FACTORS INFLUENCING PRACTITIONER ADOPTION OF AGROFORESTRY: A USDA SARE CASE STUDY.

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by

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

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DEFINITIONS AND ACRONYMS

AAA – Active Agroforestry Agent

AF – Agroforestry is "the intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits" (USDA website, 2020).

AFP(s) – Agroforestry Practice(s) is one or more of five main practice categories of agroforestry recognized in the temperate climate: alley cropping, forest farming, silvopasture, riparian forest buffers, windbreaks (USDA website, 2020).

CRP – Conservation Reserve Program "is a land conservation program where in exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality" (USDA FSA, 2020).

DIT – Diffusion of innovation theory is one of the oldest social science theories that seeks to explain how, why, and at what rate new ideas and technology spread (Rogers, 2003).

DNR – Department of Natural Resources organization at sub-national government level that works with protection, preservation, and use of natural, cultural, and recreational resources of a state.

EQIP: Environmental Quality Incentives Program – NRCS program that "provides financial and technical assistance to agricultural producers to address natural resource concerns and deliver environmental benefits such as improved water and air quality, conserved ground and surface water, increased soil health and reduced soil erosion

and sedimentation, improved or created wildlife habitat, and mitigation against increasing weather volatility" .

ICP – Implementation to confirmation period (ICP) – suggested measure of adoption rate from time of actual implementation to confirmation or discontinuation of the practice

IDP – innovation-decision period is the DIT-related concept usually measured as length of time from initial knowledge to the decision to adopt (Rogers, 2003)

NIFA – National Institute of Food and Agriculture "is a U.S. federal government body that "provides leadership and funding for programs that advance agriculture-related sciences" (USDA website, 2020).

NRCS – Natural Resources Conservation Service is the USDA agency that "provides America's farmers financial and technical assistance to voluntary put conservation on the ground, not only helping the environment but agricultural operations too" .

Quote source abbreviations (e.g. FTFamer-M1): FT - full-time, PT- part-time, F - female, M - male, AFProf - agroforestry professional.

SARE – Sustainable Agriculture Research and Education program is a decentralized competitive grants and education program funded by the USDA that "offers competitive grants to fund research and education projects that advance sustainable agricultural practices in the United States" .

UMCA - Center for Agroforestry at the University of Missouri is "one the world's leading centers contributing to the science underlying agroforestry, the science and

practice of intensive land-use management combining trees and/or shrubs with crops and/or livestock" (UMCA website, 2020).

USDA – United States Department of Agriculture is the U.S. federal executive department that provides "leadership on food, agriculture, natural resources, rural development, nutrition, and related issues based on public policy, the best available science, and effective management" (USDA website, 2020).

ABSTRACT

Agroforestry practices offer a compelling alternative to conventional agriculture as they provide a broad range of economic, ecological and social benefits. Despite its' recognized potential, on-the-ground adoption of U.S. agroforestry remains limited. Therefore, there is a need to explore factors influencing agroforestry adoption and dissemination bottlenecks. While previous studies have focused mostly on landowners and farmers interests in agroforestry, this research aims to portray the perspective of actual agroforestry practitioners. Early adopters of agroforestry represent an essential stepping stone to further agroforestry diffusion, thus, a better understanding of the factors that influence their decisions and their reasons behind adoption of agroforestry practices can help to promote wider adoption. This research study helps to inform the following questions: the who and why of early stage agroforestry adoption and what factors influence adoption decisions. Further, it explores the timeline to agroforestry adoption, preferred channels of communication and support systems. This study also represents the first attempt to map agroforestry adoption in the U.S. In addition, this work highlights the internal driving forces leading to agroforestry adoption. Recommendations are offered concerning target audiences, efficient messaging and effective channels of communication. Further research is needed to investigate both the temporal and spatial aspects of agroforestry adoption.

CHAPTER 1. Introduction

A major challenge in modern world, where agriculture is linked to many environmental problems, is to identify how sustainable agricultural practices, such as agroforestry, which benefit people, economy and environment, while sustaining the required agricultural production to feed the growing human population, can be promoted for the broader adoption by farmers and ranchers. Agroforestry is an intensive land management approach where trees are intentionally integrated into farms blending agronomic crops, trees/shrubs and livestock to enhance productivity, profitability, and environmental stewardship (USDA, 2011). According to Nair (2007), agroforestry's potential to address agriculture-related environmental, social, and economic problems have been increasingly recognized and supported by a growing body of research. However, this sustainable and holistic land management approach is yet to be widely disseminated.

Based on the diffusion of innovation theory (DIT), U.S. agroforestry adoption falls into the early adoption stage of innovators and early adopters. These groups of people are crucial for the innovation diffusion (Rogers, 2003), and a better understanding of the factors that influence their decisions and reasons behind adoption of agroforestry practices can help to advance agroforestry diffusion into early and late majority groups. The deficiencies of previous studies related to agroforestry adoption can be summed up into the following four categories: 1) the lack of studies in developed countries with temperate climates; 2) the dearth of studies involving real-life agroforestry practitioners; and 3) the need to look into temporal aspect of agroforestry adoption and 4) the need to explore contributing factors related to the effectiveness of the support system.

This study seeks to address the gaps identified above through an evaluation of agroforestry practitioners who have or are implementing agroforestry project with the support of USDA SARE funding between 1998 and 2018. **The purpose of this research** is to identify early adopters socio-economic and demographic characteristics, explore their reasons and motivations for agroforestry adoption, preferred channels of communication and support system, and review temporal and spatial dimensions of agroforestry adoption. Identifying these factors and personal reasons can help to craft a targeted message through efficient communication channels in order to reach a larger number of probable future adopters. It will also help develop policies acknowledging the motives behind decisions to adopt or abandon the agroforestry practices.

CHAPTER 2. Literature review

2.1. Agroforestry adoption research

5/12/2020 2:01:00 PMAgroforestry (AF) is an intensive land-use management practice, where trees and/or shrubs are intentionally combined with crops and/or livestock and integrated into the agricultural landscape (Gold and Garrett, 2009). AF in tandem with concept of multifunctionality provides environmental, ecological, economic and social benefits from a unit land area in a sustainable fashion via diversified income on farms and ranches; safe and healthy food; conservation benefits through clean air and water, improved soil health, carbon sequestration, wildlife habitat, along with aesthetic and environmental services (De Stefano and Jacobson, 2017; Dobbs and Pretty, 2004; Godsey et al., 2009; Gold and Garrett, 2009; Gordon et al., 2018; USDA, 2011). Considering the multiple and valuable benefits of AF systems and environmental concerns related to contemporary agriculture, AF has outstanding potential to create positive economic and ecological benefits if widely adopted. Currently however, U.S. agroforestry is far from being a widespread, acknowledged and adopted practice by farmers.

Studies on agroforestry adoption gradually appeared at the turn of the century in part to explain existing social frameworks and as an approach to introduce the technologies to communities (Montambault and Alavalapati, 2005). AF adoption research started to develop in the early 1990s (Mercer, 2004), but mainly focused on developing countries located in the tropics with few studies in temperate climates. In early 2000s this new direction in AF research was analyzed in three major AF adoption review studies by Pattanayak et al. (2003), Mercer (2004), and Montambault and Alavalapati (2005) that primarily covered tropical research from the late 1980s to the early 2000s. In a worldwide

review of AF adoption studies, only two out of thirty-two assessed works were done for the temperate climate of North America (Pattanayak et al., 2003; Valdivia et al., 2009), and even those studies were focused on adoption of non-agroforestry best management practices in agriculture (Anderson et al., 1999; Feather and Amacher, 1994). In the 1990s, relevant studies in the U.S. focused on agroforestry awareness and perception towards agroforestry among natural resources professionals, land managers (Lawrence and Hardesty, 1992; Zinkhan and Mercer, 1996), landowners (Workman et al., 2003), the extent of agroforestry use (Lawrence et al., 1992), and the kinds of AF activities being practiced (Rule, 1996).

Since those reviews many more AF adoption studies have appeared in the scientific literature, although adoption studies in developing and tropical countries still dominate the literature. The initial literature search of assorted science databases generated over 600 publication dealing with AF adoption and diffusion. A thorough evaluation of research directly relevant to AF adoption by farmers, landowners, small-holders, nature resource professionals reduced the number to 131 in mostly tropical developing countries of Africa, Asia, Central and South America and 35 in mostly temperate developed countries of North America, Europe, and Australia.

There is a clear need for an updated world-wide review of AF adoption, however this is not the goal of current study. The 35 studies include four from the 1990s that were not included in previous meta-analyses. Out of the 35 AF adoption studies, one was for Australia (Fleming et al., 2019), one covered the U.S., Canada, and Mexico (Barbieri et al., 2008), ten focused on European countries (Borremans et al., 2016; García de Jalón et al., 2018; Graves et al., 2017, 2008; Liagre et al., 2005; McAdam et al., 1997; Rois-Díaz

et al., 2018; Sereke et al., 2016; Smith et al., 2012; Tsonkova et al., 2018), and twenty three centered on the U.S., including eight in Missouri (Arbuckle et al., 2009; Barbieri and Valdivia, 2010; Dorr, 2006; Flower et al., 2005; Fregene, 2007; Raedeke et al., 2003; Valdivia et al., 2012; Valdivia and Poulos, 2009), three in the southeast U.S. in Alabama, Georgia, Mississippi, and Florida states (Stutzman et al., 2019; Workman et al., 2003; Zinkhan and Mercer, 1996), two in Washington state (Lawrence et al., 1992; Lawrence and Hardesty, 1992), two in Pennsylvania (Armstrong and Stedman, 2012; Strong and Jacobson, 2005) and two in Virginia (Trozzo et al., 2014a, 2014b), and one each in the following states, Alabama (Davis and Rausser, 2020), Florida (Shrestha et al., 2004), Illinois (Stanek and Lovell, 2019), North Carolina (Faulkner et al., 2014), and Wisconsin (Mayerfeld et al., 2016) and one that surveyed extension professionals across the U.S. (Jacobson and Kar, 2013).

In many parts of the world, the benefits of agroforestry remain under-realized (Fleming et al., 2019). Many U.S.-based studies noted the limited on-the-ground AF adoption despite considerable advances in the underlying science (Strong and Jacobson, 2005; Trozzo et al., 2014) and research into the opportunities and challenges to more widespread adoption (Arbuckle et al., 2009; Jacobson and Kar, 2013; Mayerfeld et al., 2016; Trozzo et al., 2014b; Valdivia et al., 2012). Most AF studies relate to the ecological functioning and potential benefits and costs of different agroforestry practices (AFPs), while a smaller percent of studies aim to find out farmers' perspectives on agroforestry adoption (Mercer, 2004; Rois-Díaz et al., 2018), and even fewer adoption studies were done directly involving AF practitioners as study participants. No U.S.-based published research has been found that would specifically target AF practitioners in search of answers

about adoption of AFPs, creating a clear baseline for current research. To our knowledge there is only one other currently on-going research study involving AFPs and this study explores non-monetary motivations (Decré, 2019).

2.2. Current stage of agroforestry adoption in the U.S. and prospects of diffusion

One of the commonly applied frameworks to investigate the adoption and diffusion of innovations in social systems is the diffusion of innovations theory (Darr, 2008; Mercer, 2004). Can agroforestry be considered as innovation in the U.S. and other developed regions with temperate climates? Even though combining trees, crops and/or livestock is an ancient practice (Nair, 1993; Nelson, 2014), since WWII it has been virtually eliminated in developed countries and replaced with large-scale agricultural industries (Lassoie et al., 2009). The shift from traditional to modern agricultural systems led to simplification and standardization of farming systems with substantial loss of landscape heterogeneity and trees (Dupraz et al., 2018). Relatively recently "rediscovered" and defined for temperate regions of developed countries (Lassoie et al., 2009) agroforestry can be considered as an innovative solution entering the stage of potential sustainable agricultural practices in the wake of rising public concerns about the environmental impact of modern agriculture. The understanding of the potential usefulness of agroforestry practices in addressing environmental, economic, and social problems is growing and is well supported in the literature (Garrity, 2006; Gold and Garrett, 2009; Gold and Hanover, 1987; Nair, 2007; van Noordwijk, 2019). Since the 1980's U.S. agroforestry has gained strength through the establishment of new institutions, the promotion of new policies, growth of supporting research, and examples of on-the-ground practical application (Gold, 2019). However, AF has yet to reach the tipping point to widespread adoption.

In 1962 Rogers (2003) developed a theory called diffusion of innovations (DIT) to explain the phenomena that some people adopt new products, technologies, or behavior sooner than others. This theory has been applied to test different hypotheses related to agroforestry adoption (Black, 2000; Borremans et al., 2016; Darr, 2008; Evans, 1988; Gamboa et al., 2010; Mercer, 2004). The DIT stratifies individuals within any society into five different adopter groups based on how early or how quickly they adopt an innovation: innovators (2.5% of society, innovators, first to adopt), early adopters (13.5%), early majority (34%) and late majority (34%), and laggards (16.5%) (Rogers, 2003). Innovators and early adopters play a key role in the innovation diffusion to society. When the number of early adopters reaches the tipping point the innovation adoption speeds up bridging the gap between the trend-setters and the majority.

Until recently, researchers could only estimate current scale of AF adoption in the U.S. based on random studies from different states, but generally indicate that adoption is low (Strong and Jacobson, 2005; Trozzo et al., 2014). No statistical data regarding agroforestry practices were gathered through the U.S. Census of Agriculture until 2012, when the first agroforestry questions on alley cropping and silvopasture were included (Boteler et al., 2013). In 2017 the census question was broadened to include forest farming, riparian forest buffers, and windbreaks, asking if farm-operations have practiced one or more of five major temperate agroforestry practices during 2017.

The 2017 U.S. Census of Agriculture reported that about 1.5% (30,853) farms self-identified as practicing one or more agroforestry practices (USDA/NASS, 2017). The accuracy of the results, however, should be viewed with reservation due to possible misidentification, taken that only short AFPs descriptions were provided along with the

census glossary without stressing and clarifying the intentional, intensive, integrational, and interactive nature of the AFPs. On one hand, some farm-operations may have identified unmanaged residual windbreaks or riparian buffers as agroforestry, or unmanaged livestock grazing in woodland as silvopasture. On the other hand, others may be not aware of the terms or concepts of agroforestry practices despite implementing it on their land (Rois-Díaz et al., 2018). In one study (Barbieri and Valdivia, 2010) where agroforestry information cards with short description and pictures were used in surveying farmers, 3.9% of respondents in Missouri self-identified as employing one or more of AF practices, while only 1.38% indicated so in the 2017 U.S. Census of Agriculture (USDA/NASS, 2017). The higher rate in the Barbieri and Valdivia (2010) study might be explained by the location of counties where surveys were conducted and its proximity to Center for Agroforestry at the University of Missouri (UMCA). Further research is needed to investigate the influence of agroforestry agents on agroforestry adoption.

A survey of non-industrial private forest landowners, on the extent of agroforestry use in Washington state in the 1990s, reported an astonishing 57% of respondents practicing AF (Lawrence et al., 1992). Although it is not clear how well AFPs were described in the survey, the study indicated that the most common practices were forestland grazing (39%), harvest of special forest products (12%), orchard grazing (5%), and Christmas tree grazing (0.34%) none of which would be considered AFPs. Similarly, reported use of windbreaks (34%) may or may not have been used for the intentional integrated management with crops or livestock. That would leave 2% of practitioners who intercrop their orchards plus 8% of livestock enrichment plantings for forage or shelter, which is probably closer to more realistic picture, although still would largely exceed 3%

AF practitioners for WA in 2017 U.S. Census of Agriculture (Lawrence et al., 1992; USDA/NASS, 2017). A different WA-based survey of dry land farmers showed 4.5% using vegetative wind strips practices (Upadhyay et al., 2003). A survey of Florida and Alabama landowners also showed high percent of AFPs utilization: 45% and 43% for windbreaks, 27% and 52% for riparian buffers, 26% and 16% for silvopasture, 14% and 12% for alley cropping respectively (Workman et al., 2003). In contrast, the 2017 Census showed 1.69% and 1.56 AFPs use for Florida and Alabama respectively (USDA/NASS, 2017). The discrepancies in the data suggest the need for a more scientific approach and detailed development of the surveys on the AFPs utilization and, preferably, conducting special studies within U.S. Agricultural Census on AFPs.

Anecdotal information suggest that agroforestry practices are not applied by the majority of the farming population but there are cases of agroforestry practices being applied throughout the country. Even though it would be hard to precisely determine the stage of the AF adoption in the U.S., it can be surmised that it is on its early stages of adoption by innovators and early adopters based on the 2017 U.S. Agricultural Census data.

To become mainstream and widely recognized, such as was the process with monocultural cropping in the 1950s or no-till in the 1980s (Rule et al., 2000), AF needs to bridge the gap between early adopters and the early majority. To reach that tipping point more innovators and early adopters need to be involved in practicing agroforestry so that they can spread their experience and knowledge. Understanding the factors that influence current AF practitioners is key to engaging more potential adopters in the future.

2.3. Factors influencing AF adoption

A meta-analysis of the empirical studies of agroforestry adoption qualified the factors influencing the technology adoption into five main categories: farmer preferences, resource endowments, market incentives, biophysical factors, and risk and uncertainty (Pattanayak et al., 2003). The authors included social factors such as education, age, gender into the category of farmer/household preferences, and economic factors such as income, assets, labor into the category of resource endowments, stating that they are the most common factors studied, while market incentives, biophysical factors and risk and uncertainty (which include tenure, experience, extension, and training) are examined less frequently. However, all of these factors are useful for increasing the general understanding of who adopts first and whom to approach first in which communities when introducing new AF systems, projects, or programs (Mercer, 2004).

Most of the AF adoption studies in temperate climate found economic factors influential on adoption, and AFPs profitability was one of the major concerns for farmers and landowners prevailing over non-monetary aspects (Borremans et al., 2016; Faulkner et al., 2014; Raedeke et al., 2003; Rois-Díaz et al., 2018; Tsonkova et al., 2018). Farmers associated positive aspects of AF with environmental benefits, while the most negative aspect was related to its expenses and complexity (Graves et al., 2008). Both monetary and nonmonetary motivations were important for landowners who depend on land for their livelihood and derive more of their income directly from agricultural production (Barbieri and Valdivia, 2010; Koontz, 2001; Strong and Jacobson, 2005).

Nonmonetary motivations in most of the studies were linked with environmental and social benefits of AF systems, where environmental factors were mainly about

ecosystem services, social concerns about future generations, and landscape aesthetics. Landowners interested in AF gave higher importance to environmental and recreational values in their ownership motivations (Arbuckle et al., 2009). The environmental values of planting trees had one of the strongest effects on interest in AF (Valdivia and Poulos, 2009), so were the perceived problems with the environmental factors (Pattanayak et al., 2003; Valdivia and Poulos, 2009). There were mixed results regrading socio-economic characteristics of farmers and landowners interested in AF (Arbuckle et al., 2009; Dorr, 2006; Trozzo et al., 2014; Valdivia and Poulos, 2009). The analysis of the studies from Missouri showed some consistency with results from Pattanayak et al. (2003), describing profiles of potential AF adopters as younger educated female landowners, informed through trusted sources and networks, and weighing their decisions through existing economic status and perspectives (Barbieri et al., 2008; Valdivia and Poulos, 2009). However, these studies mostly identify characteristics of the farmers interested in AF, but not those who actually adopted the practice.

Graves (2008) also indicates that farmers interest in adopting AFP does not equate to a firm commitment to plant trees and may be influenced by the "euphoria" of the interview or newly provided information. It is essential to understand that the interest in innovation is different from the actual implementation of the innovation, and interest is not a guarantee of future practical application. For example, in Strong and Jacobson (2005) study in Pennsylvania a large majority (90%) of landowners were interested in some type of agroforestry practice or combination of practices, whereas only 3.12% actually practice AFP according 2017 U.S. Agricultural Census (USDA/NASS, 2017). Hence, the study of the actual AF practitioners is needed and is the focus of this research.

Aside from the lack of studies with farmers and landowners practicing AF on their land, there is no substantive study on the interest in or adoption of AF across different states in the U.S. The Sustainable Agriculture Research and Education (SARE) program supported by the USDA National Institute of Food and Agriculture (NIFA) funds agroforestry projects implemented by farmers and ranchers, projects that support professional development, and project that support partnerships (SARE AF projects DB, 2020). In 1998, USDA SARE started supporting farmers/ranchers in AF project implementation and subsequently have committed funds throughout 35 states and 3 U.S. territories.

Even though there are a relatively small number of farmers/ranchers who have implemented AF projects, the study of factors influencing AF adoption by these practitioners can contribute to the overall knowledge and present a more reliable profile of the AF early adopters. In Germany, where AF adoption was assessed as low, the attitudes and perceived positive and negative attributes of AF differed between farmers practicing AFPs and those involved in conventional agriculture (Tsonkova et al., 2018). That indicates that early adopters currently practicing AF have different values and priorities than the majority of farmers involved in conventional agriculture. Thus, more research needs to be done to explore the differences among early adopters and the majority of conventional farmers, so that resources for AF dissemination can be directed more efficiently at the specific target population.

DIT suggests that promoting widespread adoption of new behaviors requires a different marketing approach for each adopter group, using distinct communication channels and messages (Rogers, 2003). Barbieri and Valdivia (2010) supported the need

to specifically construct messages and employ different channels and agencies for different groups of farmers to disseminate AF information. Distinct groups of landowners were identified in various studies indicating that those in dissimilar groups adopt diverse systems or agroforestry for different reasons (Barbieri and Valdivia, 2010; Hoppe and MacDonald, 2001; Strong and Jacobson, 2005). None of the previous studies have explored channels of communication and support systems specific to AF practitioners, which are of critical importance to efficiently reach potential AF adopters.

Lack of information and support systems were found to be detrimental to AF adoption. Limited awareness among farmers and landowners was identified as one of the primary barriers to wider AF adoption is of AFPs (Fregene, 2007; Graves et al., 2008; McAdam et al., 1997). Deficiencies in AF research, low dissemination of information and inadequate policy were identified as three key areas of activity essential for promoting agroforestry (Smith et al., 2012). Considering limited resources for AF promotion, understanding how it can be more efficiently utilized is crucial. Similar to targeted advertising, targeted promotion can be more efficient than general information campaigns. At the current early stages of AF adoption, it would be logical to target people with characteristics and values similar to those who already practice AF. Once there is a critical mass of practitioners and demonstration farms, people from later 'adopter' groups would start adopting AF for a wider set of reasons. Therefore, a better understanding of AF practitioners perceptions of agroforestry, their motivations to adopt, and their preferred channels of information and support are key to the design of appropriate messages, development of targeted policy measures and tools, and effective delivery to other potential adopters.

AF is considerably more complex than commodity agriculture (monocultures) as it involves the incorporation of different components into one system. Designing and integrating combinations of trees, shrubs, perennial and annual forbs, crops, and livestock into efficient systems requires more knowledge, new skills and longer time frames to assess their usefulness and suitability. As woody plants take longer time to grow and come into full production, the full realization of AF system benefits can take three to ten years compared to few months needed to evaluate new annual crop or method (Scherr and Franzel, 2002). The long period needed for testing and modification of AF systems, coupled with its multicomponent nature demanding more knowledge and elaborate management requirements, may limit adoption (Mercer, 2004) and lead to practice discontinuance after initial adoption.

The innovation-decision process goes from acquiring initial *knowledge* about an innovation through *persuasion* to *decide* to adopt and then AF *implementation,* and, finally to the *confirmation* of the adoption decision (Rogers, 2003). Temporal issues in modern agriculture and forestry have rarely been studied, even less so for AF research due to the lack of longitudinal data (Mercer, 2004). The prospect of studying the temporal dimensions of farmer/rancher AF projects supported by the USDA SARE for over twenty years, should shed new light on the time-related questions of AF adoption. This study is intended to serve as a first step in that direction, providing a unique platform to understanding AF practitioners timeline to adoption and their innovation-decision process.

To prevent practice discontinuance due to the extended temporal aspect of AF adoption, adopters require an effective, long-term, support system. Farmer-to-farmer support and extension access are among the least studied factors influencing AF adoption

(Pattanayak et al., 2003). Both formal (extension agent, education seminars or tours) and informal (farmer-to-farmer, farm visits) support systems have been shown to be essential sources of knowledge and essential for AF adoption and information dissemination (Barbieri and Valdivia, 2010; Black, 2000; Francesconi et al., 2014; Franz et al., 2010; Isaac et al., 2007; Martini et al., 2017; Stutzman et al., 2019). However, the characteristics that contribute to an effective support system are rarely reviewed. This study will address that deficiency while identifying the support system utilized by early adopters and their preferred communication channels. This study will explore the activity scale of AF agents, and whether its proximity influenced the rate of agroforestry adoption.

Apart from the need for both a formal and informal support system, the time factor of AF systems raises concern for its adoption by those in the older demographic groups, those with fewer savings, and farm tenants. Age can be negatively associated with the adoption of conservation practices due to shorter planning horizons of older farmers (Feder and Umali, 1993). That can be detrimental for AF adoption as it involves incorporation of trees into farm operation and trees take a considerable amount of time to grow and yield an economic return on investment. That said, in general the older generation of farmers are mainly men (USDA/NASS, 2017), have better and more secure access to the land (tenure) (Bigelow, 2016) and higher savings that allow them to take more risks in trying new approaches. Early AF adopters tend to be better situated regarding assets and resources available for investing in new technologies (Mercer, 2004). In that sense, it would be logical to suggest that early adopters are older male landowners, yet this is inconsistent with results from other studies where younger female landowners are the more likely AF

adopters (Valdivia et al., 2009). More research is needed to clarify the inconsistencies with potential adopters socio-economic characteristics.

CHAPTER 3. Theoretical framework, research purpose, and implications

3.1. Theoretical approach

Agroforestry has been receiving more attention in recent decades and since its 're-discovery' by western science in the 1980s, major advances have been made in scientific research and application (Gold, 2019; Jose et al., 2018). Regardless, the actual uptake of the AFPs is relatively low in the U.S., and remains low in other developed countries with temperate climate (Tsonkova et al., 2018). Why is AF not yet widely disseminated given that it has been over forty years since its rediscovery? Many rural studies have applied the DIT introduced by Rogers in 1962 to understand adoption and it has continued to be used extensively (Upadhyay et al., 2003). According DIT (Rogers, 2003), the rate of adoption is influenced by perceived attributes of innovation (relative advantage, compatibility, complexity, trialability, observability), type of innovation decision, communication channels, nature of social system, and extent of change agents' promotion efforts. The limitations associated with perceived attributes of innovation can speed up or impede adoption. However, the DIT is limited due to its inadequate attention to role of information, risk factors, and social position of the decision maker in the community (Feder and Umali, 1993), while also not taking in account individual's resources or social support to adopt the new technology (Hayden, 2014). To address this limitation other theories of change like actor theory (Barbieri and Valdivia, 2010), unified theory of acceptance and use of technology (Trozzo et al., 2014), 'habitus' and 'field' (Flower et al., 2005; Raedeke et al., 2003) were used in studies to learn about external and internal factors influencing AF adoption.

Existing literature highlights the lack of understanding of the factors influencing farm-level decisions to adopt innovative practices that do not fit conventional agriculture patterns (Raedeke et al., 2003; Valdivia et al., 2012, 2009), and therefore have focused on understanding of the various types of decision makers and their perception of the positive and negative aspects of AF.

The key points derived from the DIT theoretical framework for this research are (i) the tipping point (10-20%) of the early adopters needs to be reached for the "take of" of the innovation spread to the majority, and (ii) early adopters differ from later adopters and thus require specifically constructed messages delivered through corresponding communication channels (Mercer, 2004; Rogers, 2003). Additionally, this study explores AF practitioners' motivations to adopt AFPs and factors that influence their decision. To avoid putting AF practitioners' opinions into predefined theoretical frames, an inductive approach was chosen for the study.

It is evident that AF is not yet widespread in the U.S. but there are a number of those who practice it throughout the country consisting of about 1.5% of the farm population (USDA/NASS, 2017). Hence, it can be assumed that AF adoption in the United States is in its early stage, and those practicing it currently mostly belong to innovators and early adopters. Based on the DIT there is a need to reach a critical mass of AF early adopters to go over the tipping point towards broader adoption of AF by early and then the late majority. However, to do so we need to understand more about AF early adopters and answer following questions: (1) who adopts AF in the early stages? (2) why do they adopt AF? (3) how long does it take? (4) how do they learn about AF and what channels of communication do they use? (5) what support systems do they need?

Answers to these questions will help to construct efficient messaging and deliver it through effective channels to wider group of potential adopters; while knowing the factors influencing adoption decisions can help to develop adequate support systems and policies to promote AF. All together that should help to advance AF adoption in the U.S.

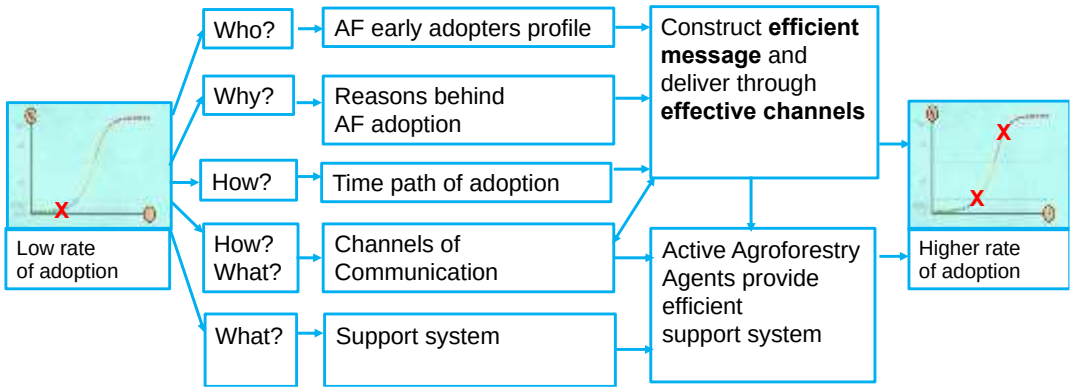
3.2. Conceptual framework

The USDA NIFA through the Sustainable Agriculture Research and Education (SARE) grant program strives to support agroforestry practice implementation and dissemination. The farmers/ranchers who had previously or are currently implementing agroforestry projects can be considered as innovators or early adopters. A total of 85 agroforestry related projects working with farmer and ranchers have been identified through the national SARE database, which covers the period from 1998 to 2019 and the geographically represents 35 states and 3 U.S. territories. It is unknown whether the farmers/ranchers who have received SARE funding have retained or abandoned the adopted AF practices after the projects were completed and what were or are the reasons behind any of these decisions.

Profiling these adopters through socio-economic and demographic data and exploring their reasoning behind AF adoption, practice retention or discontinuation can help to better understand who represents the early adopter group and construct the corresponding messages to reach a higher number of potential adopters. Identifying the channels of communication through which they initially acquired knowledge about AF, which ones they used to learn more, and which persuaded them to apply the practice, should help to more effectively utilize appropriate channels in the future and improve their message content. Understanding the support system required to retain the adoption is

crucial, as the discontinuation of AF practices by early adopters can result in adverse effects on other landowners. The theoretical framework for this research is depicted in Figure 1.

Figure 1. Conceptual framework of the USDA SARE case study



3.3. Research purpose and research questions

The purpose of this research is to study agroforestry early adopters' profiles and reasoning behind initial adoption, further retention or abandonment and to explore their preferred channels of communication and support systems. The central question for this case study is: Why early adopters adopt agroforestry? To have a better understanding of reasoning "why" question there is need to learn more about AF early adopters themselves, by exploring their demographic and socio-economic characteristics, as well as how they gain AF information and support.

The research questions that need to be answered to achieve the stated research purpose are:

1. What is the demographic and socio-economic profile of AF early adopters?
2. What are early adopters' reported reasoning for AF adoption, and subsequent retention or abandonment of AF practices?
    - 2.1. Factors favoring AFP adoption
    - 2.2. Factors limiting AFP adoption or retention
    - 2.3. Importance of the SARE program in promoting AF adoption

3. What is AF early adopters timeline to adoption?

4. How do AF early adopters gain AF information and support?

    4.1. What are the preferred channels of communication?

    4.2. What support systems do AF early adopters have?

    4.3. How can the existing information and support systems be improved?

Working with AF practitioners involved in SARE AF program allowed to address the gaps identified in the literature. Specifically: (1) expand knowledge about AF adoption in the U.S. (temperate climate, developed country), (2) help address the dearth of AF adoption studies that directly involve AF practitioners (adopters), (3) add to geographical representation of the AF adoption research in the U.S. involving participants from many different states, (4) contribute to longitudinal studies and add to the knowledge of the temporal nuances of AF adoption.

3.4. Implications

Understanding who are most likely to adopt the progressive environmentally sustainable practice of AF can help to reach a higher number of early adopters, and, thus, approach the tipping point towards adoption by the majority. It can be achieved, in part, through constructing precise messages and conveying them more efficiently to the known recipients via specific communication channels. In addition, adoption will be advanced by addressing limiting factors and creating favorable conditions for overcoming these factors through corresponding policy development, coupled with establishment of an effective support system.

Recognizing what kind of support is required by early adopters for AFP initiation and long-term continuity would help to establish such a support system and fill a critical

need. Identifying the reasons behind AF adoption will help understand the pros and cons of retaining AF practices, address identified issues in related programs, and outline the directions for policy development. Also, it might help to improve the retention rate for AF practices for recently completed, on-going, and future projects funded by SARE and other entities. Furthermore, addressing identified challenges and supporting existing strengths would help to promote AF adoption, which should lead to improvement of land stewardship, making agricultural areas more receptive to environmental conservation and sustainable development.

CHAPTER 4. Materials and methods

4.1. Research design

The case study approach was chosen for this research drawing upon the methodological principles of case study research design (Mercer, 2004; Rogers, 2003), and following procedures for conducting a case study summarized by Creswell (2013) primarily from Stake's (1995) and Yin's (2014) approaches. The *collective* case study approach was chosen because it builds from (1) desire or need to study multiple subjects within the research question, (2) importance of balance and variety from subjects with different experience and views, (3) dominance of the issue, and (4) interest in generalizations (Stake, 1995). The unit of analysis was set at the individual level. Based on the *collective* case study intent the exploration of reasoning behind agroforestry adoption (dominant issue) was set on an individual level as unit of analysis and bounded by the condition of the individual involvement in agroforestry project implementation supported by the USDA SARE program (referred to as SARE case study further on).

