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Abstract: Factors influencing adoption of soil and water conservation production systems at the farm level are discussed in the context of their influence for motivating land owner-operators to adopt and to use conservation technologies and practices. Research focused on United States (US) farmers are examined to assess how social, economic, farm structure, and conservation program-participation factors affect adoption behaviors at the farm level. Research findings suggest that contemporary conservation programs that place emphasis on the provision of information, education, technical assistance, and economic subsidies probably will not be successful in achieving societal conservation goals. Study findings basically demonstrated that factors commonly argued to influence adoption of conservation production systems at the farm level were not useful for that purpose. Alternative approaches to achieving conservation goals within the US are examined.

Keywords: Soil and Water; Adoption; Farm; Conservation

1. SOIL AND WATER CONSERVATION IN THE UNITED STATES

Soil and water conservation policies and programs have been traditionally implemented within the US using voluntary participation approaches. Most conservation programs in the US emphasize provision of information, education, technical assistance, and small economic subsidies (hereafter referred to as the *IETS* model) to motivate potential adopters to adopt conservation production systems [Lovejoy and Napier, 1986; Napier and Bridges, 2002]. The reason the *IETS* model has been so extensively used within the US is that the approach was demonstrated to be quite successful for motivating land owner-operators to adopt and to use conservation production systems during the Dust Bowl era of the 1930s. Once voluntary public conservation policies and programs became institutionalized during the 1930s, historical inertia maintained the same conservation policy trajectory for decades [Napier, 1990_a].

Voluntary conservation policies and programs remained basically unchallenged within the US until the 1970s when social scientists began to question the ability of contemporary soil and water conservation initiatives to effectively address agriculturally induced environmental problems [Napier, 1990_a]. Critics of the *IETS* model began to suggest that the assumptions underpinning the approach were faulty. Since the late 1970s, extensive research has been conducted to assess the relative influence of numerous factors on the adoption of soil and water conservation production systems at the farm level [Batte and Bacon, 1995; Halcrow et al, 1982; Lasley, et al 1990; Lovejoy and Napier, 1986; Mueller, et al 1985; Napier, 1990_a; Napier, 1990_b; Napier, 2000; Napier and Bridges, 2002; Napier, et al 1983; Napier et al, 2001; Putman and Alt, 1987; Swanson and Clearfield, 1994]. The purpose of this paper is to summarize the findings derived from this research and to assess the utility of the *IETS* model in the context of the conclusions drawn from the summary. While research throughout the US will be discussed, emphasis will be placed on watershed research conducted within the North Central region of the US because much of the research focused on this topic has been conducted within this geographic region during the past decade.

2. FACTORS AFFECTING ADOPTION OF SOIL AND WATER CONSERVATION IN THE US

Many factors have been identified as being important for motivating land owner-operators to

adopt and use soil and water conservation production systems. Some of the most frequently mentioned factors are as follows: lack of 1) awareness of environmental problems; 2) commitment to maintenance of environmental quality; 3) access to technologies and techniques to resolve environmental problems; 4) human skills to implement technological solutions; 5) access to economic resources to invest in soil and water conservation efforts; 6) access to technical assistance to implement soil and water conservation production systems; 7) access to information systems to acquire information and knowledge to effectively implement soil and water conservation production systems; 8) public policies to motivate land owner-operators to adopt soil and water conservation production systems; 9) monitoring of individual farmer behaviors relative to agricultural pollution; and 10) economic return to investments in soil and water conservation production systems. Each of these factors is examined individually to assess the merits of the assertions made about them.

Lack of Awareness of Environmental Problems --- There is considerable evidence that land owner-operators are aware of environmental problems associated with production agriculture [Napier, 1990_b; Napier, et al 1983; Napier, et al 2001; Swanson and Clearfield, 1994]. Research has shown that land owner-operators are well aware of nonpoint pollution problems on their neighbors' lands and, if pressured for a response, will admit that their farms are contributing to nonpoint pollution. Given the attention focused on nonpoint pollution in the US in the electronic and printed media, a person would have to be a social isolate not to be aware of agricultural pollution problems.

