Chapter 4.8

Production Systems Management and Conservation Practices

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Farmers manage soils, pests, nutrients, and other inputs as part of a system of inter-related production and conservation practices, whether in conventional systems (used by most U.S. farmers) or organic systems. Among all U.S. farmers, those who adopt selected conservation practices (such as crop rotation, conservation tillage, scouting for pests, and soil testing) are more likely than non-adopters to be younger, full-time operators who plant more acreage and participate in government programs. (Characteristics of organic farming systems are examined in chapter 4.9.)

Production Management Systems

Production system choices may be motivated by a desire to increase profits, respond to social objectives, or maintain a way of life for future generations. These potentially competing goals are reflected in the choices and amounts of inputs used for production. Agricultural production management deals with how farmers combine land, water, machinery, structures, commercial inputs, labor, and management skills to produce crop and livestock commodities. Management systems embody some of the more important decisions related to production, and include nutrient management, soil management, water management, weed management, and the like. The overall production management system can be thought of as the combination of activities chosen for each aspect of production.

Management Systems for Major Field Crops

Production management for major field crops can be divided into different stages and/or technology suites, among them:

- Soil management systems (see Chapter 4.2).
  - Rotation—Deciding what crops and varieties to grow, in what sequence, and whether to double-crop, fallow, or plant a cover crop in order to best use the soil's productive capacity.
  - Tillage—Deciding how best to prepare the soil for planting while preserving soil, moisture, and nutrients.

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- Conservation structures—Deciding what investments in soil conservation structures to undertake to preserve soil, soil moisture, and soil nutrients.

- Pest management systems (see Chapter 4.3).
  - Weed management—Deciding what resources to use in determining and controlling weed problems; how to combine scouting, tillage, rotation, cultivation, herbicides, and seed variety choices.
  - Insect management—Deciding how to determine and control insect problems.
  - Disease management—Deciding how to determine and control disease problems.
- Nutrient management systems—Determining soil nutrient needs for crop growth, and the method/timing of applying animal manure, compost, or commercial fertilizer (see Chapter 4.4).
- Manure management systems—Determining the manner of collection, containment, field spreading, and other means of manure disposal (see Chapter 4.5).
- Water management systems—Determining the water needed for crop growth and the means of enhancing soil moisture to meet those requirements (see Chapter 4.6).
  - Irrigation—Deciding the technology and management practices that affect water use efficiency, fuel type, source of water, and scheduling of applications.
- Farm management systems—Determining who decides what (see Chapter 4.1).
- Information systems—Determining how much to invest inhouse in computer/internet and/or use of various outside sources/professional consultants to improve the effectiveness of management and crop production (see Chapter 4.7).
  - Precision agriculture—Deciding what human skills and technologies to employ in adjusting inputs as crop needs vary within each field.
  - Variable-rate technology—Deciding what technologies to use in automatic adjustment of input use without real-time control by the machinery operator.

The choices within different management areas are not mutually exclusive. A practice decision may include more than one management system. For example, a crop rotation may be an important component of water management, soil management, pest management, and nutrient management systems.

Adoption of Recommended Conservation Practices

Farmers' production choices may be motivated by both private and public goods, including increased profits and protecting the environment. If operators are to manage their production activities to include social objectives, State and Federal communications about recommended conservation practices are critical. U.S. farmers increasingly face both economic and social pressures to adapt management practices to meet conservation goals. For example, the 2002 Farm Security and Rural Investment Act expanded the eligibility and choices for farmers to receive incentive payments for using environmentally sound practices. The Conservation Security Program (CSP), established in the 2002 Act, rewards environmental stewardship practices in nutrient, pest, soil, and water management (see Chapter 5.4, “Working-Land Conservation Practices”).

