broader problems of social, environmental and economic challenges, and utilize innovation adaptation and development processes in addition to adoption processes to address challenges.

This study focuses on understanding innovation processes undertaken by the most rapidly growing segment of sustainable farmers; small scale, resource limited, and newer farms engaged in the creation of local food systems. Sustainable agriculture in general, and this sub-group in particular has been poorly studied to better understand how innovation shapes individual farms and emerging local food systems. An emerging food system located in the northeast Georgia Mountains was chosen for an intensive four-year study that included 28 farms, focused on two new farmer networks, and identified 208 total innovations. This innovation inventory provided a new diagnostic tool to evaluate where farmers focus their creative energies towards solutions to problems.

This study finds that sustainable farmers are not just adopting innovations they are also adapting and developing innovations. They recombine different forms of knowledge arising from their personal skills and backgrounds, resource availability, evolving information sources, and specific problems and challenges found on their farms and in their communities and then develop novel, sometimes original solutions to problems. These processes occur individually in the form of farm-based innovations, and collectively in the form of network-based innovations. These observations challenge the view of farmers as "*merely passive recipients of knowledge and technology and demonstrates instead their capacities*" for innovation (Kroma 2006, p.12).

INDEX WORDS: local food systems, diffusion of innovations, sustainable agriculture, innovation systems

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B.A., Birmingham-Southern College, 1997

A Dissertation Submitted to the Graduate Faculty of The University of Georgia in

Partial Fulfillment of the Requirements for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2013

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August 2013

DEDICATION

This work is dedicated to my brilliant and beautiful wife who is one of the smartest women I've ever known. It is also dedicated to every farmer who ever showed me the kindness and generosity that I have only felt around farmers. It is my admiration for farmers that inspired my first interests in agriculture (that means you Mitch). And I want to dedicate this work to the memory of Joe Gatins who epitomized the type of person who "builds local food systems."

ACKNOWLEDGEMENTS

It is quite a blessing to be able to make some of the best friends of your life as a lucky coincidence of your dissertation topic. I am indeed blessed as Chuck and Amy Mashburn are subjects of this study, mentors, friends, pseudo-business partners, and even read me my vows at my wedding. I couldn't have hoped for two better people in this world to swap local food with on a weekly basis. Thanks for spending so much time with me…..and Ching-Yu.

I've bragged more than once that throughout this entire process I've never gotten tired of my topic. That's because I have a great topic and an incredible committee. One of the lucky breaks of my life was meeting Carl Jordan within a few months of visiting 50 farms by bicycle all over the country. We hit it off instantly and he's kept me working hard ever since. Likewise with each committee member, Kathy Roulston (her class convinced me that social research is fascinating reading when done well), Hilda Kurtz (If you're looking for someone with enthusiasm to keep you going look no further), John Bergstrom (for strong guidance in the traditions of agricultural economics and social research), and Paul Hendrix (because he's a giant in agroecology). I bonded and feel proud to have worked with the finest professors I've encountered in graduate school.

I'm fascinated with science but I love people and farm people are the people I love the most. I want to thank every single farmer that ever had me over for a visit, and almost certainly fed me something and showed me incredible hospitality. I want to especially thank Joe Gatins, Steve Whiteman, Brooks Franklin, Ronnie Mathis, Sid Blalock, Harold and Joni Kennedy, Ed Taylor, David and Katrina Lent, David Taylor, Sharon Mauney, Kim and Larry Jensen, Debbie Bouchard, Linda Lovell, Buddy and Suzanne Belflower, and Leland Gibson. Every farmer who has ever attended a GMFN meeting, participated in the Farm Tour, or sold a product through Locally Grown has also been an important part of this research. Also special thanks to Teri Parker who has volunteered every week at Locally Grown for three years. That is cool.

I owe some of my early farm experiences to the agroecology lab at UGA and other close Athens farmer friends especially Celia Barss, Krista Jacobsen and Jason Mann. This project wouldn't have gotten nearly as far as it did without the financial support of the USDA's Southern SARE graduate student grant, and the network organizers grant awarded to Certified Naturally Grown and Alice Varon. The CNG grant came from the Farmers Market Promotion Program (FMPP) so thanks to the USDA for funding this great work, and I hope that CNG will continue to receive farmer network organizing support, because they did an incredible job. Thanks also to Eric Wagoner of Locally Grown, and all the participants in the Athens Tour de Farm, my first experience organizing a farm tour.

Final thanks to my family, most of all Ching-Yu Huang who is a perfect life mate (she also helped edit every word you are reading), and Cheetos and Whisky who gave me very good company during this final month and in life in general. Thanks to my Mom for helping me every step of the way through my entire life (that's a job well done by the way), and thanks to Dad for that one time he said, "you

know people do have jobs like that." That gave me confidence to go down all the weird and wonderful paths that I've been lucky to discover. What a privilege.

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INTRODUCTION

For the last seventy years, studies of agricultural innovations have focused on diffusion processes, in which new agricultural knowledge is principally derived by investments in agricultural research institutions, and diffused to adopters in farming communities through a process of technology transfer and extension. This approach to the study of agricultural knowledge development and dissemination has largely ignored the emergence of sustainable agriculture practitioners and their contributions to the development of local food systems. For many decades sustainable agriculture practitioners have engaged in innovation development outside of institutional structures of research and technology.

Solutions to many of the challenges within sustainable agriculture originate with practitioners, as opposed to research science (Kroma 2006). In fact, many of the problems sustainable farmers are trying to resolve arise from research science, in that chemical, capital and technological inputs developed by agricultural research are perceived as having significant financial, ecological and social costs to farmers, society and the world (Buttel 1990). Sustainable agriculture attempts to develop innovations that address these broader societal problems in addition to localized production and economic challenges.

The diffusion of innovations theory developed by rural sociologist Everett Rogers (1962, 1971, 1983, 1995, 2003) has been a dominant theoretical model for the study of agricultural innovations for half a century (Padel 2001). Diffusion is essentially the study of adoption behaviors, and how the process of adoption occurs for individuals and throughout societies. Adoption, while not a passive action, is perceived as a distinct activity from invention and innovation development. According to diffusion theory innovation "*often begins with a recognition of a problem or need which stimulates research and development activities*" (Rogers 2003, p.137). Diffusion theory has tried to accommodate for adopter's "re-invention" of innovations, but for the most part innovations are perceived to arise from outside of a farmer's immediate environment.

Application of diffusion theory to sustainable agriculture has primarily focused on challenges faced by transitioning farmers and suggests that the complexity or "suite of practices" required is a major limiting factor to adoption (Padel 2001). Little attention however has been directed at understanding the role of innovation amongst the most rapidly growing segment of sustainable farmers; small scale, resource limited, and newer farms engaged in the creation of local food systems.

This study makes the assumption and finds in practice that sustainable farmers are not just adopting innovations they are also adapting and developing innovations. They recombine different forms of knowledge arising from their personal skills and backgrounds, resource availability, evolving information sources, and specific problems and challenges found on their farms and in their communities and then develop novel, sometimes original solutions to problems. These processes occur individually in the form of farm-based innovations, and collectively in the form of network-based innovations. These observations challenge the view of farmers as "*merely passive recipients of knowledge and technology and demonstrates instead their capacities*" for innovation (Kroma 2006, p.12).

The observations made in this study strive to change the discourse on agricultural innovations from "why do farmers adopt," to "why do farmers innovate, what do they innovate and how do they innovate?" An inventory of local food system innovations is posited as a useful tool in understanding how sustainable farmers address challenges. The answers to these questions are sought within a single emerging local food system located in a rural community of the northeast Georgia Mountains.

The basis for this shift in focus from "adoption" processes to "innovation" processes is a belief that farmers engaged in innovation development contribute to a more progressive agriculture. The process of adapting ideas to one's unique contextual environment is an innovative process. Sustainability is often achieved not by the adoption of technologies but in the "fit" between the technology and the context of its use (Uphoff 2002). This adaptive process is so frequently required "to be effective" that farmers' capacities for continuous change and adaptation may be a useful measure of their contributions to sustainability, local food system advancement, and individual farm success (Uphoff 2002, Hall 2007, Dyer 2012).

This study also strives to broaden the study of innovations in sustainable agriculture and emerging local food systems to include those that address:

marketing, labor, distribution, information sources, networks, and food processing. To be successful farmers are required to solve problems and address challenges far beyond those occurring solely in the production environment. Farmers attempting to solve broader social, economic and ecological goals than typically considered by agricultural research find many challenges are best addressed through social organizing, and knowledge exchange between different actors and different sectors within a food system (Pugliese 2001).

The Goals of this Research

This research seeks to understand the innovation processes of small-scale sustainable farms within one emerging local food system in the northeast Georgia mountains. Twenty-eight farms across six counties were observed for a period of four years in production, marketing and networking contexts. The first goal of the research was to determine what types of innovations farmers were adopting, adapting and developing. This data was used to build an innovation inventory, or a record of all innovation activity within the study region. The second goal was to understand why farmers were innovating. Innovations observed were categorized into an innovation typology, which identified all challenges each innovation was designed to address. This analysis allowed a better understanding of where farmers were focusing their creative energies towards solutions to problems. The final goal was to understand how farmers were innovating, or the innovation processes being engaged, with special attention given to adaptation and development processes as opposed to solely focusing on adoption processes. Each of these goals was applied to farmers' activities in production, in marketing (since farmers face challenges beyond just the production realm), and in networking (since farmers must address many challenges that they cannot achieve in isolation).

Chapters 4, 5 and 6 present the results of this four-year study. Chapter 4 focuses on the development of an "innovation inventory" and presents five case studies of Production oriented innovations. Chapter 5 presents a marketing innovation case study by describing the development and contributions of an online farmers market. Chapter 6 addresses the role of farmer networks in innovation, with a focus on networks as a forum for knowledge exchange, and how network collaborations function as a form of innovation that achieve social or economic goals that farmers cannot achieve in isolation.

The ultimate goal of this research is to advance our understanding of how innovations are shaping the development of individual farms and the broader local food systems they are helping to build. The theories and models explaining innovation processes developed during the productionist era of agriculture no longer fully explain the development of innovations contributing to a sustainable agriculture. New theories and diagnostic tools are needed that emerge from the study of the unique contextual conditions of small scale, resource limited farmers focused on local food system development.

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CHAPTER 2

LITERATURE REVIEW

Over the last seventy years American agriculture has demonstrated a unique ability to develop new technological innovations, adapt and refine these innovations through research, then encourage the implementation of these practices on working farms. Such innovations have frequently focused on improvements in production, efficiency, and profitability. This era of agricultural development frequently referred to as the Green Revolution has been characterized by a rapid increase in agricultural production and an increased reliance on mechanization, irrigation, improved crop cultivars and external inputs such as chemical fertilizers, pesticides and energy (Gold 1999; Hildebrand and Russell 1996). Many of the technological and research innovations of this era were developed, tested and promoted by the nation's system of land grant colleges through agricultural experiment stations and the Cooperative Extension System.

Throughout the 1970s and 1980s growing concerns regarding the consequences of modern conventional agriculture began to take shape, particularly in terms of ecological impacts and the loss of small farms (Altieri 1989). In response to these concerns, alternative practices slowly began to emerge that sought to ameliorate many of the biophysical and social impacts associated with conventional agriculture, and to define a more sustainable agriculture. Clear and exact definitions of what constitutes a more sustainable agriculture are fiercely contested, even amongst supposed practioners. Numerous intertwining movements have emerged under different names, philosophies, and associations including organic agriculture, local foods and local food systems, sustainable agriculture, chemical free agriculture, and agroecology. One thing that these movements share in common is that early practitioners are often forced to experiment via trial and error with innovations largely ignored or unproven by traditional scientific research (Kroma 2006).

In small-scale sustainable farming, innovation is recognized as a critical and necessary component to solving localized production and marketing challenges. Resource limited farmers often solve problems by substituting locally adapted innovations in place of more “capital intensive” solutions commonly utilized in conventional agriculture. Land grant universities and the Extension system, the traditional entities for the dissemination of innovation information, still lack capacity in addressing the rising needs of small-scale sustainable farmers. As a result, local food system communities have largely assumed the responsibility for developing innovative solutions to production and marketing challenges. However, little is known about the benefits and challenges encountered by local food system participants during the process of innovation development, implementation, adaptation and evaluation, or the role this process plays in strengthening emerging local food systems.

Historically the study of agricultural innovations has focused on single techniques, often technological in nature, intended to increase commodity yields and farm profitability (Padel 2001, Stephenson 2003, Rogers 2005). Many technological innovations have been criticized for being production focused, cost prohibitive to small farmers, inefficient in use of resources, indifferent to ecological, social and economic differences among regions, and cause rather than resolve economic inequalities (Francis et. al. 2003, Stephenson 2003).

Organic and sustainable agriculture practices, often regarded as a "suite of innovations," look broadly at problems beyond production. Local food systems are being posited as a new organizing paradigm for addressing whole systems by examining relationships across all three spheres of environmental, economic and social challenges.

History of Agricultural Innovations and their Study

A defining aspect of agriculture in the U.S. after World War II has been an almost universal and rapid substitution of capital investments (in particular mechanization and chemical inputs) for labor (Lyson 2004, Barlett 1993). Up until this time, draft livestock had carried out much of the labor of agriculture, with work animals subsisting on pasture, and their manure used as a source of fertility for crops (Hildebrand and Russell 1996). As livestock gave way to tractors and chemical inputs replaced manures, crop intensification using high yielding hybrid cultivars and monocultures created an increasing demand for pesticide use to control losses from pest and disease pressure. These changes in production slowly began to homogenize agricultural environments making it easier for agricultural research to propose "broadly adaptable" technological solutions to agricultural problems (Hildebrand and Russell 1996).

A "one size fits all" approach to technological innovations also carried over into American farm policy. Roosevelt's New Deal farm programs began to create an unequal distribution of benefits to large farms leading to increased mechanization, capital intensification, and adoption of new technologies (Barlett 1993). Both technology and policy spurred ever-increasing economies of scale, driving up average farm size, and driving down the number of farms and rural populations in general (Demitri et. al. 2005). Not all farms could afford such large capital expenditures, and for those that could, each investment greatly limited their future cropping decisions (Bartlett 1993). Ezra Taft Benson, the US Secretary of Agriculture under Dwight Eisenhower from 1953 to 1961 famously counseled struggling farms to "get big or get out" (Berry 1999). These changing capital relations of production not only began to determine which technological innovations would be adopted, but by which farms and farmers, typically those with the deepest pockets (Altieri 1989). The notion that technical change is always a source of prosperity began to be called into question by numerous authors and researchers (notably Goldschmidt's (1947) As You Sow) who began to recognize large scale technological innovations and the industrialization of agriculture as a "source of inequity" and "destructive of rural communities and culture" (Ruttan 1996).

Diffusion of Innovations theory

The study of agricultural innovations has evolved in tangent with the history of agricultural productionism in the U.S. Agricultural productionism is an ideology that privileges agricultural productivity over other values associated with farming landscapes, communities, and products (Mulvaney 2010). Buttel (1993, p.7) described it as "the doctrine that increased production is intrinsically socially desirable and that all parties benefit from increased output." To be certain, the technological innovations during the last eighty years have contributed to significant gains in agricultural productivity. Indeed, productivity during this time rose rapidly, with one American farmer able to produce food for just 19 people in 1940, 27 in 1950, 61 in 1960, 112 in 1980, and 155 people by 2010 (USDA 2012, Vilsak 2010, Rasmussen 1968). This represents a 170 percent increase in farm output between 1948 and 2009, with an annual growth rate of 1.6 to 1.9% (USDA/ERS 2012, Demitri 2005).

Such improvements in productivity were highly desirable, particularly at the outset of the American productionist period of the mid 1930s when food security during the Great Depression was at an all-time low. Perhaps no technological innovation represents the capacity of this era better than the introduction of hybrid seed corn into the Corn Belt state of Iowa, and its rapid adoption by one quarter of the nation's corn acreage between 1933 and 1939 (Ryan and Gross 1943, Stephenson 2003).

Hybrid seed corn, developed in a Connecticut Agricultural Experiment Station in 1918 and introduced to Iowa in 1928, offered farmers many advantages over open-pollinated varieties such as improved vigor, disease and drought resistance, and 20% higher yields (Ryan and Gross 1943, Rogers 2003). In the 1930's hybrid corn was actively promoted by Iowa State and other land grant colleges, as well as by hybrid seed salesmen. The diffusion of hybrid corn technology was so rapid that by 1945 the vast majority of Iowan corn producers had adopted its use (Ryan and Gross 1943, Ruttan 1996).

What differentiates hybrid corn from technical innovations that preceded it was an increased interest in understanding how the innovation spread, with hopes that other innovations developed by Agricultural Experiment Stations might improve their dissemination process and adoption rates. This research tradition, which came to be known as the adoption-diffusion model, was begun by rural sociologists Bryce Ryan and Neal Gross (1943) in perhaps the single most influential study of diffusion and adoption of a farming innovation, and one which still reverberates in our agricultural agencies today.

The Ryan and Gross study sought to explain how the diffusion process occurred in two Iowa farm communities in the '30's and '40's, particularly how communication channels and social relationships influence an individual's decision to adopt (Rogers 2003). Using a structured interview survey approach, information was collected on farmers' original contact with information about hybrid seed corn, the sources of this information, the level of influence of this information, and when farmers first adopted the use of hybrid seed.

Diffusion of innovations is defined as the process by which "an innovation is communicated through certain channels over time among the members of a social system" (Rogers 2003, p.5). The findings in this and future diffusion studies demonstrate that diffusion generally begins with a small number of farmers characterized as innovators. The innovation then diffuses to other farmers with the most influential source of information often coming from neighboring farmers. Mass communication channels often function as the source of initial information about an innovation, while interpersonal networks have the most influence over a farmer's decision to adopt (Rogers 2003). As farmers are able to see and interact with early adopters, the rate of adoption quickly increases (Stephenson 2003). The cumulative rate of adoption follows an s-shaped curve whose steepness is determined by a range of factors including characteristics of the innovation, characteristics of adopters, and communication networks (Fig 2.1).

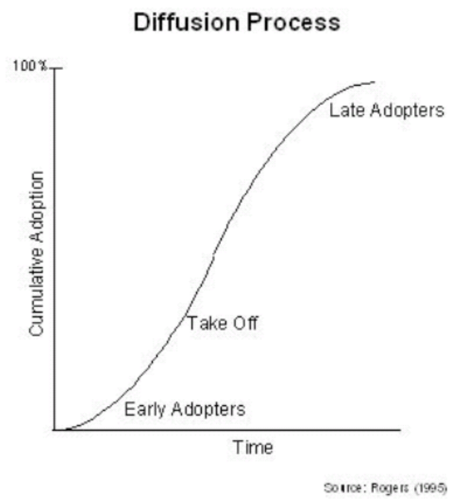

Figure 2.1: Rate of Adoption Curve

The cumulative rate of adoption of an innovation through time frequently follows an s-shaped pattern with a small number of early adopters, then a rapid take off point during which adoption increases, followed by a final slower period of adoption by late adopters.

When this same data is plotted on a frequency rather than a cumulative basis, it forms a bell-shaped curve allowing researchers to classify individuals on the basis of their innovativeness. Referred to as the *individual innovativeness theory*, diffusion research generally recognizes five categories that rate an individual's innovativeness, determined according to when each farmer chooses to adopt a given innovation. These descriptive categories define individuals as: innovators, early adopters, early majority, late majority and laggards (Rogers 2003).

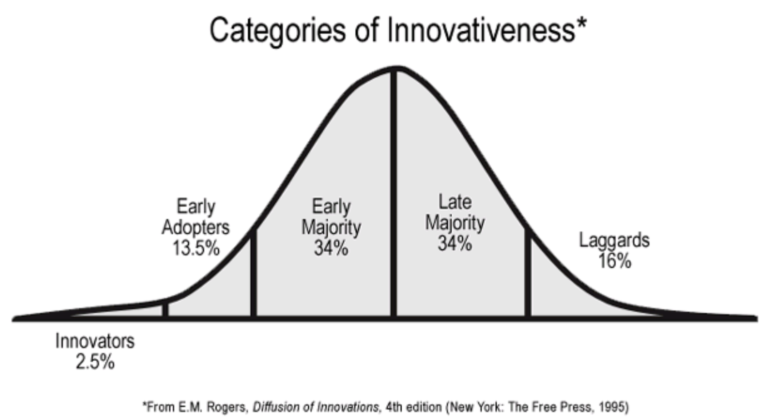

Figure 2.2: Categories of Adopters

The Innovation Curve is a frequency distribution, which allows adopters to be classified based on their time of adoption.

The characteristics of each of these adopter categories have been studied extensively in an attempt to predict innovation diffusion and adoption patterns. Everett Rogers who popularized the diffusion of innovations theory (1962, 1971, 1983, 1995, 2003) summarizes some of the generalizations that can be made from research on characteristics of earlier vs. later adopters of an innovation (Table 2:1).

Table 2.1: Characteristics of Earlier Adopters

These characteristics are summarized by Rogers (2003) under three headings of (1) socioeconomic characteristics (2) communication characteristics, and (3) personality characteristics.

Socioeconomic Characteristics	***Personality Characteristics***
No difference in age	Greater empathy
More formal education	Less dogmatic – less closed beliefs
More likely to be literate	Greater ability for abstraction
Higher social status	Greater rationality
Greater upward social mobility	Greater intelligence
Larger farm size	More favorable attitude toward change
	Better ability to cope with uncertainty / risk
Communication Characteristics	More favorable attitude toward science
More social participation	Less fatalistic attitudes
Greater interpersonal networks	Higher aspirations
More cosmopolitan	
More change agent contact	
Greater exposure to interpersonal communication channels	
Actively seek information on innovations	
Higher degree of opinion leadership	

Diffusion studies have also found that each individual passes through a series of stages in their consideration of adopting an innovation. This theory of an *innovation-decision process* or *stages of adoption* was first developed by Beal, Rogers and Bohlen (1957) and advanced by Everett Rogers (1962, 1983, 1995, 2003). Rogers (2003) describes the five-stage process in an individual's adoption of an innovation as knowledge, persuasion, decision, implementation, and confirmation.

1. Knowledge Stage – The knowledge stage begins when an individual first learns about an innovation either through accidental exposure or in a search for information to satisfy a need. Knowledge of an innovation can take three forms: awareness-knowledge, how-to knowledge, and principles knowledge. Awareness-knowledge is information of an innovations existence, how-to knowledge describes how an innovation works, and principles knowledge describes the underlying principles behind how the innovation works (such as soil ecology as the basis for nutrient cycling in the use of cover crops). Rogers suggests that change agents such as Extension can make the greatest contribution by concentrating on how-to knowledge, which is essential information in considering adoption. Awareness knowledge is most easily achieved through mass-communication channels while the more complex aspects of principles knowledge is more appropriate for formal schooling.

2. Persuasion Stage – The persuasion stage occurs when an individual forms a positive or negative opinion towards the innovation. After a period of information collection, the individual develops a feeling or attitude that will lead to either the adoption or the rejection of the innovation.

3. Decision Stage – The decision stage occurs when an individual makes the decision to adopt or reject an innovation. A small-scale trial is often part of this decision to adopt or reject.

4. Implementation Stage – The implementation stage occurs when an individual puts an innovation into use. Access to "how-to knowledge" is still extremely important at this stage. The adopter will often adapt the innovation in a process called re-invention that allows the innovation to be re-shaped to meet specific needs.

5. Confirmation Stage – The confirmation stage occurs when an individual either makes the use of an innovation a standard practice or seeks reinforcement of the innovation's utility in order to determine whether to continue use of the innovation or not.

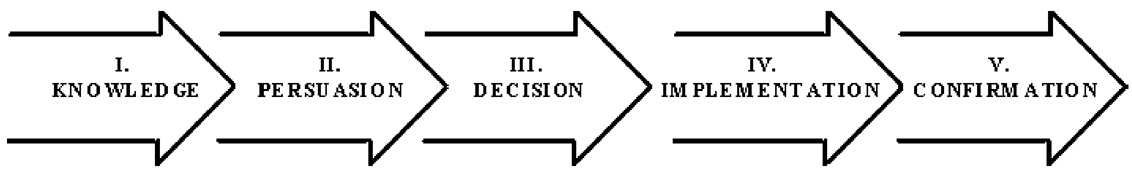

Figure 2.3: Innovation Decision Process or Stages of Adoption (Rogers 2003)

An individual's progression through this innovation decision process is likewise dependent upon characteristics of adopters, the perceived attributes of the innovation, and the transmission of information about the innovation through communication networks.

Rogers (2003) defined five characteristics or attributes of innovations that help to explain why they may experience quite different rates of adoption. He defined these innovation attributes as: relative advantage, compatibility, complexity, trialability, and observability.

Table 2.2: Attributes of Innovations as perceived by potential adopters (Rogers 2003)

Relative Advantage	Relative advantage is the extent to which a new innovation is perceived as offering benefits above and beyond those offered by existing practices. Examples of these benefits can be economic benefits, less time/effort, low initial costs, immediacy of benefits and social prestige (Rogers 2003). Relative advantage is considered one of the best predictors of adoption.
Compatibility	Compatibility is the extent to which an innovation is considered to be consistent with existing needs, previous ideas, and individual and cultural values. When new ideas clash with old ideas, adoption can be slowed.
Complexity	Complexity is the extent to which an innovation is considered difficult to understand and implement. Innovations with greater complexity are generally adopted at a slower rate.
Trialability	Trialability is the extent to which "an innovation can be experimented with on a limited basis (Rogers 2003, p.16)." An innovation's diffusion is more rapid if the practice is conducive to experimentation under "one's own conditions" (Rogers 2003). Trialability is most important in the early phases of diffusion.
Observability	Observability is the extent to which an innovation can be seen by others. When both the technological practice and the benefits of an innovation can be observed, adoption occurs more rapidly.

It is important to recognize that an individual's perception of an innovation's attributes can change quickly over time. For example, an individual, or group of individuals may not recognize high relative advantage of an innovation upon first exposure, or the innovation may seem overly complex. These perceptions may change upon repeated exposures, or as needs or attitudes towards the innovation evolve.

Criticisms of the Diffusion model

The diffusion model has been approached cautiously in its application to innovations in sustainable agriculture due to concerns with its historical development and application. Padel (2001, p.40) observes that the model originated "at the height of the productivity paradigm for agriculture and the 'green revolution,'" and that sustainable and organic agriculture in many ways presents a direct challenge to this paradigm. Other authors have highlighted similar concerns, pointing out that diffusion theory has historically focused on commercial innovations, and ignored "environmental" or "conservation" innovations (Pampel and Van Es 1977). Pampel and Van Es (1977) found that the demographics of early adopters for commercial innovations (such as large farm size) were not good predictors for early adoption of conservation innovations, and sustainable agriculture practices may have more in common with such ecologically based "conservation" innovations than technological, profit-based "commercial" innovations.

Traditional applications of the Diffusion model have also typically focused on individual practices, whereas sustainable and organic systems often rely on a system of practices and more holisitc management (Padel 2001). The diffusion model was also developed for studies primarily involving technological innovations. Sustainable and organic production systems have frequently been described as being knowledge intensive, or software based (such as understanding crop rotations or principles of soil food web processes), rather than technology intensive, or hardware based (such as the implementation of large capital solutions in the form of specialized mechanical equipment). The advancement of sustainable agriculture is frequently considered to require a "conversion from a resource-based to a knowledge-based agriculture" (Gabriel 1995, p.351), and one in which farmers need greater technical knowledge and management skills to solve problems. Because the technologies of sustainable agriculture are considered management and knowledge intensive, an emphasis on "human resource development" has also been noted, yet frequently missing from diffusion studies (Ruttan 1996).

Innovation-diffusion studies have also tended to focus on cases of a successful diffusion, introducing a pro-innovation bias. The pro-innovation bias is an assumption that "an innovation should be diffused and adopted by all members of a social system, and that it should be diffused more rapidly (Rogers 2003, p.100)." Goss (1979) identified this bias as an uncritical, perhaps even promotional attitude towards technological change, often overlooking the potentially detrimental consequences that innovations sometimes cause to other farmers or society (Buttel 1990).

Diffusion of innovations in the Agricultural Extension Model

Despite these concerns the diffusion model is still the dominant theoretical framework addressing innovations in use today by the nation's Agricultural Extension System. The Agricultural Extension System is considered one of the most successful diffusion entities (or change agencies) in the world due to their full integration of the innovation-development and diffusion process (Rogers 2003). The system consists of a three tiered approach: (1) University researchers develop technological advancements, (2) State Extension specialists link this information to localized county agents, (3) Local county agents, who are closest to farmers' communication networks, then help to diffuse the innovation through technical information and field trials (Rogers 2003). The success of this model rests in its ability to combine the certainty of advanced science with the understanding that localized interpersonal communication networks are critically important to widespread adoption.

Diffusion theories have been central to Extension programming since the '50's. Stephenson (2003) found that in addition to formal trainings and college level Extension methods courses in diffusion theory, there have been over 50 articles published in the Journal of Extension since 1984 that specifically cite innovation diffusion theory.

The importance of early adopters in the diffusion process has been a central focus of Extension diffusion efforts. Opinion leaders in particular, who are often the largest and wealthiest members of the social network, play perhaps the most important role in further expansion of an innovation. This focus on the more innovative farmers has been one of the central criticisms of extension's use of the diffusion model (Stephenson 2003). Several negative consequences of this approach are that those most in need of help (lower socio-economic status and education) are frequently the last to adopt the benefits, and the benefits of a new innovation often widen rather than reduce social and economic inequalities (Rogers 2003).

A bias towards the more elite, wealthier farms is often considered by Extension personnel to simply be the "path of least resistance" since these farmers are often already seeking new information, and have the economic means to implement new innovations (Rogers 2003). Those farms that are harder to reach can be ignored, since the theory assumes that late adopters will be reached eventually through the diffusion process (Roling 1988).

Cochrane's Treadmill

In 1958, Cochrane's theory of a Treadmill Effect threw into question the assumption that innovation adoption is always a benefit to the farmer. He described how farmers typically adopt new technologies in order to improve farm income, and that "early adopters" often enjoy increased profits for a short while as a result of lower per unit production costs (Levins and Cochrane 1996). However as more farmers adopt the technology, total production typically goes up, and as production goes up, and given the inelasticity of customer demand (customers don't consume more food when the supply goes up) then prices go down, and the initial realized profits are lost.

