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Agricultural Experiment Station

Research Report

RR No. 81-07 February 1981

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A report entitled Tennessee Agriculture -- Projections to 1990 has been prepared by the staff of the Institute of Agriculture, University of Tennessee [1]. This report is intended mainly for internal use as an aid in program planning. As such, it represents the "best estimates" of the University of Tennessee Agricultural Institute as to possible changes which might be expected in the Tennessee agriculture sector over the next 10 years.

Predictions of future events derive value from two aspects. First, the predictions per se provide information upon which to plan courses of action. This type value is directly related to the accuracy of the predictions. For example, if the population in a given area for the year 2000 can be accurately predicted, this information can be valuable as a guide for decisions relative to needs for supportive infrastructure such as schools, roads and housing. However, in the case of events which are difficult to foresee, the value of the prediction itself may be less than the value of an examination of the prediction process--i.e. examination of the many facts and trends which may affect the eventual outcome of the event. Predictions in such cases may be multi-valued predictions which lead to hedging of actions and a variety of contingency plans.

The reliabilities of estimates presented in the Tennessee Agriculture -- Projections to 1990 report are quite varied. The report contains prognostications on a large number of individual items--number of cows, price of hogs,

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etc. Also included in the report are projections relative to agriculture sector structure. Major elements included in the term "structure" are the number, size and distribution of the farms and the distribution of production alternatives. Total land in farms is also included implicitly since it is the product of numbers and sizes. These particular numbers are difficult to estimate with accuracy because the structure of the agriculture sector interacts with individual factors (i.e., crops grown, prices, and technology) as well as with nonagricultural items (i.e., personal transport costs and rural employment opportunities) and government policy decisions. In addition, there are also problems of a technical nature, such as definitions and data series. However, despite the difficulty in predicting agriculture sector structure (or perhaps because of this difficulty), information concerning structural trends is very valuable. The number of farms, size of farms, rural population, and cropping patterns all require planning for future needs in housing, employment, roads and finance.

This paper discusses figures from the Tennessee Agriculture -- Projections to 1990 report related to structure of the agriculture sector, some of the problems involved in making such estimates, and the implications of the "unknowns" for future financial needs of agriculture.

1990 Projections

Projections of farm acreage, farm numbers, tenure characteristics and farm income from Tennessee farms in 1990 are based on the assumptions that the farm definition will not change and that demand for agricultural products, especially export demand, will continue to be relatively strong over the next few years. A strong demand for farm products and resulting relatively high prices for farm commodities is expected to dampen or offset past

tendencies for reduction in the farmland base. In the past a considerable proportion of the decline in agricultural land base on Tennessee farms occurred due to the redefinition of a farm.

The major changes projected for acreage, land use, farm size, and tenure are summarized in Tables 1, 2 and 3. Comparisons were made between actual 1978 statistics and 1990 projections. The major changes projected are as follows:

1. The number of acres used for farming will stabilize. Number of acres in farms in Tennessee was approximately 13 million in both 1974 and 1978, slightly less than 50 percent of the total land base of the state. While some farmland will likely be diverted to nonfarm uses by 1990, strong demand for farm products, particularly soybeans, wheat and cotton, will likely attract additional acres into farm production.

2. There will be a continued decline in number of farms and an increase in farm size. Total number of farms is projected to decline to about 85,000--about 12 percent less than reported in 1978 Agricultural Census [10]. With no change in land base, farm size is estimated to increase from 135 acres (in 1978) to 153 acres.

3. There will be an expansion in the number of commercial farms (sales of $2,500 or more) and a reduction in the number of farms with sales less than $2,500. In 1978 over 33,000 farms (nearly one-third) had sales of less than $2,500. This number is projected to decline to 15,000 by 1990 due to inflation and consequent movement into the commercial classification and due to expansion and farm consolidation as operators strive to achieve the operating efficiency of larger units. A net increase is expected in the number of farms with sales of $2,500 or more due to inflation and to

expansion of smaller farms. This increase will be offset to some extent by a tendency for consolidation and size expansion of farms currently in this classification.

