Agricultural Competitiveness and Environmental Quality: What Mix of Policies Will Accomplish Both Goals?

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EXECUTIVE SUMMARY

Agricultural competitiveness and environmental quality are increasingly consensus objectives for American agriculture. Yet the institutional interests undergirding agricultural policy are often at odds with those promoting improved environmental quality. This paper examines ways in which institutional reforms can improve both agricultural competitiveness and the environment.

Farmers, like other business managers, make decisions based on information received from markets and other sources. This report shows how farm management as an activity responds to signals from commodity markets, federal agricultural policies, federal and state environmental regulations, and private sector and university extension recommendations. These individual signals are examined and compared in terms of their effect and compatibility. The signals are not always consistent, placing the farmer in a cross-fire between environmental critics and other interests that defend current agricultural practices.

We examine four ways in which institutional reforms can improve both agricultural competitiveness and the environment. First, the world market should be the primary determinant of what is grown at the farm level. For markets to work effectively, all policies, including trade and tax policies, must be conducive to a stable macroeconomic environment.

Second, world market signals should not be distorted by farm policies which reduce planting flexibility and control supply. The "whole farm" base or Normal Crop Acreage proposals now under discussion in Congress have merit on both competitiveness and environmental grounds. Evidence from a variety of case studies clearly indicates that current programs place farmers in a position in which they must often forsake good agronomic practices which are environmentally responsible in order to retain program benefits. Income support to the farm sector, if paid on a whole farm base, would increase flexibility without increasing the risk of lost income due to changes in cropping practices or adoption of different agronomic practices. Indeed, support levels could even be structured to reward adoption of improved agronomic practices that enhance the environment.

Third, even if federal agricultural policies were so reformed, there would still be an important role for specific policies designed to promote a variety of environmental improvements. But what appear in Washington to be effective environmental regulations appear to many farmers as misguided and ineffective. One set of environmental regulations affecting agriculture is based on denial of all farm program benefits to farmers who fail the conservation compliance, sodbuster and swampbuster tests of the 1985 Food Security Act. These provisions are difficult to uniformly enforce and are poorly designed, and should be amended to allow graduated penalties based on the degree of damage per acre. The Conservation Reserve Program (CRP) needs to be revamped so that its bidding process reflects true costs, and so that it is targeted to areas most in need of environmental protection. The CRP and the conservation compliance, sodbuster and swampbuster programs would all work more effectively if the

acreage reduction program (ARP) were eliminated and a whole farm base adopted. This would lower the opportunity cost of permanent land retirement at the farm level, target such retirement specifically to acres low in productivity and high in environmental vulnerability, and increase the flexibility with which productive land could be used.

The other set of environmental regulations affecting agriculture involve prohibitions on agricultural chemical use. The chemical-by-chemical registration process of EPA, in part because it has proceeded at a snail's pace, has actually hampered the development and marketing of more environmentally benign chemicals, while leaving other products in use. Legislation has established cancer risk at the lowest detectable level as the basis for prohibiting agricultural chemicals. This has led to restrictions on chemicals with much lower levels of risk than those now in use, and has failed to focus regulatory oversight where human health risks are actually highest. Finally, regulatory gridlock at the federal level has encouraged states to act unilaterally, creating a patchwork of state laws without any overarching pattern. Due to shortages of funds, states will be tempted to move in the direction of taxes on fertilizer or chemical inputs. Such taxes will raise farm costs but are unlikely, unless they are punitively high, to affect substantially the level of input use and thus environmental quality. In sum, current environmental policies hamper agricultural competitiveness, without substantial benefits to the environment, and are in serious need of reform.

Fourth, research, extension and private sector recommendations will remain crucial to both improvements in environmental quality and to retaining the competitive posture of U.S. agriculture. Critics have

emphasized the past preoccupation with yield increases to the exclusion of environmental concerns. Yet, there are opportunities for growth in technologies that address both goals. Research and extension need to focus on both productivity and environmental stewardship. Unfortunately, neither the regulatory nor the farm policy environment is providing positive incentives in these areas.

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INTRODUCTION

Agricultural competitiveness and environmental quality are increasingly consensus objectives for American agriculture. Yet the institutional interests undergirding agricultural policy are often at odds with those promoting improved environmental quality. This paper examines ways in which institutional reforms can improve both agricultural competitiveness and the environment.

Fundamentally, a farmer works in partnership with nature, and must understand soil types, topography, hybrids and crop varieties suited to soils, climate, and topography. They must also consider various tillage requirements and options for each crop, tillage impacts on the soil and topography of each field, and the history of weeds, pests and fertilizer and chemical use for each field. Farmers strive to conserve the assets of their business, including soil and water resources, upon which they must rely in the future. They thus confront directly many of the environmental issues of farming the land.

Farmers, like other business managers, make decisions based on information received from markets and other sources. Part of this information includes input supply prices, crop prices, interest rates, federal farm programs, and state and federal environmental policies. Farmers must also consider a variety of other forces that signal what to grow and how to grow it. These include soil, water and moisture conditions

and private sector, university and extension recommendations. "Signals" or information received by farmers are not always consistent. This paper reviews ways in which currently contradictory signals can be made more compatible with the twin objectives of agricultural competitiveness and environmental quality. It complements a companion paper, by Robert D. Munson and C. Ford Runge, which examines the technologies available to increase input efficiencies and accomplish the same objectives. Together, these papers represent an institutional and technological agenda for the 1990s.

In Figure 1, we show the sources of the various signals that the farmer receives, indicating the complex series of choices needed to farm. First are market prices for inputs and outputs. The impact of these economic signals is well understood; higher prices for an output commodity (such as corn) stimulate production, and higher prices for an input (such as fertilizer) generally cause a reduction in use or substitution away from that particular input to lower priced methods of production.[1]

A second major source of outside influence is federal agricultural policies. Since the 1930s, these policy signals (reviewed in Runge, et. al., 1990) have been a key influence in farm decisions about what crops to