This situation has an even darker side regarding late or non-adopters of innovations. As a new technology comes out that makes it possible for adopting farms to produce more, and more efficiently, if other farms choose not to adopt they will lose out in a competitive marketplace in what is called the price squeeze (Roling 2004). These farms are still forced to adopt the technology to lower their production costs but will not receive the short-term profits enjoyed by early adopters. This is essentially the "treadmill" of agricultural innovations that farmers are forced to run to stay in place, adopting innovations not to increase profits but to stay competitive. Those who do not adopt the technology due to lack of resources or other reasons may fail to survive altogether. The resources of these failed farms, particularly land resources, are typically absorbed by the wealthier early adopters who enjoy the short-term windfall profits (Roling 2004, Levins and Cochrane 1996).

An additional negative effect of Cochrane's Treadmill is that innovation competition based purely on production and price tends to promote "non-sustainable forms of agriculture" in which innovations that increase production and efficiency but are destructive to the environment and farming communities must still be adopted in order to stay competitive (Roling 2004).

Transfer of Technology Model

A discussion of agricultural innovations would not be complete without a brief history of the primary contributor of these technological innovations; agricultural research institutions. The direction of agricultural research in the U.S. (over the last century) was greatly influenced by a series of governmental policies dating back to the 19th century when President Lincoln established the U.S. Department of Agriculture in 1862 and instructed its first commissioner to *"acquire and preserve… all information concerning agriculture"* (Brenner 2006). That same year the Morrill Land Grant Act was passed which gifted federal land to the states (30,000 acres for each member of congress) that could be sold or used towards the establishment of Land Grant agricultural colleges. There are 76 such land-grant institutions today. Next, the Hatch Act of 1887 established state agricultural experiment stations (at least one for each state), which permanently established agricultural research as a function of Land Grant Colleges. The Smith Lever Act of 1914 then established the Cooperative Extension Service whose purpose it was to develop and disseminate agricultural scientific research through farmer education involving a cooperative between federal, state, and county funding support.

Prior to the integration of these policy decisions, farmer to farmer knowledge exchange had been the principal means by which farmers developed and learned new innovations and facilitated their spread throughout agricultural communities (Nerbonne 2003). In the years following, and certainly with the advent of the productionist era, the Cooperative Extension Service, Agricultural Research Stations and Land Grant Universities began developing highly effective systems for generating and distributing agricultural knowledge and innovations. This process is commonly referred to as the Transfer of Technology (ToT) model and represents a vertical process of knowledge exchange where innovation is seen to "originate in science" by research specialists (Roling 1998). Such innovations are considered technologically complex, developed through controlled experimentation, and then transferred from researchers to farmers in a fairly linear process through extension specialists, county extension agents, progressive farmers and then diffused more broadly to other end users (Roling 2004, Nerbonne 2003). Extension agents play a pivotal role of the "go between," translating the problems of "end users" into researchable questions to be answered by research scientists whose solutions must then be disseminated back to "users" through technology transfer (Warner 2008).

While Diffusion provided insights into adoption and uptake, or the consumption side of innovation, technology transfer makes certain assumptions about the origin of innovations themselves and how and by whom the tacit knowledge required to implement innovations is developed.

The Transfer of Technology paradigm (also referred to as the National Agriculture Research Systems or NARS) has been extremely effective in its ability to develop technological solutions that have wide potential applicability and disseminate them broadly (The World Bank 2007). In fact, western models of technology transfer have been replicated and spread all over the world, and influence countless sectors of business and society. However, like diffusion theory, the transfer of technology paradigm has been critically assessed and numerous weaknesses identified, particularly as it applies to sustainable agriculture and its application in agricultures of the developing world (Dyer 2012). An abbreviation of such critiques is as follows:

1. Research scientists often have a **narrow focus** on short-term yields and economic returns and treat environmental and social factors as externalities beyond the concern or control of the research (Wezel et. al. 2009).
2. A general disregard for the **broader context** in which agricultural problems and solutions occurs, which reinforces an assumption that scientific agricultural knowledge can be **equally employed across numerous spatial locations**, thus homogenizing agricultural geographies and communities. Accessibility, affordability, and appropriateness of technologies within specific conditions is frequently absent from economic analysis (Uphoff 2002)

3. A general assumption that knowledge developed within scientific systems is **superior to farmer generated knowledge** (Molnar et. al. 1992).
4. Tendency to treat all actors in agricultural systems as **passive recipients** of knowledge rather than as social actors who actively construct the systems in which they belong (Sonnino and Marsden 2006).
5. Often **fails to adequately reach resource-poor farmers** or respond to varying needs of farming communities (Van der Fliert, 2003)

Alternative Theories of Agricultural Innovations

Alternatives to the productionist era view of a technologically oriented agriculture focused on yields, profits and efficiency have been with us for more than a half century, even if such positions within agencies, farming communities and society have been marginalized until very recently. Sir Albert Howard's Agricultural Testament (1943) was one of the earliest volumes to emphasize Nature's method of managing soil fertility as instructive towards more ideal agricultural practices such as: always mixing crops with livestock, raising a diversity of crops, preserving the soil and preventing erosion, and a conversion of wastes into humus. Sir Howard's central premise that "soil fertility must be the basis of any permanent system of agriculture," has been widely incorporated into many alternative agriculture movements centered around the application of ecological principles into agricultural practice. These various movements have evolved to become: the organic farming movement first begun in Europe then popularized in the U.S. by J.I. Rodale throughout the 1950's (Barton 2001); agroecology, permaculture, biodynamics, and many others.

The origins and divergences of each of these alternative theories are less relevant to this review than what they share in common regarding their view of the role of agricultural knowledge, practice and innovation.

Agroecology

Agroecology is an interdisciplinary approach to solving broad agricultural problems using ecological theories (ie. biodiversity, food webs, carbon and nutrient cycling, systems ecology, ecosystem energy flows) to study, design and manage agricultural systems for long-term sustainability (Gliessman 1998; Francis and Porter 2011).

Agroecology has been called the "science of sustainable agriculture", and though the term has been in use since the 1930s, the field has evolved rapidly in recent decades, and its scope and scale expanded (Altieri 1995, 1987; Francis et. al. 2003, Wezel et. al. 2009). Initially agroecology was viewed as a plot or field scale discipline involving the application of ecological principles to farming practices. By understanding and incorporating the strengths of natural ecosystems into agricultural environments, agroecology is believed to make farming more efficient (modeling nature's energy flows), more diverse (biodiversity balances nutrient flows and disease), more self sufficient (e.g. natural ecosystems require only sunlight and rainfall), self regulating (natural plant defenses), and more resilient (natures ability to recover from disturbance) (Magdoff 2007). Such systems strive to minimize external inputs (energy, nutrients), and reduce external consequences to surrounding environments (pollutants, toxins). These ecological principles in practice can include: the use of cover crops (adds N, organic matter, beneficial insect habitat), rotations, reduced tillage, perimeter plantings for biodiversity, additions of diverse forms of soil organic matter (increases soil biological diversity, nutrient and water holding capacity), crop timing (to enhance nutrient uptake), and many other practices (Magdoff 2007).

What has made agroecology unique is a full recognition that human behavior and interventions are the central driving force in agro-ecosystems, a notion quite different from "early paradigms of ecology and social sciences [that] tended to view humans as independent of the natural world" (Tomich et. al 2011, pp.196). Likewise, the rules, principles and efficiencies of natural systems still apply, a viewpoint rarely encountered in the traditional agronomy paradigm. Since the activities of humans are seen as within the system under study rather than external to it (Dalgaard et. al. 2003), permanently "embedded" so to speak, then the study of agricultural innovations must examine the cultural, economic, political and social factors in addition, and in relation to, the physical and biological factors inherent to agro-ecosystems (Tomich et. al. 2011).

As a narrow field scale or "production only" focus ignores the energy, materials and cultural influences that shape other parts of the food system such as food processing, transportation, and marketing steps, agroecology has invoked a broader framework to examine these seemingly distant aspects of the food system in addition to the ecological, technological and socio-economic factors that influence the character of agricultural production (Francis et. al. 2003). Such a framework encourages new research questions within the social and human sciences that examine the societal context of food systems, and expands the field and scale of study from the plot or field, to the farm, to landscape agroecosystems, to farming more generally and eventually to whole food systems (Wezel et. al. 2009). Agroecology may be the best-positioned inter-disciplinary framework for looking beyond just sustainable agriculture to sustainable whole food systems. (Gliessman 1998, Francis et. al. 2003).

Recognizing that humans are an integral part of food producing systems shifts the discussion of innovations and technology from only those "hard systems" measured purely in physical units (yields and capital in agronomy terms, and carbon, energy, and nutrients in ecology terms) and towards social aspects of "cultural knowledge, human experiences and potentials for technological development," so called "soft systems" (Dalgaard et al 2003). This soft or human capital can sometimes even be a substitute for hard capital with knowledge systems sometimes helping to reduce physical inputs (Dalgaard et al 2003). Conversely, use of chemical inputs and fossil energy can be viewed as substitutions for ecological functions, labor, manures or management systems such as crop rotations or biological N fixation[1] (Tomich et. al. 2011).

Even though agroecology emphasizes labor, knowledge, skills, and management above external input technologies, this should not be construed as simply a reversion to a more traditional agricultural, as it does not exclude technological innovation as a solution to problems. So what then, if anything, differentiates knowledge systems within agroecology from the transfer of technology model. For one there is an increased awareness that "enhancement of

[1] Biological nitrogen fixation is frequently induced in agriculture through the use of

human abilities to make decisions, manage resources, acquire information and evaluate results" contributes to a more resilient agriculture (Uphoff 2002, p.13). Miguel Altieri (1989) proposed that a fundamental aspect of agroecology is to recognize that farmers discriminate, select and adopt new technologies, but that these innovation processes can also "originate" within their localized social group. This concept of a localized innovation capacity for technological (and other) innovations is the stone upon which we take the leap away from technology transfer and diffusion theory and towards a more empowered view of innovation development amongst sustainable farmers.

Alternative Theories of Innovation outside of Agriculture

Innovation studies have become a hot topic in contemporary research, for obvious reasons. Innovations help drive economies forward, and help individuals and society to adapt to a changing world. As a result, innovation is studied by dozens of academic disciplines with new ideas relevant to this review originating from business and industry models and the study of international agriculture. Some examples of the characteristics of this wave of research are that "science" is but one of many ingredients necessary to successful innovation, that cross-disciplinary approaches to innovation are more effective as "no single discipline deals with all aspects of innovation", and that innovations evolve and cannot be treated as a homogenous entity fully formed on a precise date (Fagerberg 2005). Contemporary theories of innovation are interdisciplinary, and freely migrate between fields of sociology, economics, psychology, geography, technology, and history.

As a result of agricultural research institutions structuring themselves for decades upon technology transfer and diffusion models these institutions have been slow to embrace new perspectives in innovation development and adoption. An additional factor has been the erosion of social science research linked to agricultural research, historically through the field of rural sociology (the most closely aligned social science), which has fallen behind in its relevance to innovation studies.

The Source of Innovations

There has been a considerable change in society's thinking about where innovations come from. Von Hippel (2005) emphasizes that individuals are increasingly able to "innovate for themselves," in what he calls "user-centered innovation." The advantages of user innovation are that an individual can develop "*exactly what they want rather than relying on manufacturers to act as their (often very imperfect) agents* (p.1)". The difference between user based innovations and the traditional model are significant in that users often share information freely as opposed to the patent systems utilized by manufactures to insure they benefit from the "selling of a product." Von Hippel also notes that 10-40% of users engage in modification of innovations, and that lead users modify innovations that are useful to all users. Many users value the process of innovating because of the enjoyment or learning that it brings them. Such research has changed the innovation discourse from "why adopt?" to "why modify?" and those benefits that arise from modification or adaptation of an innovation. There is also a difference in perspective between users (farmers in our study) and manufacturers (agricultural research institutions).

Manufacturers of innovations must address the needs of many users in order to develop an innovation that has widespread applicability (and success in the marketplace). In contrast, the needs of a small-scale sustainable farmer may seek a highly specific solution, in a context specific location (Von Hippel 1988). He or she may be the best positioned to identify the innovation, indeed to develop the innovation to solve such context specific problems.

Towards Agricultural Innovations Systems

As these new ideas about the source of innovations suggest, innovation may arise from multiple sources, ie. not solely research institutions. If innovations can be construed as presenting a solution to problems and research institutions are no longer fully equipped or capable of addressing all problems faced within sustainable agriculture, then what alternatives to the development of agricultural innovations are we left with?

The process of knowledge generation and use is changing at a global scale from one of a knowledge elite (researchers) to a knowledge society (users, organizations, and others engaged in knowledge generation – Wikipedia is an example), and from research institutions as the principal supplier of new innovations to an interaction between multiple actors and multiple sources of knowledge within a specific context as contributing towards innovations (The World Bank 2007). These ideas within agriculture first began to emerge in the '80's in the Farmer back to Farmer, or Farmer First movements in which international development researchers engaged with rural and resource poor farmers began to emphasize the integration of socio-economic needs assessments with farmer participation, and the engagement of farmer participants in the development of appropriate technologies (Rhoades and Booth 1982). Farming Systems Research, which began some years earlier, became a popular diagnostic application for engaging and incorporating farmers and their needs into research development of appropriate technologies (Collinson 2000). These ideas coalesced further into efforts that encouraged and enabled resource poor farmers to identify and address agricultural problems utilizing their own creative problem solving capacities. A principal result of many of these studies was the finding that innovation emerges from the interaction between actors, and the exchange of knowledge arising from multiple sources (Roling and Wagemakers 1998).

The notion that agricultural challenges are continuously evolving in a non-static world suggests that there are "no permanent technological solutions," within agriculture and it is therefore "crucial that farmers have the capacity for continuous change and adaptation" (Uphoff 2002). This simple idea actually marks a critical shift in thinking about innovations from providing support for agricultural research as the primary vehicle for increasing innovation, to creating an "enabling environment" for innovation, one that emphasizes interaction amongst actors, and capacity development (Hall 2007, Hall 2009).

An "innovation system" is defined as a group of organizations, enterprises and individuals that "demand and supply knowledge and technology," and their mechanisms for interaction (The World Bank 2007). The innovation systems concept presents a new theoretical paradigm that treats innovations as "neither science or technology but the application of knowledge of all types to achieve desired social and economic outcomes" (World Bank 2007 p. 68). This redefinition allows us to treat as innovations social processes such as: using different forms of knowledge exchange (ie. network or communication tools), product development, marketing channels, and labor management, as each achieve desired social and economic outcomes for farmers. Michael Pollan, author of *The Omnivore's Dilemma* helps further elaborate this idea by explaining that the "USDA needs to understand that a really clever rotation is as ingenious a technology as a genetically modified drought resistant corn seed. (Pollan 2009, keynote address)." In this case, a "clever rotation" is considered a form of knowledge, not a technology. To expand the point further, a form of farmer networking that allowed this "clever rotation" to be spread to other farms (and possibly even improved upon) would also be considered an innovation. If a farmer using this "clever rotation," decided to convey its importance to his customers as a way to market the sustainability of her farm products (a form of point of sale information) that would also be considered an innovation. In this regard, innovations can be seen as a solution to problems that farmers face beyond the production environment, into markets, social networks, knowledge acquisition, and beyond. Not only are innovations considered more broadly than in the past, but according to Dyer (2012, p.2) "to survive and be effective in an ever-changing world a continuous process of innovation is required."

Research questions regarding innovations in local food systems

At the outset of this study was a simple question. Does innovation mean the same thing in sustainable agriculture as it does in conventional agriculture? Rather than test existing theories or formulate a hypothesis in advance, this study sought to build a new understanding of innovation processes by observing farmer's actual practices and activities, and from the perspective of the practitioners themselves. Twenty-eight farms across six counties in the northeast Georgia Mountains were the focus of this four year study and are representative of small scale, resource limited and newer farms who self identify as sustainable farmers engaged in the creation of a local food system. This category of farmers has been poorly studied, and represents the most rapidly growing segment of sustainable farmers.

The study employs a grounded theory approach in which theory emerges through the collection, analysis and refinement of data as opposed to starting with a theory and applying tests designed to prove or disprove a hypothesis (Glaser and Strauss 1967, Strauss and Corbin 1994). As a result, this study focused on the collection and analysis of the following forms of data from farmers in the study region. The first stage of research asked the question, "What innovations are farmers adopting, adapting or developing?" Chapter 4 will describe the findings of this "innovations inventory," or the record of all innovation activity within the study region. This chapter will also ask, "Why do farmers adopt, adapt or develop innovations?," using the construction of an "innovations typology" which identifies the challenges each innovation is designed to address. This analysis identifies where farmers focus their creative energies towards solutions to problems. To understand the complexities of the innovation processes occurring in this local food system a deeper case study analysis of selected innovations was required. Chapter 4 will examine five case studies that address production innovations and identify new diagnostic and theoretical approaches to the analysis of sustainable agriculture innovations.

Chapters 5 and 6 will examine innovations outside of the production environment. The challenges farmers face span far beyond the boundaries of their farm fields, and the innovations they develop that address marketing, food processing, labor, and knowledge acquisition are as important a component to individual farm success and the growth of local food systems as production based innovations. Chapter 5 presents a case study of the emergence and development of an online farmers market as an example of a marketing based innovation. Chapter 6 will describe the formation and activities of the region's first sustainable farmers network as an example of an innovation that creates a forum for knowledge exchange. This case study will also examine how network collaborations serve as innovations for farmers to achieve social or economic goals impossible to achieve in isolation.

Despite the grounded theory approach to place data above hypothesis, I did enter this study with the belief that theories and models explaining innovations in agriculture that have held throughout the productionist era no longer fully explain the development of innovations contributing to a sustainable agriculture and the emergence of local food systems. New theories and diagnostic tools are needed that emerge from the study of the unique contextual conditions of small scale, resource limited farmers whose primary focus is "sustainability" and local food system development.

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CHAPTER 3

METHODOLOGY

In qualitative research the locational setting or settings are foundational to the research questions. For a study of the development of innovations within sustainable agriculture and local food systems, a specific context had to be chosen that was representative of an emerging local food system. A community of producers in the northeastern counties of Rabun and Habersham in Georgia were chosen for the following reasons.

Site Selection

In March of 2009 I spent a week meeting farmers in Rabun County to assess the potential of focusing on this area for a study on sustainable agriculture. Initially Rabun County was identified as a possible research location because it is the largest fruit and vegetable-producing region north of Macon, GA (University of Georgia 2011). I was also interested in an emerging food system in a rural area, one hour or greater from an urban market. During that week I met with seven growers, four of whom were small scale, and practicing non-certified organic farming and gardening. The other three were larger scale conventional farmers of fruits and vegetables. The purpose of the research scouting was to determine the potential participants and focus areas of the research project.

My prior research had focused on conventional farmers' "understandings of sustainable agriculture", and their interests in sustainable agriculture practices and new Extension resources (Ellis and Gaskin, 2008). That study had focused on two distinct fruit and vegetable producing regions of south Georgia, with all twelve counties falling into Georgia's top 20 vegetable producing counties in the state. The results of that study indicated that most conventional growers did not possess a clear definition for sustainable agriculture, did not believe that clear / reliable information on sustainable agriculture was readily available and had low interest in learning or implementing organic practices. The southern counties of Georgia are also geographically far removed from many of the urban centers of the state, making direct marketing of locally produced foods more difficult due to the distance from the customer base. Those findings coupled with my visits with conventional growers in the Rabun County region led me to believe that there is a strong distinction between farms that are already practicing sustainable agriculture and focused on sales to local markets, and conventional farmers who most frequently expressed low interest in sustainable agriculture practices, and are primarily focused on broader market chains due to their volume of production. A study regarding sustainable agriculture at the local food system scale needed to focus on those already engaged in such practices, rather than hypothesize about the possibility of transitioning farmers.

Two local change agents in Rabun County were instrumental in providing initial access to farmers throughout the region, and acted as liaisons to my entry into the community. Joe Gatins[2] was a central leader in the local, sustainable food movement and had founded the longest standing sustainable foods farmers market

[2] All names used are of actual persons, not pseudonyms unless otherwise noted.

in Clayton, called Simply Homegrown, which was created in 2000. The statewide non-profit Georgia Organics provided me with Joe's name, and he in turn provided names, phone numbers, e-mails and descriptions of eight sustainable farms or other local food supporters in the area. Joe also e-mailed many of these farms helping to introduce me. The Rabun County extension agent, Justin Tyson, likewise helped me make appointments to meet and interview three conventional fruit and vegetable growers in the area.

Another critical component to selecting the northeast Georgia region as the study site was a unique opportunity for me to relocate there on a semi-permanent basis. During the same week I was evaluating the Rabun County area as a research project site, I interviewed for a position as director of a small watershed protection non-profit that I had worked for prior (2002-2005) and located in Habersham County which adjoins Rabun county. In May 2009 I accepted the position and relocated to Clarkesville, GA full-time.

The site selection process took several key elements into consideration. First, the region had to have evidence of a small movement of individuals that were already engaged in growing and marketing locally produced and sustainable foods. Rabun and Habersham counties demonstrated a small but robust community of practicing farms and other elements characteristic of an "emerging" local food system (meaning a food system in an early phase of development). In 2009, though communication, marketing and information exchange networks amongst farms throughout the region were not highly developed, they did exist in some form and were of high interest to participants in the region. The region also represented a rural community dimension, but with multiple links to existing local food systems in larger metropolitan areas such as Athens and Atlanta, GA.

Second, the region and its farmers would ideally be easily accessible to me as a researcher, but also during more casual and unplanned contexts. By finding employment and relocating within the region, I was able to immerse myself within the community of study. Since participant observation can be defined as a process of becoming an insider to the culture or social setting under observation (Spradley 1980), I hoped that such immersion might lead to unexpected interactions and insights beyond those offered by more occasional and structured observations. As will be described, the ability to live and interact on a daily basis and over a period of years within the study region greatly enhanced the depth and variety of participant observation possible.

Over the course of the project, the region of study expanded considerably. Initially, the anticipated focus was on farms in Rabun and Habersham counties. With the creation of the Northeast Georgia Locally Grown Internet farmers market, interactions amongst farmers expanded into White, Stephens and Hall counties, as well as counties in North and South Carolina. The region came to be defined as the area in which farmers were willing to travel for the purposes of marketing or to participate regularly in farmer networking meetings.

Figure 3.1: Study area / Location of research / Farm participants map

Selection of Farms in the Study

Most studies that have addressed innovations in sustainable agriculture have examined transitioning farms, or those that are transitioning from conventional to sustainable agricultural practices (Padel 2001, Parra-Lopez et. al. 2007). This emphasis has tended to neglect the most rapidly growing segment of sustainable farmers, those who are small scale, resource limited and newer farms that are engaged in the creation of local food systems. Twenty-eight farms located across six counties were chosen for inclusion in the study. These farms approximated the totality of local food system farms active within the region during the period of study. The criteria for farms chosen for inclusion were that they sold food to customers within the study region and self identified as farms that were practicing sustainable agriculture. There currently is not a unified definition of what encompasses “sustainable agriculture,” and such discussion is beyond the scope of this research, but in general these farms defined themselves as sustainable farms based on a combination of practices that included chemical free farming, efforts to reduce energy consumption, efficient use of natural resources, and an interest in enhancing natural biological processes on the farm.

Data Gathering – Participant Observation

In participant observation studies, an understanding of a social phenomena is sought from the perspective of the participants (DeWalt 2011). In order to gain that perspective the ethnographer observes and takes part in the activities of the people being studied. I began my ethnographic participant observation immediately after my arrival in May 2009 and continued through the spring of 2013, a period of four years. During that time I immersed myself in the farming community, visiting as many small-scale sustainable farms in the region as I could locate, worked on many of the farms, attended farm related meetings and conferences, and participated in farmers markets.

In May of 2009 I began visiting several farms each month, and regularly attended the Simply Homegrown Farmers Market in Clayton. Farm visits for participant observation continued at irregular intervals but rarely were less than one per month for the duration of the research through spring 2013. A total of 36 individual farms were visited (28 of which were included in the study), with many farms being visited as many as 4-10 times for a total of 80 total farm visits.

Approximately 240 hours of on-farm participant observation were conducted during the nearly four-year period.

Farm visits typically consisted of arrival in the morning and participation in morning chores such as planting, weeding, feeding animals, irrigation, and other fieldwork. A lunch break often allowed me to interview the farmer about needs on their farm, practices they had trialed and their success, information sources, marketing challenges, and new ideas. I would then leave the field site in the afternoons to write field notes. Most field visits were also audio recorded using a digital recorder. Field visits proved to be invaluable in establishing a trusting relationship with each grower, by donating work time and exchanging information. I often would share information with them about other practices I had seen at other farms, and on occasion would try and forward useful information to them after the visit.

During later stages of the research, informal and semi-structured interviews (see Appendix A) were used to query all farm production practices, or to develop more detailed information for innovation case studies.

To the extent possible I adopted an "active participation" approach by engaging in every activity important to a successful farming operation that I could, including field work, marketing, tractor work, irrigation systems, etc. As the study progressed this active participation approach was enhanced by engaging in my own small farming activities, requiring me to build fences, install irrigation, purchase supplies, operate equipment, build greenhouses, and grow, harvest, and market a crop. This participation in personal farming activities and its role in the research will be described further.

Field Notes, Partial Transcriptions and Photography

Field notes are defined as notes written in "close proximity to the field" (Emerson et. al 2001). During participant observation I took very few notes while in the field, preferring to focus my attention on the dialogue and drawing out as much information as possible. I then attempted to write extensive ethnographic field notes as soon as possible following removal from the field, sometimes within a few hours, most frequently within 24 hours, and on a handful of occasions within 3-4 days. I sometimes would speak my observations into a digital recorder immediately upon leaving a farm, while my thoughts were fresh. Each afternoon or evening upon leaving a farm I would try and write as many field notes as time allowed.

Most field recordings were partially transcribed (between 30-60%) so that critical observations and dialogue could be captured in as much detail as possible. During the transcription I would often record additional observations as notes valuable in future analysis.

All farmer participants in the study were asked to complete and sign a consent form at some point during the first visit to their farm. The consent form included six elective research activities that allowed farms to determine how much personal information they were comfortable in sharing. Option 1 allowed me to conduct observational activities, Option 2 allowed me to interview participants without a recorder, Option 3 allowed me to make audio recordings of interviews, Option 4 allowed me to publicly disseminate interview and audio content for public education purposes, Option 5 allowed me to write articles or books about observations of their farm provided their identity is kept confidential and Option 6 allowed me to write articles or books about observations of their farm using their identity and other personal information (see consent form elective activities Appendix B).

Field notes were written under the assumption that “nothing is trivial” (Bogdan & Biklen 2003), using a descriptive data technique that often included narrative details like the weather, distractions, smells, uncomfortable silences, and other content that places one in the setting described. Approximately 425 pages of typewritten notes were generated during the research process and categorized by date and farm and the county in which each farm was located.

Photography was used extensively during field visits to capture the physical representation of many innovations, including materials, equipment, animals, crops, and labor practices employed. Approximately 748 images were captured and analyzed during the research process and categorized by date, farm and the county in which each farm was located.

Extensive audio recordings were collected both during farm visits and during organizational meetings of farmers. Approximately 81 hours of audio recordings were captured and analyzed during the research process and categorized by date, farm or setting in which each recording was made.

Office Visits, Phone Calls, E-mails

As the research process progressed I more frequently would have farmers stop by my office, and sometimes my home in Clarkesville to discuss markets, ideas, and projects. This increased considerably over time thanks in part to activities such as construction of a community garden, launching of the Locally Grown Internet market, and launching of the Georgia Mountains Farmers Network (these activities will be discussed in more detail). Immediately after a farmer would leave the office I would type up one or two pages of notes from the conversation.

I also frequently made, or received phone calls from farmers. I never recorded these conversations but would instead type notes during the conversation, recording many statements verbatim. I would then spend several minutes after the conversation filling in gaps.

During the analysis phase of the research I made frequent use of phone call access to farmer participants, often calling them to ask questions about their production or marketing practices that I had failed to ask during field visits. Farmers were always very free to share information and seemed to enjoy exchanging their ideas, sometimes requesting to discuss or develop ideas.

In the final phases of the research I e-mailed each farm participant a listing of the innovations I had observed on their farm and requested further information or additional innovations not listed that would help me most accurately represent their farm. Within a few days of sending these e-mails I would follow up with a phone call and ask more specific questions regarding the innovations already observed, as well as add their suggestions or comments regarding additional innovations they felt were integral to their farming operations.

Free Writing Fridays

An additional data gathering practice was a free writing exercise that allowed me to record and sometimes analyze disparate observations across numerous farms, meetings or social networks. I would usually identify one or two themes and write for 30 minutes to two hours allowing the theme to develop naturally. These writing exercises were useful in identifying themes for further development such as: the extension system role in the local food system, characteristics of farmers and their innovations, and the role of value added products and local processing capacity. This practice mirrors “memo writing” as described by Schatzman and Strauss (1973) in which raw data begins the transformation into concepts for manipulation into new insights.

Research Positionality and Participatory Action Research

As the research progressed, so did my role within the community of study. According to Spradley’s (1980) types of participation, I steadily evolved from an “active participation” position to a “complete participation” position, in which I became a part of the group being studied. In addition to my research goals I embraced the commitment to social change embodied by farmers in the study, and became actively engaged in the development of innovations to address local food system problems.

This positionality allowed me to work collaboratively with farmers to implement actions towards change. It also allowed me access and data concerning these innovations that would have been difficult or impossible to assess as an outside observer. While not initially a planned aspect of the research, this methodology most closely resembles Participatory Action Research which seeks to understand the world by trying to change it, collaboratively and reflectively. As the study progressed I did slowly embrace an "orientation toward community action," and helped pursue changes desired by the community, followed by reflection on processes and consequences of that change, then planning the next set of changes, and so on (Kemmis and McTaggart 2007).

By the spring of 2010, one year into participant observation of on-farm activities and farmers market, I was beginning to be treated as a member of the group, and was asked to become more and more engaged in the activities of the group. This began with assisting growers at the Simply Homegrown farmers market. I offered to conduct a survey of customers attending the market to determine where they came from, how much they spent at the market, and how many total customers attended. This survey did not meet any specific research goals, but instead was aligned with the goals of the farmers market itself.