These findings suggest that awareness of environmental problems associated with production agriculture is not a barrier to adoption of soil and water conservation production systems in the US.

Lack of Commitment to Maintenance of Environmental Quality --- Research has shown that farmers have a very positive orientation toward their land and are concerned about agricultural pollution [Napier, et al 2001]. It is a myth that land owner-operators do not possess a land ethic, as suggested by Leopold [1966]. Land owner-operators have internalized a land ethic even if they do not always engage in behaviors that are consistently supportive of the ethic. It is quite common for people to possess positive attitudes toward something and simultaneously fail to enact behaviors that are consistent with those psychosocial orientations.

These findings suggest that most farmers value land and water resources even though they engage in behaviors that result in degradation of these resources. The lack of a commitment to the environment does not appear to be a barrier to adoption of soil and water conservation production systems in the US.

Lack of Access to Technologies and Techniques to Resolve Environmental Problems --- Land owner-operators within the US have access to a large number of agricultural technologies and techniques to resolve agriculturally induced environmental problems. Research and development within the land grant system and the private sector have produced technologies and techniques to address practically any soil and water conservation issue [El-Swaify and Yakowitz, 1998; Moldenhauer and Hudson, 1988; Lal and Stewart, 1995]. A host of public and private conservation groups have been active in providing land owner-operators with information about technological solutions to agricultural pollution problems and most farmers have been in contact with one or more of these sources of conservation information [Tucker and Napier, 2002; Whaley et al, 2001].

These findings suggest that access to conservation technologies and techniques is not a barrier to adoption of conservation production systems in the US.

Lack of Human Skills to Implement Technological Solutions --- Inadequate human skills can be a significant barrier to adoption if the technologies and techniques are difficult to implement and to use. However, many conservation production practices such as grass waterways, grass borders of cultivated fields, and permanent retirement of highly erodible land, do not require extensive human skills to effectively implement. Evidence from many studies has revealed that US farmers are highly educated and possess extensive technical knowledge [Halcrow, et al 1982; Napier, et al 1983; Napier, et al 2001].

Evidence suggests that lack of human skills is not a major barrier even though lack of skills may impede adoption of complex conservation production systems.

Lack of Access to Economic Resources to Invest in Conservation Production Systems --- Access to investment capital is a barrier to adoption of conservation production systems for a minority of farmers in the US. A large majority of production agriculturalists possess economic resources to adopt production systems they feel will generate greater farm income. Many studies have shown that most US farmers are financially secure and have capital to invest in farm technologies [Napier, 1990_b; Napier, 2000]. Unfortunately, many farmers elect to invest in production systems that degrade the environment.

These findings suggest that access to capital to invest in conservation production systems is not a major barrier to adoption of conservation production systems in the US. The barrier appears to be a preference for more degrading production systems.

Lack of Access to Technical Assistance --- Given the numerous public and private organizations that provide technical assistance within the US, access to technical assistance does not appear to be a barrier to adoption of conservation production systems. Organizations such as the Natural Resources Conservation Service (NRCS), the Cooperative Extension Service (CES), and state departments of natural resources all provide technical assistance at no or nominal costs. Many private consulting organizations also offer a wide variety of technical services on a fee-for-services-rendered basis. All of these groups provide extensive and comprehensive technical assistance on practically any conservation issue.

While many technical support resources are available to farmers within the US, research evidence has repeatedly demonstrated that a small percentage of land owner-operators use technical assistance support services [Napier and Bridges, 2002]. When farmers seek technical support, they tend to use NRCS, feed and fertilizer dealers, and other farmers. The greatest majority of farmers do not use any type of technical support service.

These findings suggest that access to technical assistance is not a barrier to adoption and use of conservation production systems. The assistance is available; however, the greatest majority of US farmers do not perceive a need for such services.

Lack of Access to Information Systems to Acquire Implementation Skills --- There is a host of printed and electronic media systems that are available to land owner-operators within the US [Tucker and Napier, 2002; Whaley, et al, 2001]. Land owner-operators have access to many different types of information systems that provide free information about a wide variety of conservation production systems. The NRCS, CES, and state departments of natural resources provide volumes of printed information in addition to convening professional meetings to communicate directly with potential adopters. Specialized farm magazines provide information to specific target audiences, while television and radio programs provide conservation information to general audiences.

