Production Economics: Into the 21st Century[1]

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Biotechnology, environmentalism and international trade are driving forces in production agriculture, according to the former Assistant Secretary of Agriculture (Gardner, 1992). Warren Johnston (1990) adds the possible redefinition of land and water property rights to this list. As we prepare to enter a new century, agricultural economists and other production specialists will be called on to assess new technologies, environmental regulations and the effects of changing trade and consumer preferences on farming practices.

Faculties of agricultural colleges in the United States are staunch believers in the application of science as the solution to practical production problems. Resource scarcities are replaced with new information. Agricultural productivity gains, especially over the past 40 years, reinforce our faith in science and advancements in technology. Twenty years ago Vernon Ruttan (1971) noted that agricultural advances were being challenged both by intellectual and "populist" concerns for the environment and by the social costs of rapid technical change. He made the important point that, "The advance of science and technology has enabled modern society to achieve a more productive *and better balanced relationship to the natural world* than in the ancient civilizations or in early stages of Western industrial civilization." Despite the last 25 years of environmental activism, I believe this statement still holds. Nevertheless, population growth, new technologies, trade patterns and institutions must continually be assessed to give us direction for setting our research and staffing priorities.

I want to review the role of production economists, discuss some of the salient production resource trends, outline some of the upcoming changes in farm and other legislation, and propose some research priorities for economists and others. My evaluation of history and the effects of farm legislation will differ from that of some economists and environmental groups.

When speculating about the 21st century, I am humbled in remembering one of my first research projects in North Carolina. Another naive economist and I put together a publication with 15-year projections of output for each major agricultural commodity in the state. The executive director of the sweet potato association did not like our projected demise of sweet potatoes and let us know about it. Twenty years later I know he was right, and we were wrong.

History of Production Economics

Production economics is the part of agricultural economics that focuses on understanding and assessing the growth and production processes in farming. It has close links to the biophysical disciplines in agriculture, and it is empirical, relying frequently on experimental data and observable farm management behavior.

Production economics has its roots in agronomy and farm accounting that came together as Farm Management about 90 years ago. Pioneers such as Warren, Spillman, Tolley, Black and others linked up with crop and animal scientists to work at a growing number of land grant colleges and at the Bureau of Agricultural Economics at USDA. Nobel laureate T. W. Shultz worked on agricultural production and supply problems, arguing that we knew much less about supply than demand of agricultural products. He exhorted agricultural economists to study production technology, saying "Tell me what the supply of farm products will be five or ten years from now, and I shall give you meaningful answers to the more important economic problems of agriculture" (Schultz, 1956).

Earl Heady, building on the work of Ezekiel, Waugh and others, led agricultural economists in using ever-more rigorous analytical methods. Using Iowa farm data, he provided some of the earliest applications of multiple regressions to estimate growth functions, and he used linear programming to find least-cost feed rations and most profitable crop mixes. He also was a pioneer in the use of portfolio analysis to evaluate farm decisions under uncertainty (Heady, 1952; Heady and Candler, 1958).

During the 1950s production economists evaluated irrigation, fertilizer use, and hybrid corn adoption (Griliches, 1957) and introduced methods to analyze the changes in agriculture which would later be known as the "Green Revolution." During the 1960s and 1970s there was expansion of this technical-change research into the analysis of farm equipment, human capital, pesticides and production responses to commodity programs. Methods such as duality theory and advanced econometrics became state of art.

The legacy of Farm Management and the early work in production economics is the paradigm of using theoretical firm or household models to study practical farm resource allocation problems. This study area is a core component (about 20% of man years) of most agricultural economics departments today (Johnston, 1990). It links microeconomic theory with policy, resource, development and environmental economics. Many of our extension advisory activities depend on this research. In addition, our training and research in developing country agriculture will continue to utilize production studies (Pingali, et al., 1987). The focus of production economics may change in the future, but there is a vast and growing set of research problems that will continuously challenge production economists (Carlson, et al., 1993).

Trends in Resource Use

Most everyone here is familiar with the broad, sometimes spectacular, productivity gains in U.S. agriculture. Figure 1 shows that output per unit of input more than doubled during the past four decades. The technology-shifters increased agriculture relative to non-agricultural productivity in the United States. These gains have allowed us to expand export earnings, reduce labor inputs and raise output per unit of land. What is less well-known and appreciated is how these technical changes have translated both into improved income in the agricultural sector and into lower food prices. Figure 2a-2b, based on USDA data over the same 40-year period, shows how farmers' income relative to non-farm income rose from about 60% in the 1950s to near 100% and above for the late 1980s. The result has been a 50% reduction in real farm product prices (at the farm gate) that consumers must pay.[2] One implication of the farm income balance with the non-farm sector is that we may see little future loss in farm population, though these adjustments are often slow to equilibrate.

