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Designing A Successful Voluntary Green Support Program: What Do We Know?

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By Sandra S. Batie[1]

Introduction

The current debate surrounding the reauthorization of the omnibus farm legislation has refocused policy makers' attention on an expanding set of public goals envisioned for the Farm Bill. Whereas early Farm Bills mainly addressed farm income goals, recent Farm Bills have given an increasing amount of attention to environmental quality concerns. For example, the 1985 Farm Bill, (The 1985 Food Security Act), created the Conservation Reserve Program which explicitly addressed soil erosion and water quality problems as did the "Swampbuster", "Sodbuster" and Conservation-Compliance provisions in the same Act. The 1990 Farm Bill, (The 1990 Food, Conservation and Trade Act) added additional environmentally-oriented programs: the Wetland Reserve Program, the Water Quality Incentives Program, and the Integrated Farm Management Program.

At the same time, there has been a proliferation of local, state, and federal legislation addressing agriculture's nonpoint pollution problems and natural resource protection. This

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legislation has catalyzed public debates on inconsistent legislative "signals" to producers, the number and fragmentation of programs, as well as the public and private costs of compliance. These debates have resurfaced the concept of Green Support Programs (GSPs). Attractive in principle, a GSP is based on the pursuit of two public goals--(1) farm income support and (2) environmental protection--with one policy instrument. The policy instrument is the provision of monetary payments to producers who pursue some environmental goal. The basic concept is not new, but is refined in current discussions by consideration of a GSP designed to obtain more environmental quality per program dollar than has been the case in the past.

Refinement of the GSP concept is possible because there is now data that can serve as indicators of the location, nature, and magnitude of environmental problems (Heimlich, 1994). The data show that the character of nonpoint environmental problems differ in source and impact, and that these problems are unevenly distributed throughout the nation. That is, the problems of confined animal waste pollution of water in some counties in Pennsylvania differ from the problems of nitrate pollution of groundwater from crops in some counties of Nebraska, which differ from the problems of air pollution due to wind erosion of exposed cropland in some counties in Texas, which differ from the problems of chemical and toxic contamination of reservoirs in some counties in California. Some regions have severe agricultural-related environmental problems; others do not.

Having data available means that, now, more than ever before, program managers can identify and target payments to those producers who could improve environmental quality the most, if they were to change their farming systems or farming practices. These producers may not necessarily be the same ones currently receiving farm income support payments, however. Thus the politically acceptable design of a GSP is quite complex (Lynch and Smith, 1994).

Even if the difficulties of the political acceptability of a GSP were revolved, however, there still remains additional complexities. If agencies were to use existing data to target priority watersheds or airsheds with significant nonpoint pollution problems, as well as to target priority farms within these priority watersheds and airsheds, are there viable solutions for producers who are participating within a voluntary GSP? Questions to be addressed in the remainder of this paper include:

$ Do farm-level "solutions" to non-point environmental problems exist?

$ What factors will cause farm-level "solutions" to be implemented by producers on targeted farms within targeted watersheds or airsheds?

The design of a truly successful voluntary green support program will require careful attention to these questions. Presumably, the goals of a GSP are to improve environmental quality by changing farming systems without handicapping the competitiveness of American agriculture in a global economy. A voluntary program must therefore be seen by producers as a viable choice, given producers' resources, farm characteristics, attitudes, and constraints. There must be alternative technologies available to the producer, and these technologies must be used in such a way and on such farms that environmental quality is actually improved.

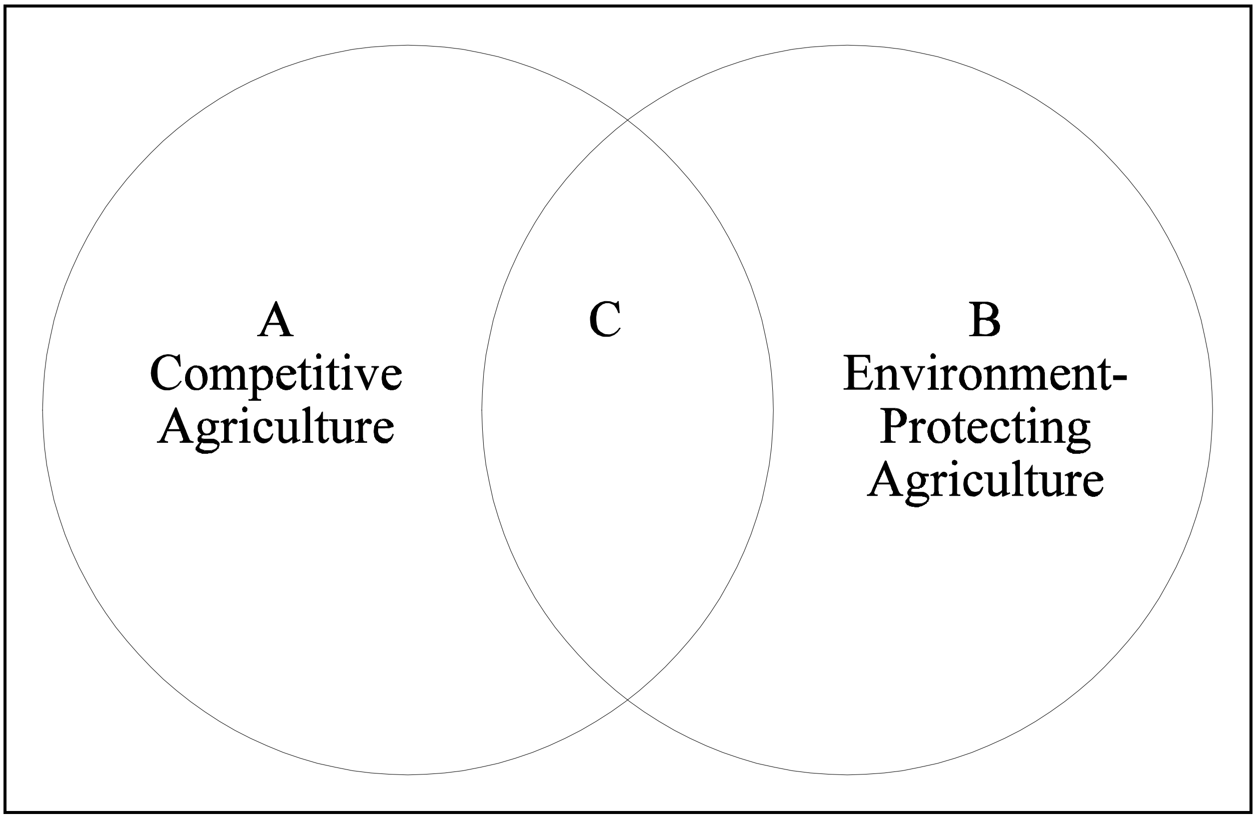
Thus, a successful voluntary GSP must identify and target the location of environmental quality problems related to agricultural uses of the land. Technologies and information must be available that improve the situation. Producers must be persuaded to voluntarily adopt these systems or practices.