Figure 2 Research design

To enhance the validity of this study it was done in four stages each involving a different source of data enabling triangulation through cross verification (Figure 2). Triangulation allows more than just validation; it is also about deepening and widening the understanding of research questions in mind, it is an "attempt to map out, or explain more fully, the richness and

complexity of human behavior by studying it from more than one standpoint" (Cohen et al., 2011). Gathering data from various sources of information empowers cross-validation of findings, patterns and conclusion and to enhances the trustworthiness of the analysis (Patton, 2015).

The first stage was based on the analysis of the AF project documents and reports from SARE database (n=85). This stage aided in identifying initial themes on the factors influencing adoption and on channels of communication and underlined the current lack of understanding of their importance to AF early adopters. This helped to provide clarity for the survey and interview questions. The second stage was based on the survey of AF practitioners and promoters. Preliminary data analysis from the survey helped to identify potential interview participants, so that the collective case study would be represented by a variety individual with different background and experience. The third stage was based on conducting the interviews with the research questions in mind, assembling factors influencing AF adoption and sources of support and information. In the fourth stage, sources of support and information identified from previous stages, the SARE AF projects themselves, and active 'AF agents' were mapped with ArgGIS Pro on the layer of AFPs by county in the U.S. to see the possible correlations.

4.2. Methods instrumentation and analysis procedures

4.2.1. Secondary data instruments and analysis procedures

The USDA NIFA Sustainable Agriculture Research and Education (SARE) program provides funding support in agroforestry research and outreach. The database that contains SARE projects related to agroforestry (SARE AF projects DB, 2020) include projects that are targeted at farmers/ranchers, professional development, and partnerships.

For this study total of 85 agroforestry projects were selected from this database. All 78 Farmer/Rancher projects that were in database by November 2019 were included, along with seven from the Partnership projects category based on the condition that they included implementation of an AF practice on Farmer/Rancher land. According to diffusion of innovation theory and based on the literature review and U.S. Agriculture census, the current stage of AF adoption is on its early adoption stage by innovator and early adopters. Hence, the farmers, ranchers, and AF influencers who have implemented or are implementing AFPs belong to the innovators and early adopters group. AF promoters are the AF professionals from partnership projects who promote AF project to farmer and ranchers.

The secondary data analyses of information available through the SARE database was analyzed quantitively and qualitatively. One of the SARE reporting requirement for grantees is to provide annual reports (for multi-year grants), followed by a final report. Descriptive statistics were used to describe the information about AF projects by agroforestry practices, locations, total, mean and median grant budget allocations, number of projects by years, regions, and states. Qualitative research was done through content analysis, which was based on the initial coding of all projects. Initial codes and themes emerged here. They revealed information on the importance of different factors for AF early adopters, e.g., the value of AFP financial benefits compared to non-monetary ones, served to help clarify subsequent survey and interview questions. After the interview process, the corresponding project documents in the SARE database were ‘in-vivo’ coded in QSR’s NVivo 12.0 software.

4.2.2. Survey instrument and analysis procedures

Primary data survey and interview research followed the protocol approved by the University of Missouri Institution Review Board. The tailored design method (Dillman et al., 2009) and approaches described in survey research methods (Fowler, 2009) were used to guide the design and administration of the internet survey. The Qualtrics platform was used to conduct the survey. The survey instrument was designed to gather information regarding AF early adopters: (1) demographic and socio-economic characteristics; (2) reasons for AFP adoption or termination; and (3) communication, networks, and influence capacity. A literature review, preliminary analysis of the project documentation from the SARE database codes, and the research questions informed the survey question design. The survey contained closed and open-ended questions. Open-ended questions and comment sections were developed to produce qualitative information that would help to cross-validate findings from other sources and saturate emerged themes. Closed-ended questions included single and multiple choice, rank order, and Likert-scale questions. A draft survey was discussed with graduate committee members and adjusted according to their recommendations. To establish content validity and clarity, the survey instrument was pretested by graduate-level students experienced with survey design in rural sociology, as well as with agroforestry practitioners contacted through UMCA. After pilot testing and further revision, the final version of survey was sent to the AF early adopters (Appendix A).

From 85 selected projects, 97 associated contacts were identified through the open-source USDA SARE database, excluding duplicates, and drop-offs. E-mail addresses were located for 91 contacts. The introduction letter about the research was sent from the SARE

staff member, and it revealed 16 e-mails to be out of service. Some updated contacts were recovered through a web-search, addressing extension agents from the projects' areas, and approaching the SARE Farmer/Rancher grant program coordinators from respective regions. Ultimately, the survey was distributed via Qualtrics in December 2019 to 81 participants. Four follow up reminders were sent throughout the 60-day survey run, three through Qualtrics and one through MS Outlook. To address the nonresponse error the follow up e-mail was sent to non-responders with a short survey asking for respondents to explain their decisions not to participate and randomly chosen non-respondents were contacted through publicly available from SARE database phone numbers associated with non-response e-mails.

Descriptive statistics including frequency distribution, averages, mean, median, and percentages were done using Minitab 18 to describe the survey respondents characteristics. Minitab 18 and Excel were used to construct graphs and figures used of data analysis visualization and representation. Responses to open-ended questions and any additional comments were coded and grouped by important themes and recorded separately.

4.2.3. Interview instrument and analysis procedures

Purposeful sampling was used to select the interview participants. According to Stake (1995), for a collective case study with interest in generalizations, the balance and variety of subjects with different experience and viewpoints is important. To represent the diverse voices of AF practitioners, individuals with different backgrounds were invited to participate in the interview process. Those invited to interview were chosen to include representation by gender and by period of SARE project implementation. The aim was also to capture both types of SARE projects, active and completed, including those that were

discontinued. The individual coded links were used in order to be able to include the interviewees with diverse characteristics and backgrounds. Prior to any analysis data were disaggregated from any individual information.

Data on the interview stage were primarily collected by conducting individual one-on-one interviews using a semi-structured protocol with open-ended questions aimed at generating insights relevant to the research questions. More specifically, the protocol was designed to reveal general themes specific to the reasons for AF adoption and retention, challenges in practicing AF, channels of communication and support through each participants personal experiences. Questions for the semi-structured protocol were informed by the research questions, literature review, and preliminary analysis of the SARE database projects documentation (Appendix B). The semi-structured manner of the interview permitted a natural flow of conversation. Such approach was suitable for recording people's perceptions, attitude, values, views, and opinions. Fifteen semi-structured interviews were conducted in January and February 2020, primarily through phone, including one with zoom, and one in person. On average, the interviews were 40-45 minutes long. The interviews were recorded with the permission of the interviewee, and notes were taken during conversations. Directly following each of the interviews reflective memos were written to document initial impressions, underlining emphases made by AF adopter, and any comments or ideas that were worth noting. The interviews were transcribed and entered into NVivo 12 (a qualitative data analysis software) for coding and analysis.

Coding at each stage was done based on an inductive thematic approach without a hypothesis to test but rather to develop the data towards new insights. No predefined

categories were assigned to allow for meaningful triangulation and possibility to enrich, refute, confirm, and explain findings (Carvalho, 1997). The inductive approach and coding focused on qualitative interpretation of the meanings allowed the researcher to represent the collective (social) view for this case study. Qualitative data analysis was conducted via use of strategies described in Creswell (2013) and Merriam (2009) for initial analysis of project documentation from the SARE database and for open-ended survey questions. Using categorical and analytical strategies, qualitative data were reviewed, memoed, and categorized through code analysis. The raw data were assigned conceptual labels (codes), each of which were constantly compared with each other to identify similarities, differences, and general patterns. The major themes emerged through a coded hierarchy construct. Analogous strategies were used to code interview transcripts and corresponding database project documentation in NVivo. The NVivo data analysis was done following approaches and techniques described by Leech and Onwuegbuzie (2011) and Al Yahmady and Alabri (2013). Tree Nodes with hierarchy of emerged codes, sub-categories, categories, and themes were transposed into tables presented in the corresponding chapter. NVivo classical content analysis based on the frequency of each code, keywords-in-context, and reflective memos aided in representing the degree to which theme, category, or code was stressed in the interview, or project document.

Direct quotes can enhance the reader's understanding of the findings in qualitative research, but additional layers of complex interpretation are required for representative data analysis (Boffa et al., 2013). Thus, the interview data descriptions are based on the rigorous thematic analysis and patterns identification with the use of rich quotations and thick descriptions to exemplify the respondents' views. To give voice to AF practitioners and

early adopters and portray their opinion, a medley of quotes from different individuals on the same topic were utilized. A reflexive and thoughtful process is utilized to avoid any influence of the researchers personal position and ideologies. Thick and rich descriptions was used to convey the findings from interviews, survey open-ended questions, and project documentation to improve the validity and credibility of the study (Creswell, 2014).

Extensive data collection from multiple sources of information is recommended to improve the validity of the case study (Yin, 2014). Gathering data from various sources of information (survey, secondary data, interviews) and triangulation of information was used to cross-validate findings, patterns and conclusion and to enhance the trustworthiness of the analysis. To improve the validity of the four-stage case study design, attention was drawn to the development of the meaningful follow-up questions and clarification which were weighted from different perspectives at each stage of the study. That allowed reinforcement of the findings and further explained quantitative results with deeper qualitative meaning.

4.2.4. Mapping instrument and analysis procedures

Data from 2017 U.S. Census of Agriculture on total number of agroforestry practices by state was put on the U.S. base map from the 2016 edition of the U.S. Census Bureau's cartographic boundary shapefiles via Flourish on-line visualization tool. The data from the 2017 U.S. Census of Agriculture on the total number of agroforestry practices by county and percent of farms with AFPs to total number of farms by county was put on the ArcGIS Pro 10.7.1. ESRI base map. Through USDA SARE AF project database 69 addresses were obtained for Farmers/Ranchers type of projects, and 24 for Partnership type of project. Fourteen 'active agroforestry agents' were identified through project

documentation, survey, and interview analysis, and their addresses were obtained via web-search. An 'active agroforestry agent' (AAA) is an entity that was referenced in SARE project documents, surveys, or interviews as influential for AFP adoption through providing information and support to the practitioner. All of the addresses were geocoded to obtain longitudinal and latitudinal data and overlaid on the same U.S. base map along with the census data.

4.3. Limitations and generalizations

The generalization of results from this research is limited due to the case study setting with a bounded system of individuals who have implemented AFPs and have received SARE support for AF project. Due to the specific focus of the study population relative to the broader U.S. farming population, the application of the results can be limited, and additional research is needed. The research methodology in the current study was to make use of rich, thick descriptions so that implicit knowledge may be revealed and so that future researchers are able to use this information in order to decide if the data is applicable in their case (Merriam and Merriam, 2009; Myers, 2000). In addition, a collective case study approach and purposive interviewee selection helped to improve on subjective generalization. Data triangulation from various sources strengthened the validity and credibility of the findings (Yin, 2014), while rich thick descriptions provide transferability (Creswell, 2014).

CHAPTER 5. Findings

5.1. Database analysis findings

The analysis of 85 SARE database AF projects involving farmers/ranchers was done through data and content analysis and is described in this chapter. Table 1 shows the selected projects by type of implementor and kind of practice. As one can see the leading category is "general" where projects were set to test an AF approach, or planting method, or research market opportunities for an AF crop. Some of projects in the general category are mixed AFPs, but some can be reclassified to other practice approaches, although the results gained from those projects can be applied in another AFPs. Considering the mixture in the classification this parameter was not used in the analysis, for example to see if one of the practices prevails in one of the regions, because the data would be inconclusive.

Table 1. Project selected for this study from SARE AF database by project type and practice

AF practice	F/R	P	Total
General	41	2	43
Windbreaks	6	1	7
Alley cropping	$7^{(-1)}$	0	$7^{(-1)}$
Silvopasture	$17^{(+2)}$	2	$19^{(+2)}$
Forest Farming	$6^{(-1)}$	1	$7^{(-1)}$
Riparian Forest Buffers	1	1	2
Total	**78**	**7**	**85**

F/R – Farmers/Ranchers project type, P – partnership project type, (-/+n) – overlap with other practice

The SARE grants are administrated in four regions: North Central, Northeast, South and West (SARE website, 2020). The project distribution by region, for 85 selected projects, are: North Central (41.18%), followed by North East (27.06%), West (17.65%), and South (14.12%) (Figure 3). The highest number of projects is seven in Missouri, Ohio, and Wisconsin. The number of projects by year and by project

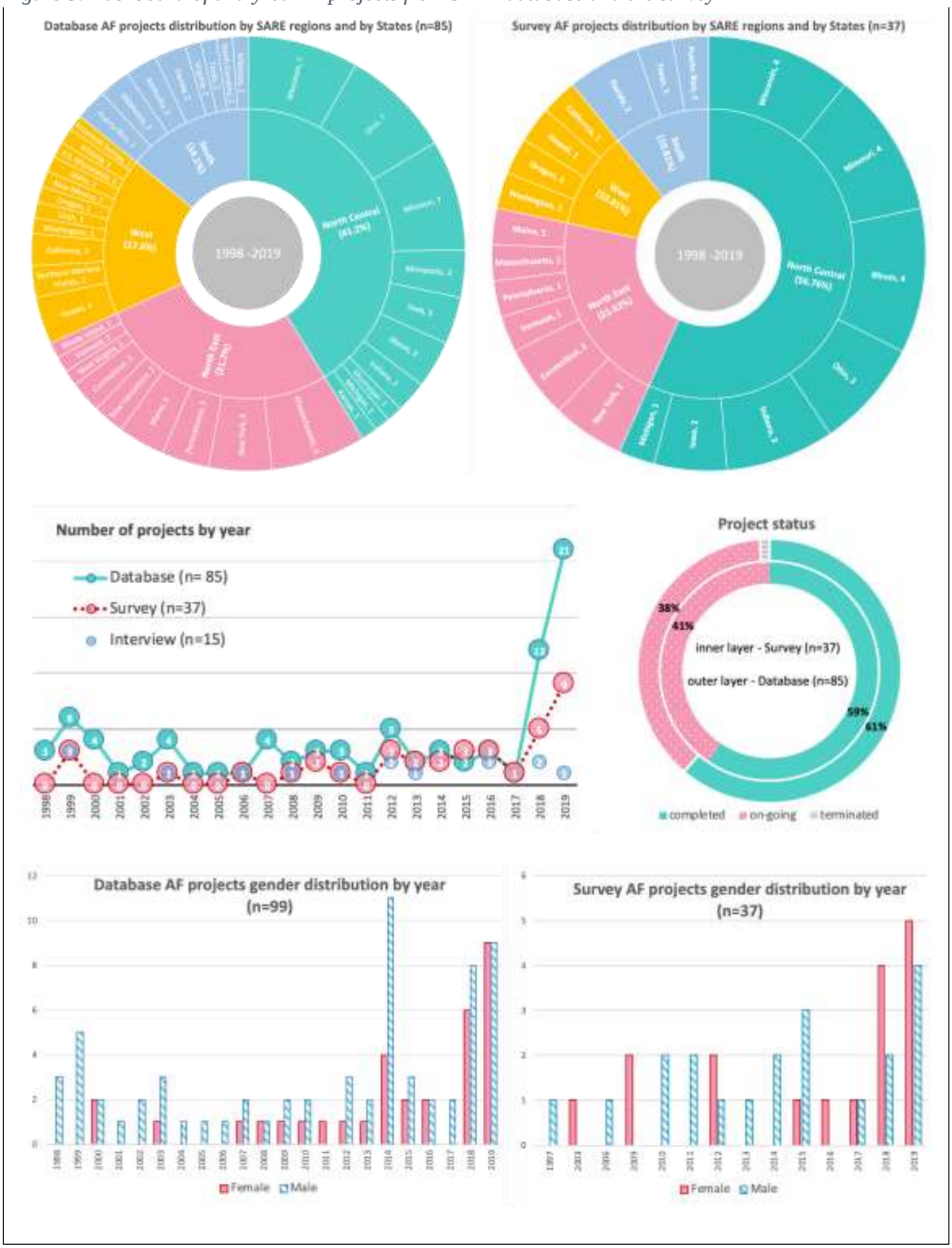
Table 2. SARE program grant allocations for selected projects from 1998-2019

Budget	F/R	P	Grand total
Total, U.S.D.	$810,622	$167,443	$978,065
Average, U.S.D.	$10,393	$23,920	$11,506
Median, U.S.D.	$8,957	$14,996	$9,107

F/R – Farmers/Ranchers project type, P – partnership project type

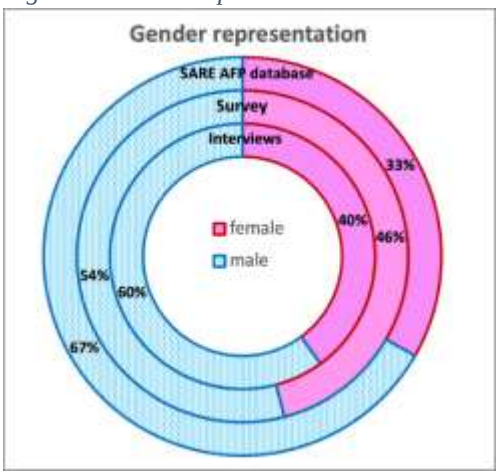
status are also reflected in the Figure 3. The total and average grant allocations budget by type of project is exhibited in Table 2.

Figure 3. Dashboard of analyzed AF projects from SARE database and the survey



A review of the contacts associated with the 85 projects revealed 99 individuals, including two couples, excluding duplicates for individuals who were involved in more than one project and those who dropped out from a project before its start. The gender distribution by year is presented in the Figure 4. The overall gender distribution of individuals involved (n=99) in selected projects was 67% male and 33% female (Figure 4), which is close to national average with 70% male and 30% female as farm principal producer (USDA/NASS, 2017).

Figure 4. Gender representation



Analysis of the SARE project documents and reports were done with research questions in mind: (1) Why AF early adopters implement AFPs? and (2) How do they gain and share AF information and find support for AF-related questions? Considering the fact that the SARE projects and reports are not designed to answer those questions it was hard to interpret some of the SARE report data. For example, a SARE project document would state that previously the farm had been conventionally cropped in a corn and soybean rotation and currently it is a diversified farm with vegetables, flowers, herbs and fruit trees production and native grasses cover, but nowhere is it stated why the current landowner has decided to transition away from a conventional agricultural system. It can be inferred that there was a shift toward a preference for alternative food system, but without it being stated or explained in the documents, such instances were not coded. Only statements with clarifications were coded. Review of additional sources of information such as project

documents and reports from the SARE AF database helped to make sure that themes were saturated from different origins.

The limitations of SARE database AF project reports lie in the requirement of the SARE grant program call of proposal. According to SARE Farmer/Rancher grant writing requirements (Benjamin, 2018), the main focus of SARE grants is that they have to address sustainable agriculture. Thus, the proposal has to explain how the project would help improve profitability, stewardship and quality of life on farm and be useful to others. Considering limited funding, a project does not have to propose in depth solutions to each sustainability aspect and can focus on one or more, but applicants are encouraged to address all of those issues in the proposal. This requirement limits exploration of reasons behind adoption. On one hand, people who do not believe in sustainable agriculture, are unlikely to apply for a SARE grant in order to implement this type of project. On the other hand, proposals might not convey farmers and ranchers true reasons for adopting AFPs. Nonetheless, personal interpretation of ecologically sound, economically viable and socially responsible approaches and attitudes was, on occasion, reflected in the project proposals and reports and were evaluated. Additionally, progress and final project reports provided in depth descriptions of challenges faced during project implementation. Considering that they were written in real time, without long delays compared to the time-hazed recollections years after implementation, the reports provide valuable input to data analysis and theme enrichment.

Responding to SARE requirements for Farmer/Rancher grant proposals, applicants would emphasize their project goals in relation to environmental sustainability, economic validity, and indicating how other farmers would benefit from these projects. This

background information helped the researcher identify major themes that stimulate farmers to adopt AF (economic, environment, social), and inform the crafting of interview questions. Some reports and project documents reflected personal views on agriculture or the importance of specific factors for implementing an AF project. This information was coded, but due the random and irregular appearance of this type of information, it did not permit the researcher to correlate the importance of those factors with those that were required in the SARE reports. Hence, they were not weighted against each other but rather used to enrich themes in subsequent stages of the research. To better understand the triangulation process, this chapter covers (1) themes, categories and codes unique to the SARE database documents, (2) where there was overlap among themes, categories and codes, further explanations were provided on differences and similarities.

As mentioned, ecological sustainability and cost effectiveness were emphasized in the project documents. In most cases these objectives were blended together within the project goal and interwoven throughout the descriptions. Here is example project justification: "*Diverse Agroforestry (DA) systems integrating fruit, nut and forage components have potential to restore ecosystem services while simultaneously providing economically viable and nutritionally valuable staple-food crops at industrial quantities."* The primary focus of the majority of SARE AF projects was to build/develop/explore/expand/test a sustainable polyculture multi-species system with further testing of its environmental, economic, or social impact. In most of the cases the environmental sustainability of agroforestry practices was assumed, while the exploration of the economic side of a sustainable practice was set as the project objective. That said, some practices also tested the environmental influence of the AF practice, for example on

soil quality, wildlife, pollinator habitat improvements, and decreased need for pesticide use. Testing economic viability of the proposed AFP approach was the main topic in the economic category expressed as *"explore a scalable and viable alternative to chemically dependent monoculture", "develop a profitable commercial organic agroforestry demonstration", "produce additional revenue streams", "opportunity to improve on-farm productivity", "permaculture principles and techniques that can and ought to be applied to commercial-scale annual crop production".* Such descriptions imply that in many cases practicing alternatives to commodity agriculture methods was primary motivation for the applicants, while exploring economic validity was important but secondary.

Often the economic results were inconclusive because the period needed for trees and shrubs to reach their production age exceeded the project length. Apart from exploring possible direct income from AF operations, the economic objectives looked into possibilities of farm diversification, alternative sources of revenue and additional animal feed production. Many projects tested new practice approaches, evaluated techniques, or explored species suitability and variety survival.

The environmental factors identified as motivation for AF project implementation were mostly focused on the environmental integrity and environmental benefits. Environmental integrity was reflected in terms of managing the ecosystem as whole unit with unique database analysis codes including species integration, moisture retention, rainwater harvest, production of fertilizer and mulch, weed suppression, integrated pest management with minimal required energy inputs and lower fossil fuel consumption, thus, reduced environmental impact. The goal of working toward eliminating chemical usage and using an organic agricultural approach were noticeable components of the

environmental integrity category. The ecosystem services category overlapped with a similar category revealed during interviews but mainly emphasized soil health and stability, wildlife habitat, and biodiversity. Other services including climate change mitigation, and water and air quality were also present but less often.

Social factors were reflected in such project achievements as establishment of full-time work for a local employee, providing part-time employment, preserving landscapes for future generations, and the diverse benefits that farmers and society gain from agroforestry systems. Social dimensions received less attention than the environment and economics.

Even with economics and ecology highlighted in the project documentation, personal perspectives were occasionally revealed in minor details, additional explanations, descriptions of the operation, etc. Here is one example of a project objective: *"I've been researching and attempting to create a sustainable food production system for hilly land that is relatively easy to manage, has low offsite inputs, and is sustainable economically and environmentally."* Even though economic and environmental sustainability is indicated, the interest in creating a sustainable food production system is noticeable, which is supported in additional information on farm history: *"In 2008 my wife and I bought 17 acres of overgrown, ridge top horse pasture with the goal to develop, share, and celebrate sustainable solutions to home and community scale food production, and to demonstrate that through creative natural resource management, the land, as always, is still the basis of our health and wealth."* Such statements provided a deeper understanding of grantees reasons for implementing AF project reflecting their belief in more sustainable alternatives to the modern industrial food production model. This is echoed in another project

description: *"The objective was to develop a profitable commercial organic agroforestry demonstration plot to illustrate the variety of benefits available from a well-planned comprehensive alternative enterprise."*

Some of the project reports contained the philosophy of farmers and their farm approaches throwing the light on the importance of their personal views on adopting sustainable practices. For example, one of the grantees shared his farm philosophy on animal raising where animals should be *"appropriate to land and stage of farm development, supportive of landscape health first and yields second, healthy and happy in their living environment, economical to maintain, easy to move through the use of portable housing and fencing, enjoyable to raise and work with"*. Such a philosophy reflects on a farmers personal values and the secondary nature of the economic income, without diminishing its importance. At the same time other project descriptions indicate the importance of the financial factor as the primary reasoning to explore and potentially adopt AFP. For others, the environmental benefit prevailed, as for example in this statement: *"Environmental benefits of food production from woodland may at some point trump all economic concerns, or receive policy-related payment rewards, if climate patterns and ecological systems continue to deteriorate worldwide."*

Overall, the internal factors influencing adoption, identified in the SARE AF project database, were (1) farmers commitment to sustainable over conventional agriculture systems, and (2) desire to promote AFPs to others by setting a successful example, (3) visual aesthetics of diverse AF systems. Desire to promote AFPs was defined through such project goals as setting an example for other farmers, establishing a demonstration site, and sharing project findings with others through various channels,

although this last goal may be viewed as due to the SARE outreach requirement. Providing a working agroforestry demonstration plot was indicated not only in the project goals but also in descriptions throughout project documents, as well as prior activity and plans set after project completion. For example: *"Our overall project rationale was to model and demonstrate on our farm that an agroforestry production system can help farmers diversify products, markets, and farm income, while emphasizing sustainable land use practices."; "While the farm also serves as an education center, hosting workshops and youth summer camps"; "The orchard will continue to be available for field tours by other interested growers or potential growers."*

Both internal and external factors were among the challenges faced during project implementation, which can be considered as factors limiting agroforestry adoption. Internal factor themes were most commonly linked to such personal capacities as available time and labor, finances, data collection, and health. One of the reports hits this point: *"It [agroforestry] seems well suited to owners who have sufficient resources to commit to a multi-year startup investment of funds, labor, and energy."* Time and labor were the most often referenced. Project activities often ended up being more time consuming than initially anticipated, as echoed in several reports: "*After setting in on the project, we found the rows of brush would be prohibitively time-consuming to construct";* "*As a single handed operator of this two acre field, I was not physically able to maintain these 48+ beds myself."* Health problems contributed to the time and labor limitations.

The financial challenge was mostly connected with the long-term establishment requirements of plants before they can be harvested or produce crops and the need to have up-front investments and contingency plans. As one of the farmers recommends: *"Based*

on this research, I would recommend having at least simple low-cost contingency plans in effect for extreme events (like drought) to protect your investment."

The factor that was more prominent in the database reports than in the interviews or survey was the farmers capacity for data collection and analysis. Data collection represented a challenge in number of cases for several reasons. First, is the hardship of collecting accurate data while having to run a farm and a business, especially for part-time farmers. As one of the farmers shared: *"We also learned that research is challenging to do when one is also farming a crop or system… Balancing the need for monitoring with the realities of farming (not to mention that picking up slugs one by one and weighing them is rather disgusting), we did not continue trying this method for too long."* Second, it was hard to maintain some of the initially planned methods due their impracticality and inconvenience. As in one of the examples, due to the long period of maturity the data measurements were refocused on plant growth rather than plant yields as primary metric for performance. Third, assessments often were a subject of changing environment, like drought in one year and abundance of rain the other, or pest outbreaks, that created difficulties for farmers to make representative data analysis.

Those are challenges often faced by field research studies, but farmers often do not have time, funds, or capacity to address them. Another farmer exemplifies this in his report: *"Ultimately, I learned to try to test one thing at a time and that the complexities of nature are hard to isolate in field trials, especially for amateurs such as myself. Still it was a very interesting and edifying experiment for me and the results although not as scientific as I had hoped are very encouraging to me."* Conversely, some project reports, but not many, contained extensive academic research style data, but those were usually done in

partnership cooperation with field interns, researchers, laboratories, extension, or by grantee with university degree in science.

Among the most common external challenges were issues with plant establishment. Compared to the interview results, project reports placed much more emphasis on such issues as wildlife pressure for establishing plants (from livestock, deer, mice), weed pressure, plant pest and diseases, poor choice of planting stock or method, and grafting challenges. E.g.: *"tree loss to mice that exceeded the loss to deer which I took great pains to almost eliminate completely."* Weather factors, especially drought, and the need for irrigation were also commonly referenced. The long period of establishment was implicitly present as an AF adoption limitation. It was not explicitly named as challenge due to logical expectations of time needed for trees and shrubs to mature, however had caused some complications in estimating results due to the relatively short period of the projects or in promoting the project through outreach activities.

Lack of information and local and regional examples was often put in as a project justification. On one hand it indicates on the applicants' desire to explore alternatives as one of possible reasons for AF adoption, on the other hand it highlights the limitation for AF adoption lacking model demonstrations. As one farmers states: *"[name of the farm] of Iowa is located in the heart of monoculture row crop production and therefore producers interested in agroforestry cropping enterprises have limited access to successful agroforestry demonstration plots. This lack of exposure provides little incentive for beginning or current producers to give serious consideration to agroforestry enterprises as a potential for significant contributions to farm income and environmental sustainability."*

The exploration of the research question on how AF early adopters gain support and what channels of communication they use developed through the analysis of the SARE AF project database provided two main directions. One regarding support and information channels used to receive answers to AF related questions, and the other regarding information channels and support provided by AF early adopter to other farmers and interested parties. Two main categories of gaining support and information were identified: (1) farmer-to-farmer communication, (2) interaction with AF experts. Farmer-to-farmer communication included interaction with other farmers that might not practice AF but are helpful with information or experience in other relevant topics, like cover crops, pest management, specialty crops. Farmer-to-farmer communication also included support from other AF practitioners either through shared information or experience.

Often those communications were during field farm days or other outreach events where grantees shared their experience and interacted with other farmers, as in this example: *"Speaking with other tree growers at my outreach event and at other tree growers meetings has helped in getting more ideas about how to tag or mark the trees."* Some project reports reflected help received from other AF practitioners, including those who have implemented prior SARE projects. For instance, one of the farmers references another SARE AF project farmer who helped with the AF part and also notes in his report about learning another technique from a different farmer: *"One permaculture technique that I tested there was to overseed beans into a strip of the previous cover crop of rye, and then go over that strip with the brush-hog. I got this idea from a farmer in Kentucky, who overseeds her beans into rye, and then scythes the rye down on top of it."*

Another channel of information and support was AF professionals – experts from the universities or government agencies. Those could be either through events organized by the organization (e.g.: *"Training from the chestnut experts at The Center for Agroforestry at the University of Missouri taught me that grafting chestnut trees with scion wood from chestnut cultivars with proven high productivity is necessary to ensure large crops of high-quality nuts in the future.")*, or through direct consultations (e.g.: *"University of New Hampshire Professor [name], technical advisor to this grant, has been active in providing advice and some lab equipment to this project. His support, Professor [name], and that of other faculty at the University of New Hampshire has been instrumental in the success of this project.")*

Because an outreach component is required by the SARE program, each of the project had some explanations of how the project results will be disseminated. In many cases that activity did not seem forced and were often practiced by those farmers prior to the grant. Those are usually the farmers who have already established alternative systems on their land, be it organic orchard, polyculture, permaculture, or agroforestry systems. For those who have instituted a new practice to their farm and held outreach events, those activities were as useful as for those who came for a farm visit, as experienced by one of farmers: *"I was pleasantly surprised by the interest that was generated by the project and as a result found lots of valuable insight and resources from individuals who visited my farm. This said, I would encourage all producers looking at alternative enterprises to be as public and visible as they can and also to participate in any and every related group or association that might lead you to human and technical resources. In my case I attended numerous field days that I normally would not have gone to."*

Some reports indicated that sharing the experience was important for those who have implemented AF projects. For example, among initially stated project achievements on direct and indirect economic income from AF practices, the final item listed was the following statement: *"Most importantly, the demonstration plot has been utilized by two producers who have also begun new chestnut plantings on their farms.",* indicating on the importance for the grantee to promote AF and share experience. Further, in the discussion part of the report this was confirmed: *"In a monoculture crop area, drawing attention to the project was not a problem and through the questions and comments received by curious neighbors and interested growers the project has certainly been a success in at least getting people to think about alternative crops for marginal ground or odd-shaped tracts of land."*

The most popular choice of AF practitioners to share their experience was through different types of events which far exceeded any other type of information channels. SARE AF project grantees put a great effort into information dissemination and sharing their experience through holding on-farm events or participating in off-farm events. The on-farm events included field days, farm visits, open farmhouse, farm-based workshops, community festivals, summer camps, and educational days, where various visitors had participated including farmers, extension agents, students, children, customers, and other interested parties. For AF projects that were established from scratch it was hard to hold field days simply because the short length (23 month) of the SARE project did not allow for perennial plants to fully establish and mature. For projects that already had mature trees (those that tested different AFP, expanded AF, or introduced forest farming or silvopasture into forest) hosting events was easier and generated higher interest. The forecast of one

farmer about generating the greatest interest in future years when plants start producing crops proved to be accurate based on the interview.

Off-farm events included participation in numerous events hosted and organized mostly by the Universities and non-profit organizations, and some by government agencies (extension). Almost all grantees have given a talk or presentation at one or other event including conferences, workshops, professional society meetings, farm shows, trade shows, or webinars. Both on- and off-farm events have generated establishment of mutually interested contacts and networking, exemplified in the following statement: *"The most valuable outcome for me personally was the contact I made with similar or like-minded growers. Anything SARE can do to help facilitate these connections on a local or regional basis would be greatly appreciated."* The connections made during project implementations are greatly appreciated by farmers, because now they have established contacts with extension agents, AF professionals, and other AF practitioners. In some cases, *"involvement has also assisted us in marketing our products and has provided marketing information for our customers and chefs."*

Farmer-to-farmer communication was the next most popular channel to share AF information. Communication was primarily accomplished through contacts established during various events, or by farmers directly contacting the grantee and asking for a consultation. In many reports, grantees planned to continue spreading the information and share their experiences "*The demonstration site will remain available for field tours"* or "*We plan on continuing to share the publication and our findings with the gardeners and farmers we teach and interact with at conferences, in classes, and at permaculture courses."*

Because SARE project reports were written immediately following the completion of project, it can be hard to trace AF adoption influence, however, some reports did contain information shedding light on adoption influence. For example, "*Being the only formal study on silvopasture establishment in the region, this project garnered quite a bit of interest. Some farmers who were interested in the study and came to visit did begin to implement silvopastures on their farms. The demonstration of silvopasture in practice through this study and others silvopastures in the region are the main driver of adoption."*

Other ways of spreading AF knowledge generated during SARE AF project implementation included publications and on-line media channels. Print-based publications included newspaper articles, newsletters, journal articles with projects hosting researchers, bulletins, brochures, and pamphlets printed by a partner organization. Information was spread primarily through on-line communication, that included sharing information (e.g., newsletters, fact sheets, bulletins, on-line articles, reports) on farm websites or partner organization websites, through mailing lists, and discussion, photos, and videos through on-line communities (Facebook groups and you-tube channels).

