

BARRIERS TO ADOPTION OF SUSTAINABLE AGRICULTURE PRACTICES IN  
THE SOUTH: CHANGE AGENTS PERSPECTIVES

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BARRIERS TO ADOPTION OF SUSTAINABLE AGRICULTURE PRACTICES IN  
THE SOUTH: CHANGE AGENTS PERSPECTIVES

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BARRIERS TO ADOPTION OF SUSTAINABLE AGRICULTURE PRACTICES IN  
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## VITA

Joysee Mariela Rodriguez Baide, daughter of Manuel Rodriguez and Hilda Baide, was born January 9, 1978 in Las Vegas, Santa Barbara in Honduras. In December of 1996, she graduated as primary school and kinder garden teacher from Normal Mixta Pedro Nufio. She attended Zamorano University and graduated in the year 1999 as Agronomist. She participated in a research project conducted by Zamorano University to obtain her first working experience in social research investigating the functioning of alternative rural finance systems in Honduras. Then she entered Zamorano University, obtaining in April of 2001 the Bachelor of Science degree on Socioeconomic Development and Environmental conservation. During 2001-2002, she worked as an intern at the Heritage Seedling Inc. in Salem Oregon. She entered the Graduate School at Auburn University, in January 2003.

THESIS ABSTRACT

BARRIERS TO ADOPTION OF SUSTAINABLE AGRICULTURE PRACTICES IN  
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Current conventional agriculture systems of production lead to environmental degradation, economic problems, and even social problems. The efficacy of sustainable agriculture systems in guaranteeing economic, environmental, and social sustainability of farming operations has been demonstrated. This qualitative study is based on a semi structured survey instrument designed to find the barriers to adoption of sustainable agriculture practices. It was found that despite having support from change agents, farmers are rarely adopting sustainable practices. Change agents are not well prepared to attend to farmers' needs regarding adoption of sustainable agriculture. Thus, farmers

have also experienced challenges to obtain accurate information, especially information about the benefits of adoption of sustainable agriculture. Many economic barriers are also identified by change agents. Government support programs are failing to encourage adoption due lack of funding, inappropriate design, and ineffective targeting of clients. Reluctance to change is frequently mentioned by change agents, but more as a way of blaming farmers for non-adoption than explaining reasons for this behavior. Social barriers, land tenure, infrastructure, and incompatibility are other significant barriers to adoption. Strategies such as improved management of the existent information, careful design of economic support programs, extension efforts addressed to change agents and the public, could help overcome some of the barriers identified by change agents.

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## I. INTRODUCTION

Agriculture is an important part of every society. Sustainable economies are, in part, based upon sustainable food systems which depend in part upon agriculture. Agriculture affects the environment, human health, and even social order. Thus, any attempt to achieve sustainability must set as priority the attainment of a more sustainable agriculture (Horrigan et al. 2002)

Present food systems are dominated by conventional (also known as ‘industrial’) methods of production. This system was developed less than 50 or 60 year ago and has lead to several environmental, human health and economic problems around the world. The United States food system “represents one of the worst case examples of the pitfalls of industrial agriculture” (Horrigan et al. 2002:446)

Conventional agriculture goals focus on increased yields and decreased costs of production and are based on excessive use of nonrenewable resources, encouraging specialization and economies of scale (Norman et al. 1997). These goals are achieved through the use of expensive off farm inputs, excessive use of non renewable fossil fuels, thus carrying environmental degradation and promoting economically inefficient production systems (Horrigan et al. 2002).

Despite the negative impacts of conventional agriculture, the current economic and pricing system continues to encourage farmers toward this type of production (Norman et al. 1997). Low commodity prices, governmental commodity price support,

subsidies, and a poor farm economy are some of the pressures faced by farmers (Fazio et al. 2003). Farmers have been forced to expand their operation, increase production, or depend on governmental price supports and subsidies that generally benefit large producers (Fazio et al. 2003). These economic pressures lead to concentration of production, forcing small farmers to abandon their farms (Horrigan et al. 2002). The development of larger farms has caused producers loss of control over input and processing/marketing of the product (Norman et al. 1997).

In the United States there are approximately two million farms, 80 percent of which are small. Most of these small farms are family owned (Local Harvest 2005; Fazio et al. 2003). Considering that most farms are small, and that the current economic environment only encourages large scale farming and resource degradation, there is an economic, environmental, and social imperative to develop more sustainable agricultural systems.

Sustainable agriculture can help farmers survive in such a system because it works with nature (Norman et al. 1997). Sustainable agriculture reduces the cost of purchased inputs by utilizing farming techniques that incorporate biological cycles and the farmers' knowledge and skills (Norman et al. 1997; Pretty and Hine 2001). It also helps small farms to continue operating through diversification and increased profits from alternative ways of marketing, such as niche markets, value added products, or direct marketing strategies (e.g. farmer markets and community-supported agriculture (CSA) (Fazio et al. 2003; Local Harvest 2005; Horrigan et al. 2002).

Despite the great alternative that sustainable agriculture represents for many farmers, widespread adoption of sustainable agriculture practices have not occurred.

There have been some government efforts to increase adoption, such as the provision of economic incentives and the creation of organizations to provide exclusive support to sustainable agriculture. Nonetheless, the impact of these efforts has been very limited.

The Southern Region Sustainable Agriculture Research and Education Program have been supporting a research project aimed at exploring specific determinants for adoption of sustainable agriculture practices and how change agents perceive the promotion and adoption of these practices. From this broader study I have decided to make a closer examination of the reasons that are preventing many farmers from adopting sustainable agriculture practices. This decision is based on the results of many studies that find non-adoption of sustainable agriculture practices is a rational decision under certain circumstances (Nowak 1991; Vanclay and Lawrence 1994; Wandel and Smithers 2000; Roling and Jigging 1994).

### **Statement of the Problem**

Despite great interest in sustainable agriculture practices, very little adoption has occurred (Derpsch 1998; Horrigan et al. 2002; Pretty and Hine 2000). This implies that strategies to speed adoption of sustainable agriculture practices are not being effective. One potential reason for the lack of effectiveness of these strategies is the reliance on traditional theories about adoption of agricultural innovations. Applying traditional theories that have emerged from research on the adoption of conventional practices may be problematic when trying to influence the adoption of sustainable agriculture innovations.

Research on adoption of sustainable agriculture practices (SAP) lead researchers to think that reliance on the traditional model to understand adoption of sustainable agriculture practices is not appropriate (Murray, 2000; Roling and Jiggins 1994; Vanclay and Lawrence 1994). Traditional adoption theories neglect the fact that non-adoption does occur, especially in the case of sustainable agriculture practices (Vanclay and Lawrence 1994; Hooks et al. 1983). Moreover, Wandel and Smithers (2000) found that despite getting information and financial incentives to motivate adoption of conservation tillage, many farmers rejected adoption due to the many constraints they encounter. Consequently, some studies suggest that in order to have a more effective impact on promoting wide spread adoption of sustainable agriculture practices, concentrating on factors constraining adoption and how these can be overcome can be more fruitful (Nowak 1991; Pretty and Hine 2001; Cary et al. 2001; Vanclay and Lawrence 1994; Roling and Jigging 1994). There have been some advances identifying constraints to adoption of SAP. However, very little is known about specific barriers to adoption in the southern region of the United States.

### **Research Objectives**

The persistence of low adoption of sustainable agriculture practices is an issue that deserves more attention and better understanding. Thus, this study was designed to gain a better understanding of phenomena of low rates of SAP adoption. The specific objectives of this research are:

1. To develop a conceptual framework for understanding the barriers to adoption of sustainable agriculture practices

2. Develop general information about the current state of adoption and delivery of sustainable agriculture practices to farmers of the southern states.
3. To identify the central themes in change agents' views about barriers to adoption of sustainable agriculture practices.
4. To suggest ways of overcoming the identified barriers to adoption of sustainable agriculture practices.

The next chapter develops a conceptual framework for understanding barriers to adoption of SAP.



## **II. CONCEPTUAL FRAMEWORK**

The purpose of this chapter is to identify reasons why the traditional model of adoption fails to explain adoption of sustainable agriculture practices. First, I address the concept of sustainable agriculture. Secondly, I explain the current state of adoption of sustainable agriculture practices in other countries and in the United States. Then I summarize the theoretical framework that has shaped the studies related to adoption of agricultural innovations. Following, use of the diffusion of innovations (DOI) framework for understanding adoption of sustainable agricultural practices discussed. And finally the barriers to adoption of sustainable agricultural practices identified in other studies are explained.

### **Sustainable Agriculture**

In the past three decades the concept of sustainable agriculture evolved as an answer to the negative impacts of conventional farming (Diver 1996). There remains disagreement among farmers, the general public, and even agricultural professionals about what the concept means (Ikerd et al. 1997).

However, most proponents of the concept will agree that sustainable agriculture is a long term goal and not a defined set of agricultural practices (Ikerd et al. 1997; Diver 1996). Ikerd et al. (1997) explains that this long term goal serves as guide toward sustainability for the present and future benefit of farmers and society. Instead of

referring to a defined set of practices, the concept of sustainable agriculture challenges farmers to think about the consequences of agricultural practices, as well as the functioning and interactions of agricultural systems (Horrigan et al. 2002).

Sustainable agriculture is more frequently defined utilizing its three main aims: environmental health, economic profitability, and social and economic equity (Horrigan et al. 2002:452). Despite these different goals, each must be pursued at the same time in order to advance sustainability. Ikerd et al. explains this requirement of the concept with the following statement: “all three are necessary and none alone is sufficient” (1997:2).

The economic component of agricultural sustainability seeks to promote the economic viability of the farm (Agunga 1995; Norman 1997; Ikerd et al. 1997; SARE 2003). Sustainable agriculture must be profitable in order to allow farmers to keep control over the use of the land. However, economic viability must be achieved at the same time as environmental and social sustainability (Ikerd et al. 1997).

The environmental component refers to the “promotion of environmental stewardship, including: protecting and improving soil quality, reducing dependence on non-renewable resources, and minimizing adverse impacts on safety, wildlife, water quality and other environmental resources”(SARE 2003:2). In short, sustainable agriculture improve the environment and natural resources upon which agriculture depends. Sustainable agriculture furthers environmental sustainability by emphasizing the efficient use of on farm resources, non-renewable resources, and the integration of biological cycles (Norman 1997; Ikerd et al. 1997; SWCS 1995).

The social component has been interpreted in different ways, all of them equally valid. For SARE, the social component refers to the promotion of “stable, prosperous

farm families and communities” (2003:2). The preservation or enhancement of quality life for farmers and society as a whole through supplying human food and fiber needs are the primary social goals of sustainable agriculture (Ikerd et al. 1997; Norman et al. 1997; SWCS 1995).

Ikerd et al. (1997) explains that quality life also refers to the increase of income and employment opportunities in agricultural communities, particularly self employment opportunities. Sustainable agriculture must provide people with the opportunity to have a productive and successful life. Thus, sustainable agriculture promotes the maintenance or increase in the number of small- and mid-size operations. For Norman et al. (1997: 4) this implies a reduction of the “frantic work schedules of many farm families.”

Some authors point out that sustainable agriculture is time and place specific, and thus represents a dynamic concept (Norman et al. 1997; Horrigan et al. 2002). Because farming systems vary greatly across geographical areas and time, sustainable agriculture will continuously adapt to the context in which occurs. Norman et al. (1997:9) explains the dynamism of the concept by stating: “What may be sustainable today may not work as the system changes; [sustainable agriculture] requires close observation and skills that can adapt to change.” Thus, sustainable agricultural technologies and practices must be locally adapted (Pretty and Hine 2001).

### **Adoption of Sustainable Agriculture Practices**

Although sustainable agriculture does not refer to a standard set of agricultural practices, there are certain methods or practices that enhance sustainability (Horrigan et al. 2002). Such methods are regarded as sustainable agricultural practices. There is a wide

array of sustainable agriculture practices that are being employed by farmers. Some of the most commonly mentioned in the literature are: crop rotation, cover crops, no-till and low-till farming, soil conservation, diversity, nutrient management, integrated pest management, rotational grazing, water quality/wetlands, agro-forestry, and alternative marketing (SARE 2003; Horrigan et al. 2002).

Despite the great promise of sustainable agriculture in helping to alleviate the problems originated from industrial agriculture, adoption of sustainable practices remains low in many parts of the world. Pretty and Hine (2001) analyzed data from Africa, Asia and Latin America and concluded that from the total agricultural land only a 3% is under some type of sustainable agriculture practice.

For example, in the United States conservation tillage is one of the most commonly used sustainable practices. Its adoption had been slow, however, and remains low. The 1985 and 1990 Farm Bills recognized the importance of conservation tillage in preventing soil erosion and encouraged the use of this practice (Derpsch 1998). Despite the emphasis placed upon this practice, widespread adoption has not occurred at the expected levels.

While Horrigan et al. (2002) report that between 1980 and 1993 the land under this practice grew at the annual average rate of 1.5%, covering a 35% of all farmland in the country. Derpsch (1998) reports that the area under conservation tillage rose to 20 million hectares in 1997, only a 16% of the total cropping area in the country. Despite the difference in the proportions reported it can still be concluded that adoption of conservation tillage is not widespread.

Moreover, in spite of the increase in use of conservation tillage, the rate is much slower than expected. In his review about the development of conservation tillage, Derpsch explains the slow adoption of this technology: “In 1975 USDA predicted that in the year 2000 about 82% of planted cropland in the United States could be under conservation tillage and 45% under no-tillage... This forecast will be impossible to meet” (1998:5).

Similarly, integrated pest management practices, were reported by the coordinators of the federal IPM program to be adopted by approximately 2% of the farmers in the year 1994. In general, very few other sustainable practices gained popularity among farmers in the United States (Fazio et al. 2003).

The low percent of land covered by conservation tillage could be due to the small number of farmers adopting it. This could also be due to the tendency for adoption by small scale farmers and not by larger scale farmers (Agunga 1995). Agunga (1995) argues that sustainable agricultural practices are being adopted mainly by small scale farmers and that large scale farmers frequently reject them because these practices are new and challenge the status quo.

Very little is known about the general stage of adoption of sustainable practices at the national and regional levels. The 2002 census of agriculture does not yet include information about to sustainable agriculture. To improve this deficiency, the National Agricultural Statistics Service (USDA-NASS) intends to include information about sustainable agriculture in the next agriculture census (USDA-NASS 2003).

USDA-NASS (2003) recognizes the need for a statistical and demographic information provision about small farms, environment, and data on sustainable

agriculture. However, the type of information that will be available is still not clear. The only specification of the type of information that will be available from the next census in 2007 is about statistical data on agricultural chemicals use, land productivity, and IPM practices. In the mean time, institutions that intend to promote sustainable agriculture, such as SARE, may encounter lack of information at national and regional level to make informed decisions about their plans and strategies.

### **Adoption of New Agricultural Technologies**

Adoption of new technologies has been the subject of many studies across different disciplines. Researchers from sociology, economics, political sciences, communication, and public health have studied the adoption of innovations (Wejnert 2002). The first efforts to study the diffusion of new technologies can be traced to the work of George Simmel and Gabriel Tarde, who observed the imitative behavior occurring in small groups or communities, and established a relationship between these processes and the changes occurring in societies (Dearing 2004; Wejnert 2002; Kincaid 2004).

The most useful theoretical framework for explaining adoption of new technologies have evolved from investigations concerning agricultural innovations. It was not until the 1940s when the influence of the green revolution put pressure on researchers to study diffusion of agricultural innovations. From this research originated the diffusion of innovations (DOI) model (Wejnert 2002; Kincaid 2004).

Although extension theory had been the object of adaptive evolution, most extension agencies throughout the world have relied upon the diffusion of innovations

model to design their extension strategies. Haug (2002:1-2) describe the evolution of extension theory in four stages: “the classical or conventional top-down in the production stage of extension; the transfer of technology in two-way communication mode; the ecological stage; and the institutional stage.” However, he clarifies that this development occurred mainly in extension theory but has not been reflected in policy or practice.

Traditional extension methods applied technology transfer or advisory approaches based on the DOI model. (Vanclay and Lawrence 1994; Schulz et al. 2004). Currently, many extension agencies work under the ideas proposed by the DOI model (Haug 2002). For instance, Australian extension agencies worked within the limits of the traditional DOI model partly due to inertia. Moreover, in this country there has been recognition that the correlates of sustainable practice adoption are different than those of conventional practices. Nevertheless, extension continues to utilize the traditional top down extension approach (Vanclay and Lawrence 1993).

Considering the great influence of DOI model upon extension strategies, I will devote the next section to describing the most important aspects of DOI. I will emphasize some of the contributions of the model previously highlighted by scientists who contributed to diffusion of innovations research literature.