Three other opportunities presented themselves in 2010 and 2011 that shifted my positionality as a participant within the community. First, there was community interest for the non-profit I worked for to develop a community garden that demonstrated organic and sustainable practices. In the spring of 2010, I completed construction of a quarter acre, 28-plot garden. That project allowed me to personally engage in many of the same activities of the farm participants, walking through many of the same steps that farmers required in opening up new land to farming including: subsoiling, soil samples, soil amendments, fencing and irrigation.

At every phase of these activities I inquired of farmers how they performed these activities for insights into my own undertaking.

A second opportunity arose to co-manage an emerging online farmers market. In early 2010 there was strong interest from growers in Rabun County to launch an Internet farmer's market patterned after the Athens Locally Grown market. Chuck Mashburn, a farmer who had experience selling to Athens Locally Grown, knew that I had been a customer of that market while living in Athens and had conducted research on its inner workings, including interviewing Eric Wagoner who designed the software system. Chuck recognized that for such an Internet market to be successful in a rural region it would need to tap into a larger customer base than one pickup location in Clayton could provide. The city of Clarkesville where I lived had no farmer's markets and no access to local, sustainably produced foods at the time. He asked if I would manage a pickup site in Clarkesville and he would manage one in Clayton. At the time I was interested in assuming this role for the opportunities it presented to the local food system, not fully realizing its potential impact on the research process.

This opportunity to become fully engaged in the activities of a local farmer's market greatly increased the access, and my frequency of contact with growers, as well as expanding a dimension of farmer's marketing challenges not easily observed during farm visits.

A third opportunity arose to facilitate organization of a new regional farmers network. In 2011 a farmer, Ed Taylor, encouraged me to apply for a Farm Network Organizer position with the non-profit Certified Naturally Grown. Ed, and other farmers in the region had frequently mentioned the need for a group or organization that would help facilitate communication, information sharing and collaboration amongst farmers in the region. Upon the encouragement of other farm leaders in the community I applied and was chosen to be one of six farm network organizers in the states of Georgia and Tennessee. The position, which consisted of approximately 1-2 hours per week dedicated to network organizing activities, began in September 2011. This opportunity created the impetus to inquire and help develop priority collaborations identified by the group.

My engagement in farming

In 2011 I deepened my participatory action role in the community further by engaging in small-scale farm production with my wife. The year before, I began growing some produce for sale through the Locally Grown online farmers market. I enjoyed the education and recognized the benefits such knowledge had to my interactions with farmers. By spring of 2011 I increased the area and diversity of foods being grown (approximately 5,500 square feet of carrots, beets, fennel, cabbage, watermelons, potatoes, garlic, okra, sunflowers, tomatoes, cucumbers, greens, kale, and kohlrabi) so that by summer my wife and I gave our operation the name Soque Lover Gardens! and began selling every weekend at local markets and through the online market. My engagement in farming significantly deepened my dialogue with farmers about production challenges. For one, it gave me a reason to ask highly specific questions, and helped focus my questions towards practical applications.

I was not the only member of the local food system community to transition quickly from one role to another. In 2010, a local food advocate and retired attorney began taking classes in the newly formed organic certificate program at the University of Georgia, which led him to an on-farm apprenticeship with one of the farms in my study. By spring of 2011, he began farming full-time. The farmer, Brooks Franklin, and his farm, Leah Lakes Farm, has now become the most successful farm in the Northeast Georgia Locally Grown online farmers market, both in terms of sales, quality, loyalty with customers and a unique ability to make the online market his central marketing venue. He and his farm will be discussed again in subsequent chapters. I mention this as an example of the frequently shifting roles within the Local Food System, including my own.

Each of these activities described helped to further immerse myself into the study community, giving me an insider's perspective, often allowing my role as a researcher to fade into the background as my active participation demonstrated that I had many of the same goals and objectives that the farmers themselves held. My goal was to follow the advice of researchers such as Spradley (1980) by "cutting oneself off from other interests and concerns, listening to informants hour on end, participating in the cultural scene, allowing one's mental life to be taken over by the new culture, themes often emerge (p145)."

The challenge in this style of participatory action research is to maintain a clear separation between the goals of the ethnographic research and the goals within the community under study. The analysis phase of the research served to clarify and differentiate my interpretations from those of the farmer participants.

“Sometimes immersion with brief periods of withdrawal generates insights” (Spradley, 1980).

Analysis

Analysis for this study was carried out in overlapping stages. As field notes were developed analytical comments were included that helped to develop concepts and categories for further inquiry during field visits.

As field notes from farm visits were accumulated, each farm was treated as an individual case study, with similar data compiled for each farm. A listing and description of every innovation observed, the date observed, the need or problem that the innovation addressed, unique resources and contributing factors, quotes related to the innovation and other details were recorded in a master list of innovations by farm. As this master list was populated I began coding specific innovations according to an emerging typology or themes. Eventually this typology was entered into a spreadsheet allowing for a rough quantitative analysis. The construction of an innovation typology allowed the analysis of the data to suggest where farmers in the food system are investing in solutions to problems.

As the research progressed, it was apparent that some innovations had the potential to shape farm management and/or the broader local food system more deeply than others. A winnowing of innovations to identify those with the broadest applicability, the most rapid adoption or which solved the most diverse number of problems was performed to identify a handful of innovations to examine as in-depth case studies.

The selection of innovation case studies was one of the most difficult steps in the analysis process and will be described in the following chapter.

The analysis of the ethnographic data utilized a grounded theory approach in which the discovery of theory arises through the analysis of data (Glaser and Strauss 1967). Data on innovations was coded as described, then the codes were assembled into similarly grouped concepts, in this case addressing needs or problems the innovations addressed. From these concepts categories were formed, and an analysis of those categories forms the basis for the theoretical framework presented by this work. A continual reflection between analysis of the data and theory was carried out during the final phases of the research.

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CHAPTER 4

INNOVATIONS INVENTORY / PRODUCTION INNOVATIONS

Innovation Identification

To examine how agricultural innovations are developed and implemented on small-scale sustainable farms, a difficult question preceded the research process, "what exactly constitutes an innovation?" Rather than impose a narrow definition that would require adjustment over the course of the research, a grounded theory approach was chosen in which the observations of all farmer's practices would allow a definition to slowly take shape over the course of the research. What constitutes innovations in local food systems is part of what this research seeks to discover.

The first stage of this research was to identify, catalogue, describe, and analyze innovations found on farms within the study region in order to answer the question, "what did farmers innovate?" To insure that nothing was missed, inquiries were made to farmers regarding all relevant practices critical to the success of the farm. These practices included all aspects of production, harvest, post-harvest, labor management, marketing, communication tools, networks for information and knowledge exchange, food processing, material and manufactured inputs, and other sources of income. Any activity considered by the farmer or the researcher to be critical to the farm operation and its success was included.

Widely applied, commonplace, or standard practices both within the study region or the broader arena of small-scale sustainable farms were recorded but not included for further analysis. For example, the use of compost applications as a soil fertility and crop performance enhancing practice was so commonplace that while noted, it was not recorded as an innovation. However, if for example a farm utilized a certain type of compost that was manufactured on their farm using feedstock ingredients that were highly unique, and that achieved a management goal that was not commonly encountered on other farms in the study, then that practice would be identified as an innovation and recorded in detail for further analysis.

As the research progressed and the discernment process was refined the following aspects helped to define practices defined as innovations:

- **Novelty –** If a practice was unique, or encountered infrequently throughout the study region.
- **New –** If the practice was fairly new to the farmer or the region, even if it was not an original idea.
- **Origination –** If the practice originated or was believed to have originated with the practicing farmer. Many practices could be described as farmer initiated "lucky discoveries," or successful experimental trials. While difficult to pinpoint if such practices are totally original or adapted from other encountered ideas, if the farmer was able to describe their process of discovery then it was recorded as an original idea.
- **Better Performance –** if the practice achieved considerable benefits to the farm operation compared to a prior practice. While such practices may not

be new, they demonstrate a farm's ability to adopt practices that constantly improve farm performance, and taken as a whole may demonstrate innovative capacity.

- **Farm Identity –** if a practice was a critical component to that farms identity and success.

Definitions of innovations encountered in contemporary literature helped to further inform these observed characteristics. Table 4.1 gives examples of innovation definitions that were consistent with observations found amongst farms in the study region.

Table 4.1: Innovation Definitions and their impact on research approach

Innovation Definitions	Source	Impact on Research
"Innovation is neither science nor technology but the application of knowledge of all types to achieve desired social and economic outcomes."	World Bank 2007 p.19	This definition focused the research beyond production tools and technology, and encouraged an analysis of all aspects of farm performance, including markets, and social networks
Innovation is the process by which organizations "master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors, their country, or the world."	Mytelka 2000 (see also World Bank 2007, p.ix)	Assisted in recognizing that there are innovations in implementation (production) and in conception (design), and that they affect both a product (goods) and the delivery mechanisms (services). The newness of an innovation is relative to the farm or the community in which it is introduced.
Innovation is developing new and better ways of doing things and trying them out in practice.	paraphrased from Oxford Handbook of Innovation p.1	The simplest definition yet complete. Innovation is development of ideas followed by implementation, again with the characteristics of newness and better performance.
Innovation "is the creation of something qualitatively new, via processes of learning and knowledge building."	Oxford Handbook of Innovation, p.149	Innovation cannot transpire without learning and knowledge attainment. This is not exclusive to knowledge exchange, as such learning can occur at the individual farm level through discovery.

"Innovation is defined as any new knowledge introduced into and utilized in an economic or social process."	Spielman 2005, p.17	Innovation is again tied to knowledge attainment towards any economic or social goals.

Based on the insights gained from innovation definitions in Table 4.1, I adopted the following working definition for innovations for this study, "Any new or novel application of knowledge that achieves social or economic outcomes, that are new to the users, regardless if they are new to the world."

The degree of newness of an innovation is perhaps the trickiest characteristic in this definition of what constitutes an innovation. As Mytelka (2000) points out, an innovation is not required to be new to the world, your region, or even to your competitors, so long as it is new to the user.

Over the course of the research it became more and more clear that innovations are not just new ideas, as farmers frequently mentioned projects they'd like to try, or planned to try that never materialized. The "trying them out in practice" principal or implementation of new knowledge is central to the idea of innovations.

Cataloging Innovations: building a local food system Innovations Inventory

After a broad array of both on-farm and off-farm practices were observed and recorded, those that stood out as new, novel, original, and contributed to better performance and/or a strong farm identity were selected as worthy of analysis as innovations. These included practices that addressed production, markets, social relationships, knowledge attainment, and expanded farm capacity as described in the definitions in Table 4.1.

Practices identified as innovations were extracted from the raw data and described and refined in a qualitative analysis document entitled “All Innovations by Farm.” For each innovation, notes were recorded on the type of innovation, needs that lead to the innovation, the origins and development process of the innovation, performance of the innovation and the context in which it was developed and used. These entries also catalogued the dates that the innovation was observed, relevant information sources, contributing resources and actors, performance, advantages and disadvantages, frequently my personal assessment of the innovation, and any unanswered questions.

Following repeated farm visits, new innovations observed were added and described. Each farm was treated as an individual case study, and as innovations were catalogued, they were transferred into a spreadsheet according to the farms on which they were observed. After three years of observations this catalogue of innovations yielded 208 total innovations from 28 farms derived from 80 total farm visits. Many of the 208 innovations were similar innovations observed on multiple farms, so this number does not represent distinct innovations, but total innovations observed at all farms.

This catalogue of all observed innovations allowed for the data to be analyzed as an “innovations inventory,” or a record of all innovation activity within the study region. This research process presented a simple, yet viable methodology for assessment of the innovation processes occurring within a single local food system locale.

This study does not account for all innovations in the study region. It is estimated that approximately half or less of all farm innovations were able to be observed due to the intricacies of farm management, willingness of participants to reveal all aspects of their farm operation, and time limitations in long-term observations of practices. However, the innovations that were recorded are believed to be representative of the principal innovations critical to the farm operations observed. At the end of the research project farmers were asked to review and suggest additional innovations from their farms that were not described, yielding very few additions.

Constructing a Typology

As each innovation from farms in the study was collected an innovation typology was created by slowly categorizing each innovation into one or more general types. A starting point in developing an innovation typology was the question "what is the innovation designed to address," or what "problem or challenge does it help to resolve?" Most innovations addressed more than one challenge or problem, so the emerging types were not mutually exclusive. As the study progressed additional innovation types were identified.

A total of 29 innovation types were identified and used to categorize each innovation observed. All innovations fit into at least one type and many occupied between 4-9 types. Of 208 innovations, only 40 occupied only one type, demonstrating that most innovations addressed multiple farm needs.

For example, one farm had cut long bamboo poles and made a mark every eight inches on the poles in order to lay them on top of a planting bed to identify plant spacing for lettuces, insuring fast, uniform planting. This simple innovation was categorized as "time saving," because of the reduction in planting time it achieved, "cost saving" in that the solution cost nothing since the bamboo was free, and "better performance" since the practice worked better than the previous practice employed. As the development of types progressed a new type tagged as "recycled/reuse" was also applied to this innovation, as it utilized a natural resource in a reusable way. As new innovation types emerged, all recorded innovations were re-evaluated for inclusion or exclusion under the emerging types.

As the innovation types emerged, they seemed to best fit under one of four broad categories. These four categories became 1) production; 2) labor/planning/lifestyle; 3) network/knowledge/marketing and; 4) food processing/safety. Table 4-2 lists each of the 29 innovation types and the four categories.

Table 4.2: Innovation Typology with four categories and 29 types

Category	**Types**
Production	Time Saving
	Cost Saving
	Energy Saving
	Recycled/Reuse
	Body / Labor Saving
	Better performance
	Yield Enhancement
	SOM management and soil amendment
	Nutrient Cycling
	Irrigation / Watering
	Season Extension
	Insect / Disease Control
	Weed Control
	Harvest / Product Quality
	Manufactured equipment
	Livestock/Animal Management

Labor / Planning / Lifestyle	Labor assistance Assessment Planning Outside Income/ Grants Quality of Life / Lifestyle Feedback
Network / Knowledge/Marketing	Network / Organizational Farmer Training / Knowledge Crop / Food Types and Uses Marketing Income Enhancement
Food Processing / Safety	Food Processing Food Policy Food Safety Innovation

The typology was considered complete when further analysis of each innovation could not identify other needs, challenges, or problems that the innovation addressed that were not represented by one of the 29 types. This typology, while imperfect, is believed to be an accurate representation of the principal areas that each innovation was designed to address.

Analyzing the Innovations Inventory

One goal of the research was to determine the types of innovations most commonly encountered on farms engaged in the development of local food systems. A rank ordering of innovation occurrence according to type was compiled for this purpose, to identify which areas, needs, or challenges were receiving the most attention from farmer's creative energies. This typology ranking by occurrence is shown in Table 4.3.

Table 4.3: Innovation Types ranked by category and frequency of occurrence

Type	Category	Occurrence	Rank
Better performance	Production	62	1
Cost Saving	Production	58	2
Marketing	Network / Knowledge / Marketing	55	3
Network / Organizational	Network / Knowledge / Marketing	40	4
Body / Labor Saving	Production	30	5
Crop / Food Types and Uses	Network / Knowledge / Marketing	29	6
Time Saving	Production	27	7
Yield Enhancement	Production	26	8
SOM management / soil amendment	Production	26	9
Season Extension	Production	25	10
Insect / Disease Control	Production	24	11
Manufactured equipment	Production	23	12
Nutrient Cycling	Production	22	13
Harvest / Product Quality	Production	22	14
Recycled/Reuse	Production	19	15
Income Enhancement	Network / Knowledge / Marketing	18	16
Weed / Control	Production	17	17
Assessment Planning	Labor / Planning / Lifestyle	15	18
Farmer Training / Knowledge	Network / Knowledge / Marketing	15	19
Food Processing	Food Processing / Safety	12	20
Irrigation / Watering	Production	10	21
Livestock/Animal Management	Production	10	22
Outside Income/ Grants	Labor / Planning / Lifestyle	10	23
Quality of Life / Lifestyle	Labor / Planning / Lifestyle	9	24
Feedback	Labor / Planning / Lifestyle	7	25
Labor assistance	Labor / Planning / Lifestyle	6	26
Energy Saving	Production	5	27
Food Safety Innovation	Food Processing / Safety	5	28
Food Policy	Food Processing / Safety	3	29

Table 4.4: Innovation Categories ranked by frequency of occurrence

Category	# of innovations by category	Rank
Production	145	1
Network / Knowledge	81	2

Labor / Planning / Lifestyle	35	3
Food Processing / Safety	16	4
TOTALS	**277***	

*Innovations by category don't sum to 208 because some innovations occur in more than one category.

One result of the ranking of innovation types according to frequency of occurrence was the discovery that non-production aspects of farm management such as marketing, networking, and knowledge acquisition activities and practices were encountered as frequently as some production innovations. Marketing innovations ranked 3rd and network/organizational innovations ranked 4th in frequency of occurrence as noted in Table 4.3.

Though frequency of occurrence of different types of innovations should not imply their relative importance in the development of the local food system, it does indicate general trends amongst farms in the types of practices focused on in their farming operations.

It is important to note that there is likely a bias towards production innovations in this study due in large part to the time spent with farmers in the production environment, ie. farmer's fields. While special efforts were taken to observe and discuss with farmers their markets, since such aspects are of critical importance in local food systems, very little time was spent with farmers in their kitchens discussing food processing and sales of processed foods. Food processing and sales of processed foods could be examined more closely, though time constraints by farmers to process food seemed to relegate this to lower significance for nearly all farms. Other elements of food processing are in early stages of development, but nearly all farms expressed a strong interest in further development of food processing capacity.

Production Innovations

Production innovations are defined as those that address challenges directly related to production, harvest and handling of a crop. The vast majority of innovations observed on farms during the study, 145 of the 208 innovations or approximately 70%, addressed at least one type of production challenge. The sixteen types of production innovations are briefly described below with a few examples of innovations that were characteristic of each type.

Table 4.5: Production Innovation type definitions and best examples of each

Type	Defined As	Examples
Better performance	Better performance when compared to another practice.	• Eye threads on blackberry trellis • Re-welding of a bed shaper to ride in the tractor tire path
Cost Saving	Practices that help farmers address problems at reduced costs.	• Homemade greenhouse construction • Kaolin clay and sprayer as shade cloth • Acquiring leaves from city as organic matter amendment
Body / Labor Saving	Practices that reduce physical work, or provide alternative labor.	• Field tools -wheel hoe / transplanter • Amish stool for reducing back work • Permanent raised beds • Use of crop mobs
Time Saving	Practices that reduce time required for tasks, or free up time for other purposes.	• Raised Beds in High Tunnel • Outsourcing Transplants • Removing Terraces (making manure spreading easier) • Geotextile Fabric – weed control barrier • Planting Calendar
Yield Enhancement	Practices that help achieve higher production yields.	• Impact Grazing, Lakota brome grass • Grafting tomatoes / eggplants • Compost Slurry
SOM management / soil amendment	Practices that enhance organic matter, biological activity and nutrient content of soils.	• Compost Slurry • Homemade compost • Compost Tea • Hay Mulch as a form of fertilizer • Never break ground after first tilling

Season Extension	Practices that allow farmers to grow more months out of the year.	• High Tunnel Grant • Conversion / poultry house to greenhouse • Lakota Brome grass (cool season grass for year-round growth) • Subsoil heat via hot water / PVC tubes.
Insect / Disease Control	Practices that help reduce or control insect and disease damage.	• Beneficial nematodes • Parasitic wasps • Motion activated bird distress call for blueberries • Bottomless Hives for medication free bees • Lag between broods to break mite life cycle • Leaving sand brier as a trap crop (weed) for Potato Beetles • Mower to vacuum bugs
Manufactured equipment	Practices in which the farmer constructed a needed tool or piece of equipment rather than purchase it.	• Subsoil heat via hot water / PVC tubes • Conversion / poultry house to greenhouse • Sand water filter and tank • Homemade Cold Bot –turns AC unit into refrigeration for walk-in cooler • Use of inexpensive tunnels • Bed Shaper – modified / extended to ride in the path of the tractor tires
Nutrient Cycling	Practices that improve the ability of soils to build, retain and make nutrients available to crops.	• Compost Tea • Aquaponics system • Pastured hen wagon with electric netting • Use of Humic Acid • Grow their own feed (apply manure to fields) • Leaf mulcher for collection/breakdown`
Harvest / Product Quality	Practices that improve the appearance and quality of produce from the field to market.	• Basement growing using grow lights • Motion activated bird distress call for blueberries • Having farmers markets on the farm (less handling)
Recycled/Reuse	Repurposing or reusing materials found, donated or already in possession for another purpose.	• Using cardboard / hay for weed suppression • Rainwater Capture • Conversion / poultry house to greenhouse • Bags of Sand to hold down row cover • Venetian blinds pieces for markers (plant date on back)
Weed / Control	Practices designed to reduce weed pressure.	• Steam Genie for Weed Control • Flaming Bermuda grass • Raised Beds in High Tunnel • Using cardboard / hay for weed suppression

Irrigation / Watering	Practices to provide or utilize water for irrigation or other purposes.	• Rainwater Capture • Sand water filter and tank • NRCS irrigation and drip tape grant • Gravity Fed Irrigation system • Windmill water pump
Livestock/Animal Management	Practices that address livestock and animal management	• Pastured hens in movable pens • Grow their own feed • Use of horse drawn farming implements • Bottomless Hives for medication free bees • Milking grass fed cow (trained to share milk with calf) • Aquaponics system
Energy Saving	Practices that help save energy, or use it more efficiently.	• Horse Farming • Use of solar panels

As noted, the vast majority of innovations observed were not mutually exclusive to just one innovation type. 168 of 208 innovations (81%) occurred in two or more innovation types.

During the latter parts of the study when farmers were given a list of innovations observed on their farms and asked if there were other innovations that they could identify missing from the list, they most frequently mentioned production practices, indicating that when farmers reflect on their activities, they focus first on the production environment.

The innovation inventory process allowed for a broad overview of innovation activities occurring on all farms during the study. Rather than discuss each innovation (a lengthy prospect), or even each innovation type, the analysis will focus on case studies of selected innovations. The first case study on "greenhouse construction," was chosen because it was one of the most widely adopted innovations, and addresses "cost savings" which was the second most frequently observed innovation type. Two case studies that address cost savings and season extension (a cob furnace and basement growing innovations) outline how unique contexts and other factors contribute to the innovation development process. The fourth case study on "compost tea applications" will define a key innovation, and the significance of key innovations to individual farms and the local food system. The fifth case study will provide a counterpoint to the key innovations concept by looking at "biochar" as an example of an innovation with significant sustainability benefits, but lacking "relative advantage" benefits unable to advance beyond the conceptual stage. Taken together these five case studies will outline some of the central patterns in what production innovations farmers innovate, why they focus on these challenges for innovation, and how these innovations are being developed.

Cost Savings innovations

This study suggests that resource limited farmers often solve problems by substituting locally adapted innovations in place of more "capital intensive" solutions to production problems. The frequency and characteristics of "cost saving" innovations in the study appear to align with that perspective. "Cost saving" innovations were the second most common to occur of all innovations, representing 58 of 208 innovations or 28% of the total. Examples of "cost saving" innovations include: construction of inexpensive passive greenhouse tunnels (using pvc), use of kaolin clay and sprayer in place of expensive shade cloth on a greenhouse, homemade greenhouse construction (using pipe benders), acquiring leaves as a source of free organic matter from a municipality, conversion of an existing poultry house into a greenhouse, construction of a homemade sand filter and tank to treat surface water used for irrigation and a wash station, use of free cardboard for weed suppression, and conversion of a Steam Genie for use in weed control. Each of these examples were recorded under numerous other innovations types as well, such as season extension, soil organic matter management, yield enhancement, manufactured equipment, and weed control, but cost savings was a principal purpose behind the decision to pursue each of these practices.

Due to the diversity of innovations observed, some groupings of innovations were treated as mini case studies in order to compare across farms, and across innovation types. Greenhouse construction was one of the most prevalent practices across numerous farms during the course of the study and presented an ideal theme for such a mini case study.

Greenhouses and High Tunnels: Homemade versus NRCS grant funded

Eleven farms constructed new greenhouses or tunnels over the nearly four-year period, and several more constructed smaller cold frame, or passive solar greenhouses for the purpose of growing plant starts. Though the terms "greenhouse" and "high tunnel" are frequently used interchangeably amongst farmers, they are typically differentiated by the presence or absence of an outside heat source in greenhouses, and only passive heating and cooling in high tunnels. Despite the expression "high tunnel", these structures can be as low as 6 feet tall. Because farmers used the term greenhouses to refer to all structures, that's how they will be referenced here, and outside heat sources will be mentioned where appropriate.

All greenhouses constructed are categorized as innovative, either because they were constructed using homemade designs and materials to reduce costs, or construction was facilitated by a new 3-year Natural Resource Conservation Service (NRCS) funded High Tunnel Pilot Program grant that went into effect in 2010, and has continued into 2013. Both approaches have allowed growers to construct greenhouses at a fraction of the costs (making it one of the most common "cost saving" innovations observed). Since the study region had very few production greenhouses amongst its sustainable small farms prior to this three-year period, this practice can also be considered to be new to farms and new to the region, making it an innovative practice. The following is an abbreviated summary of each greenhouse observed.

<u>Construction of "homemade" greenhouses</u>

Five farms in the study region constructed their own "homemade" greenhouses over the last three years, using materials sourced locally (often from local hardware stores).

Trillium Farms - (inexpensive, ideal for zone planting)

Steve Whiteman of Trillium Farms has utilized greenhouses longer than any other farm in the study region. He has three small greenhouses (360, 600, and 750 square feet) and is constructing one that will be 1,710 square feet described as a "big umbrella" with the open sides allowing considerable airflow but providing protection from heavy rains.

Advantages of having multiple houses with multiple sizes are he can "*segregrate by what I'm growing,*" and control shading and heating for specific crops. In the winter, focusing on the size house needed for the crop can optimize heating; in the summer one house can receive shade cloth while the others receive full sun.

Leah Lake Farms – (inexpensive, easy to build, ideal for sloped terrain)

Leah Lake Farms has 6 total houses of PVC construction each approximately 20x35 (700 sq feet) for a total of 4,200 square or about 1/10th of an acre. The material costs of the greenhouses are approximately $.86 per square foot. The advantages of these houses are that they are extremely inexpensive, easy to build and versatile for small farms on sloping terrain. The slope is actually an advantage allowing heat to rise out of the top pulling in cooler air from the bottom. The disadvantages are that the houses are less sturdy (at one point high winds ripped out two greenhouses that were quickly rebuilt), and expected to last only ten years.

Burton Mountain Farms - (sturdy construction, vertical space, fit together)

Sid Blalock of Burton Mountain Farms has one of the most specialized greenhouses. It consists of three 21x75 houses with 16-foot peaks each 1,575 square feet that are connected (4,725 square feet total). All of the materials were purchased at Lowe's. The total costs were $11,000 or $2.33 per sq ft. It is a steel frame construction made from chain link fence materials bent using a homemade pipe bender. "*It took about one morning to build the bender. Took until supper time to bend all the pipe.*"

The advantages that Sid has noted with his constructed greenhouses are that they are connected, since due to limited land, "*I needed a lot of them in one place*." The increased height of the houses are ideal since the aquaponic system takes advantage of vertical space, stacking two growing beds on top of the aquaculture tanks and recirculating nutrient rich water through these beds. For disadvantages, he mentioned the pipe that comes with a purchased kit is a much heavier duty pipe. However, with two major snows that stayed for almost two weeks, of almost eight inches he feels his are "*are plenty strong enough*."

Taylor Farms - (sturdy construction, use of pipe bender)

Taylor Farms constructed two 20x70 foot long houses (total of 2,800 square feet) using common steel pipes available at the hardware store, and a pipe bender purchased from Johnny's seed catalog that allowed them to bend each pipe. Each greenhouse cost about $2,000 ($4,000 total or $1.42/square foot), which was estimated to be 50% below the cost of purchased greenhouses of the same size.

One disadvantage they noted was "*we wish we had straight sides*." One challenge with greenhouses is venting heat, and one of the best ways to do that is to roll up the plastic sides of the greenhouse allowing significant cross ventilation. With a rounded hoop greenhouse, when the sides are rolled up, the plastic doesn't form a roof over the outer two feet of the bed. If it rains the water rolling down the plastic will actually roll into the houses. *"If I forget to roll it down it washes out those two beds.*"

Coleman River Farms – (re-use of existing structure)

Coleman River Farms was the only farm to adapt an existing structure into a greenhouse. Their farm had several conventional poultry houses on the property, and rather than go to the trouble of tearing them down, they simply removed a portion of the tin roof and covered it with plastic, creating a makeshift greenhouse of approximately 40x80 (3,200 sq ft). The advantages of this approach are the very low costs (only the plastic and some boards). The disadvantages were that because the house still had walls, some plants were not receiving enough light and we're reaching for the sun (the common expression is "getting leggy"). The plastic was not tight allowing strong winds to cause the plastic to rub against the wood rafters and trusses causing holes allowing water into the house. There also was extremely poor ventilation that led to problems with blight on the tomatoes. Overall this technique was interesting in its novel use of existing resources, but is not expected to be a commonly utilized approach.

NRCS Grant Funded Greenhouses

Six farms in the study region received NRCS grant funding through EQIP for their Seasonal High Tunnel Initiative.

Belflower Gardens (all steel construction, prepping soils)

Belflower Garden's high tunnel was constructed in 2012. Its size is 30x72 (2,160 sq ft), and was made by Atlas, a Georgia company. It was an all steel kit, "*we used no lumber whatsoever*."

Like several of the high tunnel grant recipients, they have endured a learning curve in mastering the rhythm of growing in greenhouses mentioning the challenge of having lettuce on one end of the tunnel (that like cooler temperatures) and tomatoes on the other end (that like warmer temperatures).

Glory Seeds Farm – (a mobile high tunnel on rails)

Glory Seeds Farm is the only farm in the study to utilize a moveable or rolling greenhouse system. One of the principal benefits of a moving greenhouse is the ability to expose soils to purifying effects of sun and rain. It also allows you to prepare the next season's crop while still protecting the end of the current season, and then simply slide the protection over.

Indian Ridge Farm - (benefits of raised beds)

Indian Ridge Farm's high tunnel was constructed in 2011. Its size is 97x20 or 1,940 square feet. The farm spent cash out of pocket to add role up sides, hinged doors, and a homemade automatic vent. Final costs were approximately $6,425

($3.31 per sq ft full cost / $.73 per sq ft matching cost).