Some grantees provided feedback to the SARE program in their evaluations. Those recommendations included: (1) the need to facilitate networking on a local and regional basis, (2) support more research to determine the benefits and tradeoffs of AFP; (3) need for continuing support of small-scale farmers (e.g.: "*Your [SARE] financial support allowed me to have a voice and a presence in my community and state)*, (4) need for continuing financial support for tree planting.

A SARE report grantee shares his lessons learned: *"It was assumed at the start of this project that the loss of income from the land occupied by a tree planting was the biggest*

barrier, and the prospect of a good income from high value crop bearing trees would make tree planting attractive to many rural landowners. I believed many additional tree plantings would be inspired by publicity about this project, even without cost sharing. I was wrong. Based on the number of people who showed interest, but ultimately decided not to plant trees without cost sharing, I now conclude the promise of income in the future is not enough incentive for most people to plant trees. Cost sharing for the tree planting seems to be an essential ingredient for most people. For many, an income from CRP rental in the interim, before the trees begin bearing crops, is needed in addition to cost sharing before they would be willing to make such a long term investment. I believe a government program specifically to cost share the long-term investment in sustainable agriculture systems such as this is needed." However, almost twenty years after this report, a former grant recipient reflected back and indicated that even though he was not able to change the minds of a majority farmers in his region, there are many individual farmers who have visited his farm and have adopted AFP based on his example without cost share program support.

SARE AF project database document analysis showed the acute need for further clarification with AF practitioners regarding their reasons to adopt AF, limitations to doing so, and preferred channels of communication and support. The database helped to form some of the survey questions and clarified points for the interview protocol.

5.2. Survey findings

Out of 81 questionnaires distributed through Qualtrics 52 were returned (64.2% gross return rate), and 37 were usable, resulting in a 45.7% usable response rate. The final follow-up reminder contained a question asking respondents to provide information on why

they decided not to participate in the survey. Responses received included: (1) invitee had no time to complete the survey, (2) felt the survey didn't apply to them, (3) their project is not related to agroforestry, (4) it was not convenient to fill out a survey on-line, (5) invitee was a contact person for an AF practitioner who passed away. To address the nonresponse error, randomly chosen non-respondents were contacted through publicly available information from SARE database phone numbers associated with non-response e-mails. Some phone numbers were not in service or were "wrong numbers", others not reached. The contacted individuals indicated that the e-mail used in the survey is not used by the participants anymore, they still practice AF but had no have time to do the survey. Additionally, through e-mail and phone communication it was revealed that several grantees did not associate their project with AF while it is actually AF (e.g. growing woody species for livestock feed). Collectively, this helps to account for some of the non-response rate.

5.2.1. SARE AF project representation.

Of the 36 respondents 78% were involved in SARE "Farmer/Rancher" grants , 17% in SARE "Partnership" grants, 3% in both, and 3% as academia. Most of the respondents (n=37) were from North Central (57%), followed by North East (21%), West (11%), and South (11%) regions, which are similar to overall distribution of SARE AF projects involving farmers with some prevalence from North Central region (Figure 3). The representation of survey participants by project year is similar to the yearly distribution of the selected AF projects from the SARE database (Figure 3). In those cases where the number of projects in the survey sample exceed that number in the selected SARE AF project sample, this is due to partnership project representation by more than one farmer in

the survey mail list of respondents. Survey results indicate 59% projects completed and 41% still on-going. Overall, the survey is fairly representative of the database of SARE AF projects involving farmers/ranchers.

5.2.2. Demographic and socio-economic characteristics

AF early adopters demographic and socio-economic characteristics are represented in Table 3. The dominant age groupings of survey participants were 36-45 (31%) and 56-65 (31%). Gender was more equally distributed in the survey population, with 54% males and 46% females, compared to gender distribution in SARE AF projects involving farmers/ranchers (Figure 4). Nearly 95% reported that they had obtained graduate (56%) or college (39%) degree. Almost 70% are married, while ~56% live at home with their spouse, significant other, or partner. Distance from an urban area with at least 50,000 were highest (31%) for two groups: 10-29 miles and 60 miles or more.

The percent of the individuals grew along with the increase of the total income and was highest (34%) for annual incomes of $100,000 or more. Most of the respondents (56%) are currently part-time farmers, and only 28% are full-time farmers. These numbers did not change significantly during the time when the SARE AF project was implemented. The majority (56%) of AF-adopters do not come from the farm family and had an occupation different from farming. For 81% of respondents reported less than forty percent of their income coming from the farm, including 19% who reported zero farm income. The percent of farm-related income that comes from AF is zero (39% of respondents) or less than twenty percent (25%), however there are 8% of farmers for whom AF derived income represented 80-99% of farm income, and 6% of respondents for whom agroforestry represented 100% of farm income.

The likelihood of the family continuing to farm after survey respondents stopped farming was evenly distributed with the majority (47%) of respondents unsure if any family member will continue their farming operation (Figure 5). While the interest in seeing the land continue to be in active farming even if no one in family is planning to do so was positively skewed with 51% of extremely interested, and zero uninterested respondents.

Figure 5. Likelihood and interest in farming continuation

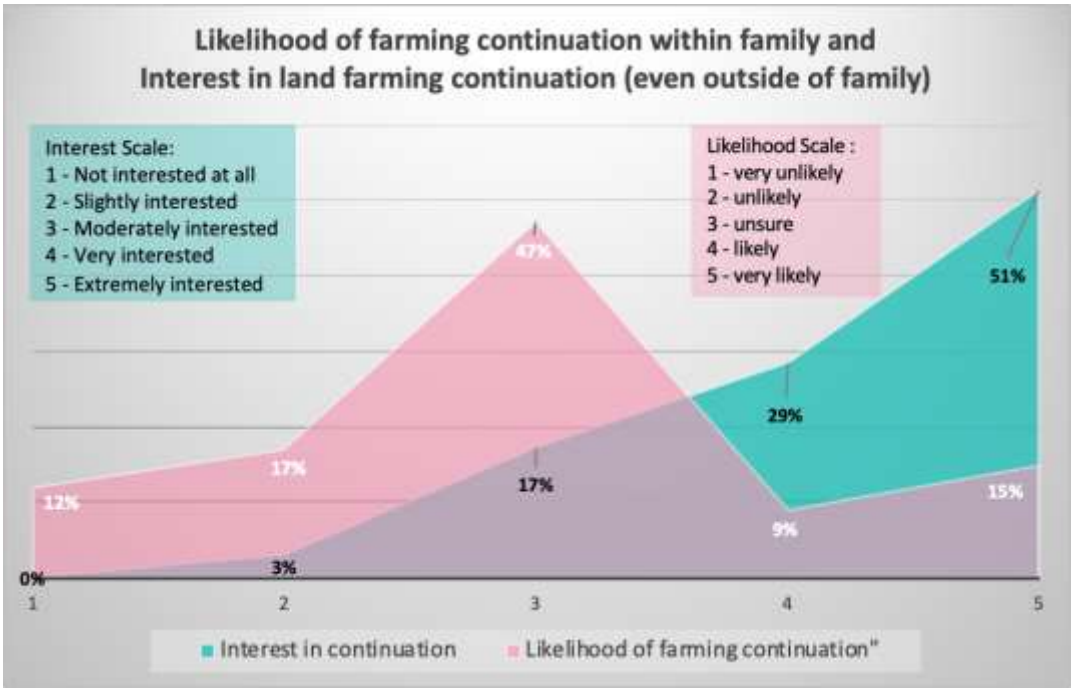


Table 3. AF-adopter demographic and socio-economic characteristics

Personal attributes	***(N)***	**%**
Age group	***(36)***	
25 or less		0.00%
26-35		16.67%
36-45		30.56%
46-55		8.33%
56-65		30.56%
over 65		13.89%
Gender	***(37)***	
Male		54.05%
Female		45.95%
Marital status	***(36)***	
Never married		19.44%
Separated		0.00%
Divorced		8.33%
Widowed		2.78%
Married		69.44%
Lives at home with	***(45)***	
Alone		6.67%
With spouse, significant other, or partner		55.56%
With child(ren) 12 years old or younger		22.22%
With child(ren) 13-17 years old		2.22%
With child(ren) 18 years old or older		6.67%
With others (parents, friends, adult children)		6.67%
Total household income	***(35)***	
< $25,000		8.57%
$25,000 - $34,999		5.71%
$35,000 - $49,999		11.43%
$50,000 - $74,999		14.29%
$75,000 - $99,999		22.86%
$100,000 or >		34.29%
prefer not to answer		2.86%
Highest level of education	***(36)***	
High School		0.00%
Technical School		2.78%
Community College, or Junior College		0.00%
College Degree		38.89%
Graduate degree		55.56%
Other, please specify		2.78%
Location from an urban area with at least 50,000	***(36)***	
We are located in an urban area		13.89%
Less than 5 miles		2.78%
5 – 9 miles		11.11%
10 – 29 miles		30.56%
30 – 59 miles		11.11%
60 miles or more		30.56%
Family ownership and active farming of a farmland, in years	***(34)***	
mean		28.6
median		15.5
mode		30.0

Farm and farmer attributes	***(N)***	**%**
Current involvement with agriculture	***(36)***	
Full-time farmer		27.78%
Part-time farmer		55.55%
Landowner living on the land but not farming the land		0.00%
Landowner living away from the farm		5.56%
(farm the land partially / living not far)		(2.78%)
(lease out the farm)		(2.78%)
Farm manager - not landowner		2.78%
Other, please specify (*research, agency)		8.33%
Involvement with agriculture during implementation of SARE project	***(36)***	
Full-time farmer		22.22%
Part-time farmer		61.11%
Landowner living on the land not farming the land		2.78%
(not leasing out the land)		(2.78%)
Landowner living away from the farm		2.78%
(lease out the farm)		(2.78%)
Farm manager - not landowner		2.78%
Other, please specify (*research, agency)		8.33%
Farming and family background at the time of implementation of SARE funded AF project	***(36)***	
From a farm family, and farming most of a life		12.50%
From a farm family, but had a different occupation for most of a life		8.33%
From a farm family, have had a different occupation, but got back to farming		13.89%
Not from a farm family, but have been farming most of a life		9.72%
Not from a farm family, and have had a different occupation for most of a life		25.00%
Not from a farm family, have had a different occupation, but decided to switch to farming (at least partially)		30.56%
Percent of the household income that comes from the farm	***(36)***	
none		19.44%
Less than 20%		38.89%
20-39%		22.22%
40-59%		8.33%
60-79%		2.78%
80-99%		5.56%
all 100%		2.78%
Percent of farm-related income that comes from AF	***(36)***	
none		38.89%
Less than 20%		25.00%
20-39%		16.67%
40-59%		5.56%
60-79%		0.00%
80-99%		8.33%
all 100%		5.56%

5.2.3. Factors influencing AF adoption.

Respondents of completed projects answered additional questions about current use of the AF practice implemented within the project and reasons for its continuance or discontinuance. A majority of respondents (76.2%, n=21) indicated that completed projects are still active, including 38.1% that have been modified since project completion and are still active, and 38.1% that are in active use as they were set up initially. The remainder of respondents indicated that their completed projects are: not managed or no longer exist and do not bring benefits (4.8%), not actively managed but brings some benefits (9.5%), and other (9.5%). One "other" option specified that within project in question AF design was developed for several farms of which at least two have adopted it, another that the AF project is not managed due to moving to a new farm and that it would have still be in use otherwise. Thus, the rate of AFP complete abandonment is very low.

Among the reasons behind discontinuing active use of the AFP were subsequent death or poor performance of the planted plants and a sale of the property. One of the notable comments for continuing active use of the AFP referenced possible reason for discontinuing: *"The goal of our implemented agroforestry practice was to test and create a profitable, salable commodity. Discontinuation of the practice would only happen if proved to be a failed system".* That indicates the importance of the economic priority of farming. Among other comments regarding the reasons for continuing active use of the AFP the most mentioned were themes of additional income (small or big, through diversification, short-term income while trees mature) and productive conservation (sustainable farm system, healthy ecosystem, shade for animals, plus customer satisfaction by that fact), followed by themes of indirect income (improved land use efficiency,

additional forage and its quality, improving land value and trees quality, tax-cuts, cost-share funding opportunity) and ecological services (soil health ad erosion prevention, wildlife habitat, water quality), and then themes of aesthetic beauty and personal interest.

> *"Agroforestry is my sole livelihood and reason for farming, in order to show an example of how a farm family can earn a good living on just a few acres, without soil erosion, use of chemical fertilizers or pesticides, with very low use of fossil fuels, without expensive machinery, and without debt."*

The most pronounced theme of agroforestry practice establishment difficulties was (1) tree survival, with most prominent issues identified: (a) weather (drought, floods, frosts), (b) animal and wildlife pressure, (c) weeds, (d) soil conditions, (e) pests and diseases. Another theme encountered in establishment difficulty was (2) time and labor intensity, followed by (3) getting the support and finances. Further, the theme of (4) lack of experience, expertise and guidance for establishing new complex endeavor. The themes of (5) disappointments in the results, (6) length of perennial crop establishment, and (7) grant requirements of quantifying results also arose but were not as prominent.

> *"everything is not as I hoped it would be, but it is a work in progress"*
>
> *"It takes a long time to maturity for some crops and then once they are producing some turn out to be poor producers or have too many pests."*

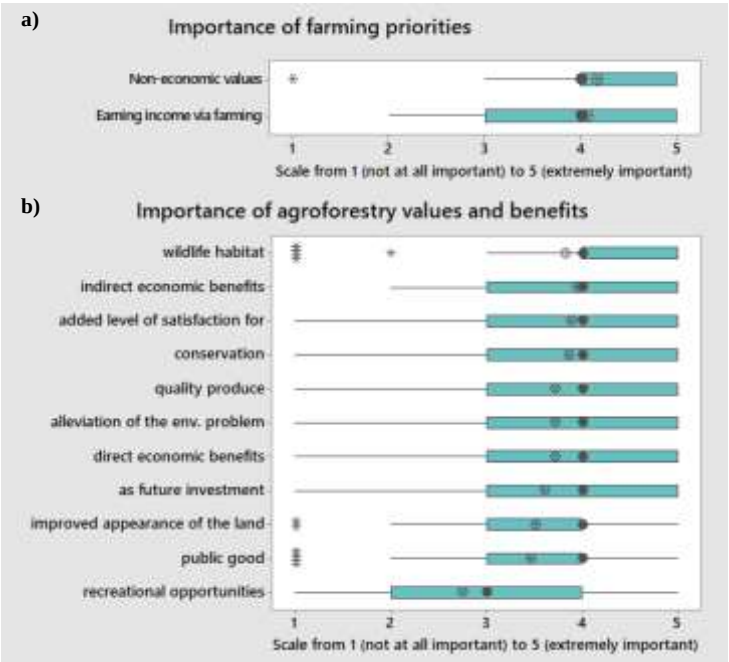
Although some of the AF projects supported by SARE were established and succeeded without real changes in initial plan, the majority of farmers had to adjust to emerging nuances. The most common theme of adjustments was (1) changes to initial project design (choice of species, number of species, planting design, etc.), followed by (2) changes in methods (planting, protection, etc.), (3) need additional equipment or finding

"the right one", and (4) changes to grant activities (budget allocations, education approach, data collection). One of the notable quotes: *"My SARE project is working as planned, however, I have shifted towards more native and disease resistant trees over the years."*

Among difficulties that AF practitioners face after establishment phase the most mentioned were (1) trees maintenance, including needs for thinning, irrigation, protection from competitive vegetation, pests, and wildlife, and (2) lack of time and labor for management and expansion. Further, quite few famers noted (3) no current difficulties in practicing AF. Other mentioned difficulties were (4) need for additional investments (equipment, methods adjustment, soil improvement), (5) lack of shared knowledge, (6) produce marketing, (7) variability of harvests.

Participants attitudes towards economic and non-economic priorities of farming and benefits and values of AFPs is demonstrated on Figure 6a. From the positions of the boxplots it is possible to determine that, in general, the respondents' value both economic and non-economic priorities of farming with slight prevalence of non-economic priority. As for agroforestry benefits and values (Figure 6b), the recreational opportunities benefits had the lowest median (3= moderately important) while boxplot position of the wildlife habitat shows highest

Figure 6. Importance of farming priorities, AF values and benefits

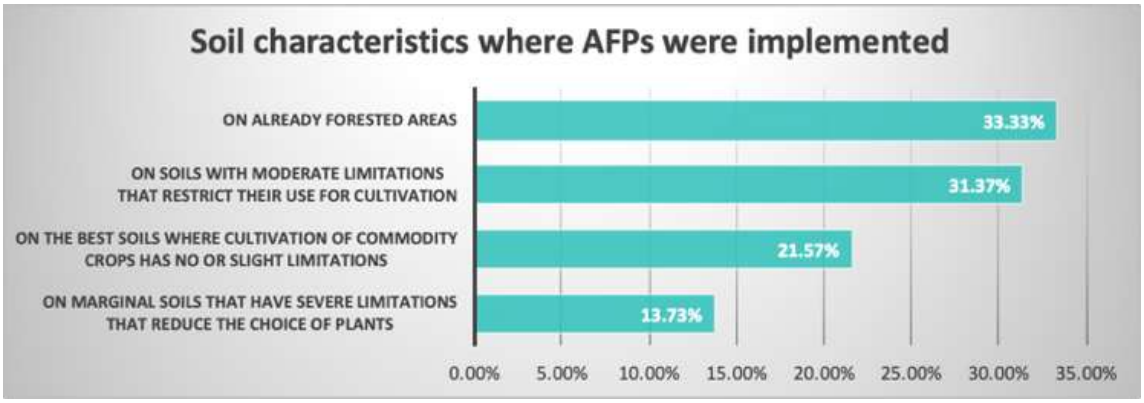


This boxplot graphics is generated by Minitab and ordered first by interquartile range box, then by median (black dot), and then by mean (cross dot); asterisk marks outliers

importance for the respondents compared to other benefits. From boxplot positions it can be seen that all other AF benefits and values lie closer to positive side of importance scale with median 4 (very important) and average scores between 3.46 and 3.94 where highest is for indirect economic benefits followed by added level of satisfaction for the work.

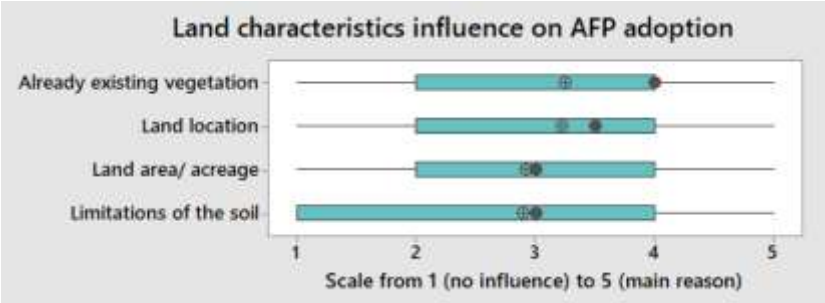
The themes that emerged in the "other" section for important values and benefits of the agroforestry practices were knowledge generation, including accumulating expertise in *"novel practices"* and sharing it with others, for e.g.: *"influence other farmers and farms in the area; provide an example".*

Figure 7. Soil characteristics of sites with AFPs



In most cases agroforestry practices (AFPs) were implemented on already forested areas (33.3%) and on soils with moderate limitations that restrict their use for cultivation (31.4%), indicating that promotion of AF practices to landowners with existing tree cover and land that is not ideal for cultivation but does not limit plant choice can be more effective (Figure 7). Respondents that implemented AFPs on marginal soils which have severe limitations reducing the choice of plants (13.73%) clarified those limitations most often as degraded soils (overuse, lack of nutrients, contamination, etc.) and limiting soil structure (rocky/clay composition, hardpan, compaction).

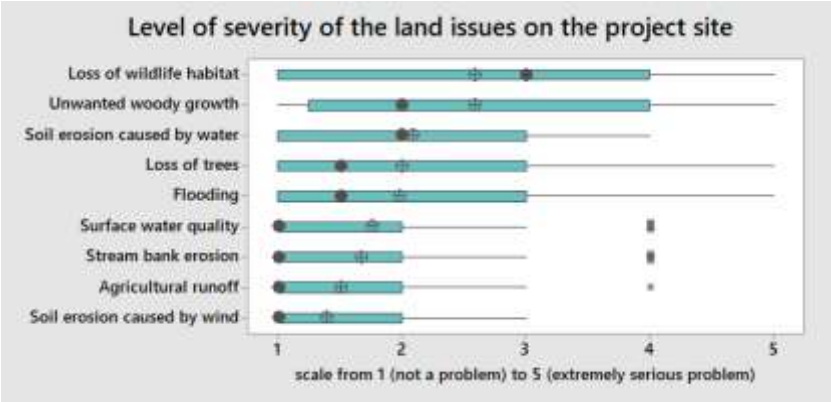
Figure 9. Land characteristics influence on AFP adoption



This boxplot graphics is generated by Minitab and ordered first by interquartile range box, then by median (black dot), and then by mean (cross dot); asterisk marks outliers

Land characteristics influence on decision to adopt AFP was mostly centered between slight (3) and strong (4) influence on 1 to 5 Likert scale (1 - no influence, 5 -main reason) (Figure 8). Such land characteristics as already existing vegetation and land location had higher medians 4 and 3.5, and means 3.24 and 3.22, respectively, compared to land area/acreage and limitations of the soil with medians 3 and 3, and means 2.92 and 2.89, respectively. Among other influencing land characteristic factors were the lack of existing vegetation, no natural tree regeneration, and need for timber stand improvement.

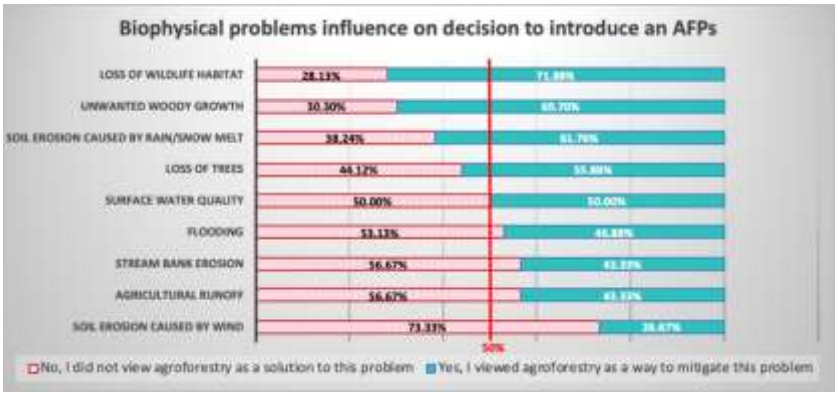
Figure 8. Level of severity of the land issues on the project site



This boxplot graphics is generated by Minitab and ordered first by interquartile range box, then by median (black dot), and then by mean (cross dot); asterisk marks outliers

Figure 9 shows that at the time of implementation of the SARE AF project the level of severity of the land issues on the project sites were, in general, a minor problem or not a

Figure 10. Biophysical problem influence on decision to introduce an AFP



problem with medians from 1 to 2 on a 5-point scale (1 as not a problem and 5 as extremely serious problem). The loss of wildlife habitat was weighted as somewhat serious problem ranked highest among all reviewed land issues median of 3 and mean of 2.58. Agroforestry was viewed as a way to mitigate four problems which had highest average score in the land issue question (loss of wildlife habitat, unwanted woody growth, soil erosion caused by water, and loss of trees), and was not considered as a solution for problems which had average score less than 2 (soil erosion caused by wind, agricultural runoff, stream bank erosion, surface water quality, flooding, loss of trees) (Figure 10). Invasive plants and poor soil health were specified as other issues that influenced decisions to introduce an AFP.

5.2.4. Communication, networks, and influence capacity

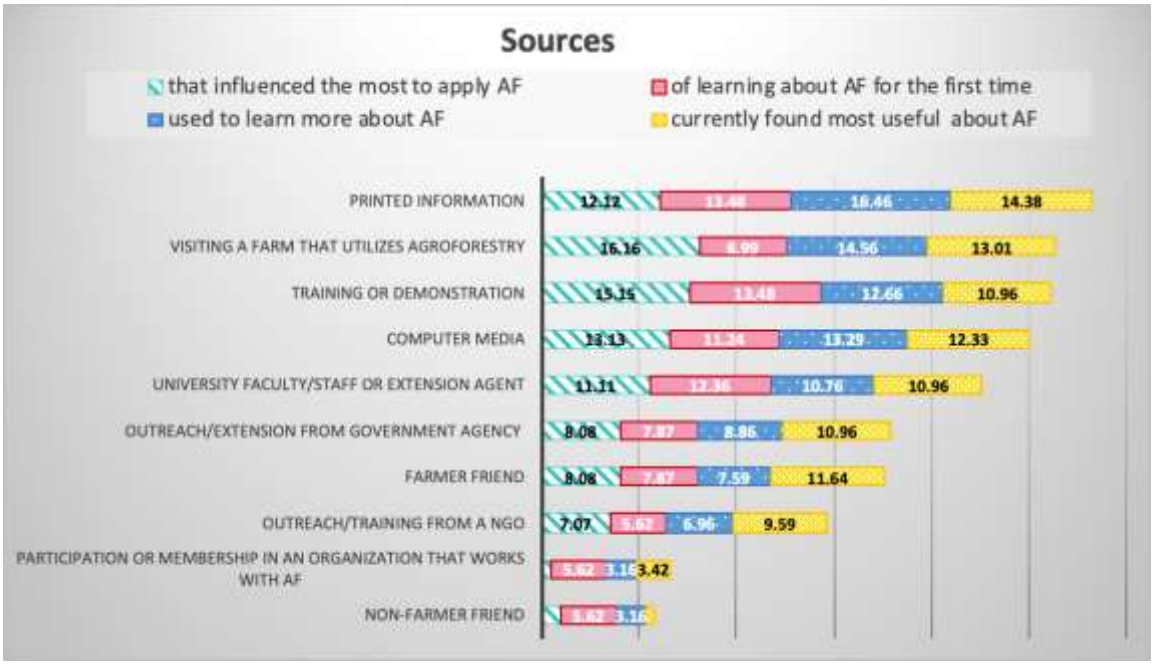
Survey respondents were asked to rate the sources of information from where they first learned about AF, those they subsequently used to learn more about AF, those they find most useful currently, and those that influenced them the most to apply AF on their land. Results are reflected on Figure 11. The highest ranking as the initial source of learning about agroforestry were: attending a training or demonstration, printed information (magazine, journal, brochure, etc.), a university faculty/staff or extension agent, and computer media (e.g. networks, websites, videos, webinars, podcasts). All of these categories retained the highest rank as sources of information to learn more about AF except for university faculty/staff or extension agent, replaced with the category of visiting a farm that utilizes AF. Printed information, AF farms visits, computer media, and farmer friend categories ranked highest as currently most useful sources of information about AF, where the appearance of the farmer friend category indicates that AF adopters expand their network over time to include mutual support among farmers.

Printed information ranked highest through initial learning about AF, subsequent learning, and currently most useful sources for answers on AF-related questions. Considering that some of respondents introduced AF as early as 1998 it is logical to assume that visiting a farm that utilizes AF might have not been an option back then to initially learn about AF, but it steadily ranks second for learning more about AF afterwards and at the present time. However, the most influential sources to apply AF on the land were visiting a farm that utilizes agroforestry (16.2%), followed by attending a training or demonstration (15.2%), computer media (13.1%) and printed information (12.1%).

Figure 11. Rating of the sources of information.

The stacked table of respondents ranking the information sources (Figure 12) reflect the changes among the sources of influence used by AF adopters through time.

Figure 12. Stacked rating of the sources of information.



Other initial sources of agroforestry information came from family practice, permaculture organizations, international experience, and nature observation. Organizations such as the Savannah Institute, Northern Nut Growers Association, UMCA, and Association for Temperate Agroforestry were specified as sources for additional learning and as currently valuable information sources.

Most useful present day internet-based sources of AF-related information included websites with text descriptions, photos and/or graphics (24%), instructional videos (20%), and webinars (13.3%). Among on-line forums, discussion platforms (9.3%) rated highest.

Identification and rating of agriculture, forestry or conservation magazines to which respondents are currently subscribed did not reveal any similarities apart from the Savanna Institute newsletter. Other subscriptions can be classified into three groups: (1) newsletters from AF-related organizations (Savanna Institute, UMCA, Cornell Small Farm, National Agroforestry Center), (2) national level organization subscriptions (USDA, SARE, AcresUSA), and (3) regional or crop-specific subscriptions.

Figure 13. Rating of groups from which AF advice is sought from

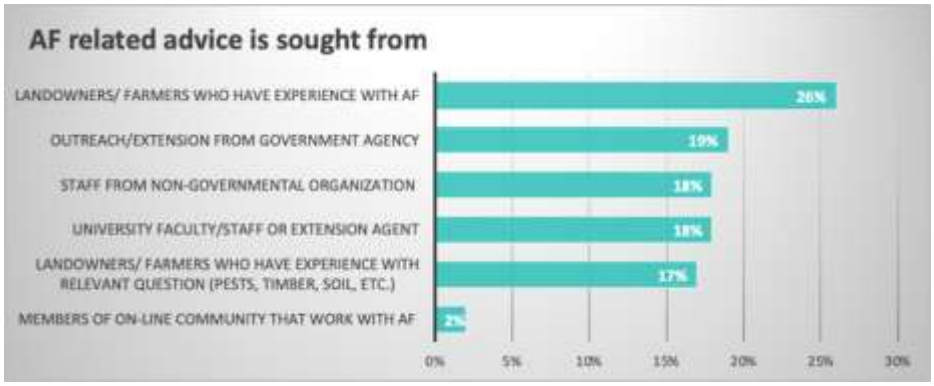
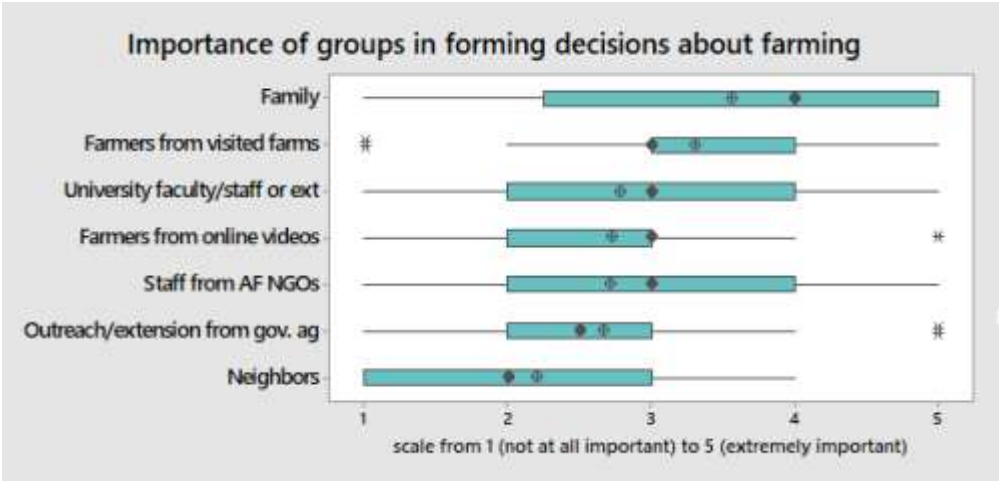


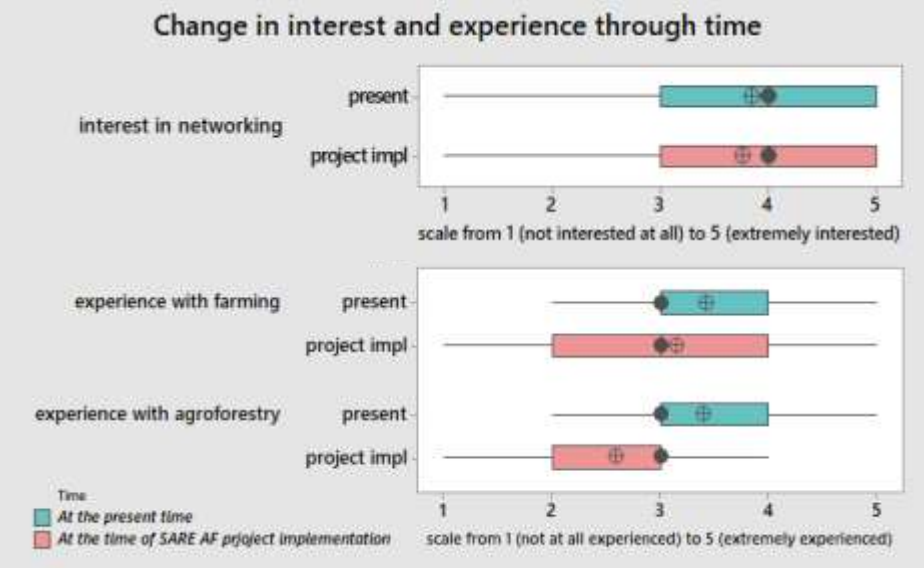
Figure 14. Importance of groups in forming decision about farming.



This boxplot graphics is generated by Minitab and ordered first by interquartile range box, then by median (black dot), and then by mean (cross dot); asterisk marks outliers

Landowners or farmers who have experience with agroforestry were the most important source of advice, underlining the importance of the farmer-to-farmer relationships and knowledge transfer (Figure 13). This is also evident in response to the question about the importance of different groups influencing farming decisions, where only "immediate family" and "farmers from visited farms" groups had mean score between moderately to very important 3.56 and 3.30 respectively (Figure 14). Family influence on decisions about farming varied widely, but also had the highest median (4.0).

Figure 15. Change of the AF adopter interest and experience through time



The majority of respondents indicated an interest in being a member of a group of farmers and/or landowners who have similar interests, both at the time of SARE AF project implementation and at present, with a slight increase in interest (3.76 to 3.84) over time (Figure 15). Experience with farming and agroforestry changed though time shifting from slightly experienced (2) towards very experienced (4), with average scores increasing from 3.13 to 3.41 for experience with farming and from 2.58 to 3.39 for experience in AF from time of the project implementation to the present (Figure 15).