This study will address the latter two components: agricultural technologies to improve environmental quality and the voluntary adoption of these technologies.

Do Technologies and Information Exist for Farm-Level Improvement of Nonpoint Pollution Problems?

A successful voluntary GSP will need to identify which alternative farming systems (or practices) meet both the criteria for general profitability (perhaps with a modest green support payment) as well as for the improvement of environmental quality. Put succinctly, a successful GSP needs to identify the practices and systems that are represented by intersection C of the Venn Diagram representation in Figure 1.

Figure 1. Technology and Information Choices



Plans versus Practices

Agricultural practices and farming systems represented by intersection C in the Venn diagram can differ for different farm situations. Thus, while it is tempting to focus a GSP toward the adoption of single, individual farming practices such as a Best Management Practice (BMP), it is not ideal. Not only are producers, farms, and regions diverse, so that individual practices are not suitable for every situation, there are also many inherent linkages between soil quality, the use of inputs, and the impact on the environment and profits. As a result, more environmental quality will be obtained by more careful tailoring GSP supported farming systems or practices to individual farms. However such a tailored approach does increase program complexity and implementation costs.

One approach might be for a GSP to require a whole farm plan of participants in lieu of implementing BMPs from which GSP farmers can select. Such a plan could incorporate an analysis of the linkages between soil quality, input use, profits and environmental quality and could be provided by federal, state or local public agencies (e.g., Soil Conservation Service, State Departments of Natural Resources, Cooperative Extension Service), by private consultants, or as an additional service from agricultural input dealers.[2] A flexible, farming systems analysis that recognizes these linkages can result in the identification of a lower cost, more effective solution to an

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[2]While there are differing advantages and disadvantages that come with using different whole-farm-plan providers, I will not address these issues in this paper. For a discussion of some of these issues see Wolf and Nowak (1994).

environmental problem than can the dictation of a BMP which addresses only one aspect of the farm.[3]

The planning process itself can also be the source of valuable information for the producer with respect to environmental quality impacts of various farm management decisions.[4] A farming system analysis can also highlight tradeoffs between alternative practices. For example, the reduction of phosphorus in sediment can lead to an increase of phosphorus in the soluble form; the use of rotations can reduce profits; reducing pesticide runoff can increase pesticide leaching; or the reduction in stream sediment can decrease stream channel stability. A farming system analysis, where tradeoffs in farm related environmental problems are identified, can result in better choices.

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[3] A farming system analysis "comprises the pattern and sequence of crops in space and time, the management decisions regarding the inputs and production practices that are used, the management skills, education, and objectives of the producer, the quality of the soil and water, and the nature of the landscape and ecosystem within which agricultural production occurs" (National Research Council, 1993, pp 106-107).

[4]If the most profits and the most environmental protection possible is to be obtained from an agricultural system, a producer must not only be informed about the relationships between agricultural and environmental systems but also possess good management skills. The careful use of this information in farming has been referred to as "high precision farming" (Munson and Runge, 1990). Such high precision farming can include alternative agricultural practices within the farm system.

Dynamic Relationships

It is also important to realize that the Venn diagram in Figure 1 is dynamic. First, the very logic of a GSP is to use payments to enlarge intersection C of both profitable and environment protecting farming practices and systems. That is, a GSP might provide payments for farming practices that are not profitable from a producer's perspective but will yield significant environmental quality benefits.

In addition, the intersection C can expand overtime as the research community increases its focus on the environmental quality impacts of agriculture. Traditionally, agricultural research has focused mainly on increasing the quantity of output, such as crop yields. More recently, there has been increased research attention to reducing the amount of chemical inputs and to the reduction of soil erosion. The result has been more technologies that are both environmentally protecting and which maintain the competitiveness of US agriculture. Integrated Pest Management is an example of such a research effort; as are many technologies that have been termed "alternative agriculture" technologies.

Are there currently enough technologies that are either both profitable and environmentally protecting or which could be made so with a modest GSP payment? The answer appears to be "yes", at least in many cases. A complete review of these technologies is not possible in this brief overview; fortunately there is other research to which one can refer.

A recently completed review of the science associated with improving soil and water quality by the National Research Council (1993) identified four fundamental principles for national policy to improve soil and water quality as well as agricultural practices and systems that could be used to pursue the goals of improved environmental quality. Many of these would be either profitable or low cost for many producers.

Fundamental Principles

The four principles for improving environmental quality from the National Research Council report are:

> National policy should seek to (1) conserve and enhance soil quality as a fundamental first step to environmental improvement; (2) increase the nutrient, pesticide, and irrigation use efficiencies in farming systems; (3) increase the resistance of farming systems to erosion and runoff; and (4) make greater use of field and landscape buffer zones (p. 4).