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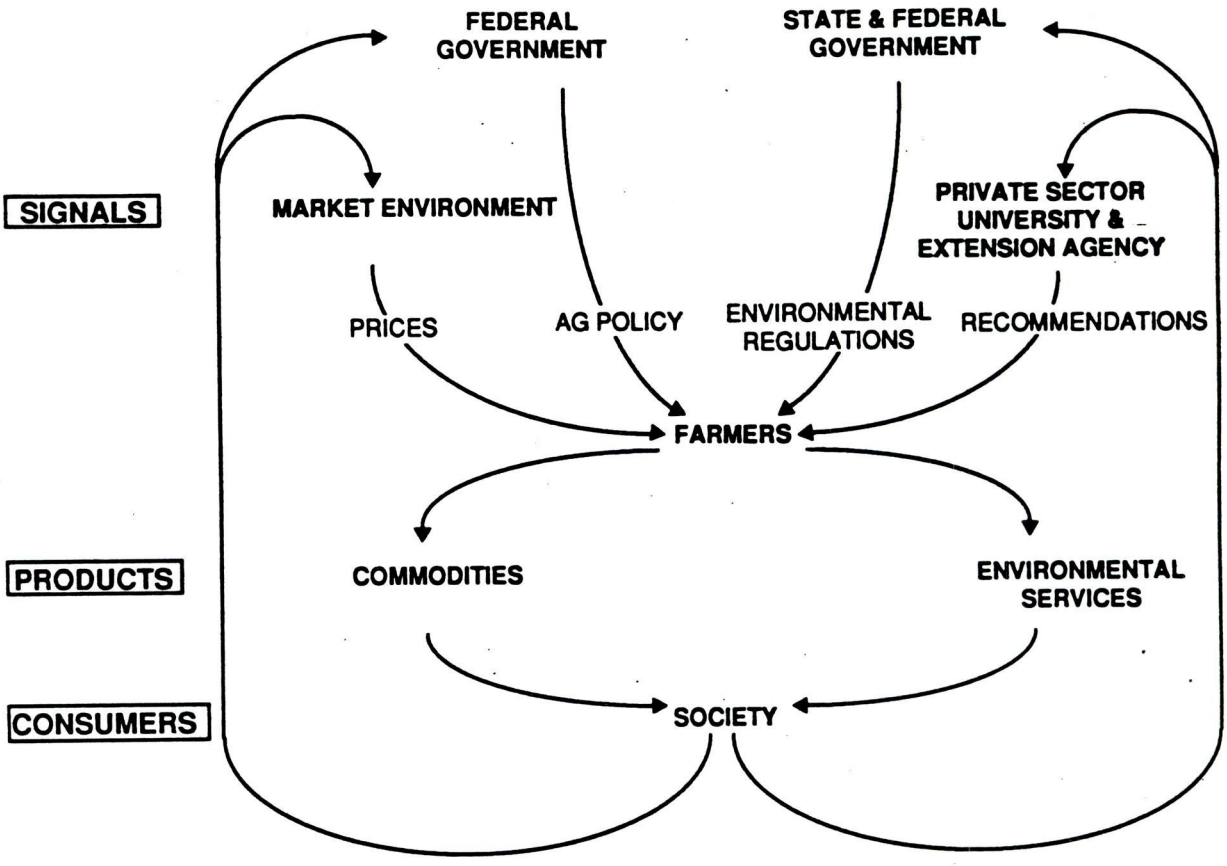
[1]The magnitude of such changes in production methods is measured by what economists call "elasticity." Elasticity of supply or demand in response to price ("own price elasticity") is the percentage change in quantity supplied (or demanded) divided by the percentage change in price. Grains, for instance, tend to be relatively supply elastic because even a small change in price gives farm managers a strong incentive to expand acreage. Fertilizers, however, tend to be relatively demand inelastic, since farmers are unable to change production technologies overnight: a small change in the price of a chemical input will not change the quantity demanded very much. The demand for fertilizers is more closely related to the price of the crop they are used on. In this sense, their demand is a "derived demand".

Figure 1.


FEDERAL GOVERNMENT
STATE & FEDERAL GOVERNMENT
SIGNALS
MARKET ENVIRONMENT
PRIVATE SECTOR UNIVERSITY & EXTENSION AGENCY
PRICES
AG POLICY
ENVIRONMENTAL REGULATIONS
RECOMMENDATIONS
FARMERS
PRODUCTS
COMMODITIES
ENVIRONMENTAL SERVICES
CONSUMERS
SOCIETY

plant, how often to plant them in rotation with other crops, and the production methods used. While markets help to determine the base level of input and output prices, federal agricultural policies have added a subsidy component to both crop prices and many inputs. These subsidies have been accompanied by a variety of supply control programs. Together these policies alter the market prices of various crops by artificially supporting prices, restraining production, and by subsidizing risks associated with specialization.

A third source of signals farmers receive comes from federal and state environmental regulations. These range from restrictions on land use (such as the conservation compliance, swampbuster and sodbuster provisions of the 1985 Food Security Act) to specific bans or restrictions on the use of certain chemicals. These regulations are likely to become increasingly stringent in the years ahead. They often conflict with both market signals and the price support and supply control provisions of federal agricultural policy. While designed to protect the environment from potentially harmful practices, these policies have been developed without close attention to their impacts on farm-level competitiveness. To date, use restrictions and denial of program benefits for noncompliance are the primary means of control, although such policies are seldom the most efficient means of achieving desired environmental goals.

The fourth source of signals to farmers comes from the private sector, including seed and fertilizer dealers, consultants, company representatives and the farm press, as well as university and extension agencies in the form of consultation, testing, and other recommendations about what to grow and how to grow it. A primary objective of this advice in the past has

been to help farmers achieve higher yields. Yet as environmental and financial pressures have increased, a shift toward recommendations geared to lower per unit costs of production and compliance with environmental regulations has occurred, making the job of giving farm-level advice more complex. Increasing availability of information is making a strong impact on the nature of these signals. A major difference between past and future recommendations is that they will increasingly emphasize the complex trade-offs between production of farm commodities and environmental impacts.

These forces interact as shown in Figure 1 to influence farm-level decisions. These decisions yield a "joint product" at the farm level. On the one hand, farmers produce a flow of agricultural commodities (milk, meat, grains, etc.) for consumption. At the same time, they also produce a flow of external environmental services (or damages). Public environmental services include wildlife habitat and clean water, which can sometimes be sold as private goods (as in hunting fees). The quantity and quality of food and fiber, together with these environmental services, flow to society, and in turn affect public opinions of agriculture. These public views feed back as signals which affect farmers.

Operating behind all of these institutions is the force of public opinion, which affects the types of farm products demanded, farm policy, environmental regulation, and even extension recommendations. Public views of agriculture increasingly stress the need for greater environmental accountability, as indicated by a variety of recent surveys and opinion polls. Few in the non-farm community fully appreciate the complex agronomic and production issues involved in running a modern farming operation. Still, nearly three-quarters of rural Americans polled favor

"government establishing tougher regulations on pesticides even if it increases production costs" (American Viewpoint, 1989, quoted in Reichelderfer, 1990, p. 2). While both on- and off-farm opinion stresses environmental concerns, on-farm opinion remains focused on maintaining a competitive structure of costs, at the same time that environmental goals are met. As a recent study of public values and their effect on agricultural policy noted:

> ...while agriculture's relative contribution to the overall economy has declined, the food and agriculture sector remains important not only as a source of domestic food but of export earnings and as the steward of much of our renewable resource base. Society appears to be increasingly concerned with the quality and quantity of soil, water, and air as those natural resources are affected by agricultural practices such as irrigation, tillage, fertilization, and the use of chemical pesticides (Henderson, Wallace, and Woods, 1987).

While farm managers are very responsive to these various signals, they are also caught in difficult and confusing societal cross-currents. Lyman, et al. (1989) and Duffy and Chase (1989), for example, discussed the way in which federal agricultural policy has put some farmers in what they termed a "vise grip", rewarding in financial terms production methods that were less preferred on environmental grounds. A separate survey of farmers recently showed support for the Cooperative Extension Service's efforts to provide information on ways to reduce chemical use, even if the advice resulted in lower crop yields,[2] showing the responsiveness of farm

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[2]Survey conducted in 1989 by the American Farmland Trust. This option received approval ratings as high as 49 percent. Highest approval ratings for information provided by Extension occurred in areas that were suffering the most severe groundwater contamination problems.

managers both to recommendations from extension agencies and the public (American Farmland Trust, 1990).