Figure 16. SARE funding impact

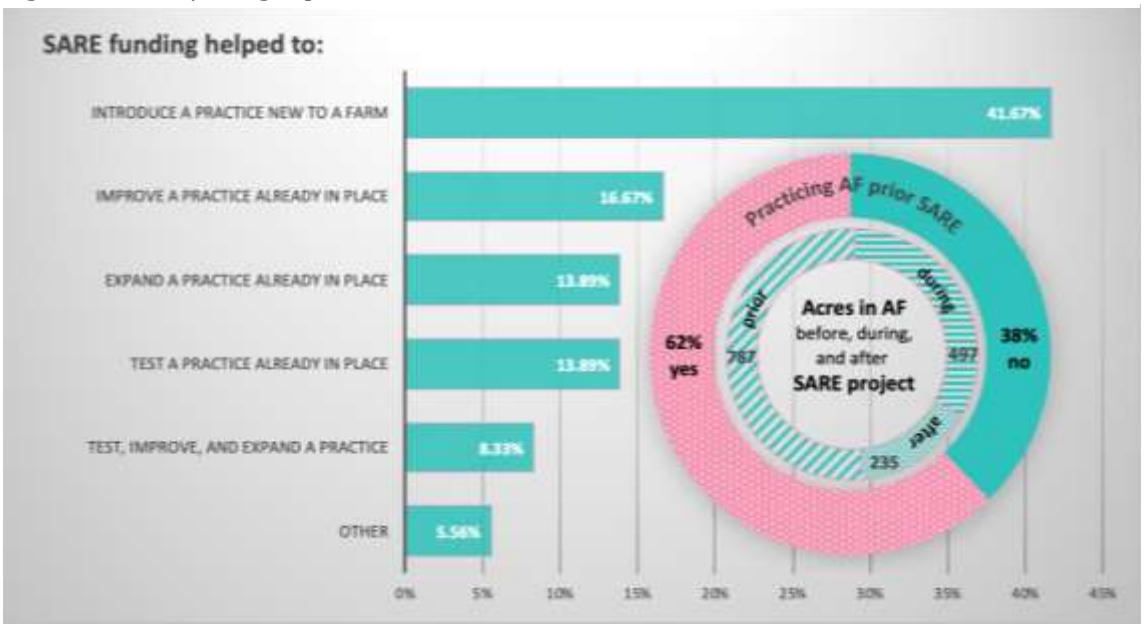
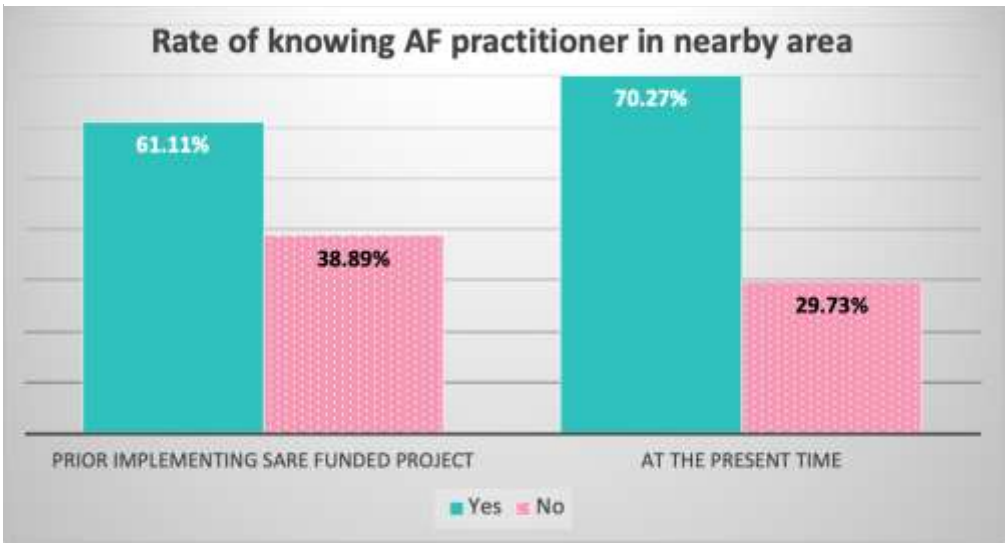


Figure 16 shows that 62% (n=37) of respondents practiced agroforestry on a total of 787 acres (10%-trimmed mean 25.64 acres, median 12, range 0.5 to 300 acres) prior receiving support for AF project from the USDA SARE. An additional 497 acres (10%-trimmed mean 5.63, median 2, range 0-300 acres) were put into AF within the projects supported through SARE program, plus 235 acres (10%-trimmed mean 4.65, median 0, range 0-100 acres) after those projects were completed. Directly and indirectly SARE support of AF projects helped to almost double the number of acreages managed under AF

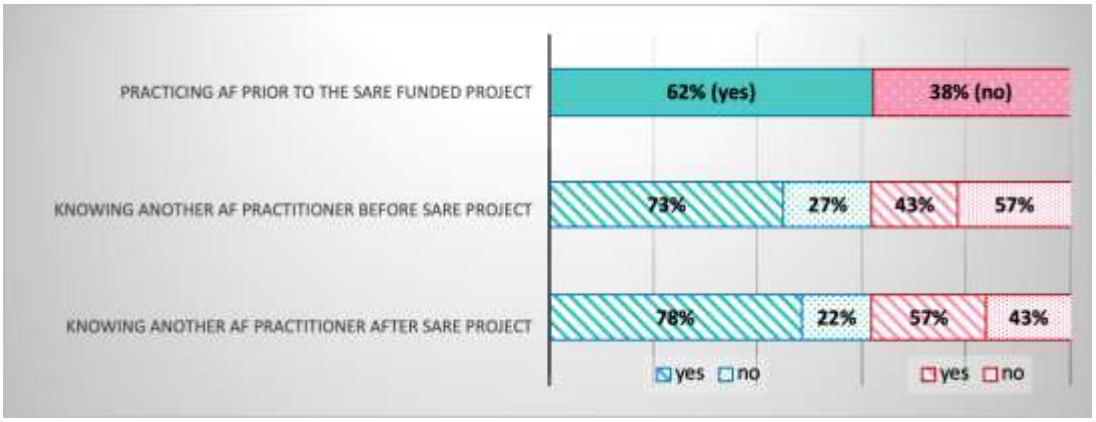
practices by farmers and ranchers who received the grants. For those who already practiced AF prior to implementing a project with SARE funding helped to improve (16.67%), test (13.89%), expand (13.89%), or all of the above (8.33%), while 41.67% of respondents (n=36) introduced a new AF practice. This data indicates that at least some of those previously practicing AF also tested new practices. The "other" option (5.56%) included "training others" in AF as a response implemented due to SARE funding.

Figure 17. Knowledge of other AF practitioners prior SARE project and at present time



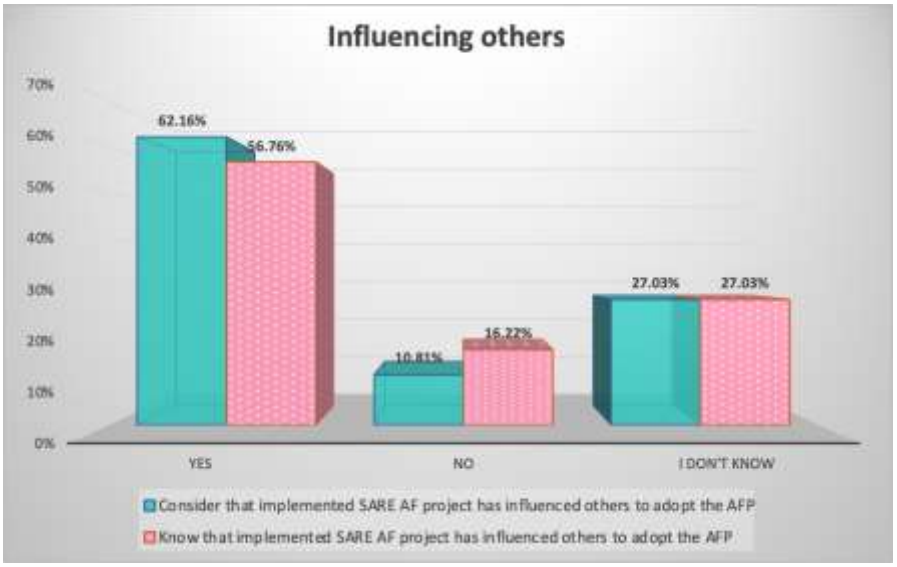
Knowledge of other agroforestry practitioners in same state or living close by prior to implementing SARE supported projects was 61.11% and then increased by 9.16% (Figure 17). The high initial level of knowledge of individuals who implement AF also points to the importance of farmer-to-farmer influence on early stages of adoption. Those who were practicing AFP prior to implementing SARE AF project were much more likely to know other AF-practitioners before SARE AF project (73%) compared to those who did not practice AFP prior to SARE grant (43%) (Figure 18).

Figure 18. Knowledge of other AF practitioners based for groups who did and did not practice AF prior SARE project.



A majority of responders assumed (62.16%) or were certain (56.76%) that the project they implemented with SARE support influenced others to adopt agroforestry. Sixty two percent of respondents (n=34) indicated that SARE grant was essential for them to implement their AF project, 29.41% responded that they would have implemented the project regardless of receiving a grant. A small group (8.82%) specified that they (1) learned about AF because of the partnership grant, (2) would have wanted to implement an AF project but that the SARE grant *"gave the ability to cover the upfront costs so it enabled to do it",* (3) *"could not have afforded to do it as well or as soon"* without a grant.

Figure 19. AF early adopters influence capacity



5.3. Interview Findings.

This chapter will present interview findings in order by research question. First, AF early adopter profiles will be described, followed by AF early adopters reasoning behind AF adoption and their timeline. Then, the question of how AF early adopters gain AF information and support will be explored. The emergent themes presented in the tables are derived from interviews, surveys and project document analyses.

5.3.1. AF early adopter profiles

Purposive sampling from a diverse set of individuals are represented in the SARE case study. Out of 15 interviewees 6 were women (40%), in line with the gender ratio in both the quantitative survey (46%) and SARE AFP database (33%) (Figure 4). The distribution of interview participants by year of SARE project implementation was similar to the overall pattern across the 20-year span of SARE AF projects: 1999 (3), 2003, 2006, 2008, 2010, 2012 (2), 2013, 2016, 2018 (2), and 2019. Eighty seven percent of SARE Farmer/Rancher grant projects were completed, with the remainder still being implemented. Of these 87%, 46% remained in active use as initially set up, 31% had been modified and still in active use, 23% were not being managed or were in passive use. SARE Partnership projects constituted 13% of the sample, relatively similar to the figure of 8% of partnership projects found in the SARE database.

Additional information on interview cases reveals representation by SARE region, state, involvement in agriculture, age group, and percent of farm-income from AFP. In both the overall SARE AF project database and the survey, the North Central region had highest representation in the interview sample (66%), followed by North East (27%), and South (7%), with the Western region not represented. Interviews included individuals from nine

states across these three regions. Forty percent of individuals were full-time farmers, 47% part-time farmers, and 13% agroforestry professionals. The age representation was quite similar to overall survey age distribution, 14% ages 26-35, 36% ages 36-45, 7% ages 46-55, 36% ages 56-65, and 7% over 65. The representation of farm-related income that comes from AF was close to that in the overall survey, with two individuals out of fourteen gaining all of their farm income from AF, no one gaining 40-99%, four gaining 20-39%, four gaining less than 20%, and four gaining 0%.

Overall, the variety of individuals in the interview sample provided a balanced representation of diverse voices and opinions. Data also shows that the interview sample was quite representative of the survey participants.

5.3.2. AF early adopters reasoning behind AF adoption

Content analysis revealed two general directions for factors influencing AF adoption. This chapter will first cover factors that favor AF adoption and then factors that limit adoption. The chapter will then cover the sub-topic of importance of SARE funding support for AF adoption in this case study.

5.3.2.1. Factors favoring AFP adoption

An inductive approach was used to answer research questions on early adopter reasoning behind adoption, retention or abandonment. The idea was to go beyond previous adoption studies, draw upon survey results, and attempt to detect differences between early AFP adopters and those groups that adopt later on (i.e., early and late majority). Positive factors were grouped into “Factors favoring the AFP adoption”, and negative factors into “Factors limiting the AFP adoption or retention”. Three major positive themes emerged: internal, external, and contributing factors (Table 4). The “force” of each theme was

identified based on the degree to which it was stressed in the interview and relative frequency of NVivo nodes and codes in reflective memos.

Table 4. Factors promoting AFP adoption

Themes	**Categories**	**Sub-Categories**	***Codes (sub-codes)***
Internal factors			DRIVING FORCE
	Action-based		
		Alternative to contemporary agriculture	*Alternative ag. and food systems; Sustainable production; Health for body; Healthy, quality produce*
		Exemplary teaching	*Provide an example; Educate others; Create demonstration; Teaching and disseminating AFPs*
		Pleasure and satisfaction from practicing AF	*Personal enjoyment; "Office under the sky"; "Love what I do"*
		Persistence	*Persistence; Adapting; Not giving up*
	Aesthetic-based		
		Visual appearance	*Aesthetic; Visual appearance; Client satisfaction*
		Love of trees	*Feelings for trees; Special connection; Nature & natural; Taking care of trees*
		Personal views and interest	*Interest; Worldviews*
External factors			PREDISPOSING FORCE
	Influencers		
		AF early adopters	*Other farmers experience; Farm visits; Examples*
		Organizations	*Influential people (Government agents; University staff; Non-profit staff); Activities (meetings, conferences; education)*
		Written Materials	*Influential publications*
	Background		*Line of work; Former experiences*
	Resources		
		Finance	*Financial support; Off-farm job or sources of income;*
		Land ownership	*Land tenure; Purchase of land; Land access; Family farm*
		Land characteristics	*Location, Soil, Climate*
Contributing factors			BENEFICIAL FORCE
	Economic		
		Direct economic	*Maximizing resources; No (initial) income; Tax advantages; Viable business*
		Indirect economic	*Animal feed (additional feed, quality forage); Farm diversity; Land value; Quality food; Animal welfare*
	Environmental		
		Healthy ecosystem	*Ecosystem as whole; Value of the ecosystem; Decrease use of pesticides*
		Ecosystem services	*Biodiversity & Wildlife; Climate Change; Soil Improvement; Water quality; Wind and Fire protection*
	Social		*Next generation; Children; Providing jobs; Legacy*

Internal factors

The internal factors of adoption possessed the highest level of influence and were assigned “Driving Force” category, due to their relevance to internal drivers that motivated the individuals. These internal factors were either action- or aesthetic-based.

Those factors that required action assumed some form of activity: creating or doing something according to personal views on the production system, ecosystem health, desire to educate others and being persistent in their actions. The action-based factors from the "Internal" theme included four sub-categories: alternative to contemporary agriculture, exemplary teaching, pleasure and satisfaction from practicing AF, and persistence. The first three of these factors (apart from persistence) had the highest NVivo reference rate (73-80% of interview participants mentioned one of these) and were highly stressed in the interviews, compared to the factors from other major themes.

Understanding of the downsides of the modern industrial agriculture, its environmental drawbacks and socio-economic injustice informed desires to create, be involved, implement, and demonstrate alternative conservation production systems in better balance with nature and ecosystem functioning. As FTFarmer-M1 puts it: "*I wanted to reinvent agriculture in such a way that it did not cause problems, including soil erosion, unsustainable addiction to fossil fuels and expensive equipment and chemical besides in fertilizers… So, when I first heard about agroforestry, I thought that might be a solution to the problems of agriculture."* and echoed by PTFarmer-M7: *"I believe agroforestry presents like an actual solution to a lot of the problems we're facing environmentally, economically."*

Many farmers mentioned that they did not want to be involved or were not interested in traditional agriculture, be it the crop growing system, or cattle ranch, or traditional monoculture orchard, or timber management. "*It* [forestry] *was really focused on solely timber and, and I'm much more of a sense of environmental stewardship work and environmental activism work. And timber management didn't feel like the way to get*

that." (PTFarmer-M5). The absence of interest in *"just a monoculture orchard system", "corn and soybeans, or anything, or veggies for that matter",* and desire to do more "*than just roundup crops"* generated interest in alternative regenerative agriculture or conservation production where an agroforestry approach fits efficiently. The search for *"some sort of more natural system"* entails moving away from *"kind of disruption to the soil that a lot of annuals requires"* towards *"something that you're building over time", "long-lasting", "long-term producing", "self-sustaining or take less work or something along those lines"* with integrated diversity of plants and animals.

Issues of food security, food access, and food quality were also mentioned, motivated by love of food, cooking, sharing food with people, or being proud of the ability to provide people with quality healthy sustainably grown food. *"I think it's the overall satisfaction that I'm getting it to work and then I am creating a successful ecosystem that feeds people healthy food. It's just, it's like this incredibly, you know, satisfying thing for just me personally to be doing it."* (FTFarmer-F5). The health component was not only associated with consumption of quality food but also with working outside in the AF system as an alternative to gym or 'office under the open sky', as well as providing a healthy, pesticide-free work environment for the workers. In the words of a female-farmer: *"*[Doing agroforestry] *Keeps you fit* [laughs], *keeps you healthy. Like I said, you're moving around and stimulated. It keeps me driven."* (FTFarmer-F2).

Another high-driving internal force was 'exemplary teaching' which included an array of NVivo codes: providing an example, creating a demonstration, educating and teaching others. The educational focus was directed to variety of groups: children, youth, other farmers, general public, customers, agritourists, food-chiefs, employees, interns,

journalists, etc. The transfer of knowledge to others was important across gender for SARE case study participants with the idea to share their world views and vision of sustainable production, showing by example that the constraints and challenges due to climate and current economic systems can be overcome for the benefit of all. Knowledge sharing and *"passing that* [agroforestry] *information on just like it was passed to me"* was noted as a really rewarding intangible benefit. The process of engaging people in learning and opening their horizons, in addition to helping others implement AFPs, was carried out through personal interactions, classrooms, conferences, seminars, workshops, on-farm education days, Facebook groups, phone, and e-mails.

Interview analysis provided a strong indication that creating a good example, a demonstration site, and/or a viable working farm was not only for the individual farmer but as a platform for sharing and promoting sustainable food system views with others. *"Really, really important for my farm is to be an example for anyone who's interested. And whether that's for people who want to try and do, you know, something similar or if it's just for people who want to learn more about where their food comes from, whatever it is, so that, for me is a really big driving force. Because it's… it's not people's opinions that get people thinking differently, it's their example! And so that's, that's really important to me. So, I guess, for me, you know, as corny as it sounds, it's kind of like, I feel like that's a big purpose for me and what I'm doing in my life. Yes, yeah. So that's really important to me."* (FTFarmer-F5). *"Well, my main goal was to provide an example of agriculture where a good living could be made from just a few acres without causing all the environmental problems, and I succeeded in doing that. And as a side benefit of that, I'm earning a good living on just a few acres."* (FTFarmer-M1)

Personal gratification and satisfaction from practicing agroforestry, and enjoyment of working with trees, were also high-level driving forces. Personal satisfaction comes for many reasons: from seeing the created positive change in the environment, solving a challenging task, connection and gratitude toward trees and nature, personal or family experience in connection with the natural environment, from the *"opportunity to sort of reconnect and rediscover and find a relationship to the landscape"*, and the "*opportunity to be outdoors and to be under the sky and the trees".* Taking a step back and looking over the descriptions provided by participants paints a picture of people talking about 'happiness'. *"Originally, I was thinking it would be really fun to have a pick-your-own kind of thing. Because we've got four kids and when they were younger, some of the best memories we have would be going out to pick apples or something like that, you know, just that agro-tourism experience… It's fine people take home chestnuts, but what you really sell, and I think that is really good for society, you know, which you can provide is the opportunity for people to come out on a nice day, have a good time, pick up some chestnuts, roast some chestnuts and remember for the rest of their lives."* PTFarmer-M4. *"A lot of euphoric time, feeling a clarity about that I'm, feeling clear about what I'm doing, that's making me happy."* FTFarmer-F4

Persistence was the fourth action-based internal factor, the personal trait that people describe in their AF experience. This one was not as prominent as other action-based factors, but it seemed like an important trait to have for an early adopter when the surrounding farming community utilizes a different approach. *"I'm really in the midst of, so we have a lot of potato farms here… We have, you know, the confined dairy cattle. So, you know, so, I am an oddball here. But I think that's sort of my personality is that I just*

have this really natural curiosity and I don't care if it's not the mainstream, like, it sounds like I'm gonna figure out how to do it [the agroforestry]*."* FTFarmer-F5

The complexity and intensity of the AFPs adds additional challenges, requiring AF farmers to have a high level of commitment to the practice and be very persistent, constantly adapting and tweaking AF techniques to make them work on their farms. As one of the farmers explains his course of action to overcome an eight-year drought and trees struggling to survive: *"Persistence or stubbornness. I just didn't give up. At that time, I didn't have any method of irrigation. I have since installed the irrigation. Hmm, just persistence."* (FTFarmer-M1). Such diverse systems as AFPs, where perennials are intercropped with other species and in some cases integrated with animals *"being able to come up with creative solutions to problems"* is crucial. So, when something doesn't go according a plan, this persistence trait (or *"incredible stubbornness")* takes effect to keep on going and adjusting to circumstances.

The aesthetic-based category of internal factors of adoption included a sub-category of visual appearance, 'love of trees', and personal views and interests. The aesthetics associated with agroforestry were often described as a 'personal thing', but it also mattered from the perspective of improving property values, neighbor relationships, and customer or agritourist attitudes. The aesthetics of AFPs, compared to contemporary agriculture, creates more beautiful and enjoyable environment that corresponded to participants intangible values. The AFP practitioners *"sense of what's beautiful"* did not include the farm to just *"look good"*, but also included *"textures"* and *"smells of the trees and vibrations that comes out of the living things, as much as just the visual"* part.

The factors 'love for trees' and 'personal satisfaction' interact but the former factor does not require any action (i.e., planting or taking care of trees). This factor is more on a scale of personal compatibility with nature and natural settings and on a level of gratification from simply observing. One of the participants explains it this way: *"I would say the benefits are that it's very good to be surrounded by nature, and it's really rewarding to see things grow… You get a chance to sit, to hear the birds, and I meet people who are wholesome, natural, people that don't always looking at their iPads."* (AFProf-M9), and mirrored in another farmer statement: "…*the motivation - plants, the bigger, just my love for that… I think of it in the like, on a personal level is just been a source of calm and beauty and helpfulness."* (FTFarmer-F1).

A special connection, relationship, and love for trees was exhibited in more than half the interviews, and were often associated with internal motivation for practicing agricultural systems that involve trees. "*There's important drive in my relationships with trees themselves",* says FTFarmer-F4. One of the AF professionals based on his experience working with agroforestry practitioners and practicing AF himself, provided a logical explanation: *"I mean, a lot of people just do like trees. I think that that's not a thing to keep hidden. So, that's a benefit for many farmers who do agroforestry, is it's an opportunity to work with trees and be around trees."* (AFProf-M8).

Apart from unifying views on the need for alternative agriculture system, other worldviews and personal interests were mentioned as motivators to apply AFPs. Those varied from the intellectual challenge, the desire to be good tree farmers, lifestyle attitudes, or simply personal interest. It was also connected to environmental views that AFPs

provide long-term stability to the system or fit well with existing vegetation and farm development concepts.

Overall, this theme of 'internal factors of adoption' holds the most powerful driving force for AF adoption. From interview analysis it was clear that without this core factor group the other AF adoption factors would not be as impactful. Describing his primary motivation, PTFarmer-M5 stated: "*I still it's hard to name, but I think there's just this bigger motivation than just the science tells us it's a good idea, or the environmental impacts are good, or the money is there. I think there's just something as spark in people that makes them curious and interested in, not everyone, but enough that there's noticeable movement happening."*

External factors

The next theme of factors influencing AF adoption are 'external' factors that include external influences, previous background, and available resources. These factors were labeled the 'predisposing force' because they create favorable conditions for those internally inclined toward AF to actually try out the practice. The 'background' factor, line of work or previous experience (i.e., college education, professional experience in forestry or agriculture, previous experience with farms that have trees, tree planting, gardening), established familiarity with trees and predisposed participants with favorable attitudes toward use of trees or alternative management options. Familiarity with AF was derived from: 1) Academic background in forestry, forest ecology, environmental studies, agricultural science, and biology; 2) Line of work (e.g., forester, extension, teaching, agriculture); and 3) previous experience (e.g., permaculture, small-scale farming, homesteading, gardening, working with orchards, greenhouse).

As noted, additional external 'influencer' factors included: 1) Other AF practitioners, 2) Organizations working with agroforestry, and 3) Written materials on relevant topics. Meeting AF practitioners, visiting their farms, and/or participating in workshops and field days organized by farmers influenced many SARE case study participants to consider, try out or fully implement AFPs. As exemplified by *FTFarmer-F1*: *"In 2009 we were on this ag workshop in this area like* [names] *farm and a few others who are going, like, look at bunch of different fruits trees with potential for the area, and we went to a field day and I'm like, "Whoa, this is great. It's kind of a really interesting ways to scale up", you know. And we were particularly turned to like agroforestry practices like alley cropping".* Influences mentioned included: practical workshops, field days, conferences, or consultations organized by different organizations (e.g., government agencies, universities, non-profits). Named organizations included University extension, Forestry extension, UMCA, Savannah Institute, Center for Holistic Management, DNR, NRCS, Forestry Bureau, and USDA Farm Service Agency. Written materials describing farming experience or about perspectives of growing a particular plant also served as inspiration. PTFarmer-F3 shared: *"So, I started with reading a lot about I mean, first gardening, and then you know, trying to choose a model of gardening and permaculture was what I landed on and dug deep into permaculture, which led to forests gardening and you know, once things at a small scale, and then Mark Shepherds "Restoration Agriculture" kind of opened my mind to what that could look like at a larger scale."*

From the interviews it was evident that the case participants, as early AF adopters, were influential for other farmers who wanted to learn more, try out, or introduce AF. Clearly, diffusion is happening. One early AF adopter who started his AFP operation in

1997 recalled that there were a lack of organizations to help with AF questions *"I wish there were more organizations and institutions locally that I can turn to, but in Iowa, they're only interested in corn soybeans",* but later indicted that his demonstration site has become a 'hot spot' for aspiring AF adopters. Over 200 area farmers and farmers from seven other states have visited this farm to start their own fruit and nut growing operations "*and that was without any budgets* [support]*".* While most SARE case study participants did not have that level of influence, many shared knowledge of others adopting AF based on their example. *"I know of four or five farms that have adopted it from like coming out on the site visits to see what I'm doing on the farm.",* PTFarmer-M6. Since farm visitors are not tracked, it is hard to know if any of them put follow up and start to incorporate AFPs. That said, educating landowners on alternative sustainable agriculture methods can help support the growth of AF through their future market purchases. *"I feel like we're inspiring to not just farmers but other people who are interested in homesteading or expanding their gardens or doing a school project"* (FTFarmer-F1).

Yet another set of external factors that have substantial influence on AF adoption are available resources, including finances, land ownership, and land characteristics. Financial aspects of available resources are two-fold: off-farm income and external financial support. One third of interviewees were full-time farmers when they started to implement SARE supported AFPs and at present, only one part-time farmer had shifted to full-time farming. Some full-time farmers indicated one of the partners have or had an off-farm job to help absorb some associated risks. For some participants the AFP was or still is at a hobby level in addition to a full-time off-farm job. "*If I was really doing this to make money, I'd have a calendar where it's really structured, right? I'm going to do this, I'm*

going to do this, I'm going to do this, because I know that has to happen.", according to PTFarmer-M4 who held a full-time job when starting his AFP. For both full- and part-time farmers used their other farms income to support AFP testing and experimentation.

Starting with small steps that do not require much investment has been another strategy for AFP adopters. Availability of a financial buffer against risks associated with introduction of AFP was typical in most cases. Thus, access to outside financial support to cover upfront costs of AFP and testing it out was welcomed by all, and crucial for some. The external financial support included already established markets with motivated customers and support from USDA programs (e.g., NRCS, SARE).

Apart from availability of extra financial resources, land access and tenure were essential for AFP adoption. While a majority of interviewees already had land, for the rest of participants buying land was a *"tipping point"* for AFP adoption. PTFarmer-M2 explained: "*Well, I mean, I knew about it [agroforestry], but I really couldn't do anything with it until I own some land."* In some of the cases, practitioners had initiated AFPs on family land or trialed AFPs on someone else's property. Those who had land agreed that for a long-term system like agroforestry, especially those that involve trees, land tenure is very important, and that *"perennials make sense to grow"* when you have your own land.

There were cases when people had agroforestry in mind prior to purchasing land, per PTFarmer-M4: "*before I started doing, doing anything with this [agroforestry], we bought a piece of property."* But there are also cases when people owned land before they knew about agroforestry, where land condition and farm resources lead to AF 'discovery'. FTFarmer-F5 explains: *"When I bought the orchard, I was not familiar with, like, I never heard of agroforestry. I guess, what happened is when I bought the orchard because I make*

apple cider, okay. And I have cider pulp that's just a waste product and then also you cannot sell you know the apples that fall on the ground you cannot legally sell those for human consumption… "What could I do with my waste product?" And so, that's where when I got a couple pigs… And then I started like, how can I integrate them more into the orchard? And how can I? And, so, I would say that I started really doing more research on it…" These perceptions about land and available resources were mirrored by other landowners.

Access to land resources, its' location and condition create another sub-category of 'land characteristic' factors influencing AF adoption. Preexisting vegetation (forested areas, fruit trees) had a positive effect on adoption of AFPs including silvopasture and forest farming. Practitioners didn't force the AFP onto their land, but rather observed the land for the opportunities provided. PTFarmer-M6 reiterates and further develops this statement: "*I didn't have the practice, like end result in mind when I started. Instead I had the resource that I work towards creating silvopasture and that was pretty functional. So, I really was using the land to help me determine what I would do, which I think it left less room to disappointment than trying to take what somebody else did and just replicate it on land where it might not be reachable."* Location of the farm, soil conditions, and local climate can also positively influence AF adoption as a sustainable alternative. Examples located in arid and windy areas indicated that shrubs and trees provided windbreak protection, and poor soils, highly erodible land, and location close to rivers promoted the choice of more sustainable practices where the "*odd-fit parcels just didn't make sense to do traditional production".*

Contributing factors

The next major theme of factors that positively influence AF adoption are the 'contributing factors', economic, environmental and social. These factors are a 'beneficial force' as they provide practitioners with important 'side' benefits, i.e., these factors are not the primary goal. The primary, and most controversial, of these important 'side' benefits are economic benefits. With only one exception the need for financial viability of AFPs was noted as important but not the primary reason for AFP adoption. SARE case study participants reported very diverse levels of AFP involvement and lengths of practice establishment, as well as different economic motivations. The end result was a high degree of variability in income generated by the AFPs, from 0% to 100%. In any case, whether 100% AFP income or a hobby, there was strong indication that AFPs *"needs to make money, or at least break even"* and that on a financial level practitioners *"are not going to keep doing something that complete loss if we're going to grow it at a big scale"* (FTFarmer-F1). Healthy ecosystems that have some profit potential are what interests AF early adopters. *"Agroforestry have to be at least net to zero with potential for upside"* (PTFarmer-M3).

Early adopters of AF also understand that the viability of farm with AFPs is important in order to promote the practice to other farmers who might have different values and reasons for AFP adoption. For example: *"While it's not necessarily, you know, that I'm going to make a lot of money. It does have to be a viable farm. And I think from a social standpoint, that's very important to help encourage people that have this interest that "yes, you can make a living at this", you know, that "you don't have to be this big conventional chemical, everything type of farmer with 5000 acres, you can do the smaller scale farming more sustainably and be profitable". And, so, yes, I'm not sure how to answer that, because*

it's like it, it has to be profitable, but yet, it's also like for me personally, it's also about that social aspect of setting an example of this kind of farming can be viable because I'm so passionate about it, like "we need to be doing this type of farming".” (FTFarmer-F5)

Economic factors can be the driving force for AFP adoption (1 of 15 cases), where “*main reason, really, was the relief of the financial burden”.* However, for the majority AF practitioners within this study economics were not the primary reason for AFP adoption but still important. In contrast, there were cases where economics played no role in AF adoption. PTFarmer-M2 notes: “*I just like trees. You know, being a forester, I just like trees. I just enjoyed planting them and taking care of them. That's why I'm currently putting trees in my pasture mainly. It's just the way I enjoy having them out there. They provide some shade for the sheep, and I'll probably never get any income off the trees. I just enjoy planting and taking care of trees. It is a pleasure… The trees don't make me any money, I don't believe that. It's just personal interest.”*

Financial viability was deemed important in the most cases, but it was secondary to the values of a holistic, healthy food-producing perennial-based ecosystem. Creating and working in these systems brought a high degree of personal satisfaction, exemplified by the following farmer who earns adequate income from his AFP and provides deeper insights: “*Lots of intangible benefits… they're kind of hard to articulate, but I just enjoy what I'm doing. I like what I'm doing. I have no interest in retiring from what I'm doing. I like being out under the trees, even in the winter. I guess you could say in the parlance of Holistic Management, it's, it's a high quality of life, which is even more valuable than income.”* (FTFarmer-M1)

The main economic benefits identified by SARE case study participants could be classified into direct and indirect economic benefits. Direct economic benefits included: gaining income, diversifying income streams, maximizing farm resources, tax advantages, and creating a viable business. These benefits are interlinked: to make a small-size farm profitable, one has to maximize the resources and stack them into a system that yields multiple income streams. AFP also provides economic advantages through product differentiation, i.e., niche crop production. *"Reducing inputs and increasing outputs on the same acreage"* enhances economic gain from both ends. For example, combining pastured pork production with fruit and cider enterprise, or long-grown mushroom with improved timber stands, or nut-trees combined with hay.

Considering that AFP are very diverse operations with a variety of crops, the time to a return on investment is variable. In one example, an AF practitioner states *"started selling mushrooms a year after started growing them",* while another had to wait for *"about 20 years for it* [alley-cropping with chestnuts] *to actually become profitable".* Two to five years is the average waiting period for returns on the AFP production according to case study participants. Indirect income often comes much earlier. "*I was seeing pasture improvements, seeing through the livestock, yeah it was pretty quick"* (PTFarmer-M6). Some positive impacts, like ground cover establishment, pasture improvements, forest stand visual appearance were noticed within two to six months.