The National Research Council report identified various changes in farming practices that could be used to implement policy that embraced the four principles[5]. For example, there is

[5]Similar recommendations have been made within other studies such as that of the Office of Technology and Assessment (US Congress, 1990) or the Journal of Soil and Water Conservation special supplement to the March-April 1994 issue. This supplement was entirely devoted to nutrient management.

considerable evidence of excess nitrogen use (compared to plant uptake) in many regions of the country. Where there is excess nitrogen, improved environmental quality could result from better record keeping, proper accounting for sources of nitrogen, soil testing, proper yield goals, and the synchronizing of nitrogen application with crop needs. Within a watershed, coordination among farms and the use of whole farm nutrient management plans could, in many cases, achieve a significant reduction in residual nitrogen (National Research Council, 1993).

There is also evidence of excessive phosphorus in many soils. Yet additional phosphorus is sometimes applied, frequently as a result of the spreading of manures. Because phosphorus binds to sediment, phosphorus loss can be reduced by reducing soil erosion as well as by reducing applications. Improved practices that may be viable in some phosphorus rich regions include the use of buffer strips, planting cover crops, storing or hauling of manure, or planting a more diverse set of crops (National Research Council, 1993).

Similarly, irrigation practices can be improved on some farms by better water scheduling, optimal allocation rates, the reuse of drainage waters and similar practice (National Research Council, 1993).

The improved management of pesticides is also possible. There is no perfect pesticide--that is, one that adequately controls only the target pest and then suddenly dissipates leaving no harmful residuals in the environment (National Research Council, 1993). While many believe that American agriculture could reduce pesticide use, the total elimination of pesticides in a short period of time would cause major disruptions in the agriculture sector (Gianessi, 1993). These disruptions would result from the lack of readily available substitutes and technologies for all situations and enterprises (Gianessi, 1993). If the public goals were to ultimately reduce pesticide use after a transition period, however, the search for substitutes would focus research attention on the development of alternative systems to a much greater degree than has hitherto been the case. Such long term efforts to reduce the need for environmentally damaging pesticides are the most promising approach to reducing environmental damages from pesticides. (National Research Council, 1993.

While total elimination of pesticide use would be extremely disruptive at this time, there currently are available technologies, farming systems and farming practices that can reduce pesticide losses to the environment for many types of agricultural systems in many regions (National Research Council, 1993). A GSP could focus attention on these situations and encourage alternative systems that reduce pesticide use where there are pesticide pollution problems, particularly when a green payment would make adoption of these practices and systems more attractive to the producer.

The basic principles to be followed in reducing the use of pesticides include:

- selection of proper pesticides and formulations;
- improved timing and application methods to minimize drift and volatile losses;
- use of erosion and runoff control measures to reduce losses through runoff and leaching;
- use of nonchemical pest control measures such as crop rotations and management; and
- integrated pest management (which embodies most of the recommended practices (cited above) National Research Council, p. 329.

The Role for Alternative Agriculture

In some cases, the agricultural technologies and systems that reduce chemical inputs and/or improve environmental quality are classified as belonging to "alternative agriculture". Although sometimes the concept of alternative agriculture incorporates a philosophy of being in "harmony with nature" (as opposed to the more conventional "management of nature") (Batie and Taylor, 1991), it more frequently refers to alternative practices or alternative systems regardless of underlying philosophies. Indeed many farms use neither totally conventional nor alternative systems, but are more-or-less "conventional" or "alternative" in their main tendencies (General Accounting Office, 1990). Farmers who adopt reduced input systems frequently do so to solve a particular production, environmental, or health problem as opposed to doing so for philosophical or ideological reasons (Buttel, et. al, 1986).

The General Accounting Office report, *Alternative Agriculture*, summarizes the differences between some conventional and alternative practices as shown in Table 1) (General Accounting Office, 1990, p. 32). While organic practices are considered alternative agricultural practices since they use no purchased chemical inputs, there are many practices that are low-chemical but not organic. These include practices that use diverse rotations, biological pest control, or conservation tillage methods.

Alternative agricultural practices are so-named because if, used properly, they are more environmentally protecting than conventional agricultural practices. Much of the debate surrounding widescale adoption of alternative agricultural practices however does not relate to their environmental impacts, rather, the debate relates to their profitability.

Table 1. Characteristics of Alternative Agriculture Practices

Agricultural Component	Conventional Practice	Alternative Practice
Crop Choice	Specialize: plant most profitable crop on same ground year after year	Increase diversity, use multiyear rotations, and develop integrated crop and livestock operations
Pest and Weed Control	Apply synthetic insecticides, herbicides, and fungicides	Use Integrated Pest Management, natural predators, resistant crops, crop varieties well-suited to agronomic conditions, crop rotations, mechanical cultivation, and intercropping
Soil Cultivation	Cultivate highly prepared seed beds	Maintain protective cover on soil and plow to minimize soil erosion and loss of soil moisture

Source: General Accounting Office, 1980, p. 32.

Profitability Factors Influencing Participation in a GSP

Agricultural practices and systems exist that are more environmentally protecting than many current conventional practices and systems. But how many are profitable or could be made profitable with a modest green support payment? The profitability of alternative agriculture has been long debated (see for examples, Buttel, et. al., 1986; Council for

Agricultural Science and Technology, 1990; Crosson and Ekey, 1988; Dobbs, 1993; Dobbs, 1994; Fox, et al, 1991; General Accounting Office, 1990; Natural Resource Council, 1989; Tweeten, 1992). A careful reading of the arguments and the evidence suggest that there are alternative practices that do reduce negative environmental impacts from conventional practices in some, but not all, circumstances. Some, but not all, are profitable or relatively low cost.[6]

The distinction between alternative and conventional agriculture may not be as useful for the purposes of this paper as is the distinction between which farming technologies and systems provide both public and private benefits.

Return to Figure 1 and consider that those practices and systems in Circle A--Competitive Agriculture--but not in the intersection C are those that yield private profits but are not environmentally protecting. Similarly, those in Circle B--Environmentally Protecting--but not in the intersection C are

[6]As Dobbs (1994) notes, however an important factor to consider is whether a producer is adopting an alternative practice such as a changed tillage method or whether a whole farm system is being adopted that changes crop rotations and the relationships between crops and livestock by, say, making livestock rations more forage-based. Dobbs predicts from his research that whole system changes to more "sustainable" farming systems would result in some decrease in profits, at the present time, in high-output regions such as the Corn Belt. However this conclusion is specific to this agro-climatic region and sustainable systems appear more competitive in predominantly small-grain areas than in the Corn Belt.

those that yield the public benefits of improved air and water quality but are not profitable. Those in intersection C yield both private and public benefits (beyond a food supply).