This project incorporated an additional innovation by constructing permanent raised beds to improve SOM management, and reduce weed pressure.

Melon Head Farm

This tunnel was constructed in February 2013 and is 30x72 (2,140 square feet). It's an Atlas greenhouse, which cost $7,400 plus $500 additional for grading costs, concrete posts, tools (NRCS reimbursed $5,900 or about 75%). Out of pocket was $2,000. ($3.69 per sq ft full cost / $.93 per sq ft matching cost). Since this is a brand new house, there is not yet additional information regarding its use.

Mill Gap Farm (letting the soil dry out)

This tunnel was constructed in the Fall of 2012 and is 30x50 (1,500 square feet). Total cost was about $5,100 of which NRCS reimbursed $3,800 or about 75%. Out of pocket was $1,300. ($3.40 per sq ft full cost / $.86 per sq ft matching cost).

Mill Gap experienced an interesting problem by not having irrigation prepared once the plastic was installed. "[We] *let the ground get too dry and that killed out the soil food web, it was like starting in the desert*." As a result of a lack of water for a period of time, it "*took awhile to get the ground rejuvenated so things would grow*," meaning additions of compost and compost tea to re-innoculate the ground with living soil organisms.

Discussion

Of the six farms that participated in the NRCS High Tunnel grant program during the study period, two would be described as part-time farms. The other four could be considered full-time farms, with two of these having some to considerable off-farm employment income, and the other two with retirement income. One interesting characteristic of all five of the farms that constructed their own greenhouses is that they all are full-time farmers, and four of the five depend on their farm income as their primary source of income. These socio-economic conditions of the farms building greenhouses are worth noting, and there does not appear to be a direct causal relationship for this unusual grouping. One possible explanation may be that the economic benefits of season extension structures were highly evident to full-time farms and they invested in the practice prior to the NRCS grant program inception. Four of the five constructed greenhouse farms began building houses before the NRCS program began (the final farm was ineligible for the program). Each farm slowly became aware of the NRCS program as other farms adopted the practice. At this stage these farms were somewhat vested in their own greenhouses. The relationship between different types of farms and the NRCS and other governmental resources is also worthy of follow-up research.

Summary

Season extension structures have become an important innovation in the development of local food farms and local food systems. As an innovation type they would first be classified as addressing "season extension," but in both the "homemade" and the NRCS grant funded scenarios would also be considered "cost saving." In addition many of those described would also address, "yield enhancement," "harvest/product quality," "manufactured equipment," "outside income/grants," and "network/organizational" due to the need to tie into NRCS programming for the grant program.

Surprisingly, two of the farms that constructed greenhouses were able to do so for nearly the same costs as the matching portion of many of the NRCS funded projects (see table 4.6).

Table 4.6: Total Square Feet and Material Costs of Greenhouses built by Farms between 2009-2013

Farm	Homemade/NRCS funded	Square feet	Cost/sq ft	Match/sq ft
Trillium Farms	Homemade	1,710	$0.85	N/A
Leah Lake Farms	Homemade	4,200	$0.86	N/A
Burton Mountain Farms	Homemade	4,725	$2.33	N/A
Taylor Farms	Homemade	2,800	$1.42	N/A
Coleman River Farms	Homemade	3,200	unknown	N/A
Belflower Gardens	NRCS funded	2,160	$3.41	$0.74
Glory Seed Farm	NRCS funded	2,160	$3.24	$0.00
Indian Ridge Farm	NRCS funded	1,940	$3.31	$0.73
Melon Head Farm	NRCS funded	2,140	$3.69	$0.93
Mill Gap Farm	NRCS funded	1,500	$3.40	$0.86
Mountain Earth Farms	NRCS funded	N/A	N/A	N/A

This evaluation did not intend to determine which approach is better, or to identify the innovation best suited for further adoption. As one farmer pointed out "*there are as many different ways to look at infrastructure on farms as there are farmers.*" Many studies within the diffusion of innovations theory presume that adoption is good, and lack a methodology for evaluating between two different innovation approaches. This case study does not attempt such an evaluation but does observe in detail what the innovations are, how they were developed and why they were chosen, in the hopes of providing insights regarding how they shape future innovation.

"Why did farmers innovate" in greenhouse construction? The benefits of season extension are fairly straightforward and comparable for both approaches: greenhouses extend the production season, which increases local food availability, which increases annual income. They also improve the quality and yield of some crops (notably leafy greens). The early innovators of homemade greenhouses were the first in the region to recognize the economic and marketing advantages of season extension. All of them were full-time farmers, and many sold to restaurants, which provide a reliable year-round market.

Homemade greenhouses definitely engage more decision-making and control in construction, which equates to more diversity in house types, and more discovery of what works and what doesn't. One farmer described his perception of the greater values of this process.

> "*Every time you solve a problem that's already been solved, it initiates something in your brain. You could say it builds your confidence. It feeds the innovation process. There's no innovation in buying a kit.*"

This additional learning in the process of constructing greenhouses might prove beneficial if farmers built greenhouses more frequently, but it's unclear how valuable such knowledge will be towards farmers' abilities to address other challenges. However, these concepts of self-sufficiency and the enhancement of innovation capacity should not be taken lightly.

NRCS funded houses certainly offer less flexibility in design, yet there were still significant differences observed in implementation including: all steel construction, moveable, and raised bed options. There was a general consensus that such houses will last longer, and may offer a better return on investment (at least given the low matching costs of the grant). It is interesting to note that no farms have purchased and installed a greenhouse kit without NRCS funding. If this ability to capitalize on government incentives was removed, it is quite likely that the interest in constructing “homemade greenhouses” would resurge. Perhaps networked knowledge on effective “homemade” greenhouse construction would be highly valued under those conditions.

This case study introduces questions about the role of government subsidies in innovations on sustainable farms, since the NRCS high tunnel grant and NRCS irrigation grants are the first two government subsidies observed to be adopted by sustainable farmers in the region. Subsidies certainly influence the nature of innovation adoption and innovation development, as can be seen here. They also introduce complex questions about the network dynamics between local farms and agricultural agencies. These agencies are slowly evolving to engage in interests and concerns of sustainable farmers, for the first time. These relationships, much like the emerging local food system, are brand new, and have only just begun during the course of this study. The future of such government incentives is unknown, and hopefully the findings of this study can play a role in evaluating how such programs are influencing innovation processes.

Context in the Innovation Development Process:

Alternative heating solutions in season extension

Two additional "cost saving" practices, both occurring on Trillium Farms, and that also address "season extension" are noteworthy, though in very different ways from the greenhouse construction example. Very few farms pay to heat greenhouses in the winter due to the high costs of fuel. That means that most farms simply grow very little or not at all for the 2-4 coldest months of the year. However, full-time farms that do not have a secondary income source are constantly looking for ways to expand their production to as many months of the year as possible.

Steve Whiteman the farmer at Trillium Farms has developed two novel techniques for addressing "season extension" during the coldest months of the year, and that also address the high costs of heating. The first practice is the construction of a cob furnace as a low-cost heating alternative for one of their greenhouses. The second is moving the growing space indoors, into a basement room using grow lights.

The Cob Furnace

Cob is a building material that has been in use for thousands of years and is still used in cooking throughout much of the world and consists of clay (15-25%), sand (75%) and straw (less than 5%). Its principal benefits are that it is fireproof and very inexpensive. The cob acts as a heat storage mass increasing the efficiency of heat output. Cordwood and other renewable local fuels can be burned cleanly (combusting all wood gases with no smoke) if the wood is dried, and the fire is small, hot, and furnished with adequate air. The heat storage capacity of the cob material allows the greenhouse to be heated throughout the night without the farmer getting up to re-load the furnace as would be required with a wood burning stove, thus providing a “body/labor saving” innovation. The farmer phrased his initial problem as, "*how do I heat a moderate sized greenhouse through the night with wood without getting up in the middle of the night*." The cob furnace provides an “energy saving” innovation due to the increased efficiency of the fuel, and a “cost saving” innovation due to minimal expense of construction materials, and reduced fuel costs. The furnace generates a minimum of 60,000 BTUs an hour maintaining temperatures of 55° F and above, with performance comparable to other conventional heating methods at a fraction of the cost.

As has been pointed out, management and labor often replace capital expenditures on small farms, and this practice does require considerably more time, as the cob furnace must be ignited and maintained each time temperatures approach 30 degrees. It takes about 8 hours to heat, and a couple of days to cool back down as the cob holds residual heat. The cob furnace is started in the early evening, then reloaded with wood again around 10pm, and then the damper adjusted for a slow burn through the night. Even though the fire extinguishes during the night, the cob is quite warm to the touch the following morning.

Trillium Farms uses the furnace to heat a 750 square feet greenhouse for approximately 63 days each year (105 potentially cold days with roughly 60% of those reaching 30 degrees or below). It burns a cord and a quarter of wood at a cost of $150 a year or $2.38 per heated day. One important thing to note is that crops grown in the cob furnace greenhouse are mainly those that have some frost protection like chard or spinach. Since the greenhouse is still "leaky" meaning not airtight, row cover and reflective fabric is placed over the sensitive greens to capture heat stored in the soil. "That really makes a difference," says Whiteman. By comparison the smaller 600 square foot greenhouse is heated with natural gas every night because it contains sensitive crops like king's lettuce or tomatoes. Cost for supplying this heat was $750 over 135 days or $5.55 per day.

Basement Room Growing System

Trillium Farms second alternative heating solution innovation is to bring production indoors into a basement room and provide grow lights. "*Because I produce heat down here it made more sense to import light*." This system is effective since Trillium Farms specializes in microgreens, which grow quickly and require only a small amount of space. Steve also jokingly refers to this practice as "*the business that Ingles built*," since the microgreens are all grown in cardboard milk boxes acquired from the grocery store and cut down to about 3 inches in height and lined with plastic bags filled with soil. Fluorescent shop lights are hung via homemade wooden stands just inches above the microgreens and aluminum reflectors are used to increase light transmission to the outside edges for more uniform growth. The room is 40x25 or 1,000 square feet and most of this space is devoted to microgreen production, making this his largest season extension space. A second cob furnace was constructed in this room, which is used to heat the home, a hot water tank and a clothes dryer. This furnace is designed for domestic heating purposes, not for the production of microgreens. "*I generate an absolute surplus of heat,*" Steve explained.

There are numerous advantages of this system. The location of the growing area is convenient to the farmer for frequent monitoring and management. The temperature stability of the house compared to the greenhouses is dramatic. Some greens actually perform better in a highly controlled environment, or take on different characteristics under grow lights, such as oils produced to protect them from the light, which add distinctive flavors. One of the most significant advantages is, "*there are no bugs*." In a controlled environment it's easier to control for the introduction of pests. Steve responded, "*I don't need any kind of fertilizer or insect control. Except for my shop vac,*" a reference to rare occasions when small black fly larvae may find their way into his soil windrows covered in plastic. When they hatch they fly to the lights and he simply sucks them up.

The low input nature of this growing practice, and the lack of fertilizer use mentioned is worthy of a brief description. After a crop is harvested, the box of soil is taken to a covered windrow where the root mass is allowed to decompose. This is a very rapid way to generate organic matter in soils as "*at least 30-50% of what's harvested off the top is in the roots*," he explained. The only amendment applied to the windrow are twelve bags of pine fines at a cost of $3.48 per 2 cubic feet or just over $40 per year. Once composted the windrow soil medium is brought back into the basement growing system. He never adjusts for pH and never adds additional fertility (though some composted manure was added in previous years, this practice has been discontinued). As the organic matter in the windrow has grown considerably over the years, it has also been used as a compost source for plantings in the field. "*I add a shovel full to each hole when I plant tomatoes*." Because of the origins of the organic material it's described as "*more like a bottom crop than a cover crop*."

Though the basement growing innovation is being described as an alternative heating solution to season extension, the practice actually occurs year-round. The farmer estimates that this basement growing system accounts for 20% of the total production of the farm in the summer and goes up to 40% in the winter months. Since nearly all of his customers buy from him each week all year long, they expect delivery through the winter, and this continuity with customers is very important, especially with restaurants, even though some weeks of the winter he may only break even.

Why did Trillium Farms innovate?

In contrast to the greenhouse construction case study that occurred on multiple farms at the same time, the cob furnace and basement growing "season extension" innovations are completely unique to Trillium Farms. We've explored the nature of the innovations and how they were developed, but why did Trillium Farms innovate in these unique ways? And does evidence of such innovations make Trillium Farms an innovative farm in the study region?

One theory is that the unique aspects of Trillium Farms niche products led to unique innovations. Microgreens require very limited space, and limited time to produce a crop (around 18-24 days) relative to most crops. This allows these two heating techniques to be practical in very small spaces. The scalability of these techniques for other crops, or for greenhouses as sized on other farms is questionable.

A second theory is simply the greater length of time that Trillium Farms has been farming relative to most other farms in the study region. As mentioned very few farms had season extension structures of any kind prior to 2011. The additional years of experience, and the full time, primary income nature of this farm creates a greater motivation for finding solutions to challenges.

Some farms simply seem to demonstrate a propensity for innovation, meaning they are looking for new solutions to problems, and preferably of their own devising, as opposed to asking other farmers how they do something, and adopting, or even adapting those techniques. Such farms enjoy experimentation, and are likely to engage in novel approaches. Steve Whiteman of Trillium Farms described it this way, "*At this point in my career as a human I'd rather experience the joy of discovering something myself than just wait and employ something someone's already done*."

Finally, and perhaps most importantly, there is a unique emphasis in developing sustainable solutions in the broadest sense. Steve's interest in the cob furnace was to develop a low cost solution to heating that anyone could build with very little capital and very little training. He calls this "*solutions for the little people*," meaning accessible to low resource farmers. Ecologically, the practice reduces long-term impacts from using fossil fuels. Economically it reduces fuel costs. Socially it increases self-reliance, and provides an example that could be easily adopted by others. These principles underlying this innovation are perhaps more visionary in their pursuit of sustainability goals than are many "adapted" innovations, which only slightly improve on existing practices. However, an innovation's attainment of numerous sustainability goals does not necessarily mean that others will adopt it.

System vs. Practice Level Innovations

The cob furnace and basement growing techniques could be said to be "system level innovations" that influence the entire production environment. For example the degree and reliability of the heat output from the cob furnace determines the crops grown in those houses, and the low costs make it feasible for production to continue throughout the coldest parts of the month. The cob furnace innovation shapes every other aspect of the production environment, even leading to other innovations such as the use of reflective fabric to hold soil heat, and the biochar technique that will be described later in the chapter. Other smaller innovations occur within these "system level innovations" such as in the basement growing system the use of free boxes to hold the growth medium, aluminum reflectors for light transmission, use of root mass for building compost windrows, and a shop vac for sucking out bugs. These will be referred to as "practice level innovations." While system level innovations are frequently the most challenging to adopt, or to spread to other farms because of their influence on the total production environment (and the unique conditions from which they are created as described here), practice level innovations may have applications beyond the systems in which they are created. In fact, variations or manipulations of these practice level innovations in new systems can lead to new innovations. This can be evidenced by the introduction of the cob material, a material known for primitive cooking, into the production environment as a tool for season extension taking advantage of its thermal mass heat holding capacities. This cob furnace innovation will be adapted again to address challenges in soil organic matter management as will be described in the biochar example below. Other practice level innovations may be adopted, or manipulated to fit with other farmers' systems leading to either variation on the initial innovation, or entirely new innovations.

Identifying Key Innovations

With the myriad array of innovations identified within this local food system during the study period, it is easy to get lost in identifying which ones are most important. In contrast to the diffusion of innovation theory which typically selects one innovation, accepts as a given that adoption of that innovation is a good thing (the pro-innovation bias), this study is challenged in determining which innovations matter most. Such a framework might aid in a deeper analysis of two contrasting innovations such as the constructed or grant funded greenhouses, or how a basement growing system might apply to other farms in the study.

While perhaps all of the innovations observed are important to the farms on which they were found, as they address problems, challenges and needs found on those specific farms, this study does set out to establish which innovations 1) address the most problems, 2) have the widest applicability, 3) most strongly shape farm management, and 4) are shaping the local food system. Innovations that meet most or all of these four criteria will be referred to as key innovations.

Innovations addressing the most types

As has been demonstrated many, in fact most innovations are categorized according to multiple types of innovations, indicating that these innovations address multiples aspects of farm management. One starting place in identifying key innovations is to assess those innovations that address the most problems or challenges in farm management.

If each innovation type could be thought of as a problem addressed by farm management, then innovations categorized amongst the most types could be said to solve or address the most problems. All 208 innovations were scored according to the number of innovation types they addressed, and Table 4.7 shows a selection of those scoring the highest.

Table 4.7: Specific Innovations observed on different farms according to the number of innovation types they address

Innovation Practices	Innovation types addressed
Compost Tea	9
Aquaponics system	8
Compost Tea	8
NRCS Rainwater Irrigation system	8
Compost Tea	8
Compost Slurry	8
CSA shares system I Cafeteria Style	7
Impact Grazing	7
Using cardboard / hay for weed suppression	7
Community Workdays – hoop house raising	7
Focusing on Locally Grown market	7
On-farm Farmers Market	7
Basement growing using grow lights	7
Cob Furnace to heat greenhouse	6
Rolling weatherized chicken tractors	6
Well and watering lines Grant	6
NRCS high tunnel (rolling greenhouse)	6
NRCS irrigation and drip tape	6
Biodynamics treatments	6
Recycled Black Plastic under tomatoes	6
Use of inexpensive tunnels	6
Locally Grown market	6

Table 4.7 shows that the use of compost teas or compost slurries represents four of the top six innovations addressing the greatest number of innovation types. Due to this frequency of occurrence further analysis of this practice as a case study was performed and used to identify characteristics that either confirm or disprove it as a key innovation.

Compost teas and slurries:

One innovation that addresses many problems

Compost tea is a practice in which various forms of fully decomposed organic matter (sometimes along with other minerals, nutrients and amendments) are steeped in water for a period of hours or days, then the resulting liquid (and sometimes solids in the case of slurries) are either sprayed onto soil, onto living crops, or applied as a soil drench to achieve numerous crop production benefits. The practice is used as part of the fertility, pest control and plant vigor management system. While the technique is not widely adopted, occurring on only 4 of the 28 farms in the study, it is selected for consideration as a key innovation due to its significant influence on total farm management, and the wide range of problems and challenges that the practice is designed to address.

The initial information sources for this innovation and the subsequent diffusion process were unique from all other innovations studied. The basic concepts for the compost tea technique have been principally developed and promoted by Dr. Elaine Ingham, a soil microbiologist who specializes in the soil food web and currently serves as chief scientist of the Rodale Institute (Ingham 2005). Most adopting farmers were familiar with Dr. Ingham's work, one even attending a multi-day workshop that she hosted. However, most farmers first encountered the compost tea practice via collaboration with individuals with specialized backgrounds, experience, and equipment for creating and applying a compost tea designed to enhance microbial activity in the soil. These collaborators are non-farmers and could be characterized as non-traditional consultants.

The presence of these non-traditional consultants within the region has had a significant influence on the dissemination of knowledge regarding the technique. These consultants have hosted workshops, visited numerous farms for trial demonstrations, spoken at meetings of the Authentic Food Growers Association based in Franklin, North Carolina, sold compost materials and other amendments, and helped develop specialized application equipment. Some of this work has been done for a small fee, and some for free. Fees for assisting farmers with the actual creation and application of the tea have averaged $200-$500 per acre per application.

Of all practices studied, compost teas and slurries represent the production innovation that addresses the broadest number of production needs. This is based on farmers' own testimonies and the observations of the researcher. The production challenges addressed include: soil building, fertility, nutrient cycling, plant vigor, stimulation of microbial life, fruit quality and yields, and pest prevention and control. These were then translated into the established innovation types and included: cost saving, better performance, yield enhancement, SOM management, nutrient cycling, insect/disease control, weed control, and harvest/product quality.

Each farmer adopting this innovation had experienced a small trial on their farm that had "made a believer" out of them. Innovation development advanced from an initial trial to a broader trial during which more careful observation of results occurred. Slowly each farm began investing in greater resources toward implementing the practice.

The general practice consists of mixing water with a high quality biological inoculant (worm castings, hen litter based compost, aged wood chips) and various food sources including simple or complex sugars (table sugar, molasses or sorghum syrup, fish emulsion) and mineral mixture (sometimes including humic acid, azimite, gypsum, soft rock phosphate, high cal lime) to stimulate a microbial flush. Aeration or mixing for 12-24 hours is desired to stimulate the microbial flush. Application of the liquid compost is then by sprayer (5-50 gallons) or by hydroseeder as a slurry (200-400 gallons). Application rates differ considerably by farm and by year. Recommendations are for highest frequency possible, but at a minimum of 3-4 times per year, mainly in fall and winter, and at least once in the spring. Early applications are thought to have the best effect "so microbes are building up" before plants need to take up nutrients. The most consistent user applies 500 gallons, 2-3 times per week on average, throughout the growing season.

Farms utilizing the practice

There are currently four farms in the study region that utilize the technique: Mountain Earth Farms, LoganBerry Farm, Mill Gap Farm, and Melon Head Farms. Even though this is a small number of total farms in the region practicing the technique two of the four farms, Mountain Earth Farms, and LoganBerry Farm are amongst the largest farms in the study (12 and 14 acres in fruit and vegetable production), and a third farm, Mill Gap Farm is considered a network hub for other farmers. In fact, the fourth adopting farm, Melon Head Farms learned the technique from Mill Gap. Several of these particular farms play a significant role in influencing the characteristics of the broader food system, either through the economic success of their farms and their high visibility, or their accessibility in Mill Gap's case where other farms go to learn. The two largest farms are also more equipment intensive than other farms in the study.

During the process of innovation adoption several farms have demonstrated interesting innovation adaptation strategies. The most significant was recognition that high-pressure sprayers likely damage and kill microbial populations, and contribute a diluted effect when compared to using a "slurry" which incorporates a wider opening on the nozzle allowing sediment to be pumped with the water. This technique uses a conventional hydroseeder (designed to spray grass sprigs without killing them), and a homemade motorized compost sifter to remove small bits of debris that would clog the nozzle. These practices appear to be original innovations in application techniques.

The rationale for the use of compost teas and slurries is a belief that increased microbial activity releases nutrients formerly locked in the mineral and organic components of the soil, making them available to plants. There is also an understanding that microbial organisms compete with and kill pathogenic and other pest organisms in the soil and on the plant vegetation itself.

Farms measure their results differently but in general crop performance (such as yield, pest resistance, crop quality), comparisons with a control, and the brix method (testing sugar content as an indicator of plant health and quality) have demonstrated positive results in 2011-2012. For example, Mountain Earth Farms in their first year of application of slurry to corn, tomatoes, and blueberries in 2010-2011 reported the following results:

- Organic corn with no additional pest control showed few to no earworms, and a sweet flavor, with a brix rating of 56 when 24 is considered to be excellent (using the standard refractive index of crop juices chart) allowing ears to be sold for $1.00 each, a 100% increase in price from the prior year. Corn in an adjacent plot not receiving compost slurry showed a "night and day difference" with earworms present and a brix of 8-9, which is considered poor.
- Mature blueberries yielded 10 gallons a bush (a 1/3 increase) and maintained full size berries over the course of the season with no size down. New bushes in their second year gained considerable growth in comparison to expected growth (with flower formation on one year old growth which had not been observed in prior years).
- Tomatoes and Peppers were exposed to a late freeze (May 5, 2011 – observed 28°F, recorded 31°F). Plants had been treated with compost sprays in prior weeks and a mineral application the day before the event. 1,800 tomatoes and 1,200 peppers survived the event with less than 5% loss.

As the benefits of the practice have revealed themselves, several of the farms have invested in programs independently of collaborators, though they still consult and occasionally hire them to do spraying. A third farm has partnered with a collaborator by investing in the hydroseeder and sifter and in exchange for assistance in preparing and applying the mix the collaborator gains access to the equipment for off-farm jobs.

This technique has particular appeal as a substitute for other more costly and more difficult soil organic matter management techniques such as extensive inputs of large volumes of compost to replace nitrogen and carbon losses by tillage, additions of hay mulch or management of cover crops. The technique does not replace these techniques, and the researcher's personal evaluation recognizes some concerns that a microbial priming effect may demonstrate short term gains by mobilizing stored nutrients held in organic matter, but that overtime soil C levels and stored nutrients could be depleted by priming microbial decomposition of soil organic matter.

Research in support of Compost Tea

Research evidence supporting the beneficial effects of aerated compost tea has been mounting in recent years (of 26 publications on vermicompost tea identified through Web of Science, 21 or 80% were published since this research began in 2009). In a greenhouse study by Ohio State University using aerated compost teas (ACT) derived from vermicompost (ie. worm castings), fungal pathogen suppression of fusarium, phytopthora, rhizcotonia, and pythium in cucumber and tomatoes was found (Edwards et. al. 2011). Though mechanisms for suppression were complex and difficult to isolate, the mesophillic process used in creating vermicompost (composting temperatures maintain 20-45°C or 68-113°F) versus the thermophillic process of generating most other composts (composting temperatures of 45-122 °C or113-252 °F) was found to promote a greater diversity of microorganisms believed to increase pathogen suppression (Edwards et. al. 2011). All farms in this study utilized vermicompost as a primary component of their compost teas.

Another study in Austria found increased biomass in indoor tomatoes and cress grown with ACT using vermicompost, but no yield effects on field grown radishes, peas, wheat and barley, though improved tastes of all crops were measured (Frtiz et. al. 2012). Pant (2011) found that while vermicompost tea enhanced plant yields, root and shoot growth, increased N uptake, mineral nutrient content and total carotenoids, these effects were not dependent upon aeration of the tea, or additive minerals. These effects were linked to microbial and hormonal processes (humic acid) not just the nutrient effects of the tea, which were isolated in this study (Pant et. al 2011).

A full understanding of microbial processes as they relate to compost tea applications are still little understood by research science in general, and the University of Georgia's extension system currently has no research or publications on the use of compost tea. Overall, current research supports some of the benefits claimed by farmers in the study, however, this has not been the basis for farmers adoption of the practice. They currently are convinced of the benefits on the basis of personal trials, and network knowledge exchanged amongst a very small group, and their personal web-based research.

Compost Teas and the "Attributes of Innovations" model

Since adoption of the compost tea innovation by other farms has not proceeded rapidly over the last four years the use of Roger's (2003) five "attributes of innovations" that help explain rates of adoption is applied to look for explanatory factors (reference table 2.2). Compost tea would be considered to have high "complexity" as it requires specialized equipment, and specialized knowledge to understand the principles and practice of managing soil microbiology. Since the microbial priming effects cannot be observed directly, at least not easily, farmers must accept on faith that a given batch of tea contains the microbial communities needed to achieve the desired crop effects after application. Due to the sensitivity of microbial viability in an aqueous solution, the complexity of the brewing process is another challenge, requiring the proper balance between duration of time, food source, water source (non-chlorinated), and microbial source. The practice does have fairly strong "trialablity," particularly in farmers' impressions and satisfaction with performance following a trial, and in fact most farms that proceeded to a trial ended up adopting the practice. Trials have been most successful following engagement with non-traditional consultants, which has likely resulted in well-orchestrated trials that make a lasting impression. "Observability" has been a notable challenge amongst the study participants. There is some evidence that the consultants have targeted larger farms, including some conventional farms rather than smaller farms. This observation is likely due to the low potential of consultants to collect fees from small acreage farms. The “relative advantage” and “compatibility” of the practice both appear to be quite high when evaluated from the perspective of other farms. This analysis demonstrates that Roger’s “attributes of innovations” model is still a useful diagnostic tool for determining influences on the adoption rate of an innovation.

One characteristic of innovations notably absent from the attributes of innovations model is its “adaptability.” Adaptability is the extent to which an innovation can be modified or improved in order to better address the specific contexts, problems and challenges found in a given setting. Some innovations such as the NRCS funded greenhouse construction example have low to moderate adaptability (relative to homemade greenhouse construction) due to the constrictions of the funding program. Compost tea appears to have considerable adaptability, in fact modifications were observed on most farms in the form of variable types of brewing equipment, use of different feedstocks, improvements in application equipment, and different rates of application. The ability of an innovation to be adapted to a given context is very likely to increase its adoption, but also should enhance its ability to be modified into entirely new innovations. The compost tea concept was modified to create compost slurry, demonstrating the adaptability of the initial innovation, and creating a new variation that achieved improved results.

Summary of Compost Tea Innovations

The question, why do farmers innovate using the compost tea practice is easy to answer; it solves more production challenges than any other single innovation in the study, and addresses numerous aspects of sustainability. Primary among these is its ability to enhance soil microbial life. The compost tea innovation actually establishes enhancing soil microbial life as a stated goal on practicing farms. This is an advanced goal from sustainable farmers' prior focus on enhancing soil organic matter (although the two go hand in hand).

Farmers are not simply adopting this practice "ready made." They are developing and implementing their own "practice level" innovations that focus on how to get large quantities into the field quickly, efficiently and with the least damage to microbial populations. Many of these innovations involve the acquisition, modification, or manufacture of specialized spraying equipment. Innovations also seek to reduce equipment problems (clogging) and add different types of microbes (fungal and bacterial).

The compost tea innovation would be considered a key innovation as it addresses the most problems, has wide applicability even though it is not widely adopted, has the potential to strongly shape farm management (and is already a central practice of those practicing farms), and has the potential to shape the local food system by enhancing farm performance. Based on observations during this study this practice has the potential to become a core concept in the management of sustainable farms in the future.

Biochar producing cob furnace – Example of a non-key innovation

In 2009 and again in 2010 Steve Whiteman of Trillium Farms, with my assistance, applied for a USDA SARE producer grant titled "Heating a greenhouse and producing biochar using a wood burning cob furnace." The project would incorporate all of the elements of a cob furnace for heating a greenhouse described earlier but also would address the challenge, "*how do I reduce the time, energy and expense that goes into adding organic amendments to the soil*?"

One of the greatest challenges for all sustainable and organic farmers is how do you maintain carbon levels in the soil, since every time the soil is tilled carbon is released to the atmosphere (through the process of microbial decomposition of soil C) and must be replaced through composts, manures, or cover crops. Farmers spend time and money to either produce compost or to acquire it from off the farm. Steve described it as "*the Achilles Heel of organic farming.*"

Biochar (similar to charcoal) is considered one of the most persistent forms of carbon found in the world and is rapidly gaining attention for its ability to sequester carbon, increase cation exchange capacity and nutrient retention, and improve overall soil properties (Lehman et. al. 2006, Prost et. al. 2013). As Steve explained from his understanding, "*biochar effectively lasts forever, it does not break down in the soil, and the carbon is not released to the atmosphere, even under tillage*." Research science supports this general view identifying biochar as highly resistant to microbial activity, thus decreasing emissions of CO_2 (Stavi and Lal 2013). Very few small farms are experimenting with biochar as an organic soil amendment in part because there are very few sources for the product.