Farm diversity, while not necessarily providing direct monetary benefits, reduces yield risk and improves stability. *"That diversity is really just kept us going and we're not going to drop it"* (FTFarmer-F1). PTFarmer-M7 recommends rather than starting *"with a large installation of a few varieties",* start with "*as much diversity as possible",* so that

there's opportunity to *"see what worked and then pick from among those."* Given plant establishment challenges that AFP face, a very sound approach tried by a number of practitioners was to scale up production using plants that showed best survival rates and lowest maintenance costs.

Other indirect economic benefit provided by AFP include additional quality animal forage, improved land values, food quality, and animal welfare. The additional forage for livestock was achieved through establishing silvopastures in previously unmanaged forested areas, harvesting hay in the alley cropping systems, integrating livestock into orchards, or introducing a pollarding system. Improvement of feed quality was emphasized by interviewees. The quality of food produced for human consumption in the AFP systems, from fruits and berries to milk and meat products, was identified. While increased quantity and quality of animal forage are linked to economic benefits, animal welfare and humane treatment was equally valued. While practitioners understood that animals had improved weight gain and milk production in silvopasture systems, this was viewed as secondary benefit compared to improved animal welfare. Associated land improvements, based largely on whether or not the trees increase property value, were mostly viewed positively indicating that AFP increased property value. PTFarmer-M3 stated: *"So, I don't think that I probably gain nearly as much financially in terms of cash paid back as I would like. But I'm very confident that my overall asset value of the ground that has agroforestry on it has gone up tremendously. So, I think I've had tremendous asset growth, but not tremendous capital growth."*

The overall picture that emerges from the interview analysis comparing the value of economic vs non-economic benefits is that AFP profitability is valued and deemed

essential, but not a primary reason for AFP adoption. PTFarmer-M5 highlights this point: *"I think that people, people are not getting into agroforestry generally, because they think it's gonna make them a ton of money. And that's, that's, that's important to have it pay in a sense, but that's not the motivation. People are curious, they're interested, they believe it's an important thing to do."*

The next category are environmental factors that include two main sub-categories: (1) healthy ecosystems, (2) ecosystem services. *"There is something that come with growing a diversity just at all layers and levels, you know, I think there's a big ecosystem value for us"* (FTFarmer-F1). Intertwined with pleasure and satisfaction derived from land stewardship are inner factors, the determination to restore healthy ecosystems, and the value of ecosystems as a whole, both positively affecting AFP adoption. *"In a way that does make me feel good in terms of sequester carbon, in terms of improving soil, in terms of developing a more sustainable system. Even a more sustainable ecosystem on our farm. So, there a lot of satisfaction in that"* (PTFarmer-F3). FTFarmer-F2 and her family chose a more environmental approach with AFP, utilizing the available resources and following personal interests: *"we weren't interested in that the cattle* [at family owned farm] *and most of our property is forest, and we were not into clear cutting, and we're, you know, environmental friendly types".*

Agroforestry was described as "*a way to accomplish conservation on working farms"* for wildlife and biodiversity conservation, improved soil health, climate change mitigation and adaptation, water and air quality, wind and fire protection. By example, PTFarmer-M7 calls upon others to *"invest in a model that could both produce nutritious food and help provide habitat for biodiversity and providing consistent* [ecosystem]

service, keeping the landscape cool, producing the oxygen." Although not everyone was striving to *"solve any kind of environmental issue",* but rather implement APF out of *"just personal enjoyment of doing it* [planting trees]*".*

Soil improvements benefits of AFPs were most often mentioned by interviewees (just over half) including the values of biodiversity and wildlife. At times the wildlife benefits were not anticipated but subsequently valued, as PTFarmer-M4 explains: *"Now there's, we occasionally see turkey, they're deer out there, you know, lots and lots of birds. So, yeah, so that's been a real big positive that we didn't anticipate. It* [AFP] *adds some nice wildlife, food, deer love them, for example. There are, so there's some, some good that comes out of it that way."*

Regenerative agriculture systems that makes the land healthier was noted by a majority of interviewees, but the relative 'weight' of environmental benefits was slightly lower than that of economic benefits. Social benefits carried even less was the weight although still noticeable and important. Future generations were a commonly stated concern. Although less than third mentioned this, the idea that AFPs could support their children, or grandchildren, or future generations, warmed the hearts of interviewees. The long-term aspect of social benefits is nicely captured by FTFarmer-F1: *"The trees are something like about the connectivity, and the staying in power, and the abundance, and the possibility that comes with planting a tree and thinking about something that it will outlast your lifetime… You know, you have to sort of think both in the immediate and then also, like, the lifespan of a couple hundred years what benefit you'd have."*

5.3.2.2. Factors limiting AFP adoption and retention

Factors limiting AF adoption are presented in Table 5. Two main themes were established based on the interviews content analysis through coding: (1) internal factors, and (2) external factors. Internal factors are those connected to internal life circumstances, while external factors with circumstances that are not dependent from the individual. The factors limiting AF adoption primarily came from challenges described by the interviewees, or from other topics negatively influencing adoption. Asterisk in Table 5 notes those challenges and factors that were or could have been detrimental for AFP continuation according to early adopters.

The internal factors limiting AF adoption encompassed three main categories which all connect to finances. However, land tenure and time and labor were given their own categories to underline their importance. The financial factor influencing AF adoption were indicated as one of the reasons to discontinue AFP. The failure to justify reinvesting into AFP operation come as a result of other factors, for example substantial death rate of trees, negatively influencing AF adoption.

Table 5. Factors limiting AF adoption

Themes	**Categories**	***Codes (sub-codes)***
Internal factors		
	Financial aspect *	*finances, money, up-front costs, crop inconsistency, equipment*
	Land tenure	*land, access, tenure, ownership*
	Time and Labor	*time, labor, personal health*
External factors		
	Lack of established markets	*market, marketing, sales, produce, customers*
	Lack of info & examples	*demonstration, examples, lack of AF information*
	Plant establishment & survival *	*plants death, establishment, survival, maintenance, weather, soils, weed-pressure, wildlife & livestock damage (browsing dear, mice, rubbing on trees), pests (plant pathogens, fungi, insects), grafting challenges*
	Relocation *	*need to relocate, new job*

** Reasons to discontinue AF*

The financial challenges faced by AF adopters include limited farm resources when one has to go off farm to obtain needed supplies, the upfront cost of AFP establishment, erratic crop yields, and specific equipment requirements. Improving farm operation requires constant investments that can also be limiting in terms of AFP development and scaling up. Perennial niche crop yields are erratic due cultivar and the need to experiment with best production practices. This creates additional challenges for income generation, planning, marketing, as well as finding specific equipment. Some equipment "*isn't necessarily intended for the type of work you're doing"* and needs to be adapted or work needs to be implemented manually.

Financial support to cover the upfront cost of AFP was emphasized in several cases. Introduction of almost any new farm innovation approach requires at least some investment resources: direct financial and/or time and labor. AFPs are no exception, as noted by PTFarmer-M6: *"Upfront costs, so just cost to get it fenced, seeded; and right now, is trying to deal with invasive shrub, trying to get them out in forest conversion, cost of planting trees in the field and protecting that."* These financial burdens complicate AF adoption, thus the external help and support are welcomed. *"If it* [AFP] *doesn't pay, that is always going to be a barrier and important one to pay attention to. But I also know of plenty of people who are finding space and time to invest in these projects to experiment to play with because they're motivated by something else",* PTFarmer-M5. This statement reaffirms other interviewees opinions that early AF adopters mostly start with small plots and depending on its success and available resources (including finance, time, labor) either expand or leave it at small scale. The pace of enterprise scale up also depends on available resources. Long lag times to returns on investment limits AF adoption. PTFarmer-M7

states: *"So, financial, it's* [AFP] *a big upfront investment. And then the payoff takes several years, if not longer. And it's very new. So, a lot of it is experimentation."* As was mentioned earlier the lessons learned advice is to start with *"a really big variety of things in the beginning"* which, again requires investment resources.

Another internal factor is the lack of capacity to measure the AFP impact. To promote the practice or possible sale of environmental services there is need to measure and prove the positive impact of the AFP on a specific farm. However, that requires a lot of knowledge and time investment to properly measure those impacts, e.g., improvement of biodiversity habitat, carbon sequestration, soil health, etc. Lack of capacity to track impacts limits promotion or AFP scale up. Reported SARE results were limited due to farmer aptitude or capacity. Thus, the environmental impact was mostly reported at a descriptive level: *"I think its* [positive environmental change] *happening. You know, we see some impacts on anecdotal level but there's no time or resources to, I haven't really meaningfully documented that in a deep way over the last 10 years or so. So, it always feels tricky... But again, it's really great* [the results]*, but I can't say exactly how"* (PTFarmer-M5). Governmental commitment to support carbon trading and clearly defined ways to document carbon sequestration would potentially increase interest in AFP and create additional incentives to scale up AFP operations. *"Money should be available to, to pay farmers to plant trees and maintain them for a few years",* PTFarmer-M5.

Land tenure / ownership plays a key role in promoting AF adoption. The absence of land access was another factor limiting AFP adoption. PTFarmer-M5 notes: *"Access to land that had, you know, some consistent tenure was a big challenge."*

Time and labor were often-mentioned internal challenges to AF adoption and scale up. AFProf-M9: *"I would say that as a human being that I only have so many hours and energy and stuff like that. That's a little bit of a limitation."* PTFarmer-M6 also notes: *"After I saw first results, I wanted to do more of it, but time was very limiting. So, I've kept up on the similar pace."* Thus, the support from family, partners, interns was critical in some of the cases for AFP uptake and development.

Practitioners whose AFP operation is not their primary work and source of income note that they did not always pay enough attention to their AFPs. "*I have not been as really dedicated as I should have been to things like pruning and timing of fertilization and weed control all that kind of stuff… I'm limited by my time and energy to do the things that I know I need to be doing"* (PTFarmer-M4). For established AFP business operations, the cost of labor and workers health insurance constitutes a limitation as well. Additionally, the health of AF practitioners contributes to time and labor availability for the AF operation. There is also an expectation for some of practitioners that eventually they will have more time to invest in AFP as their kids grow, or as they retire, or due to maturation of AFPs providing return on investment.

The external factors limiting AF adoption and/or abandonment included: lack of established markets, lack of specific information and local examples, plant establishment and survival, and need to relocate. Plant establishment, survival, and maintenance were the primary external factors, referenced by almost half of the participants. After time and effort was invested into successful in tree establishment, if the trees subsequently died this proved to be especially *"disappointing", "devastating"* and *"heartbreaking"* for AFP practitioners. The challenge of keeping the trees and other woody species alive was in many

cases affected by the weather and soil quality. Changing climate patterns, unusual dry seasons, absent or excessive rains, floods and frosts were all mentioned as weather-related difficulties. Figuring out the watering approach or establishing watering infrastructure were recommendations based on practitioners' lessons learned. At times, these challenges lead to new and unforeseen opportunities. In one case a major rain event flood caused massive shiitake fruiting, and out of this the AF adopter came-up with a value-added product line for dried shiitakes and dried mushroom-based food mixes.

Poor soil quality and bad drainage also affected plant survival, along with planting techniques, and selection of trees species and varieties. "*I think probably the most disappointing thing was, like, planting trees early on and having a lot of die. And part of that was technique and part of that was trees, just, some, some just die. So, so, that was a big piece that led me to question continuing, it felt really hard to invest those long-term things and take that risk"* PTFarmer-M5.

After initial establishment and survival, plants required further maintenance and protection, like weeding and fencing from browsing. These additional inputs can constrain some part-time practitioners due to the intensity of time and labor requirements.

When trees mature and finally start to produce, the question of marketing and selling the products creates new challenges, especially in regions where markets for specific AFP produce are not developed. On a small-scale level, it can be hard to invest in local market development, and that constraint may limit the growth or continuation of AFPs. In some cases, step by step market development was working and worth the investment. The marketing challenge is described by the experience of one of the AF professionals (AFProf-M8): *"Another challenge, it's an important for a lot of farmers, is*

the lack of established markets for many agroforestry products. And, so, in many cases, farmers need to not only grow it and harvest it, but also do the marketing and sales. can be more challenging than if there's already an established market that you can go to. And it also makes it more difficult to plan and to get financing and to scale up if you don't have established and proven markets. So, I think, you know, that's not the case for every agroforestry practice." Erratic crop yields add to the marketing challenge.

The lack of specific agroforestry information and proven, local examples of AFPs is another often referenced category of factors limiting AF adoption. The lack of information is caused, in part, by large variability and uniqueness of the AFPs, involving many different plants, animals and technical approaches. Therefore, finding proven examples specific to region, climate information on particular AFP is difficult. Therefore, AF early adopters have to figure many things out on their own as they *"are doing something that hasn't been done before".* "*It would be great to be able to talk to someone else who was in the same environment and, you know, can give me more pointers about, you know. I mean, we've had trial and error here in growing* [woody species]*, this is hasn't been absolutely easy"* FTFarmer-F6.

There was strong desire for local examples and regional networks of people with similar experience to provide more opportunity for firsthand learning. PTFarmer-M7 elaborates: *"There's not like a farm down the street that I can actually go visit and see exactly how, to copy it. And part of that is, you know, every site is different and the soils different".* AF professionals reaffirm these same needs (AFProf-M8): *"I think the lack of examples, working examples of agroforestry in many parts of the Midwest is also a major barrier. It's, you know, much easier, more feasible to do something when you can see where*

somebody is already done it in your same area, and you can you can either copy or adapt what they've done. So, in many cases people doing agroforestry are the first ones in their area doing and that has inherent challenges."

Finally, the long time lag to return on investment is impacted by land ownership and job stability. With the exception of the portability of inoculated mushroom logs, the need to relocate due to new assignment, job opportunities, or other life circumstances are not compatible with AFP relocation. This constraint may limit AF adoption. Within the SARE case study, there were two cases of relocation. In both cases practitioners re-installed the practice on their new property, although on different scales: one more like a hobby-personal interest level and shade for animals, another more on a level of a farm operation. In the first case described above, the fate of the original AFP location is unknown, in the second case the new owners did not maintain the silvopasture practice, but they like and care for some of the established trees.

5.3.2.3. Importance of the SARE program in promoting AF adoption

The influence of SARE funding support was also evaluated. Sixty two percent of survey participants and almost 80% of interviewees had AFPs prior to receiving SARE funding. About thirty of survey respondents and just over half of interviewees mentioned that they would have done some of what they did without SARE funding, however they *"wouldn't have gotten done near to the extent"* as they were able to with SARE funding. Without SARE support the projects would not have been at the same scale and would have progressed much more slowly. FTFarmer-F5 shared her thoughts: *"It* [SARE funding] *was extremely important, but I wouldn't done it* [AFP] *anyway. But I would have probably done*

it slower. [With support] *I was just able to get that up and going quicker. I would have done it anyway, but it just I would be so much further behind right now."*

There were cases where SARE funding sped up the decision to adopt AF. FTFarmer-M1: *"I probably would have had to delay beginning by a few years if not for the grant. That's probably the biggest difference, I'd probably would have done it anyway, just later."* In cases where participants need to relocate, the SARE funding support was critical for initial AF project, but after relocation the PTFarmer-M2 planted trees in the pastures on his own a *"few trees at a time, just slowly putting it together"*. PTFarmer-M6 also re-established silvopasture on the new farm without grant funding. In other cases, there were parts of project that participants did on their own or continued to improve the practice long after the project was completed.

For yet others, the importance of participating in SARE program was not so much about the funding per se, but in the motivation to get organized. AFProf-M9 explains: *"It was very crucial, extremely crucial, because for one thing, writing a grant causes you to collect your thoughts and be focused and to list your goals. And to organize, organize the project in grant writing, is the first fringe of research which leads to science and everything like that. So, I would say it was it was crucial."* SARE support was important not only for structuring the approach to AFP but also for testing new ideas and sharing results with others, as FTFarmer-F1 highlights: *"I think we would have always continued to* [practice AF], *I've always grown fruits, but this* [SARE support] *was really instrumental in helping us be deliberate about how we're doing it, how we are thinking about it. And that being supported to test an idea and ground truth that, and try to share that with, you know, other growers interested. That was huge."*

In addition to the opportunity to test and explore some ideas and find answers to AF related questions, SARE funding enabled the sharing of results with others. SARE funding also helped to address such challenges as upfront investment costs for plant establishment, testing out varieties, tools, consultants, labor, and time, reducing the investment risk, and helping to scale up and commercialize the AFPs. In slightly under half the cases, SARE funding proved crucial for AF project implementation because it alleviated the above described challenges, without which the projects wouldn't have been implemented. PTFarmer-M5 explains: *"There's things we were able to choose to spend time doing that we wouldn't have done otherwise, just, in our day to day farming because of the cost, whether it's time or materials. So, it* [grant] *really helped, help us ask a question and answer it. And if we didn't have the funding, we wouldn't have done it, simply."* His point is mirrored by FTFarmer-F6: "*It's a small grant, but it you know, it encouraged me to take the extra time to put to the care and understanding of these plants, development of this* [practice]*."*

Pursuing on-farm research was highly dependent on the SARE funding and reflected by several individuals, as for example PTFarmer-M6: *"I wouldn't have done the research aspect of it* [AF SARE project] *but I would adopt the agroforestry practice.".* Another positive aspect of SARE funding is the network building. FTFarmer-F4 explains: "*So, the SARE grant had hugely multiplied my contacts with other people that can use the information. And therefore, I get more information because they all know something that I don't know."*

Appreciation for SARE funding support is shared by all case study participants, as explained by FTFarmer-F1: *"There are very few grant programs that help support*

innovations in sustainable agriculture for farmers, especially smaller mid-sized farm". And by PTFarmer-M7: *"It's just encouraging to see that they* [USDA] *are supporting and encouraging projects like that. And then you know, the financial component is great, it's very helpful. I probably would have done like a smaller version of what I did had I not gotten the grant, so it really it did allow me to take it to another level."*

To sum up, SARE funding support was appreciated and helpful in all cases, enabling project participants to realize a number of goals. It was critical for implementation on almost half of the projects, but not the decisive factor for AFP adoption for over half of the participants. Financial support helped speed and scale up practices. Practice continuation and expansion was often done without external grants as FTFarmer-F4 notes: *"I'm getting some done towards having more of a rotation, that it will be important as a demonstration project, whether or not I'm funded."*

5.3.3. Timeline to agroforestry practices adoption (innovation decision process).

The timeline to AFP adoption was estimated in Table 6 based on an analysis of interview question responses and SARE AF project documents and reports. According to Rogers DIT, adopters go through an innovation decision process: acquiring initial *knowledge* about AF, then *persuasion* to *decision* to adopt, and after that to actual AFP *implementation*, and, finally to the *confirmation* of the adoption decision. The first four steps of DIT were coded from 1 to 4, then two additional steps were added to reflect the specifics of this case study and agroforestry's longer timeline of expected results. Thus, code 5 was given for SARE AF project implementation, and 6 for "seeing the first results". Because agroforestry practices involve perennial crops, results may take long period of time and it was important to reflect that in the timeline. After seeing or not seeing the

expected results, practitioners either commit to AFPs adoption or decide to discontinue the practice. Confirmation of the fifth step in the DIT timeline was assigned code 7, and discontinuation of AFP received code 0. The indicated year of events may not always be correct due to faulty memory or misinterpretation of dates, e.g., "about 9-11 years ago" in combination with other analyzed data. However, the main idea is to reflect the time-path trajectory and the sequence of AF adoption stages. The sequence of "1" would indicate first appearance of 1 as receiving the initial knowledge about AF and following "1" as learning more about it out of interest without indicating the need for further persuasion. When intonation or data from interviews tapes and transcripts indicated the decision formation stage about AF, or some kind of event that lead to the decision to adopt, the code "2" was used. Whereas, the code "3" was used when decision to adopt AF was made.

Table 6. Timeline to agroforestry practices adoption

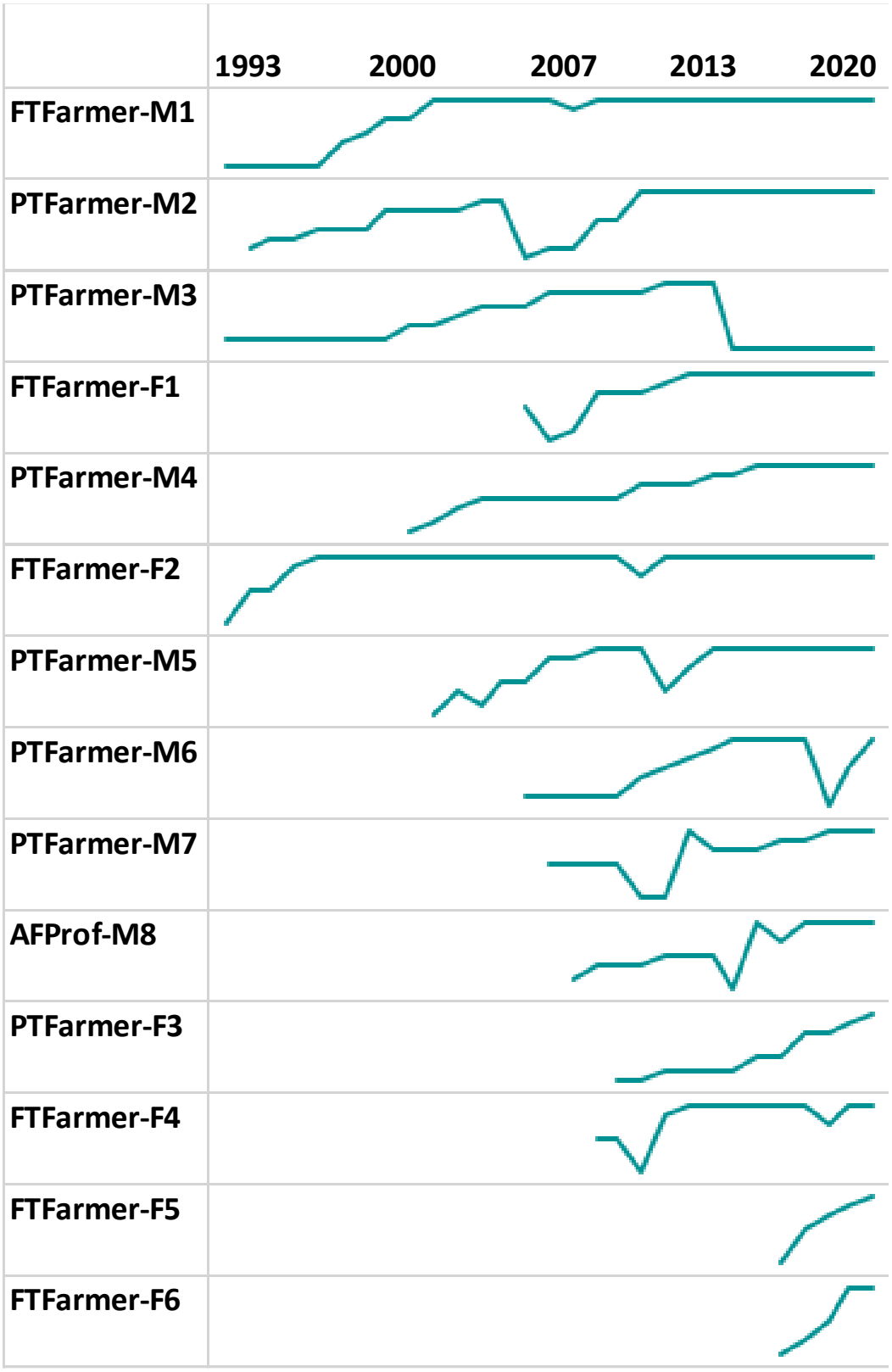
	1988	1990	1991	1993	1994	1995	1997	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	IDP * (1 till 3)	ICP ** (4 till 7)
FTFarmer-M1	1	1	1	1	1	3	4	5	5	7	7	7	7	7	7	6	7	7	7	7	7	7	7	7	7	7	7	7	7	5	3
PTFarmer-M2		1	2	2	3	3	3	5	5	5	5	6	6	0	1	1	4	4	7	7	7	7	7	7	7	7	7	7	7	3	11
PTFarmer-M3	1	1	1	1	1	1	1	1	2	2	3	4	4	4	5	5	5	5	5	6	6	6	0	0	0	0	0	0	0	10	11
FTFarmer-F1														4	1	2	5	5	5	6	7	7	7	7	7	7	7	7	7	0.1	7
PTFarmer-M4									1	2	3	4	4	4	4	4	4	4	5	5	5	6	6	7	7	7	7	7	7	2	12
FTFarmer-F2	1	4	4	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5	7	7	7	7	7	7	7	7	7	7	1	3
PTFarmer-M5										1	3	2	4	4	6	6	7	7	7	3	5	7	7	7	7	7	7	7	7	1	3
PTFarmer-M6														1	1	1	1	1	3	4	5	6	7	7	7	7	0	4	7	4	3
PTFarmer-M7															4	4	4	4	1	1	7	5	5	5	6	6	7	7	7	0.1	6
AFProf-M8																2	3	3	3	4	4	4	1	7	5	7	7	7	7	1	4
PTFarmer-F3																		1	1	2	2	2	2	3	3	5	5	6	7	6	3
FTFarmer-F4																	4	4	1	6	7	7	7	7	7	7	5	7	7	0.1	4
FTFarmer-F5																									1	4	5	6	7	1	4
FTFarmer-F6																									1	2	3	5	5	2	n/a
																												Average		**2.6**	**5.7**

Where 1 - initial knowledge, 2 - persuasion, 3 - decision to adopt, 4 - AF implementation, 5 - SARE AF project, 6 - first results, 7 - confirmation, 0-discontinuation of AFP
FT - full-time, PT- part-time, F - female, M - male, AFProf - agroforestry professional.
** IDP (innovation-decision period) is usually measured as length of time from initial knowledge (1) to the decision to adopt (3) (Rogers, 2003)*
*** Implementation to confirmation period (ICP) – suggested measure of adoption rate from time of actual implementation (4) to confirmation or discontinuation of the practice (7 or 0)*

As seen in Table 6 and visualized in Figure 20, each individual case is different and does not necessarily follow a straight line from receiving initial knowledge (1) to confirmation of AFP adoption (7) or practice discontinuation (0). In four out of 15 cases

the adoption began prior to acquiring knowledge about "agroforestry". An agroforestry professional who promotes AF adoption among other farmers and practices it his spare time said: "*To be honest, I started doing agroforestry before I knew what the word for it was. Let's see, in 2011 I started planting trees and alley cropping systems in our hay fields. but I didn't know what alley cropping was, I didn't know what agroforestry was.*" Other interviewees who owned land indicated that they were actively managing trees on their farm based on an innate love of trees. "*Polyculture, perennial polycultures in particular, have always had place on our farm*" says one of female full-time farmer, where she and her husband decided to scale it up to alley cropping after learning about agroforestry on a workshop from another farm family.

Figure 20. Timeline and Trends to AF adoption based on data in Table 6



Usually, even if the timeline does not start from Stage 1, learning about AF, practitioners search for the information regarding the activities they implement and 'discover' agroforestry. *"I didn't hear about it, I started doing something before even thought of it as agroforestry. I'm pollarding trees, but I didn't know the word pollard the first year that I was pollarding trees. I didn't know that anybody did it. I just was doing it because the goats wanted it and it made sense to have it above ground height. So, I was reinventing pollarding for the first year. And then I found the word and I get very excited and started researching"* (FTFarmer-F4). The process occurs sooner or later, but may take several years according to this farmers' experience: "*And it wasn't until maybe several years later that I actually heard, like, found out that I was doing agroforestry. I was just really excited about planting fruit trees and then I got more organized about it, I guess, after the more I read and researched. It was just an organic process."* (PTFarmer-M7).

The majority of interviewees received initial knowledge about AF prior to implementation. As was previously mentioned the initial knowledge about AF was primarily received from a farmers' line of work or background experience, where personal interests and worldviews could have influenced the occupation and education choice. The internal factors (e.g., inner drive for more sustainable production systems, "love of trees" and enjoyment of working with trees) might explain the absence of stage 2, persuasion, i.e. "forming the attitude toward the innovation" (Rogers, 1993) in half of the cases. Information about AFPs just naturally fits within their world view, e.g. *"it just resonated with what we were already doing, the language for what we're doing."* Consequently, after learning about AF, those individuals skip straight to the decision to adopt the new idea. As one of the farmers put it: "*I feel like just after discovering it* [agroforestry], *I felt very*

committed to it. I just didn't know exactly how I'd be able to fit it into my life until, you know, I "grew up" a little more, honestly."

In half of the cases, stage 2, persuasion, took place in form of personal research for more information about the practices, or in form of external influences (e.g., workshops, seminars, individual contacts), or simply as a natural way of working with the land and available resources. The above-mentioned 'Influencers' from the external factors of AF adoption play a key role in forming positive attitudes towards new practices and moving forward to stage 3, the decision to adopt. The following quotes from female and male part-time farmers provides a richer description and deeper understanding of the process: *"So initially, as I mentioned, it was just kind of social interaction. But then there would be seminars, I would go to the seminars that they would have here. And then there was that there are a couple of agroforestry training centers or training sessions that they had, for a couple of two-day ones, they were really, really good. And they did a lot with chestnuts at those and that those must have been, ohh* [pause], *maybe almost 15 years ago now, at least, at least 10 years ago. So that really got me thinking a lot more about chestnuts. I put a few trees in, planted them myself and then I was trying to figure out what to do with the next steps."* (PTFarmer-M4). *"I started with reading a lot about I mean, first gardening, and then you know, trying to choose a model of gardening. And permaculture was what I landed on and dug deep into permaculture, which led to forests gardening and you know, once things at a small scale, and then Mark Shepherds "Restoration Agriculture" kind of opened my mind to what that could look like at a larger scale."* (PTFarmer-F3).

However, no matter what the process towards the decision to adopt AF was, the key point of stepping up to actual implementation was land access and, more accurately in

most cases, land ownership. *"The tipping point was actually the purchase of ground. From the time I was able to purchase ground I knew I could do something with agroforestry. It was probably less than 24 months from opportunity and an idea to like doing something."* (PTFarmer-M3)

As already discussed in previous section, land tenure was referenced by majority of interviewees as some kind of keystone in starting the action. The fact that those who started practicing AF prior learning about it had access to the land (owned or family farm) supports the idea of land tenure factor as essential for AF adoption. Nevertheless, the absence of land or time working the land did not stop some study participants from testing AFPs on someone else's property, or promoting AF adoption to other farmers, helping them to implement AF projects. One of the interviewees (woodworker and environmentalist), who's timeline was not constructed due to the lack of full relevant information, has been promoting the propagation of certain varieties of trees through agroforestry systems and educational programs for over twenty years. Other interviewees indicated that they had implemented AF projects on the land they did not own, however it was more on the "test-level" scale rather than full commitment. As one of the farmers indicate: *"I was committed to doing agroforestry and really learn that, in order to do that, I would probably need to buy a land because I had a number of scenarios that, you know, I started a project and then the landowner said they didn't want me to do it, or relationship didn't work out, or those sort of things. So, tenures are very, very important."* (PTFarmer-M5)

The importance of the SARE program support for agroforestry projects implementation is discussed previously. Here it is reflected in the relevance of its

importance across the AF adoption timeline, and also shows that not all cases had SARE financial support for implementing AFPs prior engaging in stage 4, implementation. In fact, 80% of the interviewees practiced AF to some degree prior receiving SARE funding. Nevertheless, the financial aspect of upfront costs and delayed returns on investment may be a crucial part of the length of innovation-decision process.

The final stages of the timeline to the AFPs adoption include stage 6, seeing the first results after establishment of the AFP and then, either stage 7, confirmation and further AFP use, or, stage zero (0) the decision to discontinue. What is notable that in several individual cases, stage 7, confirmation, occurred prior seeing the results, mostly because such systems aligned with personal views on the agricultural system and attitudes towards trees. In other cases, the initial satisfaction was not necessarily linked to the direct economic benefits, but rather to the group of indirect benefits (e.g., additional feed for livestock, animal welfare) and to the categories of "aesthetic-based" (e.g., the joy of working with trees) and "environmental" (e.g., improved wildlife habitat, soil health) factors influencing the AF adoption. A quote from a full-time female farmer pulls it all together: *"I was just in shock at how fast the ground got green with so many species. The biodiversity just went up, you know, probably 500% because it was just bare* [before]. *Plants beneath maybe five times, now there's more plants than I can count in just one year from letting the sun in… Goats are happy that they eat perennials… Anyway, it's the greenery is the big reward for me. I want to be in a lush green healthy, you know, world of healthy foliage and grass and everything being vibrantly dark green, healthy, not yellow, not suffering from the drought. You know, looking moist and growing fast. That's the biggest draw for me"* (FTFarmer-F4).

‘Seeing results’ is technically the part of the implementation stage in the innovation-decision process that includes the adapting and adjusting the innovation for specific local conditions. The adaptation of AFP technique can include changes within one type of AFP or switching to another. For example, in the case of PTFarmer-M2: *“Well, I didn't expand or anything after the initial planting. Some of the varieties of berries that I tried did not do well, so that was a little frustrating. And then, and then I kind of switch gears and planted some fruit trees in my pasture that I had and then I was grazing sheep around the fruit trees.”* The changes within the practice in most cases dealt with change of species that have best survival rate and low-maintenance needs, e.g.,: “*I've switched almost entirely, you know, away from apples and pears and peaches to more native and naturalizing species”* (PTFarmer-M7). Due to the perennial nature of AFP, the period of *“tweaking and experimenting and filling in the gaps and just trying to work with nature”* takes longer, while desire to improve the system is ongoing, as FTFarmer-F5 states: *“There's always gonna be things that I try to keep improving on and whatnot.”* The persistence and stubbornness of AF early adopters, as discussed earlier in the chapter on factors influencing AF adoption, are important traits for this stage of innovation adjustment and continuum of technology use. Even if adjustments are not needed, there is readiness to make them: *“If I saw something that didn't work, I'd definitely shift how I'm doing it toward what works. It just happens that a lot of the things that I did first worked very well”* (FTFarmer-F4).

The adapting of AFP technologies that occurs during stage 4, implementation, corresponds to the ‘re-invention’ described by Rogers in the DIT (2003). Rogers generalized that it happens “for many innovations and for many adopters”. This study

supports Rogers generalization, showing that 60% of interviewees adapted the AFP to their farm to some degree, and that half of survey respondents whose SARE AF project was completed had subsequently modified their AFPs. Comparing interviewee survey and interview responses suggests that the rate of AFP modification by survey respondents might be lower than reported. This might be due respondents understanding that the adjustments they make for AFPs to work on their farm are the norm for introducing any new technology.