One of the key inputs behind the productivity gains is agrichemicals. USDA data (Figure 3) show expenditures for both fertilizer and pesticides increasing more than six-fold between 1950 and 1980. Environmentalists frequently point with alarm to these increases, but they usually overlook four important points. First, these expenditure increases are partly due to higher prices and qualities of chemicals. Quantities have risen less rapidly. Second, most all of the increases were warranted from the farmer's perspective because fertilizer and pesticide studies of the 1960s showed large profit gains per unit increase in use of both fertilizer and pesticides (Headley, 1968; Huffman, 1974). Third, the upward trend of the previous three to four decades has stopped during the 1980s—use has decreased or remained level in most commodities and chemical classes. Figure 4 shows that real expenditures and applications for herbicides in corn and soybeans declined in the 1984 to 1988 period. Fourth, and finally, the pesticides used during the 1980s are less hazardous than ones used earlier. Examples of the safer chemicals are the new sulfone urea herbicides and pyrethroid insecticides which are used at very low rates, have low toxicity to mammals and decay rapidly. For the largest herbicide markets—corn and soy-

Figure 1.
Agricultural productivity (output per unit of total inputs)

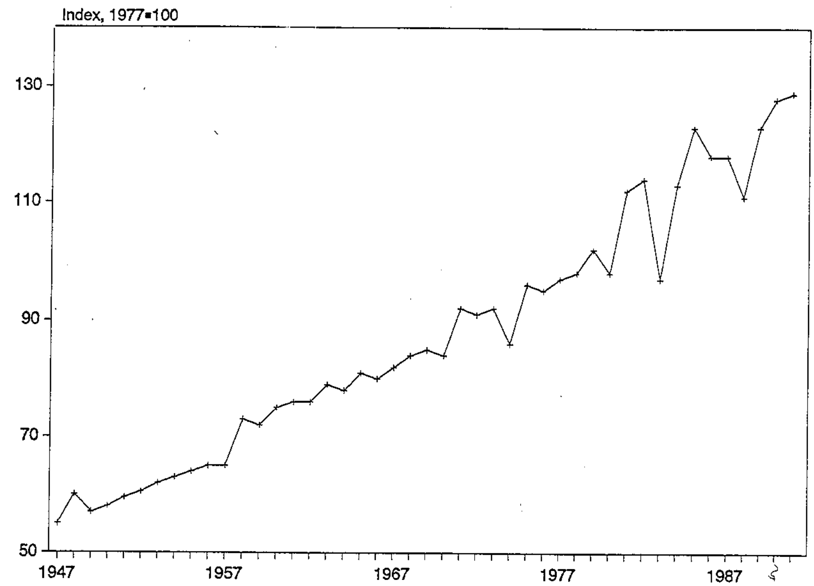


Figure 2a.
Farmers/nonfarmers' income (income from all sources)

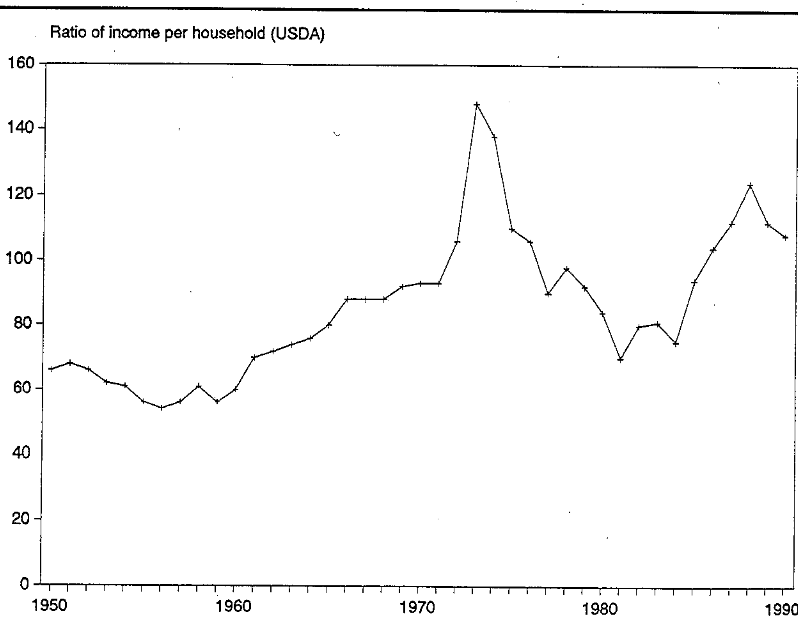


Figure 2b.
Real farm prices (all commodities) USDA prices received index/ CPI (USDA)

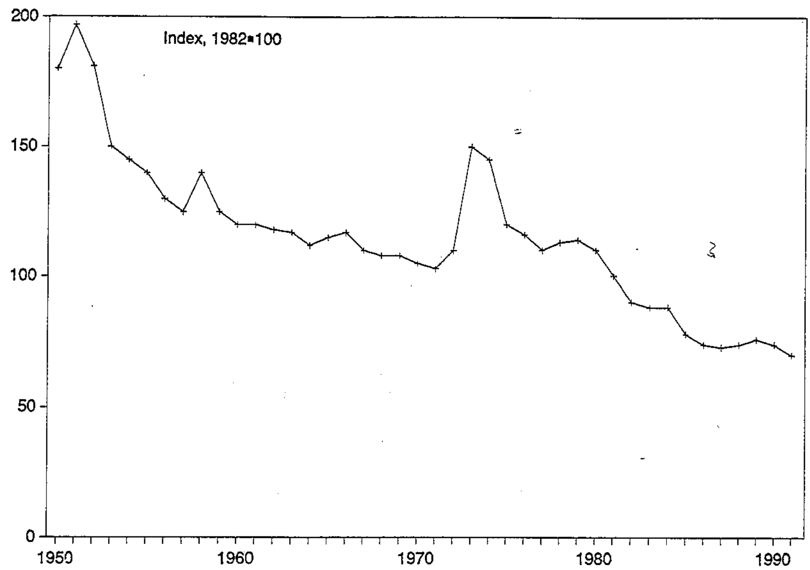


Figure 3.
Agricultural chemicals index pesticides and fertilizers (USDA)