Pampel and van Es (1977) make the distinction between technologies that are commercial innovations--that is those that improve profits (i.e., in the portion of Circle A not in the intersection) and those that are environmental innovations (i.e., in the portion of Circle B not in the intersection)--that is, they have as a first objective the protection of an existing natural resource. The means and goals of these two types of technologies are sufficiently different and imply different adoption behaviors; and, they will also therefore imply different GSP payment policies (Camboni, Napier and Lovejoy, 1990).

One way to categorize farming systems in a manner that encompasses this distinction between commercial and environmental technologies is to adopt a producer's point of view of the perceived outcome of adoption. Will there be a positive private outcome from adoption? Whether the farming system is perceived as a profitable system may not be the sole factor, but for many producers it will be the dominate factor. At the same time, the perception of the adoption of the proposed farming system on a desired public good such as environmental quality is important too. Where the producer perceives a positive outcome for both himself (or herself) and the public, adoption will be more readily forthcoming. Furthermore, if the perceptions are accurate, the system will remain in place (that is, there will be no reason for the producer to abandon the new farming system and return to former practices). Perceptions will also be weighted by the producer in ways to account for uncertainty of outcome. The more uncertain the producer perceives the outcome, the more likely will be the presumption that it will be negative[7]. Table 2 displays these categories in matrix form.

Win-Win

In the Table 2 matrix, the northwest cell identifies a farming system (or a farming practice) that is termed "win-win". That is, the producer views the system to be profitable and to fit within the acceptable range of other socio-economic constraints and goals; the producer also perceives the system to produce positive public environmental benefits. An example might be a nutrient management plan that both reduces the purchase and use of commercial fertilizers, but does not negatively impact yields (National Research Council, 1993). For these types of systems, voluntary, targeted GSP programs have great potential to change behavior since the producer should have an incentive to adopt

[7]Uncertainty surrounding the ultimate impact of adoption of different farming systems and technology is an important barrier to participation in a GSP. More research is needed on the marginal economic impacts of alternative conservation systems. What is known needs to be better disseminated to producers. See Fletcher and Seitz (1986) for a detailed discussion of information needs for conservation decisions from a producer's perspective.

them. However, educational programs and transitional cost-sharing may be required even in "win-win" situations. The decision to change behavior should be stable and continued cost sharing should not be necessary to maintain the system or practice.

Table 2. **Producers' Perceptions of Technological Impacts and GSP Payment Implication**

Perceived Public Outcome	**Perceived Private Outcome: Positive (Profitable)**	**Perceived Private Outcome: Loss**
Environmental Gain	Win-Win: Transitional GSP Payments	Lose-Win: Continual GSP Payments
Environmental Loss	Win-Lose: Continual GSP Payments to Avoid Technology	Lose-Lose: No GSP Payments

There are models of promising state-level programs from which to draw lessons. For example, Iowa has had a program to improve nitrogen management since 1982. In the Big Springs Basin in Iowa, a combination of education, technical, and financial assistance resulted in 52 percent of the producers reducing their application of nitrogen fertilizer compared to the decade earlier. State wide demonstration projects were an integral part of the program (National Research Council, 1993). "The experience in Iowa suggests that aggressive, coordinated efforts can accelerate the voluntary adoption of improved farm management techniques, at least when improved management results in financial as well as environmental benefits (National Research Council, 1993, p. 170).

It is probable that there are systems and practices that belong in this northwest cell, but that are not yet so perceived by producers. For example, there are numerous studies that suggest that many producers do not view a reduction of chemical use or other alternative agricultural practices as compatible with profitability goals. In a Wisconsin study, for example, 71 percent of the farmers felt their yields would drop if chemical inputs were reduced. And in an Iowa survey half the respondents felt that the increased costs of tillage, labor, and machinery would cancel any savings from reduced herbicide use (U.S. Congress, 1990). Not all of these impressions are accurate, and thus a targeted and tailored educational/demonstration program would seem to be needed to change perceptions and accelerate adoption.

Lose-Lose

The southeast cell in Table 2 can be termed a "lose-lose" situation as perceived by the farmer. The producer has no incentive to adopt this farming system or practice nor does he or she perceive it to have positive effects on the environment. Assuming these perceptions are accurate, this situation is stable and no adoption will take place, nor should it. No GSP payment should go to these practices.

Win-Lose

The southwest cell on the other hand represents a situation where the producer perceives a positive outcome from the adoption of the system (or practice), but there is a negative public outcome (win-lose). The farming of fragile highly eroding soils, intensive chemical use near waterways, concentrated livestock production near waterways could be practices in the southwest cell. Clearly no GSP payment should be available for this system (or practice). However, changing behavior so that this system (or practice) is abandoned is more problematic in a voluntary program. Such changes may require continual cost sharing incentives--perhaps backed up with the threat of future regulation. Of course, cost sharing programs must be carefully designed in these cases. If too small, they will not elicit the desired changes; if too large, they create windfalls for producers and lead to public opposition.

Here too there may be a need for educational programs if the producer fails to perceive a negative impact on the public benefit--either from his or her farm or in general. Thus, the producer may perceive a system or practice belongs in the northwest "win-win" cell when in actuality it is the southwest ""win-lose" cell. Some extension agents have claimed success with an educational technique that involves actually sampling the runoff or leaching from a farm enterprise for contaminants and sharing the results with the producer within the context of overall pollution of nearby water so the producer will recognize the farm's contribution to water quality degradation (Tompkins, 1994).