4. There will be a slight increase in acreage used for row crop production. With strong demand and favorable farm prices for soybeans, wheat, and cotton an incentive will exist to expand row crop acreage on existing farmland and/or to rent acreage not now being used for farm production. On the other hand, increased emphasis on soil conservation and meeting soil loss tolerance guidelines will tend to favor fewer acres for row crop and more small grain, hay and pasture. Efforts to meet soil loss guidelines are likely to result in expanded use of minimum till farm practices and perhaps to increased acreage of wheat, particularly as a double crop with soybeans.

5. Only minor shifts in tenure and organizational structure of farms are foreseen. In 1990 about two-thirds of the farm operators are expected to be classified as full owners and to use about 50 percent of the farm acreage. Part owners are expected to operate 27 percent of the farms and 44 percent of the acreage. A slight reduction in proportion of farms operated by tenants is projected. A slight increase is projected in the proportion of farms operated as partnerships and corporations. By 1990 corporations are expected to operate 2 percent of the farms and 4 percent of the acreage.

Technical Difficulties

Figures presented in the Tennessee Agriculture -- Projections to 1990 report were based on current (i.e. 1979-80) prices. While such an approach may be acceptable for prices, problems arise in estimating structural

aspects because the definition of what constitutes a farm is dependent on prices. For example, any number purporting to represent "land in farms" obviously involves some definition of exactly what constitutes a farm, and this definition is couched in dollar terms. Presently, a place which produced $1000 or more of agricultural sales was classified as a farm, and thus land in the place was added to the total "land in farms." A given place with sales of $900 in a particular year would not be classified as a farm, but it might become a farm the following year via several routes:

1. It could be amalgamated with another similar place and thus the new, larger place would have sales of $1800 per year and would be classified as a farm. In such a case, there might be no actual increase in total sales and no increase in the number of acres actually utilized for agricultural purposes. Yet there would be an increase in the number of farms, total sales and farmland acres reported.

2. The place could increase its physical volume of output via more intensive use of land, thereby generating more than $1000 in sales per year and becoming a "farm." In this case, there would be no real increase in the amount of land utilized for agricultural purposes, but the number reported as "total land in farms" would increase.

3. The place could produce a given volume of physical output year after year, but inflation could push the value of this output above the $1000 per year mark thus making this place into a farm. In this case, there would be no change in volume of inputs (including land) or outputs--just the effects of inflation.

The census definition of what constitutes a farm changes from time-to-time, mainly to account for the effects of inflation. However these changes

are not periodic or regular in any way. Thus all time-series data relating to farm numbers, sizes and distributions are based on changing definitions, presenting additional difficulties in determining trends in real variables.

Factors Affecting Structure

As suggested earlier, the structure of the agriculture sector interacts with almost every other measurement of agricultural activity. The three factors discussed below--aggregate demand, fuel prices and government policy--were chosen because they have a strong effect on structure and because they are difficult to predict. But if contributory factors cannot be accurately predicted, neither can structural changes be accurately predicted.

The level of aggregate demand for agricultural products can affect agricultural structure via several channels. A high level of demand can cause a shift of additional acres (normally unused) into agricultural production. If such a shift occurred exclusively on places already classified as farms, reported data would show no increase in land in farms, farm numbers or farm size. There exists considerable potential for such changes in Tennessee. In 1978, Tennessee had more than 8 million acres of cropland (on farms), but less than 55 percent of these acres were harvested. More than 37 percent of total cropland was used only for pasture [3]. A strong level of aggregate demand could shift much of this grazed cropland back into crop production.

However, if the increase in acres utilized for agricultural production should come from land in places not currently classified as farms, reported data would indicate an increase in agricultural land, an increase in number of farms, and a decrease in average farm size. The size distribution of

farms in Tennessee is skewed towards small farms. As indicated in Table 1, more than half of the farms reported by the 1978 Census of Agriculture were classified as noncommercial farms (those having sales of less than $2500). The skewed size distribution of farms suggests that an increase in the level of aggregate demand would result in an increase in small farm numbers--due to places not presently classified as farms gaining 'farm' status--and a decrease in average farm size.

