Chapter V

Technology Adoption

Photo credit" U.S. Department of *Agriculture*

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Technology Adoption

INTRODUCTION

Why do some farmers adopt technologies, while their neighbors do not? What attracts some farmers to publicly subsidized conservation programs? Could these programs be modified to attract more participants or different participants? Considering that a number of the major technologies with great potential to preserve and enhance agricultural land productivity are neither new nor extremely complicated, quest ions such as these assume considerable importance.

Many factors affect how quickly farmers and ranchers adopt new technologies, Various characteristics, including age, education, management capacity, and the size and type of farm operation may predispose a producer's views toward a given technology. Other important factors are the cost of the technology and the rate of return on the investment, the complexity of the technology, its compatibility with current farm size and operating methods, and the accessibility of information.

In the past, conservation programs often were designed as though all farmers had similar abilities and motivations, and similar resources of capital, knowledge, and management skills. Actually, though, many farmers and ranchers lack some or all of these resources, For instance, a conservation program may use loans or cost sharing to make various conservation practices affordable or profitable for farmers. But if a farmer lacks management skills or fails to integrate the practice into the overall farming operation, his yields and profits may actually drop. As a result, even if a farmer receives cost-share funds from the Federal Agricultural Conservation Program to convert part of his cropland to no-till farming, it does not mean that he will stick with the new system. If he does not master the technology in the first 2 years, or suffers weed problems that reduce yields and profits, he may revert to conventional methods when the cost sharing is discontinued. And he may become convinced that the fault lies in the conservation practice, and so be more likely to reject future new technologies or programs. Clearly, understanding the producers' managerial capacity and other factors that influence their decisions on the adoption of productivity-sustaining technologies is an important step in influencing the management of the Nation's agricultural lands.

LAND TENURE AND OWNERSHIP

Farm ownership in the United States is concentrated. Even though more than half the acres in the country are farmland, they are owned by just 3 percent of the population (USDA, 1981). Only 25 percent of the Nation's farmland is owned by full owner-operator (those who own and operate all their own land without renting extra acres). Another 30 percent is owned by nonoperator lancllords. The remaining land is owned by farmers who rent supplemental acreage or who rent out a portion of their acreage to other farmers (Lee, 1980),

As farm ownership and farm operation have become increasingly separate, questions have arisen regarding the effects of this trend on conservation. Some experts have hypothesized that 1arger corporate farm structures will have unfavorable consequences on land stewardship. They suggest that landlords, particularly absentee landlords, are more likely to plan for short-term objectives and to favor maximum current income over investments in resource protection (Lee, 1980).

Some research has supported this view. One study, for example, found that a significant number of absentee landlords in the Corn Belt were unaware that conservation measures would improve farm income over time. Research in Iowa showed that owner-operators are more likely than renters to use conservation practices because owners are more likely to reap the long-term benefits. Similarly, owner-operators benefit more from institutional factors, such as economic incentives and regulations designed to improve the short-term profitability of conservation practices (Nowak, 1980).

Recent research at the national level, however, finds no significant differences in soil losses among different types of ownership groups. This work, which used the 1980 National Resource Inventories data and 1978 data from the U.S. Department of Agriculture's (USDA's) Land Ownership Survey, did find differences in average erosion by ownership in 4 of the 10 U.S. farm production regions, but attributed the differences to physical rather than management factors (Lee, 1980).

In 5 of the 10 regions studied (the Northeast, Corn Belt, Delta, Southern Plains, and Mountain regions), there was a relationship between higher incomes and lower erosion rates, In the Corn Belt, for example, full owner-operators with net incomes of $20,000 to $49,000 averaged 9.4 tons an acre less erosion than did owners with farm incomes below $3,000. The correlation seems to result from the larger operations having less erosive land as well as more conservation practices. *

Nonfamily corporations appear average in their adoption of minimum tillage and residue-management practices, Family corporations and partnerships with family members generally had higher use of those conservation practices than did other owners (table 20]. Because these practices have been promoted as energy and labor saving as well as soil conserving, they may not be the best indicators of an owner's conservation ethic.