Farms that adopt more of the recommended practices under CSP or the Environmental Quality Improvement Program (EQIP) differ from less intensive adopters, and achieve different economic/environmental results. The Agricultural Resource Management Survey (ARMS) includes several questions on the adoption of recommended conservation practices. Farmers were grouped by their combined score on representative practices in five aspects of production management (see box, “Index of Recommended Practices”). ARMS data for 1998 wheat, 2001 corn, 2002 soybeans, and 2003 cotton were used to compare high and low adopters of recommended practices on the fields used to produce these crops.

Adoption ranges from only 3 percent of wheat acreage using variable-rate technology to 92 percent of cotton acreage being scouted for pests (table 4.8.1). (This is primarily a reflection of differences in both economic returns from these practices and in conservation needs, and should not be interpreted as an indicator of differences in conservation effort or commitment.) The number of recommended practices used per acre ranges from an average of 1.8 for cotton to 2.4 for soybeans. There is a strong economic incentive to rotate crops for soybeans (84 percent rotated) and corn (80 percent). Farmers who rotate wheat crops tend to fallow their fields for a year in dryer regions, and double-crop, observing a corn-wheat-soy rotation, in warmer regions. Scouting for pests was the most common recommended practice used for wheat (83 percent) and cotton (92 percent). Pest control accounts for a larger proportion of cotton production costs compared with other crops, and scouting helps minimize pest control costs.

Table 4.8.1

Percent of acreage with recommended practice, by crop

Practice	Corn	Soybeans	Wheat	Cotton
	Percent of crop acreage			
Crop rotation	80	84	57	27
Conservation tillage	43	69	33	11
Scouted for pests	55	58	83	92
Soil test for nitrogen	26	24	30	37
Variable-rate tech for inputs	11	6	3	15
Avg. number of practices per acre	2.2	2.4	2.1	1.8

Source: USDA’s Agricultural Resource Management Survey: 2001 for corn, 2002 for soybeans, 1998 for wheat, and 2003 for cotton.

Index of Recommended Practices

For each crop, an index was constructed based on the following practices recommended as contributing to conservation objectives. The total score could range from 0 (adopted none of the practices) to 5 (adopted all of the practices), where 1= used recommended production practice, and 0= did not use recommended production practice.

- **Rotation—**Zero indicates the same crop was planted for 2 consecutive years. All other rotation schemes are scored one. Under this definition, idling or fallowing land during the previous spring and summer counts as rotation. Double cropping is not counted as a rotation if the current crop is the same as the crop planted 1 year prior.

- **Tillage—**One indicates producer used conservation tillage (30 percent or greater residue remaining). Conservation tillage includes no-till, mulch-till, and ridge-till systems.

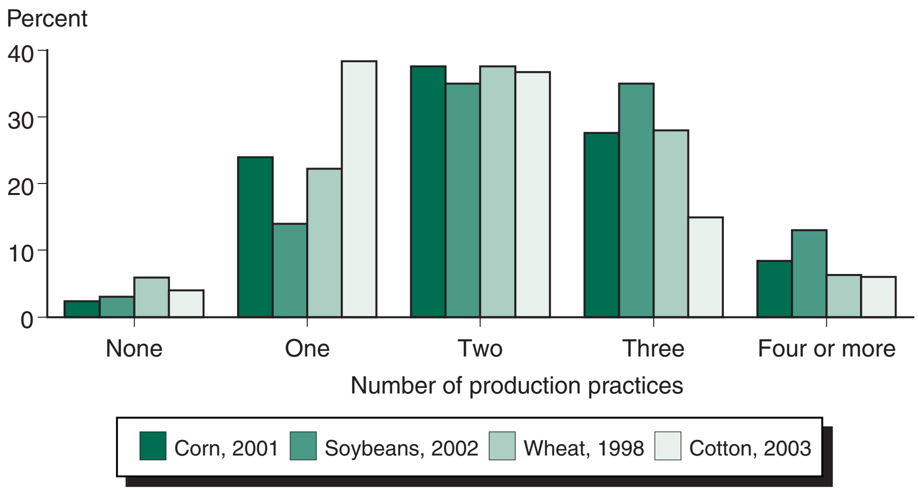
- **Scouting for pests—**One indicates producer scouted crop for any pests, including weeds, insects, or disease. Casual scouting while in the field for other purposes is counted.