### **The Diffusion of Innovations Framework**

The diffusion of innovations is the most widely used framework to explain and predict adoption of new technologies. It was created in the United States by the rural sociologist Everett Rogers in the 1940s. Rogers defines diffusion as “the process by which an innovation is communicated through certain channels over time among the

members of a particular social system; this process includes both planned and spontaneous spread of new ideas” (Haider and Kreps, 2004:3). This definition emphasizes four important elements: innovation, communications channels, time, and social system. These are discussed in detail below.

**Elements of DOI: Innovations.** A well defined element of the DIO model is the innovation and its characteristics. Rogers (1983) explains that the attributes of the innovations are influence in the rate of adoption. Innovation attributes include: relative advantage, compatibility, trialability, and observability. Dearing (2004: 26) argues that one of the three reasons that lead potential adopters to adoption is “what they think about the innovation.”

Another important element of DOI is communications channels. The basic premise of the DOI model is that access to information regarding a new technology is the principal factor affecting the adoption decision process (Hooks et al. 1983).

**Time.** The next important element of DOI framework is time of adoption. One way that the model refers to time is in the stages through which adopters pass when deciding about adopting new technologies or ideas. Rogers (1983:164) defines the innovation-decision as: “the process through which an individual passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation, and to confirmation.”

Hornik (2004) suggests that one of the important contributions of the model is the idea that the adoption is a process that includes several decision phases, and is not simply a single decision to adopt or not. The following five stages are identified by Rogers



(1983:164) as those describing the adoption process: knowledge, persuasion, decision, implementation, and confirmation.

Another way in which the model accounts for time is through defining the adopter categories that result when adoption is studied in its totality within social systems. In this way one can distinguish adopter categories according to the time taken to adopt the innovation (Rogers 1995). This type of analysis produces a normally distributed adoption curve. The curve classifies adopter into five categories: Innovators, Early Adopters, Early Majority, Late Majority, and Laggards. Emphasis is placed upon characterization of each category to find predictors of adoption (Haider and Kreps 2004).

**Social System.** Innovations spread through social systems, thus aspects of such systems will also affect adoption. For Dearing, the second important impetus that potential adopters consider in the adoption decision process is, “what they think others think about the innovation” (2004:26). In other words, potential adopters are greatly influenced by opinions within their social networks.

Other authors claim that social influence is more likely to occur through opinion leaders of the social systems (Dearing 2004; Kincaid 2004; Haider and Kreps 2004). Dearing (2004) explains: “opinion leaders, through communicating or social modeling, do the rest [of diffusion] as long as: their attitudes are favorable toward the new practice [and] others positively identify the opinion leader with the innovation” (2004:27).

Therefore the rapid spread of innovations can be attributed in part to the high degree of support or acceptance that opinion leaders allocate to the innovation. When innovations spread rapidly, it means they have been accorded a high degree of approval from opinion leaders in a social network. On the other hand, the opposite may occur

when opinion leaders show a passive or active rejection of the innovation, adoption may be hindered (Dearing 2004). In many situations, change agents could also be considered performing such role within social networks (Rogers 1995).

Thus, Haider and Kreps (2004) point out that a very important component of the DOI model is the change agent. They define change agent as an “individual who influences clients’ innovation decisions in a direction deemed desirable by a change agency” (2004:5). The change agent is considered to play the following roles: “develop a need, establish the information exchange relationship, diagnose problems, create an intent in the client to change, translate an intent to action, stabilize adoption and prevent discontinuance, achieve a terminal relationship” (Haider and Kreps 2004:5).

### **Implications of DOI for Sustainable Agricultural Practices**

Promotion of sustainable agriculture practices through extension methods based on the traditional diffusion of innovations framework are very unlikely to be successful. There are theoretical and pragmatic explanations for the inapplicability of this framework to the promotion of sustainable agriculture practices.

While the efficacy of extension of conventional agriculture based on such model is controversial, its utilization for promotion of sustainable agriculture is incompatible (Vanclay and Lawrence 1994). Murray (2000) explains DOI’s inapplicability for sustainable agriculture: “[it] is increasingly been seen as an outdated model of extension for dealing with complex systems” (p. 520). The model has been largely criticized as a top down approach which failed to meet farmers’ needs (Vanclay and Lawrence 1994; Schulz et al. 2004).

In response to these failures many bottom up or participatory approaches of extension have emerged. Such approaches are characterized in general by active farmers' participation in knowledge generation (Murray 2000), the definition and implementation of research agendas (Schulz et al. 2004).

Other authors argue that the evaluation of new bottom up approaches lags behind that of top down approaches, leaving a lack of clearly defined alternative adoption theory (Murray 2000; Vanclay and Lawrence 1993). Wandel and Smithers (2000) agree that in the body of knowledge about innovation adoption in the social sciences, there is no clear model of adoption of conservation practices. The lack of models explaining adoption of sustainable agriculture practices have lead researchers to rely upon the DOI or mathematical modeling of economic factors to explain adoption of these practices (Wandel and Smithers 2000).

**Inapplicability of DOI to Adoption of Sustainable Practices.** There are several reasons for the inapplicability of DOI to the adoption of sustainable agriculture practices. Factors such as: (1) the nature of the technology (2) innovations under DOI are discrete additions, are universally applicable, and always triable (3) DOI leads to neglecting indigenous knowledge (4) It assumes voluntary change because its pro-innovations bias; and neglects the influence of external factors (political, economic, infrastructure).

DOI was developed by analyzing adoption of conventional agricultural technologies, and is therefore difficult to use in understanding the adoption of sustainable agriculture practice. The first difficulty refers to the nature of the technology to be promoted. Shifting to sustainable agriculture systems implies a change in the nature of

the technology used in agriculture. While the nature of conventional agriculture is production maximization through external inputs usage, sustainable agriculture is based on reduction of external inputs through maximization of knowledge and labor (Roling and Jiggins 1994).

Also, the change to sustainable agriculture implies a paradigm change and modifications to the management of the entire system must occur. This can only be achieved with increases on learning and knowledge about the farming system (Roling and Jiggins 1994) Conversely, extension agencies tend to promote sustainable agriculture as discrete management technologies, similar to the way conventional agriculture practices are promoted (Vanclay and Lawrence 1994).

The next difficulty is that DOI assumes innovations to be only individual additions made to the system. Van den Ban and Hawkins (1988) explain: “the model has been concerned with peripheral innovations (small and discrete technical changes) than with those that are central to a farming system” (p. 119-122).

Another reason of the inapplicability of the DOI framework is that sustainable agriculture practices are not applicable to all farmers nor to all physical or environmental conditions. Conventional practices were usually designed to be applicable in a variety conditions whereas sustainable practices are much more dependent of local conditions. Thus, sustainable practices are not universally valid, or at least need validation at the local level (Vanclay and Lawrence 1994).

Additionally, the stages of adoption described in the DOI do not necessarily apply to adoption of sustainable agriculture practices. Some sustainable agriculture practices tend to be indivisible and are difficult to try or be adopted in parts. Therefore farmers

might decide that non adoption is the best choice. Moreover, the model assumes that awareness and knowledge will lead to adoption. But, for sustainable agriculture other factors influencing the decision making process can prevent farmers from adopting (Vanclay and Lawrence 1994).

Another reason for the inapplicability of DOI is that the model leads to neglecting indigenous knowledge which is crucial for sustainable agriculture (Williams and Muchena 1991). Williams and Muchena (1991) define indigenous knowledge as beliefs/values, cognitions, practices originated, and valid in a certain context. They explain that it is the product of communities or social systems constantly solving problems by utilizing local resources. Van den Ban and Hawkins, in their criticism to DOI, explain this problem: “[DOI focuses on] utilization of scientific knowledge...assumes that all innovations are generated by research agencies, neglecting innovations originated from farmers or adapted by farmers to their situation” (1988:119-122). This represents a contradiction with sustainable agriculture philosophy.

Another reason for inapplicability of DOI arises from the models’ pro-innovation bias. Innovations are considered to be beneficial for all farmers. It neglects that innovations have differences in their desirability or in the perceived desirability they represent for each farmer, in their specific situation. This assumption leads one to expect voluntary change from farmers.

Vanclay and Lawrence explain that the model “supports voluntarism (non-regulatory) approaches to resources management, because [it] assumes that adoption of the desired technology or behavior will always eventually occur” (1993:26). Conventional innovations were usually intended to increase productivity and often

adoption was of clear economic interest to farmers. However, for sustainable agriculture practices, economic desirability might not always be obvious for farmers. Although it has been demonstrated that sustainable practices are “highly productive and economically competitive” (Horrigan et al. 2002:453), the economic benefits are not always as apparent to farmers or are not immediately available.

Sustainable agriculture practices are not always the best economic interest for farmers, at least in the short run, and non adoption occurs (Vanclay and Lawrence 1994). For example, adoption of soil conservation technologies is unlikely to take place until the net returns with conservation are greater than without, which has been reported to take 40 to 60 years after soil deterioration begins (Castano et al. 1995). Moreover, while the cost of adopting is usually carried by farmers, some or all of the benefits are social (Souza Filho 1997). For instance, farmers will rarely consider non-economic benefits of soil conservation such as downstream benefits for others (Castano et al. 1995).

Another difficulty for the application of DOI to sustainable agriculture is the importance of socioeconomic, political infrastructure, and even cultural context for adoption of sustainable practices. Under the DOI framework, adoption is seen as an individual decision based on formal rationality (Vanclay and Lawrence 1993:26). Conversely, sustainable innovations are very likely to be affected by social, political, and especially cultural contexts (Norman et al. 1997; Vanclay and Lawrence 1993).

### **A Better Approach for Understanding Non-adoption of SAP**

Compared to the large amount of research conducted to determine the factors influencing adoption of conventional agricultural technologies, adoption of sustainable

agriculture practices, have less research examining socioeconomic factors that influence its adoption (Arellanes and Lee 2003). However, trying to find explanations for adoption of sustainable agriculture practices, as has been done in the past for adoption of conventional agriculture technologies, is somehow “simplistic and unidimensional” (Cary et al. 2001:4). This way of approaching the issue implies that farmers need only to be persuaded to change in order to adopt sustainable agriculture practices and that these are available to them, which is not usually the case (Cary et al. 2001).

Some authors report that farmers do not adopt sustainable agricultural practices even after they are aware of the negative consequences from conventional agriculture (Alonge and Martin 1995; Lovejoy 1999). This suggests that awareness is necessary but not enough impetus for adoption, and that there might be factors outside of farmers’ control affecting their decision to adopt.

Thus, many authors have suggested that to accelerate adoption of sustainable practices it is necessary to have a broader understanding of the factors constraining farmers’ decisions regarding adoption of these technologies. In addition, these barriers to adoption need to be not only identified but overcome (Nowak 1991; Vanclay and Lawrence 1994; Cary et al. 2004).

There are barriers to adoption of sustainable agriculture that must to be analyzed in order to understand non adoption as a rational choice within the concept of substantive rationality. Weber’s concept of substantive and formal rationality can help to explain non adoption of sustainable agriculture practices as rational choices. Formal rationality is based merely on economic potential outcomes while substantive rationality considers other goals and values in life. Adoption of sustainable agriculture practices might be

based on substantive rationality and not in formal rationality (Vanclay and Lawrence 1994)

Sustainable agriculture advocates tend to blame main stream farmers for rejecting the concept (Agunga 1995). However, a farmers' non adoption decisions might be a rational choice from their point of view (Castano et al. 1995). Understanding the reasons for this decision can be more beneficial for the advancement of adoption of sustainable agriculture practices than trying to find the correlates to adoption.

After investigating the adoption of residue management systems among farmers in Ontario, Nowak (1991) concludes that in order to increase the adoption of such systems or any other innovation, the reasons for non adoption must first be defined and addressed. When limitations are overcome, then farmers' persuasion from being unwilling to adopt can take place. Nowak (1991) also explains that emphasis needs to be placed upon understanding and addressing farmers reasons for being unable or unwilling to adopt because, "in many cases is not [the] farmer's failure as it is a system failure" (1991: 33).

In the traditional diffusion model, non adoption was only explained by the period of time required by some farmers to adopt innovations (Hornik 2004; Haider and Kreps 2004). However, non adoption may occur, especially for sustainable agriculture practices, due to factors constraining farmers' decision to adopt (Hooks et al. 1983; Vanclay and Lawrence 1994). Thus, it is not surprising that the Soil Water and Conservation Society (1995) asserts that: "research, education, and policy initiatives should be directed reducing the barriers to development and adoption of more sustainable agricultural systems" (p. 4)



## **Barriers to Adoption of Sustainable Practices**

Most research on adoption of sustainable agriculture practices finds several barriers that impede its widespread adoption. Cary et al. (2001) point out that there is a range of constraints that discourage adoption of natural resources' management programs. They also explain that these constraints can have four different backgrounds: "perspective of individual landholders, the characteristics of desirable management practices, the socio-economic structure of adopters' communities and the broader institutional settings" (p. 4).

Barriers related to the information and knowledge about sustainable practices are commonly found. Barriers related to the generation and spread of information, the knowledge of agricultural professionals, and knowledge needed from farmers to adopt these practices are some of the commonly mentioned barriers for widespread adoption of these technologies in many parts of the world.

**Farmers' Knowledge and Information Needs.** Many sustainable agriculture practices are highly complex (Nowak 1991; Souza Filho 1997). Thus, adopting them imposes a need for increased learning. The intellectual cost of adopting environmental innovations is usually greater than conventional innovations because they require a better understanding of farm systems, cropping systems, or chemicals. Thus farmers may not be attracted to changes that require such intellectual investments (Vanclay and Lawrence 1994).

One of the reasons for non adoption reported by Norman et al. (1997) is that sustainable agriculture practices are management intensive and require great commitment to constant learning. Nowak (1991) states that one reason for farmers being unable to

adopt is their inadequate managerial skills. He explains that the issue is exacerbated by the fact that residue management systems often are designed for average or above average managers, and local assistance networks are also oriented to this group. Similarly, farmers in Brazil found lack of knowledge as a barrier to adopt organic farming (Souza Filho 1997).

**Lack of Information for Farmers.** The lack of information about sustainable agriculture practices is often regarded as a barrier to adoption (Bell et al. 2001; Nowak 1991; Norman et al. 1997; Northwest Area Foundation 2004). Nowak (1991) explains that one of the reasons for farmers being unable to adopt residue management techniques is the lack or scarce information regarding economic or technical issues of these technologies. Lack of knowledge about implementation and viability of these practices is an important barrier to adoption (Norman et al. 1997; Bell et al. 2001). Additionally, Young (2003) suggested that farmers in the United Kingdom, Spain, and Brazil lack enough information about economic viability of organic farming and need to be sure that organic farming represents an economically viable option in order to adopt.

In an interview of sustainable farmers in Iowa, Minnesota, North Dakota, and Montana, the Northwest Area Foundation (2004) found that when adopting sustainable practices, farmers were concerned about the lack of reliable information for decision making regarding these practices. And moreover, this concern was not substantially reduced after some time of adoption and experience with sustainable practices.

If information is not available to farmers who are trying to adopt sustainable practices, they may need to generate such information on their own. However the cost of information generation may be too high for a single farmer. Nowak (1991) found that the

high cost of obtaining information (time, expense and difficulty) about residue management techniques is a reason farmers were unable to adopt these practices.

Farmer's perception of technical soundness is a necessary condition for adoption. However, there are many challenges to develop farmers' perception of technical soundness. One is, that practices need to be demonstrated to be technically sound at commercial scale and with acceptable cost. Another challenge is that systems are promoted, but without comprehensive scientific evidence of their effectiveness. For example, evidence about practices that can enhance farm biodiversity is not clear. Additionally, complex systems have a high risk of poor implementation. Poor quality of implementation will affect farmers' perceptions of technical soundness of the practice (Pannell 1998).

**Generation and Spread of Information.** There appears to be several barriers related to the generation and spread of information about sustainable agriculture practices. Gamon and Scofield (1994) explain that low adoption of sustainable agriculture practices is related to the "lack of dissemination of clear and reliable information" (p. 38). Similarly, Nowak (1991) reports that one reason farmers are unwilling to adopt is that information about residue management techniques can be often conflictive or inconsistent, for farmers who use several sources.

Another reason for their unwillingness to adopt is the poor applicability and relevance of the information to the local conditions (Nowak 1991). Potential adopters may delay adoption based on the rationality of uncertainty reduction. They may wait to adopt technologies with uncertain outcomes until better information becomes available to them through their peers' experiences utilizing the innovations (Bearenklau 2005). Thus,

conflicting or locally irrelevant information can delay or prevent adoption of sustainable agricultural practices.

Young (2003) found that in the United Kingdom, Spain and Brazil, traditional sources of information have failed to supply adequate coverage of sustainable agriculture practices. Similarly, in Iowa, Minnesota, North Dakota, and Montana, farmers were found to rely more on learning from other farmers and from their own research than from traditional sources. The majority of farmers never used traditional sources of information such as Cooperation Extension, Soil Conservation Service and Universities. Farmers who considered other alternative sources, such as sustainable farmer's organizations, found them useful sources of information and advice (NAF 2004).