In summary, the relationship between land tenure and conservation remains unclear. It appears, however, that farm structure alone has little direct relationship to soil loss rates,

In light of the increasing significance of absentee landownership, more information is needed on the relationship between various leasing arrangements and the use of conservation practices. Tenancy arrangements determine the distribution of the costs and benefits of conservation investments between owners and operators, and so may encourage or discourage conservation. The shift from crop-share leasing to cash leasing, for example, may influence conservation efforts, As cash leasing increases, it could create an incentive for the exploitation of soil resources.

Further research is necessary before policymakers can be certain about how land tenure affects land stewardship. And while a national perspective on land tenure issues relative to

* Nationally, only 40 percent of cultivated cropland owned by operators in the $20,000 to $49,000 range is classified as having an erosion hazard, while 59 percent of cultivated cropland owned by operators below $3,000 is labeled erosion-prone.

Table 20.—Adoption of Conservation Practices on Cultivated Cropland by Type of Owner and Land Quality

Type of owner	Erosion hazard land with conservation practices	Nonerosion hazard land with conservation practices
	Percent of acreage	
Sole proprietor	48.0	531
Husband-wife	45.0	47.3
Family partnership	51.6	589
Nonfamily partnership	46,4	532
Family corporation	566	55.4
Other corporation	470	51.3
Other	49,3	504

SOURCE Linda K Lee, "Relationships Between land Tenure and Soil Conservation, " OTA background paper, 1986 soil conservation would be useful for policy planning, regional and local analyses are necessary for implementation of conservation strategies.

MANAGERIAL CAPACITY

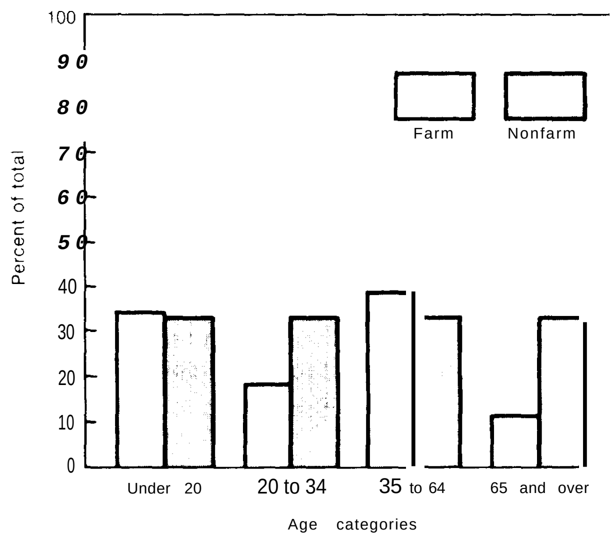
A producer makes management decisions in three major areas: production and organization, administration, and marketing. In fulfilling these management functions, the operator can supplement his own capabilities, and those of his family and employees, with professional management services and institutional resources supplied through Government programs, financial institutions, educational institutions, and farm cooperatives.

Age and education are associated with management capacity and with attitudes toward the adoption of conservation technologies. The U.S. farm population has an older age structure than the nonfarm population (fig. 14). In 1979, the median age of the farm population was about 34 years compared with about 30 years for nonfarm residents. Farm populations also had a lower proportion of young adults and a higher proportion of middle-aged persons than the nonfarm group (Nowak, 1980).

The relation between age and managerial capacity as it relates to maintaining productivity often depends on the "newness' of the technologies employed (Nowak, 1980). Government conservation strategies that involve adopting and maintaining new technologies may be less successful among older farmers. On the other hand, many conservation practices hale been in existence for some time. Older farmers with experience using these practices often can integrate them successfully into their overall farming operations,

Age and education among farmers are highly correlated. In 1970, 72 percent of farmers aged 55 to 64 years had not finished high school. However, only 12 percent of young farm operators (20 to 24 years) had failed to finish high school, and more than 25 percent had some college training (USDA, 1980). In general, the amount of forma 1 education is directly associated with managerial capacity (Nowak, 1980),

Figure 14.— Farm and Nonfarm Population by Age, 1979



SOURCE Peter J Nowak, "Impacts of Technology on Cropland and Rangeland Productivity Managerial Capacity of Farmers OTA background paper 1980

Farmers with more education often translate this into greater managerial skills that are reflected in larger and more prosperous farms. Importantly, there also is a direct relationship between managerial capacity and the use of productivity-enhancing soil conservation practices (Rogers, 1980).