- **Testing for nutrient requirements—**One indicates a soil test for nitrogen or phosphorus was performed, or that a plant tissue test was performed.

- **Use of variable-rate technology—**One indicates that a variable-rate technology was used for applying fertilizer, lime, seeds, or pesticides. Yield, soil, or pest mapping without use of a variable-rate technology is not counted.

Figure 4.8.1

Distribution of planted acres across number of recommended practices adopted, by crop



Source: USDA's Agricultural Resource Management Survey.

The number of recommended conservation practices used ranges from an average of 1.3 practices on cotton in the Prairie Gateway to 2.7 practices on wheat in the Southern Seaboard. For each of the four crops, more than 80 percent of the acreage received one to three of the five recommended practices and less than 6 percent received none (fig. 4.8.1).

Role of Government Programs

Corn and soybean producers who participate in government agricultural programs adopt more of the recommended production practices than producers who do not participate. In 2001, corn producers who received program payments used, on average, almost twice as many of the recommended practices as producers not receiving payments. Conversely, operators who adopted one or more of the practices were much more likely (82 percent) to receive government payments than nonadopters (57 percent).

Factors other than program participation influence adoption of recommended practices. Large farms adopt more recommended practices (and are also more likely to participate in programs). Also, any producer with cropland that contains a wetland or is highly erodible, as defined by the Natural Resources Conservation Service, must use an approved conservation system on that land to receive government payments (see Chapter 5.3, "Compliance Provisions for Soil and Water Conservation"). They may also benefit from adopting recommended practices, regardless of program requirements, through reduced costs. ARMS data show that farms with wetland or highly erodible land (HEL) adopt more of the recommended practices, and are also more likely to participate in programs. The increased likelihood of wetland or HEL among program participants could explain part of the higher adoption rates for program participants.

Other factors that affect both adoption of approved practices and participation in programs include livestock production, age, education, primary occupation, off-farm occupation, and business structure (see Lambert et al., 2006). Each could explain a part of the higher adoption rates for program participants.

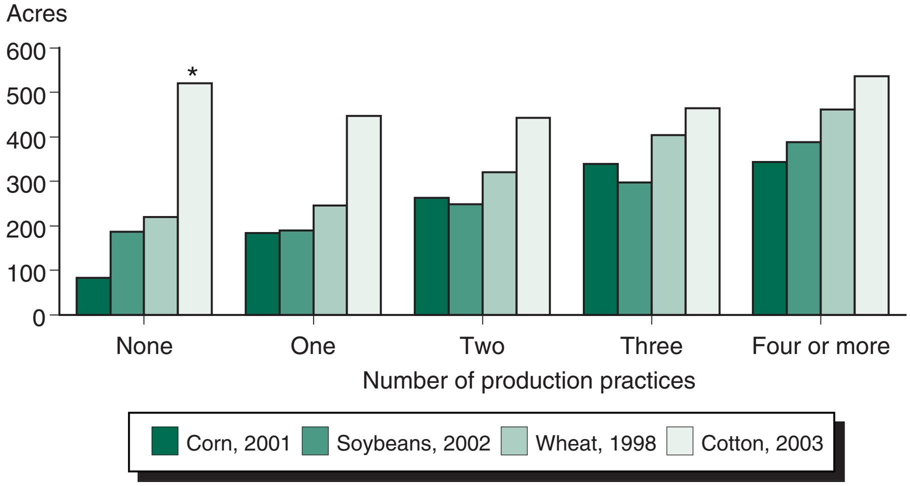
Farm and Operator Characteristics

Farms that plant more acreage also use more recommended practices than farms that do not. Farms that use four or five practices typically plant about four times as much corn and about twice as much wheat or soybeans as farms that use none of the practices (fig. 4.8.2).