If there is any problem with access to conservation information for decision-making, it is that too much information is being provided to farmers. Farmers may be receiving too much information to be effectively assimilated. It is also possible that some of the information being provided is contradictory which creates confusion and distrust of the various sources.

Since farmers are not a homogenous occupational group, they vary in terms of information needs. While most farmers secure most of their agricultural information from feed and fertilizer dealers, they do use other sources [Tucker and Napier, 2002]. Unfortunately, most of the investment in information dissemination is via established agencies, such as the NRCS, CES and state departments of natural resources, used much less frequently by potential adopters. The use of CES as a preferred channel for agricultural/conservation information has declined in recent years.

These findings suggest that access to information about agricultural problems and conservation issues is not a barrier to adoption of soil and water conservation production systems. However, multiple contributors to the information flow to potential adopters may be generating confusion about what position is correct on issues being discussed.

Lack of Public Policies to Motivate Land Owner-Operators to Adopt Conservation Production Systems --- This definitely is not a barrier to adoption of soil and water conservation production system in terms of incentive systems. Governmental policies and programs have been in existence in the US since the early 1930s and have provided many incentives for farmers to adopt and use conservation production systems [Napier, 1990_a; Napier, 1990_b; Napier, et al 2001]. Early conservation policies and programs provided potential adopters with conservation information, training, technical

assistance, and economic subsidies to adopt and to use recommended conservation practices. Public policies using the *IETS* model ranged from multiple-year to annual set-aside programs.

What has been lacking in terms of public conservation policy is use of more coercive approaches. While disincentive programs have been extensively discussed in the conservation literature [Halcrow, et al 1982; Lovejoy and Napier, 1986; Napier, et al 1983; Napier, et al 1990_b], little serious attention has been given to such policy instruments at the national level. There is little desire on the part of national policy makers to raise the ire of land owner-operators by creating public conservation policies that mandate compliance with recommended conservation production systems.

Existing literature suggests that lack of public conservation policies that employ incentive systems is not a barrier to adoption of conservation production systems. However, lack of disincentive policies is probably a barrier to adoption.

Lack of Monitoring of Individual Farmer's Behaviors --- This definitely is a major barrier to the adoption of soil and water conservation production systems at the farm level within the US. Without the ability to monitor what is being transported to rivers and streams from farmland, it is extremely difficult to attribute responsibility for off-site damages. While the technology exists to make nonpoint pollution point pollution, society does not have the political will to do so. Remote sensing, in-stream monitoring, and/or on-farm monitoring by technical field staff could make nonpoint agricultural pollution another form of point pollution. Using such capabilities, land owner-operators could be forced to internalize their contributions to pollution. The possibility of imposing pollution taxes or fines for noncompliance with national conservation norms would serve as a strong motivator for farmers to adopt production systems that would reduce pollution.

The lack of monitoring of individual land owner-operator behaviors acts as a major barrier to the adoption of soil and water conservation production systems. This factor does not have to remain as a barrier. Implementation of a valid and reliable monitoring system would do much to eliminate abuse of soil and water resources by land operators within the US.

Economic Return to Investments in Conservation Production Systems --- This is probably the most significant barrier to adoption of soil and water conservation production systems within the US. Farmers frequently report that farm output would probably be reduced and production costs increased if their farm operations were managed in a manner to reduce degradation of soil and water resources.

US farmers are business-persons who are engaged in production agriculture to generate income and make production decisions in the context of probable returns to investment [Kandeh and Napier, 2001]. Since adoption of conservation production systems has often been shown not to produce profits in the short-term and often in the long-term [Batte and Bacon, 1995; Mueller, ET al 1985; Putman and Alt, 1987], farmers are unwilling to assume the risk associated with adopting conservation production systems. To reduce risk associated with the farm enterprise, most farmers tend to employ production systems that have been shown to produce desirable outcomes in the past. Oftentimes the less risky production systems tend to be more degrading of the environment.