One trend that could have great impact on sustained land productivity is the genera] movement among farmers and ranchers toward continuing education, or life-long learning. Today's producers are better educated and are more open to information than werc earlier generations.

It cannot be assumed that information necessarily changes attitudes and behavior. But information is a first step toward action; if a farmer or rancher receives a thorough briefing on, for instance, some innovative, land-sustaining technology such as conservation tillage, he is more likely to adopt that technology than if he does not. Many variables, including the adequacy of the information, will affect his decision.

It is difficult to measure the value of information. Some experts estimate that 25 to 60 percent of the expected returns on public investment in agricultural research would not be realized without extension involvement (Araji, et al., 1978). Both intuition and research indicate that at an individual level, the farmer or rancher who receives information will be a more capable manager than the one who does mot; one simulation suggests that information added an average of 12 percent to a farmer's annual profits (Debertin, et al., 1976).

Although many potentially valuable new communications technologies exist or are being developed, in general they seem to offer more than they deliver—i.e., designing new communications tools seems easier than putting them to use. This seems especially true of efforts to bring some of the new electronic media into rural areas, and illustrates that it is important to address both technological and sociological questions simultaneously.

INFORMATION DIFFUSION

Diffusion of agricultural technology to the U.S. producer is accomplished mainly through three broad channels: the private sector, public institutions, and peer groups. Private technology suppliers tend to develop and support only those technologies that can make substantial profits. On the other hand, public research and information is more generally disseminated for those technologies being developed and supported by public institutions.

The third channel, peer group action, is particularly important because even the most independent farmer is subject to peer approval or disapproval. Changes in conservation behavior that are not supported or reinforced by the farmer's neighbors or community opinion-leaders are unlikely to occur or be maintained (Nowak, 1980).

The dominant system in the United States to diffuse agricultural technology is the USDA's Federal Extension Service, in coordination with the 50 State agricultural extension services. This is the world's largest public investment in a diffusion system and is guided by three basic principles (Rogers, 1980):

- the innovation to be diffused is fully developed prior to its diffusion;
- information diffuses from a center of expertise out to its ultimate users; and
- diffusion is directed by a centrally managed process of dissemination, training, and provision of resources and incentives.

This centralized system is effective in promoting certain types of innovations. But it may not adequately disseminate innovations that evolve as they diffuse and those that originate from sources other than the center. Diffusion processes also need to be shaped by user demands, in interactive arrangements where problems are solved by innovations and sources of information among the users, Such a decentralized diffusion system would depend mainly on peer networks for transferring technological innovations among local groups (Rogers, 1980).

Research into producers' rates of adoption of new technologies suggests that innovative producers often hear about new ideas from agricultural experts and specialized technical publications. Those who are slower to adopt new practices usually get their general information from mass media, Early adopters tend to use the more expert sources at all stages in the adoption process, while slower adapters tend to use peer sources (Bohler, 1977).

According to an Iowa study that related farmers' information sources to the number of conservation practices being used, those farmers who had adopted five to eight practices were much more likely to use Government agencies as their major source of conservation information (table 21). On the other hand, there was a more random distribution of information sources and a dependence on friends and relatives among the medium and low users of conservation practices (Lee, 1980). This suggests that decentralized diffusion may be an important approach for promoting technological innovations among certain producers in U.S. agriculture.

Access to knowledge and information are not distributed homogeneously across any group of farmers or ranchers. Producers have varying circumstances and capacities for effective adoption and implementation of technologies. Information is neither available nor diffused simultaneously through all parts of a system (Nowak, 1980). And information is passed via specific communication networks to which individuals have differential access. Furthermore, individuals have different base levels of knowledge as well as the capacity to assimilate new knowledge.