Since the level of aggregate demand for agricultural products can affect structure, predictions concerning structure have within them implicit predictions (or assumptions) concerning demand. Aggregate demand is composed of domestic demand plus export demand. Domestic demand for most agriculture products does not shift rapidly from year to year. A major determinant of domestic demand for many consumer items is personal income. However demand for agricultural products does not follow the pattern of many other consumer products. The income elasticity of demand for agricultural products tends to be quite low [2]. Similarly the income elasticity of demand for all domestically consumed agriculture products as a group is low--.15 [9]. Accordingly a one percent change in income causes only a .15 percent change in domestic demand for farm products. A much more volatile component of aggregate demand for agriculture products is export demand. Export demand not only varies from year to year but does so in response to factors which are very difficult to predict, including world weather patterns and politics. For many years the press has reported predictions of an impending worldwide food shortage which will shift large amounts of additional resources into agricultural production. A recent U.S. State Department bulletin suggests that grain imports by developing countries will increase from 45 million tons in the mid 1970's to 90 million tons by the year 2000 [14]. In 1976

the U.S. exported 79.4 million tons of grain, which was 31 percent of total U.S. production [10] and 59 percent of total world trade in grains [13]. If it is assumed that U.S. consumption and U.S. exports to developed countries each increase by one percent per annum to the year 2000, and that the U.S. supplies a constant 59 percent of developing country needs, there will be a demand for U.S. grain production in the year 2000 of 442 million tons, an increase of 71 percent over 1976 production which was a record year.

If demand for agricultural products is measured by some indicator of physical need, such demand is quite high today. But as long as the present system of international trade exists, demand, to be effective, must be expressed in monetary terms--i.e. those who want the food must be able to pay for it. This requirement tends to curb effective demand for agricultural products at present. However the same State Department bulletin quoted above goes on to stress the need for additional concessional sales of grain to those countries which cannot buy on the open market. Thus politics, or politics combined with weather, could greatly increase short run effective demand.

Present agricultural exports are dominated by five products--wheat, corn, tobacco, soybeans and cotton [10]. Only one of these crops (wheat) is relatively unimportant to the Tennessee agricultural sector. And should world demand for wheat increase, this increase could have secondary effects on the Tennessee agricultural sector as land elsewhere in the U.S. is converted to wheat production thereby increasing the potential for Tennessee to supply the demand for products which are no longer produced elsewhere and are suitable for production in Tennessee.

To summarize, any prediction relative to the structure of the Tennessee agricultural sector makes implicit assumptions concerning the level of aggregate demand for agriculture products. This aggregate demand for agriculture products is subject to large variations due to largely unpredictable factors.

A second major factor affecting the structure of the agricultural sector is the cost of fuel. For many years the costs of labor increased more than the cost of fuel, thus encouraging farmers to substitute machinery for labor. However recent years have seen fuel price increases exceed labor price increases. Fuel use in agriculture is closely related to machinery stocks which are fixed in the short term and still somewhat fixed in the medium term. Thus, a priori, one would expect the labor/fuel usage ratio (in physical terms) to change slowly. And such has been the case. Fuel prices increased by 74 percent from 1973 through 1977 while labor prices (wages) increased by only 43 percent [10]. Though there has been no large shift towards more labor intensive production methods to date, if fuel price increases continue to exceed wage increases, shifts towards the use of more labor should be expected. Relative to agriculture sector structure, a shift towards more labor intensive production practices would tend to favor smaller farms. While such a shift would require less financing of capital equipment, it would result in a higher rural population and thus increased financing of consumer goods in rural areas.

A second effect of increasing fuel costs will be to limit the movement of nonfarm workers into rural residences. Such movements result from one of two instances; either a single family moves into a rural area for life-style preferences, or a factory or industry moves into a rural area bringing

its labor force along with it. Higher fuel prices will tend to make industry locate closer to population centers and major transport routes, and individual families locate nearer to their places of employment. And to the extent that the use of farmland for rural residences decreases, price increases of farmland should be mitigated.

The third effect of increasing fuel prices on the structure of the agricultural sector will be due to increasing costs of transporting both agriculture products and other consumer products to consumers. Increasing transport costs will tend to make production of bulky items shift to locations near population centers and will also tend to make living costs rise sharply in isolated rural communities. Such shifting production patterns will probably be felt more intensely in central and western parts of the U.S. rather than in the southeast section.