The SARE producer grant proposed to construct a cob furnace that contained a specialized biochar chamber that would allow for the creation of biochar every time that the furnace was used to heat the greenhouse. The process is called pyrolysis and consisted of a dual chamber system in which a bottom chamber called the “fire box” would burn a fully combusted fire, with the biochar chamber sitting on top of the “fire box”(both covered in cob), loaded with wood that would smolder (partial combustion) in a low oxygen environment. The biochar would then be removed, ground, (evaluated for quality by the Agriculture Research Service - ARS lab in Ohio) activated microbially with compost and applied in several sample plot trials to evaluate crop performance and soil organic matter levels.

Though the proposal was submitted for funding two years in a row the project was never funded. Given time to reflect on this rather innovative idea and compare it to other innovations throughout the study region, several observations can be made.

A key innovation analysis

The biochar innovation differs from other innovations in this study in that it is in the “idea phase,” and has not been implemented. As such, many of its benefits or influences on individual farm management are speculative. However, based on current conditions it appears not to meet most of the criteria set for a “key innovation.” The practice does not have “wide applicability” because virtually no other farmers (Burton Mountain Farms being the exception) are heating their greenhouses through the winter. If farmers began heating greenhouses, it may require a very large leap for them to consider heating with wood requiring hours of additional manual labor, both in the acquisition of the wood and with the feeding of the furnace on a nightly basis. The practice does not seem to have significant potential to "shape overall farm management" in the near term (ie. become a system level innovation). This is true even at Trillium Farms, primarily because compost is not a huge expense for the farm given the very small growing space required for microgreens. Currently pine fines are the primary SOM amendment used which cost about $3.50 per 2 cubic feet (using approximately 12 bags a year or $42). The practice does not likely have the potential to "shape the local food system" in the near future, again, due to lack of current interest in heating greenhouses and the rather complex nature of adoption of the innovation, including unknowns regarding performance of biochar.

Steve Whiteman admitted that as time has gone on he's realized that he really has to focus on practices that pay the bills. He had a strategy to economize the practice (since the reduction of organic soil amendment costs by $42 annually is negligible) by bagging the biochar and selling it to customers, primarily home gardeners, as a soil amendment. From his experience marketing a virtually unknown niche product once before, in the form of microgreens, he recalled the challenge of introducing a new product and building up a base of support for it, *"I'd* *be breaking new ground and starting a new education process. There wouldn't have been that many sales to begin with*."

A diffusion analysis

The "attributes of innovations" model from diffusion theory (see Chapter 2, Table 2.2) provides a useful diagnostic tool for this innovation. While the "relative advantage" or perceived benefits of the innovation sound appealing (low cost of cob, reduction in need for compost, etc.), the immediacy of benefits, especially economic benefits appear to be low or risky. The innovation has low "compatibility" (consistency with needs, previous ideas, etc.) with most farms in the study area. This is due to the very small size of the greenhouse being heated (700 sq ft), compared to average size of greenhouses (~2,000 sq ft), and the lack of farmers currently heating greenhouses. The innovation would be considered extremely "complex", in that most farmers are still unfamiliar with the concept of biochar, have not used it, and are uncertain how and if it works. Science in general has many unanswered questions, especially regarding the quality and effects of different biochars (based on feedstocks, grain size, activation with composts) (Prost et. al. 2013). "Trialability" is extremely difficult for this innovation, requiring one to build a furnace, create and grind the biochar, apply it to the soil, and monitor crop response before any benefits could be determined. The innovation has extremely low "observability" at this time, as no one within the study area, including Trillium Farms has experimented with biochar as a soil amendment, or created it from scratch.

Biochar as a sustainability innovation

Based on this analysis it would be easy to dismiss the biochar innovation as one of little importance, however this analysis has only considered the "adoptability" of an innovation, and its "current" significance in the local food landscape. It has not evaluated the long-term and global sustainability benefits (innovation studies appear to lack strong tools for such sustainability evaluations). The biochar innovation presents significant sustainability advantages: permanently reducing long-term carbon input requirements thus stabilizing soil SOM, creating this stable SOM pool locally using renewable C resources, capitalizing on heat production of the pyrolysis process, increasing nutrient retention, reducing greenhouse gas emissions, and increasing soil C storage capacity. Farmers aware of this project expressed considerable interest in such benefits. Given these benefits, why does the innovation seem likely to remain in stasis?

Sustainable farmers place extremely high importance in agricultural management that provides sustainability benefits to natural resources, global ecosystems and society, but if the costs of implementing such practices are greater than the benefits received then the relative advantage of such practices diminish rapidly. Evidence of the farmer's cost vs. benefit analysis were observed when the SARE funding was not obtained (which would have offset the farmer's costs in developing and implementing the practice) implementation of the practice was abandoned. The farmer simply could not pay the costs of time and energies devoted to developing the innovation compared to the benefits he expected to receive.

This case points to a complex problem with some sustainability innovations; the lack of incentives for adoption, despite obvious benefits to society.

Sustainable farmers are quite innovative in their efforts to increase the relative advantage of sustainability practices that do not naturally provide immediate benefits back to them. Trillium Farms recognized that to make the effort worth it he needed the short-term assistance of a grant to offset his investment in time to develop a new practice. In fact one of the purposes of the SARE producer grant is to "*take a little of the financial risk away from the farmer who is trying to solve a problem"* that may have a longer-term return. (John Mayne, Assistant Director SSARE, personal communication October 30, 2009). Trillium Farms also understood that to make the innovation pay for itself he had to market it as a new farm product, effectively paying him for the additional labor required to produce the biochar. Both approaches were innovative attempts to balance the cost/benefit dilemma of this longer-term, sustainability-oriented innovation.

Summary of the Biochar innovation

The biochar innovation was in some ways the most innovative concept encountered during this study. This is in part due to its newness (so new it has yet to be implemented), and its potentially grand scope with links to global carbon cycling, climate change, and perhaps even carbon credit trading.

Trillium farms recognized that adoption of the practice would entail greater costs. These costs would have to be recouped through either grant funding, marketing of a new and relatively unknown product (biochar soil amendment), or simply by raising prices for all products, in essence selling the sustainability benefits of the innovation to customers. When customers are willing to pay higher prices they are essentially encumbering the expense of increased benefits to natural resources, global ecosystems, and society. This will be a necessary process for the adoption of many sustainability innovations that have a longer-term and more indirect return to farmers. Farmers cannot assume those costs alone or such innovations may never be developed.

Steve Whiteman clearly recognized the link between sustainability practices on the farm and the investment by customers in the benefits of those practices. He's quite good at "*selling a story*," that explains the sustainability costs. In fact, since farmers in this study do most of their own marketing the development of those stories are a critical innovation process all their own, one in which farm identities are built upon their unique sustainable production systems.

One final note. The biochar innovation was not scored on the innovation typology because the innovation was not yet implemented. Speculation on the innovation types that would have been addressed revealed 11 different areas: time, cost, and energy savings, recycled/reuse, better performance, yield enhancement (studies show variable results in this area -Chan and Xu 2009), SOM management, nutrient cycling, crop/food types, marketing, and income enhancement. This would have ranked this innovation as addressing the highest number of innovation types, higher than the ranking for compost tea. However, this ranking does not address the degree that an innovation addresses these challenges, and current research shows extremely variable results in biochars influence on yields, and uncertainty regarding affects on soil N availability. Perhaps more so than any other innovation in this study, more scientific research, and/or context specific field trials will be necessary to increase the perceived relative advantage of adoption of this innovation.

Summary of Production Innovations

An examination of 145 production innovations observed in the study region found that some innovations can be characterized as "system level" innovations, or those that influence the entire production environment, while "practice level" innovations rest within systems, but often have applications beyond the systems in which they are created. Each of the case studies represented system level innovations, and described examples of practice level innovations occurring within them.

Key innovations were defined as those that address the most problems, those with widest applicability, those shaping farm management, and those shaping the local food system. This concept was introduced to help identify innovations that have the greatest current or potential impact on individual farm management and the local food system as a whole. The concept arose as a result of the innovation inventory data and its ability to rank innovations according to the types of challenges they address; with compost tea addressing the most challenges. This study suggests that an innovations inventory and typology followed by a key innovations analysis may be a useful methodology for identifying innovations with the most potential to shape local food systems. A benefit of this approach is that analysis of key innovations comes from within the system being studied as opposed to desirable innovations being pre-determined and imposed by outside agencies. This allows for a more critical analysis of the innovation itself, within the context in which it will be used.

There is still a risk of inheriting the diffusion model's pro-innovation bias if one assumed that all farms should adopt practices identified as key innovations. To avoid this, additional research on farmers' responses to identified key innovations should be performed, but was not within the scope of this study.

Challenges remain in assessing production innovations using an innovations inventory approach. Sustainability characteristics of an innovation are still poorly accounted for using both the attributes of innovations model and the key innovations concept. This is because these tools focus on the current adoptability of an innovation, evaluated primarily based on the relative advantages of adoption to the farmer, as opposed to the advantages to society and global ecosystems. While sustainable agriculture has already shown incredible creativity in convincing society to absorb some of the costs to achieve sustainability, it can be quite challenging for farmers to realize immediate benefits for each sustainability innovation adopted. Those that demonstrate immediate benefits back to the farmer such as season extension innovations, and crop performance enhancement associated with compost teas will likely see more rapid adoption and further adaptations and development. The benefits of biochar are more abstract and far reaching, at least until scientific research or farmer driven trials advance an understanding of more accessible and immediate benefits of the practice.

The cob furnace, basement growing and biochar examples fail to meet most of the key innovation criteria and are not likely to be adopted by other users in the near term because the contexts for adoption are so unique. Many farmers don't have basement rooms, and most crops wouldn't be appropriate for that type of production. The cob furnace may be considered too labor intensive for the benefits acquired.

A key difference between diffusion's attributes of innovations model and the key innovations analysis used here is that diffusion is focused on what innovations are likely to be adopted, while the key innovations analysis is focused on identifying innovations with the most potential to enact change.

Non-Production Innovations

Though this chapter has focused on production innovations on sustainable farms, this study looks beyond farming-based innovations to examine other challenges farmers address in "local food systems." Local food systems provide the broader context within which local farmers are embedded. In addition to production decisions, farmers are required to make decisions regarding marketing, labor, distribution, knowledge sources, social networks, finances, food processing and numerous other areas that lie outside of the production environment but have a significant impact on farm success. In most studies of agricultural innovations, these areas are often ignored.

This study observed 63 innovations (out of 208 or 30%), categorized into 13 different types of non-production focused innovations. Farmers perceived these innovations as equally important to overall farm management.

These non-production innovations were as widely diverse as those described in the production environment. Each innovation type according to category is defined with examples shown in Table 4.8.

Table 4.8: Non-production innovations, definitions and examples of each

Category	Type	Defined As	Examples
Labor / Planning / Lifestyle	Assessment / Planning	Practices that help farmers assess and plan farm or market performance	• Planting Calendar • Brix Method • Using Athens Locally Grown as a Pricing Guage • Computer Software for crop planning
	Outside Income/ Grants	Practices that help farm finances by bringing in outside income through related work or grants	• NRCS High tunnel grant • NRCS irrigation and drip tape grant • Non-profit status / grant access • Teaching Farming and Gardening Classe
	Quality of Life / Lifestyle	Practices that have a quality of life benefit for farmers	• CSA shares system Cafeteria Style • Atlanta Based CSA • On-farm Farmers Market
	Feedback	Practices that help farmers get feedback for improved farm management	• Formation of the Ethical Growers Guild • Certified Naturally Grown - conducted during farm tour
	Labor assistance	Practices that assist farms with labor	• Use of horse drawn farming implements • Community Workdays hoop house raising • Dept. of labor state youth program • Labor assistance
Network / Knowledge / Marketing	Marketing	Practices that influence farmers markets or marketing	• Renaming greens to protect their identity • Direct Marketing • Home Delivery - weekly purchases • Whole comb honey sold in a tray • Using logo and stickers, etc.

	Network / Organizational	Farmers relationships with other groups for information, collaboration, etc.	• CNG certification • Organic Certification • Collaboration with Food bank • Importance of Locally Grown markets
	Crop / Food Types and Uses	Seeking ways to introduce new crops/foods to customers	• Marketing cuts of meat (tongue, etc.) • Recipes and Tastes tests at market • Selling starts to Gardeners
	Income Enhancement	Activities that directly improve the income potential of the farm	• Basement growing using grow lights • Restaurant kitchen waste as Feed for livestock • Commercial Kitchen • Annual sale of specialty tomato starts
	Farmer Training / Knowledge	Methods for farmers to obtain additional knowledge or training	• Use of Soils Analyst Consultant • Membership in Authentic Growers • Visiting other markets • Extension websites from other states`
Food Processing / Safety	Food Processing	Practices to enhance the processing or preservation of food	• Commercial Kitchen • Skinning broilers instead of feathering (reduces labor, cholesterol) • Freezing blueberries sale throughout year
	Food Safety Innovation	Practices that enhance food safety	• Sand water filter and tank
	Food Policy	Practices that utilize or address food policy	• Non-profit exemption for selling baked goods and jams

The non-production environment is often neglected when examining innovations in agriculture. Francis et. al (2003) pointed out that this focus only on the production sector, ignores the energy and materials that go into processing, transportation and marketing that all shape the food system. It also ignores the very real and very pressing challenges that farmers face outside of the production environment.

Of the thirteen types of non-production innovations described in table 4.8, "marketing" and "network/organizational" innovations were encountered most frequently, ranking 3rd and 4th amongst all 29 innovations types including production innovations. Many of the "Marketing" and "network/organizational" innovations also addressed the most problems, had the widest applicability, and most strongly shape farm management and local food systems. The innovations inventory found that farmers devote considerable time and energies to solving problems and addressing challenges in these non-production aspects of farm management.

The following chapters will focus on case studies of innovations in these two areas. Chapter 5 will examine a unique type of online farmers market as a form of marketing innovation. Chapter 6 will address the role of farmer networks in innovation, examine how networks function as innovations themselves, and how they contribute to innovation capacity.

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CHAPTER 5

THE LOCALLY GROWN INTERNET BASED FARMERS MARKET: A RURAL FOOD DISTRIBUTION NETWORK

In an era defined by the rapid rise in digital technology and the ubiquity of the Internet, it is not at all surprising that farmers markets are also taking advantage of these tools for reaching customers in novel and convenient ways. The adoption and use of an Internet based farmers market is one of the best examples within the study region of how adoption and modification of marketing innovations can address challenges faced by individual farms and local food systems. This innovation was found to move laterally to other farmers, and farmer groups in close proximity to one another throughout the region. The widespread adoption of this new market is representative of the value that marketing innovations (in addition to production innovations) have in the development of emerging local food systems.

In this chapter we'll describe the origins of the Internet market innovation and how it was introduced to the area, followed by a description of how the market functions. Over a period of three years the market has contributed numerous unique solutions to local food system challenges affecting rural communities. Many of these advantages are inherent to the adoption of the initial innovation, while others required the modification and improvement to the Internet market to realize new opportunities. Interaction with other internet markets located adjacent to the study region have been a significant source of improvements to enhance these market opportunities.

Origins of the Internet Market innovation

An Internet based farmers market called Northeast Georgia Locally Grown market (NGLG market) was created in the study region by area farmers and myself and launched on April 28, 2010. The impetus for creation of the market arose from the experience of several farms in the region with the Athens Locally Grown market (hereafter ALG market) an online ordering system created and developed by a farmer and software engineer Eric Wagoner in Athens, GA in 2004. Athens is approximately an hour and a half drive from the study region, and several farmers had sought marketing outlets beyond the Simply Homegrown market in Clayton (which only runs May until October). The ALG market was appealing as an additional market because orders were exact meaning you harvested to fill specific orders (no waste, no leftovers), the farmers could pool their orders together and take turns delivering them, it took very little time beyond the driving time as orders were simply dropped off, it allowed the Rabun County farmers to interact with other farmers at the market, and provided a reason to drive into Athens to transact other business.

The ALG market system has experienced incredible growth and success over the last nine years. In 2009 the ALG market had achieved annual sales of nearly $500,000, averaging $8,000 to $14,000 in weekly sales (Wagoner, 2009 personal communication). By 2012 this growth had declined slightly to $359,442 annually (attributed to the rise of other markets in the region)(Wagoner, 2012).

The Locally Grown market system could be described as a franchise system of marketing. When the software was redeveloped in 2006 it was specifically designed so that other farmers markets could adopt the software and setup their own Locally Grown online farmers markets anywhere in the world using the same platform. Since the websites are hosted, maintained, and updated via a central server, rather than pay a very expensive one time upfront software fee, each startup market pays 3% of sales for continuous use of the market system.

A strength of the platform is that the software designer, Eric Wagoner, also serves as the market manager of the ALG market, and is himself a grower. These perspectives aided in the design of the system, allowing him to identify the specific needs and challenges experienced by growers, customers and market managers. This hands on, day-to-day experience interacting with customers, farmers, and the software itself allowed the design to be very robust in its ability to meet emerging needs, and the software is continuously improved and updated automatically to all users. Eric's professional career as a programmer gave him the unique ability to update and adapt the system on a regular basis.

The adoption rate of the Locally Grown market system has been very impressive as well. In 2009, there were over 100 markets across the country, and a few in Australia and one in Japan (interview with Eric Waggoner 2009). In April of 2013 the Locally Grown system had grown to 289 markets scattered throughout the U.S., with a significant cluster of 60 or more markets in the Southeast, specifically Georgia and Tennessee.

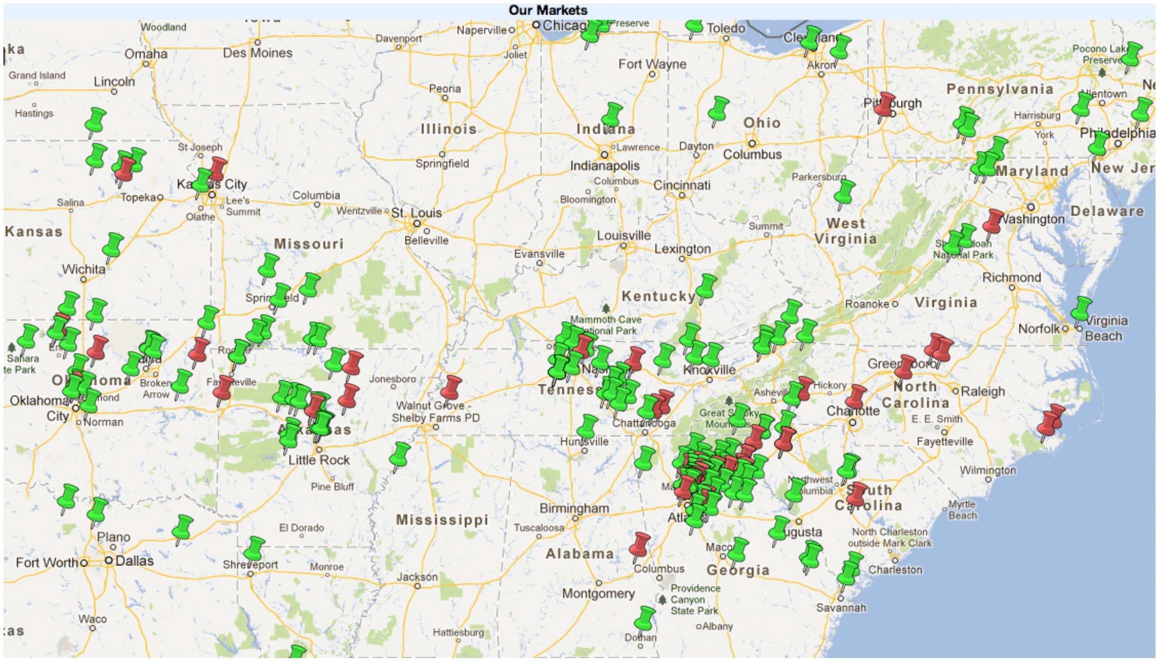

Figure 5.1: Locally Grown franchise market distribution in the eastern U.S. Green pins represent active markets, and red pins represent organizing markets.

The rapid growth of Locally Grown franchise markets has occurred in tangent with continued growth in farmers markets nationwide. The USDA's Agricultural Marketing Service tracks farmer's markets known to operate in the U.S., and over the last 18 years the number of markets has increased an average of 14% per year (frequency of surveys increased to an annual basis beginning in 2008) (USDA AMS 2013).

Table 5.1: USDA Farmers Markets Growth 1994-2012 (USDA AMS 2013)

YEAR	MARKETS	% INCREASE
1994	1,755	
1996	2410	37%
1998	2746	14%
2000	2863	4%

2002	3137	10%
2004	3706	18%
2006	4385	18%
2008	4685	7%
2009	5274	13%
2010	6132	16%
2011	7175	17%
2012	7864	10%

These figures are likely to be a significant underestimate of the actual numbers of farmers markets. In a random sampling of five of the Locally Grown franchise markets listed on the website (located in Stillwater, NY; Bedford, PA; Tampa, FL; Champaign, OH and Williamsport, TN), two were not yet fully functional markets, and the other three did not appear in the USDA's registry despite evidence that they were fully formed markets established for one or more years. The Northeast Georgia Locally Grown market was listed in the registry, though our next nearest Locally Grown market, the Clemson Area Food Exchange (CAFÉ) was not listed. If all 289 Locally Grown markets had been represented in the registry, Locally Grown would have accounted for 3.67% of all farmers markets nationwide.

Foundations of the NGLG Market

One of the most cosmopolitan farmers in our study region, Chuck Mashburn, had experience selling to the ALG market beginning around 2008-2009, and understood the system from a grower's perspective. He introduced two other farms to the ALG market, Sylvan Falls Mills and La Gracia Farms, and the three began exchanging turns making the deliveries (an early example of a distribution collaborative).

Before moving to the study region in May 2009, I had lived in Athens between 2007-2009, and experienced the Locally Grown market as a regular customer, and as a researcher. I was particularly interested in the interactions that were occurring between farmers at the market due to the abundant free time they had after dropping off their items. Rather than simply drive back to the farm, many farmers spent time visiting with each other exchanging ideas, and as I would later discover, exchanging products for their own Locally Grown markets located in their home communities. I also conducted an interview with Eric Wagoner at his home on the history and the development of the market on Easter of 2009.

As a result of our knowledge and experience with the ALG market, and our different perspectives, Chuck and I began talking to each other and to other farmers in the region about how well the market worked, and the opportunities it provided throughout 2009.

At the time, farmers in North Georgia had only seasonal markets, so the appeal of the Locally Grown market was that it could generate food sales during more months of the year. Most farms also had a customer base located within a fairly close radius to their farm, basically markets accessible within a 30-minute drive. Farmers rarely had customers in adjacent counties as either the customers were unwilling to drive to them, or they were unwilling to drive to customers.

Some farms had a very different problem. Their principal markets were located outside of their home counties in larger metro areas such as Atlanta or Gainseville, due to the larger demand and customer base found in urban areas. This meant that food from these local farms was not available to local consumers. The simplicity of the deliveries to a Locally Grown market would allow such farms to sell food locally without having to make a significant time commitment, or setup up a second weekend market in a less populace area.

In March of 2010 farmers met at the home of Chuck Mashburn to discuss formation of the market. By the completion of that meeting two pickup locations had been established, one in Clayton managed by Chuck Mashburn, and one in Clarkesville, managed by myself. A checking account was opened (later transferred to the Soque River Watershed Association non-profit for tax purposes) and the market opened on April 28, 2010 with seven growers participating and about $150 in sales.

How the Market Works

The foundation for the NGLG market is the website's marketplace where approved farmers list photos, descriptions and prices of their products on a weekly basis. The process for farmers starts by opening an account and creating a farm profile. Before being approved as a new farm, the market established minimum guidelines for participation that must be met, and market managers visit each farm to insure eligibility as outlined in a document called "Guidelines for Growers." These guidelines state the prohibition of chemical fertilizers and pesticides, requirements for processed foods (such as licenses and ingredient requirements), animal standards (pasture based), and what non-food items are allowed.

Customers open an account that requires only their name, phone and address, and order using a shopping cart system. Items are listed alphabetically by name of the product, like "Beans," followed by the specific type like "Rattlesnake."

Customers can customize the market menu to show only specific categories they are interested in (such as Meat, Dairy, Vegetables), or toggle items from specific farms. Each product listed shows the price, quantity available, and description provided by the growers, and optional photo of the item.

After customers order, the farmers receive an e-mail of the orders for harvest. The website generates labels which are affixed to every item sold identifying the customer's name, product item, name of farm, and delivery location. Farmers then deliver their items on Wednesday afternoons during a thirty-minute delivery window, to one of the two delivery locations closest to them, Grace Calvary Church in Clarkesville (Habersham County) or Mill Gap Farm in Tiger (Rabun County). Farmers separate their items based on the two delivery locations, placing items into market coolers, and are paid a check, before leaving the market.

Market managers then transport the items designated for the other delivery location via a 24-mile shuttle. One series of coolers is dropped off and another picked up before returning. Market managers alternate shuttle duties weekly. Once the shuttle run is complete, items are unloaded and customers come to pick up their orders between 5-7pm. Market managers and volunteers use a packing order form to gather items from coolers as individual customers arrive, identifying products by their labels. Items are checked off to confirm order completion, and customers pay the market managers.

The market uses what Eric Wagoner describes as a "shared cash box" system. What this means is that the Locally Grown market is not purchasing food from farmers and re-selling it.

> [The growers are] *"paid out of the shared cashbox when they drop off their sales.* [Customers then] *arrive and pay into the cashbox for your order …. you are really ordering directly from and paying the growers yourself, but our shared cashbox system makes things convenient for you and them. (Imagine if you ordered from ten growers having to write ten checks when you picked up your items!)"* (Wagoner, 2012)

Advantages of Adoption of the Locally Grown Market

The NGLG market creates several advantages for farmers distinct from traditional farmers markets. The following is an abbreviated listing and description of these advantages:

1. Requires less time and labor relative to farmers markets (requiring only driving and unloading times)
2. Less risk of waste and spoilage (products are pre-sold so farms only harvest and deliver items known to have sold)
3. A midweek market enhances the freshness of perishable products
4. Reaches customers across a broader region
5. Delivery locations create opportunities for networking and knowledge exchange with other farmers
6. Easily accessible market for new food producers to experiment with new products, learn marketing skills
7. The Locally Grown system is easily adopted due to its ease in use and low initial costs.

Some of the most notable advantages of the Locally Grown market will be described in detail to illustrate why farmers and the local food system are interested in adopting the innovation.

Farmers markets represent a major commitment of time, labor and resources for most small-scale local food producers. As one farmer commented "*my biggest expense is people, and it costs a lot to send someone to a farmers market. That's almost a full day.*" The reduced time commitment was perhaps the most oft cited benefit of the NGLG market. Farmers made additional comments such as:

> *"It's efficient. I know beforehand what I need. I pick it and I deliver it. If I go to a Saturday market I'm picking what I hope they want, and I hope they sell it. You are always bringing something back. With Locally Grown I'm never bringing anything back."*

This statement points out the risk that farmers face in spoilage of food unsold at the end of the day from traditional farmers markets. The NGLG market provides a confirmed sale, which greatly reduces the risk of overharvesting, or having to sell harvested items at a reduced price via wholesale markets. Some items "left on the vine" that have an extended period over which to harvest can be kept until sold, reducing waste.

Not all products have an extended harvest period, and in fact require multiple harvests during the week to avoid becoming over mature. One appeal of local food markets is the enhanced quality attributes, with freshness being at the top of the list. Items harvested midweek and sold on the weekend may fail to meet the expectations for optimum freshness that also command a premium price. The NGLG market, and most other Locally Grown franchise markets are organized as midweek markets precisely to fill a niche that helps to move produce that might otherwise spoil or be downgraded in quality before weekend markets.

A Centralized Marketplace across a broad rural region

A significant contribution of the NGLG market, infrequently mentioned by farmers but recognized by the managers, and a topic of interest to this research is its value as a "centralized" and "virtual" marketplace accessed by farmers and customers widely dispersed across a broad, rural region**.**

Traditional farmers markets are by their very nature place oriented. When you think of a farmers market you think of a specific location, typically in a public space, in which each farm travels there and sets up their booths week to week. The customers also travel to this location to see with their own eyes what each farm has to offer and to make their selections from the choices available.

Of all marketing systems, the NGLG market most closely resembles this traditional farmers market, except that the marketplace exists in a centralized virtual space, online where the farmers booth is a series of photos and descriptions, and the customers choices are made based on the presentation of the product, or their past experience with the farm and their products. The significant difference is the elimination of travel to a central location between the two parties in order for a transaction to transpire. The transaction is made before the travel begins, and this, in some ways, reduces the risk for both parties.

One of the central challenges of rural communities is the disparate nature of the population. Rural communities and remoteness go hand in hand, therefore travel and distance become a chief obstacle in how farms reach the maximum number of customers possible with the least amount of travel, labor, and duplication of efforts. These challenges are not uniquely imposed on the farmer, as rural customers likewise desire some assurance that the products they would like to obtain will be at the market when they arrive.

Before the NGLG market, farmers could not easily access customers in adjacent counties without setting up weekend farmers market stands in multiple locations (expending considerable labor, travel costs and risk). Unfortunately rurally located markets often feature low customer turnout relative to urban-based markets. One farmer explained, "*I would love to do our local Saturday market but I can't sell enough for the amount of time it takes me to get ready for market, be there for five hours and then come home*."

For this farm and many others in the region, having a centralized marketplace on the web reduces many of the barriers to accessing a disperse customer base. First, it provides a tool to convey product availability information to a large number of customers spread across a geographical distance on a week-to-week basis. Rather than customers driving a great distance to a market to see what's available, this information is provided in advance.

At traditional farmers markets, products setup on a table at one market, cannot also be offered to customers at another market. In contrast, product listings on Locally Grown can be seen simultaneously by customers located in Habersham, Stephens, White and Rabun counties; an area of almost 1,000 square miles.