This variation in information sources creates a barrier to adoption of sustainable agriculture practices. Different sources of information provide conflicting recommendations that may negatively affect farmer's decision to adopt. Moreover, farmers trying to adopt sustainable innovations often felt that they get information that is contradictory (Vanclay and Lawrence 1994).

**Lack of Information and the Knowledge of Change Agents.** It is also reported that lack of practical knowledge from change agents to help farmers to implement practices is a barrier to adoption (Bell et al. 2001; Agunga 1995; Nowak 1991). Due to their lack of knowledge, change agents are doubtful of sustainable agriculture and less interested in promoting the concept. This may represent a great barrier to the wide spread adoption of sustainable practices (Agunga 1995). Widespread adoption depends greatly on the extension service from which farmers can obtain information, because of its large network of personnel that can reach farmers in a consistent manner (Agunga 1995).

One reason for the change agents' lack of knowledge is that they often neglect research findings that are not from the traditional sources, especially information originated from farmers' research. Agunga (1995) explains that despite many research findings that could help to convince change agents about the scientific bases of sustainable agriculture, change agents often dismiss such findings because these are collected from farms. Paulson (1995) found that most agricultural professionals value university research as the most scientific and unbiased source of information, and prefer it over other sources of information.

Another cause of change agents' lack of knowledge is the lack availability of information to them. Agunga (1995) suggest that lack of information available to change agents is caused by a communication gap between them and members of the sustainable agricultural movement. In addition, Bell et al. (2001) found that information is available through extension publications, but farmers and extension staff are unaware of much of its existence.

In the 1990 Farm Bill, all change agents were mandated to complete training in sustainable agriculture to improve their understanding, competence, and ability to teach or communicate the concept (Agunga 1995). However, Paulson (1995) conducted a study to evaluate such training programs and found that their lack of effectiveness was caused by the top down approach that defined them, which failed to consider change agents' beliefs, values, and previous knowledge. She concluded that "success of educational programs in sustainable agriculture will depend on the knowledge, beliefs, and values the student brings to them" (Paulson 1995:122).

**Change Agent's Beliefs and Values.** Change agent beliefs can affect their perception about sustainable agriculture. An example is the belief that scientific knowledge is only generated in research stations (Paulson 1995; Agunga 1995). If agents do not value farmer run research, which in most of the cases is necessary to develop locally adapted sustainable practices, there will remain a barrier to communication between change agents and other sustainable agriculture information sources (Paulson 1995).

Change agent beliefs are strongly influenced by their past experiences with conventional farming and can prevent them from promoting sustainable agriculture practices. Some change agents hold other beliefs that “a trend toward fewer and larger farms either is a natural economic process or was necessary to meet other social goals (cheap food); economic and environmental goals of sustainable agriculture are being met by conventional agriculture; social goals of sustainable agriculture are unrealistic and impossible” (Paulson 1995:125-127). These beliefs were reported to be negatively affecting change agents' perception of sustainable agriculture. Paulson (1995) explains that change agents often believe that only increases in productivity can motivate farmers to adopt or are the only source of increased profit. There is also the belief that sustainable farming means low chemical input, which at the same time means low productivity. These types of ideas can cause rejection of sustainable agriculture practices (Agunga 1995).

**Economic Factors.** Even for sustainable agriculture practices economic factors are the important determinants for adoption (Pannell 1998). Economic factors are frequently mentioned as barriers to adoption of sustainable agriculture practices by

farmers and also by change agents. Some of the commonly mentioned economic factors holding farmer from adoption are the cost of adopting, the uncertainty of profitability, loss of productivity, labor demand, short term economic necessity, and economic policies.

Changing any agriculture practice can increase risk of negative outcomes. However, for sustainable agriculture practices the increased risk is often regarded as an important barrier to adoption (SWCS 1995; Nowak 1991; Souza Filho 1997; Barlas et al. 2001). Whether real or perceived, the risk of negative outcomes or uncertainty about the profitability of sustainable practices is another frequently mentioned barrier. Among farmers, concerns about the profitability of sustainable practices can be a major barrier (Bell et al. 2001; NAF 2004).

Risk can be a great limitation for adoption of environmental practices. Often environmental innovations may require farmers to give up their income during transition, so cost of adopting increases. Many farmers may not be in a situation to take the risk of failure. Souza Filho (1997) found that farmers perceived an increase in risk when trying to convert to organic farming. This was a significant barrier to adoption of organic farming by Brazilian farmers.

In order to adopt sustainable agriculture practices farmers need to be able to overcome the transition period. However, in the United States, the economic environment has often made conventional agriculture more profitable (Norman et al. 1997). Thus, this period can appear to be very risky for farmers (Rawson 1995). Souza Filho (1997) found that the financial risk of the transition time represent a significant barrier to adoption of organic farming.

The cost of making the transition to more sustainable production systems is frequently encountered as an obstacle for adoption. The cost and investments involved in adoption of residue management systems was identified as one reason farmers are unable to adopt these practices (Nowak 1991). This is a problem especially when changes in equipment are required in order to adopt. Equipment considerations, either existence of conventional equipment or the cost of acquiring new equipment, are regarded as the bigger barriers to adoption of conservation tillage in Ontario (Wandel and Smithers 2000).

Additionally, in the United States many conventional agriculture practices have been promoted by the government to reduce financial risk (e. g. monoculture). Farmers are then encouraged to act under risk aversion behaviors. Thus, agriculture programs that encourage conventional practices pose important barriers to adoption (SWCS 1995). Great perceived risk due to possible yield reductions were found to be a barrier to adoption of conservation tillage by farmers from Ontario (Wandel and Smithers 2000)

When environmental problems are not overcome, current and future productions are at risk, as well as financial and time investments. Thus, farmers need to be sure that the new technology will provide the expected environmental benefits and effect (Vanclay and Lawrence 1994).

Another factor closely related to risk is farmers' economic ability. When farmers' economic situation is not economically solvent they may tend to overexploit natural resources in order to maintain their operation. In such a case, the negative interactions among the components of sustainability, especially environmental and economic, can also be a barrier to adoption. This has been identified mainly in low income countries



where poverty and ecological degradation are found to be closely related (Norman et al. 1997; Antle and Diagana 2003).

However, the same can be said about farmers of a developed country such as United States where conventional farmers are often ambushed in an “economic treadmill (e.g. having to raise enough money to service debts)” (Norman et al. 1997:7). Short term economic necessity prevents them from giving the attention that sustainable practices deserve. Thus, when farmers have a solvent economic situation they opposite may happen; farmers can have more freedom to adopt sustainable agriculture practices. For example in the UK and Spain, organic farmers were less likely to depend on income from only agriculture than conventional farmers (Young 2003).

Although it has been demonstrated that sustainable practices are as economically viable as conventional practices, profitability of sustainable practices is a concern among farmers and even change agents (Horrihan et al. 2000; Roling and Jiggins 1994). Paulson (1995) found that many agricultural professionals consider sustainable practices as not economically viable.

Some of the factors that are frequently considered to affect the profitability of sustainable practices include the loss of yields and an increase in costs of inputs or quantity of inputs. Although many agricultural practices have been demonstrated to even increase yields, proof of such results may not be available to farmers, thus generating uncertainty about their outcomes. For example, in Kenya, adoption of “push-pull” pest-management systems resulted in increases of 60 to 70 percent in maize yields (Pretty 2001).

The uncertainty about profitability due to the lack of confidence on yields was a significant barrier to adoption of conservation tillage for farmers in Ontario (Wandel and Smithers 2000). According to the NAF (2004), a major concern among conventional farmers is losing their yields when considering adoption of sustainable practices. Among farmers who adopted, this concern diminished in three of the four studied states, but remained for most farmers from North Dakota. However, contrary to conventional farmers, the majority of farmers who adopted sustainable practices expressed that if these practices were more widely adopted, yield would remain steady or increase.

Labor demand is another economic factor that negatively affects profitability and the farmers' decision to adopt. Nowak (1991) cites that increase on labor requirement is one reason that farmer do not adopt residue management systems. NAF (2004) found that increased labor demands represent a substantial barrier to adoption for many conventional farmers (horticulture). Conversely, for farmers who have already adopted sustainable practices, labor concerns ceased. Reed (2004) explains that for organic farmers labor demand represents a constraint to the economic rationality of transition to such production systems.

**Policies.** In addition to specific reasons that prevent adoption at the farm level, external factors such as policies may negatively influence farmers' adoption decision. Adoption of sustainable agriculture practices is commonly affected by influences from higher levels (e.g. national, regional, and watershed). National policies influence the economic environment upon which farmers decide if whether adopting new agricultural practices is feasible or not (Norman et al. 1997). Moreover, Pannell (1998) explains that

farming systems are the result of “farmers’ reaction to government policies and institutions in place” (p. 1).

Although there has been a general recognition of the importance of sustainable agriculture in most countries, supportive policies for sustainable agriculture remain in the margins. For the widespread adoption of sustainable practices to take place, it is necessary to ensure that policy environment is favorable rather than unfavorable for adoption of such practices. Only Cuba and Switzerland have given open national support to sustainable agriculture through their policies (Pretty and Hine 2001). Similarly Young (2003) observes that in the UK, Spain, and Brazil there is a continuous policy failure in providing the adequate economic environment needed for the transition to sustainable systems, there by causing a barrier great to adoption.

Market failures caused by the domestic policies are often a great obstacle for advancement of sustainable agriculture systems (Norman et al. 1997; Antle and Diagana 2003). Low commodity prices, caused in part by continued subsidization of agriculture in much of the developed world, abate the incentives to invest in agriculture in these and other countries (Antle and Diagana 2003). Subsidies increase production above market needs. The real prices of agricultural products are so low that it is very difficult for farmers to obtain the capital needed to make the change to sustainable agriculture (Selby 2005).

In the United States, policies such as Farm Bill and market prices often have made conventional agriculture more profitable (Norman et al. 1997). Rawson (1995), felt that commodity price and income support programs have acted as barriers to widespread adoption of sustainable agriculture. These support programs encourage farmers to

continue farming conventionally and discourage adoption of sustainable agriculture practices. For instance, in Iowa, Minnesota, Montana and North Dakota many conventional farmers considered that federal farm commodity programs were the major influence on their farming practices, contrary to a 17 percent of the sustainable farmers (NAF 2004). Similarly, county extension agents identified “cheap food policy” as a barrier to meeting the goals of alternative agriculture (Paulson 1995).

In the United States, subsidies to commodities have hindered adoption of SAP (Horrigan et al. 2002). Horrigan et al. (2002) explains that despite the demonstrated positive socioeconomic effect of small farms on rural communities (production of more jobs, more local retail spending, and more local per capita income than large corporations) there is a great disparity in the amount of agricultural subsidies going to large farms and small farms. Moreover, subsidies are frequently used for unsustainable practices (e.g. overgrazing, increased use of chemicals).

Government reliance on agricultural subsidies to support conventional agriculture commodities, usually in hands of large producers or companies, has been subject of many debates. However, Horrigan et al. (2002) cites an interesting remark about U.S. subsidies made by the International Institute for Sustainable Development:

“Almost 30% of subsidies go to the top 2% and over four-fifths to the top 30%. Ironically, if the United States government were to shift its target from the top 30% to the bottom 70% of farmers, it could save at least \$8 billion a year while supplying a competitive boost to lower income farms” (453).

In his analysis about the barriers to sustainability, Horrigan et al. (2002) give a tacit explanation for the lack of policy support to sustainable agriculture in the United States. “Most important powerful economic interests benefit from the status quo in

agriculture. Industrial agriculture relies heavily on external inputs..., which means cost for farmers but profits for farm input industries” (p. 452).

**Farmers’ Personal Characteristics.** Some personal characteristics are barriers to adoption of sustainable agriculture. The frequently mentioned personal and demographic farmers’ characteristics that act as barriers are: reluctance to change, age, and other attitudes.

In their analysis of perceived barriers to adoption of conservation tillage among farmers from Ontario, inertia or reluctance to change was the most frequently stated barrier (Wandel and Smithers 2000). However, this reluctance to change is often related by researchers to demographic factors such as age or to the economics of sustainable practices compared to conventional. Lack of receptivity from older farmers in Honduras was one barrier to adoption of minimum tillage (Arellanes and Lee 2003). The advanced age of farmers was perceived to be a limiting factor to adoption of conservation tillage by Canadian farmers (Wandel and Smithers 2000).

Factors such as belief that conventional systems are better, give higher yields or work well, were identified as the biggest barriers to adoption of conservation tillage by Canadian farmers (Wandel and Smithers 2000). Similarly, in the U.S. Nowak (1991) found that farmers were unwilling to adopt residue management systems because they represent less risk in the constantly changing agricultural markets.

Farmer’s perceptions of environmental problems and media promotion are other barriers to adoption. Farmers are likely to adopt environmental innovations when they perceive a risk of environmental degradation by using traditional practices. However, the extension literature that gives images of dramatic environmental degradation may have

contrary effects. Farmers may feel incapable of solving these problems. In some cases farmers may not perceive they have such dramatic damage and thus take no action to solve the problem (Vanclay and Lawrence 1994).

**Incompatibility.** Compatibility of sustainable practices with the current agricultural systems in terms of management style, farm size, physical setting, and production goals is often identified as a barrier to adoption. Also, incompatibility with farm and personal objectives is a barrier to adoption (Vanclay and Lawrence 1994).

When practices are complex and non divisible they tend to require substantial changes in farm management (Vanclay and Lawrence 1994). As Roling and Jiggins (1994:5) explain “sustainable management requires profound changes in the activities which constitute farm practices,” thus tend to be incompatible with current management strategies.

In some cases new practices are incompatible with the current farming system. Wandel and Smithers (2000) found that farmers who have livestock tend to use inverse plowing for manure incorporation and this was a limitation to adoption of conservation tillage. Additionally, Nowak (1991) explains that residue management systems were found to come into conflict with existing production systems.

In some situations farmers might be obligated to use conventional and sustainable systems at the same time (e. g. when working with own and rented land). Bell et al. (2001) found that the desire to have a uniform implementation of practices in all the operation was a significant barrier to adoption of sustainable practices in Iowa farmers. Having to manage both rented plots and owned plots, in different ways will be less cost affective and take them more time and effort. Incompatibility with current living

practices was found as barrier for adoption of organic practices in Espirito Santo, Brazil (Souza Filho 1997).

Farm size is other factor identified as barrier to adoption. Agunga (1995) found that for small scale operators is easier to adopt because for commercial farmers or mega farm operators take more time to examine the risk involved with the adoption of new technologies or practices. Conversely, technologies that represent a considerable economic investment, such as conservation tillage, are considered to be not worth adopting by small operations (Wandel and Smithers 2000). On the other hand the NAF (2004) found that sustainable practices are being used in small and large operations (50 or more than 1000 acres).

According to Nowak (1991) farmers are unwilling to adopt residue management systems because these are not compatible with the physical setting. In other words, the practice is inappropriate in the local environment and can even cause additional problems such as yield losses, inefficient use of inputs, negative environmental impacts, and various other problems. Similarly, Dyrmondsson (2000) found that organic practices in Iceland are incompatible with the physical environment. The cool climate in Iceland makes growing nitrogen fixing legumes difficult, which would otherwise help to provide nitrogen avoiding artificial fertilizers.

Complexity of new practices is a factor that can negatively influence the adoption decision. The knowledge and management skills needed for adopting sustainable agriculture practices can be attributed to the complexity of these types of production systems (Vanclay and Lawrence 1994).

Since many environmental or sustainable practices are complex we can understand the farmer's rationale for non adoption (Vanclay and Lawrence 1994). Nowak (1991) explains that residue management systems that are too complex will unlikely be adopted because some farmers are unable to do it. For example, in their Canadian sample of farmers, Wandel and Smithers (2000) found that in clay-based soils, the complexity of conservation tillage increases, posing a significant barrier to adoption.

Pannell (1998) explains that sustainable agriculture systems are complex in their biology, management, economic impact, and in the social attitudes and perceptions they generate. Farmers may find many reasons related to the complexity of such systems to reject them.

Other barrier to adoption of sustainable agriculture is the difficulty in triability, some of these practices present. It is clear that trial of technologies is crucial for adoption. In trying the new technology, potential adopters will reduce their uncertainty and accelerate adoption. Through personal experiences they will learn about the factual results of adoption and change their beliefs (Marra et al. 2004).

One difficulty is that sustainable agricultural practices often incorporate management of the farm system as a whole. These practices usually are not divisible and thus less likely to be adopted (Vanclay and Lawrence 1994).

Marra et al. (2004) also stated that many difficulties have been associated with the trial of environmental management technologies in Australia. These difficulties include low observability, long time lag between treatment and effect, the borderless nature of environmental problems, and the necessary (large) scale of implementation for effectiveness (small scale adoption poorly demonstrates potential benefits). Aspects of



farm variability, such as soil types, are confounded with the effects of a new farming system, making interpretation of results difficult (Marra et al. 2004; Pannell 1998).