Most land owner-operators will sacrifice environmental quality to maximize farm income even though they may value environmental protection highly. This assertion is based on the assumption that the production systems employed to maximize farm income will not result in degradation of land resources to the point that long-term productivity of land resources will be jeopardized in the future. On-site damages from erosion are strong motivators for environmental action. Unfortunately, on-site damages are no longer a major factor for motivating land owner-operators to adopt conservation production systems on most agricultural land in the US because the long-term losses of productivity are of little consequence. Given the present level of erosion on farmland within the US, it is highly unlikely that long-term degradation would occur on most agricultural land even using production systems that are defined as being environmentally unfriendly. It must also be noted that highly erodible land constitutes a small percentage of all agricultural land in the US. This means that most cropland can be operated for extended periods of time without use of conservation production systems and suffer little loss of productivity. When there are productivity losses from erosion on US cropland practically all of the losses can be masked by application of inorganic fertilizers. All of these factors combine to suggest that few incentives exist to motivate land owner-operators to adopt conservation production systems.

Unless conservation production systems can be shown to generate higher farm income compared to systems presently being used, there are few motivations for potential adopters to change behaviors.

These findings suggest that it will be difficult to motivate land owner-operators to adopt conservation production systems until it can be demonstrated that they will benefit from change in existing production systems. This may be difficult because research to date suggests that adoption of conservation production systems will not result in greater benefits to the adopter. In fact, there is evidence that adoption of conservation production systems can result in loss of farm income and introduce higher levels of risk into the farm enterprise. Unless some mechanism is created to force land owner-operators to assume the pollution costs associated with production, it is highly unlikely that return to investment in conservation production systems will ever be large enough to motivate farmers to adopt conservation systems to the extent required to achieve national environmental goals.

Economic return to investment in conservation production systems is a major barrier to adoption of soil and water conservation production systems within the US.

3. CONCLUSIONS

Research focused on adoption of conservation production systems at the farm level strongly suggests that existing conservation policies and programs have not achieved their objectives. Study findings also suggest that contemporary approaches probably will never be able to achieve conservation goals because the assumptions underlying the policies and programs are faulty. Factors assessing the conceptual underpinnings of existing policies and programs have been shown not to be very useful for motivating land owner-operators to adopt conservation production systems.

Research findings indicate policies and programs that place primary emphasis on providing information and training will continue to be inadequate for motivating land owner-operators to incorporate conservation production systems into their farm operations. The only exception to this assertion is a new conservation technology or technique that is risk-free and highly profitable.

Programs that rely primarily on the inculcation of a positive environmental ethic are also doomed to failure. Most US farmers already have internalized such attitudes and perceive themselves as being stewards of the land. Programs designed to increase stewardship orientations among US farmers may be successful in doing so but will probably not produce any significant changes in conservation behaviors because such attitudes do not affect conservation decision-making at the farm level.

Research findings strongly indicate that incentive approaches motivate land owner-operators to adopt conservation production systems as long as the economic subsidies to the landowner are above the rent value of the land. Subsidies are used basically to rent land for conservation purposes. Subsidies are perceived by landowners to be rent and the entity providing the subsidy is viewed as a tenant. If the subsidies are withdrawn, landowners will use the land to produce income. If landowners are denied the subsidies, they will put the land back into production oftentimes using the same production systems that were employed before they participated in the subsidy program.

Subsidies can also be used effectively to motivate land owner-operators to purchase production inputs that are required to adopt certain types of conservation systems. Economic subsidies reduce the cost of modifying production systems. Many farmers will not allocate limited economic resources to purchase requisite technologies to adopt conservation production systems without economic subsidies.

Study findings indicate that relatively little consideration has been given to more coercive approaches to achieve national environmental goals. While experience with point pollution within the US clearly demonstrated the effectiveness of the mandatory approach, national policy makers have been reluctant to embrace this means of addressing agricultural nonpoint pollution problems. Until political leaders are willing to assume the political costs of making such decisions, it is highly likely that future conservation policies and programs will continue to use the same ineffective approaches that have been employed in the past.

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