Product listings also don't have to remain confined to just one Locally Grown market. As there are now multiple Locally Grown markets located within a 30-90 minute driving distance (Athens Locally Grown and Clemson Area Food Exchange are the closest). Once established, product listings can be easily ported from one LG market to another. For example, if Mill Gap Farm has a "Jerusalem Artichoke" listing on the NGLG market, they can port that same listing to the ALG market and to the Clemson Locally Grown market, and make changes to the quantities they want to make available at each one. In the real world, this is the equivalent of popping up your produce stand in multiple locations with the click of a button. This built in capacity of the virtual marketplace addresses a central challenge for farmers, the difficulty or impossibility of being present at two or more markets at once. When customers are spread out, farms have been forced to choose the strongest market, and often they have chosen markets outside the region, to reduce their risk and ensure greater sales.

Attending a traditional weekend farmers market in a rural location can be construed as taking a risk for customers as well. Customers do not know in advance what they will find at the market, and they may not find what they're looking for, or it may be sold out by the time they arrive. A web-based market allows potential customers to not only know in advance what is available, but to know that they have confirmed a purchase. A centralized marketplace expands the number of farms and products a customer can reach in a single purchase. Because the geography of the farms that sell to NGLG is so broad, it would be difficult to impossible for customers to access many of these farms products individually. The online marketplace allows customers to gain access to farms and farm products that do not setup tables at their nearest weekend markets.

Some customers don't want to have to wake up early on a Saturday to attend traditional farmers markets. The NGLG market fits into a midweek routine of stopping and buying groceries on the way home from work, with one key difference, a requirement to place your orders in advance.

A centralized marketplace also allows farmers to reach new customers well beyond the geographical area they are able to access via traditional weekend markets. What makes this possible, and also sets the NGLG apart from its founder the ALG, is the multiple pick-up sites used by the market, and the shuttle system and other forms of distribution collaboration.

Replication of the Locally Grown Model

The Locally Grown market model is notable for its replicability, which is a product of the software design and ease in use. There are no upfront fees, so anyone can set up a market, and populate it with farms and products before paying. The software fee is 3% of market sales. The system is also designed to help pay for market management costs with optional membership fees, and optional table fees established by market managers. The NGLG market's annual membership fee for customers is $20 (automatically applied to their fourth order), and farmers pay a 12% table fee. These provisions allow markets to establish themselves with very low to zero up front costs. While the formation of many farmers markets have required initial start-up funds from grants and other sources, NGLG has generated funds over expenses of nearly $3,000 (from membership fees) since 2010 to be used towards potential capital expenses or collaborative projects. Pickup locations are located at a private residence and a church carport, therefore eliminating capital upkeep costs. Farmers earn a higher profit when they aren't absorbing the costs of a retail location's rental, power, and labor expenses. These same benefits are realized from most traditional open-air farmers markets.

Many of the advantages to adopting the Locally Grown market innovation briefly outlined here are likely responsible for the impressive rate of adoption of the innovation from its initial creation as a single market in 2004 to the 289 Locally Grown markets that exist today. As a result of these advantages further adoption of the Locally Grown and other Internet based marketing systems is expected to continue as more farmers, customers and local food systems become aware of the technology. Certainly one reason that Georgia has such a high number of LG markets, 42 of 289 or 15%, is due to the observability of the innovation, and the direct interaction between farmers or customers already familiar with the system. This clustering effect appears to be occurring in the areas around Nashville and Chattanooga, TN and around Little Rock, AR.

Advantages of modification /improvement of the Locally Grown Market

While many advantages of the Locally Grown market are inherent to the system, and are realized through initial adoption, the development of the NGLG market demonstrates that adopters also modify and improve the innovation to meet context specific needs and opportunities. Some of these improvements subtly improve market management, efficiencies, or collaborations; others increase customer engagement and feedback; and some have the potential to shape the Locally Grown system as a whole. The following is an abbreviated listing and description of market improvements observed during the study:

1. Establishing distribution collaboratives to improve delivery efficiencies
2. Establishment and refinement of market standards
3. Promoting a Market Kickoff every year (despite the fact that the market is year round). The day is consistently the highest revenue day of the year indicating that promotions impact customer turnout.
4. Expanding purchasing days from one 24-hour period to three full days.
5. Adopting a policy to refund customers when items do not meet quality standards
6. Improving naming protocols to the site for better user experience
7. Adding farmer contact information to the website to enhance communication between farmers and customers.
8. Conducting annual surveys

A selection of the most significant innovation improvements will be described to indicate the motivations that lead to innovation improvements, how the processes develop, and the benefits gained.

Establishment and Refinement of Market Standards

In the first two years of the NGLG market a central activity was establishing, and refining the standards for a farms entry and participation in the market. Local food markets that have sustainability standards face considerable challenges in defining and co-marketing the attributes that the foods in their market share. Of the 28 farms in the study, only four were certified organic through the USDA's National

Organic Program, and five certified through Certified Naturally Grown (see Chapter 6 for details on CNG certification). This meant that most farms were practicing their own version of what they considered sustainable. This creates challenges in articulating to customers exactly how products are grown in sustainable ways. The market needed to establish a shared definition for what constituted sustainably produced foods.

As a starting point, the NGLG market managers examined how the ALG market handled standards for farm entry. The ALG does not use a written standard; instead the ALG market manager determines each farm's entry on a case-by-case basis. As a baseline the market does not allow any synthetic fertilizers, herbicides, or pesticides, farms can only sell what they grow themselves, and must be located within 75 miles of Athens (with exceptions for some products that cannot be produced locally). One of the more interesting ways that ALG handles its standards is that as farms enter the market with more stringent practices, such practices establish a new standard for all future farms. For example, when a new coffee vendor began purchasing beans directly from international farmers (no middle men), and did all the roasting and packaging themselves, the ALG market manager decided "[t]hat set the standard and other coffee vendors have to match it (Wagoner, 2012)." Another example included a farm from our region, Sylvan Falls Mill who mill grains obtained from relatively local organic growers. "From now on, all future millers wanting to sell through ALG will have to meet that standard (Wagoner, 2012)." This "always evolving upwards" approach to market standards is quite unique and puts real market pressure on new farmers to stay even or ahead of their competition in implementing sustainability practices. It may also create an advantage for those farms whose practices are grandfathered due to their earlier entrance into the market.

For the NGLG market, a written guideline was deemed necessary since many of the farms signing up to participate were unknown to market managers. A written standard insured that everyone, both producers and customers, were clear on what the market required. Many standards were similar to the ALG but were described in more detail. In addition to chemical free farming for produce, other practices required by organic certification such as crop rotations, use of organic seed, manure applications four months before crop harvest and other specific standards were mentioned. We assumed that many growers had little to no knowledge of the specifics of organic certification and that has indeed been the case.

Market Standards as innovation tool

Market standards are one of the best ways for local food producers to differentiate some of the quality attributes of their products. The conceptual notions of the quality 'turn' define quality in local foods more broadly than just food properties (such as freshness) to include the means to achieve those properties (sustainable production practices) and the social relationships between the farm, its customers and the community (Goodman 2003). In order for these "quality" values to be capitalized upon they must be imparted to the consumer in a convincing way. One of the disadvantages of the NGLG market is that many of these quality values cannot be imparted through direct farmer and customer interactions, since in using the LG system the two rarely meet. Establishing market standards, and a process for ensuring compliance help to make that "convincing case" to customers that the quality values they seek are real. If sustainable production practices are an innovation that imparts value to the products sold, then market standards that communicates and insures those production practices are real are an innovation that imparts value as well.

One motivation for improving the market's written standards and compliance procedures was a small number of instances where NGLG farmers were found not to be in compliance with standards. When issues were found, affected products were removed from the market, and market managers explained actions required to come back into compliance. The role or need for market managers to serve as "pseudo" regulators of market standards was not anticipated, and led to several changes in how the NGLG implements its standards. First, all new farms to the NGLG are now required to fill out and sign a "disclosure statement and contract" attesting their understanding and compliance with standards to participate in the market. The statement requires growers to describe: soil amendments, pest control, weed control, inputs/products, tillage, irrigation, types of mulches, and seed or live plant sources. Market managers also visit each new farm following their submission of the disclosure statement. This visit is not described as an "inspection" but serves the same purposes in which market managers inquire on production practices and insure that farmers understand the market standards.

An interesting improvement recommended by a farmer but not yet implemented was to make each farm's Disclosure Statement available on the website. Such transparency would likely increase customer's trust in participating farms and the vetting process employed by the NGLG market, while also conveying knowledge about practices employed in sustainable agriculture. It would also likely decrease the likelihood of non-compliance concerns due to the emphasis on high disclosure. The reasons why this improvement has not been implemented are due in part to system level obstacles in posting items to the Locally Grown website, and in part to time and labor constraints. Disclosure forms would need to be filled out and saved electronically to avoid lengthy efforts to scan handwritten documents and upload them. In order to attach disclosures to each farm description an individual pdf would be uploaded and given a unique weblink address, then each farm description text box would have to be edited using a Textile to embed an HTML link. Since farmers cannot upload documents to the site, these activities would have to be performed by market managers, requiring considerable time. This demonstrates a small example of how some identified improvements to LG markets encounter system level obstacles.

The effort to establish and revise market standards for the NGLG market exceeded initial expectations, and additional areas such as standards for non-food items, live plant and seed sales, animal products, and processed foods added additional layers of complexity. However, there is a recognition that LG markets, perhaps more so than traditional farmers markets, are built on foundations of transparency and trust. As a result of customers and farmers never meeting directly, market managers are responsible for establishing a vetting process and this process has improved as the market has advanced.

NGLG market as a distribution collaborative

Just as a centralized marketplace on the web made it easier for farmers and customers to meet each other (creating a sales point of transaction), the "shuttle run" system between the two delivery locations (24 miles apart) increases the efficiency by which farmers products reach customers in physical space. These distribution efficiencies may be one of the central benefits of an Internet based market, particularly within rural communities. The NGLG market expands the distribution reach of any participating farm by aiding in their access to customers that would be impractical for them to access alone or through other markets due to the costs in labor, travel and time.

<u>Benefits of a Shuttle Run system</u>

The Locally Grown system is designed so that multiple pick up locations can be designated. When customers sign up they can choose which pick-up location they prefer, and when orders are placed each label indicates which pick-up location that item is intended for. To prevent each farmer from making two deliveries a shuttle run between the two pickup locations increases the efficiency of distribution. The map below (Figure 5.2) demonstrates the geographical layout of 18 of the most active farms and their delivery locations. The farms in green deliver to Tiger, and the farms in blue deliver to Clarkesville (each delivery location is red), with a 23.7 mile shuttle run between the two delivery locations.

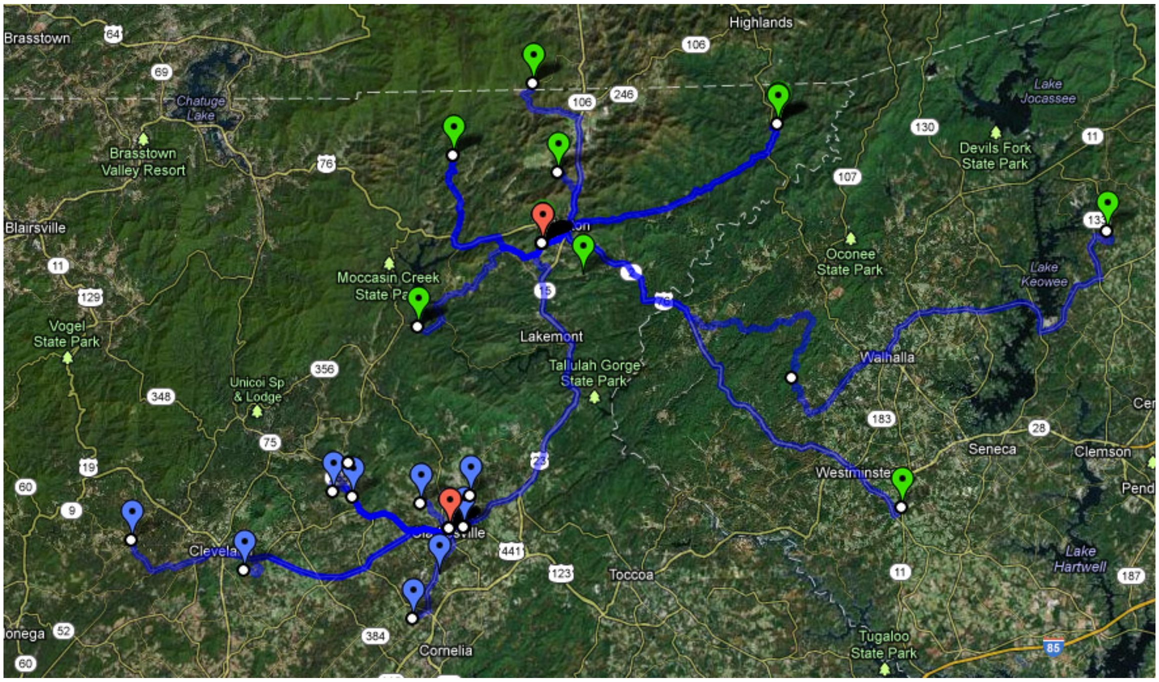

Figure 5.2: Distribution pattern and driving routes of farms delivering to the Tiger and Clarkesville delivery locations

These distribution efficiencies can be quantitatively analyzed with some precision using tools readily available on the Web. Though ArcView GIS technology is a readily available tool for such analysis, I wanted to demonstrate that public access tools such as Google Maps could provide the same functionality. To determine the efficiencies achieved through the NGLG's shuttle run system, I used the addresses of 18 of the most active farms (some substitutions were made to account for historically active farms) and identified their most likely route to their preferred delivery location. The actual delivery miles for each farm, shuttle distance, and total delivery miles if they were required to drive the shuttle distances themselves are shown in Table 5.2.

Table 5.2: Distribution pattern and driving routes of 18 historically most active farms delivering to the Tiger and Clarkesville delivery locations

FARM NAME	Delivery Location	Actual Delivery Miles	Shuttle Distance	Miles if no shuttle
Baird Family Farms	Tiger	55.6	23.7	79.3
Belflower Gardens	Clarkesville	15.1	23.7	38.8
Burton Mountain Farms	Tiger	12.3	23.7	36
Coleman River Farm	Tiger	12.6	23.7	36.3
Habersham Bakers	Clarkesville	9.9	23.7	33.6
Gibson Farms	Tiger	32.8	23.7	56.5
Gloryseeds Farm	Tiger	5.8	23.7	29.5
Indian Ridge Farm	Clarkesville	14	23.7	37.7
La Gracia Farm	Tiger	18.9	23.7	42.6
Leah Lakes Farm	Tiger	14.1	23.7	37.8
Liberty Farms	Clarkesville	3.5	23.7	27.2
Logan Berry Farm	Clarkesville	21.9	23.7	45.6
Melon Head Farm	Clarkesville	4	23.7	27.7
Moonshadow Farms	Clarkesville	3.4	23.7	27.1
Mountain Earth Farm	Clarkesville	1.2	23.7	24.9
Pure Natural Honey	Clarkesville	7.1	23.7	30.8
Royal Oaks Farm	Clarkesville	7	23.7	30.7
Sylvan Falls Mill	Tiger	6.8	23.7	30.5
TOTALS		**246**		**672.6**

Since every farm does not sell to the market every week I needed to establish the average number of farms selling per week, then calculate the average delivery miles travelled per farm for each market. I chose four market dates at random, one occurring during each quarter of the year (April 11, July 11, September 26, and November 21) counted the number of farms selling to those markets and established an average of 16 farms participating per week. Since the market began running 50 weeks of the year in 2012, with 16 farms participating per week that established 800 total deliveries in a year.

The average miles travelled per farm per week were averaged to 13.67 miles. If each farm had to deliver products to both market locations (ie. no shuttle run) this average shoots up to 37 miles per week. These figures allow us to estimate the savings the "shuttle run" produces in travel miles, hours, and gas mileage. Table 5.2 demonstrates that the total miles of travel eliminated through the shuttle are 18,522 miles. Savings achieved through this reduction in miles travelled were $2,904 dollars in fuel savings (calculated at $3.45/gallon, 22 miles to the gallon costing ~.16 per mile), and $4,026 in labor savings (calculated at $10 an hour based on an average rate to pay someone for those hours). The market managers are paid $20 each time they run the shuttle, deducting $1,000 from this savings, leaving $5,931.36 in total savings by eliminating travel distances for all farms to both markets.

Table 5.3: Delivery miles reduced and savings achieved through the distribution efficiency of a shuttle run

DELIVERY MILES	
Total Delivery Miles (All Farms each week)	246
Average Delivery Miles (per farm each week)	14
Average Delivery Miles if no shuttle (per farm each week)	37
Total Deliveries per year (16 farms x 50 weeks)	800
Total Deliveries x Average Miles (per farm per week)	11,371
Total Deliveries x Average Miles (plus shuttle miles)	29,893
DIFFERENCE (or miles saved w/ shuttle)	**18,523**
SAVINGS	
Gas Savings ($3.45/gallon, 22miles/gallon, .~16 per mile)	$2,904.69
Driving Time Saved in hours (46 miles takes 1 hour)	402.67

Value of this time at $10 an hour	$4,026.67
Gas and Labor SAVINGS	$6,931.36
Less cost for SHUTTLE RUN	$1,000.00
TOTAL SAVINGS	**$5,931.36**

This analysis is useful in trying to ascertain the benefits of such farm collaborations, and in fact are likely greater if incorporating time lost from the farm, wear and tear on vehicles, etc. However, such benefits may be purely hypothetical, as many farms would likely not participate in the NGLG market if it required a doubling or more of driving distances. And if farms were limited to deliveries at only one location, the number of customers and sales would likely be cut by half, making the market less appealing for the effort possibly eliminating the participation of some farms. As a consequence it is likely the pooling of customers, farms, products, and travel miles that create the efficiencies necessary to make the market worthwhile to all parties.

The use of the NGLG market as a distribution network is where this model diverges slightly and is a rural adaptation from the ALG market upon which the initial innovation is formed. The ALG market has a single delivery location in a customer saturated urban city, so multiple delivery locations would have limited benefit in terms of reaching greater numbers of customers, or reducing farmer distribution costs. In contrast, the NGLG market would likely not be successful without the pooling of geographically scattered resources including customers, farms and products.

<u>Distribution Collaborations between Locally Grown markets</u>

Due in part to the rising number of Locally Grown markets across the Southeast, distribution collaborations between separate but adjacent franchise markets are increasing. I first encountered the concept of Locally Grown drop off locations being exchange sites for other markets in April of 2009 during observations of the ALG market. I found that one of the farms, Double B Farm, had started their own home based Locally Grown in Conyers, GA. After dropping off their products to ALG, the farmer, who also manages the Conyers Locally Grown then received orders from other farms (dairy products as I recall) that he was taking back for his market being held the next day. The ALG had become a distribution hub for this farm to both drop off their own products, and then pickup products for their own home based Locally Grown market. This farm made an additional delivery at the ALG market to a third Locally Grown franchise market, also being held the following day.

Not only did this observation sow the first seeds of an idea, that a Locally Grown market might be easily established with a proper network in place, but that by capitalizing on the exchange opportunities with other markets, you can expand the reach of farm products, and diversify the products available through any given market.

Distribution collaboratives have materialized in the NGLG market in two ways. The first is the result of a need for niche farm products not commonly available in all Local Food Systems that are in an early emergence stage. Products such as pastured beef, chicken and pork, dairy and goat cheeses were either not available at all in our region in 2010, or not in high quantity, or not by growers interested in selling through the NGLG market. To give customers the widest array of products possible, market manager Chuck Mashburn established a relationship with a farm outside of the study region (in Madison, GA) that sells pastured meats to the ALG and several other Locally Grown markets. Since Chuck saw this farmer every Thursday at the ALG Market, it allowed this farm to sell products to the NGLG market with a week delay before delivery, with Chuck picking up the orders on Thursday and holding it for customers until the following Wednesday. For this farm the distance to our delivery location (Madison to Clarkesville is 81 miles) combined with the volume of sales would not have made it worthwhile for them to deliver these orders themselves. However, the mutual attendance of both farmers at the ALG market created an exchange site, and the diverse products create a benefit for the NGLG market. This is an example of a "uni-directional" distribution collaborative in which the NGLG assists a farm with distribution, and the farm assists the NGLG with their product diversity.

Multi-directional or pooled collaboratives occur when farmers from a general region who are all selling to the same Locally Grown market decide to pool their products and take turns making deliveries, reducing the total distribution costs for all farms and products. The benefits of these distribution collaboratives in rural areas can be significant. They often occur through a conversation such as, "I have to head right by your place on the way there, why don't I drop by and pick up your stuff and carry it there for you, and next week you can carry mine for me."

While this type of collaboration sometimes occurs within the NGLG market distribution, it is much more common between farmers that participate in multiple independent but adjacent Locally Grown markets. For example, two to three farmers from the NGLG market also frequently sell to the CAFE market (Clemson Area Food Exchange), which is also part of the Locally Grown system. The average distance to Clemson from these farms is 45-60 miles. Another producer is located in Westminster, SC, which is about 27 miles from these farms and 17 miles from the CAFÉ market delivery location. The Georgia farmers take turns delivering all items sold to the CAFE Market by delivering them to the SC farm, and he carries them the additional 17 miles to the CAFÉ market. In exchange the SC farm has his products that have been sold to the NGLG market carried back to be delivered the following day (See Figure 5.3).

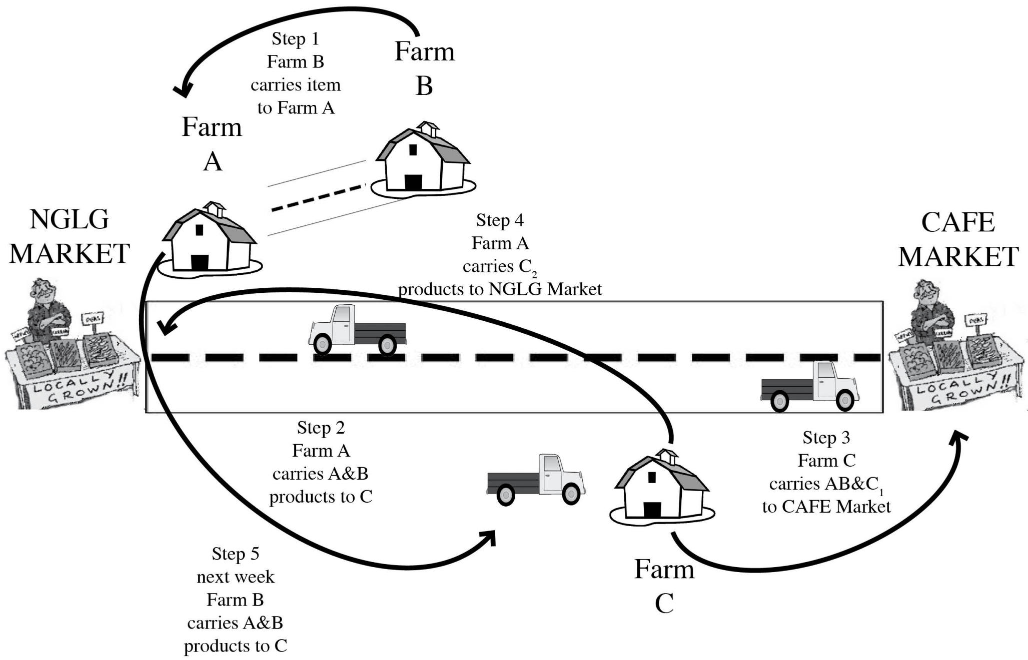

Figure 5.3: Diagram of a Pooled Distribution Collaborative between three farms and two Locally Grown markets

Sizing Up and Relationship to Food Hubs

One reason this distribution collaboration is effective is that the size of the markets and sales are still sized adequately so that products can all fit in the back of a truck or car, and are relatively easy to move from one vehicle to the next with little effort. However, this example highlights that the study region is still very much an emerging local food system, as opposed to one in which hundreds or thousands of pounds of food are being sold within the region on a weekly basis. The concept of food hubs has emerged in just the last three to five years and has been defined broadly as “networks that allow regional growers to collaborate on marketing and distribution" (Thompson 2012). Defined this way the NGLG market activities would be considered a food hub.

The USDA's working definition for food hubs is a bit grander in scope defined 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*" (USDA Rural Development 2013).

Regardless of the scale and scope that accurately describes food hubs, it is rapidly becoming a term and concept that is gaining traction, particularly at a policy and institutional level. It's yet to be seen if the NGLG market is a cornerstone to a broader food hub, or is simply construed as a farmer's market with a bit more collaboration amongst its members for mutual distribution efficiencies.

Expansion Plans

At the close of the 2012 season, the growers and managers of the NGLG decided that one of its primary goals was to expand the market by establishing an additional delivery location, preferably closer to an urban market. The impetus for this idea was a phone call from a representative of a subdivision in the Atlanta Metro area that wanted the NGLG market to consider selling to their residents. Though this opportunity did not come to fruition, it introduced the idea of establishing an out of area pick-up location. That same year, the neighboring CAFE market in Clemson (in which many of the NGLG growers also participate) added a pick-up location at an area hospital in an adjacent community and experienced a roughly 35% increase in sales. These new opportunities led the NGLG group to consider the following factors:

- New farms are establishing within the region increasing local food supply, while the customer base in rural areas is expected to grow at a slower rate. More farms may be competing for a limited number of customers.
- Nearby urban areas likely have significant untapped demand for local foods.
- The NGLG market is the best tool to market products from throughout the Georgia Mountains to new urban markets.
- In order to tap such markets, NGLG needs a collaborative partner within these urban areas to help establish relationships with the local community and provide a venue for the pickup location.

Fortunately, the LG market system accommodates such an expansion scenario, through it ability to allow multiple pickup sites. Market managers then just have to work out the distribution logistics. It is uncertain if the LG system was designed with this type of expansion in mind. More than likely the original conception for the LG markets was to establish a centralized urban market that then pooled farmers and products from a broad regional area. This flips that model so that rural farmers and their products organize first and then look for new untapped urban markets to sell to.

These expansion plans certainly constitute a significant modification to the LG market system and one that identifies interesting and uncertain relationships between rural and urban communities. Typically we associate urban markets as being under the control of the local community, and individual farmers must conform to the policies of the markets, including trying to gain access. In the future there may be increasing opportunities for established networks of farmers in rural communities to establish their own markets within urban areas by building key partnerships or relationships that facilitate access to new customers. In the case of the Clemson CAFE market, existing customers who were employed at the hospital helped facilitate establishment of the new market location, including volunteer and hospital administration support. The details for a NGLG market expansion are still on-going.

Even though the NGLG group has never mentioned the word "food hub" in its discussions, these activities could be seen as being in the same vein, as they address one of the primary constraints in expanding local foods, the "lack of distribution systems for moving local foods into mainstream markets." (USDA Rural Development 2013)

A Few Disadvantages of the NGLG Market

There is a tendency to evaluate innovations only in terms of their benefits. Despite the numerous advantages described, a small selection of disadvantages should be noted.

The NGLG market is an alternative, not a replacement for traditional farmers markets. NGLG customers, especially new customer are taking a significant risk by purchasing an item they have not seen, from a farmer they have not met. This risk likely translates to more caution by customers as they slowly feel out the reliability of the market as a whole, and any given farmer specifically.

One thing notably missing is the direct modes of interaction between customer and farmer. The modes of interaction created by the NGLG market (customer to farmer, customer to market manager, and market manager to farmer) are not always as fluid as desired. The ways that all parties interact are constrained by the LG market communication structures. These communication structures are system level features built into the website and largely beyond the control of the users. For example, farmers must sometimes be billed for missing items, or an item must be refunded due to quality problems. A debit is added to a farmer's account and taken out of their next check, but there is no means to attach a message explaining the reasons for the debit. A phone call, or e-mail can be made increasing the effort required to sort out such changes, but the ability to simply explain at the time of action is not inherent to the software at this time.

Another example is that farmer contact information is not automatically added to the website to allow customers to easily contact growers directly with concerns or questions, even though farmers provide their contact information when they establish an account. Because the LG market founder and designer has sole access to functional changes to the site, many problems of this kind must be addressed by other means that are under the control of the NGLG managers and users. Such solutions could be categorized as "work arounds" in which system level changes cannot be made, so a temporary, perhaps less desirable solution is implemented.

One effect of these modes of interaction is that market managers are required to serve as go-betweens for customers and farmers. This creates a greater responsibility for managers to correctly convey concerns expressed between the two, and to develop systems for both effective communication and response to problems. Such activities, if not constituting innovations, certainly represent additional modifications and improvements to the LG market innovation necessary to optimize performance.

For example, most customers are hesitant to express concerns when products do not meet expectations. It's uncomfortable to have to say that you were disappointed, especially when in traditional markets customers are usually able to simply avoid products that do not meet expectations. It's equally uncomfortable for market managers to inform producers that their products received complaints. These distanced modes of interaction do not convey valuable information that might otherwise improve a farmer's service, such as hearing from a customer who was surprised by the quality, packaging, sizing, or other characteristics of a given product. When market managers convey this information, farmers are often more protective, making corrections and subtle improvements more difficult. Market managers are put in the unenviable position of forwarding complaints, suggestions and other information that may better be conveyed directly between parties at a traditional market.

If customers fail to convey concerns and/or feel less assured of consistent quality from "all" items they purchase from the market, they are more likely to cease participation in the market. The NGLG market has lost customers due to such concerns, demonstrating a unique dilemma inherent to collaborative markets. Poor quality products from one farm (perhaps even on one occasion) can cause the permanent loss of customers to the entire market. Such intertwined fates reinforce the necessity of strong standards beyond those described for sustainable production practices that also include food quality standards. In response, the NGLG adopted a refund policy so that if customer expectations are not met, and the market manager agrees that the quality is not "as described" or what reasonably would be expected, then the item is refunded and billed to the farmer. When items with questionable quality are spotted in advance, customers are given a choice to decline the item, or pay a discounted price, with farmers billed for the remainder.

Adaptation of a Farm to the Locally Grown system:

Farm level innovations for success

Of the 43 farms and food producers that have participated in the NGLG market, there is one that stands out for its ability to develop a farming and marketing system highly compatible with Locally Grown markets. This short summary will highlight ways in which Leah Lake Farm, run by Brooks Franklin, and located in Otto, North Carolina, has adapted his farm management to be highly successful selling through Locally Grown. In fact, this new farm (beginning it's third season in 2013) sells almost exclusively through two Locally Grown markets, the NGLG and CAFE markets (80% of all farm sales), and had the second highest sales of all farms selling to NGLG in 2011, and the highest sales in 2012.