Most farmers' lack experience with these technologies leads to a low quality of implementation, a higher risk of trial failure, and an unavailability of resources required for implementation (Marra et al. 2004). Furthermore, triability can be difficult because additional resources are required to conduct trials (e.g. extra labor, capital, time) (Pannell 1998).

Trials seem irreplaceable by information received from others. Opinion leaders can help to promote trialing of practices but "their advice will never be accepted as a substitute for a trial" (Pannell 1998:5). Trial by other farmers needs to be relatively close in location to potential adopters to be convincing.

**Land Tenure.** Land tenure issues are often found to be an important barrier to adoption of sustainable practices in developing countries, and in developed countries such as the United States. Antle and Diagana (2003) explain how insecure property rights would make very unclear and thus difficult to establish contracts for carbon sequestration with farmers from developing countries. Moreover, farmers with insecure property rights may degrade soil unintentionally. Insecure property rights have existed in Honduras for a long period of time, causing a conflict that affects many resource poor farmers. This has been demonstrated to have a deterrent effect on adoption of sustainable practices. Plots that were owned by farmers were four times more likely to employ minimum tillage and conservation tillage (Arellanes and Lee 2003).

In the United States, property rights issues have also been identified as a significant barrier to adoption of sustainable practices. Bell et al. (2001) conducted a

study to describe the implications of property rights issues for adoption of sustainable practices among farmers in Iowa. They found that the majority of leasing agreements were one year term and cash rent, which are antagonistic to adoption of sustainable practices.

The uncertainty that exists in one year agreements strongly restrains the tenant's ability and willingness to adopt. While landlords often reject sustainable practices because of uncertainty about the economic benefits of such practices, competition for rented land leads tenants to farm according to the landlord's regulations. For tenants, trying new techniques increases the risk of failure, preventing tenants from adopting. They want to maintain a good reputation and consequently the ability to rent land in the future. Moreover, non adoption on rented land was the cause for non adoption in owner farmed land, because of more time and commitment needed with two different management strategies (Bell et al. 2001).

A broader study that covered four states (Minnesota, North Dakota, Iowa and Montana) found that there is a tendency of conventional farmers to rent more land. Thus, sustainable operations are often smaller. In other words, sustainable farmers farm less land but are more likely to own it (NAF 2004). It is not clear if whether this tendency is caused by property right issues or by conventional farmers being obligated to expand their operations by using rented land. Issues identified in Iowa may be similar in other states. It can be understood that land tenure may have a negative effect on adoption of sustainable practices.

Physical and social infrastructures may present other barriers to adoption. Physical infrastructure such as marketing infrastructures may constrain the adoption of an

innovation. Social infrastructure is very important because farmers often refer their peers for information. Therefore, most farmers wait until there is sufficient interest in the innovation by their peers before adoption occurs.

**Social Infrastructure.** One dimension of social infrastructure is the farming subculture or farming style. Meeting the expectations of subcultural norms is a fundamental part of social behavior. In farming subcultures there are norms about acceptable agricultural practices. The subculture concept lead us to understand that “ideas that are different to the currently held in the subculture are likely to be rejected...[thus] subcultures are a powerful force in resisting change” (Vanclay and Lawrence 1994:11-12). For example, new environmental practices are often not part of the subcultures. Therefore, adoption of new environmental practices is less likely to occur.

Vanclay and Lawrence (1993) recognize that adoption decisions regarding sustainable agriculture are based on precise factors such as risk, cost, and benefits. These types of decision are often based on more imprecise factors such as “what is considered to be socially and culturally acceptable by members of [potential adopters’] social group” (Vanclay and Lawrence 1993:23). According to a change agent “two drivers determine whether a farmer will adopt a new technology: if he thinks it’s profitable and if his peers accept it” (Bearenklau 2005:5).

The degree to which this type of influence will affect adoption of technologies may depend upon the degree of risk of the technology. Bearenklau (2005) specifies that the neighbor effect may have more importance for smaller, less costly, and reversible decisions. According to Vanclay and Lawrence (1993), for innovations high in apparent

risk or uncertainty, diffusion occurs through an interpersonal process. In such a process social influence will either facilitate or impede adoption.

However Marra et al. (2001) argue that social influences are not as relevant as others state. In their study about adoption of transgenic cotton, they found that potential adopters are more likely to be affected by information they consider as important (effective) in their decision than by neighbor effects or popularity of the innovation.

**Physical Infrastructure.** It is well known that infrastructure issues play an important role in farming decisions. Khanna et al. (1999) find that drip irrigation did not reach wide spread adoption until a support infrastructure was establishment. Extension specialists, dealers, support staff, and farmers understood its implementation and functioning.

Infrastructural problems have been identified in developing countries as a barrier to adoption. After analyzing a large sample from 52 countries in Latin America, Africa, and Asia, Pretty and Hine (2001) suggested that for a more widespread adoption of sustainable practices, countries must invest in markets options, transportation, and communications. Dyrmondsson (2000) finds lack of sufficient quantities of organic fertilizers is the most difficult barrier to overcome for a widespread of organic farming in Iceland.

Also, in the U.S. infrastructural issues have been identified as a constraint to adoption of sustainable practices. Nowak (1991) identified one reason for farmers being unable to adopt residue management systems, is the availability and accessibility of supporting resources. He explains that only few farmers adopt without significant support from local equipment and agrochemical dealers, USDA information and assistance, credit

sources, and other components of the surrounding agricultural infrastructure. Likewise, a study conducted ten years ago in the Southern United States, found that the lack of marketing infrastructure was the key constraint to sustainable agriculture (Texas Environmental Profiles 2004).

The loss of flexibility is another barrier for adoption of many environmental practices. Farmers' flexibility to respond to market or climatic changes can be constrained. For instance, "Zero-tillage systems with chemical control of weed restrict the range of crops that can be grown and the rotation of those crops" (Vanclay and Lawrence 1994:11). Additionally, when new practices involve expenditures, farmers may feel a loss of flexibility and resist adoption (Vanclay and Lawrence 1994).

**Summary.** Despite the wide use and acceptance of the DOI framework for predicting adoption of agricultural innovations, many concerns roused regarding its applicability to sustainable agriculture innovations. The use of traditional DOI framework for understanding adoption of sustainable agriculture practices, and thus influence adoption, have lead to low impact on accelerating the speed of adoption. Some studies propose that the identification of the constraints to adoption of sustainable agriculture practices can lead to more effective strategies to influence adoption (Nowak 1991; Pretty and Hine 2001; Cary et al. 2001; Vanclay and Lawrence 1994; Roling and Jigging 1994).

Many barriers to adoption of sustainable agriculture practices have already been identified. Barriers related to the farmers' knowledge and information needs, and the availability of information to farmers and change agents, seems to be important in the literature. However, beliefs and values of change agents and farmers' communities seem to be a reason for the lack of receptivity to information about sustainable agriculture

practices. On the other hand economic factors seem to be equally important in the literature. Some studies explain how policies are shaping the economic environment that constrains adoption of these technologies (Young 2003; Norman et al. 1997; Antle and Diagana 2003; Rawson 1995; NFA 2004; Paulson 1995; Horrigan et al. 2002).

Additionally, there are incompatibility factors with sustainable practices and several aspects of the farming systems. Incompatibility is exacerbated by the fact that sustainable practices are relatively more complex compared to conventional technologies, in that sustainable practices depend more on local conditions. These practices also seem to be difficult to try in many cases, diminishing the possibilities of reduction of uncertainty of the impacts of adoption at the farm level.

Land tenure appears to be a factor that can greatly influence the rejection of sustainable agriculture practices. Not only in developing countries but also in the U.S., where many farmers have been forced to expand their operations often using rented land. Social structures can play a negative role on diffusion of sustainable agriculture practices. Social norms and the influence of peers are also barriers to adoption. In addition, infrastructural issues were also mentioned in the literature to be negatively affecting adoption of sustainable agriculture practices.

### **III. METHODS**

This chapter describes the methods and sources used to obtain the sample of change agents used in this study. Also, I describe the survey instrument and the procedure utilized to collect data. In addition, I explain the methods and instruments used to analyze the data obtained through the survey.

#### **Sample Selection**

Agencies such as extension service are described as organizations which distribute agricultural information through a large network of personnel, are able to reach farmers in a consistent manner and in a broad geographic area (Agunga 1995; Udoto and Flowers 2001). Thus, they can give information about trends and also specific problems in the areas where they work.

Often, sustainable farmers have identified non-traditional sources of information as more useful than traditional sources such as the extension service (NAF 2004, Young 2003). On the other hand, traditional sources of information such as the extension service, have gained conventional or mainstream farmers' trust and respect (Agunga 1995). However, all agricultural professionals from extension agencies are also expected to have training in sustainable agriculture (Agunga 1995; Paulson 1995) and thus, in some cases, they might also be serving farmers who adopted sustainable practices.

My interest is in the problems of farmers who have adopted sustainable practices and those who are interested in adopting sustainable practices, but have remained

conventional. Therefore, agricultural professionals from traditional and non-traditional agencies are considered as experts in farmers' situations and potential experts on sustainable agriculture.

Agricultural professionals, especially those working for traditional information sources such as the extension service can be found and contacted through the Internet. However, there is a variety of non-traditional information sources (NRCS, private consultants, farmers' organizations, etc) some of which may not be easy to contact.

Therefore, a combination of two purposive non-probability sampling methods was used: expert or positional sampling and snowball sampling. Expert sampling is the best approach to obtain the views of people who have specific expertise (Trochim 2001), such change agents' expertise on farmers' situations. Snowball sampling is useful when there is no clear sampling frame or when populations are difficult to reach (Trochim 2001), such as a broad array of advisory agencies that give farmers advice that may not be easily contacted through the Internet.

Email addresses for agricultural professionals were obtained from the websites of Land Grant Universities Systems, the USDA, the NRCS, the American Society of Farm Managers and Rural Appraisers, the Certified Crop Advisers of the American Society of Agronomy, and private consultants from commercial companies or other consultant networks (Georgia Association of Professional Agricultural Consultants, DuPont, Monsanto, Agrodist).

Email contacts obtained from the Internet were collected in a way that all the 13 Southern States were included. In some cases web pages provided lists by state or county. In other cases, especially in large data bases, it was necessary to collect data according to



zip code numbers in each state. An online tool (zip code lookup directory) was utilized to retrieve zip codes per state and county. These were further utilized to obtain the email contacts of change agents on every county of the states of interest.

Additionally, one list of 28 change agents that have been working with sustainable agriculture in Georgia was obtained from Southern SSAWG. Other list of 29 SSARE coordinators who could forward the survey to change agents was also included. A list of approximately 1,882 change agents' e-mail addresses was obtained. However, further review of repeated email addresses yielded a final valid list of approximately 1,292 e-mail addresses of agricultural professionals to be contacted.

### **Data Collection**

Since our study purposes are description and explanation using a large sample of individuals (Babbie 2004), a survey research method was selected. Considering that the sample was geographically scattered, but people could be reached through email, the survey was distributed electronically through the web.

A semi-structured questionnaire instrument was designed (Appendix A). A set of 12 open ended questions were utilized to capture respondent's opinions in their own words (Babbie 2004), about the important issues in adoption of sustainable agriculture practices. These were combined with a set of 14 closed-ended questions that intended to get a general description of tendencies regarding adoption of sustainable practices, respondent's demographic description, and background. To ensure the validity and reliability of the survey, the instrument was reviewed and pre-tested by a panel of

research and extension professionals at Auburn University and a selected set knowledgeable individuals in the SARE network.

Respondents were contacted by e-mail explaining the objectives of the project, encouraging them to participate, providing assurance about their confidentiality and directing them to the web based survey. They were also, asked to forward the email to other agricultural professionals who could also be knowledgeable about and farmers' situation regarding adoption of sustainable agriculture practices. With a time interval of approximately one month three additional follow-up e-mails were sent when data base stopped getting completed surveys. Data was received and stored automatically in an access data base that was frequently inspected to see the number of responses entered every day to define the best time to send follow-up emails.

### **Data Analysis**

Data were compiled in an access database file. This file was separated in two different files. One file containing the answers to the closed-ended questions was transferred to SPSS. Analysis of this information was conducted utilizing descriptive statistics (mean, frequency).

The results to the open ended questions were separated in individual files containing the verbatim responses to each item for all respondents for each question. Information was stored in a way that the identification number for each participant was kept in each file. This allowed for revising respondents' answers to other questions when indicated by respondents or when needed. Each file was stored with a distinctive name and imported to perform analysis with ATLAS.ti software for qualitative data analysis.

ATLAS.ti software was used to summarize the comments and responses to the web survey. The software contains a set of powerful tools for the management, evaluation, and visualization of qualitative data.<sup>1</sup>

Cross case analysis of patterns among data was performed utilizing a variable oriented strategy (Babbie 2004). Information for each respondent's answer was coded or classified in individual pieces of data. A name or code was assigned to each piece of data.

The coding process was initiated by initial or open coding and followed by focusing coding techniques (Newman and Benz 1998; Trochim 2001). After studying each respondent's answers initial codes were constructed. Following, initial codes were combined into categories devised in the researchers' own terms (Newman and Benz 1998). Data was sorted in a way that materials with similar content were located together. This allowed analysis to focus on each subject so that detail and distinctions can be appreciated (Ritchie and Lewis 2003).

Patterns were identified utilizing frequencies of each code and category. ATLAS.ti was used to obtain frequencies for each code. Frequencies of codes included in a cluster or category were added to find a frequency for that category. Categories or clusters were organized from most to least frequent. Codes in each category were organized in same way. This helped to establish a hierarchy of importance among categories or themes.

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<sup>1</sup> ATLAS.ti stands for "Archiv fuer Technik, Lebenswelt und Alltagssprache." Translated, "archive for technology, the life world and everyday language." The extension "ti" (pronounced TEE EYE) stands for text interpretation. Project ATLAS (1989-1992) of Technical University of Berlin was the origin of the software's first prototype.

Following the established frequency hierarchy, data was further summarized and synthesized (Ritchie and Lewis 2003). Utilizing the query tool of ATLAS.ti software, data on a specific theme was brought all together so that it could be studied and synthesized across all cases. Information about each theme was closely analyzed and reported in a meaningful way. This close analysis allowed further identification of subtopics embedded into each theme. In summarizing and reporting, verbatim phrases or expressions from participants were retained as much as possible. Interpretation was kept to a minimum so that at a more refined level of analysis original expressions can be re-examined (Ritchie and Lewis 2003).

During the summary and synthesizing stage, codes and categories were refined. In some cases codes were renamed. In other cases, codes were merged, and in some other cases, they were even moved from categories.

In this chapter I explained the methods utilized to accomplish this research. I first described the methods used to select the sample of respondents and the reasons for choosing these methods. Following I described the methods and instrument utilized to collect the data. And finally I presented the methods utilized to analyze the data obtained. In the next part of this document I will present the results obtained from the survey instrument that agricultural change completed to help the development of this research.

## **CHAPTER IV**

### **RESULTS**

In this chapter I present the results obtained from the web based survey targeted to change agents who are working with sustainable agriculture. First, I describe some characteristics of the sample obtained and their typology regarding the type of institution or organization they represent. Following, I present the change agents perceptions, their involvement with sustainable practices, the relevance of sustainable practices offered in the Southern States, and the extent of adoption of these practices at the state and change agents individual influence levels.

Then I present the familiarity of change agents with some of the most widely used sustainable agriculture practices, as well as the contrast of additional practices that are being employed by farmers in the southern region of the United States. Finally, I describe the main themes captured from change agents' views regarding barriers to adoption of sustainable agriculture practices in the southern states.

#### **Sample Description**

A final sample of 269 respondents was obtained for the change agents' survey. From those who answer the survey 94 percent are male and 6 percent are female. The age of the respondents ranged from 23 to 77 years of age, with an average of 48.5 years.

Change agents were asked to classify themselves. The self-reporting included professionals from agribusiness (37 percent), extension agents (24 percent), USDA-NRCS representatives (12 percent), non governmental organizations (9 percent), and other (17 percent). The participants were evenly distributed among the private and public sectors. Note that of the 269 respondents one half were farmers. The first hand experience of these farmers provided a more in-depth discussion on the role of change agents.

The distribution of change agents according to their level of education is depicted in Figure 1. Approximately 40 percent have college degrees, while nearly one-half of the 269 respondents went on to post-undergraduate education programs.