Government policy changes can become major determinants of agricultural sector structure via direct action, indirect action and/or incidental action. During the past two years U.S.D.A. has played a major role in discussions of the merits of direct legislative attempts to alter or direct the evolution of structural change in the agricultural sector [8, 11, 12]. If the case for such legislation were clear cut, then predicting eventual structural changes might be less hazardous, but both the necessity and the feasibility of attempting direct manipulation of structure are open to question [15, 5]. Thus USDA's forays into the possibility of direct structural manipulation have taken on distinct political overtones [7]. This leaves the question of direct policy action to alter structure as a major imponderable for those who wish to predict future agricultural structure. Examples of government actions which indirectly, but not intentionally, affect agriculture

structure are easy to find. One such example which is important in Tennessee is the tobacco program. This program has provided high returns to growers of tobacco and has tied production rights to specified plots of land. Allocation of production rights was based on actual production patterns in the 1930's, a time when small farms were common. The result of this has been to assist the survival of these small farms under conditions which would otherwise have favored either their amalgamation or shifts into alternative (perhaps nonagricultural) uses. In 1974, of the 61,577 farms that grew crops, 34,419 (55.9 percent) grew tobacco and 41.7 percent of these tobacco farms classified as noncommercial. Revenue from tobacco sales accounted for only 18.6 percent of total crop revenue on commercial farms, but it accounted for more than 63 percent of the revenue on noncommercial farms [4]. Thus, a predominant feature of the structure of the Tennessee agriculture sector today--the large number of small farms which exist mainly in eastern portions of the state--is, at least, in part, a direct result of government policy. While the tobacco program was not enacted for the purpose of manipulating structure, the effect of the program has been to alter structure. Burley tobacco quotas are now negotiable within counties. Further relaxation of supply controls on tobacco--and particularly the separation of quotas from land ownership rights--could have significant effects on the continued viability of many small Tennessee farms and thus on agriculture sector structure. While such relaxation is possible, its particular form and timing are difficult to predict.

Government policies relative to environmental factors have already had a measurable impact on the agricultural sector and may have a much greater impact in the future. Such policies are not aimed specifically at the agriculture sector and are not intended to deal with problems of commercial

agricultural production. Nonetheless, because agricultural production interacts directly with the natural environment, the burden of environmental regulation falls heavily on this sector. The two areas of environmental regulation which relate most strongly to Tennessee agriculture are chemical usage and erosion. The results relative to agriculture sector structure of future increases in government regulations in these two areas would likely be mixed. Increased restrictions on chemical usage might force farmers to attempt to substitute other inputs for chemicals. This could lead to increased labor usage and perhaps smaller farms. On the other side, if increased government regulation of chemical usage and tillage require additional farmer investment in capital equipment, smaller farms might not be able to economically justify the required purchases, shifting the farm size distribution in favor of larger size farms. Consideration of probable shifts in regional cropping patterns in response to increased government regulation further clouds the crystal ball used to view structural change in agriculture.

Rates of Change

A major constraint to accurate economic forecasting is that of estimating future rates of change in key variables. General trends in many of the items discussed above can be predicted with some degree of surety; i.e., fuel costs probably will increase, tobacco supply-control regulations probably will be relaxed, and increasing populations abroad probably will result in strong demand for U.S. exports of agricultural products. But the real problem comes when a specific date is placed on projections. Then projections must be couched in time-specific terms; i.e., how much will fuel costs rise

by 1990; will Congress change tobacco programs, and if so, when; and what will be the export demand price for wheat in 1990? Furthermore, given that these estimates are made, how long will it take for such changes to have how much of an effect on agriculture structure? Shortrun projections allow limited time for these changes to take place and to thus foil estimates. Long-run projections--for instance, for the year 2025--have two advantages; (1) it can be assumed that most trends visible today will have had time to work themselves out by the year 2025, and (2) it is unlikely that anyone in the year 2025 will remember projections which are made today anyway. Projections for the intermediate-run (such as the 1990 Agriculture Projections) must attempt to estimate where each of a large number of trends or changes will be during a particular point in future time. But despite the difficulty inherent in medium-run estimates, it is these estimates which can be of most interest to planners.