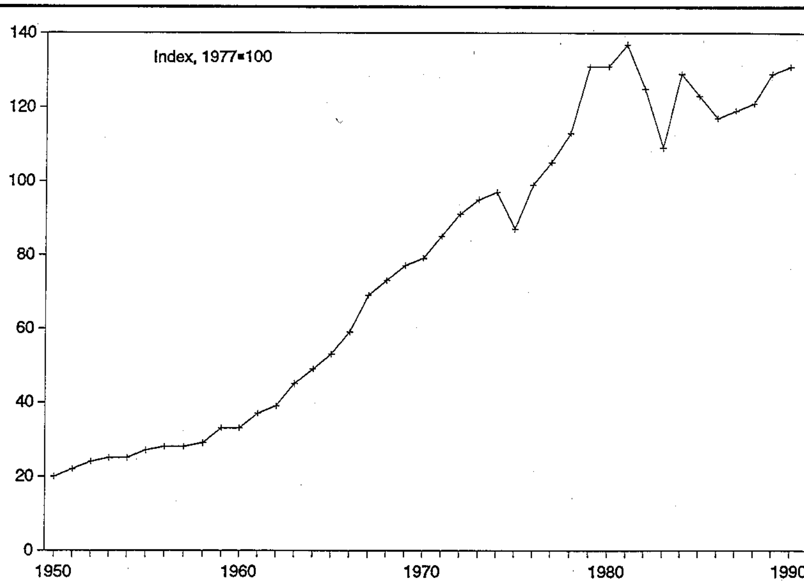
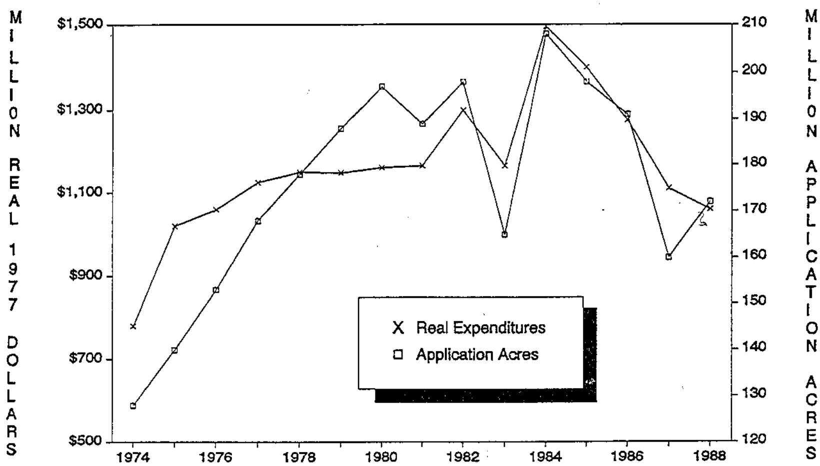


Figure 4.
Applications and real expenditures for soybean plus corn herbicides all U.S. (Doane, Martiz Surveys of 5,000 Farms)



beans—a recent study found that farmers themselves were willing to pay more for compounds with lower human toxicity (dermal LD_{50}) and for those less likely to leach to groundwater (Beach and Carlson, 1993).

The increasing pesticide-to-fuel and machinery-use ratios are partly explained by the ratio of their costs which were declining rapidly during the 1960s and 1970s (Figure 5). These ratios, however, began to turn around during the 1980s, and we saw a slowing of the intensity of chemical use.

Fertilizer-use rates for N, P, and K have also stabilized in the U.S. since 1980 (Figure 6). During the 1980s there is some decline in nitrogen use per acre of corn, yet yield per acre has continued upwards (Figure 7). Soil testing, split applications, higher management levels and reduced returns to fertilizer are each causal forces. Several prominent agronomists have claimed that applied nitrogen levels could be cut as much as 50% and not reduce corn yield (Pesek, 1991; Keeney, 1991). They partially base their assessments on residuals soil nitrogen found at the end of the season. Farmers, on the other hand, know only roughly about soil levels of nitrogen, corn uptake, or nitrogen loss rates at the time they must make application decisions. Even with split applications, they must apply "extra" nitrogen in case of high denitrification, low soil nitrogen, or difficulty entering fields for second applications. This means that it is easy to detect soil nitrogen in some years and locations at the end of the year, but it is poor science to conclude that the end-of-year nitrogen is "excess." Farmers can not wait until the end of the year to make fertilizer decisions. Agricultural economists must