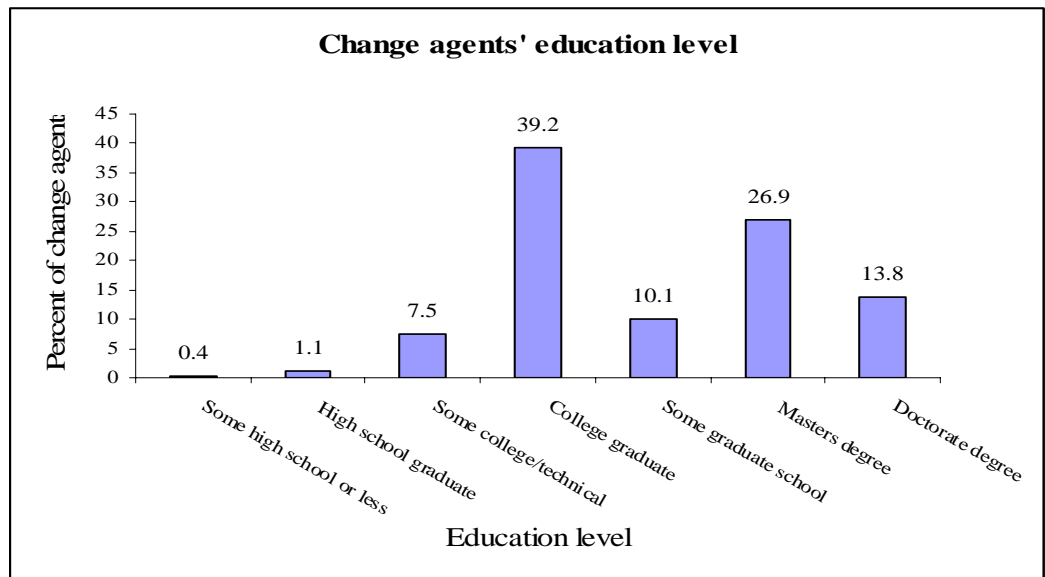


Figure 1. Education level of change agents, 2004.

Around 95 percent of the respondents were change agents from the 13 southern states. The other 5 percent were change agents from outside of the

southern region. The following graph illustrates the number respondents from within the Southern region and indicates that fall outside the area.

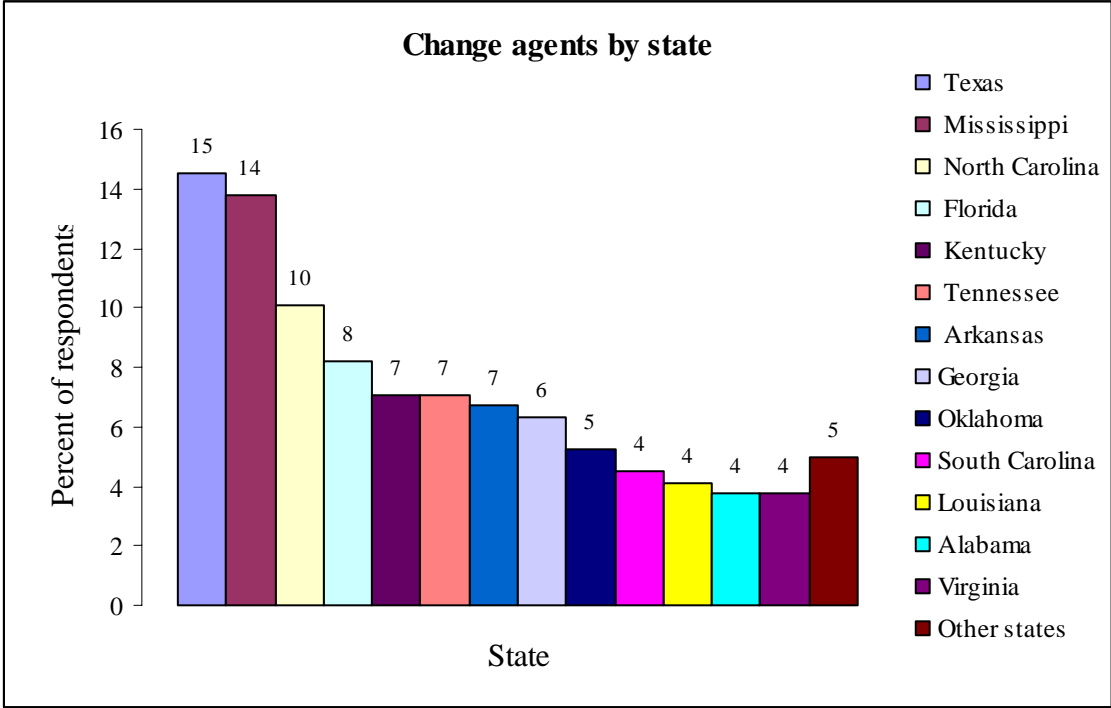


Figure 2. Number of Internet survey participants by state, 2004

**Sustainable Practice Availability and Adoption**

Four questions measure change agents involvement in sustainable agriculture and perceived availability of sustainable practice information. Change agents were asked to respond to each item using the response framework: not at all, slightly, somewhat, great extent, and don't know. Table 2 summarizes the respondents' choices by percentage.

**Table 1 Perceived rate of adoption of sustainable practices, regional change agents, 2004**

Questions	Percent				
	Great extent	Somewhat	Slightly	Not	Don't know
Rate the extent of your involvement in supporting the adoption of sustainable agriculture practices? (N=261)	43	41	13	3	–
To what extent are clearly understandable and useable sustainable agricultural practices available to farmers to adopt in your state? (N=267)	24	54	19	1	4
To what extent are farmers in your state adopting sustainable practices? (N=268)	10	58	27	0.4	4.5
To what extent are farmers you work with adopting sustainable practices? (N=268)	18	54	24	1	2

The table shows that 41 percent of participants have a high level of involvement in supporting adoption of sustainable agriculture practices. In contrast, there is an almost equal level of participants (40 percent) are only somewhat involved in this effort. Change agents noted that there are understandable and usable sustainable practices available in their state, only 24 percent reported that the practices were available to a great extent. Comparatively, a majority of the change agents (73 percent) reported that the practices were available somewhat or slightly.



Change agents (58 percent) reported that the majority of farmers somewhat adopt sustainable agriculture practices. Ten percent of change agents perceived that farmers in their states adopt the practices to a great extent, while 27 percent only report a slight adoption.

Perceptions of farmers that the change agents work specifically with differ only slightly from perceptions about the whole state. Fifty four percent of change agents reported that the farmers they directly work with adopt sustainable agriculture practices somewhat. Compared to the 10 percent reported above, 18 percent perceive the farmers that they work with adopting to a great extent. Twenty four percent report only slight adoption.

Change agents were asked to rate their familiarity with a set of 25 sustainable agricultural practices. The following table reports the eleven practices with the highest rating.

**Table 2. Familiarity with selected sustainable agricultural practices, regional change agents, 2004**

Sustainable practice	Percent (N=287)		
	Not familiar	Somewhat	Very
Soil testing	0.4	14	<b>84</b>
Crop rotation	0.4	22	<b>76</b>
Conservation tillage	3	21	<b>75</b>
Keep soil covered all year	0.4	24	<b>74</b>
IPM-pesticides management	4	33	<b>62</b>
Cover crops and green manures	1	40	<b>57</b>
Diversification	4	43	<b>52</b>
IPM-cultural management	5	43	<b>51</b>
IPM-biological control	7	47	44
Fresh plant as green manure	10	47	42
Weed control (rotation, minimum weed seed)	11	45	42

It can be determined from Table 3 that over 50 percent of change agents report being very familiar with the top eight practices. The practices that the majority of change agents are only somewhat familiar with include IPM (biological control), fresh plants as green manure and weed control (rotation, minimum weed seed).

In addition to the list of 25 sustainable practices presented to change agents in the survey respondents had the opportunity to identify other practices that are currently used by farmers in the South. Change agents identified 118 additional practices. For purposes of analysis the practices were then sub-divided into 12 groupings. Table 4 lists each category and the detailed frequency of practices under them.

**Table 3. Detailed listing of other sustainable practices reportedly used by farmers in the South, regional change agents, 2004**

Sustainable practice	Frequency	Percent of responses to question (N=67)
<b><u>Soil conservation</u></b>	<b>37</b>	<b>57</b>
<b>Nutrient management</b>	<b>13</b>	<b>19</b>
Precision farming remote sensing, GPS	3	
Controlled release fertilizers	3	
Legumes	2	
Split nitrogen applications	1	
UAN solutions	1	
Natural fertilizers	1	
Homemade compost	1	
Mycorrhizal association	1	
<b>Soil structure</b>	<b>11</b>	<b>16</b>
No-till	5	
Strip-till	2	
Spading	1	
Aerator	1	
Permanent beds	1	
Improved no-till	1	
<b>Erosion Control</b>	<b>7</b>	<b>10</b>

Riparian buffers	2	
Cover cropping	2	
wind and contour strip-cropping	1	
Hay feeding in winter	1	
Vegetative barriers	1	
<b>Other soil conservation</b>	<b>6</b>	<b>9</b>
Lime to optimum pH	1	
Intercropping	1	
Multicropping	1	
Restoration of marginal crop lands	1	
crop to pasture land	1	
Flooding & growing rice	1	
<b>Water conservation and management</b>	<b>18</b>	<b>27</b>
Canal bank vegetation	2	
Furrow damming	1	
Hoops structures	1	
Livestock exclusion	1	
Reservoirs building	1	
Storm water management	1	
Tail water recovery	2	
Water table control	2	
Irrigation water management	2	
Land leveling	1	
Multiple inlet rice irrigation	1	
Subsurface drip irrigation and fertigation	2	
Water efficient center pivots	1	
<b>Livestock</b>	<b>16</b>	<b>24</b>
Rotational grazing	9	
Agro forestry	3	
Seasonal dairying	1	
Suitable forages	1	
Silvopasture	1	
Alternative livestock	1	
<b>Pest control</b>	<b>15</b>	<b>22</b>
Crop rotation	3	
RoundUp Ready	2	
Filter strips	1	
Floating row covers	1	
IPM-mating disruption	1	
Multispecies animal production	1	
Pesticides rotation	1	

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Prescribed burns & good spray programs	1	
Bt cotton	1	
Season extension	1	
Smart sprayers	1	
Botanical insecticides	1	
<b>Marketing</b>	<b>8</b>	<b>12</b>
CSAs	3	
Direct marketing	2	
Farm stands	1	
Farmers' markets	1	
Value added products	1	
<b>Economics</b>	<b>7</b>	<b>10</b>
Cooperatives	1	
Financial analysis	1	
Local money systems	1	
Production for local markets	1	
Record keeping	1	
Self help funding	1	
Tax management heir property	1	
<b>Crop production</b>	<b>6</b>	<b>6</b>
Variety selection (native, locally adapted)	4	
Alternative crops	1	
Cotton planted into wheat	1	
<b>Animal production</b>	<b>5</b>	<b>7</b>
Pasture-based animal production	4	
Insecurity	1	
Range chickens	1	
<b>Waste management</b>	<b>4</b>	<b>6</b>
Chicken waste application	1	
Methane digestion	1	
Mortality composting	2	
<b>Weed control</b>	<b>5</b>	<b>7</b>
Drilled soybeans	1	
Flooding	2	
Herbicide rotation	1	
Narrow soybean row	1	
<b>Organic production</b>	<b>2</b>	<b>3</b>
Organic crop, beef and dairy	1	

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Organic certification	1	
<b>Other</b>	<b>13</b>	<b>19</b>
Wildlife habitat management	1	
Buffer strips	1	
Cleaning out drainage	1	
Integrated crop/livestock	1	
Interning	1	
On farm plant breeding	1	
On farm seed production	1	
Sod-based rotations	1	
Stripper headers	1	
Transplants for direct-seed crops	1	
Farm to school programs	1	
"Best Management Practices" in forestry	1	

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Change agents are aware of a variety of practices that are being used by farmers in the South. The majority of practices seem to be related to soil conservation. Water conservation, livestock, and pest control are also issues that farmers are trying to include in their sustainable management. It is important to note that marketing and economic practices are also being included in sustainable management of farms in the South.

### **Barriers to Adoption**

Change agents were asked: What were the major obstacles or barriers that producers must overcome to adopt sustainable agriculture practices? Their responses to this question are classified in the following eight categories. From the total responses to the survey, 78 percent of respondents answered this question. The following table shows the frequencies and percent for each variable from the total answers to this question.

**Table 4. Detailed summary of responses to the question, “What were the major obstacles or barriers that producers must overcome to adopt sustainable agricultural practices?” regional change agents, 2004**

<b>Categories and codes</b>	<b>Number</b>	<b>Percent of responses to question (N=210)</b>
<b>Economics</b>	<b>118</b>	<b>56</b>
Cost	29	14
Financial	19	9
Uncertainty	15	7
Inadequate incentive programs Incentives	13	4
Profitability	10	5
Equipment change	8	4
Risk	8	4
Low commodity prices	7	3
Deferment	7	3
Economics	2	1
<b>Education and information</b>	<b>111</b>	<b>53</b>
Lack of knowledge/ education	40	19
Lack of information	17	8
Lack of institutional support of information sources	15	7
Change agents beliefs about SAP	14	7
Need of information about effectiveness	11	5
Information management	6	3
Giant corporations	5	2
Lack of information about government programs	3	1
<b>Resistance to change</b>	<b>50</b>	<b>24</b>
<b>Use of technology</b>	<b>48</b>	<b>23</b>
Time incompatibility	12	6
Labor incompatibility	7	3
Lack of on farm trials and demonstrations	7	3
weeds/pests	5	2
Incompatible with management	5	2
Incompatibility	4	2
incompatibility with operation size	4	2
Complexity	4	2
<b>Social</b>	<b>33</b>	<b>16</b>
Change of beliefs	8	4

Perceptions of inefficacy of some SA practices	8	4
Peers pressure	7	3
Lack of farmers examples	6	3
Misleading perceptions	3	1
Conventional/Sustainable opposition	1	0
<b>Infrastructure</b>	<b>19</b>	<b>9</b>
Inputs and equipments	10	5
Financial institutions	6	3
Market	2	1
Lack of processing options for small scale	1	0.5
<b>Landlessness</b>	<b>15</b>	<b>7</b>
<b>Personal characteristics</b>	<b>7</b>	<b>3</b>
Age	5	2
Apathy	2	1

**Economic Factors.** Many economic factors constrain the adoption of sustainable practices. The following economic factors are costs, farmers' financial situation, change of equipment, uncertainty, inadequate federal programs, equipment change, risk, and low commodity prices, deferment of benefits.

The most frequently mentioned barrier to adoption of sustainable agriculture practices is cost. This includes in first place the “*initial cost*” of “*converting*” or “*changing practices*” including the “*cost of new equipment*” but also the costs of “*changing for one management style to another.*” More over one change agents affirm that the “*cost of transitioning to a more sustainable or organic system is great.*” One change agent remarked that farmers would be willing to adopt sustainable practices if this means, “*incorporating practices into existing rotations without having to make large capital investments.*”

Respondents included as part of the initial cost “*cost of the [new] system*” which are permanent or “*extra costs*” such as new inputs’ “*transportation costs* (e.g. “*organic materials*”)”. One respondent called the attention to the cost of sustainable compared to conventional practices stating, “*Synthetic products are cheaper in general unless you are using a by-product of your farm operation.*” Farmers are greatly constrained by initial cost of adoption. This is an indicative that they are economically unable to make a transition.

Other barrier described by change agents is farmers’ precarious financial situation. This is a reason for farmers need of short-term benefits. Change agents expressed this problem by stating as barriers, farmers’ “*lack of ...financial resource,*” “*money*” or “*capital*” to keep their business running under conventional farming. This is an important barrier to implement new practices, as stated, “*Most producers need to generate the maximum cash flow to keep the business running.*” They are found “*cash strapped,*” as one respondent clearly explained “*so many growers are so squeezed financially that, even if their current financial situation under conventional farm [management] is terrible, they are afraid to make the jump into sustainable practices.*” One reason for which the financial situation of farmers is a barrier to adoption was explained as, “*too many years of poor [management] places soil nutrient levels at a level that recovery does not fit into the cash flow.* Some federal programs offer incentives but these seem to be not enough; *EQIP offer some incentives, [but] not enough.*”<sup>2</sup>

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<sup>2</sup> The Environmental Quality Incentives Program (EQIP) was reauthorized in the Farm Security and Rural Investment Act of 2002 (Farm Bill) to provide a voluntary conservation program for farmers and ranchers that promotes agricultural production and environmental quality as compatible national goals. EQIP offers



Other barrier for adoption of sustainable practices is the uncertainty or “*fear of the unknown.*” Farmers have “*suspicion of new practices*” or “*uncertainty of consistency [of new practices]*” in terms of maintaining their profits. Uncertainty makes farmers to formulate enquiries such as “*will this different way of controlling weeds, insects, etc. really work?*” “*Will the practice work in my climate, in my soils, and with my management style?*” In other words make farmers develop “*economic fears,*” “*the fear of failure*” or “*reduced yields*” that is normally associated with “*doing something new and different*”. Moreover, with adoption of sustainable practices “*most often the producer fears that the new practice will not work and thus decrease their profit.*”

Another frequently mentioned barrier to adoption is change of equipment; this increases the initial cost and makes adoption more difficult. When adopting a sustainable practice requires a change in equipment or simply discarding old equipment, this represents a barrier for farmers to adoption of the new practice. As a respondent explained, “*if new equipment and technologies are required that is an impediment.*”

This probably was frequently mentioned because one of the most widely adopted sustainable practices seems to be no till, as can be grasped from a change agents’ statement of a barrier to adoption, when “*old tillage equipment has to be converted or sold to make way for NT*”. As other change agent, cited after dealing with the old equipment farmers still need to do “*equipment investment*” on new technologies, “*as in buying conservation tillage equipment.*” The problem of investments in new equipment is caused either because the poor financial capability of farmers and/or because the

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financial and technical help to assist eligible participants install or implement structural and management practices on eligible agricultural land.