The decisions to discontinue the AFPs occurred in 3 of 15 cases. In two cases this was due to relocation and sale of property with subsequent re-establishment of AFPs at the new farm. One of them re-established the same practice, while another established a different AFP. The single case where the discontinuation of their AFP occurred was linked to poor tree survival and the financial costs of sustaining the practice: *"I was pretty motivated to stick it out but I had three winters in a row that were just incredibly brutal on my tree mortality. And it just got to the point when death rate was substantial enough that I just couldn't justify reinvesting it in a new plant stock to the extent that it was out"* (PTFarmer-M3). Installing an alternative conservation practice that was more financially attractive, less time consuming and "*not quite so heartbreaking*" made better sense for the farmer and were implemented instead of the AFP. At present, this farmer is engaged in improving his forest stand "*trying to increase the value of property*" through timber stand improvement and invasive species control.

The average innovation-decision period for SARE case study interview participants was approximately 2.6 years from time of initial knowledge till decision to adopt and 5.7

years from on-the-ground practice implementation to confirmation or discontinuance decision. The implications are presented in the discussion chapter.

Despite being different for each individual, the analysis of the timelines to agroforestry adoption revealed some previously discussed similarities. To conclude this chapter, the following quotes reflect farmers timeline to adoption and commitment to AFPs:

"I kind of discovered it [agroforestry] *around 2001-2002, and then I've stared explored it in different ways. From then till about 2010-2011 I worked at* [name of organization] *and we tap trees and we're doing mushrooms and started doing stuff with* [name of organization] *and were, you know, I worked on other people's projects and land and then 2011 was when we bought a farm and started* [AFP] *there. So, so roughly, you know, 10, 10-year chunk phase of discovery to exploring to then sort of committing."* (PTFarmer-M5)

"It's just a personal enjoyment. So as long as I'm physically capable of doing it [planting trees], *I'd like to keep doing it. You know, if I get too old, or health wise I can't do it anymore, then I'd stop that. But otherwise, I plan on continue as long as I'm capable."* (PTFarmer-M2)

5.3.4. How AF early adopters gain AF information and support.

To explore how AF early adopters gain answers to their AF related questions and get support, interviewees were asked to discuss their preferred channels of communication and information resources, as well as the support system they have and would prefer, and suggestions for improvements.

5.3.4.1. Preferred channels of communication and information resources

Results from descriptive coding on information channels and resources are presented in Table 7. The main themes were identified as oriented as direct interpersonal communication and indirect mass communication. An additional emergent theme is AF early adopters themselves as sources of information and support due to their pioneering experience. AFP practitioners utilize various channels of communication and information resources, and there was no clear border between direct interpersonal communication and indirect mass communication themes or among categories. For example, PTFarmer-M4, his first introduction to AF was due to social interactions, and then *"going to seminars, talking to people, seeing demonstrations, going to some training sessions at agroforestry center"* to learn more about AF in search of answers on introducing AF practices.

Table 7. AF early adopters preferred information channels and resources

Themes	**Categories**	**Sub-Categories**	***Codes (sub-codes)***
Direct interpersonal communication			
	Farmer to farmer		*visiting farms, talking to farmer, farmer to farmer, seeing AFP in action*
	Organizations agents		
		Educational institutions	*universities, universities extension agents, university affiliated organizations*
		Government agencies	*USDA, NRCS, Forest Service, SARE, government agencies extension*
		Non-profit organizations	*Savannah Institute, nut growers associations, farmer organizations*
	Networking		
		Events	*conferences, trainings, meetings, workshops, field-days*
		Contacting	*e-mails, phone-calls*
	Land itself		*learning from the land*
Indirect mass communication			
	Publications		*hard copies of publications (books, newsletters, journals, magazines, technical reports)*
	On-line		
		online publications	*books, newsletters, research papers, technical reports*
		online communities	*Facebook, mail lists, webinars*
		videos	*You-tube videos, videos from AF organizations*
		web-browsing	*googling, searching online, web-browsing*
AF-pioneers as info source			*AF early adopters becoming sources of information themselves*

However, there were similarities and differences in priorities in each case and variation in the emphasis given to one category or the other. This was captured through the interview analysis based on post-interview memoing, NVivo coding, and annotations.

Direct interpersonal communication

The direct interpersonal communication theme inferred interpersonal communication based on face-to-face interaction between two or more individuals. The categories within this theme were interconnected, for example farmer-to-farmer interaction established during an event organized by an AF organization. Nevertheless, the farmer-to-farmer category was the most highly emphasized, followed by networking, and interaction with different AF-related organizations representatives. Land was also indicated as source of information.

Thirteen out of fifteen interviewees indicated farmer-to-farmer interaction as important, as PTFarmer-M6 describes: "*I also definitely use what other farms are doing when visiting other farms in what they're doing, or talking with them or like adopting technologies, learning different ways, or different ways to graze, and all those technologies I really like to learn those from other farmers... And that's why I like to go on farms, talking with farmers, because you see it on the ground, you really see what works and what not.*" Even farmer-to-farmer connections not involving AF were indicated as valuable.

The lack of local and regional examples, discussed previously, creates certain restrictions to obtaining first-hand information from similar practitioners. Different people are willing to travel varying distances to see the practices in action, and this readiness and ability also changes with time and circumstances. Distance from one to four hours is preferred by AFP practitioners for other farms visits, but some individuals have even

combined their travels with farm visits abroad as far as Japan, Kyrgyzstan, England, France. FTFarmer-F1 states *"I think that we're borrowing and, like, sharing and tweaking from other parts of the world. There are other places that are doing similar projects, have knowledge systems that have been doing this* [agroforestry] *for a longer time than we, and we can tap in without being exploitive, you know."*

For some farmers to be able to talk to or visit other AF practitioners is highly desirable but challenging, for others it is the most useful approach and is locally available. Compare, for example, FTFarmer-F6 struggles to find people: *"so it'd be nice to talk to someone and discuss, you know, what it could, you know, what can we improve in our process, but there isn't a lot of people now"* with PTFarmer-M7 experience: *"What been some of the most useful information is just talking with other growers and I visited a lot of farms. That's one of the most useful for me to go on the farm where someone else is doing it."*.

The opinion of AFProf-M8 sums up the general idea behind the farmer-to-farmer interaction and the importance of seeing working farms*:* "*I think a general principle at all ages is to see it for yourself, is the most useful to see it as to believe it. And so, I think maybe that's especially true for older individuals. But I think it's true for everyone. But maybe younger people are more willing to try something new, because they have more time left for trial and error."*

In-person interactions with representatives of an agroforestry-related organization was another category of information resource. University representatives, government extension agents, and non-profit staff were mentioned as *"people to go to"*. Often those interactions were not limited to just acquiring AF-related information but include finding

other AF practitioner contacts reinforcing the importance of working farms and demonstration sites. *"I learned mushroom cultivation from a professor here at Cornell as well as there was a mushroom farmer close by up the road. And, and then another practitioner that has a pretty established silvopasture. So yeah, I was able to really benefit from being active, practice from an early point, which I think really helped. I think I continue to know that when I'm seeing people progress through and understand more, that seeing those demonstrations and actually getting that real sense of things is really essential to understanding it and then see being, like, "Oh, I can do this. Not so, not so hard",* shares PTFarmer-M5.

Organizations mentioned included government agencies (USDA, National Agroforestry Center, NRCS, Forestry extension, other extension specialties), educational institutions (UMCA, Cornell University), and non-profit organizations (Savannah Institute, Northern Nut Growers Association, Iowa Nut Growers Association, Nebraska Nut Growers Association, Chestnut Growers of America, Practical Farmers of Iowa). Specific events included the Savannah Institute's Perennial Farmers Gathering, the UMCA Agroforestry Academy and Agroforestry Symposium, meetings of farmers associations, including Northern Nut Growers Association, Small Farm Today, MOSES organic conference, Acres USA, and field days with various organizations.

One third of respondents have consulted with various government agency extension specialists with different degrees of success. Some have had very positive experiences; others returned disappointed. The case of FTFarmer-F6: "*I did try to talk to our local ag agents, agricultural agent and some other in the other people involved with the USDA, but they, they knew nothing about it"* and this was echoed by PTFarmer-M6 who lives in the

different part of the country: "*The knowledge of extension professionals, conservation folks is pretty limited with agroforestry."*

The usefulness of organizations was identified in the option for personal consultations, in the publication materials that they produce, and in the events that they organize. Conferences, trainings, meetings, workshops, and field-days were valued by the study participants for opportunities that those provide. First, for obtaining relevant AF information, and second but perhaps of greater importance, is the opportunity to establish contacts with other farmers and AF professionals. PTFarmer-F3 notes: *"I found this Savanah Institute perennial farmer gathering to be a pretty indispensable source for me because I'm still kind of at a stage where I am open to a lot of ideas… The nutshells I find, like, indispensable because of the people specific experience… they're growing so many different things, right. And, so, you can hear in five minutes, you know, what they're doing and what's working, what's not working, what they like, what they don't like, you know. And so just to hear those bits helped, helps me make decisions about what I might want to do or not."* For established AF entrepreneurs, participation in conferences decreases in importance as an information source or for gaining useful contacts but does provide the opportunity to share experience and help beginners.

Networking opportunities were valued by the study participants along with opportunities to see *"agroforestry in action"* for themselves via field-days. The visits to working AFP farms and demonstration sites can be invaluable and influential for AF adoption. "*I will say two field-days, like I've been to two at hog-orchard over in Minnesota and just to go to someone's place, and you know, there's other people who have the same interest and you're on a farm, and of course, no farm is exactly the same, but actual field*

days, I just think there's no replacement for that. So those are really, really valuable" (FTFarmer-F5).

Establishing contacts with AF professionals and farmers helps to develop relationships and *"tap into the network"*, so that when AF questions arose there was someone to call and ask. PTFarmer-M2 explains: *"I like peer to peer networks, if you can find them. Those are those are nice people. You can call and ask questions when problems arise, who have experience doing the same thing."* Farmer-to-farmer *"in partnership with expertise"* is mentioned by several interviewees as having *"an important value of a network of peers and experts working in partnership with each other"*. This is mirrored by the experience of PTFarmer-M5: "*And then people really, both sort of practitioners as well as researchers have been really important to connect with and learn from directly. That's mostly how I gathered, continued* [to learn about AF]*."* Having established relationships makes it easy to connect in future and ask detailed questions to an expert *"because either he knows the answer, or he knows who to talk to"* (PTFarmer-M4).

Networking helps to solve problems as they arise and swap experiences, "*share new ideas, and new tree, or a new variety to try growing, or a new grafting technique".* Some network professional relationships turn into friendships, as with FTFarmer-F2: "*I just I tend to work with "Field and Forest Products" a lot because there are spawn suppliers and they probably have the most knowledge because they've been doing it longer than I have, and they become friends too."*

There is a general understanding among respondents that no single organization or individual has all the answers due to the variability of AFPs and comparatively low level of AF adoption in the U.S., as noted *"where it's not like, you know, all knowing individual*

experts who comes in and sits down and tells you everything you need to know" (FTFarmer-F1). This awareness reinforces the need to interact with multiple AF practitioners and professionals.

"Land" was recognized by some practitioners as another source of information. Learning from nature, observing what "land tells", and just "learning by doing" was empowering in a number of cases. *"They* [goats] *taught me to prune to them so I started climbing taller and taller trees… So, yes, the goats pulled me deeper into the woods. Now I'm farming my woods more than my openings"* (FTFarmer-F4).

Indirect mass communication

The indirect mass communication theme contained two main categories: (1) printed publications (2) on-line information and communication. In modern times the internet is ubiquitous, at least in developed countries, and has changed how people communicate, gain information, and look for answers. Often, even to obtain a physical book one has to find and order it on-line. AF is no exception to this rule and when participants were discussing publications there was a mix between hard copies and on-line versions. Nevertheless, the majority of participants (80%) appreciated the printed versions of publications, with some individuals creating personal libraries by printing out on-line available materials and those collected from different meetings and conferences. There was also higher rate of trust with printed materials, even if they are found on-line. For example, the online version of a publication from an organization would be trusted more than just text on a website. There were a few cases wherein computers and internet technologies were harder to work with, while good 'paper' books were valued by everyone. For example, for FTFarmer-M1, annual reports and handbooks published by Northern Nut Growers Association were *"by*

far my most important source of information", and in addition to meetings and networking, hard copy books became important: "*One other source of information that I've used that was rather recently, when I had already tried growing pretty much every fruit and nut species I could think of to grow in our climate, I actually purchased an encyclopedia of fruit "Fruit and nut trees of the world". And I went through that encyclopedia page by page. And I think I ended up finding maybe two or three additional species that I hadn't considered planting before. But, aside from the organizations and their meetings, that's the only additional one I can think of."*

The combined use of several information sources has its advantages. PTFarmer-M4 explains: *"I kind of like the printed material. And maybe with the option of talking to somebody who's an expert… talk to them and they kind of give the idea of where to focus, and then go look at the literature."* Or in the case of FTFarmer-F4, who got in contact with authors of research articles she found on-line to clarify questions and share experiences. Some books have proven very influence on peoples' perceptions of growing trees and aligned with their vision for the agricultural systems they want to be involved in, in particular those books that include farmers practical experience with supporting research references.

Participants whose interest or involvement with AF began in the late 1980's and 1990's noticed the shift in importance towards on-line resources, as well as the increased quantity of AF-related literature and research, and the appearance of new organizations working with AF. FTFarmer-M1 notes: *"Nowadays it's become pretty hard for me to say find new information in print form. And, so, the Internet Information is has become more important recently."* The indirect mass communication information resources available on-

line were grouped into following four sub-categories: (1) web-browsing, (2) on-line publications, (3) video resources, (4) on-line communities.

PTFarmer-F3 viewpoints represent many study participants: *"Then if I'm, I'm looking for answers to specific questions, I usually just Google it… Google is faster than looking things up in the index."* Looking for an answer on-line is the norm in modern society because of its convenience and adequacy to meet people's needs. However, web searching also generates un-reliable information and each individual uses their own filters to determine what to read. Some prefer trusted ".edu" sources, others find links to publications and research articles, still others use videos. Web-browsing allows information gathering from all other the world and can provide ideas that can be adapted to local conditions. On-line research helps not only to obtain information, but also to locate contacts for further communication on AF-related questions.

Research articles, technical reports, AF organizations reports, newsletters, brochures, and other publication are popular reading materials among AF early adopters. These kinds of materials are also considered to be more trusted sources: *"I like getting things from like, you know, extension, research institutions or, or like even nonprofit organizations that are supporting agroforestry because usually it got a little more credibility to it and it's organized concisely in terms of publication"* (PTFarmer-M6). Newsletters from the USDA National Agroforestry Center, Savanna Institute, UMCA, Cornell were pointed as useful.

On-line communities are connected to some organization's forums, webinars, and mail-lists, but mostly referenced as Facebook groups. *"On Facebook there is a special interest groups for every topic that we think of, as a persimmon group, paw-paw group"*

(PTFarmer-M7). These communities can be helpful, because they allow the user to ask questions to various practitioners who might have dealt with a similar problem. The credibility of responses is often questioned but can be validated through further research or farm visit exchanges. On-line communities provide also a chance to find and visit people with similar interest and experience: "*I'm on NAFEX, North American Food Explorers, they got a Facebook group. And, so, I asked a lot of questions on that group. And then I ended up calling people that I meet there and asking them questions."* (PTFarmer-M7). On the other hand, as there are diverse opinions presented in these online groups, some advice may prove inaccurate. *"I'm a member of the silvopasture.meat.com group with Cornell. I don't really stay online too much. And then I'm a member of the Facebook silvopasture group, but I just stopped participating in that because there's so much false information on it. And it just frustrates me to even look at it. Just like bad, there are a lot of bad knowledge being implemented, some of it is actually wrong, or people without any experience looking for like a magic cure and then somebody experience can give them one, I just, I don't like it. There's no credibility, no credibility to what they say"* (PTFarmer-M6).

Similar to on-line communities, opinion on the convenience of using video resources also divides among those who like using videos, and those that don't. For some, videos constitute a lot of valuable information (*"a lot of my research has been like watching YouTube videos"* PTFarmer-M7), for others it is not as essential (*"I don't like videos because they take so long to watch. Like, I'm a very fast reader and I like to skim you know, thing and I can't do that in a video"* PTFarmer-F3). Overall, *"how to…"* you-tube videos were identified as useful and helpful, like video tutorials about fruit tree care, pruning, mushroom inoculation ideas and techniques. FTFarmer-F2 makes the point:

"there's so many different little stories you can tell. I think stories are good, people like stories that are "show-me" and factual. ... You know, nearby, so and there's lots of information out there on YouTube, it may not always be correct, but that's where you get your troubleshooting ideas how to make, like, a humidifier cheaply so you don't have to spend you know $3,000 on a compressor and $2,000 on that, you know, really expensive piece of equipment to help people start off." The comment doubting accuracy of information is stressed by others, and usually validated through additional research or experimentation. A good point made by an AF professional clarifies the general perception of on-line resources value, credibility and validation: *"I know a lot of people like videos, I don't find videos very efficient, or podcasts or webinars, a lot of those media. I think those are good to generate interest, but when I want information efficiently, I'll go either to a book or to a scientific article, or to talk to a person directly or to visit their site that has what I'm looking for so I can see it for myself, that's efficient"* (AFProf-M8).

Communication channels importance

To sum up, the significance of different channels and resources varies from case to case and depends on the individual needs and preferences. However, in general, there were similarity in patterns and importance. Initial AF information is usually received from and indirect mass communication channels like books, on-line materials, videos, education background, conferences, and travel, but can come from direct interpersonal communication channels as well, e.g., friends, farm visits, social interactions. Indirect mass communication channels work well also for exploring additional information on a topic, however, for later adoption stages of persuasion, decision to adopt and actual implementation, the interpersonal contacts become much more important. Field visits to

AF demonstration sites and working farms communicating directly with farmers and experts are the most valuable.

AF early adopters as sources of information

AF early adopters as sources of information stood out as an additional theme. Not all, but the majority of the SARE case study participants were ready to share their experience and promote AF. Given that their practices, projects, and approaches are often unique to their respective regions, they become those essential contacts and sources of trust-worthy information for others. There is usually an outreach component required by SARE grants, but after projects end, some AF practitioners host farm visits, practice agritourism, respond to phone-calls and e-mails, and participate as speakers in conferences and webinars. Some of this activity can become a source for consulting income, but is mostly done for free, especially with networking and responding to info-query requests. *"I talked with a lot of people, people call me based on SARE report and ask me questions",* shares PTFarmer-M7. Because of their pioneering experience, AF early adopters become invaluable sources of information for others who want to introduce AFP on their land. Thankfully, most of AFP practitioners are willing to help with what they can *"I usually am pretty happy to hop in and share if I, if I if I have the knowledge or have the experience to share"* (PTFarmer-F3). That willingness can be explained by their initial motivation to practice AF, their internal drive to practice and promote more socially sustainable, environmentally sound and economically viable agricultural systems.

5.3.4.2. Support system

There is no effective support systems in place for AF early adopters, but there are some support mechanisms present. The existing support system has four legs: (1)

informational support, (2) institutional support, (3) financial support, and (4) moral support. None of these systems are well developed, but development is in progress.

Informational support, the first leg, has been discussed from a slightly different perspective. To recap, the growth and development of the information resources about AF and organizations dealing with AF have been noted by participants involved with AF for a long period of time. There is still a lack of specific regional information and a shortage of local examples of working farms, demonstration sites, regional organizations, and extension specialists. Many AF early adopters get deeply involved in networking and help one another.

Somewhat similar situation exists with institutional support, the second leg. There are plenty of organizations where farmers can address their questions, but those organizations usually do not deal directly with AF. There are more organizations involved in AF at present than there were twenty years ago. Some universities and government agencies were identified as useful and helpful but are limited to specific regions. FTFarmer-M1 notes: *"Well, like I said before, organizations are particularly valuable to me. I wish we had an organization like Savannah Institute in Iowa. And I wish that our State University had an Agroforestry Center, but it doesn't."*

Financial support, the third leg, was the biggest concern for AF adopters. While appreciative of existing opportunities with the USDA SARE, USDA NRCS EQIP/CRP, and forestry TSI programs, AFP practitioners agreed that the financial support for innovative alternative agriculture is very limited. As PTFarmer-M6 states: *"Our federal conservation in forest, it doesn't get agroforestry, that's hard. I can get money to put a building, but I can't get money to like establish silvopasture. That's pretty wrong from*

federal government for conservation effort. Counterintuitive to me." In addition, AF practitioners indicate that there few government programs support small-scale agriculture. Nonetheless, participants acknowledge some positive changes in USDA conservation programs, but, overall, they consider that financial resources are scarce. "*In some way it* [applying for SARE grant] *was like it was validation to see that USDA was willing to support a project that seems novel at the time. And I think when I applied for my first agroforestry related grant it wasn't something they really done much of before. It's been, I don no, they seem to have gotten more and more excited about agroforestry over the last 10 years. And it's just encouraging to see that they are supporting and encouraging projects like that and then you know, the financial component is great, it's very helpful."* (PTFarmer-M7).

The fourth leg is moral support from surrounding community and family. The majority of study participants have family support for their AF endeavors, some running it as family business, and others doing it on their own with "*no support necessarily but there's no disincentive either from family".* The more common situation is moral support and partial help from AFP practitioner partners. *"I mean, it's mostly my thing, but... but it's, I think it's critical for both… for family to be on the same page, just for having a farm and land, whether it's agroforestry or not, because it's so much extra time and energy going in and sort of the lifestyle, not just the job, so. So, it was mostly important that we're just on the same page in the big picture of wanting to pursue a farm and that kind of lifestyle"* (PTFarmer-M5).

The community at large does not generally provide any moral support, but typically those who are neighbors, farm customers and visitors usually appreciate the sustainability side of AFP, its visual aesthetics, and humane attitude to animals.

Moral support from institutions depends on overall community needs. With few acres in AFP, AF would not be likely to obtain the attention of extension agents. FTFarmer-F6 provides an example, indicating that extension agents are overwhelmed with other tasks that are agency priorities and address the local needs of the larger community: *"We have the USDA offices about soil, what is this office called?... NRCS... Anyway, and they've been out to our property. You know, we're talking about, you know, grant money for possibilities, but, you know, they, they just, and I have, I my sense is that they, they have a lot to deal with, and they don't really have time to get involved in these wacky little projects. But, you know, I kind of was hoping that they might be more interested. But they weren't they, you know, they weren't or they couldn't, I don't know, huh. Yeah. And it's a large area for them to deal with in* [state name]. *You know,* [conventional] *ranchers are priority."* The inadequacy of extension agents to answer AF-related questions was highlighted in several cases.

5.3.6. Suggestions for improvements

There was no single recipe for support system improvement but in essence the suggestions made could be assigned mainly to refinement of the different legs of informational and institutional support.

Despite the efforts of different organizations (e.g., USDA NAC, UMCA and the Savannah Institute) to provide AFP information, some AFP practitioners still *"feel sometimes it's a little fragmented"* and *"a little all over the place"*. More effort can be put

to systematize practices based on type, crop, and region. For example: *"There is "How to grow shitake mushroom" little pamphlet. It'd be fun to maybe have a more detailed shitake agroforestry bible or something less researchy orientated and more for the farmer more practical and in different options to do things"* (FTFarmer-F2). People often mention absence of specific *"directly applicable"* information, and knowledge of locally adapted species for AFPs. General descriptions of AFPs and possible variations *"leaves people feeling very it's very vague".* A process for information consolidation and increased regional specificity needs to be set up to systemize new research information and to translate that information into hands-on farm-applicable content. New research needs to address more practical applied research *"documenting what other farms are doing, things, and timing, and the cost, where the revenue streams are"* and tailored for specific regional climates and practices. A good point is made by PTFarmer-M5: *"People want like recipes, the specific combinations of trees or specific practices, and I don't think we do enough to, to articulate those… and offer some of the specific combinations and planting patterns and things that have worked for us. And people really want to at least start with a template. So, I think that's really important."*

Three main areas of institutional improvements were suggested: (1) strengthening networks, (2) developing AF extension programs, and (3) increasing financial support.

Strengthening networks had a geographical aspect to it: *"there's a network of farmers who are doing the work and we're close. Or, like, on paper, it feels like we're close, but we're like geographically we're still kind of spread out. But sometimes it's just, I wish there was more like kind of aggregate hubs of people or be more tool and sharing an idea sharing that way. I think sometimes like, I don't know, I could actually be more coordinated*

effort with that" (FTFarmer-F1). In addition to local hubs, suggestions were made on regional conferences where people could network with other AF practitioners, including regional tours of farms actively involved in different AF practices. The need for external facilitation of peer to peer networks became apparent from participant comments, including those that can happen in person (through local hubs, conferences, farm tours) and those on-line. With more formal organizations like universities or government agencies "*restricted in sort of informal networking to a degree"* the vision for building networks of practitioners and network facilitation is through more informal organizations *"independent nonprofits"* with the support from more formal ones. The need for facilitation is subtly noted by FTFarmer-F5: *"I know that there's people willing to help and talk and everything, it's just a matter of actually connecting."*

Another major topic for improving support was related to the development of extension programs. Contacting local extension agents was not fruitful for many AF practitioners, which created the desire to see this situation improved. "*If we could have an extension network that knows about agroforestry and have experience with farming that would be great"* (PTFarmer-M6). A desire for quality extension programming that were knowledgeable of AF practices and offered relevant resources was expressed in the concerns and aspirations of AFProf-M8 "*So those are people that have qualification and capacity and expertise to assist landowners and farmers to do agroforestry and to connect them with sources of public assistance for financial and technical assistance. And there, but there are very few agroforestry technical service providers… so if I had a magic wand, now, every county or at least every region within each state would have more agroforestry technical service providers"*. Quality agroforestry information coming from USDA NRCS

and other public agencies with authority and trust would be an efficient way to connect landowners with public assistance.

An interesting suggestion was made to improve outreach via the development of real time online learning. *"A little more robust system that you could have planned to FaceTime or live chat, where they'd* [AF practitioner] *say, hey, look, here's an issue I'm dealing with and to show it via my camera or my tablet or laptop and have somebody that could respond to me and visit with me remotely consult on right out my situation or problem that I'm trying to solve"* (PTFarmer-M3).

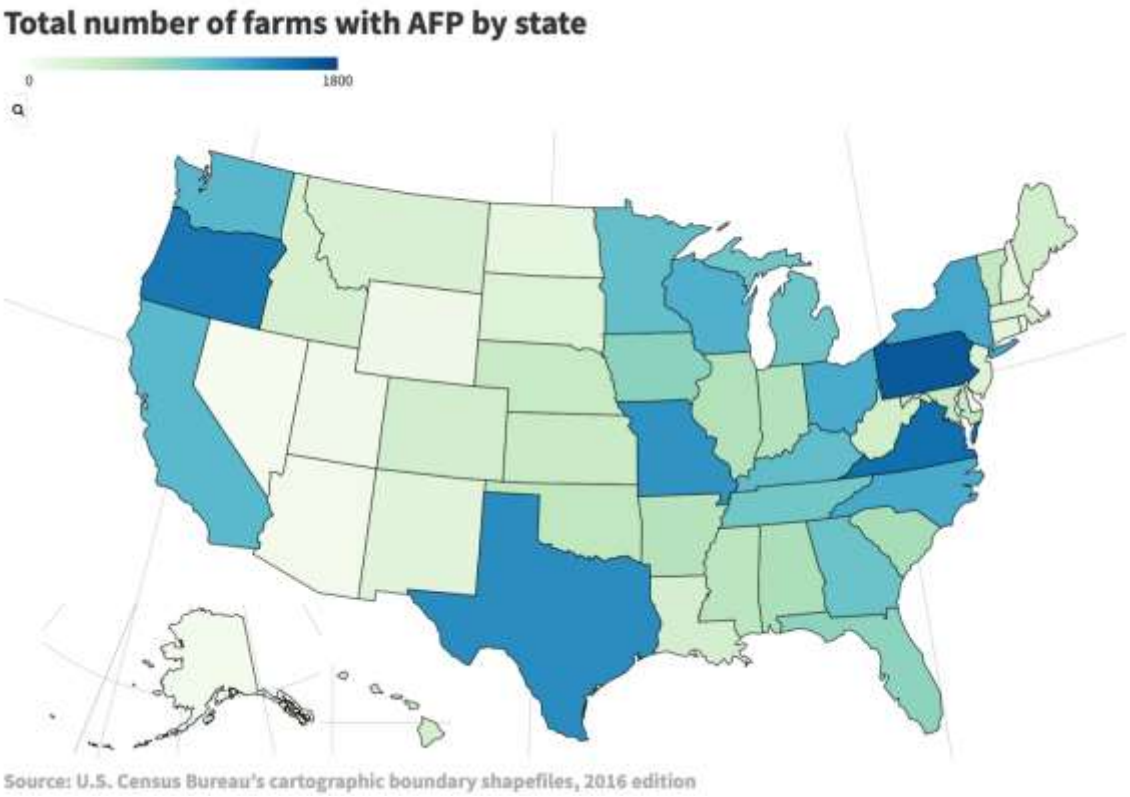
Enhancement of financial support was highly sought after. Farming by itself is challenging and with agroforestry the additional challenges of the long-term investment is added, where not everyone is ready or able to take a risk. "*Financially help with capital, upfront costs to take on agroforestry endeavors, that that's not there"* (PTFarmer-M6). Financial support for upfront costs can increase AFP adoption. There is also a need to provide clear information on how to get *"support from like NRCS, or state governments or even private investment, which is becoming more and more interesting in the regenerative agriculture world"* (PTFarmer-M5). There is potential for the development of private sector investment into AFPs due to interest in carbon sequestration, but these lack clear policy guidelines and methodologies to easily document carbon sequestration at the farm level. Measuring soil carbon, biodiversity richness, and other ecosystem services at the farm level is problematic. Developing such methodologies would help to promote those services or justify funding from governmental sources.

Finally, apart from the external support, there are simply limitations on a personal level, exemplified by PTFarmer-M4: *"I don't feel I'm limited by the information or the support. I'm limited by my time and energy to do the things that I know I need to be doing."*

5.4. Mapping findings

From the 2017 National Agriculture Census, a map was created to show the total number of farms self-identifying as practicing one or more of AFP by state (Figure 21). The highest number of farms with AFP were located in Pennsylvania (n=1,657), Virginia (n=1,526), Oregon (n=1,467), Texas (n=1,347), and Missouri (n=1,311). Although somewhat useful, AF adoption mapping by state is impacted by the size and total number of farms in the state. For example, Texas is the largest of the lower 48 states and has 248,416 farm operations, compared to 53,157 in Pennsylvania. While this does not change the total number of farms practicing AF per state, bigger states with higher number of farm operation would tend to have more farms practicing AF. Thus, showing data by county provides a more accurate picture of AF adoption in the U.S. Even though the AFP visualization by county is still affected by same parameters of size and total number of farms, the smaller size unit provides a more realistic depiction, especially for bigger states.

Figure 21. U.S. map of operations implementing AFPs by state



A map showing the total number of farms self-identified as practicing one or more of AFP in 2017 by county (Figure 22) indicates that the highest number of AFPs were adopted in Hawaii - Hawaii county (204), followed by the Oregon counties of Lane (152), Clackamas (151), Douglas (135), Yamhill (135), Sonoma in California (125) and Lancaster in Pennsylvania (120). The highest number of counties with 50 or more farms with AFPs were in Oregon (11), Washington (8), California (5), Pennsylvania (5), Virginia (5), and Vermont (4).

Figure 22. Number of U.S. farms practicing agroforestry in 2017 by county

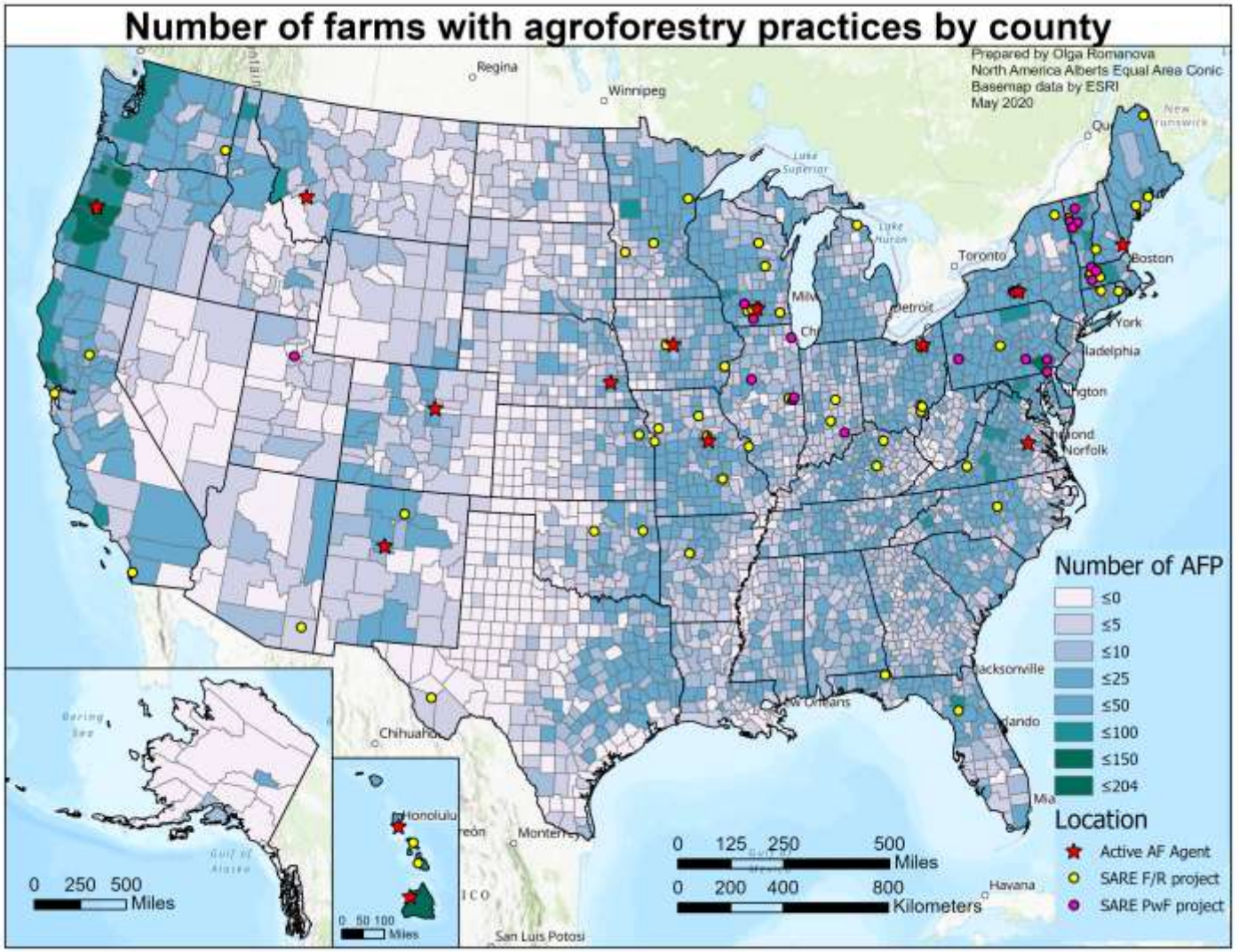


Figure 23. Farms practicing agroforestry in 2017 toward total number of farms by county in the U.S.