The management problem of farmers is made worse when these signals are contradictory and change unexpectedly over time. Because of the powerful role of farm policy it makes sense to focus especially on it as a source of confusion. Agricultural policy signals have been overriding in recent years as evidenced by the high rates of program participation: more than two-thirds of all cropland in the U.S. in 1989 was enrolled in agricultural programs (National Research Council, 1989). Of total corn, wheat, and other program crop acreage, 80 percent was enrolled in 1989 (Hershey, 1990). Examples of contradictions among agricultural policy signals include production subsidies which have increased the number of acres under cultivation, while other programs have lowered them; markets for certain "non-program" crops which send signals to increase production, while farm programs discourage any such plantings that would decrease the program base; and agricultural policies which discourage the preservation of wetlands, while others penalize farmers who drain and plow swamps. It seems unreasonable to lay the perceived problem of environmental quality in agriculture solely at the feet of farmers when public policies are so confused. While it is naive to suppose that perfect consistency can be found, we contend that a variety of substantial changes in these institutional signals can be made.

There is increasing discussion of reorienting agricultural programs so that market signals play a larger role. In the sections to follow, we will consider policy and other signals individually to see how they enter the farm manager's decision-making process. We then show what desired changes

could come about if they were in greater harmony, and the frustrations created when they conflict. Using this framework, we will discuss some policy alternatives that would help to promote improvements in both agricultural competitiveness and environmental quality. We believe that in many respects, the key to maintaining a competitive agricultural sector, while also minimizing negative environmental impacts, is finding the right balance between these signals.

ECONOMIC POLICIES AND THE MARKET ENVIRONMENT

Underlying the price of crops, like corn, and inputs such as fertilizer and chemicals are a variety of macroeconomic variables that affect the agricultural market environment through their influence on interest costs, export competitiveness, and the price of land and farm equipment. Much agricultural policy analysis is done without sufficient attention to these variables, despite their impact on agricultural competitiveness (Schuh, 1983).

These variables are affected by both monetary and fiscal policies. Monetary policy affects both interest rates and exchange rates, which have an overriding effect in an agricultural system where interest payments are currently the largest farm cash production expense, and where a large percentage of the crop is exported (Henderson, Wallace, and Woods, 1989). A tight monetary policy, such as was pursued in the early 1980s, tends to force interest rates up and strengthen the dollar, making credit and exports more expensive. Large surpluses of grain built up in the early 1980s were also partly caused by the strengthening dollar.

Fiscal (tax) policy also has a major role. Whereas monetary policy affects prices and competitiveness of American farm commodities and agricultural credit, tax policy affects the investment value of irrigation, land, farm equipment, and animal confinement facilities, among other inputs. As Benfield, Ward, and Kinsinger (1986), noted, before passage of the Tax Reform Act of 1986, agriculture received investment credits and accelerated depreciation on such investments. Additionally, favorable tax treatment allowed individual farmers to exclude from taxation 60 percent of capital gains income received from the sale of assets such as land, breeding stock, and certain unharvested crops. Favorable capital gains treatment provided incentives to purchase highly erodible fields and

wetlands, rangelands, or forestlands at relatively low prices; convert these lands to cropland; sell them at a profit; and exclude 60 percent of the gain from taxation. Benfield, Ward, and Kinsinger (1986) estimated the tax advantages of large-scale conversion of wetlands to cropland to be as much as $603 per acre.

Similarly, converting the sandhills of Nebraska to center-pivot-irrigated corn has been estimated to generate $175 per acre in tax advantages through a combination of the water depletion allowance, accelerated depreciation and investment tax credits (Benfield, Ward, and Kinsinger, 1986). Some results of those policies are readily seen. From 1950 to 1978, 25 million new acres came under irrigation, 94 percent of which are in 17 western and 3 southeastern states. Today 13 percent of cropland is irrigated, but that land accounts for 30 percent of the value of crops produced, especially in states such as California and Nebraska. Overall, agriculture accounts for 85 percent of all consumptive use of water, and 94 percent of agricultural water is used for irrigation. In fact, the depletion allowance mentioned above was awarded to farmers who could prove that they were irreversibly depleting (mining) groundwater reserves (National Research Council, 1989).

While governments clearly influence both monetary and fiscal policies, much of the explanation for the prices of farm inputs and outputs results from market-driven demand and supply conditions on a global scale. These market signals are, however, largely disguised by the influence of direct government intervention in the agricultural sector. By artificially constraining supply and supporting agricultural prices, farmers are given signals to plant crops that may not, in fact, be in greatest world market demand.

FEDERAL AGRICULTURAL POLICIES

Farmers in the United States have experienced a tradition of intervention that began with the agricultural programs instituted in 1933 to alleviate hardship arising from the Great Depression. These policies, originally justified as temporary expedients, stimulated production as they became fixtures. By the mid-1950s, the need for major production restraint became evident. Part of this restraint was justified as conservation, resulting in creation of the "Soil Bank." As a recent study concludes: "income support has been a principal - probably the principal - objective of U.S. agricultural policy: and manipulation of commodity prices has been the principal means of achieving it" (Roberts, et al., 1989).

The effect of agricultural price manipulation on production decisions has been large. Over the 1980s, government payments were a growing fraction of net farm income, especially in regions where program crop production predominated. For example, in Iowa 1987 government payments amounted to 70 percent of net farm income (Duffy and Chase, 1989). It is interesting to note that although justified in the name of price stabilization, substantial farm income support has had only a minor stabilizing effect on year to year variations in incomes. Indeed, farm incomes and prices both became substantially more unstable in the 1970s and 1980s compared with the 1960s and early 1970s, despite increasing government transfer payments (Myers and Runge, 1986).

However, one clearly positive association is between the acreage planted to certain crops and the receipt of government price supports to plant these so-called "program crops". Cropping patterns respond directly and significantly to these payments (Houck, et al., 1976). Acreage

reduction programs, meanwhile, have been only partly successful in reducing output, in part because the attractiveness of the commodity program determines the amount of acres enrolled in acreage reduction programs. In recent years, between 80 and 95 percent of program crop acreage has been enrolled in the federal commodity programs (National Research Council, 1989). Because the amount of acreage reduction is determined by the U.S. Department of Agriculture (USDA) annually prior to planting, it is difficult to guess how much the supply control "brake" should be applied in the face of the "accelerator" of both market and government price signals. Moreover, farmers regularly retire acres of lowest productivity, leading to substantial "slippage" in the amount of production actually reduced through mandated acreage reductions. Over time, income support programs also have increased the amount of investment in added capacity, contributing to growing problems of surpluses. The conclusion of a recent analysis was that the "brakes" approximately offset the "accelerator" pressure, so that "the production reducing effects of the acreage reduction arrangements approximately offset the short term production stimulating effects of the deficiency payments" (Roberts, et al., 1989). In the long term, however, per acre yields have continued to grow, as new technology is brought to the farm. As government has applied both brakes and accelerator to farm production simultaneously, budget costs have soared.