*“equipment prices at increasing levels every year,”* so, *“affordable technology”* is unavailable.

Given previous discussion of financial situations and uncertainty, there are little incentives for farmers to adopt sustainable practices. Some change agents cited the problem simply as *“limited incentive to change.”* Others respondents related the lack of incentives to the external sources of incentives. The mentioned that the failure is on *“lack of some funds to motivate participation.”* More precisely those funds from government, because was reported that there is a *“lack of governmental incentives for sustainable farming.”*

A respondent affirms that there are government incentives but claim as a barrier the *“insufficient government support for adoption and expansion of sustainable practices on working lands (the new Conservation Security Program was originally designed to address this, but was largely gutted by low budgets and highly restrictive enrollment criteria).* Other respondent claims that the roots of this problems that farmers face with programs and their regulations are rooted in the *“political misunderstanding of capital incentives useful to facilitate necessary activity and shortage of personnel necessary to implement same.”* Stated as a barrier was the *“lack of understanding of agriculture by state and local regulatory agencies such as Water Management Districts (WMD).”* A change agent suggested that in *“cotton country, the barriers consist of government payments.”*

A response to dysfunctional markets is federal programs designed to help farmers in the transition to alternative production systems. However, these are reported by change

agents to be ineffective or even detrimental. It was stated that farm programs and their regulations are constraining adoption of sustainable practices because these are “*tailored for large farms*” or show “*bias towards large-scale producers in federal programs (EQIP)*.” It was also mentioned regulatory programs have many and/or difficult requirements that makes them unavailable to many farmers. As was explained, “*Federal, State and WMD regulatory programs which require extensive permitting and engineering studies to implement common practices,*” other respondent precisely cited the “*lack of application of CSP.*”

The next encountered barrier to farmer is the risk after initial investments associated with adoption of sustainable practices. It was frequently mentioned that such practices are perceived to involve a high risk over the “*investments*” on new equipment or other types of investment. It was mentioned that with adoption of sustainable agriculture practices farmers have an “*increased risk of losses to insects, weeds, and pathogens.*” Thus “*many farmers feel that the potential lost in income does not justify adopting more sustainable practice.*” In the other hand was identified as barrier the risk of “*increased costs,*” because farmers have the “*thinking that sustainable growing cost[s] more.*”

Farmers’ bad financial situation was mentioned in relation to “*indebtedness.*” In addition, one respondent explained how low commodity prices are the cause for such bad financial situation faced by many farmers and thus a barrier to adoption. As one respondent precisely explained “*low commodity prices..., have placed some producers in that area of not being financially [sound] enough to adopt, or "tool up" to more sustainable practices. [Basically], they are out of business but don't realize it yet.*” As other respondent stated “*with commodity prices at the levels they are(basically*

*unchanged in the last 50 years) and equipment prices at increasing levels every year, growers can't afford to change to strip-till or no-till. They can do some form of conservation tillage, but not to the extent they need to."*

Moreover, it was also mentioned that sustainable producers have problems "getting more money for [their] products," which represents an important barrier for adoption. This may be caused by "bias of food retailers against small-scale producers and distributors" or perhaps to agricultural policies that are unfavorable to small producers.

One aspect of sustainable practices that is often identified as a barrier is the deferment of results that often implies changing from conventional to sustainable practices, especially when changing a farming operation that has been used for a long period under conventional agriculture. Some respondents mentioned that with sustainable agriculture it is "hard to see immediate benefits" because "some of these practices provide benefits but only over long-term usage." Farmer need to give "sustainable practices a fair chance by not giving up after just one year of trying them, since it typically takes 3-5 years to see the full benefit," the problem arises because most farmers are "looking for high, short-term results."

A cited reason for the need of short-term results is that despite "most realize the long term benefits...they have bills to pay today," so that for them is a problem "giving the practices time to work." It was suggested that is important to have a "prove that sustainable agriculture is profitable TODAY" in order to facilitate farmer's decision to adopt.

**Education and Information.** Almost as equally important are education and information factors cited as barriers to adoption of sustainable practices. The following factors were identified by change agents: lack of knowledge or education, lack of information, need information about economics, lack of information, management of the information, information about government programs, lack of institutional support, giant corporations, and change agent beliefs about reduced yields.

Other important farmer characteristics that represent a barrier for adoption of sustainable practices, is their lack of knowledge or education “*concerning sustainable agricultural practices.*” As was stated, “*Not being familiar with practices*” or “*unfamiliarity with a lot of practices*” is constraining potential adopters due the uncertainty of changing to something unknown.

In order have the opportunity of considering a change on their practices, farmers need to be “*aware of the practices and how [these] function.*” More importantly, they need to “*learn new technologies*” and develop a clear “*understanding [of] the process*” and “*of the sustainable agricultural practice.*” Thus, the need of “*learning*” about sustainable practices that was often mentioned as important barrier for adoption of sustainable practices.

Also was mentioned that there is “*lack of knowledge as to the benefits of sustainable practices.*” One change agent notes, “*many lack an understanding of how the practice will benefit them in the long term.*” Another explained, “*too many growers do not fully realize the value of a cover crop.*” What can be more important, to be able to adopt they need “*knowledge that the new system will pay.*” However was mentioned that

farmers often are found *“being uninformed as to the benefits to sustainable agricultural practices to their land, communities and income.”*

This factor limits farmers in their capability to decide to change their ways of farming because they will find difficult taking such important decision *“without clear picture of profit opportunity.”* It was suggested, *“they need knowledgeable people to educate them on how to change the way they do things and be able to show them that it can be done economically,”* and, *“They need someone with enough economic knowledge to make recommendations that are practical and cost effective.”*

Many stated that this is an *“educational problem”* among farmers and suggested that they need *“more education”* in general and in specific *“on the sustainable agricultural practices concept in stewardship of the resource and how they are beneficial to income of the farm.”* One respondent even state that *“sustainable farming is a highly skilled profession! There is simply SO much to learn, and you can only learn some of it in textbooks.”* For example, farmers need an *“understanding that soils are an ecosystem, and that everything that is done to produce a crop [a]ffects everything else in the system.”*

A change agent stated as a barrier the farmers’ *“lack of ability to adopt and successfully use improved technology. It takes a better farmer to use conservation tillage than a moldboard plow,”* in other words *“applying sustainable amendments”* is difficult for some farmers.

Change agents perceive that there is in general a lack of information or in their own words *“lack of good sound information”* about sustainable practices. Some change

agents pointed precisely to the “*lack of good economic information on use of practices,*” which causes that farmers’ “*economic questions...may be left unanswered.*” On the other hand there is a lack of “*knowledge and understanding of long-term benefits*” of sustainable practices, which may not be only economic but also environmental and social. Moreover, one respondent felt, “*there is no local research showing dollars and cents savings from certain practices.*”

Thus, “*more research from university or commercial trials*” is needed to obtain “*proven and demonstrated research results for basing confidence by the farmer that if [adopted] will trend toward achieving maximum economic yield.*” Moreover, there is a need to “*proof by example, especially in the research and University area, that sustainable practices will provide the grower with a profit.*”

Besides the lack of knowledge about the economic benefits of sustainable practices, general lack of sustainable alternatives was reported. One respondent explained “*the lack of usable knowledge about [sustainable] alternatives.*” Thus, it was suggested, “*practices that are practical and effective must be developed and advocated.*”

One major concern repeatedly noted as barrier by change agents is lack of institutional support from the traditional agricultural information providers. This is manifested not only at local, but also at state and national level from government and private sources. As explained by a respondent, “*local governments [are] more interested in revenues to induce manufacturing.*” Also the “*lack of support from major institutions in state,*” and in general the “*lack of support in traditional ag structure - Farm Bureau,*

*Dept. of Ag, extension*” are important barriers that affect the production and dissemination of information about sustainable agriculture.

Moreover was mentioned that these information sources do not believe and thus do not support sustainable agriculture practices, there is “*not enough support [from] ag advisors [or] Ag info providers saying it can't be done.*”

Change agents manifested great concern for “*the lack of support from extension and research... [is being] disappointing in many areas.*” This is manifested in the lack of “*technical assistance*” regarding sustainable practices that farmers are facing. A mentioned reason for the lack of technical assistance was, “*there is not enough economic incentive for a Certified Crop Advisor, Technical Service Provider, or a Nutrient Management Planner to spend the amount of time it take to really assist the farmer with the implementation of all these good conservation practices. When grants are requested for financing the assistance of these qualified people it is ignored. Most grants area given to foundations or groups who already have enough financing to handle all projects they are implementing.*”

Other reasons for the “*establishment of Land grant information... not supporting [the] concept*” of sustainable agriculture were exposed; as for example the “*lack of full-time person[nel] devoted to sustainable agriculture in the university system.*” In addition, the lack of understanding from these institutions, which is perhaps a manifestation of their lack of knowledge, is an important barrier to the creation and dissemination of information. As explained by a respondent, “*lack of knowledge of sustainable practices:*



*relatively low level of understanding within cooperative extension and university support staff.”*

Also one respondent well explained that the roots of the problem may be on economic constrains into the university systems; *land grant universities have sold out to chemical or pharmaceutical companies, so research and teaching do not focus on sustainable practices (unless of course the university can get some of the scarce grant money). It is clear that rebellious farmers have done the footwork and sweating, at their own expense, for all the recent great advances in small-scale farming, which have been largely co-opted by the universities and industry. So unless a farmer is willing and able to go beyond what he or she is offered by the usual information sources (Extension, chemical companies, Farm Bureau, etc.), there is almost no access to alternatives. It's getting better, but in most cases farmers have to find their own resources.”*

Other barrier to generation and distribution of information that helps adoption of sustainable practices is the change agents' belief of reduced yields that is associated to such practices. This is consequently transmitted to farmers limiting the adoption of such practices. This can be grasped from a change agent's expression about barriers to adoption, “[farmers] *can't give up yield.*”

In addition, some change agents said that “*sustainable agricultural practices ...cuts maximum yields*” or “*lower yields.*” Some felt that that this reduction is caused by a “*loss of some crop land.*” This reduction in yield is translated by change agents to a “*reduction of income using sustainable practices*” which transmitted to farmers represents an important barrier to adoption. Moreover one noted, “*there is disagreement*

*in the ranks of academics as to the benefits of sustainable practices,”* which can be a reason for the lack of support from the people who are suppose to help farmers.

An identified barrier is the lack of *“acceptance, support, and promotion by the extension service and USDA agencies line employees.”* This represents an important limit that potential and current sustainable farmers need to deal with; as one respondent broadly explained *“county extension agents (home and agriculture) and vocational agriculture teachers, plus university extension professors who are [farmers] their sources of information, who: 1) believe that sustainable means subsistence agriculture, 2) they do not believe in it and openly do not support or detest it, and 3) are not willing to change.”* Moreover was mentioned as barrier the *“lack of knowledge...by extensionists and other ag advisers”* about sustainable agricultural practices.

This lack of acceptance in the agricultural education and information system was mentioned to have some manifestations in the past related to organic farming. As mentioned by change agent, the *“Ag university programs have had a bias against "organic" methods in the past and many current extensionists or conservationists reflect that bias.* This issue seem to be overcome, in part because *“where it has become apparent that organic can be substantially profitable large producers who are able to take on the risk have gotten into organics and it appears that universities may be influenced in that.”*

Another barrier is the need of information about economics of sustainable practices. To be able to adopt farmers will need guaranteed profitability from changing their methods. As explained by a change agent, farmers *“must feel they can make a profit and stay in business,” “they must be sure it is indeed sustainable, economically.”*

Otherwise farmers will be *“unwilling to change unless they can realize a short tem... benefit by changing practices.”* One respondent even mentioned, *“Some good practices are not adopted because a more profitable option exists.”*

Change agents understand that *“sustainable ag must be as economically efficient or more so as the standard cultural practice or else there would be no incentive to try something new.* They are convinced that *“showing them in easy to understand terms how they can be profitable by adopting new sustainable practices”* will have positive results in terms of adoption of sustainable practices.

However, other respondents think that the problem of lack of information is not the real issue but the management of information regarding to access, classification, and application of it on a specific farm. As he wrote, *“I could have said "lack of information" or "need for more information" or even "insufficient awareness of, and support for sustainable agriculture in extension services." However, there has been major improvement in each of these areas over the past few years – [such as] more and more sustainable ag research and outreach, vital information services such as ATTRA.”* The same agent explains that the *“big information-related barrier is how to access and assimilate the growing mass of information, sort the good info from the less-substantiated and the downright bogus, and most challenging, how to apply it to one's specific farm!”*

Despite the good results with new practices in research settings the problems that farmer face when implementing such new technologies are not actually solved. A change agent stated, *“Most practices are good in paper, workable in research settings [but] difficult to apply on a large scale.”* The implementation is not only difficult when it is

done at large scale but also because variability within farms. One said, *“Some of my farmers farm different types of soil, requiring different systems...too much confusion.”* In consequence was suggested that there is a *“need to develop better and more user-friendly methods or approaches to sorting out what practices would be truly sustainable and economically viable for a specific farm.”*

These information management problems are also related to farmer ability to look the information and assistance to implement sustainable practices. Regarding to this it was stated, *“the major obstacle and/or barrier the producer must over come to adopt sustainable agricultural practices is the ability to receive information and guidance to aggressively implement these practices.”*

The influence of giant corporations at the policy level is another barrier related to information generation and dissemination. This was even cited as *“possibly the most severe barrier of all in the long run.”* It was thoroughly explained how giant corporations negatively affect adoption of sustainable practices. As explained, *“the concentration of food system economic power and control in the hands of a few giant corporations”* are barriers because *“these economic interests pull all kinds of strings to dissuade or even prevent growers from adopting truly sustainable systems - mostly through lobbying at governmental levels to limit the growth of pro-sustainable policy; to remove limits on GMO crops and livestock, and on corporate power over growers (contracts, markets); and to maximize global “free” trade (giving corporations even more control internationally).*

Economic power allows some to work for their own interest in ways influencing farmers' decisions. As explained by a respondent, there is "*propaganda from fertilizer dealers*" "*promulgated directly to farmers to persuade them that modern chemicals, GMOs and "get big or get out" is THE way to succeed in agriculture.*" It also mentioned the "*promotions by equipment dealers to stay with tillage.*"

These commercial companies even try to avoid showing important information to farmers. As stated in a change agent answer, "*chemical fertilizer can be incorporated successfully with OM (compost) with really good results and reduced environmental impacts for farmers who would not readily [switch] to organic production. However, the fear of losing market share "drives the lies." Unfortunately, the fertilizer companies are not liable for the environmental impacts of their recommendations.*"

Another mentioned issue is farmers' lack of information about government programs. There is a need from farmers "*to be informed about programs when they are available.*" Afterwards if they are interested on those "*then they need help applying for them*" because the "*red tape is rampant.*"

**Resistance to Change.** It was frequently mentioned as a barrier in relation to adoption of the farmers' "*reluctance*" or resistance to change "*traditions,*" "*old habits,*" "*old ways of doing things*" and even "*mindset.*" "The adoption of a new way of doing things is often difficult due to resistance to change." One said, "*there is a mindset in many cotton farmers that leads them to monoculture even when they agree that it would pay to diversify.*"

In consequence it was constantly mentioned that in order to adopt sustainable agriculture practices producers “*must overcome the resistance to change,*” “*get out of the old mindset of farming,*” “*break from tradition,*” “*learn to break old habits,*” “*change of attitude and way of doing things,*” “*break the routine.*” It was suggested that producers “*must... be open minded*” because adopting sustainable agriculture practices implies “*changing from a way of doing farming for long time to a more cost effective, long term profitable way.*”

While “*traditionalist*” farmers were some times described as “*short sighted*” and with a “*ain't broke don't fix mindset.*” There were some reasons explained by change agents for these attitudes. In first place, they connect farmers’ attitude to the fact that “*often times a grower farms the way he farms because his daddy did it and his granddaddy before that,*” so that their way of farming is a “*custom or cultural habit*” and the change of it represents “*cultural shifts.*”

In second place , farmers’ resistance to change was also attributed to their “*thinking that their dads and granddads didn't necessarily farm in a sustainable fashion, so sustainable practices are not the best route to take, i.e. Dad and granddad raised excellent crops and did not practice sustainability very much at all.* So farmers see no need to change “*what works now*” and are reluctant to change to something new with what they are unfamiliar. As was stated, “*Many producers feel comfortable with the currently used technologies with which they are familiar but are reluctant to charge into use of production techniques that they are not familiar with.*”

In a third instance, change agents consider that comfort associated with farmers' current management strategies are a cause of their resistance. Thus, they think that resistance to change will be difficult to overcome because it implies changing farmers' habits and will create them discomfort. As was stated, farmers "*are accustomed to having their cropping system wrapped in a nice package (jugs and bags) and readily available to apply today. This is habit forming and the habit will be hard to break.*"

In fourth place, some habits that can be assumed to refer to farmers' management strategies are developed after many years of trial and error learning processes. These strategies are part of the farmer's agricultural system and thus are difficult to change. Farmers were and are told that increased yield should be their only goal and their current farming systems were developed under that paradigm. Due to their current system works well, under that paradigm, farmers see no reason for change to different farming strategies.