Figure 5.
Relative cost of pesticides compared with machinery and fuel costs

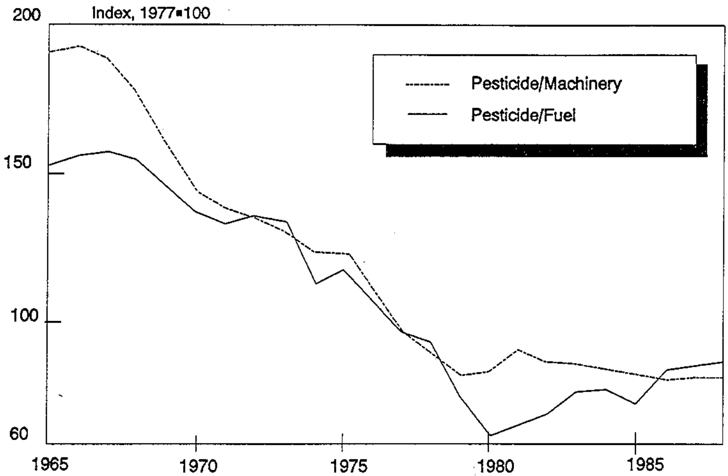


Figure 6.
Consumption of primary plant nutrients

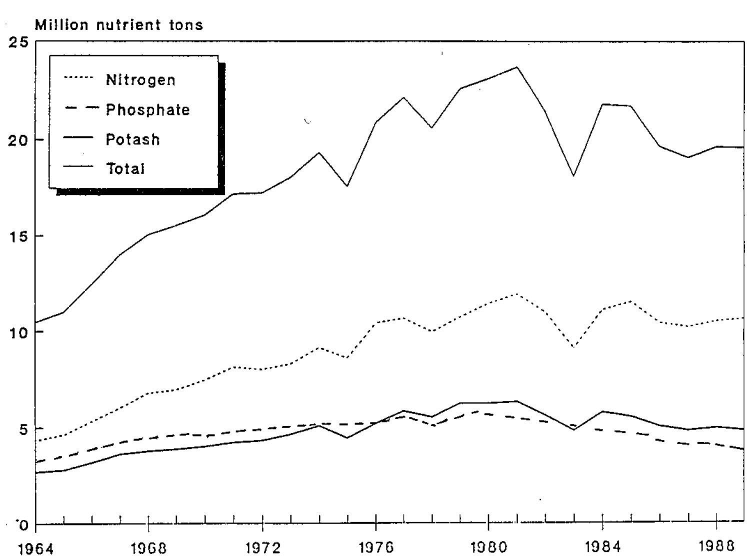
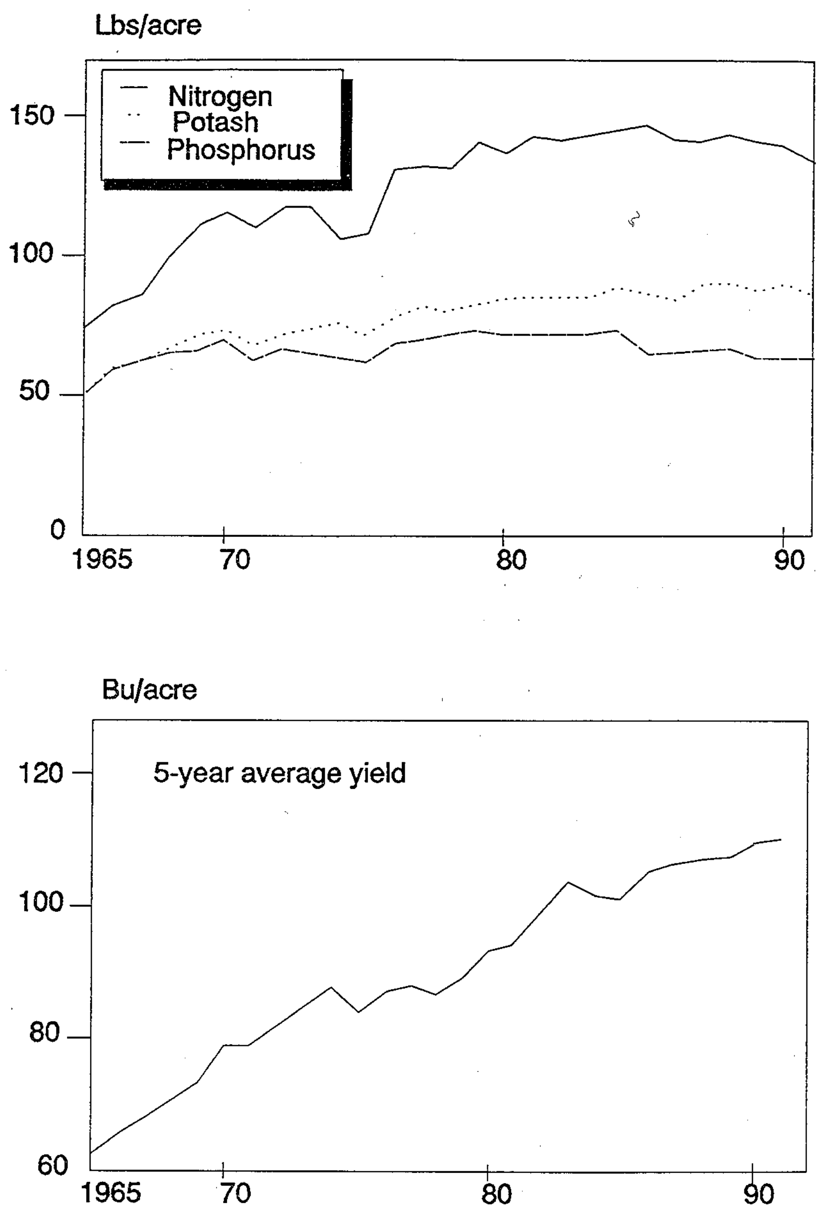