Producers who used more conservation practices were typically younger (fig. 4.8.3). Whereas about a third of producers using none of the practices were younger than 50 years old, half of producers that used four or more conservation practices were under 50. Younger producers have longer time horizons for receiving the benefits from conservation practices and are more likely than older producers to make an investment for a long-term payoff. No-till and variable-rate technologies, for example, require large capital investments. Younger producers also have more of an incentive to rotate their crops to keep their field productive since they are more likely to be using the field for many years.

Figure 4.8.2

Average acres planted per farm by crop and by number of practices adopted

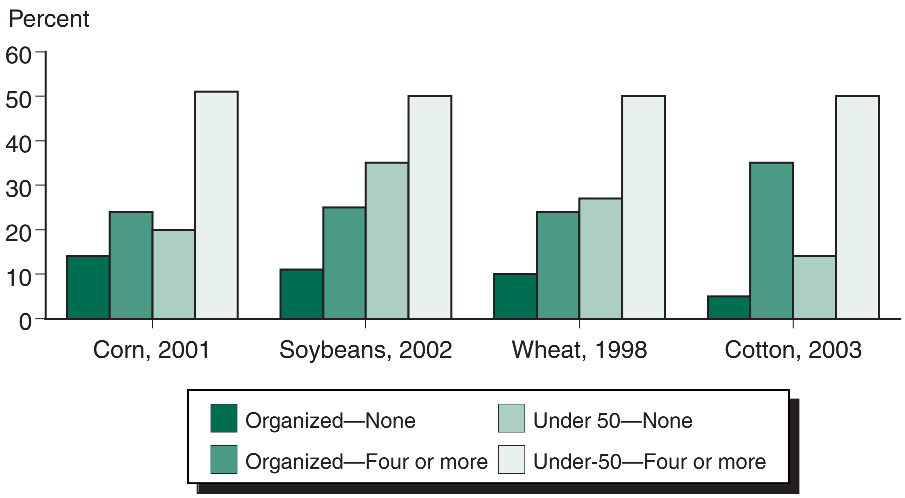


*Small sample size.

Source: USDA's Agricultural Resource Management Survey.

Figure 4.8.3

Producers using four or more recommended conservation practices are more likely to be under 50 and organized as a partnership or corporation

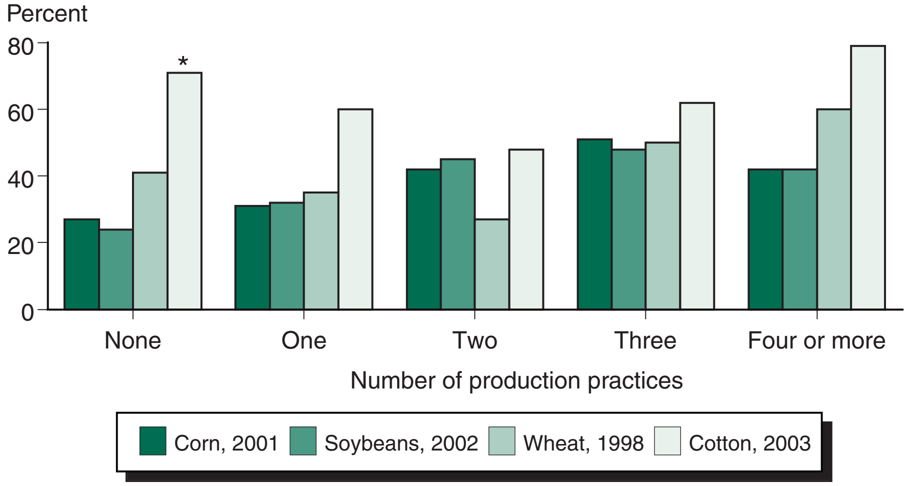


Source: USDA's Agricultural Resource Management Survey.