Lose-Win

The analysis of the northeast cell is similar to the southwest cell. Whereas the southwest cell requires a cost sharing approach to have a producer replace a environmentally damaging system with a more environmentally supportive one, the northeast cell, involving encouraging a producer to adopt a practice that may be perceived as harmful to his or her goals, but protective of the environment (lose-win). Such practices might include for example the adoption of filter strips or the setting aside of land for the protection of wildlife habitat. Here again long term cost sharing or other payments will be needed in a voluntary GSP.

One approach currently being used in Wisconsin to get voluntary adoption of wind erosion control practices that most likely fall in the southwest cell is "The Conservation Credit Initiative". Producers in the Central Sands area receive a $3 to $5 credit per acre on their property tax bill for each acre voluntarily enrolled in a Conservation Credit Program. The program has also been expanded to include Pepin County dairy producers for the adoption of water quality protection practices. The credits are incentives to those who farm their own land, and the program has positive attributes of rewarding good stewards, being locally directed, and being flexible.[8]

Which Technologies Where?

As previously discussed, the determination of which technologies and which farming systems and practices belong in which cell requires a careful analysis that is unique to the particular watershed, airshed, and farm in question. However, the evidence suggests that, for many, perhaps most situations, there are both win-win systems (and not yet adopted) or that there are unexploited opportunities to change lose-win situations into win-win situations with modest public payments. Furthermore, foreseeable research results should expand such opportunities. However, success in a GSP program depends not only on the accurate identification of those opportunities, but also on overcoming other non-profitability barriers to participation in a GSP.

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[8]However, property tax credits, like all permanent financial entitlements, will be eventually capitalized into the value of land, thus eventually reducing the intended incentive.

Non-Profitability Factors Influencing Participation in a GSP

There is considerably more known about which farming systems should reduce environmental degradation, then there is known about why individuals producers farm they way they do. This ignorance is partly due to inadequate research directed to the question.

However, another reason for this ignorance is the complexity of the answer. This complexity stems from the diversity of the agriculture in the United States. This diversity includes the variation in soils, landscapes, climates, and hydrogeology in which farming takes place; the variation in the type, size and ownership of the farming enterprise; and the variation in the socioeconomic motivations and characteristics of producers. There is also variation in institutional settings and variation in the signals producers receive from markets, policies, and information suppliers (Creason and Runge, 1992; Fletcher, 1986: Soil and Water Conservation Society, 1993).

A recent study by the Office of Technology Assessment (U.S. Congress,1990) provided a summary of the research on diffusion of conservation innovations and the factors influencing producers' decisions with respect to farming practices (See Table 3). Several of these findings appear to be particularly germane to the successful participation of producers in a voluntary GSP, particularly perceptions of the source and magnitude of environmental problems, attitudes about the value of environmental goals, and producer involvement in program design.

The successful design of a voluntary GSP will depend on understanding producers' motivations for adoption of appropriate farming systems in these complex and heterogenous settings.

"No Problem on My Farm"

One reason producers are unwilling to participate on environmentally-oriented programs is that they fail to see that they are part of a problem that requires remediation. Several studies suggest that while farmers are aware of water quality or soil erosion problem as a serious national or local problem, they tend to exempt their own operation as contributing to the problem. While in some cases this exemption may be warranted, studies indicate that many producers underestimate their actual pollutant loadings to water or their actual soil erosion rates (Bosch, et. al, 1992; Nowak, 1982; Napier, Camboni, and Thraen, 1986; Camboni, Napier, and Lovejoy, 1990: U.S. Congress, 1990). That is, there appears to be little correlation between the physical characteristics of the producer's farm and his or her perception of an environmental problem or choice of farming practices (Nowak, 1987).

Table 3. Research Findings on the Diffusion of Conservation Innovations[9]

1. **Farmers are a heterogeneous group with unequal abilities and unequal access to information and resources for decisionmaking.** Farmers vary in their objectives, level of awareness, use of information, and willingness to take risks; factors strongly influencing some farmers may have very little effect on others...

2. **Farmers' decisions are based on their fundamental reasons for farming; their objectives may not be clearly defined or articulated.** Farmers' objectives include: making a satisfactory living (either as an owner-operator, tenant, or employee); keeping a farm in operation for family inheritance or other personal reason, perhaps while working at an off-farm job; obtaining a satisfactory return on investments in land, labor and equipment; obtaining tax benefits from the farm; obtaining recreation or esthetics enjoyment from the farm; or a combination of these.

3. **Economic factors exert important, but not sole, influences on farmer decisionmaking**. Economic factors are key in defining what is financially possible for farmers, but a variety of personal, cultural, and environmental factors also shape farmers' decisionmaking....

4. **Farmers typically make production decisions within short time frames, which discourages investments in resource protection measures**. Farmers often are forced to make decisions within a short-term, year-to-year planning horizon that can prevent them from taking risks or making the most economically efficient decisions over the longer term....groundwater contamination are more complex than individual BMPs (Best Management Practices) or technological products. Complexity of systems-oriented changes will slow their adoption.

5. **Farmers make changes slowly.** The decision to change farming practices requires a considerable degree of deliberation, and maintaining new changes frequently necessitates on-farm experimentation and adaptation beyond that conducted during initial technology development....

6. **A farmer's innovation decision process consists of several sequential states.** These proceed through: 1) knowledge,... 2) persuasion,...3) decision,...4) implementation, and 5) confirmation.... Farmers need different kinds of information and use different communication channels at each stage....

7. **Farmers adopt "preventive innovations" more slowly than "incremental innovations."** Agricultural innovations studied in most diffusion research have been "incremental innovations, " or ideas adopted in the present (e.g. hybrid corn, commercial fertilizers) to gain possible increases in value in the future.... "Preventive innovations" are new ideas adopted in the present to avoid possible loss in the future.... Adoption rates of preventive innovations usually are slower than those for incremental innovations....

[9] Abbreviated from Office of Technology Assessment Report, *Beneath the Bottom Line* (1990), pp. 189-191.

(Table 3 Cont.)