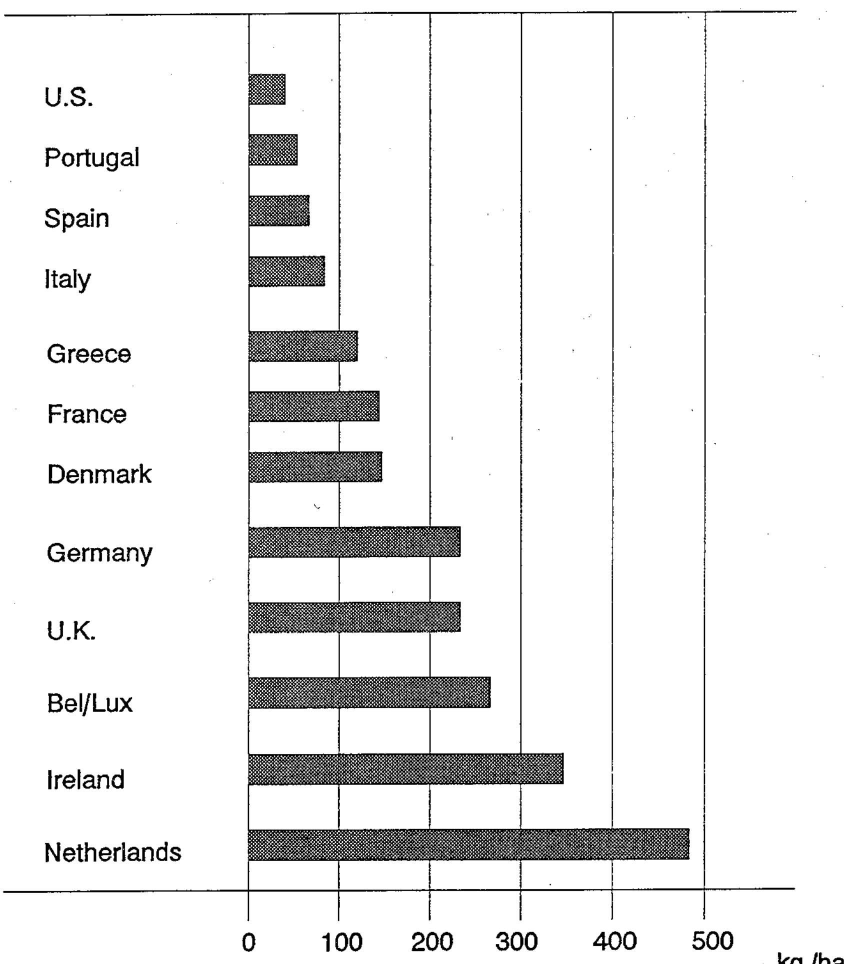
Figure 7.
Fertilizer application rates and 5-year average yield (USDA, ERS, 1992)



convince agronomists and others that most corn farmers are applying fertilizer at near-optimal levels, given the uncertainties in the production process. Babcock (1992) shows that with current corn and nitrogen prices on corn following soybeans, economically efficient nitrogen rates are about 36% higher than when ignoring the uncertainty.

Fertilizer use in agricultural production is much lower in the U.S. than in Europe (Figure 8). During the 1980s, while the U.S. farmers were reducing

Figure 8.
Nitrogen use per hectare of cropland in various countries

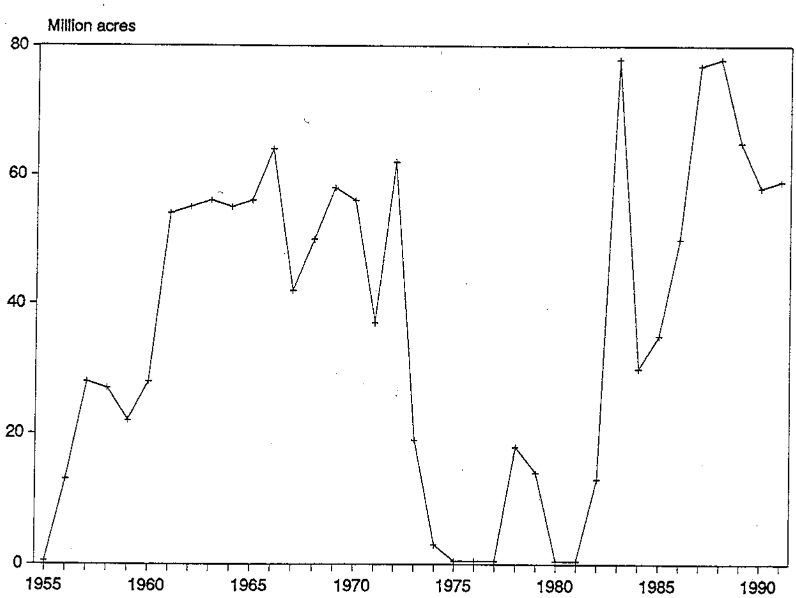


dependencies on agrichemicals and manure, European producers continued expanding the use of these inputs. It will be informative to U.S. agriculturalists to know how and if the Europeans efficiently manage the downward adjustment in use rates.

Other important resources that production economists evaluate are land and soil use. The main programs today affecting the idling of land are the Conservation Reserve Program (CRP) and the Acreage Reduction Program (ARP). Farmers join these programs to qualify for government deficiency payments. Figure 9 shows the total idled acreage over the past four decades. The Soil Bank of the 1950s and 1960s actually included less idled land than what we have had in the last five years. The CRP program, which has 36.5 million acres as of June, 1992, was initiated in 1986, and renewal of these 10-year contracts will be the subject of debate in the mid 1990s. The average government cost of the CRP program is $49.70 per acre. This amount results in the reduction of soil erosion by an average of 19 tons per acre (USDA, 1992).