Thus, merely increasing the flow of knowledge into a group of farmers, the typical procedure in current educational programs, may magnify existing knowledge gaps rather than decrease them. General education programs will not necessarily inform farmers equally of the existence of a problem, create a need to do something about it, or instill the capacity to accept and implement technical or economic assistance.

Table 21 .—Most Important Source of Soil Conservation Information by Users of Conservation Practices

	Sources of information (percent of total)				
Use	Friends and relatives	TV, radio, and print media	Farm supply dealers	Farmer organizations	Govern-ment agencies
Currently using one or two practices.	13.6	9.1	13,6	4.5	59,1
Currently using three or four practices. . . .	17.8	14.3	3.6	7,1	57,1
Currently using five to eight practices. .	0.0	15.0	5.0	0.0	80.0

SOURCE Linda K Lee 'Relatlonshlp Between Land Tenure and Soil Conservation. " OTA background Paper 1980 Information is from interviews with 135 induviduals

COMMUNICATIONS TECHNOLOGIES

Agricultural communications is in a period of rapid change. Worldwide there has been a staggering increase in the volume of scientific information produced, agriculture being no exception. And the information is more specialized and changeable than ever before, with new research, even new fields of inquiry, being added every day.

The other strong influence on the growing and changing content of agricultural communications is its clientele. There are fewer agricultural producers today than ever before—a decline from a peak of 13.6 million in 1916 to about 3.9 million in 1978 (Evans, 1980). As a total of the U.S. population, the farm segment fell from 23,2 percent in 1940 to 3,7 percent in 1978 (USDA, 1980). Yet because of the nature of modern agriculture, farmers have greater information demands than ever before. Thus, the various new electronic media, especially computers and other interactive systems, seem particularly suited to fulfill these needs.

Communications technologies are one step removed from actually affecting land productivity. They affect the farmer, making him more or less willing to adopt new technologies, The most basic communications medium in agriculture, word-of-mouth, is still the producer's primary way to gain, share, and evaluate information. But woven around primary interpersonal communications is a complex, dynamic system for moving agricultural information to and from farmers and ranchers and helping them make management decisions. Some of a producer's sources are public, such as agriculture study programs in schools, the local, State, and Federal extension systems, and other State and Federal agencies. Farmers and ranchers also receive information through non-public media, including the telephone (found in 93 percent of U.S. rural farm homes); commercial farm periodicals (about seven are received in the average U.S. farm home); various breed organizations, commodity groups, and other agricultural organizations; agricultural supply and service dealers and marketers; and radio, television, and newspapers (Evans, 1980). But beyond these traditional communications methods lies a whole range of new communications channels born of recent advances in electronics. This does not mean that the importance of interpersonal and print communications will diminish in the future. Rather, the new electronic media complement the mainstay channels of voice and paper.

Emerging Communications Technologies

Computer Applications

Computer technologies are already affecting farms and ranches in many ways, although few producers actually own personal systems. Access to computer information is through farm management decision aids, computer-based information systems, computer-based instruction, and personal computers. Computers are especially useful because they are highly adaptable, easy to update, and allow the user to tailor information and tasks to his individual needs.

Photo credit *U S Department of* Agriculture

Douglas Duey, Extension Service farm management specialist and Wayne Nielsen of Lincoln, Nebr., look over computer printouts, with which Duey will help Nielsen analyze his cash flow and overall farm business situation

Radio

Radio is a prime information source for producers because it supplies timely reports of news, weather, and commodity market prices. As farm populations have declined, however, broadcast stations have reduced farm programing, Today, relatively little information about technical aspects of farming is aired. Also, the kinds of stations most active in farm programing have changed from clear-channel and other large stations toward smaller rural stations. There has been some increase in farm broadcasting on FM stations in recent years, but it is not prominent. Independent commercial program services—farm radio networks that distribute news and features—are increasingly available to sell agricultural information to stations that cannot afford farm reporters.