Despite their failings, government programs simplify a key issue at the farm level: what to plant? If government provides deficiency payments well above the market price for corn, compared with soybeans, farmers will be inclined to plant corn. If retaining eligibility for government price

support payments for corn requires continuous cropping, then farmers will be inclined to forego rotations of corn with other crops. Finally, since government deficiency payments have been based on a farm's or a county's average yields, farmers will be inclined to raise yields, beyond the point that market forces might dictate. All three of these judgments: what to plant, how often to plant in rotation with other crops, and how far to push yields, have direct implications for fertilizer and chemical use.

First consider the issue of what to plant. If farm programs increase the prices of crops (in recent years especially corn and wheat) above levels that would effectively have been received in the absence of price supports, this sets off a chain reaction. Planting decisions on the farm are increasingly tied to deficiency payment announcements rather than market conditions (farmers refer to this as "farming the government"). The result has been to reduce the diversity of cropping and to encourage crops that depend heavily on chemical inputs (Reichelderfer, 1989). Corn and wheat now account for over 50 percent of all nitrogen fertilizer applications in the U.S. (The Economist, 1989).

A related issue concerns the mix of crop and livestock production. Livestock production (except dairy and wool) receives no direct government price supports. Traditionally, in addition to off-farm income augmentation farmers kept livestock (poultry, hogs, cattle) as one form of insurance against price fluctuations in grain crops. Livestock also utilized available labor more effectively and was an on-farm source of manure. Over the 1970s and 80s, increasing government subsidization of grains and oilseeds made this crop/livestock insurance less necessary. In addition, legislation restricting practices on feedlots encouraged many farmers to

reduce livestock and to specialize in "cash grains", thus increasing their reliance on purchased fertilizer nutrients instead of manure nutrients from livestock or legume nitrogen from crop rotations. (Manure itself may have adverse environmental impacts, and usually can supply only a fraction of total fertilizer demands). Poultry and other livestock production have increasingly become separate specialties, leading to large feeding operations which pose major problems of waste disposal. Through complicated technological and market interactions, the decline in diversity at the farm level -- encouraged by government programs and technology -- has meant fewer and larger farms.

A second major effect of government programs concerns how often a certain crop is planted in rotation with others. Commodity programs have included acreage "bases" for each of several crops. This "base acreage" entitles the farmer to crop price support payments in relation to its size. But retaining the base has also required that the specific crop continue to be grown on the farm year after year: program "base" has generally been decreased if the acreage planted declines. This is a disincentive to rotate program crops, such as corn, wheat and barley, with non-program crops, such as grasses, alfalfa, or other specialty crops that are less prone to soil erosion, and might decrease the need for some fertilizer nutrients and chemical inputs. It has also reduced the attractiveness of planting soybeans (the price of which has been supported at much lower levels than corn) even when market prices suggested the merit of doing so.

Third, government program benefits have also been calculated according to average yields, sometimes referred to as "yield base". Prior to the current farm bill, farmers have had an economic incentive to

increase yield if the higher yield in one or more years would increase the yield base and returns from the government program over a number of years in the future.

In a recent study, Young and Painter (1990) studied the impact of the 1985 Food Security Act on what farmers planted and the rotations undertaken. They examined the interacting effects of (1) deficiency payments, (2) acreage reductions, (3) crop prices and (4) maintenance of program "base" in the Palouse region of Washington state, a wheat producing area. Some evidence has suggested that the first two factors -- higher deficiency payments and acreage reductions -- create opportunities for green manure crop rotations (e.g., Dobbs, et. al., 1988). However, Young and Painter found that whenever deficiency payments are relatively high and acreage reductions are in force, the farm programs create disincentives to green manure rotations, because the opportunity cost of growing something other than the price-supported crop is large. When deficiency payments are relatively low and acreage reductions are high, there is less opportunity cost to such rotations. But when the second two factors -- crop prices and base maintenance -- are integrated into the analysis, a picture emerges which even more clearly suggests the disincentives to green manure rotations arising from current farm policies, at least in the Palouse. Current law creates a situation, (similar to that noted by Lyman, et. al., 1989, in Minnesota) in which farmers choosing green manure rotations are seriously penalized by loss of wheat and barley base, creating a dilemma -- between choosing more agronomically sound rotation practices and foregoing future program benefits -- or protecting base acres at the expense of environmental considerations. This is what Lyman, et. al., called a "vise grip".

If farm program benefits were calculated instead on a "whole farm base", or Normal Crop Acreage (NCA) as in a variety of legislative proposals now under review in Congress, many of the negative farm program effects on crop rotations would be mitigated. An NCA would pool the growers base acreage over all program crops, and permit green manures and "conserving crops" to be counted in future base calculations, as well as qualifying these crops, if left unharvested, for deficiency payments on base acreage for that year. In addition, unharvested conserving crops would continue to satisfy acreage reduction requirements, and would provide cost-sharing for perennial cover crops on multi-year set-asides. Even without these additional benefits, which are relatively unimportant in the Palouse, Young and Painter (1990) found that if NCA had been in place during 1986-90, instead of 1985 Food Security Act (FSA), "the NCA would have been markedly more effective than the 1985 FSA in sheltering the base of a farmer using the environmentally sustainable perpetuating alternative legume system (PALS) rotation" (p. 13). However, if the NCA had increased crop prices, the green manure rotation would still have been under pressure from a conventional rotation, as its opportunity costs would have risen.

In sum, Young and Painter note that:

> This study's findings strongly support the base flexibility proposals under consideration for the 1990 Farm Bill. It is crucial, however, that these proposals include soil building green manure crops in the list of specified alternative crops that can be grown on "flexible" base acres and on ARP acres, as in the Administration's 1990 Normal Crop Acreage (NCA) proposal. Retroactive application of the NCA to 1986-90 would have sheltered all the PALS rotation's green manure acreage as whole-farm base. Furthermore, the non-ARP green manure acreage would have qualified for deficiency payments under the NCA, thereby

sharply increasing its profitability in comparison to the FSA and relative to the conventional rotation.

Of course, this single region case study involving an experimental green manure rotation does not ensure that widespread adoption of similar rotations would occur with passage of the NCA or similar proposals. Such rotations may still fail to be competitive in some regions due to physical and/or economic factors. Planting flexibility should also strengthen prices and thereby profitability of program crops as the incentives promoting excess production are reduced. Nonetheless, these proposals represent an important step toward making farm programs neutral as they relate to program and conserving crops (pp. 15-16).

Price risk is effectively mitigated by support programs, whether tied to specific crops or to a "whole farm" base. Altering the structure of income support so as to provide a single farm payment based on a whole farm base, as under the NCA proposal, would also have a risk-reducing effect that might encourage adoption of alternative, environmentally beneficial technologies. A risk-reducing income safety net can be consistent with far greater flexibility in the choice of cropping practice at the farm level, so long as payments are not tied directly to specific crops.