Implications for Financial Institutions

We appear to be, at present, in a period of potentially large changes for the agriculture sector. A number of important and longstanding trends show signs of either slowing or perhaps even reversing themselves. The migration from the farm to the city must soon end because there simply aren't that many farmers left to migrate; relatively cheap energy appears to be a thing of the past and the established trend of substituting energy-using capital for labor will likely slow, if not reverse; environmental disregard may have brought us to a point at which increasing governmental regulation is required; world population levels may be approaching a level which will increase the importance of the U.S. as a world food supplier.

Two conflicting developments of the above have important implications for financial needs in agriculture. Any large shift in agricultural production techniques will require additional investment and financing. This is true for crop- and/or operation-specific changes, for changes in the organization of individual farms, and for changes in the system as a whole. New, more efficient methods to fit changing economic conditions will be adopted and will require new capital and infrastructure expenditures--i.e. long-term investments.

Changing conditions offer expanded opportunities for investment capital. However, the inability to accurately predict the future structure of the agricultural sector means that many farm-level changes which will eventually prove wise are not now apparent, either to farmers or to financial institutions. A time of rapid change in any segment of society reveals some successful operators and some units that go broke. The changes which require adaptation also result in additional risk to long-term investments. The additional risk involved in long-term financing during unsettled times will tend to cause financial institutions to favor short-run financing at a time when the industry needs increased long-term credit. Just as the successful farmers of the future will be those who devise new methods of overcoming emerging problems, successful lending agencies of the future will be those that change with the times to develop novel procedures which funnel needed funds to these successful farmers.

Table 1. Number, Size and Distribution of Farms, 1990 Projections[a] with 1978 Comparisons[b]

	1978	Projected 1990	Change 1978-1990
			-percent-
All farms -			
Number of farms	96,792	85,000	-12
Land in farms (000 acres)	13,092	13,000	- 1
Average size (acre)	135	153	+13
Farms with less than $2,500 sales -			
Number of farms	33,420	15,000	-55
Land in farms (000 acres)	1,882	600	-68
Average size (acre)	56	40	-29
Farms with sales of $2,500 or more -			
Number of farms	63,372	70,000	+10
Land in farms (000 acres)	11,210	12,400	+10
Average size (acre)	177	177	--

[a]Preliminary estimates.

[b]Assuming no change in farm definition and continued inflation rates of 7-8 percent.

Source: Klindt, T. A., Wm. M. Park, Neal Walker and Luther Keller, "The Farm Sector," Preliminary 1990 Projection Report, Department of Agricultural Economics and Rural Sociology, University of Tennessee, Knoxville, October 1980.

Table 2. 1990 Projected Farm Land Use for Tennessee with 1978 Comparisons (000)

	1978	1990	Change 1978-1990
			-percent-
Total land area, acres	26,450	26,450	--
Land in farms, acres	13,092	13,000	-1
Row crops, acres	3,540	3,600	+2
Total cropland, acres	8,007	8,000	--
Cropland harvested, acres	4,477	4,500	--
Cropland pasture, acres	3,011	2,800	-7
Woodland, acres	3,500	3,500	--

Source: Klindt, T. A., Wm. M. Park, Neal Walker and Luther Keller, "The Farm Sector," Preliminary 1990 Projection Report, Department of Agricultural Economics and Rural Sociology, University of Tennessee, Knoxville, October 1980.

Table 3. Farm Operator and Tenure Characteristics, Farms with Sales of $2,500 or More

Characteristic		1978 (%)	1990 (%)
Farms and land operated by -			
Full owners:	Farms	64	65
	Acreage	NA[a]	50
Part owners:	Farms	27	27
	Acreage	NA	44
Tenants:	Farms	9	8
	Acreage	NA	6
Farms and land by type of organization -			
Individual of family:	Farms	87	85
	Acreage	NA	78
Partnerships:	Farms	12	13
	Acreage	NA	18
Corporations and other:	Farms	1	2
	Acreage	NA	4

[a]Not available.

Source: Klindt, T. A., Wm. M. Park, Neal Walker and Luther Keller, "The Farm Sector," Preliminary 1990 Projection Report, Department of Agricultural Economics and Rural Sociology, University of Tennessee, Knoxville, October 1980.

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