Four observations are pertinent with regard to the CRP. First, several studies (Sinner, 1990; Putnam and Alt, 1986) have shown that targeted SCS subsides are lower-cost methods of preventing soil erosion than is CRP. Second, much of the idled land under CRP is located far from population centers, where reduced

Figure 9.
Idled acreage in annual programs amd conservation reserve (USDA)



soil runoff might benefit more people (Young and Osborn, 1990). Third, USDA data show evidence of improvements in wind, sheet and rill erosion prior to the initiation of the CRP program (USDA, 1987). Not all soil loss is inefficient for farmers. There are costs of preventing soil loss, and there are sometimes important substitutes for soil, such as new crop varieties (Walker and Young, 1986). Finally, as the U.S. was idling acreage in the 1980s, other agricultural countries were expanding output, thereby lowering our relative agricultural productivity position. Clearly, production economists will need to combine forces with environmental and trade economists to evaluate carefully both the environmental and farm-income benefits of various land retirement and soil loss options. This must be done before new land retirement policies are set and in the context of efforts to control U.S. Treasury costs. Further evaluation of other policy changes is the subject to which I now turn.

Production Economics and Agricultural Policies

Agriculture is becoming one of the most highly regulated businesses in America. Previously, regulation affected farmers mostly through price supports, acreage retirement, and other commodity program features. Now it is clear that familiar commodity programs are being replaced with Farm Bill sections that are more directed at input use related to the environment, food safety and sustainable agriculture.

Bruce Gardner, former Under Secretary of Agriculture, argues that there is a movement "away from rewarding farmers for engaging in socially desired activities towards penalizing farmers if they don't" (Gardner, 1992). He compiled Table 1 to show the increased number of Farm Bill titles directed at environmental quality and food safety. He reminds us that legislation added "swampbuster," "sodbuster" and "conservation compliance" in 1985, and mandatory pesticide record keeping, worker reentry standards, training for pesticide applicators and required training of extension agents in the principles of sustainable agriculture in the 1990 FACT legislation.

In addition to farm legislation, many other regulations directly impinge on agriculture. Some of this legislation is up for renewal in 1993, including both the Clean Water Act and the Endangered Species Act. Pesticide regulations under FIFRA, state regulations, a recent court ruling calling for stricter enforcement of the Delaney Clause, and an August 1992 Federal Register rule on worker reentry will make pesticide policies a volatile area of study in the next few years. Some of the production issues related to the farm legislation are outlined below, followed by a discussion of other regulations.

Table 1.
Environmental/food titles of recent farm legislation

1977 Act	1981 Act	1985 Act	1990 Act
XIV. Research, Extension and Teaching: Subtitle H, Solar Energy; Subtitle J, Sec. 1461, Organic Farming Study XV. Rural Development and Conservation	VII. Research Extension and Teaching: Sec. 1434-35, Solar Energy XV. Resource Conservation	XII. Resource Conservation: Subtitles A-C. Conservation of Highly Erodable Lands and Wetlands; Water Resource Conservation XIV. Research Extension and Teaching: Sec. 1410, "High Priority" to biotechnology and conservation research; Sec. 1444, Pesticide Resistance Study	XII. Subtitle C, Tree Planting XIII. Subtitle C, Cosmetic Appearance XIV. Subtitles A-H, Highly Erodable and Wetland Conservation; Environmental Quality Council; Water Quality; Pesticide Recordkeeping; Composting Research XVI. Research. Subtitle B, Sustainable Agriculture; Subtitle G, Alternative Agricultural Research; Subtitle H, Sec. 1668, Biotechnology Risk Assessment Title XXI. Organic Certification Title XXIV. Global Climate Change

Source: B. Gardner, 1992

It is common to claim that commodity programs increase pesticide and fertilizer use, discourage crop rotation and cause farmers to "jeopardize their future income by allowing soils to erode, groundwater to be contaminated, wildlife to be poisoned, and reservoirs to silt up" (Faeth, et al., 1991). Without any specific analysis or data, economists and others often conclude that "farm price and income-support programs have actually contributed to environmental degradation" (Brown, et al. 1992).

Some of the empirical evaluations I and others have made in recent years do not support these assertions. First, analysis of rotation, pesticide use and farm program participation data for 1984-1989 shows that crop rotation by corn farmers is high. A telling fact is that 60%-80% of all corn planted is first-year corn or corn planted in rotation. Moreover, the use of rotation is higher in the areas and years in which participation in the Feed Grain Program is highest

(Gargiulo and Carlson, 1992). This implies that the use of insecticides to control corn rootworm is about 70% lower because of land rotation and those factors increasing rotation. In addition, fertilizer use is about 20% less on corn following soybeans. The main point is that farmers realize that the net benefits of production of continuous corn are less than corn following soybeans. They practice continuous planting on a regular basis only in a few locations, such as under irrigation. The flex acreage provision of the 1990 FACT bill may also have helped rotation the last year or so. One of the main advantages of the ARP program relative to CRP is that ARP provides low-cost land for rotation, whereas the CRP lands must be kept in permanent conservation use.

Second, it is often claimed that higher price supports will increase pesticide use (Daberkow and Reichelderfer, 1988). Carlson and Shui (1992) evaluated three large pesticide markets—corn and soybean herbicides and cotton insecticides. They found that per-acre pesticide use increased only slightly from higher price supports, but *decreased* from higher ARP requirements that occurred at the same time. After one adjusts for quality changes and application costs, they find that per-acre use rates declined from the combination of price supports and ARP requirements of the 1980s. Additionally, total pesticide use declined because of reduced cropped area, especially in the South.