Because risk reduction has been targeted instead to a relatively narrow group of crops, the effect has been to encourage the intensive cultivation of these crops, to the exclusion of rotation and diversification. While such risk reduction is partly responsible for the rapid rates of production technology adoption seen in U.S. agriculture over the last half century, it has biased this technology toward yield increases for a relatively few crops, notably coarse grains, wheat, and soybeans, and

away from integrated crop/livestock operations, reducing the return of animal manures to the soil.

Risk reduction through government safety net payments tied only to a whole farm base could be important to farmers in adopting alternative, more agronomically sound and environmentally benign technologies, especially if incentives were created through taxes or subsidies for those willing to adopt them early. As recently noted by Church (1989), "Increased down-side (price) risk can weigh heavily in a farmer's decision [not] to adopt even those conservation practices that can save the farmer money in the long run," (such as capital investment in machinery for conservation tillage).

As the foregoing analysis suggests, the overriding importance of agricultural price and income support policy at the federal level creates major opportunities to improve the agronomic and environmental impacts of farming practices through changes in those policies over time. It is our view that increasingly flexible farm programs, operating through a Normal Crop Acreage (NCA) or "whole farm" base approach, will also enhance American agriculture's overall competitiveness, by allowing farmers to respond more readily to market signals.

However, even if such changes were undertaken, and farmers were allowed to plant more freely in response to markets, there would still be conflicts between some of these signals and reduction in environmental concerns. As a Minnesota case study (Legg, Fletcher and Easter, 1989) emphasized, high commodity prices raise the opportunity costs of rotations, whether these prices originate from government subsidies or the market alone. For this reason, environmental policies will continue to be important in promoting improved impacts of agricultural practices. The question is: are current environmental policies doing the job?

ENVIRONMENTAL REGULATIONS

The evolution of public attitudes about agriculture and the environment has led from a view, prevailing for the better part of the 20th century, that agriculture and farming are environmentally healthy, to something approaching the opposite view today. Today, farmers are caught in a cross-fire between environmental critics and other interests that defend current agricultural practices (Batie, 1990).

Beginning in the 1970s, environmental interest group activity and the judicial system began to put pressure on Congress and state legislatures to restrict the use of certain agricultural chemicals, and popular literature critical of their use began to arouse public fears. Partially in response, in 1970 some responsibilities formerly held by the U.S. Department of Agriculture (USDA) were transferred to the new Environmental Protection Agency (EPA). By the 1980s, as Reichelderfer (1990) recently noted, "the divergence of agricultural and environmental policy goals reflected a growing schizophrenia in the American public... The public's call for strong farm supportive measures was often at odds with its equally vocal demands for a clean, environmentally sensitive agricultural sector." By the end of the 1980s, after mushrooming farm program costs and horror stories of large payments to already-rich farmers had become common news, public support for farm price and income subsidies had become the weaker of the two demands, even as the call for environmental quality had strengthened. In a lead editorial titled:
"Get Fat Farmers Off Welfare," the June 19, 1990 New York Times noted:

> Of course farmers resent the notion that farm subsidies are called welfare. They prefer to think of them as payments to

> stabilize output, conserve soil or save the small family farm. But the nation's farm program encourages soil erosion, destabilizes production and favors large farms.

Faced with such criticism, many farm interests have become highly defensive, seeking to block additional environmental regulations through Congressional and state lobbying efforts. While partially successful short-run strategies, these efforts have reinforced the suspicions of many environmentalists, who in turn inform the public that the "agricultural establishment" is opposed to environmental improvements. As David S. Cloud, writing of the shifting balance of power between the groups, recently noted:

> Environmentalists have spent a quarter century repudiating the notion that tillers of the soil are the best stewards of the land, water and food supply. They finally have the public nodding its head -- and farmers shaking theirs, bewildered by their sudden unpopularity (Cloud, 1990, quoted in Reichelderfer, 1990).

The conflicting signals sent by environmental regulations and current farm programs are perhaps the most striking discordance in the current policy debate. We have already reviewed several problems in current farm policy. Environmental regulations are not integrated with or clearly related to these policies, posing additional dilemmas for American farmers.

Environmental policy has largely followed a separate institutional path, only recently colliding with agricultural interests (Capalbo and Phipps, 1990). While a complete review of all the environmental regulations affecting and likely to affect agriculture is beyond the scope of this study (and has yet to be written), it is useful to categorize the

basic issues, and to indicate how environmental policies can be structured so as to better achieve their aims, while minimizing the additional costs to the farm sector.

Three main issues dominate the environment/agriculture discussion. The first is water pollution. The EPA has identified agriculture as the largest nonpoint source of surface water pollution (National Research Council, 1989, p. 3). As Clark, et al. (1985) note:

> In addition to biological damages, the off-farm cost of agricultural runoff from increased flood damages, impaired recreational opportunities, and interference with water conveyance facilities, industrial and municipal uses has been estimated at $2.2 billion per year.

The second and related issue is the safety of groundwater supplies. Approximately 50 million people in 1,437 counties rely on potentially contaminated groundwater for drinking water. These problems tend to be localized in areas of concentrated agriculture and/or specific geologic formations that are conducive to rapid transport of contaminants to the water table.

The third area of concern is fragile land areas such as wetlands and native prairie. Approximately one million acres of wetlands are drained each year, the vast majority for agriculture, threatening the breeding ground and habitat for approximately two thirds of the major commercial fish species and many types of waterfowl (Church, 1989, p. 6).

Aside from outright bans on the use of certain farm chemicals (to which we will return), the primary mechanisms to deal with these issues are the "conservation compliance," "sodbuster" and "swampbuster" provisions of the 1985 Food Security Act, together with the Conservation Reserve Program

(CRP). Conservation compliance requires farmers to develop conservation plans for their farms, and after 1990 penalizes farmers who fail to do so or cultivate highly erosive land by loss of all farm program payments for all crops grown on the entire farm. While a seemingly draconian measure, conservation compliance has several essential design flaws that make it difficult to implement. First, in times of high reliance on government deficiency payments (and other government payments) for net farm income, it has come to be viewed by farmers and their elected representatives in Congress as an excessively punitive measure, out of proportion to the environmental damages likely to occur. Thus, when farm income payments are high, enforcement will be problematic, and a variety of loopholes are likely to be created through legislative and administrative means. But even when market prices rise (reducing deficiency payments), the incentive to undercut conservation compliance remains, because when prices are high, conservation is most threatened by the incentive to farm every available acre. And when prices are high, the penalty for noncompliance -- the deficiency payment -- is low.

Conservation groups have recently charged that state Soil Conservation Service offices have retreated from conservation compliance under pressure from farmers who claim its requirements are too strict and its penalties too severe. Noting weakened standards in the key farm states of Iowa and Nebraska in April, 1990, the Center for Rural Affairs (1990) raised the concern that "The SCS is sending a signal to other regions and states that weaker erosion standards are acceptable."