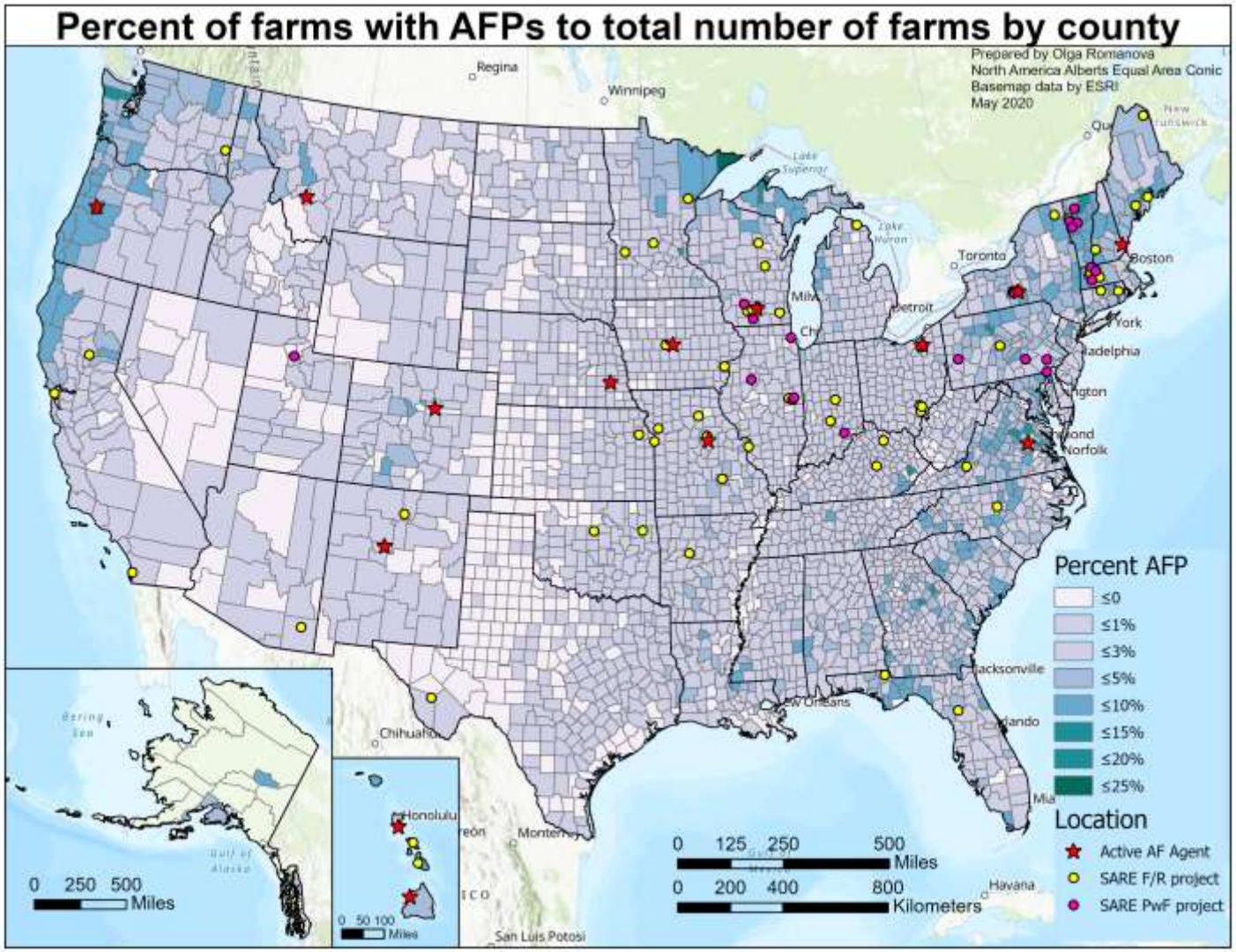
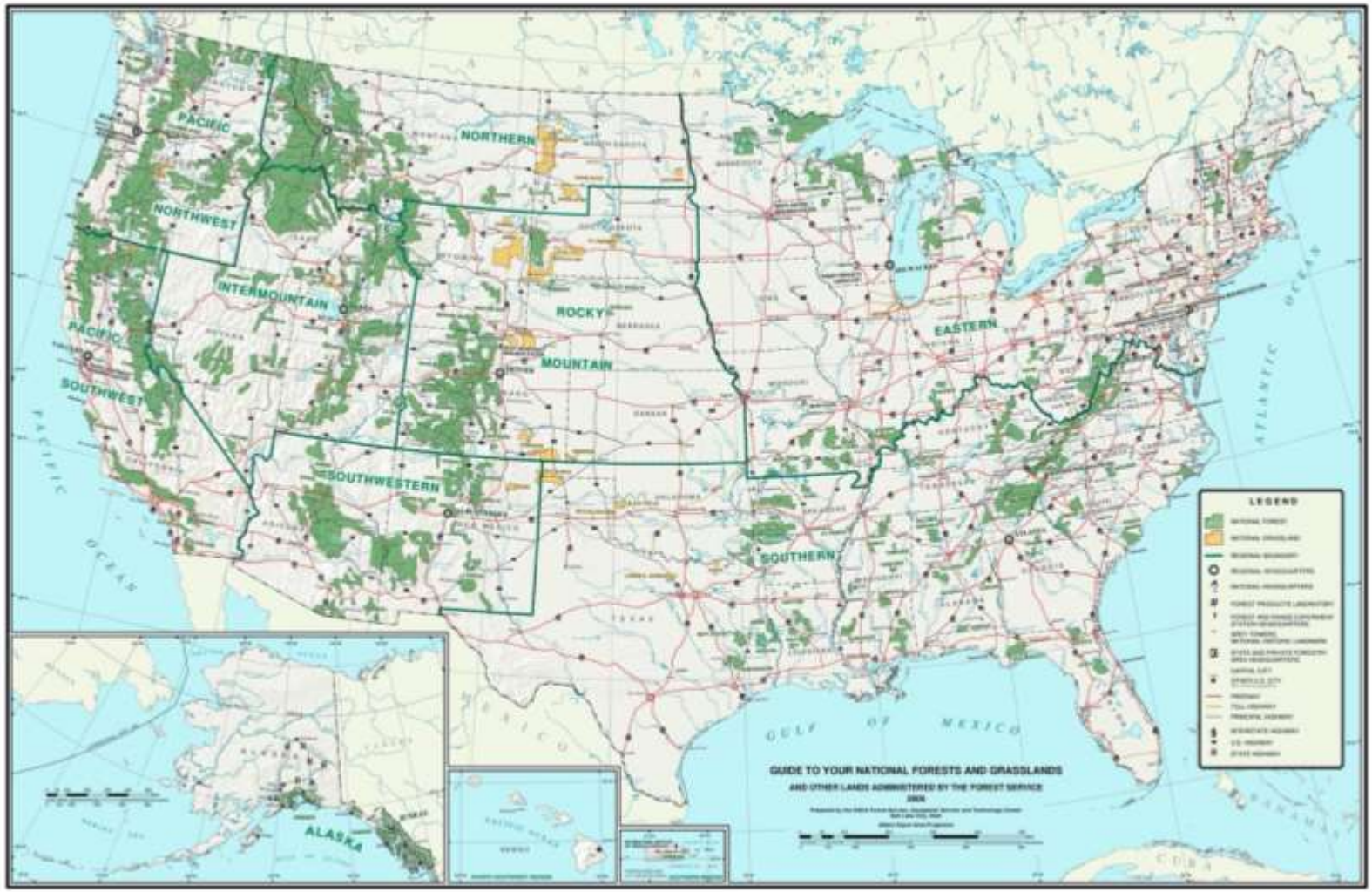


Figure 24. National forests and grasslands. Source: (USDA Forest Service, 2006)



As one can see on the map (Figure 23), the size of counties on the West coast are larger than those on the East coast, South, and Midwest. Therefore, the map reflecting the ratio of farms with AFPs to total amount of farms by county was developed. Mapping the percent of farms with AFP to total number of farms provided slightly different ranking information, but, overall, did not dramatically change the map view. The higher percent of AF adoption was found in Queens county in New York (25%), followed by Nantucket in Massachusetts (24%), Cook in Minnesota (22%), Putnam in New York (18%), and Caroline in Virginia (15%). It should be noted that all of these counties have a small total number of total farm operation, thus even several farms with AFPs increase the AF adoption percentage. The highest numbers of counties with 10% and more percent AFPs adoption were in the states of Georgia (4), New York (3), Virginia (3), and two in each state of Minnesota, Washington, Maine, Vermont. Once again, they are characterized by a relatively smaller number of total farm operations by county (less than 300) (except for Virginia, Washington and Vermont). However, overall, Hawaii, Pacific Northwest and East coast states have a relatively higher rate of farms practicing AF. For counties with highest number of total farms and greater than 2,000 farms per county, the average percent of AF adoption is 1.26%, and are located in Oregon, followed by Hawaii, California, Pennsylvania, and Washington states.

At the current stage of adoption, the total number of farms practicing AFPs is more indicative of the influence of 'active agroforestry agents' (AAA) than the percent of adoption. Therefore, the corresponding map was used to see if there was any connection between location of AAA and SARE AF projects (note: the location of the AAA and SARE AF projects was put on both maps). The most frequently referenced AAAs were: Savanna

Institute in Wisconsin, UMCA in Missouri, Cornell Small Farms in New York, and the University of Hawaii. It is noticeable (Figure 22) that the AF projects implemented with the support of SARE funding are more clustered around these organizations, including the earliest Farmer/Rancher SARE projects from the late 1990s. The clustering of several SARE AF projects from different years of implementation may point to the influence of existing AF projects as models for new projects, but more data is needed to strengthen these relationships. There is no strong visual correlation with census data on AF adoption and location of AAAs and SARE AF projects, except for Hawaii and the North East U.S.

The higher coverage of National Forests and State and Private Forests (Hewes et al., 2017; USDA Forest Service, 2006) can explain the higher rate of AFPs in the Appalachian region and Pacific Northwest, and other places. Existing vegetation as well as climate, soils, and water availability can influence AF adoption and the types of AF to be adopted, more cartographic research is needed. A geographic information system assessment of the place suitability for AF application has shown promise (Bentrup and Kellerman, 2003; Bentrup and Leininger, 2002; Ellis et al., 2000) and can also be used to correlate existing factors with current AF adoption. Finally, additional investigative research is required to probe the accuracy of the AF data gathered through the national agricultural census. Such studies can contribute to the understanding of external factors influencing AF adoption, whereas studies on AF networks will help establish evidence of diffusion.

CHAPTER 6. Discussion

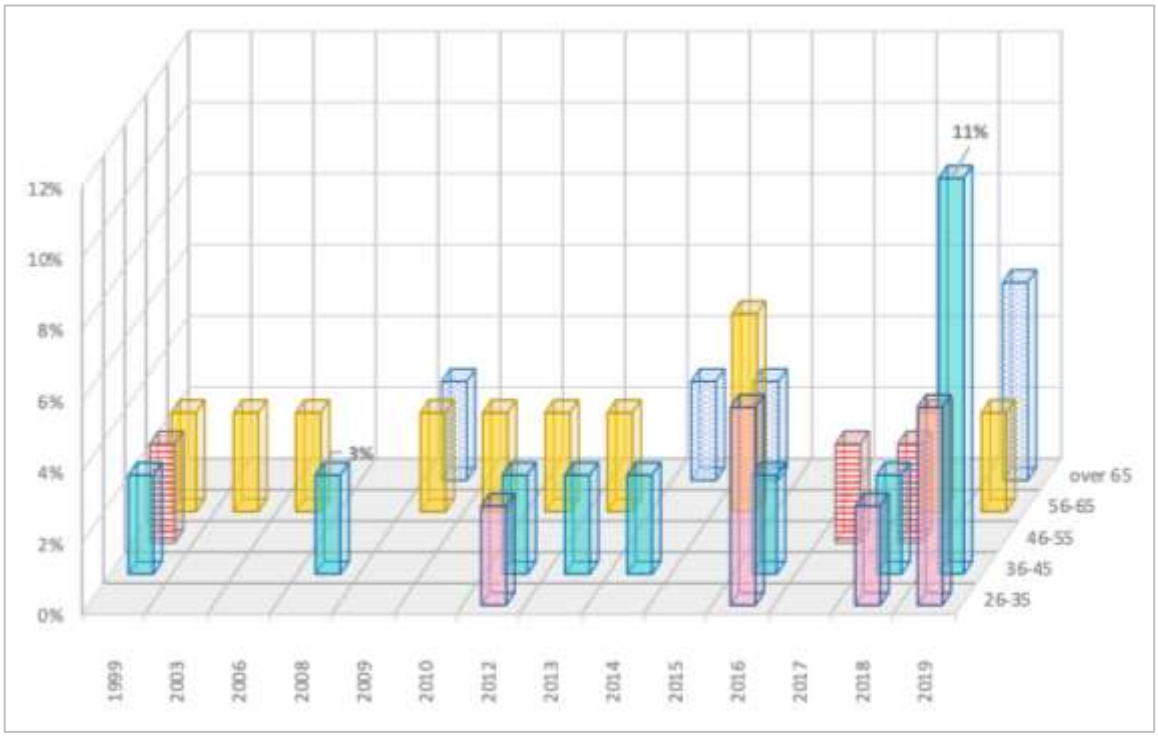
The cultural, social, economic, environmental, and political differences between developing and developed countries, as well as the different climatic conditions between tropical and temperate regions, affect AF practices (Gold and Garrett, 2009) and can similarly influence people's reasons for AF adoption. This research aimed to compare results with studies from developed countries with temperate climates.

The socio-economic profile of AF early adopters in the U.S. are primarily married adults (36-45) or older (56-65) part-time farmers with a university degree who do not come from a farm family, obtain most of their household income off-farm and have secure land tenure. This generic profile represents the majority of participants in this study. This profile is somewhat correlated with findings from other U.S. based research where practitioners of diversified farms were preponderantly young (<45 years), highly educated, showed strong participation by women (Barbieri et al., 2008), with higher off-farm income (Trozzo et al., 2014). Older farmers were associated with lower interest in AFP adoption (Dorr, 2006; Fregene, 2007; Strong and Jacobson, 2005; Valdivia and Poulos, 2009). An analysis of other research findings showed no effect of gender and age variables on AF adoption (Arbuckle et al., 2009; Matthews et al., 1993; Trozzo et al., 2014; Valdivia et al., 2009).

This study had mixed results concerning the influence of gender. More males (67%) have implemented AF project with the support of the SARE program, however, this correlates with the national male/female gender farm ratio. Additionally, interviews reflected that farm spouses are be equally involved in AFP. Moreover, the long-term temporal view of the projects by year and gender (Figures 3) shows that within the last decade more females are implementing AF projects. As one of the long-time AFP

practitioner female interviewee noted: *"It's so inspiring to see so many more women doing this* [agroforestry]*. I mean, in the old days, I was like the only woman anywhere."*

Figure 25. AF Adopters age groups by years of SARE project implementation



Socio-economic characteristics (Table 3) show that there is a clear lack of farmers under age 25 involved in AF SARE projects. This can be explained by a lower probability of this group owning land. From the current time cross-section (Figure 25), one can see that younger farmers implementing AF projects with support of SARE have increased in recent years. However, the distribution of age groups back in 1999 suggests that people who are now in the older group may have started practicing agroforestry twenty years ago, and were thus much younger than at time of this current survey. In addition, the majority of responders indicated that they practiced AF before receiving SARE grants, and many interviewees specified that they started AFPs several years before implementing a SARE project. Thus, from the temporal viewpoint, age is less relevant for AF adoption.

While age and gender do not seem to matter for early stage AF adoption, education is highly relevant with 95% of AFP early adopters having graduate or college degrees. Moreover, over a quarter of interviewees mentioned that they first learned about AF through their college education, in addition to forestry related jobs (most of which required a B.S. degree). Education supports adoption of conservation and agroforestry practices (Flower et al., 2005; Upadhyay et al., 2003). Hence, including agroforestry education, at least on the introductory level, in relevant college and graduate school programs can play a positive role for future AF adoption. The integration of agroforestry into high school agriculture science programs can also prove fruitful for future AF adoption owing to effectiveness of experiential learning for both student and teacher (Hemmelgarn et al., 2018). Valdivia and Poulos (2008) have shown that Missourians with more education were more interested in riparian buffers and forest farming, although Dorr (2006) found education level significant only for interest in silvopasture but not for windbreaks, alley cropping, riparian buffers and forest farming and Lawrence et al. (1992), publishing almost thirty years ago, found no correlation between education and AFP.

Background experiences with trees through education, line of work, or farming was a predisposing factor for getting involved in AF. A family farming background has been shown to be a characteristic for diversified farmers (Ilbery, 1991), and family or regional traditions were one of the three the most important factors influencing adoption of agroforestry systems in Europe (Rois-Díaz et al., 2018). In this study only 35% of survey respondents came from a farm family, however, some respondents indicated that trees have always been a component on their family farms, while others mentioned that even though their parents farmed conventionally, they were not interested in this type of farming.

Conservative traditions in farming can negatively impact AF adoption as current generation farmers recall the efforts of their ancestors to remove trees from farmland as part of family legacy (Raedeke et al., 2003). Considering these facts, in the U.S. it can be easier to promote AFPs to farmers who are not from a farm family background, or those who have returned to farming after having a different occupation. This study showed that most of AF early adopters (65%) do not come from a farm family, confirming results from a Virginia study on landowners interest in riparian buffers where newer owners had greater interest in multifunctional riparian buffers (Trozzo et al., 2014).

Partial farming involvement was another characteristic that was prominent for the AF early adopters with only 28% being the full-time farmers. This does not agree with findings by Carter (2001) where a relatively large proportion of diversified farmers describe their farms as being their only occupation, but concurs with Trozzo et al., (2014) where newer owners with higher incomes and less active in farming were more interested in AFPs. Part time farming interlinks with the off-farm household income, where in this study 81% respondents earned less than 40% of their household income from the farm. The alternative source of income through either personal or life partner off-farm occupations, provides a safety net from risks associated with the long-term AFP investments. Other AF adoption studies have also shown that early adopters have more financial resources (Upadhyay et al., 2003). Sustainable practices were given priority over conventional agriculture when farming was a secondary occupation and not the primary source of income (Rois-Díaz et al., 2018). Greater diversification was related to the number of days that the farmer's spouse worked off-farm (Barbieri et al., 2008).

One more noticeable factor influencing AF adoption was the land tenure. The importance of the land ownership derived not so much from statistics, with 89% owning land on average for 29 years (median 16), but more from the interview context. With SARE Farmer/Rancher grants it would be logical that participants would implement projects on their own land, although there are examples then it's not the case, plus partnership projects where one can test or introduce a practice onto partner-farmers land. However, in the majority of interviews it was evident that owning the land was essential for AF adoption and land purchase became a key point for introducing the AFPs. The reviews of AF adoption in tropical countries have shown critical role of land tenure for AF adoption (Mercer, 2004; Pattanayak et al., 2003). Research in temperate regions show similar positive associations of land tenure with adoption of tree-based practices (Borremans et al., 2016; Raedeke et al., 2003; Soule et al., 2000) and farm diversification (Anosike and Coughenour, 1990).

The rich context of the interviews helped to clarify the survey data and SARE database information regarding the similarities and 'weight' of economic and non-economic values of farming and practicing AF for early adopters. Survey data alone does not draw as clear picture as the interviews, however with open-ended questions interviews it is harder to estimate quantitative data in percent or rating. Data triangulation permitted a fuller perspective. Exploration of economic and non-economic factors within SARE project document analysis and our survey showed that non-economic and economic factors are almost equally important factors for adopting AF. The interviews enabled the researcher to further explore and deepen understandings of the farmer's priorities. The economic viability of the AFP in many cases was important and, in some cases, essential,

but it was secondary to why farmers adopt AF. In only one case, the interviewee specifically adopted AF out of financial considerations; yet, in all but one case the economic side of AF still played an important, but secondary role in adoption decisions.

The driving force for AF adoption are the internal personal factors, such as the belief in the sustainable diversified agricultural system as an alternative to the current system, desire to practice productive conservation and promote that example to others, personal gratitude gained from working with trees, and visual aesthetics. It can be argued, for example, that visual aesthetics alone do not rate high in the importance compared to other AF adoption factors, however, visual aesthetics adds to the 'power' of the internal factor theme that is the driving force behind AF adoption. At the same time, the survey permitted a comparison among importance of the different AF benefits belonging to different theme categories, where the top three benefits were wildlife habitat, indirect economic benefits, and added levels of satisfaction. Previous AF adoption studies have investigated farmers' perceptions of the positive and negative aspects of AF indicating the primary categories are economic (profitability, productivity, markets, time and labor), environmental (ecosystem services), social (next generation, animal welfare), but rarely have personal factors (primarily aesthetics) been shown to be important.

Farmers, landowners, and extension agents emphasized the importance of economic factors for AF adoption (Raedeke et al., 2003; Rois-Díaz et al., 2018), and many failed to see AFP as a viable business opportunity (Faulkner et al., 2014; Lawrence et al., 1992), as a profitable investment (Borremans et al., 2016; Graves et al., 2017; Jacobson and Kar, 2013; Tsonkova et al., 2018), or even as an efficient system (Davis and Rausser, 2020; Sereke et al., 2016). Basically, farmers were not convinced that AF benefits would

be profitable on their farms or that benefits would tend to be more important environmentally or socially nature compared to economically (Borremans et al., 2016; Tsonkova et al., 2018). Other studies on farmers, landowners, extension agents pointed to economic factors as either potential barriers that can discourage AF adoption or potential benefits that motivate AF adoption. The economic-related obstacles to wider agroforestry adoption included poorly developed markets, additional expenses, lack of financial assistance, time and labor, decline in crop-yield, complexity of work, and difficulties in mechanization (Fleming et al., 2019; Fregene, 2007; García de Jalón et al., 2018; Graves et al., 2008). The economic challenges identified by AF practitioners in this study are financial (upfront costs; increase expenses on establishment, maintenance, equipment; long period on investment return), time and labor, and undeveloped markets.

The potential economic-related benefits identified in other studies were enhanced productivity (Lawrence and Hardesty, 1992), income and land use diversification (Barbieri et al., 2008; García de Jalón et al., 2018; Lawrence et al., 1992; Lawrence and Hardesty, 1992; Mayerfeld et al., 2016; Rois-Díaz et al., 2018; Tsonkova et al., 2018; Valdivia and Poulos, 2009), and land value increase (Lawrence et al., 1992; Workman et al., 2003). Current study participants also valued direct (AFP profitability, diversifying land use and income sources, tax advantages) and indirect economic benefits (additional animal feed of high quality, increased land value, shade for livestock, quality food) of AFPs. Similar to Koontz (2001) our findings have shown that when the AF practice is neither the sole nor even important income source, then nonmonetary motivations can be a driving force. Other studies showing the primary importance of economic factors among AF adoption may be related to the fact that they targeted farmers, landowners, and extension agents in general,

whereas our study specifically targeted AF practitioners in early stages of adoption. These distinctions indicate that early adopters exhibit different characteristics and values than those from early/late majority groups. Preliminary results from the only other U.S. research (currently on-going) that directly involves AF practitioners coincide with the findings in our study. Our study also supports the findings of Decré (2019) indicating that the majority of current AF practitioners do not see monetary benefits as their primary motivation but that economic aspects are deeply intertwined with social and biophysical ones.

AF adopters in this study valued the environmental benefits of the AF system, but it was not a separate priority or highly rated motivation. Environmental benefits were linked with the benefits of productive conservation, social responsibility, aesthetics, and personal gratitude. The benefits that AF practitioners valued were related to healthy ecosystems and ecosystems services. A holistic approach to land management connects to healthy ecosystem values, where farming as land stewardship can be done sustainably, producing healthy crops and a healthy planet. This holistic approach to agricultural land management was not mentioned in other studies on AF adoption, but the idea of AF as productive conservation has been found viable among landowners in Illinois (Stanek and Lovell, 2019).

Other environmental benefits were linked with ecosystems services: biodiversity conservation and wildlife habitat, climate change, soil improvement, water quality, wind and fire protection. AF farmers in Europe also valued an improved environment, shelter for animals and birds, nature conservation, and enhanced environmental services (wind protection, prevention of water erosion and fire) (Rois-Díaz et al., 2018). Our study, combining SARE project document analysis, surveys, and interviews, consistently

revealed a high emphasis given to biodiversity and wildlife components. That said, it needs to be pointed out that these were not the primary factors motivating adoption. Improved biodiversity and wildlife habitats were seen as the main positive aspects in areas of Europe where agroforestry is linked with strong cultural values toward nature and trees (García de Jalón et al., 2018). The importance of biodiversity and wildlife habitat to farmers (Sereke et al., 2016), extension professionals and landowners (Workman et al., 2003) provides a solid basis for AF promotion to wider range of people. Soil conservation was another highly rated AFP ecosystem service benefit in our study, similar to extension agents and landowners in Alabama (Workman et al., 2003) and farmers practicing (silvoarable) alley cropping in Europe (García de Jalón et al., 2018). The topic of climate change mitigation and adaptation was noted in our study findings, with participants describing AFP as "*way to accomplish conservation on working farms"* and sequester carbon. The potential benefit from increase trees establishment was linked to participants hoping to receive the payments for ecosystem services (PES) in the future. The findings by Sereke et al. (2016) indicated that PES alone does not change farmers' behavior.

According to our findings, environmental factors like soil conditions, climate, location can also be viewed as limiting factors for AF adoption depending on geographic location. For example, in arid climates while some farmers may be encouraged to introduce drought-resistant woody perennials for animal feed purposes, others may be dissuaded from introducing trees on farm that require irrigation for establishment. Preexisting vegetation was one of the most common land characteristics that influenced the decision to adopt AF, thus promoting AFP to landowners with forested land shows promise.

Tsonkova et al. (2018) have found that farmers with conventional agriculture are willing to plant AF on marginal lands which is otherwise unprofitable. Our study showed that AF early adopters were less skeptical as to the profit potential of AFPs, 22% introduced AFP on their best soils and only 14% on marginal soils. The highest percentages were from farmers who owned forested lands (33%) and those with soils having only with moderate limitations (31%) for arable cultivation.

The environmental factors that impact plant establishment (climate, soils, wildlife, weeds, pests, plant stock) was among most often referenced challenges faced during AFP introduction. Interviews helped to clarify that the emotional impacts of plant failure (disappointment, devastation, heart ache) on farmers can be as discouraging as the financial costs of replanting. The financial costs of tree establishment and management were found to have negative effects on interest in AF (Fregene, 2007; Lawrence et al., 1992; Valdivia et al., 2012).

In the current study social factors influencing AF adoption included such concepts as 'future generations', 'legacy', and 'animal welfare'. Other temperate climate AF adoption studies also reflected the influence of social factors such as landscape value (Borremans et al., 2016), future generations (Sereke et al., 2016; Valdivia and Poulos, 2009), or needs for social connections, keeping the farm in the family, and farm diversification (Barbieri and Mahoney, 2009). In contrast, Fregene (2007) did not find attitudinal factors of 'trees for future generations and for scenic beauty' to be significantly associated with interest in AF adoption. In Washington state the most frequent motives for owning land were passing land on to children (Lawrence et al., 1992). Planting trees for future family generations can become a potential obstacle if there are no obvious successors

to continue working the farm (Sereke et al., 2016). Of interest is the fact that the majority of AF early adopters in our study were not sure (67%) if anyone in their family will continue farming but were extremely interested (51%) in their farms continuation regardless. This suggests the opportunity to develop apprenticeship and matching programs to sustain AF practices continuation. Using AF for animal health and welfare were found to be valued more for the social aspects than as shade for improved animal production, although the latter was also appreciated. Socials aspect of animal health and welfare (less stress, better quality feed) were seen as the main positive aspects in European AF systems (García de Jalón et al., 2018; Rois-Díaz et al., 2018; Sereke et al., 2016), and also stressed by farmers and agricultural professionals in southwest Wisconsin (Mayerfeld et al., 2016).

Finally, the AF knowledge and information availability were influencing factors for AF adoption. Lack of local and regional information and AF demonstration farms, lack of expertise and guidance for establishing AFPs, and lack of shared knowledge were often mentioned in SARE project documents, surveys, and interviews and found to be influential on AF adoption. Among other information resources, 'visiting a farm that utilizes AF' and 'training and demonstrations' were rated as the most influential. This supports findings of other studies where low familiarity with AF correlated with low intention to engage in AF (Borremans et al., 2016). Access to and quality of information had a positive impact on interest in AF (Prokopy et al., 2008; Valdivia and Poulos, 2009). Knowledge of existing successful practices was a positive driver for the uptake of agroforestry practices (Rois-Díaz et al., 2018), while lack of active agroforestry demonstration sites, and lack of technical assistance and educational support were major barriers for AF adoption (Faulkner

et al., 2014; Jacobson and Kar, 2013; Lawrence et al., 1992; Lawrence and Hardesty, 1992; Valdivia et al., 2012; Workman et al., 2003).

For farmers in this and other studies, first hand evidence (experimental results and real sites) was required to consider AF and make a well-informed decision (Graves et al., 2008; Mayerfeld et al., 2016). Strong and Jacobson (2005) found that information was more valuable than financial support for AF adoption in Pennsylvania.

The importance of information access in this and other studies supports the idea behind DIT where communication channels play an essential role in the innovation diffusion. While other studies mainly explored farmers and landowners channels of communication, our study specified preferences of AF practitioners. Additionally, this study separated importance of the information sources at different stages of adoption into: initial sources of AF information, sources used to learn more about AF, those currently found most useful, and those most influential to apply AF on the land. The importance of different channels fluctuated depending on the stage of adoption, however cumulatively the top five information sources about AF were, in descending order: print-based publications, AF farm visits, training or demonstration, computer media, and extension agencies.

Interviewees placed the highest emphasis on farmer-to-farmer communication and publications. Borremans et al. (2016) and Fregene (2007) showed that agricultural journals were the most popular source for farmers and landowners to learn about tree management and AF, while knowing someone using practices increased the probability of adoption by 3.5 times (Fregene, 2007). Our study shows that majority (61%) of survey participants knew another AF practitioner prior implementing AF project supported by SARE.

The exploration of the AF adoption timeline provides a deeper understanding into AF adoption. After discovering initial information about AF, those interested strive to learn more through available resources. Initially, this can include indirect mass communication publications and on-line resources along with direct interpersonal communication channels such as extension agents and event participation. Later on, interpersonal communication with other farmers and visiting working AF farms becomes essential for AF adoption decisions. These findings correlate with Rogers (2003) DIT where mass media communication are usually the most rapid and efficient means of increasing awareness about innovation, but interpersonal channels are most influential for personal decisions on adoption.

Another contribution from our study explaining AF diffusion and low rates of adoption comes from the temporal evaluation of adoption that explored AF practitioner's innovation-decision process. In general, the steps on the timeline to AF adoption are in line with stages suggested by Rogers in the DIT, but they are not always linear, and people may start experimenting or practicing AF without prior knowledge about it. According to DIT this could partially be explained by the adventurous characteristics of innovator adopters. Our study shows that it is more likely due to the fact that AF appeals to AF early adopters moral and personal views and attitudes.

The current low rates of AF adoption can be explained. First, due to the lack of specific information in different geographic regions and for specific practices. Second, the limited AF knowledge of extension agents (with exceptions in specific regions). Third, the long period of AFP establishment prior to returns on investment which results in longer innovation-decision periods (IDP) and implementation to confirmation periods (ICP).

The average innovation-decision period (IDP) for SARE case study interviewees was 2.6 years. That IDP is short compared to some agricultural innovations which do not involve long-term woody crops, e.g., 2.5 years for innovators and 1.2 years for early adopters for IDP of corn silage as forage (Harhash et al., 2012), 5 years for IDP of vermiculture technology (Latika, 2012), 2.1 years for weed spray (Beal and Rogers, 1960). According to Rogers (2003) in a strict sense IDP should be measured from initial knowledge to the time of confirmation, but such measurement is impractical because that stage may continue or end at an indefinite period of time, and, thus is usually measured until the stage of adoption decision. This study suggests that it would be more practical to use the period from implementation to confirmation (ICP) stage to account for the AFPs longer period of establishment involving perennial and woody species. The average ICP for the SARE case study was 5.7 years.

Although it is hard to generalize due to high variability of AFPs, where berry shrubs can reach full production much earlier than trees (especially of trees managed for timber). In addition to IDP, ICP can be more a practical way to explain the slower rate of AFP diffusion in the U.S. due to the perennial nature and longer time needed to realize expected outcomes for AFPs.

It could be argued that given the variety of potential AFP practices, the time period from establishment to production can vary drastically. In such cases ICP should be measured separately for each type of practice. Given that the SARE case study covers over 20 years of AFP practitioners' experiences, it should be noted that many interview participants started with one type of AFP but switched or adjusted or amended it with another AFP, thus measuring IDP and ICP by practice was problematic.

While it is impossible to change the woody perennial agricultural system establishment period, it is possible to improve on the specific required information availability and extension capacity. Jacobson and Kar (2013) argued that more local studies and more training on agroforestry technologies would better equip the extension professionals who are essential links to widespread adoption of AFPs. Natural resource professionals were shown to be important sources of AF information for farmers and landowners in several studies (Lawrence et al., 1992; Lawrence and Hardesty, 1992; Mayerfeld et al., 2016; Pattanayak et al., 2003; Stutzman et al., 2019; Workman et al., 2003). A personalized collaborative design process between farmers and AF professionals was found to be most preferential by landowners (Stanek and Lovell, 2019). These authors indicated that a personal approach leads to deeper understanding of benefits, helps to develop personalized solutions integrating AFP, that, overall, leads to a higher probability of AF adoption even without financial assistance. To ensure AF uptake, our findings support the recommendations given by Strong and Jacobson (2005) who proposed "the creation of a statewide multidisciplinary team comprised of university, non-profit association and landowner representation, to develop agroforestry applications relevant to each cluster and promote the practices through landowner-led on-farm demonstrations and workshops." Without local examples and practitioners, extension agents can't have the same influence as those who apply AF on their land.