Some price support provisions help change cropping patterns, which in turn may lower soil erosion and chemical use per unit of output. Double cropping of wheat and soybeans requires use of minimum tillage to rapidly plant soybeans in wheat stubble. This usually means fewer soil run-off problems in double-cropped soybeans relative to conventional soybeans. During the 1970s and 1980s, the amount of double-cropped soybeans in the Southeast increased with the wheat price support program. Both a higher average net return and a less variable net return occurred with the wheat program. Although some producers initially used more herbicides for double-cropped than for conventional soybeans, they quickly learned to lower herbicide use under minimum tillage. Chemical use per dollar of product declined (Marra and Carlson, 1986).

Finally, some writers continue to point to the objective of building yield base as a reason to "over use" agrichemicals (Brown, et al., 1992; Avery, 1991). However, this provision of the farm legislation has not been in effect since 1986. Some farmers may have thought these "yield bases" would be unfrozen, but after seven years this prospect has a low probability. The lower price supports since the 1985 Farm Bill give little incentive to overuse chemicals. At the same time, pesticide costs are increasing relative to land, machinery and fuel costs. There definitely was some inducement to use more pesticides by acreage allotments that kept cotton production out of low-pest areas, but these provisions disappeared 20 years ago. Simply, we need economic assessments of the current mixture of farm program provisions.

The future policy for resource use in agriculture is going to be shaped by direct regulatory actions by EPA and state agencies. Agricultural economists have a critical role in evaluating farmer costs of regulatory changes. Once regulations are enacted, economists can assist in finding least-cost adjustments for farmers and others. Let me illustrate some of the analyses by discussing pesticide regulations.

Under FIFRA, the Pure Food and Drug Act and various state statutes, pesticide use is controlled by restricting entry of new products, cancellations, and label restrictions. The latter can affect rates, methods and timing of application, applicator protection, reentry time, preharvest intervals and levels of tolerable food residues. There are important rules on the handling of containers and pesticide residuals, application training and pesticide recordkeeping. In some states certified pest control advisors must write prescriptions for each application.

These efforts to protect food, surface and groundwater, worker exposure, fish, and wildlife have certainly been effective. But we have only a limited number of studies on the effectiveness of these actions or on how much individuals are willing to pay for pesticide-free food, water or exposure on the job.

Davis et al. (1992) provide a model and a case study of economic benefits for worker protection in apple orchards in Massachusetts. Beach and Carlson (1993) provide separate estimates of farmers' willingness to sacrifice farm income for groundwater safety for corn and soybean herbicides. Cropper et al. (1992) have examined EPA pesticide cancellations over the past 15 years to infer the relative importance of various risk and benefit categories. They found worker exposure relatively significant. One interesting finding was that during the evaluation process dietary risks changed 50% of the time, while those for worker risks (18%) and producer benefits (21%) did not. Of 245 EPA decisions (by crop and chemical) 39% were cancellations, 4% were suspensions of registration for failure to provide data, 52% were continuations of restrictions, but only 5% of the cases resulted in unrestricted continuations. The types of restrictions were usually measures to protect mixers, loaders, applicators, or to replace human flaggers with mechanical ones.

In the 1992 Waugh lecture, V. K. Smith (1993) presents his estimates of environmental costs of agricultural production. He focuses on in-stream effects of soil erosion, wetland conversion and groundwater contamination from agrichemicals. He freely admits that the estimates have "little chance of being correct, [but] the judgments and often heroic assumptions made to develop them identify the research needed to convert our externality message into more effective policy." He estimates that the largest category of environmental costs are those associated with groundwater contamination: 6.27% of gross crop value. Soil erosion costs were estimated at 1.98% of crop value, with wetland conversion costs at 1.90%. Regionally, his highest estimates of environmental costs of agriculture pollution are in the Northeast (3%-40%), but the estimate for the Southeast is second highest at 7%-14% of gross crop value.

My main purpose in highlighting Smith's pollution cost estimates is that they are the most complete set based on fairly current data. They do not include any worker exposure cost or food residue effects of agrichemicals. The groundwater estimates rely on very gross estimates of what part of drinking wells are "contaminated" because the Nielson and Lee estimates on which they are based use poor estimates of pesticide use, no consideration of actual well contamination and no consideration of pesticide characteristics or rates of use.

EPA's 1990 drinking-well survey (U.S.E.P.A., 1992) finds low frequency of contamination with pesticides (only 12 of 127 compounds found above minimum reporting limits in an estimated 4% of rural domestic wells). There were higher nitrate detections (50% wells with above-minimum detection levels). The detections did not correlate well with soil parameters but they are positively correlated with fertilized pasture land, average monthly rainfall, shallow well depth and well water pH. I believe these pollution estimates indicate that production economists must work to connect environmental cost assessments with benefit estimates of agrichemicals.

There are few serious estimates of the costs of regulatory actions on agriculture (Zilberman, et al., 1991). Pesticide cancellations effect some farmers more than others. In addition, cancellation of major classes of chemicals can affect crop prices and raise the costs of livestock production as well as food costs. Taylor et al. (1991) recently reported estimated costs to farmers and consumers of six different chemical bans. They used estimates of yield and cost changes from 140 agricultural scientists together with a large econometric model. Table 2 is a summary of their results. The first three bans limit pesticides on three soil groups with different possibilities for groundwater contamination. Price changes are larger for corn than for other crops. Both price increases and net income losses jump sharply when bans of all herbicides or all pesticides plus nitrogen fertilizer are considered. These estimates consider only six field crops and must be based on crude guesses at how farmers would respond without particular groups of pesticides. However, they do give us initial estimates of losses that might result from drastically changing commercial agriculture.