8. **Individual and farm characteristics appear to explain only a small portion of conservation adoption behavior; institutional factors (e.g. farm programs, credit availability) probably are highly influential.**

9. **Studies on adoption of farm practices have rarely examined the physical settings of adoption decisions or the extent or resource degradation as it relates to adoption of remedial farm practices.**

10. **Farmers tend to underestimate the severity of soil and water quality problems on their own farms.**

11. **Farmers are most likely to adopt technologies with certain characteristics.** Favored technologies are those that: 1) have relative advantage over other technologies (e.g., lower costs, higher yields); 2) are compatible with current management objectives and practices; 3) are easy to implement; 4) are capable of being observed or demonstrated; and 5) are capable of being adopted on an incremental or partial basis....

12. **Decentralized information exchange among farmers promotes a wider range of innovations that do more centralized diffusion channels.** Diffusion research indicates that local social networks are more important in the dissemination of preventive innovations that they are in incremental innovations.... Farming changes to protect groundwater will likely be facilitated by decentralized farmer-to-farmer information exchange....

These findings appear to hold even when a program is accompanied by cost-sharing incentives. Hoban and Wimberly (1993) found that one quarter of the nonparticipant in 21 Rural Clean Water Program (RCWP) project areas did not participate despite cost sharing of practices because they did not believe water pollution was a problem on their own farm. These perception existed despite the deliberate selection of RCWP to areas having water quality problems (Mass, Smolen, and Dressing, 1985). Other factors cited included six percent who said that cost shares were too low or who cited other deterring financial factors. Fifteen percent resisted participation because changing practices would be too much trouble, involve too much red tape or be too complicated. Ten percent had never heard of the program.

Similar studies have found that farmers failed to participate in the Conservation Reserve Program because they believed they were ineligible, when in fact their land would have qualified. Esseks and Kraft (1986) found in a national survey of farmers that the most frequently cited reason (41 percent) for farmers not entering a bid into the CRP was that they thought there land was not eligible. This figure compares with 25 percent who thought the rental payments were inadequate and the 30 percent who thought the ten year contract period was too long.

Lack of knowledge of a program and the lack of cost-sharing is frequently cited in studies as reasons for nonparticipation in a program (Ligon, *et. al*., 1988). Ligon and her colleagues (1988) study of Chesapeake Bay farmers found that small, part-time, or absentee farmowners were less likely to know about the existence and eligibility requirements of the Conservation Reserve Program.

There is some evidence, however, that producers already enrolled in commodity programs are more likely to be aware of new programs, such as the Conservation Reserve Program (Camboni, Napier, and Lovejoy, 1990). This correlation implies that, if there is to be voluntary improvement in environmental quality stemming from practices of nonparticipants in commodity programs, then there need to be a specifically tailored outreach program to this audience. Commodity program participants such as grain farmers appear to have more access to information on cost sharing programs than, say, livestock producers. If the target problem is animal waste runoff, then specific information will need to be targeted to livestock producers.

Esseks and Kraft (1990) as well as the National Research Council (1993) recommended that these educational programs be modeled on what they termed an "industrial marketing" approach that "sells" a tailored best management system by relating the system to the goals and objectives of the "buyer" (i.e. farmer). This selling is accomplished by using techniques not unlike those used in "Madison Avenue" advertising campaigns for normal consumer goods. Targeted and tailored information is crucial for a voluntary program. As Padgitt and Lasley (1990) note in writing about conservation compliance "mass approaches and trickle down education are not likely to meet the needs..." (p. 398).

Attitudes

Attitudes toward the environment in general can influence adoption. For example, Purvis, Hoehn and Sorenson (1989) found that farmers who are concerned about the environment are likely to set aside more of their eligible acreage in filter strips or to require lower yearly payments for participation. Farmers who indicated they were not concerned about the environment would require a yearly payment approximately $35 per acre higher than those who consider environmental quality an important reason to enter a filter strip program.

Similarly, Napier and Brown (1993) found that farmers who believed that pesticides and fertilizers in groundwater posed a threat to family health tended to perceive that groundwater pollution was an important environmental issue. They were also more willing to "force" farmers with legislation to use groundwater protection practices.

Thus, it appears that a perception of a problem is a logical prerequisite to adoption of changed system of practices (Norris, 1985; Ervin and Ervin, 1982; Napier and Forester, 1982; Ervin and

Alexander, 1981; Hoover and Wiitala, 1980; Nowak, 1982). Nowak and Korsching (1983) as well as Bosch, *et. al*. (1992) found that there is a negative correlation between the perception of both water quality and soil erosion problems and the years of experience in farming. The more experienced producers tend to underestimate their contribution to an environmental problem. Similarly, in a study of 570 North Carolina farmers, Anderson (1988) found that full time farmers with more agrichemical intensive operations expressed significantly less concern about chemicals potential to harm wildlife than did those farmers who had less intensive operations. These findings are consistent with some in Virginia (Halstead, Batie, and Kramer, 1988; Halstead, Padgitt and Batie, 1990) and Iowa (Padgitt, 1987). However,in general, individual and farm characteristics explain only a small portion of differences in adoption behavior (Napier and Brown, 1993; U.S. Congress, 1990).

Other studies have shown that the number of contacts producers have with various sources of technical and education assistance was positively related to accurate perceptions of erosion problems (Choi and Coughenour, 1979; Hoban, 1990; Nowak and Korsching, 1983; Ervin and Ervin, 1982).

These factors influencing producer decisions imply that a targeted voluntary GSP will need to be accompanied with a tailored educational component so that producers recognize the severity and nature of the environmental problem as well as their contribution to it. However,studies of environmental problems show that environmental problems are unevenly located in various regions and parts of regions throughout the nation. If producers are to recognize their contribution to an environmental pollution problem, there needs to actually be a problem. Broad general assertions that imply all farms contribute to equally severe environmental problems are not only inaccurate, they tend to reinforce attitudes of "not on my farm". Targeting to genuine and more severe environmental problems such as the loss of important wildlife habitat, the extinction of endangered species, the imperiling of human health or recreational benefits, or the destruction of long term productivity will increase the credibility of using voluntary technical and financial assistance.