Telephone=Related Systems

Telephones are one of the main communications links for rural people. They are interactive, accessible, easy to use, flexible, and relatively low cost, Phones can be used to link the home television with a computer data base (known variously as viewdata, videotext, and wired teletext). For instance, Green Thumb, sponsored jointly by the National weather Service, USDA, and the Kentucky Cooperative Extension System, is a pilot information service for farmers, With a TV and relatively inexpensive telephone/TV interface device, the farmer has access to area news, local weather, and timely data on pest management, agricultural economics, forestry, animal science, plant pathology, and horticulture, However, the cost of such systems is still unknown,

Other phone-computer links might also prove useful. "Advance calling, " for example, allows an extension advisor to call a computer, enter a message about impending pest infestations, approaching storms, etc., then enter the phone numbers of all those those should receive the message.

Finally, the telephone still has great potential in its basic "voice" format, especially for continuing education and extension. TeleNet, for example, links county and regional extension offices throughout Illinois with specialists a t the University of Illinois; it also operates as a "party line" for group calling, educational meetings, etc. The audio can be supplemented with written instructional materials.

Audio Cassettes

Audio cassette technology is unsophisticated, yet holds valuable potential in this era of increasingly. specialized agricultural information, Cassettes are widely used for continuing education and arc particularly attractive because of their low cost, simplicity, and mobility, making it possible for a user to listen to a tape while doing chores or driving a tractor. Cassettes are inexpensive and easy to produce, so extension can distribute timely information at little cost,

Television Technologies

Adaptations of current video technologies may hold potential for farm and ranch audiences, Standard TV broadcasting (commercial and public] does not address farm audiences as much as radio because farm viewers account for such a small share of the total audience. Farm advertising occurs far more frequently than farm programing. However, TV has other uses, Broadcast teletext offers many of the same advantages as wired teletext (viewdata-it 1 inks the home with computer data bases for immediate, timely information. Unlike viewdata, however, this is a one-way, noninteractive system and can handle only a limited data base. Television broadcast translator stations are low-power stations that receive incoming TV or FM signals, amplify them, convert them to a different output frequency, and retransmit them locally. They require relatively low capital inputs and low maintenance at total cost much lower than cable systems, especially in rural areas. A version of translator technology—mini-TV-has proven successful in bringing TV to rural Alaska. Mini-TV, teamed with videocassettes, gives local users greater control over programing than standard translator systems.

Cable and Satellite Transmission

Cable television (TV) may be the most significant of the new mass communications technologies because it greatly expands the scope of available programing. Interactive cable, such as QUBE in Columbus, Ohio, offers special promise for educational uses. But while cable programing could provide a range of information useful to farmers and ranchers, its potential is limited by the high capital costs involved in laying lines in rural areas. Farm subscribers are therefore an unpromising market for commercial cable. Further, there is concern that pay-TV may weaken the present "free" commercial radio and TV stations on which many rural people depend for information.

Agricultural producers already benefit from satellite systems that permit the monitoring of weather and crops, but other benefits may arise, Direct satellite broadcasting of TV programing is technically feasible and has proven value in delivering education and social services in Canada. A demonstrate ion project in Alaska shows some potential, especially for adult education. Limitations, including cost, user-resistance, inadequate software, etc., make direct satellite broadcasting less promising in the short run than some other technologies available to U.S. farmers and ranchers. Regulatory and public policy questions also will be important to the future of this tech nology.

Videodisc and Videocassette

Although relatively few individuals own such systems, videodiscs and videocassettes are useful in agricultural education through schools, extension, and other organizations. The primary disadvantage is high initial cost. Videocassettes offer the advantage of allowing the user to record programs from TV and, with the addition of a camera, of producing one's own shows. Videocassettes, however, cost more than videodiscs, cannot be accessed randomly, and wear out faster than discs, For instructional purposes, videodiscs may be more useful, especially when linked with computers.