Agroforestry early adopters desire and capability to teach about sustainable agriculture systems and share knowledge and experience plays a substantial role in further dissemination of AFPs. As was discussed in the interview findings, many SARE case study participants have learned from other AF practitioners and consider the farmer-to-farmer

information channel as one of the most efficient. Their desire to educate others and provide an example, helps diffuse AFP adoption. This is based on information gleaned from interviewees as well as survey results where 57% responded knew that their SARE AF project influenced others to adopt AFPs.

Additionally, there may be other AF adopters who visited the demonstration project whose subsequent actions were unknown to SARE case study participants. PTFarmer-M7 shares: *"I get a lot of visitors who come take tours. And, you know, I never know that they actually do this. I've actually, I've had influence on the local community college, I help them to start an agroecology program with the agroforestry component. And, so, the students actually come and work at my farm, I run a bunch of classes with them … I get to influence a bunch of students each year."* Some of those students who have inner drive and interest in AF may in time adopt AF on their land. More research is needed to explore the AF diffusion process.

The inductive approach of this study adds to diffusion of innovation theory as it applies to AFP dissemination. First, through showing that AF early adapters differ in their motives to adopt AF as well as in their socio-economic and demographic characteristics compared to the larger population. Second, results support the importance of different types of information channels at different stages of adoption. Third, our study explored the AF practitioner adoption timeline in conjunction with the innovation-decision process.

Even though economic gain was identified as the primary motivating factor in the adoption of agroforestry in the U.S. and shown to have high correlation with interest in AFP adoption (Fregene, 2007; Raedeke et al., 2003; Rois-Díaz et al., 2018), it was not the primary motivation for AF early adopters in this study. In contrast to Fregene (2007)

findings that attitudinal factors do not significantly influence interest in AF adoption, current research shows that personal attitudes and values matter the most for introducing sustainable practices. This separates the general farm and landowner population from AF early adopters. The internal driving factors such as desire to practice and promote productive conservation distinguish the AF early adopters group from the population at large. According to DIT, further diffusion of AFPs to a wider group of early adopters who have achieved economic viability and environment sustainability, would help to bridge the gap and successfully reach early majority adopters.

In an Australian study of farmers and farm advisors perceptions of AF, the authors apportion them into three groups based on three major themes: (1) those who value economic perspective of trees, (2) those who do not see trees as viable economic alternative to conventional farming, and (3) those who consider trees essential beyond their economic aspects (Fleming et al., 2019). The latter groups portray similar characteristics and values to the AF early adopters in our current study indicating that there is a potential for promotion of AF adoption to a wider population. The particular similarities are in the themes reflecting on personal views: philosophy, legacy, environment, biodiversity, aesthetics, beauty and contribution. Specifically, in both cases, this group of people value the sense of well-being, quality life, and satisfaction from seeing the results and realization of contribution to ecosystem health and future generations. The groups are also alike in such socio-economic characteristics as having education, a work history and some income stream outside of farming, and therefore are motivated to farm more for personal enjoyment and satisfaction. Considering results from current study and Sereke et. al. (2016) showing that profitability of trees is not the main motivation for AF adoption, and results

from other studies that indicate the economic aspect prevalence for the majority of farmers (Fregene, 2007; Garrett, 1997; NARC&DC, 2000; Zinkhan and Mercer, 1996) the three groups identified by Fleming et al. (2019) can be put into categories from the DIT perspective. Specifically, apprise innovators and early adopters as those who consider trees essential no matter their economic attributes, the majority groups as those that value trees economically, and laggards as those who do not see planning trees on farms as economically viable.

DIT attributes that influence the rate of adoption need to show the relative advantage of the new practice, be compatible with values, beliefs, and needs, be relatively easy for understanding and use, easy to try out, and be observable. This can be developed through further obtaining farm-, practice-, and climate-specific research knowledge, developing AF capacity of local extension, and building up network of demonstration farms. However, DIT does not discuss the individual's resources or social support to adopt the new innovation, which was shown to be substantial in this and other studies.

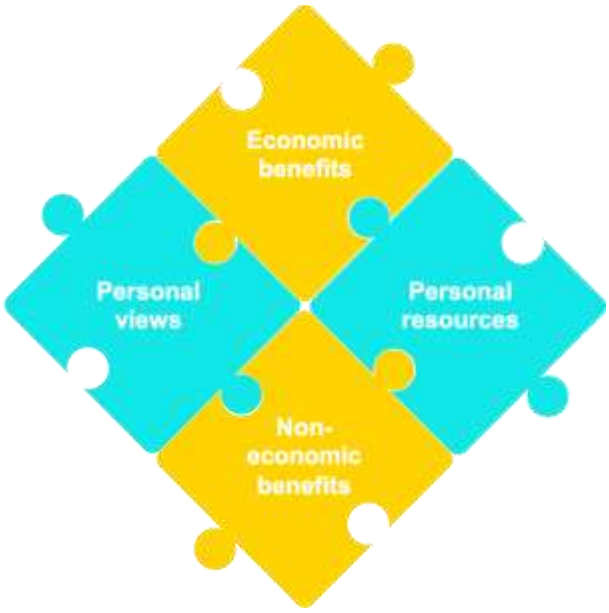
Relevant policy development to overcome those difficulties are needed. Currently, however, next steps in AF promotion can be focused on targeting farmers and landowners who have similar characteristics and values with AF early adopters. This would allow for the establishment of a wider network of locally available demonstration sites, develop a bigger base of AF practical on-farm knowledge, and create success stories of economically viable environmentally sustainable enterprises. Taken together, this would influence and motivate farmers and landowners from other ‘adopters’ groups and help to bridge the gap between early adopters and the early/late majority. To increase the numbers of AF early adopters, the information message about AF should not only contain information on

economic and environmental benefits but also appeal to inner drivers that motivate AF adoption. Specifically, stories about satisfaction of being involved in productive conservation, being advocate of positive change, and those that emphasize gratification and quality life from working with trees while managing healthy agricultural ecosystem, and joy from a diverse landscape that supports wildlife. Note that such messages have to include messaging on the economic viability of the AFP, covering financial prospects of income from AFP, including enough detail on establishment and management expenses in addition to all other non-monetary benefits.

CHAPTER 7. Conclusions

The tabletop of the agroforestry adoption sits on the four intertwining legs of the factors influencing adoption, schematically depicted on Figure 26. Personal views include internal factors such as personal beliefs, attitudes, and aesthetics. Personal resources include individual and farm attributes, such as education, background, income sources, land tenure, and farm vegetation. Economic benefits include direct and indirect financial gain, whereas non-economic benefits include environmental and social contributions. The influential force of each of the 'leg' can differ for different adoption groups, although they all are important for AF adoption and promotion. For AF early adopters, personal views are more influential and drive adoption, while economic benefits might be more important for early and late majority groups.

Figure 26. The intertwining parts of AF adoption



Given the current early stage of AF adoption, more practitioners need to be involved to set the stage for wider adoption by majority groups. Hence, to promote further AF adoption, relevant agencies need to promote AF messages to targeted groups of people who share similar traits with AF early adopters. The recommended strategy for AF adoption agents would be to provide AF information and involve groups of landowners and part-time farmers who value productive conservation and enjoy landscapes with trees. Targeted messaging should include information not only on economic and non-economic

benefits of AF adoption but also relate to personal values. Highlighting personal gratification from working with trees and teaching others sustainable ways of living can help motivate adoption decisions. AF information should address the deficiencies identified in this research including lack of local climate and practice specific 'recipe-like' AFPs, lack of local demonstration sites and regional conferences, and lack of available financial resources. More effective policies need to be developed to provide financial assistance for the up-front costs of AFP on-farm introduction.

At present, the most efficient channels available to reach potential AF adopters are book- and manual-style publications, AF events with trainings and demonstrations, and farmer-to-farmer communication. Both, direct interpersonal and indirect mass communication channels should involve the experience and expertise of current AF practitioners. Improving extensions AF capacity would be very beneficial for promoting regional AF. AF agents should also strive to facilitate networking among farmers, landowners, AF practitioners, researchers, and businesses.

Spatial and temporal aspects are important to obtain a better understanding of AF adoption and diffusion in the United States. This study has taken the first steps in these directions. AFP adoption is a long-term process lasting from two years to over a decade. It would be beneficial to start longitudinal research on different types of AFPs and develop more studies that incorporate temporal aspects of AF adoption. More research is also needed to gain a better understanding of the spatial aspects of AF adoption. It would be desirable to conduct a special study within the U.S. Agricultural Census on AFPs or at least expand the Census to include more AFPs questions within the regular agricultural census. It would be essential to specify the four "i"s of AF (intentional, intensive, integrated,

interactive) in the census definition section. More in-depth research is required to explore AF adoption in different states and the influence of existing AF sites and AAAs on AF diffusion.

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APPENDICES

Appendix A.

Agroforestry Early Adopters Survey: SARE case study - Final

Survey Flow

Block: Introduction (1 Question)
Standard: I. GENERAL (11 Questions)
Standard: II. REASONS AND ATTITUDES (10 Questions)
Standard: III. COMMUNICATION, NETWORKS, AND INFLUENCE CAPACITY (18 Questions)
Standard: IV. RESOURCES: FARMS AND FARMERS (19 Questions)
Standard: V. SOCIO-DEMOGRAPHICS (7 Questions)

Start of Block: Introduction

Intro **Agroforestry Early Adopters Survey: USDA SARE Case Study**

The purpose of this survey is to follow-up with farmers and ranchers involved in the implementation of agroforestry projects supported by the USDA SARE program to evaluate if those practices are still in use, expanded, or abandoned and to determine the reasons behind those decisions. This survey aims to gather the information that can help us to understand who is most likely to adopt agroforestry practices and for what reason, and to learn more about farmers' preferred information sources, communication channels, and support systems. By completing this survey, your feedback about challenges and opportunities you have encountered doing agroforestry will help programs like SARE improve their ability to support farmers and ranchers, to construct effective messages and to employ efficient channels of communication to distribute agroforestry information in order to promote its wider adoption. Your participation in this survey is entirely voluntary, by clicking next [-->] button you agree to participate in the survey. You may refuse to take part in the research and are free to decline to answer any particular question you do not wish to answer for any reason. No names or identifying information would be included in any publications or presentations, and your responses to this survey will remain confidential; only aggregated results will be shared. The survey link is personalized and should not be shared.

Thank you for your participation in this survey!

End of Block: Introduction

Start of Block: I. GENERAL

I.1. **What type of SARE grant agroforestry project were you involved in?**

- ❒ Farmer/Rancher (direct project implementor)
- ❒ Partnership (through a partner organization, as cooperator)
- ❒ Both
- ❒ Other, please specify _____

I.2. **In which region, state or territory were you involved in a SARE project?**

Region (1)

State/Territory (2)

- ❒ North Central (Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, Wisconsin)
- ❒ North East (Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, West Virginia)
- ❒ South (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Oklahoma, Puerto Rico, South Carolina, Tennessee, Texas, U.S. Virgin Island, Virginia)
- ❒ West (Alaska, American Samoa, Arizona, California, CNMI, Colorado, FSM, Guam, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, Wyoming)

I.3. **What year did you receive your SARE grant for your agroforestry project and for what duration (12, 18, 24 months, etc.)?** (*If you participated in more than one SARE agroforestry project, please indicate the data for the first and the most recent projects).*

	(year of start for the first SARE agroforestry project)
	(project duration in months)

	(year of start for the most recent SARE agroforestry project)
	(project duration in months)

I.4. **What is the status of your <u>earliest</u> SARE agroforestry project?**

- ❒ the project is still on-going
- ❒ the project is completed

Skip To: I.8. If What is the status of your earliest SARE agroforestry project? = the project is still on-going
Skip To: I.5 If What is the status of your earliest SARE agroforestry project? = the project is completed

I.5 **For completed projects, the agroforestry practice/system is:**

- ❒ Not managed or does not exists anymore and does not bring benefits
- ❒ In passive use (not actively managed but brings some benefits)
- ❒ Modified and in passive use (has been modified after project completion, but not actively managed currently)
- ❒ Modified and in active use (has been modified after project completion and is still in active management)
- ❒ In active use, same it was set up initially (actively managed and provides benefits)
- ❒ Other, please specify _____

Display This Question:
If For completed projects, the agroforestry practice/system is: = Modified and in active use (have been modified after project completion and still in active management)
Or For completed projects, the agroforestry practice/system is: = In active use, same it was set up initially (actively managed and provides benefits)
Or For completed projects, the agroforestry practice/system is: = Other, please specify

I.6. **Please describe your main reasons for continuing active use of the agroforestry practice(s)?** *(This question is essential for helping us understand what motivated you to continue using agroforestry practices. Please take your time to elaborate on your answer.)*

_____
_____

_____
_____
_____

Display This Question:
If For completed projects, the agroforestry practice/system is: = Not managed or does not exists anymore and does not brings benefits
Or For completed projects, the agroforestry practice/system is: = In passive use (not actively managed but brings some benefits)
Or For completed projects, the agroforestry practice/system is: = Modified and in passive use (have been modified after project completion, but not actively managed currently)

I.7. **Please describe your main reasons for discontinuing the active use of the agroforestry practice(s)?** *(This question is essential for helping us understand what lead you to discontinue agroforestry practices.* Please take your time to elaborate on your answer.*)*

_____
_____
_____
_____
_____

I.8. *Your answer to the following questions is very important to understand the challenges that you have faced while implementing agroforestry practice(s). Please take your time to elaborate on your answer.*

I.8.a. **What difficulties if any, did you face in establishing your agroforestry project?**

_____
_____
_____
_____
_____

I.8.b. **What changes, if any, did you need to make to the project in order for it to work on your farm?**

_____
_____
_____
_____
_____

I.8.c **What difficulties, if any, do you still have with your agroforestry practices?**

_____
_____
_____
_____
_____

End of Block: I. GENERAL

Start of Block: II. REASONS AND ATTITUDES

II.1. **Farming brings both monetary and non-monetary benefits. In your farming operation, how would you rate the importance of the following priorities?**

	Extremely important	Very Important	Moderately important	Slightly important	Not at all important
Earning income via farming business	❒	❒	❒	❒	❒
Non-economic values (scenic beauty, recreation, nature, etc.)	❒	❒	❒	❒	❒

II.2 *This question refers specifically to the agroforestry practices on your farm, not your farm as a whole.* **How important for you are the following values and benefits of the agroforestry practices you are using?**

	Extremely important	Very Important	Moderately important	Slightly important	Not at all important
direct economic benefits (e.g., additional income via fruit/nut/wood production, improved livestock production, etc.)	❒	❒	❒	❒	❒
indirect economic benefits (e.g., to improve soil quality that allows an increase in main crop yield, wind protection of main crop/livestock)	❒	❒	❒	❒	❒
improved appearance of the land (e.g., aesthetic purposes)	❒	❒	❒	❒	❒
Alleviation of environmental problem(s) on the land you own, farm or manage (e.g., flood protection, prevent soil erosion, etc.)	❒	❒	❒	❒	❒
as future investment for me, my children, grandchildren	❒	❒	❒	❒	❒
for conservation purposes	❒	❒	❒	❒	❒
for public good					
for wildlife habitat	❒	❒	❒	❒	❒
for recreational opportunities					
provides an added level of satisfaction for my work	❒	❒	❒	❒	❒
provides quality produce for me and my family consumption	❒	❒	❒	❒	❒

Other, please specify _____ _____	❒	❒	❒	❒	❒

II.3. **Where did you implement agroforestry practice on the land you own, farm, or manage?** *(mark all that apply)*

(mark all that apply)

❒ On already forested areas
❒ On the best soils where cultivation of commodity crops has no or slight limitations
❒ On soils with moderate limitations that restrict their use for cultivation
❒ On marginal soils that have severe limitations that reduce the choice of plants

Display This Question:
If Where did you implement agroforestry practice on the land you own, farm, or manage?(mark all that... = On marginal soils that have severe limitations that reduce the choice of plants

II.4. please clarify limitations *(mark all that apply)*:

❒ degraded soils (overuse, lack of nutrients, contamination, etc.)
❒ highly erodible soils (steep slopes, crevasse, ditches, etc.)
❒ limiting soil structure (rocky/clay composition, hardpan, compaction)
❒ often flooded
❒ other, please specify _____

II.5 **How influential the following characteristics of the land you own, rent, or manage were on your decision to adopt agroforestry?**

	very strong influence	strong influence	moderate influence	slight influence	no influence
Limitations of the soil	❒	❒	❒	❒	❒
Land location	❒	❒	❒	❒	❒
Land area/ acreage	❒	❒	❒	❒	❒
Already existing vegetation	❒	❒	❒	❒	❒
Other, please specify _____ _____	❒	❒	❒	❒	❒

II.6. **<u>At the time of implementation of your SARE</u> agroforestry project please indicate the level of severity of the following issues on the land you farmed**

	Extremely serious problem	very serious problem	somewhat serious problem	minor problem	not a problem
Soil erosion caused by wind	❒	❒	❒	❒	❒
Soil erosion caused by water	❒	❒	❒	❒	❒
Agricultural runoff	❒	❒	❒	❒	❒
Stream bank erosion	❒	❒	❒	❒	❒
Surface water quality	❒	❒	❒	❒	❒
Loss of wildlife habitat	❒	❒	❒	❒	❒
Flooding	❒	❒	❒	❒	❒
Loss of trees	❒	❒	❒	❒	❒
Unwanted woody growth	❒	❒	❒	❒	❒
other, please specify _____	❒	❒	❒	❒	❒
other, please specify _____	❒	❒	❒	❒	❒

II.7. **Did any of the biophysical problems listed in the previous question influence your decision to introduce an agroforestry practice?**

	No, I did not view agroforestry as a solution to this problem	Yes, I viewed agroforestry as a way to mitigate this problem
Soil erosion caused by wind	❒	❒
Soil erosion caused by rain/snow melt	❒	❒
Agricultural runoff	❒	❒
Stream bank erosion	❒	❒
Surface water quality	❒	❒
Loss of wildlife habitat	❒	❒
Flooding	❒	❒
Loss of trees	❒	❒
Unwanted woody growth	❒	❒
other, please specify _____	❒	❒

End of Block: II. REASONS AND ATTITUDES

Start of Block: III. COMMUNICATION, NETWORKS, AND INFLUENCE CAPACITY

III.1. **How did you learn about agroforestry for the first time?** *(mark all that apply)*

- ❒ through printed information (magazine, journal, brochure, etc.)
- ❒ from a non-farmer friend
- ❒ from a farmer friend
- ❒ through computer media (e.g. networks, websites, videos, webinars, podcasts)
- ❒ attending a training or demonstration
- ❒ touring or visiting a farm that utilizes agroforestry
- ❒ from a university faculty/staff or extension agent
- ❒ outreach/extension from government agency (e.g., Department of Conservation, Nature Resource Conservation Service, National Agroforestry Center, etc.)
- ❒ outreach/training from a non-governmental organization (e.g., Savanna Institute, Appalachian Forest Farmer Network, etc.)
- ❒ participation or membership in an organization that works with agroforestry, please specify _____
- ❒ other, please specify _____

III.2. **What sources did you use to learn more about agroforestry after you first learned about it?** *(mark all that apply)*

- ❒ printed information (magazine, journal, brochure, etc.)
- ❒ non-farmer friend
- ❒ farmer friend
- ❒ computer media (e.g. networks, websites, videos, webinars, podcasts)
- ❒ attending a training or demonstration
- ❒ touring or visiting a farm that utilizes agroforestry
- ❒ university faculty/staff or extension agent
- ❒ outreach/extension from government agency (e.g., Department of Conservation, Nature Resource Conservation Service, National Agroforestry Center, etc.)
- ❒ outreach/training from a non-governmental organization (e.g., Savanna Institute, Appalachian Forest Farmer Network, etc.)
- ❒ participation or membership in an organization that works with agroforestry, please specify _____
- ❒ other, please specify _____

III.3. **Who or what influenced you the most to apply agroforestry on the land you own, farm, or manage?** *(Choose top 3 or more and rank them, with 1 as most important)*

Source	Rate
❒ printed information (magazine, journal, brochure, etc.)	
❒ computer networks, websites, videos, webinars, podcasts	
❒ non-farmer friend	
❒ farmer friend	
❒ attending a training or demonstration	
❒ visiting a farm that utilizes agroforestry	
❒ University faculty/staff or extension agent	
❒ outreach/extension from government agency (e.g., Department of Conservation, Nature Resource Conservation Service, National Agroforestry Center, etc.)	
❒ outreach/training from a non-governmental organization (e.g., Savanna Institute, Appalachian Forest Farmer Network, etc.)	
❒ participation or membership in an organization that works with agroforestry, please specify _____	
❒ other, please specify _____	

III.4.a. **What sources of information about agroforestry do you <u>currently</u> find most useful?** *(Rank up to 5, with 1 as most important)*

Source	Rate
❒ printed information (magazine, journal, brochure, etc.)	
❒ computer networks, websites, videos, webinars, podcasts	
❒ non-farmer friend	
❒ farmer friend	
❒ attending a training or demonstration	
❒ visiting a farm that utilizes agroforestry	
❒ University faculty/staff or extension agent	
❒ outreach/extension from government agency (e.g., Department of Conservation, Nature Resource Conservation Service, National Agroforestry Center, etc.)	
❒ outreach/training from a non-governmental organization (e.g., Savanna Institute, Appalachian Forest Farmer Network, etc.)	
❒ participation or membership in an organization that works with agroforestry, please specify _____	
❒ other, please specify _____	

Display This Question:
If What sources of information about agroforestry do you currently find most useful? (Rank up to 5... [computer networks, websites, videos, webinars, podcasts] Is Not Empty

III.4.b. **When you use the internet, which of the following sources of agroforestry-related information do you find most useful?** *(Rank up to 5, with 1 as most important)*

On-line source	Rate
❒ Website text descriptions with photo and/or graphics	
❒ Website text descriptions without photo and/or graphics	
❒ Instructional Videos	
❒ Webinars	
❒ Podcasts	
❒ Facebook	
❒ Instagram	

❒ on-line journal or magazine	
❒ on-line forum, discussion platforms	
❒ other, please specify _____	
❒ other, please specify _____	

III.5. **Please list any agriculture, forestry or conservation magazines you currently subscribe to? Include online subscriptions, mailing lists.** *(Then, please rank order of importance or usefulness for informing your decisions about farming with 1 as most important).*

Magazine or Mailing Lists	**Order of Importance**
❒	
❒	
❒	
❒	
❒	

III.6. **How interested were/are you in being a member of a group of farmers and/or landowners who have similar interests?**

Time period	Extremely interested	Very interested	Moderately interested	Slightly interested	Not interested at all
At the time of implementation of your SARE agroforestry project	❒	❒	❒	❒	❒
At the present time	❒	❒	❒	❒	❒

III.7.a. **Please indicate, in order of importance, the top three groups you are currently seeking advice from for agroforestry related questions.** *(Choose top 3 or more and rank them, with 1 as most important)*

Source	**Rate**
Landowners/ farmers who have experience with agroforestry	
Landowners/ farmers who have experience with relevant question (pests, timber, soil, etc.)	
University faculty/staff or extension agent	
Outreach/extension from government agency (e.g., Department of Conservation, Nature Resource Conservation Service, National Agroforestry Center, etc.)	
Staff from non-governmental organization (e.g., Savanna Institute, Appalachian Forest Farmer Network, etc.)	
Staff or members of an organization that works with agroforestry, please specify	
Members of on-line community that works with agroforestry, please specify	
Other, please specify	

III.8. **How important are the following groups in forming your decisions about farming?**

	Importance in forming decisions				
institutions/organizations	Extremely important	Very important	Moderately important	Slightly important	Not at all important
Your family (those who live with you)	❒	❒	❒	❒	❒
Your neighbors	❒	❒	❒	❒	❒
Other farmers whose farms you have visited	❒	❒	❒	❒	❒
Other farmers who share their experience on-line, but whom you haven't visited yourself	❒	❒	❒	❒	❒

Outreach/extension from government agency (e.g., Department of Conservation, Nature Resource Conservation Service, National Agroforestry Center, etc.)	❒	❒	❒	❒	❒
Staff from non-governmental organization (e.g., Savanna Institute, Appalachian Forest Farmer Network, etc.)	❒	❒	❒	❒	❒
University faculty/staff or extension agent	❒	❒	❒	❒	❒
Farm, forestry, livestock, horticulture, conservation-related or similar organizations you belong to, please specify _____	❒	❒	❒	❒	❒
Local civic organizations (e.g. Elk, Lion's Club, Rotary club, VFW, etc.) you belong to, please specify _____	❒	❒	❒	❒	❒
Other, please specify	❒	❒	❒	❒	❒

III.9.a. **Prior to the SARE funded project did you practice agroforestry?**

❒ No
❒ Yes

Display This Question:
If Prior to the SARE funded project did you practice agroforestry? = yes

III.9.b. **On how many acres?**

_____

III.10. **How many acres were put into agroforestry practices during the SARE funded project?**

_____

III.11. **How many additional acres were put into agroforestry practices after the SARE funded project ended?**

_____

III.12. **Did/do you know anyone in your state or who lives close by who has applied any of the agroforestry practices?**

Time period	Yes	No
Prior to implementation of your SARE funded project	❒	❒
At the present time	❒	❒

III.13. **Do you think the SARE agroforestry project that you were part of has influenced others to adopt the agroforestry practice?**

❒ yes
❒ no
❒ I don't know

III.14. **Do you know anyone who specifically adopted an agroforestry practice after visiting the land you farm, own, or manage?** *(it doesn't have to be the only reason they adopted the practice, but something that might have influenced the decision)*

- ❒ yes
- ❒ no
- ❒ I don't know

III.15. *If you have any comments regarding questions on this page, please write them here*

_____
_____
_____
_____
_____

End of Block: III. COMMUNICATION, NETWORKS, AND INFLUENCE CAPACITY

Start of Block: IV. RESOURCES: FARMS AND FARMERS

IV.1. **Did the agroforestry project you implemented with SARE funding help you to do the following?**

- ❒ introduce a practice new to your farm
- ❒ test a practice you had already started
- ❒ improve a practice you were already implementing
- ❒ expand a practice you had already implemented
- ❒ other, please specify _____

IV.2. **How important was the SARE grant for you to introduce or test an agroforestry practice?**

- ❒ it was important: I would not have done it without the grant
- ❒ it was not important: I would have done it regardless, but I appreciated the SARE support
- ❒ other, please specify

IV.3.**What best describes your <u>current</u> involvement with agriculture?**

- ❒ Full-time farmer
- ❒ Part-time farmer
- ❒ Landowner living on the land but not farming the land
  If marked:
  Do you lease the land?
  - ❒ No
  - ❒ Yes
- ❒ Landowner living away from the farm
  If marked:
  - ❒ farm the land partially (living not far)
  - ❒ lease out the farm
  - ❒ both
  - ❒ none of the above
- ❒ Farm manager - not landowner
- ❒ Other, please specify _____

IV.4. **What best describes your involvement with agriculture <u>during the</u> implementation <u></u>of your SARE agroforestry project?**

- ❒ Full-time farmer
- ❒ Part-time farmer
- ❒ Landowner living on the land not farming the land
  If marked:

Do you lease the land?
❒ No
❒ Yes

❒ Landowner living away from the farm
If marked:
❒ farm the land partially (living not far)
❒ lease out the farm
❒ both
❒ none of the above

❒ Farm manager - not landowner
❒ Other, please specify _____

IV.5. **<u>At the time of implementation of your SARE project</u> what would best describe your level of experience with farming and agroforestry?**

	Scale:				
Experience with:	Extremely experienced	Very experienced	Moderately experience	Slightly experienced	Not at all experienced
Farming	❒	❒	❒	❒	❒
Agroforestry	❒	❒	❒	❒	❒

IV.6. **What would best describe your level of experience with farming and agroforestry <u>today</u>?**

	Scale:				
Experience with:	Extremely experienced	Very experienced	Moderately experience	Slightly experienced	Not at all experienced
Farming	❒	❒	❒	❒	❒
Agroforestry	❒	❒	❒	❒	❒

IV.7. *If you have any comments regarding questions on this page, please write them here*
_____

IV.8. **<u>At the time of implementation</u> of your SARE funded agroforestry project what would best describe you:**
❒ I come from a farm family, and I have been farming most of my life
❒ I come from a farm family, but I have had a different occupation for most of my life
❒ I come from a farm family, have had a different occupation, but got back to farming
❒ I do not come from a farm family, but I have been farming most of my life
❒ I do not come from a farm family, and I have had a different occupation for most of my life
❒ I do not come from a farm family, have had a different occupation, but decided to switch to farming (at least partially)
❒ other, please specify _____

IV.9. **How many years has you or your family owned farmland and actively been farming?**
❒ years _____
❒ not applicable
❒ other, please specify _____

IV.10. **What is the likelihood that someone in your family will continue farming the land you own when you stop farming?**
❒ very likely
❒ likely
❒ unsure
❒ unlikely
❒ very unlikely
❒ not applicable

IV.11. **Are you interested in seeing your land continue to be in active farming even if no one in your family is planning to do so?**

- ❒ extremely interested
- ❒ very interested
- ❒ moderately interested
- ❒ slightly interested
- ❒ not interested at all

IV.12. *If you have any comments regarding questions on this page, please write them here*

_____

_____

IV.13. Most households have several different sources of income, which can include such things as wages and salaries, social security, and alimony among other things. In this question, **please specify the percent of the total household income <u>that comes from the farm.</u>**

- ❒ none
- ❒ Less than 20%
- ❒ 20-39%
- ❒ 40-59%
- ❒ 60-79%
- ❒ 80-99%
- ❒ 100%

IV.14. **What percent of your farm-related income comes from your agroforestry enterprises?**

- ❒ none
- ❒ Less than 20%
- ❒ 20-39%
- ❒ 40-59%
- ❒ 60-79%
- ❒ 80-99%
- ❒ 100%

IV.15. *If you have any comments regarding questions on this page, please write them here*

_____

_____

End of Block: IV. RESOURCES: FARMS AND FARMERS

Start of Block: V. SOCIO-DEMOGRAPHICS

V.1. **What is your age?** *(years, including only your last birthday)*

- ❒ 25 or less
- ❒ 26-35
- ❒ 36-45
- ❒ 46-55
- ❒ 56-65
- ❒ Over 65

V.2. **What is your gender?**

- ❒ Female
- ❒ Male
- ❒ Other

V.3. **What is your marital status?**

- ❒ Never married
- ❒ Widowed
- ❒ Divorced
- ❒ Separated
- ❒ Married or living with partner

V.4. **With whom do you live at home?** *(Mark all that apply)*

1. ❒ I live alone

- ❒ With my spouse, significant other or partner
- ❒ With child(ren) 6 years old or younger
- ❒ With child(ren) 7-12 years old
- ❒ With child(ren) 13-17 years old
- ❒ With others (parents, friends, adult children...)

V.5. **What is your total household income?**

- ❒ Less than $25,000
- ❒ $25,000 - $34,999
- ❒ $35,000 - $49,999
- ❒ $50,000 - $74,999
- ❒ $75,000 - $99,999
- ❒ $100,000 or more
- ❒ prefer not to answer

V.6. **What is your highest level of education?**

- ❒ High School
- ❒ Technical School
- ❒ Community College, or Junior College
- ❒ College Degree
- ❒ Graduate degree
- ❒ Other (specify) _____

V.7. **How far do you live from an urban area (at least 50,000 people)?**

- ❒ We are located in an urban area
- ❒ Less than 5 miles
- ❒ 5 – 9 miles
- ❒ 10 – 29 miles
- ❒ 30 – 59 miles
- ❒ 60 miles or more

End of Block: V. SOCIO-DEMOGRAPHICS

Appendix B.

Semi-structured interview Protocol for:
Factors of influence and reasons behind agroforestry adoption and retention: SARE case study

Time of the interview: Interviewer:

Date: Interviewee:

Before we start, I'd like to tell a little bit about myself, if you don't mind. So that you'd know a little bit more about my background.

Share personal background and relation to agroforestry. Establish rapport.

Questions

To start with I'd like to talk a little bit about your relation to agroforestry practices.

1. I want you to think back in time a bit… When did you **first become interested in agroforestry** practice? What motivated your interest?
2. Back then, how did you **learn about AF for the first time**? From who or from where?
3. Who or what **influenced** you the most in pursuing to learn more about agroforestry and to eventually implement it?
   (personal motivation based on info, farmer to farmer, field visits, extension?)
4. Next questions are about your **time path** from learning about AF towards being someone who practices it in his/her farm operations.
   How long did you know about AF before you decided that you going to try it when you'll have chance?
   How long after that decision did it take you to actually introduce AF on your farm? (What AF practices did you implement?)
   After you implemented AF when did you saw first results that led to decide that you going to stick with this practice?
   If you would not have seen those results would you continue practice AF?
5. Were there any AF practice which you tried, but **decided not to use** any longer? And why?
6. What were the **main reasons** you introduced AF on the land you farm, own, or manage?

Now I want to talk about AF information resources and support system. I am realizing that there is a community of farmers, landowners, businesses, researchers, and other experts involved in AF. This is very interesting to me how that "AF community" interact and can support or help each other.

7. What **information channels** and **resources** are most useful to you to learn about AF and get answers to your AF-related questions?
8. What kind of **support system** do you have today to seek advice on AF?
9. What kind of **support system you wish to have**? What can be improved?
10. Did you know anyone who were practicing agroforestry in your area prior implementation of SARE funded project? Is situation different today? What do you think has influenced that?

If time allows:

1. Overall, what are the **main challenges** you face doing AF practice?
2. What are the **main benefits** you received from the introduced AF practice on the land you farm, own, or manage? [pause] Are there any others you can think of?

Other Topics Discussed:

Documents Obtained:

Post Interview Comments or Leads:

Closure:
Thank you again to participate in the interview and your time to answer these questions. I'd like to ask you permission to get back to you, if I have questions to follow up, or if I would need to make sure that I've interpreted your words in a correct way.
Also, if you'd think of something else related to today's question what you think I should add into analysis, please let me know.