The farm's focus is on lettuces and other leafy greens, which thrive in the microclimate of the farm located in the mountains where cooler temperatures prevail even in the summer months. A series of inexpensively constructed low tunnels provide protection to the greens, and their orientation on sloped land allows heat that builds up in the tunnels to be vented naturally as warm air rises up slope and cool air is pulled into the houses from the low ends. These conditions likewise are ideal for the year-round production of leafy greens.

Diversity Sells

Leah Lake Farm capitalizes on product diversity, understanding that it may be hard to sell the same items to customers every week, week after week. For example in 2011, Leah Lake Farm sold 115 unique products through Locally Grown, 10 of which were flowers, 15 were lettuces, 45 were plant starts sold to home gardeners, and assorted leafy greens and root crops. In 2012, this diversity shot up to 184 unique products, 42 of which were lettuces, 85 were plant starts, and the rest assorted leafy greens, root crops and flowers.

The key to this diversity is planting with markets in mind. Since the farm plants crops that are often harvested within 30 days of planting, they plant 4-6 trays of starts a week. The key is to plant half trays of each variety. Since customers are unpredictable and may buy all of one variety one week, and the next week buy none, they offer more options but less of each option on any given week to avoid entire rows growing past harvest size due to lack of demand. This has the added benefit of making customers familiar with different varieties. Most customers will not buy one type of lettuce every week for months, but they may buy a different type of lettuce every week, then switch to Asian greens, then to collards, then back to lettuces, ensuring you capture those sales every week. *"You just never know so I plant in short bursts to get around that type of thing."*

<u>Marketing quality, consistency and brand loyalty</u>

Because customers and farmers rarely meet through Locally Grown establishing a reputation for consistent high quality produce makes a considerable difference. Market managers have observed individual farm sales plummet after problems with poor quality produce, leading customers to avoid that farm in future purchases.

When asked why Leah Lake Farm has paid so much attention to details in both the produce quality and the packaging Brooks answered, *"Because that's what they do at the grocery store…I don't wash my lettuce at home* [bought at the grocery store], *so I don't expect people when they get my lettuce to wash it. Our customers have the choice to either come to us or go to the grocery store. I try to make mine look just like the grocery store. People have choices."*

Leah Lake Farm's products come in a clear bag with a Leah Lake Farm sticker affixed to each bag. He hires high school age kids every few months to affix stickers to 2,000 bags in a couple of hours and it costs him $40. These simple extra steps achieve several long-term advantages. When customers pick up their items at Locally Grown they often observe other products that catch their attention, leading to future purchases. The clear bags allow customers to see the product, and to observe its quality. The stickers then notify customers of the farm associated with the products. For the purchasing customer if they are satisfied with the product they develop a positive impression and loyalty to the farm. This is especially valuable, as many customers likely don't bother to remember which farms produced the foods they purchase from week to week. Even though farm names are affixed to the delivery label, in conversations with customers they frequently recall an item they particularly enjoyed but not the farm that produced it. This is rarely the case with Leah Lake Farm products as every time you reach in the fridge you are reminded.

For customers observing products at the market the sticker reminds them to look for products from that farm. "*Just seeing the sticker, they know what's gonna be* *in there.*" Marketing and brand loyalty are time-tested approaches to establishing a relationship with customers and one especially important to this type of marketing system.

Summary

Evaluation of the NGLG market over a three-year period suggests the following findings. The unique characteristics of LG markets create a strong incentive for farmers to adopt the innovation. LG markets are very easy to adopt due to the intuitive nature of the software, and the constant refinement of the system to incorporate improvements stemming from the innovation founder's personal market experience. LG markets also provide extensive benefits to farmers in terms of reduced risk, reduced time and labor, extended season, broadened customer base, and creates network opportunities with other farmers.

Once LG markets are adopted, improvements must be made at the local level to insure increased performance and satisfaction from farmers and customers. These improvements should be evaluated as innovations as their contributions increase the social and economic benefits realized beyond the adoption of the initial innovation. Many of the improvements made by the NGLG market are context specific and based on the needs and feedback given by farmers, customers and the broader community, and shaped significantly by the roles and responsibilities of the market managers.

For the NGLG market these improvements consisted of market standards, distribution collaboratives, surveys, market kickoff days, refunding customers, expanding purchasing days, and improving naming protocols. Some of these innovations arose through identification of needs and opportunities within the local food system, while others were observed and adapted from adjacent LG markets. This interaction with adjacent LG markets provides a rich source for both innovation adoption, and innovation development based on ideas generated through observations.

The NGLG market meets all criteria for a key innovation, as it addressed numerous farm problems, had wide applicability, strongly shaped farm management and strongly shaped the local food system. Likewise the NGLG market easily met criteria according to Rogers (2003) attributes of innovations model, in which its relative advantage, compatibility, complexity, trialability and observability were all advantageous for adoption of the practice.

The market clearly provides a valuable tool for increasing innovation capacity within the local food system, primarily through the increased interaction amongst farms within the local food system, and with farms and markets in adjacent local food systems (demonstrated through interactions with adjacent Locally Grown markets). Such interactions are anticipated to lead to new opportunities and possibly the development of new innovations.

The NGLG market helped unify local food system participants (producers and consumers) across a broad geographic area that once had little to no interaction with one another. Most farmers from adjacent counties did not know one another prior to this collaboration, so this market became the starting point of networking collaborations throughout the region.

Most of the innovation improvements to the NGLG would be described as "practice level" as opposed to "system level" innovations. One significant limitation for making system level innovations is the constraint in making functional changes to the market software, an activity beyond the control of adopters. The Clemson CAFE market is in the process of developing their own ordering system software in order to regain some control over these system level processes, with an additional benefit of retaining the annual software-licensing fee. It's unclear which of these motivations is dominant. Such development of a new system is likely to be challenging given the complexity and the years that were required to develop the initial LG system, but suggests that in the future, farmers may want to have more influence over system level processes.

The adoption and replication of Locally Grown markets throughout the entire Southeast region has significantly influenced the collaborations that are occurring amongst adjacent local food systems. These interactions were unanticipated at the outset of the study and are significantly shaping future opportunities. Taken together, the Locally Grown market innovation is contributing towards early development of regional distribution systems, as well as loose networks for rapid knowledge exchange, both activities worthy of further study.

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CHAPTER 6

THE ROLE OF FARMER NETWORKS IN INNOVATION

Nationally, the spread of sustainable agriculture has been greatly facilitated by a variety of organizations, many of which focus on the generation and exchange of knowledge amongst practicing farmers (Hassanein 1999). Knowledge networks are those in which the "generation, sharing and use of knowledge and information between network members" is the primary organizing principle (p.44, Engel 1995). They can be formal or informal associations, consist of "like-minded" or heterogeneous actors, and typically maintain their autonomy (especially in comparison to government facilitated organizations) (Engel 1995). Such knowledge-based networks serve two important roles for sustainable agriculture practitioners. They provide a forum for farmers to exchange "*ideas and techniques ignored or marginalized by agricultural science* (p.27, Hassanein 1999)." Such exchanges frequently lead to innovation adoption, innovation adaptation, or may contribute to the development of completely original innovations based on unique combinations of ideas. Networks also frequently engage in collaborations. Network collaborations can become a form of innovation in and of itself, in that they can achieve social or economic goals that no individual farmer can achieve in isolation. Such collaborations can also expand the innovation capacity of individual farms, the network and the broader local food system.

In this chapter we explore the development, formation and activities of the region's first "farmer based" knowledge network, and assess how this network contributes to individual and collective capabilities to innovate, and the innovations which result.

Networks in the Region

During farm visits, farmers frequently mentioned the desire for a cooperative, or described efforts to glean knowledge from other farmers, at farmers markets, or by attending farmer meetings or workshops in other communities. There was almost universal desire for more frequent interaction between local farmers, with a primary goal to exchange knowledge and ideas. One farmer commented that "*Chuck* (a fixture in the sustainable farming scene) *kind of officially is the farmers network in Rabun County*," demonstrating that key farmers served as hubs for information. Aside from one-on-one interactions between farmers, meetings related to farmers markets were the only occasions that farmers met together, and these meetings focused primarily on the needs of the market, and less so on individual farms, knowledge exchange, cooperative opportunities, and local food system issues.

To better understand the role of networks in innovation, I participated in as many meetings as I could of groups or organizations that addressed goals or interests of farmers. A listing of every known network in the study region that had significant farmer involvement is found in Table 6.1. Each group facilitated informal communications amongst numerous actors that led to mutual support of local food system goals.

Table 6.1: Listing of all local food and farming social networks within the study region organized by date founded

Name of Social Network	Description / Dates of Activity / Participation
1. Simply Homegrown Market	The first local/sustainable foods focused market formed within the region. Located in Clayton, GA. Founded 2002. Still Active. Approximate participation – 20-30
2. Authentic Food Growers Association	A loose group organized by a technical expert for use of compost tea with the primary intent to promote concepts of soil life management. Mixture of farmers and non-farmers. Located in Franklin, NC. Founded - unknown. Approximate participation – 25-30
3. So Called Farmers Market	A local/sustainable foods focused market located in Sautee, GA (White County) that was active between 2008-2012. Approximate participation – 12-16
4. Foodways Alliance	A local / sustainable food advocacy organization who hosted an event in Clayton called "Grow, Cook, Eat" which highlighted local food production and local chefs. Mixture of farmers and non-farmers. Active 2007-2010. Approximate participation - 25
5. Sustainable Mountain Living Communities	A non-profit working in Rabun County focused on developing a sustainable food hub. Projects include a community garden, gardening classes and film series, sponsorship of the Simply Homegrown market (to give non-profit coverage), and development of a community kitchen. Leadership is primarily by non-farmers. Formed in 2009. Approximate participation - 30
6. Northeast Georgia Locally Grown Farmers Market	A local/sustainable foods focused internet based farmers market covering a 5-7 county area. Founded 2010. Approximate participation - 40.
7. Transition Sautee	A community group based in the Sautee community focused on the need for societal adaptations to peak oil and climate change. Active 2010-2012. Very few farmer participants, but considerable interest in farming, gardening solutions. Approximate participation – unknown.
8. Clarkesville Farmers Market	A new local/sustainable foods focused farmers market founded summer of 2012. Approximate participation - 16.
9. Ethical Growers Guild	A short-term ad-hoc group with almost solely grower participation to discuss how to handle competitive situations in the marketplace in an ethical manner. Active 2011. Approximate participation – 8
10. Georgia Mountains Farmers Network	A network of local/sustainable direct to market focused farms for the purposes of information sharing and collaborative efforts that benefit all farms in the region. Approximate participation – 30-40
11. North Georgia Farm to School	More of a funded project than a network, this effort did bring together a diverse group of farmers, educators, chef and others. Also mixed conventional and sustainable farmers for the first time through a program to get more local foods into schools.

A review of networks described in Table 6.1 reveals several different types of networks with unique organizing principles. "Market networks" are those in which communications and collaborations are centered on the goals of a single market. These goals can be rather broad and include: establishing participation guidelines; governance policies; co-marketing or advertising; and distribution collaboration (in the case of an on-line market, see Chapter 5). Occasionally, market network collaborations evolve beyond the immediate needs of the market, and certainly individual farm goals can be met or enhanced through market collaborations (see Chapter 5).

Two networks, the Sustainable Mountain Living Communities, and Foodways Alliance, focused on local food system goals, with participation from a broad audience of community members interested in promoting and increasing availability of local foods. These networks most closely resembled NGO styles of organization. While farmers participated in these "local food system" networks they were not "farmer focused" associations. A frequent comment heard from farmers is that they hoped that these groups would focus more attention on the support of farmers and the farming community. These were not criticisms per se, as farmers still very much support such groups. However, they did observe that a mixed audience diluted the focus, demonstrating that there are some network advantages to a homogenous group of just farmer participants that cannot be achieved by heterogeneous groups, and vice-versa.

Several networks could be described as "knowledge networks." The Authentic Food Growers Association, despite its name, consisted of mostly nongrowers and focused almost exclusively on "soil life management" principles, and was led by one of the non-traditional consultants in compost tea applications. Only one farmer in the study consistently participated in this network. Transition Sautee, likewise had minimal participation from farmers in this study (only two) and focused broadly on sustainability practices beyond small-scale farming, especially fuel and energy self-reliance. These peripheral networks influence the farming community but do not constitute farmer networks.

None of the existing networks visited through 2011 fulfilled farmers' expressed desire for more farmer interactions, increased knowledge exchange, potential collaborative efforts, and a focus on farmer's needs. This assessed need, my own background and interest in "farmer-based" networks, and a uniquely timed opportunity led to formation of the regions first "farmer-based" network.

Initiation of a Farmer Centered Network

In February of 2011 under the encouragement from a local farmer, Ed Taylor of Indian Ridge Farm, I applied for a small grant from the national non-profit Certified Naturally Grown (CNG) for funding support to help with the formation of a farmer-centered network in our region. The grant was to fund an Organizer to help develop "*a shared vision for the network with other area farmers*," and guide "*the implementation of this vision* (CNG, 2011)." I was selected for the organizer position in September 2011 and through March 2013 the CNG grant provided support to facilitate the formation and development of the Georgia Mountains Farmers Network within the study region.

Certified Naturally Grown (CNG), the organization that provided the seed money for the network, is a nationwide non-profit that provides a certification alternative to the USDA's National Organic Program for small, direct market farmers that use natural growing practices. The organization, with offices located in Brooklyn, New York, has approximately 800 certified farms located in 48 states; quite small relative to the 12,941 USDA certified organic farms in the U.S. in 2008 (CNG 2010, USDA/ERS 2010). The certification process uses a Participatory Guarantee System (PGS), in which CNG certified farmers conduct the inspections for other farms located within a close geographic proximity of one another. The PGS certification is defined as *"locally focused quality assurance systems* [that] *certify producers based on active participation of stakeholders and are built on a foundation of trust, social networks and knowledge exchange* (IFOAM 2013)*."* Farmers must reach out to other farms in the region to perform their inspections (since reciprocal inspections in a given year are not allowed), and the program encourages sharing and advice between farmers during such interactions, which they believe strengthens the natural farming community. While the standards for certification are based on the USDA's National Organic Program, there are some key differences most notably CNG's minimal reporting and record keeping requirements, and the significantly reduced costs of CNG certification which runs about $110 annually, compared to the USDA organic certification (organic third party certifier fees in Georgia without cost share run about $650 plus mileage expenses for small farms).

In 2010, the Certified Naturally Grown organization applied for a USDA Farmers Market Promotion Program (FMPP) grant to focus on the development of at least four new farmers networks for small, direct market, naturally producing farms within the states of Georgia and Tennessee. The goal of these pilot networks would be to implement strategies for achieving group based "*cost-savings, collaboration, learning, resource sharing and joint marketing of locally grown food*" (CNG, 2010 p.2). The project also set out to identify the elements of successful farmer network development in order to use these findings to assist in the startup of additional networks.

Georgia was chosen as a target state for the pilot program as the number of CNG certified farms is higher than in any other state in the U.S. numbering 80 in 2013, or about 10% of all CNG farms. Three network organizers were selected from Georgia, and two from Tennessee. Each organizer made a one to two year commitment to work approximately one hour a week on network activities (on average), with grant funds used to pay an hourly rate.

Network organizers were provided with guidance materials to assist in early organizing activities such as "how to organize a successful first gathering", or a listing of "possible activities for a network." In the first year, network organizers also participated in monthly conference calls held by the CNG Executive Director in which the five organizers in Georgia and Tennessee would exchange experiences, insights and ideas to help further develop each network. These organizer conference calls became a critical forum for encouraging adoption and adaptation of ideas and techniques used by other groups.

Preparation for a Network

In order to achieve a "shared vision" of a network "with other area farmers" phone interviews with 12 farmers were conducted prior to a first meeting to collect significant input on farmers interests in forming a network, and what they'd like to see a network accomplish. Detailed feedback from farmers was typed, condensed to bullet points and circulated back to participants as a document titled "possible activities for a growers network." This would later be adapted into a draft list of network priorities. Farmers' feedback was also sent back out via e-mail and a weblog, so they could see different responses from the group, including verbatim quotes. This technique of making sure individuals felt their voices were heard has continued to be a key practice in facilitating the network.

All the farmers that were called expressed a strong interest in the development of a farmer's network, specifically in visiting one another's farms through comments like, "*I've never seen Sid's farm,*" or "*I'd be into seeing what people with Greenhouses are doing."* Farmers recognized the benefits of visiting each other's farms by noting, "*we all need new ideas*," and expressed an interest in forums for "*sharing information.*" One farm had particular insight on the potential benefits.

> "*The biggest problem I see that small farmers have in Habersham and Rabun is we don't talk with each other and we feel real isolated. It's exciting to hear people talking about what they're doing. I think it makes people feel less isolated….. it makes us more open and less competitive.*"

It was clear that even though many of the farmers in the region did have some interaction, it was not meeting farmers' needs. In the years leading up to the launch of the network many small-scale sustainable farmers had yet to meet each other and many of those farms that had met, had yet to visit each other's farms. One farmer commented, "*We get to see one another but it's not in that context,*" meaning learning from each other's farms and a forum in which the sharing of information and collaborations towards mutually beneficial goals are the primary purpose.

Farmer networks and collaborations were not an unfamiliar concept. One farmer explained, "*we experienced a similar thing in Virginia called SHARE DAYS where you share information… great for new farmers, a tour and a kind of class.*" Many of the insights offered by farmers during these preliminary interviews were used to help structure future network activities. This description of "share days" helped demonstrate to those new to hosting farm tours the value of structuring the talk like a class on a few focused topics that you teach to the group, giving each farm tour and farm host more focus.

Some farmers expressed a concern that "*some people have proprietary information*," and this may impede the free sharing of information at network gatherings. Another farmer mentioned that the gatherings would be successful "*as long as folks don't worry about trade secrets*." These comments bring to the fore the notion that the sharing of information and ideas in a competitive marketplace may have disadvantages, namely that people may steal your ideas and use them against you in the marketplace. These perceptions will be addressed again in the analysis.

First Meeting / Establishing Network Activities and Priorities

The first meeting of the network was hosted by Burton Mountain Farms in Rabun County on Wednesday, January 25th, 2012. In preparation for the meeting all farmers received several e-mails that included a summary of quotations from fellow farmers regarding their interest in forming a farmer's network, and possible activities such a network could pursue. Twenty-two farmers (of forty contacted) participated in the first meeting. The first meeting followed a similar format to nearly all-subsequent get-togethers with a farm tour given by the host farmer beginning at 4pm, followed by a potluck and social time (each farm always described their dish and its ingredients) at 5pm, then followed by a network or business meeting at 6pm.

The central focus of the first business meeting was to discuss and vote on activities or priorities for the group to work on together. Using input gathered during the phone calls and a brainstorming activity during the meeting a list of eleven possible network activities was identified. In order to gauge the relative interest the group had towards each activity a sticky dot survey method was used, in which each farmer received three stickers which they could place next to the items they felt were most important (method adapted from Lev et. al. 2007). Table 6.2 shows the priorities and votes from this first prioritization.

Table 6.2: Listing of Possible Activities for a Growers Network or what would you like a Growers Network to accomplish?" priorities set at first network meeting.

Priority	Description	Votes
Cooperative Marketing efforts	Example- Develop systems for bulk deliveries to Atlanta area, restaurants, etc.	8 VOTES

Coordinating Bulk Orders	To increase availability and reduce shipping on amendments, supplies, seeds, potatoes, onions.	7 VOTES
Share up-to-date Contact Lists	That includes other farmers, but also restaurants who buy local, local suppliers, technical experts, etc.	6 VOTES
Host Farm Tours	Specifically for GROWERS (focused on sharing information)	5 VOTES
Acquisition and Sharing of Equipment	Such as compost tea sprayers, bed shapers, others?	5 VOTES
Obtaining or Producing Organic Feed	It is difficult and costly to obtain organic feed easily.	5 VOTES
Organization of Crop Mobs	Labor assistance. Bringing volunteers to your farm to have them work on a project or weed for an afternoon.	4 VOTES
Create Forums for more frequent Farmer Communication	Possibly launch a Yahoo Group or website so that we can post information for each other to see.	3 VOTES
Developing Marketing as a Group	Co-branding regional products like a logo, identity	2 VOTES
Organizing specific and technical workshops	Bringing in experts from other areas	1 VOTE
Hosting Public Events	Increase customer base / awareness	This option not posted during voting

Shortly after the first meeting the organization chose the name Georgia Mountains Farmers Network (hereafter referred to as the GMFN), created a website to post calendar announcements and other communications and began working towards several priorities identified on this list.

The network's priorities have been revisited frequently, with each discussion refining the needs of the group, how each priority is described, and what activities the group wants to undertake. In February and March of 2013, after a full year of network meetings and discussions, 13 farmers participated in an online survey that adjusted the ranking of the above priorities, added a new priority (to increase capacity for local food processing), consolidated priorities that were redundant, reviewed accomplishments and outlined future goals (see Appendix C).

Most of the network activities in Table 6.2 could be construed as innovations themselves since they represent social and economic outcomes that can best or only be achieved through network collaborations. For example, cost savings achieved from bulk orders is a very simple concept, and in fact small groups of farmers had coordinated amongst themselves prior to the network helping to facilitate the practice to a wider group. In evaluating such practices it is useful to ask what, if anything, makes the network collaboration engagement with this practice innovative. For the bulk order practice it may be the following: more developed communication channels that can be replicated (use of website, spreadsheet of farmers), identification of resources (one farm that had forklift to unload and covered space to house orders), increased participants (that reduced shipping cost and increased savings), and continuity from year to year allowing improvements (though ironically interest for a bulk order the following year was smaller). For some farmers, the bulk order process exposed them to materials and practices that they were not familiar with before. Again, these are small improvements, but through the nature of networks, the social and economic results achieved can sometimes prove to be significant. Once a system of relationships is in place they can lead to coordination on other unforeseen efforts based on new opportunities, as will be demonstrated as the network develops.

Just as individual farm innovations could be sorted into types according to the challenges they addressed (the innovation typology), network innovations also address challenges and answer the question, why would the network innovate, what are the motivations? Though it was unanticipated at the outset of this research that network activities could be treated as innovations, it was useful in the analysis to sort each one according to the innovation typology that was developed. For example, "cooperative marketing efforts" were found to be time saving, costs saving, energy saving (fuel miles), labor saving, achieve better performance, and address marketing, network/organizational, and income enhancement. One advantage of this analysis was to thoroughly examine how each network priority benefits network participants. For "acquisition and sharing of equipment" it was found that the typology was somewhat incomplete in its specificity. While "cost savings", and "network/organizational" benefits were clear, it was unclear how to account for the ability to trial a piece of equipment before making a purchase. Though "knowledge acquisition/farmer training" most closely fits, it was valuable to parse out the specific contribution, as the network itself demonstrated its ability to tangibly improve the "trialability" of other innovations through an equipment-sharing program.

Structure and Focus of the Network

Many knowledge networks maintain an informal structure, and though the GMFN has not yet incorporated into a formal organization or established stringent governance policies, the group has maintained goals and priorities as a way to keep farmers vested in the process. In an interview with CNG staff I commented, *"I really feel that the networks that will succeed in bringing change in their communities are the ones who are able to define who they are and what they're doing....But I'm also* *trying to remind myself that networks are valuable even if they are just to get-together."* Farmers have likewise expressed that just "getting together" to exchange ideas is what they appreciate most about the network. Collaborative efforts are definitely a secondary goal, and are likely to create structure for the network as it grows and matures, but farmers value the network most in its early stages of development for its ability to increase interaction and knowledge exchange.

Meetings and Activities of the GMFN

In the course of 15 months (January 2012 – March 2013), which was the duration of the CNG funding, the GMFN coordinated 9 activities, 6 of which would be described as Farmer Get-Togethers in which one farm offered to host a tour, potluck and network meeting. The other three activities each represented a priority activity established by the network. Table 6.3 provides a summary of these meetings and activities.

Table 6.3: GMFN Meetings, Activities and Outcomes (January 2012-March 2013). Bolded items are non-farm tour network activities

Date	Location	Activity/ Outcomes
1.25.12	Burton Mountain Farm	First On-farm tour, potluck, meeting Established 11 Network Priorities
2.27.12	Woodland Gardens	On-farm tour Committed to Georgia Mountains Farm Tour
3.8.12	Burton Mountain Farm	**Organized a bulk order ($1,400 worth of supplies)**
4.24.12	Taylor Creek	On-farm tour, potluck, meeting Conducted group CNG inspection Established retail markets as priority Established details for Farm Tour
6.29.12 & 7.1.12	18 Locations	**Hosted the Georgia Mountains Farm Tour** Raised $600 for the network
9.10.12	Melon Head Farm	On-farm tour, potluck, meeting Reviewed Tour Feedback
2.19.13	Ladybug Farms	On-farm tour, potluck, meeting Established Priorities for 2013

3.19.13	Blairsville, Union County	**Union County Cannery Tour**
3.26.13	Leah Lake Farms	On-farm tour, potluck, meeting Planned Georgia Mountains Farm Tour 2013 Discussed group insurance

General Knowledge Exchange

Observations of network activities reveal that knowledge exchange occurs each time that farmers interact. The forms of this interaction are valuable to distinguish. The “farm tour” format of network gatherings allows the host farmer to build trust amongst network participants by sharing their practices openly and freely. The openness of the host farm is a significant signal to the group, that they trust the group enough to share intimate details of their farm and practices with the hopes that such information may be helpful. In exchange for this openness, attendees often share their experiences and ideas back with the host farmer and the group, laying out many different approaches for all to consider. As one farmer observed such interactions, “*makes us more open and less competitive,”* and ideally helps to diminish the perceived concern that “*some people have proprietary information*," or “*trade secrets*,” that would prevent them from freely sharing information. The advantages of freely sharing are often greater than any perceived needs to keep secrets.

This give and take of interaction during farm tours also means that knowledge may come from any participating farmer, not just the farm host. The host farmer creates the context for discussion, but ideas, suggestions and solutions may come from anyone in the group.

Knowledge and innovation exchange also occurs around the peripheral of network gatherings, via side conversations and phone number exchanges. Following the first meeting, several requests were made for phone numbers of farmers they'd met at the meeting. Many farmers met each other for the first time at network meetings, particularly those living in different counties. These first encounters led to several farmers coordinating visits to each other's farms, independent of any network activities. Initial interaction often encourages more interaction.

A small number of farmers often remain after meetings to continue exchanging ideas on particular challenges and needs. One farmer commented, "*this is more important than the actual meeting*," as such interactions often allow farmers to go into more depth in their experiences. These slightly more intimate conversations have a deeper "give and take" aspect, which increases farmers' willingness to reveal more than they might with the full group. There was sometimes a cautiousness in such interactions (especially in early stages of the network), in which farmers share secrets only to the extent that there is a real balance within the exchange, meaning one person is only willing to share as much information as the other is willing to share with them.

Networks benefit from consistent communication tools that serve to enhance knowledge exchange in-between formal get-togethers. Following the meetings, a short summary of the tours, along with photographs, and on occasion, audio recordings, were posted to a Network Blog (http://georgiamfn.blogspot.com/) so that farmers who were unable to attend are able to glean some of the information that was shared. Such digital postings are the equivalent of what formerly would have been a hardcopy newsletter. Since these postings are made public on the web, they also provide an opportunity to stimulate deeper interest from others in the community, in effect communicating how farmers practice their craft with existing and potential customers, and perhaps future farmers. However, the meetings and activities themselves are for growers only, in order to maintain a farmer-centered focus, with others in the community able to peer in slightly from a distance.

Specific occurrences of innovation adoption

The network interactions described have led to the adoption and/or adaptation of specific innovations shared between farm participants. Table 6.4 provides a short list of known innovation exchange and adoption as a result of network interaction.

Table 6.4: Specific occurrences of innovation adoption from network interactions

Innovation	Description
Passive solar greenhouse with black painted rainbarrels for thermal retention	This innovation was observed during a farm tour in September of 2012. The practice was adopted, adapted and implemented and discussed by the host of the next farmer gathering in February 2012.
Soaking Seeds	A farmer mentioned that he achieved significantly better germination rates when soaking seeds before planting. Many farmers tried this practice and we're pleased with the results.
Spraying plants with worm casting tea	After meeting at a network event two farmers arranged a one-on-one meeting at which a compost tea trial was demonstrated. As a result the farmer began implementing the practice.
Mixing lettuce seeds	Rather than plant single varieties of lettuce, lettuce mixes are planted together in starter trays. Implemented by a farmer attending the tour.
Cutting in a swale to divert water	This technique to divert water away from problem areas was observed and applied in a different setting.

Hoop Houses and Drip Tape	For a new farm, our tour of established hoop houses with drip tape in Athens in February of 2012 was their first observations of these techniques. By the following year they had adopted the practices.
NRCS grants - high tunnels and irrigation	A tour exposed a farm to information about NRCS grants. The farm followed up by applying for and receiving the grant.
Use of an Earthway Seeder	The GMFN purchased its first piece of shared equipment and gave a tutorial on how it is used in March of 2013. A farm loaned the equipment and utilized it.
CNG Tour Inspection	During a Farm Tour the attendees conducted a Certified Naturally Grown inspection as a way to familiarize the group with the process and to go over every aspect of farm management. This method of conducting CNG inspections was adopted by CNG and promoted widely to other networks, some of whom have implemented the practice.

When farmers self reported innovations they had adopted following exposure at network activities they most frequently mentioned production innovations. Farmers tendency to focus on production innovations, a point noted in prior chapters, may cause them to overlook innovations they've learned regarding marketing, food processing, or other farm related practices. However, just as my time on farms was spent mainly in farmers' fields, farm tours are likewise focused on the production environment (a cannery tour being the one exception). There was also likely a failing on my part to consistently emphasize an interest in innovations adopted beyond the production environment.

Newer farmers benefit the most from innovation exchange opportunities presented at network hosted farm tours, with new farms reporting the most innovations adopted, and established farms reporting the fewest, or none at all. This finding is not surprising as knowledge requirements are highest for new farms, and many practices will be new to them, making them innovative in their implementation on their own farms. In this regard, new farms have the most to gain from network interactions, and are likely to adopt the most innovations.

Sharing Innovations / Competition vs. Cooperation

A critical question when looking at the mobility of innovations within a specific region is, "do farmers want to share their knowledge of the innovative practices that make their farm more efficient, profitable, and help them market to customers more effectively or would the sharing of these ideas potentially harm an individual farm in a competitive marketplace?"