Expanded Print Media

Print media are becoming increasingly specialized and directed to specific audiences. More and more, "free controlled circulation" is used by publishers to send their publications free to producers who meet certain geographic, demographic, economic, or other criteria. Increases in direct mail, newsletters, and publishing of periodicals by farm organizations also are channels for reaching target groups. Farm publications are pioneering the concept of the "individualized issue, " where through sophisticated binding systems each subscriber receives an issue tailored to his specific site and needs, This technique has great potential for improving the kinds of information a particular farmer or rancher receives.

Print reference services, either commercial or public, are uncommon in the United States. Elsewhere, however, this ringbinder-notebook style of indexed information sheets offers several advantages over traditional printed extension publications. It can generate a wide range of highly specific information pieces quickly, at lower cost, and is easily updated. The farmer, however, must be willing to maintain his files.

Electronic publishing—newspapers, and other periodicals experimentally joining a national computer data network such as that being assembled by Computer Service Information and Associated Press—is blurring the boundaries between print and electronic media, Publishers see this as a way to reduce printing and postal costs; readers get timely news but lose the portability of print. Within agriculture, electronic publishing may find early applications in directories, catalogs, and classified advertising (Evans, 1980).

CONSTRAINTS ON TECHNOLOGY ADOPTION

Some producers are unwilling or unable to adopt practices that preserve long-term land productivity. Moreover, there are significant differences between those who cannot and those who will not adopt recommended practices.

Conflicting Goals

One reason why producers may be unwilling to adopt a recommended practice can be that a conflicting goal, such as a desire to maintain traditional farming methods, may be valued more highly than conservation goals. Producers justify their unwillingness to use resource-conserving practices because of their real or perceived effect on immediate profitability. Profitmaking must be a primary concern or the farm-business would soon cease to exist. Thus, only if the level of profit is such that conservation costs do not jeopardize the farms' economic viability could policy makers employ disincentives such as fines, penalties, and taxes for resource degradation, Where these strategies would threaten financial stability, more voluntary implementation strategies are appropriate.

Adopting conservation practices has broad social benefits beyond the view of most producers and not reflected in farm markets. Thus, it may not be feasible or fair to place the entire responsibility for conservation on the shoulders of the producer. A recent study of a 5.3-million-acre area in southern Iowa found that the immediate costs to the producer of reducing soil erosion to tolerable levels using available techniques were three times greater than immediate benefits. As the study concluded, this benefit-cost ratio leaves farmers unable to finance erosion control without cost sharing or similar public investment (Shrader, 1980).

Current economic conditions make farmers discount future benefits heavily. Many have extensive financial obligations and must maximize this year's profit to pay this year's mortgage. Moreover, many have based their investments in land and/or equipment, expecting high inflation rates to continue, rather than by calculating efficient input/output ratios (Woodruff, 1980). Current high interest rates also play a key role in shortening farmers' planning horizons, in effect making farmers work for short-term goals and neglect long-term consequences.

Recognizing these shortened individual planning horizons for agricultural decisions is critically important in examining the effectiveness of policy alternatives. For instance, some past analyses from the Center for Agricultural and Rural Development (CARD) at Iowa State University have assumed that long-run costs and benefits are variables of primary importance to farmers in their soil management decisions. However, recent CARD studies suggest a very different conclusion: that agricultural producers have a planning horizon closer to 1 year than to 25 years (Dairies and Heady, 1980),

Yet practices that may not return the farmer's investment for even 25 years may be of great concern to the public as a whole. The public stake in the effects of stream pollution, reservoir sedimentation, water-supply contamination, erosion, and ground water overdraft are sound reasons for public investment. Social planning horizons can take into account the Nation's responsibility to maintain the productive capacity of the resource base for future generations.

Inadequate Information

Another reason why producers may be unwilling to adopt recommended practices is that they lack adequate information. They may need to know more about implementing the practice, how it fits into the larger operation, or the consequences of using the practice. Evidence suggests that farmers who are unwilling to adopt a recommended practice may gain information and change their perceptions if they adopt the practices on a trial basis. Thus, implementation strategies that focus on trial adoption could encourage the acceptance of recommended management practices.