As was explained by a respondent "*most producers are caught up in the old paradigm of using petroleum based fertilizers and pesticides to increase or maintain crop yields. They believe in that system. They trust that system. They often have such little faith in the sustainable practices that they dismiss them before they try them. Many producers do not even want to learn about sustainable agriculture. They feel an aversion to the name.*"

Fifth, farmers resist to the change because this involves the conduction of new on-farm trials with what to generate the new required management strategies. As was

explained, with adoption of sustainable practices farmers “*have to try new methods and many are not willing to make that change.*”

And last but not least, it can be perceived that part of this reluctance to change is the risk factor associated with sustainable agriculture, this “*fear of changing the way things have always been done*” without having assurance of the outcomes. As explained by a respondent, “*there are always some costs to instituting new practices, and many people think it's just fine the way it is.*” In other words, they prefer to avoid the risk that involves changing their agricultural practices.

The problem of “*overcoming the 'that's the way we've always done it' mentality*” is not only about the young or mid aged farmer that are doing things as their predecessors did. It is also about “*the older traditional farmers,*” about whom some change agents felt “*are not going to change.*” This was mentioned to be an issue for younger and mid age farmers because “*older generation*” are the ones “*that still have control over the land,*” in many cases.

On the other hand, agencies are not actually accelerating this process. Some change agents think, “*change comes slowly without a strong external influence to drive it.*” Thus, they see as necessary to “*find governmental agencies which can change their thinking from traditional agriculture to a more diverse agriculture which uses the best of traditional and sustainable practices to become more progressive.*”

**Barriers Related to the Use of Sustainable Agricultural Technologies.** Some of the barriers to adoption of sustainable practices are related to the use of these technologies. Aspects of sustainable technologies usage mentioned as barriers are: time



incompatibility, labor incompatibility, lack of on farm trials and demonstrations, management style incompatibility, incompatibility with operation size and complexity.

Another barrier to adoption of sustainable practices was mentioned to be time incompatibility. This refers to the time that these practices will require, and that farmers may lack to implement them successfully. It was indicated that sustainable practices requires time investment. As stated by a change agent, these practices are “*too time consuming,*” either because the need of “*investing the time to learn different methods*” or “*to implement some practices.*”

In addition, some mentioned the investment on “*time involved to separate areas to trial*” and the “*shortage of time with [two] growing seasons*” that farmers may encounter with adoption of some sustainable practices. Thus farmers’ lack of time affect negatively adoption of sustainable practices, they “*lack of time to learn more.*”

Farmers may also find labor incompatibilities as an issue to consider when thinking about changing to sustainable practices. This will depend upon which practice is being adopted, but farmers may need more “*employees (help)*” or “*labor for cultivation, etc*” when adopting sustainable practice. In addition, they may need to eliminate their current labor and because their “*people commitments*” they are “*waiting for employee who has been with them for 20 years to retire.*”

The barriers of lack of information and complexity are also related to the lack of on-farm trials and demonstrations, because farmers “*want to see it work prior to adopting the practice.*” Unfortunately, change agents report that farmers “*lack good tests of what practices will work best on their farm.*” Other change agent explains that there are “*not*

*enough on farm trials - time research is done is years before any on farm trials and demos are initiated.”* Also is reported, *“Sometime the research stays in the science field and not put into the farmers hands.”* These may be the reasons why change agents report, *“Both the long-term and short-term BENEFITS of sustainable agriculture have not been stressed enough.”*

There is a need for *“application by local Universities to demonstrate feasibility”* and *“intangible benefits such as improving soil, reducing weed growth and other aspects that are hard to economically quantify.”* Assessing changes emanating from a large-scale, long-term cropping systems experiment, Young et al. (2004) discovered that the planning and execution of field research plays a significant and influential role in transferring more complex, and perhaps high-risk, conservation-based farm technology. By understanding how research and field design affect different user groups within the grower community, professionals can identify appropriate strategies to expand interest beyond their primary target audience and influence attitudes and behaviors that facilitate widespread adoption.

The incompatibility of practices with current systems may also represent in some cases a barrier. One change agent explained that some farmers are *“unable to adapt innovative techniques to current practices”* because the *“new method that doesn’t fit well into their current practices.”* Incompatible with management strategies was a barrier related to farmers’ management ability because *“change in operation practices”* implies a change from *“one management style to another.”* Changes in managements styles are more critical when involves a changes in the way of *“managing disease and pests.”*

Incompatibility with operation size is also another barrier because “*most producers are farming a greater number of acres than they used to be. Their time is strained trying to implement their normal operations.*” Large producers may find it difficult to implement some practices at large scale, as stated by a respondent “*adaptation of practices to large acreage commercial crops.*” Also was mentioned the problem that “*larger producers feel it cost more and will slow them down in the busy season.*” Other change agent suggested that sustainable producers “*typically... farm a large number of acres and are unwilling to change unless they can realize a short term financial benefit by changing practices.*”

One that is related to the lack of information problems in sustainable agriculture is the complexity of sustainable practices. This is referring to “*the highly complex and site-specific nature of sustainable and organic farming methodologies.*” This was attributed to site-specific problems of implementation of sustainable practices, such as with “*adaptation to all soil types*” for certain practices. As one respondent well explained, “*the variability of reaction to sustainable practices is a big problem. One soil or field may respond differently from another because of historical use, extent of previous topsoil loss, the existence of natural root restriction zones, etc. Tillage resolves some of this inherent variability, and makes more soils act alike, thereby simplifying management for farmers. They resist anything that adds complication to their world.*”

This complexity of sustainable practices was also attributed to the complex nature of interactions among elements of the agricultural system. As stated by a respondent “*the interactions between soils, crops, insects, weeds, micro-organisms and livestock are so*

*complex that much is still unknown. As a result, a specific practice that works very well in one situation may not work in another.*

**Social Context.** Social issues related to farmers' social context are also barriers to adoption of sustainable practices. Factors from farmers' social context that are barrier to adoption are: change agents perceptions about sustainable practices, change on social norms and beliefs, lack of farmers examples, peer pressure, misleading perceptions about sustainable practices, conventional or sustainable opposition.

According to one respondent, a "*widespread disbelief that these practices will work*" prevails among both change agents, farmers and perhaps others in society. This perception of inefficacy of sustainable practices by change agents is a clear barrier to their adoption. This refers to the problem that sustainable practices considered by change agents and in consequence by farmer, to be "*not profitable*" or to have "*questionable economics*." One change agent clearly report as barrier the "*efficacy of some practices compared to conventional measures*."

The view that only increases in production should be the goal, is detrimental to adoption of sustainable practices. As was stated by a respondent, "*profitability in my mind is the largest road block hindering sustainable agriculture practices. To be profitable growers must move to increase production on every acre, which will in turn lower cost for each unit produced. While some of these practices...are positive and could in turn increase production, I personally really don't see the two concepts as [similar] (i.e. rock phosphate as fertilizer can only serve to increase soil [phosphorus] levels because it is unavailable to promote growth in plants.)*."

Moreover, the view from change agents that conventional practices are effective in achieving sustainability is hindering the adoption of sustainable practices. Other change agents felt that *“current production methods are keeping our producers financial sound (sustainable). Adopting some of the methods proposed by SSARE would reduce profits and make some operation un-sustainable.”*

In addition, other beliefs related to alternative agricultural systems are affecting adoption of sustainable practices. As examples change agents stated, *“Strong belief that organic fertilizers can never achieve same yield results as chemical fertilizers”* and the *“strong belief that biological controls are not as dependable as chemical pesticides, cannot reduce pest populations enough to maintain populations below economic thresholds.”* These beliefs are transferred to farmers, perhaps contributing to the generation of the *“won't work on my farm”* attitude on farmers.

In addition, the socially created belief that the appearance of the field is an indicator of how good the farmer is, affects negatively farmers decision to adopt sustainable practices. Farmers feel the *“need to have best looking fields.”* In consequence, part of the necessary change that will facilitate adoption of sustainable practices lies on change of these beliefs, not only on farmers but in their social context. As reported by a change agent, many times *“farmers are prideful people who want other farmers to see weed free fields with row[s] that are completely weed free.”* Thus, it was reported that adoption of sustainable practices often times involves *“getting used to a different appearance for their farmland,”* and producers *“must be... willing to look at "grown up mess" for a while.”* Moreover, *“many growers need to learn to be comfortable with the*

*fact that a field need not be completely weed or pest free in order to gain maximum profit/acre.”*

Other important social barriers to adoption of sustainable practices are lack of farmer examples and peer pressure. It was explained that there are “*not enough examples for farmers to observe*” or even more precisely, there is a “*lack of good successful examples.*” Other change agent noted that farmers’ lack of “*exposure to creative, out-of-the-box thinking.*” The other social constrain of peer pressure was frequently mentioned and even considered by a change agent to be a “*much bigger deterrent that most folks realize.*”

The general lack of support from change agents to sustainable agriculture can be attributed to their perceptions and beliefs. These are affecting farmers negatively in adoption of sustainable practices, either by transfer of these perceptions to farmers or by the lack of support from change agents to farmers. There are many misleading perceptions about sustainable agriculture or sustainable farmers among information sources that are detrimental to the process of adoption, as cited above “*believe that sustainable means subsistence agriculture*” or “*way out practices.*” Others may hold perceptions that “*sustainable is organic and the idea that the organic folks are determined to take away the chemical options that traditional farmers have.*”

In addition, there is the conventional or sustainable opposition that had lead to rejection from the part of farmers of sustainable concepts. As mentioned by a respondent this rejection is due that, “*producers’ dislike of avid sustainable ag proponents who often badmouth what the evil greedy or stupid farmers are doing to our environment.*”

**Infrastructure.** Manifestation of the general lack of support that sustainable agriculture faces is the lack of infrastructure encountered by sustainable farmers. Some of the infrastructure factors mentioned as barriers are: inputs and equipment sources, financial institutions, market, lack of processing options for small-scale producers.

An infrastructure barrier encountered by farmers is the availability of alternative inputs and equipments or the lack of sources for them. In other words, problems such as lack of “*availability of alternative materials*” or “*organic materials*” and “*equipment*” are being felt among the farmers. This is also referring to the lack of existence of inputs or equipments; as mentioned by a respondent “*lack of proper equipment*” as for example “*harvests equipment for narrow row.*” Also can be the difficulties in the “*access to new materials (fertilizers)*” originated from the lack of “*sources for alternative management inputs.*” Thus it was suggested the need for “*easy source of material.*” It was also mentioned the scarcity of essential resources such as “*water supply to grow the double crops*” to be a barrier.

The alternatives sources of funding that could facilitate adoption are not supporting adoption of sustainable practices. Financial institutions are not really prepared for helping farmers to make the transition. This barrier refers to the fact that “*banks and insurance programs [are] not set up to accommodate the different practices involved in sustainable ag.*”

It was mentioned that there are “*external limits – imposed...by the financial community.*” This probably originated because “*lenders... are not knowledgeable*” about sustainable practices. This leads to a lack of understanding by financial institutions, “*bankers... are not interested in long term practices, just annual bottom line.*” Change

agents saw a need for “*understanding by lenders*” to eliminate the current “*bias of lending institutions against "new" production methods and alternative enterprises.*”

The market which for sustainable products is a significant issue mentioned by respondents in terms of “*lack of proven market history for sustainable products.*” This is affecting the development of “*markets for new crops*” and “*established distribution networks for sustainable products.*” On the other hand, there is also “*bias of food retailers against small-scale producers and distributor,*” which is limiting the development of market alternatives for sustainable products.

Another part of infrastructure that is affecting sustainable producers is the lack of processing options, as one respondent stated there is a “*complete lack of facilities for small-scale poultry processing; limited facilities for temporary storage of horticulture crops (cooler space); lack of local canning, freezing, processing facilities that are available to the farmer or local processor.*” All these infrastructure limits may be contributing negatively farmers’ adoption of sustainable practices.

**Land Tenure.** Other frequently mentioned economic constraints for adoption of sustainable practices is the landlessness or “*absentee land ownership.*” It was mentioned, “*Many farmers lease lands,*” or in other words “*landlord or tenant relationships control [majority] of the acres.*” It was mentioned that those producers who are “*farming leased land*” might be refrained to adopt sustainable practices because usually “*landlords dictate what can be done with their land*” and he “*may or may not allow*” such changes. Moreover, landlords may “*not allow new practices to be tried on their land.*”



Farmers may also be refrained by the only reason that he will “*worry about what the land owner will say.*” These issues give us the idea that only “*growers who own their own land, not lessors*” may be able to adopt sustainable practices. It was also remarked that there is an increase of farmers with “*limited amount of land to farm,*” and this problem of “*producers with dwindling acres*” was attributed to “*land utilization issues,*” such as *high land values and increases [in] land development.*

**Personal Characteristics.** Because of the farming history of old generations some change agents think that definitely age is a barrier to adoption, so that older farmers “*for example: Father's or Grandfather's who are going to farm the way they always have farmed,*” are unlikely to consider adoption of sustainable practices; in contrary “*younger growers may be more interested than old*” probably because they are “*ready to retire*” and “*do not have the years to see some of the benefits.*” As mentioned before old generations may be stopping younger ones to adopt because often they “*still have control over the land.*”

**Philosophies and Perceptions.** Another identified barrier is farmers’ apathy to the negative effects of conventional farming. This was attributed to farmer’s lack of understanding of farming systems, as explained by a respondent, “*most growers have their eyes on the money, and that is the most important thing to them. They can't see that farming is a whole system, they can only see the bits and pieces.*” Other mentioned reason was that farmers are unable to perceive negative effects of conventional farming and “*they require proof that bad practices (pesticides) are harming them and their land, whereas they should be requiring proof from the Chemical Company that is just trying to make a profit off of them.*”

A change agent noted that farmers’ *“perceptions that changing practices may result in [yield] loss.”* This is also mentioned to be directly associated by some farmers to sustainable practices, as a respondent explained the *“perception of the cost or return of some recommended sustainable practices limits their use”* is an important barrier to adopt.

**Summary.** The delivery of sustainable agriculture practices presents some difficulties. Only less than half of change agents appear to be really involved in supporting adoption. While from the 25 most widely known sustainable agriculture practices only half of these were reported to be very familiar for more than half of change agents, there is a great variety of sustainable agriculture practices that are being used by farmers. In addition only a quarter of the respondents considered that clearly understandable and usable sustainable agriculture practices are available in their state.

In part, as a result of these difficulties in the delivery of sustainable agriculture practices, adoption has not advanced significantly in the southern states. Only 10 percent of the respondents think that sustainable agriculture practices have been adopted to a great extent in their state. Apart from these difficulties in the delivery of sustainable agriculture practices change agents have described many other barriers to adoption in the southern states.

Economic factors are more frequently cited as barriers and at the same time motives for adoption of sustainable practices. The main perceived economic barriers are: cost of transitioning, farmers’ precarious financial situation, risk and uncertainty of

adopting sustainable practices, and deferment of benefits that characterize many sustainable practices.

Equally important in change agents' view are the barrier related to education and information regarding sustainable agriculture practices. The lack of education or knowledge about these technologies is a great barrier, especially regarding the impacts and benefits of adoption. This appears to be exacerbated by the lack of available information. This is in part attributed to the lack of receptivity of change agents to information about sustainable agriculture practices, and the lack of effectiveness of information sources on accumulating, classifying and delivering relevant information to farmers

Resistance to change was frequently noted as a barrier by the change agents. Farmers do not adopt sustainable practices because they are reluctant to change traditions, old habits, farming cultures, and mindset. Some asserted that farmers see no need for change, are caught in the old paradigm, and that sustainable practices represent a cultural shift.

Barrier related to the incompatibility of sustainable agriculture practices with the current management strategies (e.g. weed and pest management) and the characteristics of operations (size, labor needed) are a barrier clearly explained by respondents. This is exacerbated by the complexity of sustainable agriculture practices.