Reichelderfer (1990) claims there were minor aggregate effects of banning nine pesticides and placing some restrictions on the use of 26 others during the 1970s. This may be because most of these compounds were older insecticides to which insects had developed resistance (Carlson, 1977). Today, in many cases the benefits lost to agriculture show up only indirectly through increased

Table 2.
Estimated crop price changes and income losses of various agrichemical bans

Price changes	DRASTIC-2[a]	DRASTIC-4[b]	DRASTIC ALL[c]	No Herb.[d]	No Pest.[e]	No Chem.[f]
Corn	1.5	5.5	12.7	33.9	37.1	88.5
Soybean	–1.7	–0.2	–5.9	91.1	100.1	122.0
Cotton	0.7	1.2	1.3	9.6	35.2	92.3
Wheat	0.4	0.4	0.4	8.6	7.1	20.5
Net Income Losses ($ Mil.)	208	1,364	3.707	18,196	21,885	33,136

a – No aldicarb, triazine, and acetanilides on soils with DRASTIC Score >160.
b – No aldicarb, triazine, and acetanilides on soils with DRASTIC Score >130.
c – No aldicarb, triazine, and acetanilides on soils with DRASTIC Score >100.
d – Ban all herbicides.
e – Ban all pesticides except seed treatment.
f – Ban all pesticides and inorganic nitrogen fertilizer.

Source: Taylor, et al., 1991.

from foreign markets (e.g., summer apples from Chile to replace those previously stored using Alar), or through less productive young citrus trees without aldicarb (from a temporary state ban) being replaced by Brazilian imported orange juice. Some of the costs of banning chemicals may rise more steeply in the future, especially in fruit and vegetable production and in other minor crops where there are few pesticide substitutes. Clearly, we are looking with hope at new biopesticides that can be incorporated into crops, and for other substitutes for the more dangerous pesticides.

My overall assessment is that we must be careful to avoid over regulating chemical use in the future for two reasons. First, pesticide use restrictions in most cases have been irreversible. For example, the 1958 Delaney Clause banning any compound shown to cause cancer in test animals has for years disrupted the setting of food and feed tolerances (National Academy of Science, 1987). To get this changed by legislation would require a majority of congressmen to vote "for cancer." Second, our ability to supply low-cost food to low-income people in the U.S. and in international markets will be jeopardized if we restrict use of new pesticides and other technologies. The comparative advantage this country has in agriculture with its export surpluses is one of the long-term sources of economic strength for the United States.

Research Objectives for the 21st Century

I have indicated the high priority we must make to link marginal changes in production technology to water, worker and food safety. This is not defensive research, but it will help us look at the tradeoffs. State referenda like the 1990 "Big Green" vote in California helped researchers there realize that they could and should provide voters with estimates of costs of drastic reductions in agrichemical use (Zilberman and Siebert, 1990; Zilberman, et al., 1991).

A second major study area for production economics is the assessment of biotechnology products. Some product introductions, such as BST in dairying, are being stalled by coalitions of legislators representing dairy with high costs of production together with fearful consumer groups. New genetic products have a long history in plant and animal agriculture. Low-cost pork from PST and biopesticides, such as *Bacillus thuringensis* genetically engineered into crop plants, are likely to assist agriculture and consumers greatly. Imagine where protein consumption would be today if we had restricted genetic developments in broiler and turkey production; the relative price of broilers has declined threefold since the 1950s. There are some risks from field tests of new biotech products, but safeguards are available.

Economists must also work with those seeking low-input agricultural systems. Much of the alternative agriculture research is poorly evaluated to date, mainly because labor and management costs have been underestimated. But research shows that markets for organic products are limited. And it is difficult for producers in some locations to adopt low-input systems, and many low-input systems are not profitable relative to current production systems. Many successful technologies of today were not profitable until modifications were made. Some low-input systems may have the additional advantage of lower off-site or pollution costs.

Agricultural economists must continue to examine market and other indicators of the value of new technologies. Many new developments are difficult to assess because they only lower income variability or provide information (soil tests, computers, pheromone traps) which may indirectly increase production and lower consumer prices. It is impractical for every farmer to evaluate every new technology that comes along for his or her particular environmental conditions. Our research efforts are productive for agriculture and economic science.

Finally, institutional and market changes need evaluation as they relate to production agriculture. In the western United States the competition among agriculture, fisheries and urban uses is a topic of heated conversation. In southern Florida and Texas it is the possible replacement of winter tomatoes and early melons from adoption of NAFTA. A few years ago I was heavily involved with economic assessment of area-wide eradication of the cotton boll weevil in the Southeast. One lesson I learned from a cotton farmer was that these external forces can be much more acceptable if there is assessment of the expected farm-level impacts in advance of the institutional changes.

Notes

1. 1992 J. W. Fanning Memorial Lecture, Co-sponsored by the Agricultural Economics Association of Georgia and the Department of Agricultural and Applied Economics, University of Georgia, Athens, GA, October 30, 1992.
2. Real consumer prices at retail have remained constant over this same period because of quality increases, rising costs of other food inputs, and the decreased share of raw products in the retail food dollar.

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