Moreover, users and nonusers may perceive different conservation practices quite differently. Studies of farmer perception of three practices—minimum tillage, contour planting, and terracing—in Iowa suggest that users and nonusers have significantly different percept ions of the characteristics of the practices (table 22). For instance, a quarter of the farmers not using minimum tillage viewed the technology}' as having very high costs, while only 3 percent of the users viewed it as expensive (Nowak, 1980).

Farmers Unable to Adopt Practices

When individuals are unable to adopt recommended practices, a different situation exists. Farmers may be unable to adopt a practice because they lack the necessary management skills. Reduced tillage, for instance, has important conservation effects. But while fewer operations are involved in reduced-tillage farming, the sequence of operations and the correctness of each action is more critical than with conventional tillage. Educational strategies may be most appropriate to encourage adoption by this group of farmers, as neither penalties nor incentives would address the underlying problem.

Farmers also may be unable to adopt recommended practices because they lack the necessary capital and/or land. Small-scale, part-time, or marginal farms often have cash-flow problems that prohibit investment in additional

Table 22.— Perceived Characteristics of Soil Conservation Practices

	Minimum tillage		Contour planting		Terraces	
Characteristic	Users	Nonusers	Users	Nonusers	Users	Nonusers
Cost for .ushg						
No cost.	49.3%	38.2 %	52.6%	21.0 %	22,2 %	2.6 %
Moderate cost	47.4 %	35,3 %	43.1 %	54.8 %	51 09%	17.8 %
Very high cost	3.3 %	26.5 %	4,3 %	24.2 %	25.9 %	79.6 %
	1 00.0%	100.0 %	1 00,0“6	1 00,0“h	1 00.0‘h	1 00.0%
Profitability						
Costs exceed returns.	7.8%	21,9 %	5,2 %	45.9 %	20,0 %	58.2 ‘%
Costs equal returns	32.5%	46.9%	44,4 %	37.7 %	32,0 %	27.4 %
Returns exceed costs	59.7%	31.2 %	50,4 %	16.6%	48,0 %	14.4 ‘%
	100.0“[	100.0170	1 00,0‘k	1 00.0‘%	1 00,0%	1 00,0“:
Time/labor requirements						
More time/labor.	7.8 %	20.0 %	66,4 %	89.1 %	53,8 %	78.8 %
No change	1 7.5%	28.6 %	28.4 %	10.9 c%	46.2 %	1 8.6“b
Less time/labor	74.7 %	51.4 %	5.2 %	0.0 %	0.0 %	2.6 %
	1 00.0%	100.0%	1 00.0“h	1 00,0‘%	1 00.0“6	1 00.0“h
Ease of use						
Very difficult	2,6 ‘%	20.6%	1 9.0‘!	54,0 %	33.3 %	63.9 ‘%
Moderate	22.2%	29.4 %	36.2 %	36,5 %	33.4 %	25,8 %
Very easy	75.2 %	50.0 %	44.8 %	9,5 %	33.3 %	i 0, 3
	100.0%	100.0 %	1 00.0“h	1 00,0%	100.0% -100,0	100.0%
Compatibility						
Not compatible	3.9 %	28.6 %	11 .2“[	63.9%	18,5	66.5
Moderately compatible	15.6 %	28.5 %	25,9 %	24.6 %	33,4	21.2
Very compatible	80.5 %	42.9 %	62,9 %	1 1.5“b		
	1 00.0%	1 00.0%	1 00,0“;J	100.0 %		1 00.0“:
In Influence on soil erosion						
Worsened	1.4%	0.0 %	1.8%	0.0 %	0.0	
No change ., ...	1 6.8‘1	50.0%	27.0 %	61,0 %	12.5	45.0
Improved	81 .8%	50.0 %	71.2 %	39,0 %	87.5	55.0
	100.0%	1 00.0%	1 00.0%	1 00.0‘%	1 00.0‘%	“ :

SOURCE Peter of Farmers, ” report to OTA, Dec 19 1 !380

farm implements or time-consuming practices. Their existing machinery limits their adoption of new agronomic practices. Further, off-farm employment may limit the amount of time these farmers have to establish new management procedures. Yet these types of farmers may be the owners of a disproportionately large share of the highly erosive or otherwise fragile land.