Trillium Farms is one of the longest standing local food farms in the study, beginning operations in 2002 and specializing in microgreens, which are juvenile salad greens of a wide variety of plants usually harvested within 14-21 days of germination and highly regarded for their high vitamin content. The farm cultivated this niche product to capitalize on the small growing space that microgreens require (the farm is space limited), the high dollar value, the nutrient density, the appeal to high-end restaurants and the niche market appeal (namely that virtually no other farms were competing with him in the marketplace). The farmer, Steve Whiteman also relies on his farming income as his primary source of income, which distinguishes his operation from the majority of farms in the study who do not rely solely on farm income.

Perhaps more so than other growers, Steve is concerned with competition in the marketplace both in the form of pricing, and in niche market development. For example, Steve's primary product is a microgreen mix consisting of about seven different kinds of greens. This mix is his trademark and he expressed concern that other growers could figure out what the mix consisted of and imitate it. He mentioned another grower known to grow microgreens, once purchasing a bag of his microgreen mix, which he feared was with the intention to identify each variety in the mix. Since there is nothing proprietary about his mix his strategy has been to give unique names to his greens to protect their identity. This practice not only helps keep other growers from discovering some of his innovations (ie. the specific plant/seed varieties that he has chosen or that perform well due to color, taste, etc.) but also enhances the intrigue or interest for customers. By giving each green a name of his own invention such as “Basawi” for a spicy green (a derivative of the word wasabi), “tiny brown” for a very small flavorful green, “kings lettuce” for his staple green that adds body to the mix, and “corn sickle” for micro corn greens he draws customers in to his storytelling abilities, creating a marketing advantage since customers are rarely interested in the specific variety name, and much prefer an interesting story.

In the late summer of 2011, Steve mentioned that he was organizing a group of growers to form what he called the “Ethical Growers Guild” or EGG. His stated purpose for the group was an “association of mutual aid,” or to open the channels of communication amongst farmers to reduce encroachment and competition amongst one another. The group had only one formal meeting, and they discussed that instead of principles of the guild it was easier to discuss specific instances where an opportunity to exploit a market may encroach on another grower and how they might deal with that. The goal was to be a good EGG.

Steve had encountered a competitive conflict when a restaurant asked him if he could grow large leaf lettuces, which he doesn't normally grow. Steve was aware of another grower who also sold to that restaurant and also grew large leaf lettuces. Rather than take advantage of the invitation to grow the product for the restaurant, he decided that the right thing to do was to simply call the grower and describe his dilemma. He found out that the grower had thought that he was several weeks away before his lettuces were available, but that he was actually ahead of schedule and could fill the restaurants orders.

This example indicates two things. For some growers, competition is perceived as a significant risk to farm stability. To account for this risk, farmers see the benefits of establishing a dialogue through networks to establish principles or ethics for fair competition. While the GMFN has not undertaken this issue, as it has not yet come up at a network meeting, competition negotiations amongst farmers have come up in other group settings.

Specifically a desire for a "price floor" on specific products has been brought up many times at market meetings. The problem begins when part-time or hobbyist farms that do not rely on the income from their farm are able to enter markets not fully incorporating the full cost of production and therefore undercut prices established by full time farmers who do depend on farm income. Steve's catch phrase is that *"you can compete on anything you want, but you never compete on price."*

This statement suggests that market competition in the form of prices and customers is a more significant risk to farmers than concerns in sharing production innovations for instance. This may be another reason farmers focus on sharing production innovations during farm tours, and less so on innovations in niche market development.

One farmer mentioned after a tour that he was surprised the farmer had stated, "*I can sell every carrot and leek that I grow*," suggesting that such a statement is like giving away a secret regarding potentially unexploited markets. What sells and what doesn't and to whom and how it's marketed may be innovations that are less likely to be shared between farmers within the same markets. Or alternatively, until a greater degree of farmer saturation is encountered within the local food system, farmers may utilize their network connections in a more collaborative spirit, to avoid stepping on one another's niche markets.

Networks as locations for innovation adoption

The Diffusion Theory approach

In diffusion theory, social networks are treated primarily as "communication channels" through which knowledge of innovations spread, via close friends, relatives and neighbors (Klerkx et. al. 2012). Less attention has been given to the role networks play as a "venue" for the adoption of many small innovations, from many different farms, over an extended period of time.

One of diffusion theories most frequently used tools to evaluate the appeal of innovations for adoption is Rogers' (2003) "attributes of innovations" model. This model can be applied to how information about innovations is transmitted in the farmer network context.

1. **RELATIVE ADVANTAGE** - Benefits above and beyond those offered by existing practices. Considered one of the best predictors of adoption.
2. **COMPATIBILITY** - Consistent with existing needs, previous ideas, and individual and cultural values.
3. **COMPLEXITY** - Extent to which an innovation is considered difficult to understand and implement.
4. **TRIALABILITY** - Extent to which an innovation can be experimented with under "one's own conditions."
5. **OBSERVABILITY** - Extent to which an innovation can be seen by others.

While network activities of the GMFN, especially hosted Farm Tours, provide an excellent venue for sharing information on an innovation's relative advantage, compatibility, and complexity, it is the observability of innovations that is most tangibly achieved by getting together on each other's farms, and it is the "observation" of innovations that is frequently the most challenging for busy and isolated farmers to acquire. Networks have a direct influence on the ability of farmers to observe innovations on farms throughout the local food system, and it is doubtful that the extent of such observations could be achieved through any other means.

However, the value of farmers organizing to see an innovation in practice is not only its direct relevance to your farm practice, but in its ability to stimulate discussions or thinking that can lead to new combinations of practices. Observation of one innovation may stimulate an idea that leads to new innovations. Network activities help to “expand and [promote] the learning process[es] that underpin innovations” (Hall 2009, p.24). Network gatherings should not be perceived as only creating a venue in which “knowledge adoption” occurs. That kind of one-way transference of knowledge (such as the Transfer of Technology model) does not fit observations of the network. Instead, they suggest principles of social learning theory in which the social context of the knowledge exchange actually expands the innovation capacities of individual farmers and the network itself. Networks can stimulate new innovations by spurring new ideas.

Diffusion theory presents a more hierarchical view of how information travels through networks emphasizing the importance of “opinion leaders”, or those who “lead in influencing others’ opinion,” and suggesting that as opinion leaders adopt innovations, everyone else will too (Rogers 2003, p.300). This view reinforces problems with a “pro-innovation bias,” in which a single innovation is believed to be beneficial to all adopters and should be diffused to everyone, and rapidly. In such cases, network get-togethers to observe an innovation would be most successful if held by the most influential opinion leaders.

This study embraces a more democratic view. The innovations adopted from network interactions shown in Table 6.4 have little to nothing to do with the opinion leadership positionality of the host farmer. These innovations were adopted due to the contextuality of the practice observed in relation to the context of challenges faced by the participating farmers. If these contexts were a close match, and the innovation met other attributes of innovations such as greater benefits, reasonable complexity, and compatible with other farm practices then they considered adoption based on the merits of the practice, not the merits of the farmer. Farmers assume during attendance at a tour that some farm practices will be contextually relevant and some will not. However, even when contexts are different, ideas towards solutions in other contexts can be generated. For example, the context for "cutting in a swale to direct water" on the initial farm and the adopting farm were quite different, one being in an open field on a slope and the other occurring adjacent to a greenhouse, but the concept was mobile across different contexts. It is the characteristic of idea mobility across contexts that is most valuable and expands network potentials beyond just a medium for adoption, and into the realm of expanding innovation capacities potentially leading to innovation development on individual farms.

Diffusion theory offers an additional concept worthy of discussion. The concepts of "homophily," or a tendency for individuals to associate in groups with those who are similar, versus "heterophily," in which individuals who interact are more diverse, are important to understanding networks and innovation (Rogers 2003). Because communication with those who are greatly different from ourselves requires more effort to make communication effective, it is thought that homophilous networks are often more effective in communication. Evidence in support of this view can be seen in the farmers desire to have a network that is for growers only, as they speak a common language and have similar needs. The homophilous aspects of the GMFN network have created an advantageous (or enabling) environment for the communication of knowledge and ideas that are most useful and relevant to the participating group.

However, heterophilous networking is believed to be necessary to introduce innovation, as diverse interaction introduces a greater diversity of ideas, while close acquaintances rarely have information that we ourselves don't already have. This concept is seen elsewhere in diffusion theory in recognizing that cosmopolitan farmers, or those with the broadest social connections, tend to be the most innovative. Heterophilous networking also accounts for many if not most of the innovations described in this study such as the compost tea practice, the farm tour described below, and the online farmers market (see Chapter 5). However, in an internet age, this type of networking can occur on a continuous basis, such that individual farms can continually be accessing new ideas and then introducing them to the homophilous local networks. Trillium Farms ability to take the cob material from a third world cooking environment and incorporate it into a farming context is an excellent example of the value of importing ideas from heterophilous sources (see Chapter 4). The cob example also demonstrates how the more diverse the source of the idea, the more innovative the idea can be perceived, often making it more difficult to communicate to homophilous networks.

Networks as sources for innovation development

Thus far we have examined networks as a forum for knowledge exchange, sometimes leading to innovation adoption, and acknowledged that farmers can utilize knowledge gained from network interactions toward their own innovation development. These findings suggest that networks successfully increase the innovation capacity of individual farmers.

Networks also build "collective" innovation capacity, meaning an enhanced ability of groups to better address challenges. Many activities that have an economic or social benefit to farmers can only occur through collaboration with other individuals. The following are examples of such activities observed during network activities, and many of which are in early stages of development. Since a broader network of organizers in Georgia and Tennessee with assistance from CNG were all trying to enhance their individual networks simultaneously, innovation development at each level of farmer networks are identified.

Table 6.5: Evidence of network innovations developed as a product of network interactions

Network Innovation Description	Challenges Addressed	Specific innovations contributed
Holding a regional FARM TOUR for the public	• Promotes individual farms • Promotes the region • Improves network collaboration • Reaches new customers • Creates a revenue source for the network	• Farms participated on just one day allowing them to visit other farms on the other day. • $5 certificate to area markets in brochure
Expanding Collaborative Markets to an Adjacent Region	• Expands customer base/sales • Reaches an urban market without all farms having to drive there • Allows farms to expand production	• This practice has not yet been implemented.

Utilizing Blog as Communication Tool	• A free and permanent location to post messages, calendars, photos, audio, surveys, etc. where everyone can find it all the time. • Way for members to keep up with activities that they did not attend • Historical record of activities • Community can observe farmer interactions from a distance • Promotion tool with public	• Unaware of another farm network using a blog so all practices would be considered innovative.
Obtaining Joint Product Insurance	• Reduces cost on individual insurance. • Many farms do not have insurance. • Opens up ability to access new markets.	• This practice has not yet been implemented • Method of observation was through CNG network / webinar
Coordinating Bulk Orders	• Bulk discount / cost savings • Reduced time in obtaining inputs	• System for orders to make it an easier process
Sharing Equipment	• Reduces cost for specialized equipment rarely used. • Provides access to equipment you may or may not want to purchase.	• Developing methods for prioritizing, purchasing and loaning shared equipment
CNG – Networker phone conferences (other network archive materials)	• Learning how to build a network from scratch. • Makes available information on network success stories (and failings)	• Notes developed and distributed to all organizers for future use. • Development of network case studies to share with all future network organizers.
CNG – Webinars	• Exceptional network innovations can be diffused to groups all over the country • Allows direct communication between individuals	• Use of available technology coupled with understanding of farmer needs

This study has assumed that innovations are more than the material implementation of science and technology (ie. improvements within the agricultural production environment) and include any activities that achieve social or economic benefits. The organization of the GMFN itself is treated as an innovation due to the social and economic benefits such networks produce. Individual network activities and processes (as described in table 6.5) that are new or novel to farmers can likewise be evaluated as independent innovations developed by the network.

One of the network processes that constitute an innovation is the interplay amongst network organizers themselves. Monthly phone conferences provided a rapid way for participants to learn from each other's experiences and challenges, while also receiving suggestions, feedback and encouragement from the group. This network of network organizers stimulated stronger networks, by allowing each organizer to learn from others mistakes, and generate ideas as they described their activities. Dialogue breeds new ideas. This pattern of communication was perhaps the most effective way to increase all organizers capacities for network organizing, especially given that other sustainable farmer networks were not easily observable.

Network innovations worthy of diffusion

One of the goals of the CNG pilot network grant was to identify "elements of successful farmer networks" and utilize these lessons to assist in the startup or further development of other networks. One of the great advantages that CNG had in network development was an established and trusted relationship with numerous certified farms, and some insight into their specific needs. As each of the five new networks came into its own, several developed very specific areas in which they achieved success, most notably: joint product insurance coverage (developed by the Chattanooga Sustainable Farmers), and a regional tour of farms (developed by GMFN). Recognizing the benefits that specialized knowledge in these areas had in meeting needs of other farmers and farm groups, CNG asked these organizers to develop webinars that were then advertised to Certified Naturally Grown members across the country.

The Georgia Mountains Farm Tour

The most notable network innovation to arise from the GMFN in its very short existence was coordination of a regional tour of farms as a public event designed to: increase the exposure of local food farms throughout the region, reach new customers, improve network identity and collaboration, and create a revenue source for the network. The farm tour is an ideal example of an innovation arising from lateral observation; followed by adoption with subtle adaptations to fit new needs in a different context. The basic idea for the tour was taken almost entirely from the Carolina Farm Stewardship Association's Piedmont Farm Tour (started in North Carolina in 1995) and Upstate Farm Tour (began in South Carolina in 2005). The Georgia Mountain Farm Tour mimicked the structure (two day event, multiple farms, one pass for a carload), and brochure design. Many GMFN farmers were familiar with these tours and a few had even attended or participated in the event due to its relative proximity. However, the GMFN adapted and modified the event in order to allow farmers to visit one another's farms as an outcome of the event. In the original tour, participating farms would host two consecutive days of farm tours (leaving no time to attend one day of the tour), but in the GMFN tour farmers hosted just one day and could visit other farms on the tour on the other day. Many farmers took advantage of this and were able to visit multiple farms in a weekend, with many farmers reciprocating the visits the following day. This reinforces the value farmers place on networking and observing one another's farms.

According to diffusion theory the GMFN's embrace of the farm tour idea observed in the adjacent Carolina's would be seen as simply the diffusion of an innovation that originated elsewhere, with GMFN representing an early adopter of the innovation. It's highly likely that the Carolina Farm Stewardship Association had observed and adapted the idea through a similar process. This view tends to disregard and undervalue the innovation development process that takes place. The innovations systems theory would take a different approach recognizing that farmers and networks are constantly reworking existing stocks of knowledge and in the process make incremental improvements to innovations (World Bank 2007). From this view "*there is no logical progression from one type of innovation to another*" (World Bank 2007, p.73). Networks take in ideas from numerous sources and bring them into a new context where they become new innovations.

Summary

While the first phase of this research focused on an inventory of innovations and the types of innovations most prevalent within the study region, later stages of the study have identified mechanisms that should increase the "intensity of interaction" amongst stakeholders which is believed to be central to the innovation capacity of a given region (World Bank 2004). If "interaction" is correctly equated with "access to new knowledge" then farmer focused networks may provide the best vehicle for speeding up the adoption, adaptation and development of innovations within emerging local food systems.

References – Chapter 6 : Role of Networks

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CHAPTER 7

CONCLUSIONS

There is an increasing understanding of innovation not as invention, or science and technology, but as the "practical application" of new ideas within the unique social, ecological, and capital contexts in which they will be utilized. Innovation does not occur at a discrete point in time, it unfolds incrementally. If innovation occurs as ideas are applied within specific contexts then farmers are invoked into the innovation process. This innovation process begins not with the implementation of solutions to problems or when innovations are adopted, adapted or developed, but earlier in the identification of the problems and challenges most important to farmers in the local food system.

The challenges addressed by local food system farmers are significantly broader than those previously addressed by agricultural research. They are also much more context specific, with opportunities shaped by availability of local physical resources, knowledge resources, and social network infrastructure more so than by capital and technological resources. Research scientists are at a disadvantage in meeting the needs of local food system farmers, as they cannot understand and adapt practices to every context in which a practice may be applied, and researchers are often required to meet the needs of the largest share of end users, which tends to homogenize innovations (Hippel 2005). This means that farmers may often be better positioned to innovate exactly what they need for themselves (Hippel 2005).

This research set out to understand the innovation processes of small-scale sustainable farmers engaged in building local food systems. The research design consisted of cataloguing every innovation observed on individual farms and farm collaboratives over a four-year time frame. This methodology provided insights regarding farmers' processes of knowledge acquisition, their adoption and implementation behaviors, and how frequently farmers adapted, modified or developed new innovations to address challenges.

The innovations inventory provides a valuable diagnostic tool for identifying which challenges are receiving the most attention from farmer's creative energies. The first finding was that 30% of farmers' innovations were non-production oriented indicating that challenges addressing marketing, distribution, labor, planning, knowledge acquisition, and networking were of considerable importance to farm management. Most innovations address multiple farm challenges, sometimes overlapping to solve both production and non-production problems. The ability to rank innovations according to the challenges they address using an innovation typology allows for a better understanding of an innovation's potential impact within a local food system and was the first step in identifying the key innovations concept.

Amongst production innovations the cob furnace, basement growing and biochar innovations all occurred on a single farm and suggest that unique innovations often arise from the specific needs of niche products, a farmers propensity for innovation, and a deep focus on sustainability. Though these innovations may be too context specific for rapid adoption, they demonstrate a strong capacity for innovation development, and produce practice level innovations that may have applications beyond the systems in which they were created.

The concept of key innovations was introduced as a way to identify innovations that have the greatest potential to enact change on individual farms and throughout the local food system. Compost tea was identified as a key innovation due to its ability to solve more production challenges than any other innovation. The key innovations concept (potential of an innovation to enact change) contrasts with diffusion theory's "attributes of innovations" model (potential of an innovation to be adopted). Both models were useful in this study, but highlight the differences in examining innovation processes at a local food system scale as opposed to adoption processes at the individual farmer scale. The "attributes of innovations" model was the most relevant aspect of diffusion theory to this study, though "adaptability," or the extent to which an innovation can be modified or improved to address specific contexts, problems and challenges was notably missing from the model. The adaptability of some innovations may have as much to do with the capacities of farmers to modify and improve innovations as any qualities inherent to the innovation.

Strong tools from "diffusion theory" for assessing the sustainability characteristics and potentials of innovations are lacking. The biochar case study highlighted the struggle between sustainability characteristics of innovations, their relative advantage to farmers and a need for incentives for adoption. Current data collection and analysis tools (including the key innovations analysis developed here) can easily overlook innovations that present significant sustainability potentials but lack immediate benefits to farmers. Sustainable farmers have shown considerable aptitude in incentivizing the adoption or development of sustainability innovations, but these processes are not well understood and provide a rich topic for future study. Historically more scientific research would be suggested as the method to identify and refine the relative advantage attributes of the biochar innovation. The history of sustainable agriculture innovations might suggest that farmer's context specific trials may serve the same purposes. Both approaches have merit. This study suggests that broader aspects of increasing relative advantage (beyond the production environment and beyond just engagement by "adopting farmers" to society as a whole), such as market incentives (to compensate for increased labor demands), public buy-in regarding the benefits of such practices, and potentially even public participation in the innovation (such as the selling of biochar as a product to home gardeners) are also topics worthy of further investigation.

Collaborative marketing innovations such as the Locally Grown market were found to solve farm challenges that farmers could not solve alone. The NGLG market was also one of the most widely adopted innovations in this study and contributed to broader interactions between farmers and customers across a geographically diffuse rural area thanks in large part to distribution collaboratives. Modification and improvement of LG markets is an almost unavoidable aspect of adoption of the innovation in order to insure improved performance. The most notable modifications were distribution collaboratives and refinement of market standards. Further development of this market is likely to lead to activities associated with food hubs, continuing to aggregrate and distribute products for possible delivery to nearby urban markets. The market has contributed to building trusting collaborative relationships, leadership, capital, and confidence in pursuing new opportunities. Internet technology is likely to continue to be a critical tool in enhancing interactions and efficiencies between farmers and customers within local food systems.

The interactions and innovation exchange occurring between adjacent and overlapping Locally Grown farmers markets provides a rich source for future studies, and suggests that groups that share system level innovations have a lot they can learn from one another. This study focused on innovations arising from farmers in one geographical location. Future studies looking at multiple Locally Grown markets across the country to examine the innovation adaptation and development processes under different contexts and challenges would likely yield interesting results. The sharing of results of such a study with Locally Grown participants would likely spur rapid adoption, adaptation and further development of practice level innovations.

Formation of a “farmer centered” network helped to facilitate innovation adoption, adaptation and development, due in part to the enhanced observability of innovations. Farm tours facilitated the exchange of individual farm based innovations, while farmer feedback, CNG network organizer meetings and webinars aided in the development of network innovations. Newer farms benefit the most from network interactions and tend to adopt the most innovations due to their higher knowledge requirements. By focusing on establishing networks as a locale for innovation exchange as opposed to innovation transfer (ie. transfer of technology model) farmers appear willing to share their knowledge through balanced interactions. The observations of one innovation may stimulate ideas that lead to new innovations, despite differences in contexts. The GMFN is in an early stage of development but its "collective" innovation capacity has significant potential to meet individual farm and local food system challenges that include: market collaboratives, acquiring joint product/liability insurance, raising the visibility of local food farms through events, and increasing institutional buying opportunities (ie. Farm 2 School programs).

Interaction with diverse ideas and diverse actors is believed to be a source for new innovations as suggested by innovation systems theory, which is taking hold in international studies of agriculture (World Bank 2007). This study suggests that network activities may help to increase some of these innovation capacities by increasing interaction. However, this study suggests that some innovations can also arise from isolation, in which farmers in the absence of observing others solutions end up solving problems in unique ways, precisely because they were unaware of how everyone else was doing it. The cob furnace, basement growing and biochar innovations are representative of this sourcing of innovations. Further work in differentiating between networked innovations (compost tea would be an example) versus individual farm innovations would continue to identify important distinctions between these innovation pathways.

Innovations from outside the local food system, including research-based innovations will continue to play an important role in local food system development, but they do not play the only role. Farmers and farmer networks are capable of developing their own solutions to problems, and their own innovations. Sometimes these constitute original innovations, but most frequently represent context specific adaptations that help to refine innovations for improved performance within a specific context. These refinements and the capacity for such refinements are a critical component to the success of farms and the local food system.

The emphasis of the diffusion of innovations model has been on the adoption process. In the years ahead greater emphasis will be placed on adaptation and development processes and how these lead to new innovations. Identifying ways to increase farmers' capacities for innovation adaptation and development will be a new focus, such as stimulating interaction with diverse actors (Hall 2007) This new focus is founded on the belief that we are all creators and disseminators of knowledge and innovations. This is a much more productive and enabling view that also suggests that being around innovators makes you innovate. Such ideas are not new as evidenced by rural sociologist Carl C. Taylor's observations over seventy years ago:

> *"Trading ideas is different from trading any other commodity in the world. This is illustrated by the old statement, "I have a dollar and you have a dollar. You give me your dollar and I give you my dollar, and we each still have just one dollar. But I have an idea and you have an idea. When we have traded ideas, we*

each have two ideas. Trading ideas goes even further than this, for sometimes one or the other of us, or both of us, will get a completely new idea just because we talked things over." (Taylor 1941:1-2, see also Hassanein 1999)

It's the exchanging of ideas and doing something new with them, adding to them, making them your own, or letting them inspire a brand new solution, that's what constitutes innovation.

References – Chapter 7 : Conclusions

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APPENDIX A - Semi-structured interview key

The following is an abbreviated listing of questions that were generally asked of all farms during the course of farm visits. This is not an exhaustive list of questions, and the questioning evolved as the study progressed, but the following provided a general guide to insure critical topics were covered. These questions would often be fine tuned through repeated visits and interactions with farmers.

Describe your practices/activities in the following areas:

- Seeds, starts, crops chosen, machinery, pest control, tools
- Soil management, fertility, use of composts, amendments, microbial innoculents
- Tillage, crop rotations, cover crops
- Irrigation / wash water
- Labor / labor reduction
- Season extension
- Sources of supplies / equipment
- Financial management
- Marketing strategies
- Sources of information
- Social networks
- Food processing / handling / storage

For practices identified as innovations the following questions would be asked:

- How did you come to adopt/develop the practice (how encountered)?
- How long have you been doing it?
- Why was this practice chosen over other practices?
- Have you changed the practice since you first encountered it? How? Why?
- Describe the performance of this practice.

APPENDIX B - Consent Form - Elective Research Activities

Elective Research Activities

Your participation in this research is very valuable to us. You can elect to participate in some activities while choosing not to participate in other activities. Please check and initial below each of the levels of participation that you are comfortable with.

Option One – Observational Activities
You can agree to participate in observational activities (in which the researcher will observe your day to day activities) but opt-out of interview activities.

____ YES, I agree to participate in the observational activities for this study.
____ NO, I do not agree to participate in the observational activities for this study.

Please initial and date here:______________________

Option Two – Interview Activities
You can agree to participate in interview activities (in which the researcher will ask semi-structured questions while taking notes) but opt-out of the audio- recording of these interviews.

____ YES, I agree to participate in the interview activities for this study.
____ NO, I do not agree to participate in the interview activities for this study.

Please initial and date here:______________________

Option Three – Audio Recording of Interviews
You can agree to participate in audio recording of interviews (in which the researcher will use a digital recorder to record conversations that will later be transcribed) but opt-out of the public dissemination of these interviews.

____ YES, I agree to participate in the audio-recording of interview activities for this study.
____ NO, I do not agree to participate in the audio-recording of interview activities for this study.

Please initial and date here:______________________

Option Four – Public Dissemination of Interviews
You can permit the researcher to utilize audio clips from interviews for public education purposes in conferences, classrooms, and via a website. The purpose of such dissemination is to educate others about local food system practices.

____ YES, I will permit the researcher to disseminate clips of audio recordings from my interview in conferences, classrooms, and via a website.
____ NO, I will NOT permit the researcher to disseminate clips of audio recordings from my interview in conferences, classrooms, and via a website.

Please initial and date here:______________________

Option Five – Contributions to Articles in the Popular Press - Confidential

You can permit the researcher to write newspaper and other articles using observations and interviews obtained during the research provided your identity is held confidential.

____ YES, I will permit the researcher to write articles using observations and interviews, provided my identity is held confidential.
____ NO, I will NOT permit the researcher to write articles using observations and interviews, provided my identity is held confidential.

Please initial and date here:______________________

Option Six – Contributions to Articles in the Popular Press – Non-Confidential
You can permit the researcher to write newspaper and other articles that include your identity and other personal information obtained during observations and interviews.

____ YES, I will permit the researcher to write articles that include my identity and other personal information obtained during observations and interviews.
____ NO, I will NOT permit the researcher to write articles that include my identity and other personal information obtained during observations and interviews.

Please initial and date here:______________________

APPENDIX C – GMFN 2013 Priorities

Georgia Mountains Farmers Network
2013 priorities
or what would our Growers Network like to accomplish?

#1 - Host Farm Tours (HIGH PRIORITY)

- DEFINED - Specifically for GROWERS (focused on sharing information)
- ACCOMPLISHMENTS – held 6 of these over the last 14 months.
- FUTURE – every other month schedule.

#2 - Cooperative Marketing efforts (HIGH PRIORITY)

- DEFINED - Develop systems for bulk deliveries to ATL area, restaurants, etc.
- ACCOMPLISHMENTS – established a focus on retail rather than wholesale markets.
- FUTURE - Working to expand Locally Grown to Gainesville area. (or other nearest urban market)

#3 - Hosting Public Events (HIGH PRIORITY)

- DEFINED – Goal is to increase the customer base and awareness
- ACCOMPLISHMENTS - The Georgia Mountains Farm Tour helped create a sense of unity of purpose and pride in our region.
- FUTURE – hosting and growing tour again in 2013.

#4 - Organizing specific and technical workshops (HIGH PRIORITY)

- DEFINED – Using both local farmers and experts from other areas to host workshops on production and business management topics.
- ACCOMPLISHMENTS – Haven't done this yet.
- FUTURE – Compile a list of technical workshop topics and speakers and select and schedule those in highest demand.

Coordinating Bulk Orders (MEDIUM PRIORITY)

- DEFINED - To increase availability and reduce shipping on amendments, supplies, seeds, potatoes, onions)
- ACCOMPLISHMENTS – One bulk order completed February 2012. Ten orders - $1,400. Didn't have enough interest in 2013.
- FUTURE – Try again in 2014.

Create Forums for Farmer Communication (MEDIUM PRIORITY)

- DEFINED – To improve communication and networking between farmers throughout the region.
- ACCOMPLISHMENTS – Created Blog Site that archives all communications, and allows us to post event announcements, calendars, etc. (over 2 dozen posts so far) A Yahoo listserve was not successful due to lack of sign ups. Also have a Facebook account that has 56 likes, not used much by farmers but good way to communicate with the public.
- FUTURE – keep doing what we're doing.

Acquisition and Sharing of Equipment (MEDIUM PRIORITY)

- DEFINED – Identify equipment to purchase with GMFN funds or develop sharing/rental program between farmers. Other examples - compost tea sprayers, bed shapers, others?
- ACCOMPLISHMENTS – Purchased an Earthway Seeder that can be borrowed by any member of the GMFN.
- FUTURE – Working on a barter bank or other system of borrowing/trading equipment amongst farms in the area.

Organization of Crop Mobs (MEDIUM PRIORITY)

- Labor assistance. Bringing volunteers to your farm to have them work on a project or weed for an afternoon.

Obtaining or Producing Organic Feed (MEDIUM PRIORITY)

- It is difficult and costly to obtain organic feed easily.

<u>NEW PRIORITIES</u>

Increase capacity for local food processing

- Work to have a licensed processing facility where farmers can jar, can, freeze and do other value added processing that they are legally allowed to sell.
- FUTURE – working on having the Habersham cannery built so that it allows valued added processing. Visit Blairsville cannery to see how they did this.

<u>REMOVED PRIORITIES</u>

Share up-to-date Contact Lists

- That includes other farmers, but also restaurants who buy local, local suppliers, technical experts, etc.
- Determined that this isn't really needed.

Developing Marketing as a Group

- Co-branding regional products like a logo, identity
- Seemed to be lumped under **Cooperative Marketing efforts**