Producer Involvement

Even if a producer is aware of a problem, he or she must still have a favorable attitude toward the proposed solution if they are to voluntarily adopt a new farming system or practice (Lovejoy and Napier, 1986). Some researchers argue that adoption will be increased if there is producer involvement in both problem definition and problem solution. For example, J.C. van Es (1982) notes:

> This undoubtedly sounds trite, but soil and water conservation programs have a history of defining a physical

> problem, developing a technological solution, and then devising a way to have the solution implemented by the farmers. Heavy reliance on voluntary approaches will require that farmers be involved much more actively in problem definition and problem solution that has traditionally been the case (p. 250).

Given the diversity of site-specific problems, failure to involve producers will undermine cost-effective solutions. Furthermore, if producers assist in problem and definition, they are more likely to carefully implement changes. One outcome of producer involvement, then, is reduced program implementation and enforcement costs. The involvement of producers is also essential for tailored educational components that should underlie a targeted voluntary GSP.

Can A Voluntary GSP Achieve Improved Environmental Quality?

Even if producers are involved, perceive a problem, and participate in concentrated, tailored educational activities, voluntary programs will not achieve improved environmental quality by themselves, except perhaps in the win-win situations.

Many believe that voluntary programs alone, at least as currently designed, will not accomplish all the desired environmental goals desired (Batie, 1983; Buttel and Swanson, 1986; Harrington, Krupnik, and Peskin, 1985; Hoban, 1990; Napier, 1987; Swanson, Camboni, and Napier, 1986). Epp and Shortle (1985) note that voluntary actions for most environmental problems have not been very successful. After a review of the Wisconsin Nonpoint Source

Water Pollution Abatement Program, Konrad and his colleagues (1985) conclude that "no voluntary program will achieve the desired levels of control in all situations. In those case, regulatory mechanisms must be considered (1985. p. 61).

Similarly, the Chesapeake Bay program review panel concluded that voluntary incentives, at least as implemented in the past, have been ineffective in achieving the program goals (Nonpoint Source Evaluation Panel, 1990). Surveys also suggest that many farmers want some coercion to penalize non-compliers with environmental legislation (Padgitt and Lasley, 1993), so that historical and consistent "bad actors" are not rewarded for their behavior.

Harrington, Krupnick, and Peskin (1985) note that those nonconservation, voluntary programs that have been successful in the past share common elements. "The first condition is agreement that the policy objective is a worthy one and that the action sought will advance that objective. The second is easily observable noncompliance in order to create social pressures for compliance. The third is that the cost of a voluntary approach should not greatly exceed the value of its private benefits. The fourth is a belief that failure of the approach will eventually lead to mandatory action" (p. 28). Thus, there may be a need for a perceived threat of additional governmental action if the voluntary nonpoint pollution programs failed to achieve satisfactory results.[10]

There appear to be few voluntary non-point programs which are designed using these criteria for their success, in part because many are based on earlier conservation programs characterized by pursuit of farm income support goals (Batie, 1985).

Implications for a Green Support Program

What do we know about designing a voluntary GSP that improves environmental quality? For many farming situations appropriate technologies and information exist to achieve more "environmentally protecting" farming, but environmental problems are unevenly distributed nationally as well as within watersheds and airsheds. Furthermore, successful voluntary programs tend to occur where producers are aware of their contribution to an environmental problem they believe is important, where the benefits of participation are not swamped by the costs, where the producers have assisted in program design, implementation, and enforcement, where education programs are tailored to producer

[10]For am interesting discussion on compliance see Esseks and Kraft (1993). Their research on midwestern producers suggests that producers are more likely to expect detection when they are not in compliance if they have relatively frequent contact with the local USDA offices and if they also believe that monitoring makes use of aerial photography.

needs, and where an implicit or explicit threat of future regulatory programs exist (National Research Council, 1993).

These conclusions suggest some fundamental elements of a voluntary GSP. A voluntary GSP is more likely to be successful if it reflects the national diversity of problems and farm characteristics, that is, if it targets priority areas and priority farms within these areas, and if it emphasizes tailored site-specific planning processes with meaningful producer involvement.

One Size Does Not Fit All

The lesson from the diversity of the problems, the landscape, the farm enterprises, and the producers is: "One size does not fit all." Data on diversity and from the experience with other programs such as the Coastal Zone Act Reauthorization Amendments (CZARA) suggest that a single comprehensive program that specifies the adoption of specific practices for all farms would be ineffective and expensive. There is a public payoff in targeting to both "priority areas" and to "priority farms"--both in reducing the cost of the program and in improving environmental quality (National Research Council, 1993).

Heimlich (1994) demonstrates the use of national data to focus attention on certain problems in certain regions. However, the national data is too aggregated to pinpoint precise watershed problem areas for local planning purposes. Nevertheless, there is increasingly refined data available at the state level to enable reasonably accurate identification of priority areas for a targeted GSP as well as for the identification of polluting farm enterprises within those priority areas. This data is in need of refinement (National Research Council, 1993), but such refinement could come in response to a targeted, voluntary GSP.

The payoff to targeting is the acceleration of the adoption of conservation systems in areas of most critical need, the maintenance of long term agricultural productivity, the reduction in off-site damages, and an increase in cost effectiveness. In addition, only those farmers with significant contributions to environmental problems should be required to change their farming systems. By focusing on a priority area, the opportunity exists to provide flexibility in program design, to include producers in program design, and to strengthen the role of local and state agencies in coordination with federal programs (Nielson, 1986).

Equally important, is the ability provided by targeting to focus on different problems in different areas. Thus, in one region, such as the watersheds influencing the quality of the Chesapeake Bay, a major problem may be animal waste pollution. The targeted producer is then the livestock, poultry, or dairy producer. In other areas, such as the High Plains of Texas, the concern may be windblown dust and long term soil productivity. The targeted producer is then the crop producer.