The "sodbuster" and "swampbuster" provisions of the 1985 Food Security Act suffer from related problems. The first is designed to limit the

plowing of cropland designated as highly erosive; the second to limit the conversion of designated wetlands to croplands. To do either leads, in principle, to the future loss of eligibility for all farm programs. Again, these laws are likely to be undercut precisely when they are most needed by administrators and legislators who view the penalties involved as excessive. An important feature of both is that they are interpreted and enforced by local committees acting on behalf of USDA. At the local level, where the offending farmer is likely to be well-known to committee members, the lack of proportionality between the punishment and the damage makes it particularly difficult to impose the "death penalty" of loss of all payments. To date, only a handful of such penalties have been handed down, and many have been overturned on appeal. The National Wildlife Federation, after seeking access to USDA records under the Freedom of Information Act, found that as of April, 1989, "there are only 26 producers in the entire United States who have actually lost benefits as a result of swampbuster violations which occurred between December 23, 1985 and April 15, 1989" (quoted in Hayden, 1990, p. 583).

In short, what may appear in Washington to be effective environmental regulations appear to many farmers as misguided and ineffective measures unrelated to farm-level incentives to produce (signals also sent from Washington). One obvious amendment to the provisions would be to impose mandatory financial penalties (fees) for lack of conservation compliance as well as sodbusting and swampbusting on a graduated basis, depending on the number of acres affected and the degree of damage. These fees could either be subtracted from deficiency payments or (since many farmers receive few if any such payments) simply assessed through the EPA or Department of the

Treasury, entirely outside the USDA enforcement apparatus. By graduating penalties to fit the magnitude of the damage, and divorcing them from both commodity programs and the USDA, environmental goals would be more realistically and effectively advanced, while reducing the total burden of penalties on farm level competitiveness.

The other major program designed to promote environmental conservation is the Conservation Reserve Program (CRP), also a part of the 1985 Food Security Act. Unlike the above programs, its primary objective is temporary acreage retirements through voluntary ten year bid contracts, in which landowners with eligible acres (previously cropped land designated as highly erosive) are paid rent by USDA to convert it to conservation uses, such as grass and forest cover, for which USDA may share the costs. At the end of the ten year contract, some of this land is likely to be subject to conservation compliance, swampbuster and sodbuster provisions, although the enforcement problems cited above will remain.

The CRP currently has enrolled 32 million acres, and has a goal of 45 million, although appropriations have been frozen in light of a number of serious problems, not least of which is the waning popularity at the farm level of keeping land out of production as commodity prices have strengthened. These problems were predicted at the inception of the program (see Taff and Runge, 1987, 1988). Farmers were asked to "bid" how much they needed to be paid in per-acre rent to remove the land from production. Even in the low commodity and land price environment of the mid-1980s, these bids were pushed up by the high levels of acreage retirement then already in force, together with the fact that the CRP reduced farm base, and thus eligibility for future deficiency payments.

Combined with an administrative imperative to get as many acres into the CRP as possible, the accepted bids substantially exceeded market rental values in many areas, adding hundreds of millions of dollars a year to the cost of the program. In 1989, the General Accounting Office (GAO) confirmed this design flaw, noting that:

> CRP costs could have been reduced by about $300 million a year with minimal impact on the benefits achieved... USDA's bid acceptance process was not competitive but was essentially an offer system wherein CRP payment rates frequently were set much higher than local cash rental rates to induce enrollment in areas with large amounts of eroding land.... In many parts of the country, this process resulted in CRP rental rates that were 200 to 300 percent higher than local cash rental rates. GAO estimates that, as a result, USDA could be paying as much as $296 million a year more than necessary for CRP rental payments (U.S. GAO, 1989, p. 4).

In addition to its excessive costs, the design of the CRP has failed to make use of information available to USDA to target lands most in need of retirement. Despite massive computerized information gathering exercises (Natural Resource Inventories) conducted by the federal government in recent years to determine the vulnerability of various land categories to environmental damages, this information has not been applied systematically to distinguish the vulnerable lands that are <u>low</u> in productivity (and thus relatively inexpensive to retire from production) from those that are highly productive and/or not vulnerable at all. The push to enroll acres dominated all other considerations, especially at the outset of the program.

Consequently, lands have been retired that are quite productive, but not as vulnerable to erosion as many others, raising the costs of the CRP

program and undercutting U.S. agricultural competitiveness without maximizing environmental benefits (Taff, 1989). At the same time, much highly vulnerable land, as well as land subject to problems unrelated to erosion (such as groundwater contamination) have not been targeted at all. As the GAO report noted:

> USDA could have improved the effectiveness of the program by targeting cropland eroding at the highest rates. Although USDA officials have stated that reducing soil erosion was the primary objective of the CRP, program managers chose not to focus on the land experiencing the worst soil losses. As a result, only about 30 percent of the most highly erodible land is now enrolled in the CRP. USDA could also have improved the effectiveness of CRP by targeting cropland that contributed most to surface water and groundwater contamination (GAO, 1989, p. 3).

A basic targeting model distinguishing vulnerable from productive acres, such as the one employed in Minnesota to develop state land retirement objectives (Larson, et. al., 1989), could have saved the federal government billions of dollars both by lowering CRP bids and freeing productive, non-vulnerable lands from retirement, so that it is available for low-cost production. Such a model is described in Appendix 1.

A final set of environmental policies, operating outside of traditional farm bill legislation, involve federal (and increasingly state) prohibitions on agricultural chemical use. At the federal level, these include the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and the Federal Food Drug and Cosmetic Act (FFDCA). Together with the Clean Water Act, as amended, these laws are the primary means by which agricultural chemicals are restricted from use. Unfortunately, the treatment of agricultural chemicals under all three has been unclear and at

times contradictory. Adding to the regulatory complexity is the emergence of numerous state laws which impose even tighter regulatory standards. Under FIFRA, for example, EPA is supposedly responsible for determining what constitutes legitimate pesticide use, and for regulating the marketing of pesticides through a complex registration process. The EPA's Special Review Process takes from 4-8 years to complete. Despite these requirements, nearly 600 active ingredients used in nearly 50,000 commercial pesticides have not undergone EPA review, which is leading many states to take unilateral actions banning certain chemicals (Capalbo and Phipps, 1990, p. 13). The most pronounced such effort is California's "Big Green" referendum, which is likely to serve as a model for other states.

An important factor missing from EPA's approach to pesticide regulation, the pace of which was noticeably slowed during the 1980s, is that such regulatory slowdowns actually harm private firms seeking to bring more environmentally benign pesticides to market. In a strange reversal of mission, EPA has in effect constrained the ability of the private sector to respond to market demands for more environmentally benign chemicals. As the National Research Council noted in 1987, "In some cases, new compounds that are safer than the existing products they might replace have been denied registrations while more hazardous products remain on the market". An additional consequence of the current regulatory climate is to encourage research to make crops pesticide or herbicide resistant. While environmental groups have objected to this research, it is at least partly a response to current EPA regulatory practices, which constrain the registration of more environmentally benign technologies.

The other major regulatory law affecting agricultural chemicals is the

Federal Food Drug and Cosmetic Act. FFDCA prohibits "any legal use of any pesticide which concentrates in processed food and is shown to present a cancer risk" (Capalbo and Phipps, 1990, p. 13). This standard has been called into question on a variety of grounds, not least that it becomes increasingly binding as our ability to detect risk becomes more sensitive. At some point, the detection of a new substance may show demonstrably lower levels than many natural but non-regulated substances, yet still be prohibited. In response to these and other inconsistencies in the enforcement of FFDCA regulations, the Board on Agriculture of the National Academy of Sciences has recently issued a report calling for a total reexamination of the standard-setting process, so as to concentrate pesticide regulation where risks are demonstrably highest. While no such standard yet exists for unprocessed food, there is increasing evidence that some set of risk regulations will be applied to water (see Benbrook, 1988).