Social factors are also barriers to adoption identified by change agents. Lack of support from technical personnel due their misleading ideas about sustainable practices and sustainable farmers was explained by respondents. A tendency to cling the old

production paradigm is a considerable barrier to adoption, as are beliefs supported by peer pressure, regarded as a much bigger deterrent than commonly expected. Lack of farmer peer examples was noted a central social barrier to adoption.

In addition, change agents identified as barrier the lack of infrastructure to support adoption. Lack of sources of inputs and equipment, financial, marketing and processing options are the problems directly pointed by respondents. A considerable number of respondents considered land tenure as an important barrier to adoption.

## **CHAPTER V**

### **CONCLUSIONS**

The perspectives provided by change agents from across the southern region of the United States leads to the conclusion that there are several important barriers to adoption of sustainable agriculture practices. From the nine open questions in the survey, the one referring to barriers to adoption of sustainable agriculture practices yielded the second highest response rate. However, the answers about barriers to adoption are more varied. There were 30 percent more codes from the answers referring to barriers than those referring to motivations. Change agents have a lot more to say and discuss when asked about barriers to adoption than about other subjects.

The majority of respondents indicated they were ‘somewhat’ involved in supporting adoption, that relevant practices were ‘somewhat’ available, and adoption is ‘somewhat’ occurring. This is promising in that there appears to be progress in the offer and demand of these technologies. However, it also indicates there are obstacles to adoption originated from the promotion side. In other words, sources of information are also failing to provide enough adapted options to farmers; not only for the existence or availability of options but for the delivery of them.

Additionally, there is a significant discrepancy between the percent of change agents who consider themselves to be very involved in supporting adoption of sustainable practices, and respondents who consider that adoption is happening to a great extent.

This indicates that despite having a sort of support from change agents farmers may have other important obstacles to adopt, which are not a result of the failure of information sources.

From the twenty five most widely known sustainable practices, only 50 percent of change agents are ‘very’ familiar with half of them. While farmers seem to be using a considerably broader array of sustainable practices, only some change agents are prepared to help farmers with some of the most common practices. This indicates that farmers may encounter important difficulties obtaining the technical help they need to adopt sustainable practices.

Soil and water conservation strategies emerge as important practices for farmers. This might be a sign that soil and water problems are significant and thus receive more attention by farmers and even agencies. Farmers are also using practices to maintain financially sound operations, including marketing, financial management, and credit strategies. In addition, farmers are using sustainable practices that are more specific to their operations (livestock, animal and crop productions). This points out the need for more attention to specific production systems by research and extension agencies.

Most change agents agree that the economic dimension of barriers to adoption of sustainable practices is an important issue. While many of them state that cost is a barrier to adoption, few clearly explained this point. Those that further explained their ideas of cost as a barrier indicated that if conversion implies great costs, such as new machinery or discarding old machinery, or additional new costs associated with the use of practices, the initial hurdle of implementation can be too high, and farmers will be discouraged

from adopting. Additionally, respondents explained that transition costs are a great barrier to adoption, because the resource base is greatly depleted.

The initial cost and transition cost barriers are greatly exacerbated by the farmers' precarious financial situation and the uncertainty about the economic outcomes of the new practices. All of the previous factors combined increase the farmers' perception of the risk associated to adoption. Most farmers are looking for economic benefits attainable in a short term because many have insecure finances and need to keep their operations functioning. Farmers' difficult financial situations make them unable to adopt sustainable agriculture practices that will generate economic benefits only in the long run. Such a situation is caused by low commodity prices which affect all farmers. Therefore many farmers cannot afford changing to sustainable practices.

The United States Government has implemented economic incentive programs that intend to help farmers to make the transition. However, many problems seem to have impeded the effectiveness of these programs. In first place, low budgets have limited their impact. Secondly, some respondents expressed their limited effectiveness due their highly restrictive requirements which make them actually helpful only to large operators. While these approaches may intend to have more impact with the available scarce economic resources assigned to sustainable agriculture, it might be leaving behind small farmers, who can have more difficulties than large scale farmers in investing in new practices and marketing their products. More importantly, such approaches imply a disregard for the social goals of sustainable agriculture, which support small farms that bring greater economic and social benefits to communities.

In addition to all the economic constraints encountered by farmers, there are also barriers to acquiring the information and the knowledge needed to make a transition. Most farmers lack of knowledge about implementation and benefits of sustainable agriculture practices. This is aggravated by the fact that sustainable agriculture is a highly skilled profession. These factors can limit the farmers' ability to adopt sustainable practices to a considerable degree.

Despite of farmers' needs of information, technical assistance, and education regarding sustainable agriculture, there is a lack of relevant information about sustainable practices and many problems with the delivery of information. Lack of information, especially about the economic impacts and other long term benefits of sustainable agriculture, is an important barrier to adoption. The lack of research and local trials results in the inappropriate technology problem.

The lack of research and trials can be attributed to the lack of support from traditional information sources. This relates to the lack of personnel assigned to work in sustainable agriculture and also to the limited knowledge and understanding from personnel of these institutions of sustainable agriculture. This general lack of support from the traditional information sources is caused by scarce economic resources allocated to sustainable agriculture within the public monies.

In addition to the lack of support from traditional information sources, alternative sources of information also face difficulties getting financial support in the form of grants to promote sustainable agriculture practices. These leave farmers in a difficult situation, trying to get information and assistance implementing such practices.



The lack of information available about sustainable agriculture practices causes change agents' beliefs that sustainable practices are economically inefficient. These beliefs contribute to change agents' lack of acceptance of such practices.

The problem of lack of information is related to the lack of research and the inadequate management of existing information regarding sustainable practices. Access and adaptation at the local level of existing information are significant barriers to the delivery of information, which does not complement the farmers and change agents' needs for locally adapted information. Moreover, the impact of a lack of relevant and reliable information is worsening by the fact that many giant corporations aggressively bring confusing information to farmers causing.

On the other hand, if we compare all the issues mentioned as barriers, it can be observed that the most frequently mentioned barrier to adoption is reluctance to change. However, this issue was not fully explained by many respondents. This leads us to believe that many change agents only use these terms to blame farmers for the non-adoption, neglecting the reasons for such behavior.

Some respondents explained this resistance to change in terms of the culture and traditions that farming represents for many producers. Additionally, the practicality of staying under a known, less complex and effective system (in farmers' view) explains their resistance to change. Also, there are, as mentioned before, many costs associated with adoption, including the cost of conducting trials that might cause such an attitude to exist. A farmer's advanced age can be another explanation for this attitude.

Barriers related to the incompatibility and complexities of sustainable agriculture practices are also considerable. There are incompatibilities with time, labor, management

strategies, and operation size. However, the barriers of incompatibility and complexity appear to exist in close relation with the lack of information barriers, especially the lack of trials. Incompatibility with operation size is related to the problem that most farmers are forced economic situations to farm large quantities of land.

The social context, in which farmers are facing the decision to adopt sustainable agriculture practices, is also a source of barriers to adoption. Socially held beliefs and perceptions are hindering adoption. These can be affecting farmers through change agents, peers, or the other members of their community. Some of these beliefs can be rooted in the lack of information and knowledge about sustainable agriculture and the traditional production paradigm. In addition to the negative influence that the surrounding people can have over farmers' adoption decision, the lack of examples of successful sustainable farmers is another social barrier.

There must be a favorable infrastructure for sustainable farmers to implement sustainable agriculture practices. There are important infrastructural barriers to adoption. The lack of input and equipment sources, the lack of processing and marketing options and the lack of adequate financial services are all important barriers affecting farmers' decision to adopt. The lack of financial options seems to be also related to the lack of information and the diffusion of the existing information to financial institutions who design credit options for farmers.

Another important barrier to adoption of sustainable agriculture practices is land tenure constraints that cause many tenants to not feel comfortable with trial and adoption. High land values and land development are some of the reasons for pressure over the land. These may cause a limited amount of land to farm and pressure over land. Thus

tenants need to be cautious about adopting sustainable agriculture practices under the previously explained limiting conditions.

### **Implications and Recommendations**

Sustainable agriculture needs greater support from traditional information sources agencies. This is being limited by the lack of funding for sustainable agriculture that these institutions face. However, data from this research supports the idea that better administration of scarce resources could have an impact on the spread of adoption of sustainable practices. Adequate allocation of financial incentives and grant monies, and constant evaluation of their impact, can generate positive results. Agencies need to be careful in choosing the allocation of economic resources. Targeting farmers and change agents that are really interested in sustainability, who need the economic help, and who can maximize the impact of such scarce resources, can lead to the wise use of economic resources.

Additionally, improved management of the existing information should lead to relevant and available information for change agents and farmers. This in turn should help to overcome the many believes and uncertainties about sustainable agriculture and to wide spread acceptance of the idea. Practices need to be designed and delivered under a bottom up approach that allow for initial assessment of local needs. This can reduce unnecessary efforts and expenses. Additionally, the two way communication links between information delivery and research agencies need to be strengthened.

Agencies need to break the ideas that have been left behind by the traditional extension paradigm. The idea that farmers are to be blamed if adoption does not occur,

after information was provided, needs to be eliminated. If farmers fall under such criticism, this research shows that the farmers' decision of non adoption might be rational, under the current conditions limitations to adoption. Agencies trying to promote sustainable agriculture need to examine how they can prevent such obstacles in the short and long run.

It is also clear that agencies need to address their efforts, not only to farmers but to change agents, communities, and the general public. This can help to reduce some of the beliefs and perceptions that are hindering adoption, and at the same time increase public support to the concept. Public support in the long run will help sustainable agriculture to obtain more support from government, and from the other components of the infrastructure needed for agricultural production and commercialization.

### **Methodological Conclusions**

It is necessary to document the pros and cons of the experience of this research which had utilized new methodologies for information gathering. The use of Internet based questionnaires was a powerful instrument to get responses from people that otherwise could be difficult to contact and find. However, certain inconveniences have arisen. Of great importance for this research is the fact that many respondent mentioned certain issues, but did not further explain them, leaving researchers with difficulties in explaining the existence of phenomena.

The use of the ATLAS.ti for analysis of qualitative information has been an advantage in managing the amount of and varied information received from this survey. Without this tool, this information can be extremely difficult to manage. While some

criticize that programs such as this can serve to lose clarity, even while improving the scope of studies; I agree with those who see that such tools can serve to conduct qualitative research where scope is also required, as was the case of this study.

It can also be said that the great complexity and great amount of information received from this survey limited the full use of the advantages of this analytic tool. Diagrams of relationships between variables could have been very helpful but in the case of such amount of information and variety, they are difficult to construct.

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## APENDIX

APPENDIX A

Web-based Survey Instrument

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# Sustainable Agricultural Practices

*How can we make more progress?*

**An Internet Survey Conducted by Auburn University**

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Dear colleague:

The Southern Sustainable Agriculture Research and Extension Program (SSARE) has asked us to identify and clarify barriers to the adoption of sustainable agricultural practices.

You were identified as a knowledgeable individual with respect to the practice of sustainable agriculture.

We believe that those practicing sustainable agriculture or working with farmers who do so have insights and perspectives that can help the organizations and institutions serving agriculture improve their support they provide on this vital topic. Your comments and views are a vital part of this process.

Information from this study is confidential; your name will never be linked to the study results or outcomes. You and your firm or agency will not be identifiable in our written reports or oral presentations.

Do you have any questions or concerns about this? If so, email your questions to Dr. Joseph Molnar or his private email.

After you have submitted your responses, a separate process will ask you if you want a copy of the results and where they should be sent.

1. Please rate the extent of **your involvement** in supporting the adoption of sustainable agricultural practices? (*Check one*)

Not at all   Slightly   Somewhat   Great extent

2. How **familiar** are you with each of the following sustainable agricultural practices? (*Mark each practice*)

***Sustainable Agricultural Practices***

A. Conservation tillage that avoids moldboard plowing

Not            Some            Very

B. Biologically active compost

Not            Some            Very

C. Biorational fungicides-compost teas, baking soda, plant extracts

Not            Some            Very

D. Biorational insecticides-soaps; pheromones, and insect growth regulators

Not            Some            Very

E. Cover crops and green manures--perennial and biennial sodgrasses, clovers, alfalfa

Not            Some            Very

F. Crop rotation-break weed and pest life cycles, provide nutrients to sequenced crops

Not            Some            Very

G. Diversification-spreading income and costs, animal wastes as inputs to plants

Not            Some            Very

H. Farmscaping--habitat for beneficial organisms, borders, windbreaks, special plantings

Not            Some            Very

I. Fresh plant material incorporated as green manure

Not            Some            Very

J. Grazing or hogging-off of grain residue

Not            Some            Very

K. Intercropping to reduce weeds and cultivation

Not            Some            Very

L. IPM- biological control -natural enemies and soft pesticides

Not            Some            Very

M. IPM- cultural management- delayed planting, crop rotation, altered harvest dates



Not            Some            Very

N. IPM-pesticide management--economic thresholds, sampling, need-based spraying

Not            Some            Very

O. Keep soil covered all year--to reduce erosion, retain nutrients, protect water-holding ability

Not            Some            Very

P. More natural chemical fertilizers such as (12-50-0) MAP

Not            Some            Very

Q. Multispecies grazing to control weeds

Not            Some            Very

R. Soil testing to guide additions of lime, rock phosphate, other amendments

Not            Some            Very

S. Transitional fertilizers in combination with composts

Not            Some            Very

T. Using composts or aged manures

Not            Some            Very

U. Weed control--allelopathic cover crops; timing interventions to control seedlings

Not            Some            Very

V. Weed control--mulch, nurse crops, smothering with short-term planting

Not            Some            Very

W. Weed control--sound rotation, thwarting weed seed, minimizing new weed seeds

Not            Some            Very

Are there **other** sustainable agricultural practices not mentioned in the above list that farmers in the South are using? (*Answer in your own words*)

3. To what extent are **farmers in your state** adopting sustainable practices? (*Check one*)

Not at all            Slightly            Somewhat            Great extent  
Don't know

4. To what extent are clearly understandable and useable sustainable agricultural practices **available to farmers** to adopt in your state? (*Check one*)

Not at all            Slightly            Somewhat            Great extent  
Don't know

5. To what extent are **the farmers you work** with adopting sustainable practices? (*Check one*)

Not at all            Slightly            Somewhat            Great extent  
Don't know

6. What characteristics of producers do you see as being helpful for implementing sustainable agricultural practices? (*Answer in your own words*)

7. What were the **major obstacles or barriers** that producers must overcome to adopt sustainable agricultural practices? (*Answer in your own words*)

8. What do you see as the major forces **motivating farmers** to adopt sustainable agricultural practices? (*Answer in your own words*)

9. How have **public agencies** (extension, NRCS, universities) have been most helpful in efforts to put sustainable agricultural practices in place? (*Answer in your own words*)

10. In what ways have **public agencies** been most **disappointing** to you in their efforts to support the adoption of sustainable agricultural practices? (*Answer in your own words*)

11. How have **commercial firms or dealerships** helped efforts to adopt sustainable agricultural practices in your state? How have they hindered? (*Answer in your own words*)

12. To what extent have **farmer organizations, conservation organizations, or environmental groups** hindered or helped efforts to adopt sustainable practices in your state? (*Check one*)

		Hindered		Make No Difference	Helped	
		A lot	Some		Some	A lot
a	farmer organizations					
b	conservation organizations					
c	environmental groups					

13. In what ways have they **helped or hindered**? *(If applicable, please answer in your own words)*

14. What **communication methods** will be most effective for advancing the adoption of sustainable practices in the next few years? *(Mark each method)*

Methods		Effectiveness				
		Not	Slightly	Some what	Very	Don't Know
A	Field days					
B	Farmer-to-farmer support					
C	Group meetings					
D	One-on-one extension					
E	Mass media					
F	Web-based information					
G	Word-of-mouth					
H	How-to-leaflets					
I	Books and manuals					

What other methods would be effective for promoting the adoption of sustainable agricultural practices? *(Answer in your own words)*

15. What kinds of cost-sharing or other forms of financial assistance would be most effective for advancing the adoption of sustainable practices? *(Answer in your own words)*

16. Are you: *(Check one)*

- Agribusiness professional
- A county extension professional
- An area or state extension professional
- A USDA-NRCS county professional
- A USDA-NRCS state or area professional
- A professional with a non-governmental association or organization
- Other (specify)

17. In what state do you live?

18. What is your gender? *(Check one)*

Male

Female

19. What is your ethnicity? *(Check one)*

- White or Caucasian
- Black or African-American
- Asian or Pacific Islander
- Native American
- Other (specify)

20. Which category best describes your level of education? *(Check one)*

- Some high school or less
- High school graduate

Some college/technical  
College graduate  
Some graduate school  
Masters degree  
Doctorate degree

21. Over the past three years, what proportion of your total annual income came from farming?  
(*Select one*)

None  
1 - 10 Percent  
11 - 49 Percent  
50 – 74 Percent  
75 + Percent

22. What is your age in years? (*number*)      Year

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