Whole Farm System Planning

When reduced to its fundamentals, there are only three basic choices for the design a GSP: (1) the identification of a specific set of practices for each type of farm (i.e., design or technology based standards), (2) the articulation of a tailored site specific planning process, and (3) the specification of specific environmental quality goals (i.e., performance standards). The evidence concerning the factors that influence participation in a GSP as well as the diversity of environmental problems suggest that a voluntary GSP should focus on the development of a tailored site specific planning process. The development of targeted farm system planning is also the approach recommended by the National Research Council Committee that authored the report, *Soil and Water Quality: An Agenda for Agriculture* (1993).

Whole farm planning can be simple, but they do involve examining the whole farm as a system and changing how the producer gathers information and makes decisions. Plans, thus are information-gathering, recommendation-building exercises rather then a selection of management practices from a list of approved BMPs. Plans should be flexible and coordinate with individual enterprises characteristics. Integrated farm plans should focus on improving the way information is gathered and used by the producer to make farm management decisions. Indeed, standards such as record keeping or certification requirements intended to improve the flow of information may be far more valuable than technology-based standards (Batie and Cox, 1994).

Clearly, a voluntary GSP that relies on whole farm system planning cannot involve all farms everywhere; there are not enough resources to accomplish the job, nor is it necessary to do so. The importance of targeting to priority areas and farms within these areas is again emphasized.

There are some approximate models to use in developing this approach. For example, Wisconsin legislature created and funded the Wisconsin Nonpoint Source Water Pollution Abatement Program in 1978. The Wisconsin program concentrates on hydrological units called priority watersheds and areas within these watersheds termed priority management areas. Konrad, Baumann, and Bergquist (1985) describe this program. They note that six criteria are used to select the priority areas: (1) the severity of the water quality problem, (2) the magnitude of the loadings and the potential to reduce the loadings significantly, (3) landowners willingness to participate, (4) the ability and willingness of local agencies to assist the program, (5) and the capability of the local agencies to control pollution through the necessary enactments of local ordinances, (6) the potential public benefits and use from the proposed project. The selection process is quite specific and includes numerical rankings of watersheds. The priority watershed plan then has two parts: a technical assessment and an implementation strategy that outlines the process of achieving project objectives. These two parts are described in Table 4.

The National Research Council Report (1993) also provides a detailed discussion of the Narrows Creek Middle Baraboo Priority Watershed Project which is part of this Wisconsin program. Dairying is the major activity in this watershed and the project was used to reach four priorities: (1) the appropriate use of soil tests, (2) nitrogen crediting from legumes, (3) nitrogen crediting from manures, and (4) construction of manure storage structures. Each of the three regions within the watershed required a different emphasis among the four general priorities (National Research Council, 1993, pp 164-166). Thus, the Wisconsin program contains many of the targeting, information-gathering, planning, and producer involvement elements discussed earlier.

Table 4. The Wisconsin Nonpoint Source Water Pollution Abatement Program[11]

Selection of Priority Watersheds
Selection of priority watersheds is a four step process that involves the numerical ranking of watershed following evaluation by the Department of Natural Resources (DNR), review and recommendation by regional committees, the establishment of a list of 15 to 20 watersheds by a committee with various agency and interest group representation, and final selection of projects by the DNR.

Project Objectives
Selection of a priority watershed project is followed by an eight to nine year planning and implementation process. An Implementation plan is prepared based on a detailed inventory and assessment of critical source areas and the project's water quality objectives.

The priority watershed plan has two parts:

Part I. Part I is the technical assessment and the setting of the watershed project goals by (a) assessing water quality problems and objectives, (b) Identifying significant nonpoint sources, (c) identifying water quality improvements that can reasonable be achieved through nonpoint pollution controls, and (d) identifying management needs.

Part II. Part II is the implementation strategy that outlines the process for achieving project objectives. It identifies (a) the tasks necessary to accomplish the management needs identified in Part I, (b) the agencies responsible for carrying out those tasks, (c) the time frame, (d) the staff resources needs, (e) the cost share dollars need to implement the recommended nonpoint source control practices.

Agreements
Following approval of a priority watershed plan, there is a three year period during which landowners and municipalities can sign cost share agreements for the design and installation of BMPs. Installation of BMPs must take place within five years of the date the cost share agreement is signed. The BMPs must be maintained for 10 to 20 years. Failure to do so is a breach of contract and requires repayment of the cost share funds received.

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[11]Abbreviated from John G. Konrad, James G. Baumann, and Susan E. Bergquist, (1985).

Summary

This review suggests that there is both technology and information available to develop a voluntary and targeted GSP that is dedicated to improving environmental quality as it relates to agriculture. However, the elements of such a program are complex and require understanding of both the data on the location, type and magnitude of the problem as well as the diverse motivations of the nation's agricultural producers. However, the producers involved in a GSP oriented to environmental improvement may not be the same producers currently participating in agricultural commodity programs.

This review further suggests that elements of a successful, voluntary GSP include (a) targeting to priority areas and farms within these areas, (b) tailored and targeted educational programs, (c) whole farm system planning (e) emphasis on information gathering and use (f) producer involvement in the design and implementation of the program and plan, (g) transitional cost-sharing for some practices and longer term cost sharing for other practices as part of a system, (h) an explicit or implicit threat of future mandatory programs should voluntary programs fail to achieve public goals.

What is clear is that improvement of nonpoint pollution will require changing the way we have approached the problem in the past. We know enough to do better, to be more cost effective, and for many farms, still preserve the profitability of farming.

At the same time, we should be realistic about how much a targeted, voluntary GSP program can reasonably be expected to accomplish. Etzioni (1994) in an editorial on social programs makes some comments equally germane to conservation programs.

> On one level, both from personal experience and from numerous studies, we know that it is extraordinary difficult to change habits, personality traits, culture, and social institutions.... Let us...dedicate our efforts to effective but clearly delineated projects... This humbler approach is likely to have a very attractive side effect: it may enhance public willingness to pay for such projects and may also restore public trust in our leaders and institutions (pp. 15-16).

Still, we know enough to improve the design of conservation programs, and improved information will be forthcoming that will allow even further refinement of such programs. Whether a voluntary GSP program will reach its full potential will depend on both creativity in using such information and public resolve to implement the program as designed (Hoban, 1990).

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