The third main area of environmental regulation impinging on agriculture is the Clean Water Act, as amended. Under 1987 amendments to the Act, EPA is given authority to require states to submit groundwater protection plans, which may include agricultural leaching of fertilizers and chemicals including pesticides. These state plans, if enforced, may lead to increasingly stringent restrictions on farm input use, although such restrictions have yet to be widely felt. EPA has adopted a state-by-state approach to such regulation, which leads to the devolution of responsibility from federal to state agencies (Capalbo and Phipps, 1990, p. 15).

While arguably more efficient, in the sense that each state's problems differ, this approach relegates difficult decisions to state agencies with comparatively limited resources, and raises the distinct and important

problem of a patchwork of different standards and regulations to which input suppliers will be forced to respond. In particular, a lack of state resources may contribute to a growing movement to tax fertilizer and chemical inputs, such as Iowa's recent tax on nitrogen fertilizers. These taxes will raise revenues, but also farm costs. The available evidence suggests that they would need to nearly double the price of fertilizer to have any major impact on use. For example, Hrubovcak, LeBlanc and Miranowski (1990) concluded that a 10 percent tax on agricultural chemicals would only decrease use by 6 percent, and a 100 percent tax (doubling the price) would decrease chemical use by only 34 percent. And reducing commercial fertilizer use would not necessarily reduce total applications of nitrogen fertilizers, since manure might be substituted.

Even more threatening to agricultural costs are the potential legal implications for farmers of holding them financially responsible for nonpoint source pollution (such as contaminated wells). It is possible that farmers may be found financially liable for damages resulting from non-point source pollution which was previously untraceable and is increasingly defined as a contestable damage under law. The U.S. Committee on Irrigation and Drainage, for example, recently convened a panel of water experts who "foresaw the end of the Agricultural Exemption from the provisions of the Clean Water Act" (quoted in Fairweather, 1989).

In summary, environmental policies both within the 1985 Food Security Act, and outside it, such as FIFRA, FFDCA, and the Clean Water Act, as amended, each impose both direct and indirect requirements on farmers to comply with a variety of new and changing regulations. These regulations are not likely to ease in the future, and instead will become more binding However, they can all be improved on both environmental and competitiveness

grounds.

The penalties associated with conservation compliance, sodbuster and swampbuster rules would function substantially better if they were graduated to fit the damages they are intended to prevent. The CRP could also be made less expensive and more cost effective if its bidding process were allowed to work and if other, competing elements of the farm program were reformed. A "whole farm" base (discussed above) combined with the elimination of the acreage reduction program (ARP), would reduce the upward pressure on CRP bids, so that the government would pay closer to market rental values for environmentally vulnerable land. A land-targeting system which distinguished vulnerable from productive acres (outlined in Appendix 1), would focus the CRP on lands most in need of retirement, while freeing acres low in environmental vulnerability and high in productivity for competitive production.

Both FIFRA and FFDCA reflect regulatory gridlock at the federal level. FIFRA's chemical-by-chemical approval process has been so slow that it is actually preventing newer, more environmentally beneficial chemicals from coming onto the market. FFDCA has been the victim of standards, which draw attention away from the most important health risks. The Clean Water Act, as amended, may lead to a patchwork of state plans, without an overarching federal policy for surface and groundwater quality, if the states are forced to fend for themselves. States, meanwhile, will be tempted to impose taxes on agricultural inputs. These taxes will raise revenue and farm costs, but are unlikely to reduce input use substantially unless they are levied at punitively high levels. As environmental standards become an important part of the American farm economy, these problems are too important to ignore.

EXTENSION AND PRIVATE SECTOR RECOMMENDATIONS

The Extension Service of the U.S. Department of Agriculture, operating through the Land Grant Colleges and Universities, represents an extraordinary county-level dissemination mechanism for agricultural research and technology. Its successful history in translating research findings to farm level production decisions has made American agricultural research and technology a model for much of the rest of the world (see Ruttan, 1982). In the post World War II period, the rise of large input supply firms, and the integration of farm cooperatives, has allowed the private sector and a variety of consultants to enter the business of giving farm level advice as well. While sometimes competitive with extension, the overall effect has been to provide an even greater flow of useful information to farm managers concerning what to grow and how to grow it.

Neither public or private extension, nor the research scientists involved with them, operate in an institutional vacuum. Their research and technology programs are affected by market demands, federal farm policies and, increasingly, environmental policy. Like farmers' choices, these program decisions are made more difficult by conflicting policy signals. In the face of changing public opinion, and the growing role of environmental interest groups, the research and extension efforts of the major universities and private companies have been criticized for failing to reflect the new environmental awareness. This criticism often overlooks the extraordinary productivity gains resulting from the research and extension system. Its critics maintain that yields have been too much the focus, to the detriment of a variety of "quality of life" issues that are more difficult to measure and achieve.

This criticism has prompted a clash between "conventional" and "alternative" agriculture advocates which has polarized views and tended to obscure the critical role that research, extension and the private sector will play in the development and implementation of environmental improvements in agriculture. Ultimately, changes in agricultural technology occur for two major reasons: first because they are profitable; and second because farmers have confidence that the new methods are worth making the personal investment in time and knowledge to undertake. The diffusion of agricultural technology is a set of personal choices. Person-to-person contact, together with observance of the success of other farmers, is the basis on which it proceeds. It is our view that the research and extension establishment, public and private, will be critical to providing information to farmers that will allow them to achieve efficiencies and retain a level of cost competitiveness while minimizing the environmental impacts of agricultural practices.

If this argument is valid, then the recent budget cuts suffered by public research and extension (fueled in part by criticism on environmental grounds) will only slow the diffusion of technologies leading to environmental improvements. And the polarization of "conventional" and "alternative" agriculture will alienate groups that must be prepared to work together. It is highly doubtful that an environmentally oriented research and extension agenda can be implemented without the active participation of the public and private institutions that have been at the center of agricultural technology transfer in the past.

The specific types of research, technology and dissemination methods

needed are beyond the scope of this paper, and are discussed in detail in a companion paper by Munson and Runge. However, some illustrative examples may be useful.

Consider the advice provided on fertilizer needs for corn. Given the signal by farm policies to continue producing price-supported crops year after year in order to maintain program base, the definition of fertilizer needs becomes conditional on the amount of nitrogen "required to obtain the average corn yield or yield goal following two or more years of corn production" (Legg, Fletcher and Easter, 1989). Advice concerning appropriate yield goals is also a key parameter. As Kelling (1989), notes, there is evidence that overly optimistic yield expectations suggested to farmers may be partly responsible for higher than necessary fertilizer applications. In a four year survey of 158 (Nebraska corn) producers, only 10 percent consistently reached their yield goal, 50 percent attained 80 percent of their yield goal, and the remaining farmers fell more than 20 percent short of their estimated yield goal. Because of the shape of fertilizer response functions, even a 10 percent overestimate of yield can cause a large error in fertilizer recommendations and potential leaching of nitrogen.