Strategies to maximize the effectiveness of conservation initiatives must try to minimize the number of producers who are put into the position of being unwilling or unable to adopt recommended practices. Consequently, conservation policy needs to include implementation strategies that explicitly recognize why producers are not adopting the recommended practices and that attempt to remove obstacles to adoption. Strategies must be flexible to accommodate critical social and economic variations among farm operations.

INFLUENCING TECHNOLOGY ADOPTION

When farmers assess new products or practices, their adoption decisions generally will be based on their judgment about relative advantage. Relative advantage generally is judged by: 1) the usefulness of the technology in terms of the producer's basic values, 2) the economic costs relative to benefits, and 3) the payoff time (Bohler, 1977).

A technology's apparent advantages or disadvantages can be greatly influenced by how that technology is presented to the farming public. For instance, presenting minimum tillage as a way to enhance profits is likely to make it more attractive than promotional efforts that stress the system's ability to prevent erosion. In other words, a technology is more appealing if it does things rather than prevents things from happening. Promoting a practice as a preventive measure may emphasize characteristics that hinder adoption such as high initial costs, low profitability, unknown risks, few tangible rewards, and increased management complexity (Korsching and Nowak, 1980).

By emphasizing the positive benefits, conservation programs and promotions might garner greater attention. Changes could include:

- Emphasize the monetary and energy savings made possible by various techniques of conservation tillage and the fact that adoption of these techniques conserves the soil's natural fertility, reducing dependence on expensive fertilizers.
- Minimize the idea that adopters (producers) are reducing pollution; rather, emphasize that the}' arc conserving their own resources.
- Integrate any economic incentives into educational programs that are built around the above strategies, Present the innovative technology as part of an overall program designed to increase the profitability of the farm operation.
- Minimize the connection between mandatory Government regulations and agricultural conservation practices. Integrate the mandatory regulations into the economic incentives that support agricultural conservation practices. It is important that conservation practices not be identified with "bureaucratic red tape. '
- Redefine organizational goals and agency involvement so that conservation programs are presented in terms of economic gain rather than environmental degradation—e. g., Farmers Home Administration or Small Business Administration involvedment rather than the Environmental Protection Agency.
- Increase involvement of commercial organizations and the Cooperative Extension Service in promoting soil conservation efforts, More social recognition and rewards for conservation efforts should be implemented in USDA-assisted group s-e, g., FFA, 4-H. Conservation awards should not be a separate category but should be combined with production awards-e. g., the highest production with an active conservation plan (Korsching and Nowak, 1980).

CONCLUSIONS

The main factors a fecting farmers' decisions to adopt agricultural innovations include:

1. The personal and economic characteristics-of the farmer, such as farm size, formal education, age, availability of capital, managerial capability, degree of contact with extension, and exposure to mass media (especially farm magazines).
2. The perceived characteristics of the agricultural innovation, such as the relative advantage of one practice over another (especially profitability); compatibility With farmers' prior experiences, beliefs, and values; the complexity of the innovation; visibility of results; and ease of' trial uses [Rogers and Shoemaker, 1971).

It is not clear how land tenure problems affect conservation behavior. In some instances, absentee landowners seem to have less motivation to invest in protecting the land, but little research supports this hypothesis, A more pertinent factor seems to be farm income: the higher the income, the more prelalent is conservation. Age and education, too, are associated with management capabilities and openness to innovation. And importantly, access to information influences technology adoption and is the principal means by which policymakers can promote the use of productivity-sustaining technologies. The communications fields, in fact, will play increasingly vital roles in informing and educating farmers and in improving farm management.

To be more effective, conservation promotion efforts need to be tailored to the particular circumstances of the farmers who have the most severe conservation problems. Conservation programs seem most successful when they emphasize the economic advantages of productivity-sustaining technologies rather than the environmental disadvantages of not applying the recommended practices.

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