Producers using more conservation practices are also more likely to operate farms as partnerships or as family corporations rather than sole ownerships (fig. 4.8.3). Full-time operators of larger, more complex enterprises may be more likely to have the necessary skills to optimize implementation of newer conservation practices. They also can spread the costs of obtaining information over a larger operation. Producers in partnerships and family corporations may have multiple managers to split the farm management workload, allowing greater depth of knowledge and experience about farm practices. Partnerships and corporations are also more likely to have management successors, giving them a longer time horizon.

Figure 4.8.4

Percent receiving some college education, by crop and by number of recommended conservation practices adopted



*Small sample size.

Source: USDA's Agricultural Resource Management Survey.

Producers who adopt more recommended practices are more educated, on average (fig. 4.8.4). A higher percentage of corn, soybean, and wheat producers who adopted four or more conservation practices completed some college, compared with producers who adopted none. Increased schooling may help producers handle complex farming operations by improving the operator's ability to assimilate new information. Education may also help a producer understand and adapt to changing technologies and recommendations.

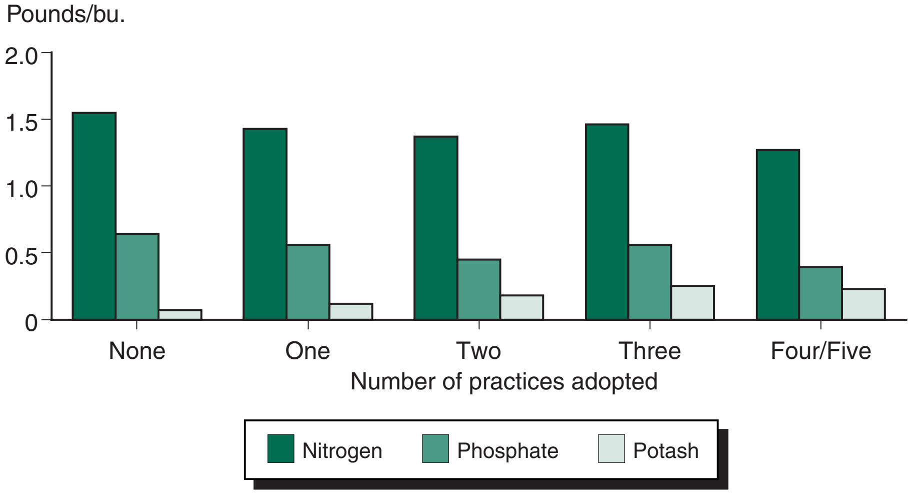
Producers who adopt more practices are more likely to be full-time farmers listing farming as their principal occupation. Full-time producers are less likely to have nonfarm jobs that compete for their time or provide alternate sources of income. Producers more dependent on farming for income are likely more motivated to explore every possibility to reduce the risk of crop failure or yield reductions. Hence, full-time producers may be more likely to scout their fields for pests, conduct nutrient tests, and stay abreast of the long-term benefits of using conservation practices.

Indicators of Conservation Performance

According to ARMS, farmers who adopt more recommended practices generally perform better on conservation objectives. One such objective is to minimize spillover loss of nutrients into the environment. In practical terms, that means reducing the application of nutrients to just what is needed by the crop. A higher ratio of nutrient applied per bushel of grain or bale of cotton lint indicates a higher potential for nutrient contamination of surface and ground waters. ARMS data show that farms using more recommended practices generally apply less total nutrients per unit of product. This is especially true for wheat (fig. 4.8.5). High adopters also apply less phosphate on soybeans and less potash on corn. Using fewer inputs both conserves resources and lessens the potential environmental impact from the manufacture, transport, and use of the input.

Figure 4.8.5

Nutrient pounds applied per bushel of wheat, by number of recommended practices



Source: USDA's Agricultural Resource Management Survey.

References

Lambert, Dayton, Patrick Sullivan, Roger Claassen, and Linda Foreman (2006), *Conservation-Compatible Practices and Programs: Who Participates?* ERR-14, U.S. Dept. Agr., Econ. Res. Serv., Feb.