Many farmers fail to account adequately for nutrient contributions from green and animal manures. Legg, Fletcher and Easter (1989) and Legg, et al. (1990), researching an area in Southeast Minnesota, found that farmers using manure as a source of nitrogen often failed to account adequately for this additional nitrogen when applying purchased fertilizer. Further analysis of this case study is instructive. The surveyed farmers agreed that nitrogen was a risk reducing input, so one would expect the

more risk averse farmers to use more. Yet this study concluded that the mixed crop and livestock farmers, whose operations are more diversified and therefore less risky, applied higher rates of nitrogen than the cash grain farmers. The conclusion is that fertilizer overapplication is related at least as much to incomplete information as to risk avoidance, even assuming realistic yield goals (Legg, et al., 1990).

Through recommendations leading to more accurate accounting of nitrogen in the farmer's field, leaching into groundwater and runoff to surface water of excess fertilizers can be minimized. This is a relatively low cost, low-technology option which depends on widespread use of soil testing. Higher technology options are also being developed. In Minnesota, Soil Teq, Inc. has developed a computer controlled fertilizer applicator that works in conjunction with grid sampling to vary the rate of fertilizer applied automatically as machines move across the field. In one case, grid sampling allowed the farmer to reduce fertilizer costs by $7.97 per acre (15 percent) without lowering yield. Yields could increase because high yielding areas get more fertilizer, even though the entire field received less (Reichenberger, 1990). Case studies of homemade variable rate spreaders showed savings of 42-50 percent of the effective cost of applying 150 lbs N to the entire field (Smith, Seim, and Finck, 1990).

While this discussion has focused primarily on fertilizer recommendations, similar low-cost advice can have major impacts on pest and erosion control. A better understanding of the life cycles of pest species (plant and animal) has the potential to empower effective control with reduced environmental impacts, and is a major research focus in the private

sector. The University of Minnesota Center for Farm Financial Management is currently developing computer software designed specifically to integrate economic and environmental decisions at the farm level. The software, termed SMART, will be available in 1990.

In addition to advice on agricultural input use, recommendations on watershed improvement also are needed. An example is the Soil Conservation Service's Rural Clean Water project on Rock Creek, Idaho. The $2 million dollar project paid farmers for environmentally sound management practices (discouraged by the commodity program environment) and cut sediment runoff 78 percent. The creek has literally been reborn and now supports a trout population. Prairie Rose lake (Iowa) was another beneficiary of the Rural Clean Water program. Here, cost sharing induced terracing and seeding to cut sediment runoff (Patrico, Seim and Johnson, 1990).

In summary, both public and private advice will continue to play a crucial role in changing farm technology. This advice is given in a framework determined by large institutional forces which can help to propel the process of environmental improvement or can retard it. If farm programs encouraged cropping diversity and flexibility, while regulations allowed new, more environmentally beneficial products to come to market more rapidly, this process would be accelerated. In contrast, treating extension and the private sector as the "enemy", and reducing public sector funding or private profits (through taxes on inputs, for example) is likely to slow down the diffusion of more advanced production methods.

CONCLUSIONS

This report provides a framework for the analysis of a variety of policy signals affecting farm decisions with impacts on both agricultural competitiveness and the environment. The overall conclusions can be summarized for each of the four main signals.

First, the world market should be the primary determinant of what to grow at the farm level. Stable macroeconomic policies will allow global supply and demand to signal what agricultural products are in scarce supply, and those that are in surplus. These market signals should not be distorted by tax policies which encourage overinvestment in farm assets with adverse environmental impacts.

Second, market signals should not be distorted by farm policies which falsely encourage the production of specific program crops, reduce the flexibility of farm planting and rotation decisions, and artificially reduce the supply of farm products through acreage reduction programs. The "whole farm" base, or Normal Crop Acreage (NCA) proposals now under discussion in Congress, have strong support on both competitiveness and environmental quality grounds. Evidence from a variety of case studies clearly indicates that current programs place farmers in a position in which they must often forsake preferred agronomic practices which would also minimize environmental effects in order to retain program benefits. Income support to the farm sector, if paid on a whole farm base, would increase flexibility without increasing the risk of lost income due to new or innovative farming methods. Indeed, support levels could even be structured to reward such innovation.

Third, even if federal agricultural policies were so reformed, there

would still be an important role for specific policies designed to promote a variety of environmental improvements. Currently, one set of environmental regulations affecting agriculture is based on denial of all farm program benefits to farmers who fail the conservation compliance, sodbuster and swampbuster tests of the 1985 Food Security Act. These provisions are inadequately enforced and poorly designed, and should be amended to allow graduated penalties based on the degree of damage. The Conservation Reserve Program (CRP) needs to be revamped so that its bidding process reflects true costs, and so that it is targeted to areas most in need of environmental protection. The CRP and the conservation compliance, sodbuster and swampbuster programs would all work more effectively if the acreage reduction program (ARP) were eliminated and a whole farm base adopted. This would lower the opportunity cost of permanent land retirement at the farm level, target such retirement specifically to acres low in productivity and high in environmental vulnerability, and increase the flexibility with which productive land could be used.

The other set of environmental regulations affecting agriculture involve prohibitions on agricultural chemical use. The chemical-by-chemical registration process of EPA, in part because it has proceeded at a snail's pace, has actually hampered the development and marketing of more environmentally benign chemicals, while leaving more harmful products in use. One result has been to encourage genetic "crop resistance" research. Other legislation has established cancer risk at the lowest detectable level as the basis for prohibiting agricultural chemicals. This has led to restrictions on chemicals with much lower levels of risk than those now in use, and has failed to focus regulatory oversight where human health risks

are actually highest. Finally, regulatory gridlock at the federal level has encouraged states to act unilaterally, creating a patchwork of state laws without any overarching pattern. Due to shortages of funds, states will be tempted to move in the direction of taxes on chemical inputs, which will raise farm costs but are unlikely, unless they are punitively high, to affect substantially the level of input use and thus environmental quality. In sum, current environmental policies hamper agricultural competitiveness, without substantial benefits to the environment, and are in serious need of reform.

Fourth, research, extension and private sector recommendations will remain crucial both to improvements in environmental quality and to retaining U.S. agricultural competitiveness. Critics of their performance have emphasized a preoccupation with yield increases, to the exclusion of environmental concerns. This criticism has contributed to a climate in which funding cuts to public agencies and taxes on agricultural inputs are more likely. This criticism is not fully warranted. Efforts to develop conservation tillage and best management practices are an important and growing focus of extension and applied research. It is highly unlikely that an environmentally oriented research and extension agenda can be implemented without positive incentives directed at the public and private institutions at the center of agricultural technology transfer. For public agencies, these positive incentives are higher levels of funding directed at developing and transferring environmentally responsive technology. In the private sector, they are the profits available from sales of this technology. Neither the regulatory nor the farm policy environment is providing these incentives today.

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