A TYPICAL FARM SERIES: DEVELOPMENT AND APPLICATION TO A MISSISSIPPI DELTA FARM

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Economic analyses of typical farms are often useful in applied agricultural research, because agricultural policymakers and analysts have a particular need for information on policy impacts and indicators of well-being at the farm level. Variables influencing the economic environment in which farms operate can be identified and their impacts on farming units assessed. This information is also useful in monitoring the economic performance of farms. ERS/USDA has developed twenty typical or representative farms whose characteristics are defined in an objective and consistent manner to meet these demands.

Historically, typical farms have had an intrinsic appeal for comparative-static analyses and for descriptive reports. If properly specified, the use of composite farms can save research resources and permit inductive research for a wider range of farms. The specification of a typical farm is not an easy task, and is often associated with the concept of a mean or a mode. For example, an average farm size would represent the mean of all farms in the population, but would not necessarily be a close approximation of any specific farms. An alternative is to define the typical farms so that they approximate the greatest number of real farms. This can be accomplished by choosing modal intervals from marginal distributions of the decision criteria variables.

This paper discusses (1) the role of typical farms in agricultural research; (2) specifies the procedure used in developing the farms; (3) presents preliminary descriptions of farm sizes and enterprise mixes for twenty farms; and (4) presents 1980 financial information for the Mississippi Delta cotton-soybean farm. Costs and returns, and an analysis of the impacts of alternative product prices and yields on the well-being of the farm are included.

TYPICAL FARMS IN AGRICULTURAL RESEARCH

The concept of a typical farm has been used since the late twenties and early thirties. Typical farms provide such information as (1) typical sizes in different regions; (2) the most common mix of enterprises; (3) combinations of capital items required for production; and (4) financial measures of the economic well-being of farm firms.

Agricultural policy researchers have employed typical farms in determining the impacts of alternative programs on specific types of farms (U.S. Department of Agriculture, 1978a). Typical farms analyses can also provide information for descriptive studies concerning the financial health of farms in the sector (Jensen et al.), and can measure the efficiency of resource use in a micro-economic environment (Miller et al.). Typical farms are of limited use in determining aggregate impacts of different policies and programs.

The most recent set of typical farms developed by the U.S. Department of Agriculture was for the 1976 crop year (Strickland and Fawcett). Data on the farms were not widely distributed and were used mainly for internal research in the department. The limited use of early department typical farm data resulted from a number of problems—principally, the lack of a consistent procedure to define the farms across regions, and the lack of a data source that would provide detailed information on sizes of farms and mixes of enterprises.

Recent improvements in ERS access to census data provided the incentive to develop a standardized procedure to define the physical characteristics of typical farms and to derive associated costs and price information. These improvements have made the new set of typical farms a more defensible source of data for agricultural research.

PROCEDURE FOR DEVELOPING TYPICAL FARMS

A three-step procedure was followed in developing the twenty typical farm descriptive data sets. First, relevant farm types and production regions were identified. Second, farm characteristics such as size, and the mix of crop and

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livestock enterprises were derived from census data for each farm. The final step consisted of creating budgets for each of the enterprises and aggregating them into a whole farm budget.

Farm Types. The selection of farm types and number of typical farms was the area of greatest relative subjectivity. A major consideration was to emphasize those farms growing crops covered by federal commodity programs, and thereby enhance policy analysis capability. A second objective in selecting farm types was to have a farm for each major commodity located in areas with different production technologies and cost structures. An example of this was the selection of cotton farms in California, Arizona, and Mississippi. The farms were always developed around a primary commodity—the first one listed for each farm in Table 1. Because of the indirect influence of government programs, only a few livestock operations were included in the initial set of farms.

The geographic locations of the typical farms were chosen using the 1974 Census of Agriculture rankings of counties by commodity (U.S. Department of Commerce 1978b). The location of a representative farm was established when five ranked counties fell within an area used for the U.S. Department of Agriculture cost of production estimates (Boundaries for these areas are on the map in Figure 1). The Arizona cotton farm and the Montana wheat farm were the only exceptions to this rule because of large county sizes. They were chosen even though the locations encompassed fewer than five counties.

Farm Characteristics. Farm level respondent data from the 1978 Census of Agriculture were analyzed to determine the modal farm size and the most common enterprise mix. Data from the five ranked counties were placed in separate files by census personnel, and modal characteristics were estimated, using the Census Typical Farm Program (CTFP) (Hatch), a system developed specifically for this task. The system consists of a number of sub-routines, which perform a series of sequential data sorts. A new data file was created whenever the farm data in a file were identified and selected by the CTFP. The CTFP used the following steps to define the crop farms:

(1) Process all of the farm data in the five-county area, select and place in a new file only those farms growing the primary commodity.
(2) Derive a frequency table of total cropland acres and determine the farm size interval containing the most total acres of the primary commodity (the modal interval). A second check of the file was made in order to select the farms falling within the determined interval.
(3) Determine the most common crop mix by deriving a joint distribution of crop acres

TABLE 1. Description of the Twenty USDA Typical Farms

Location	Acreage		Enterprise	Units
Arkansas	cropland	640	soybeans-irrigated	200
	total land	720	soybeans-non-irrigated	180
			rice-irrigated	260
Arizona	cropland	760	cotton-irrigated	760
	total land	910		
California	cropland	440	cotton-irrigated	440
	total land	640		
California	cropland	0	milk cows [a]	350
	total land	20		
California	cropland	480	rice-irrigated	480
	total land	680		
Georgia	cropland	520	peanuts	80
	total land	720	soybeans	220
			corn	220
Illinois	cropland	360	corn	180
	total land	380	soybeans	180
Iowa	cropland	320	fed cattle [a]	120
	total land	360	corn	200
			soybeans	100
			alfalfa	20
Iowa	cropland	240	pigs [b]	100
	total land	300	corn	140
			soybeans	60
			oats	40
Kansas	cropland	480	wheat	360
	total land	580	alfalfa	80
			sorghum	40
			beef cows [a]	15
			stockers	30
Louisiana	cropland	480	rice-irrigated	160
	total land	520	soybeans-dryland	320
Minnesota	cropland	320	corn	160
	total land	340	soybeans	160
Mississippi Delta	cropland	1,040	cotton	480
	total land	1,280	soybeans	560
Montana	cropland	1,920	wheat	780
	total land	2,140	barley	180
			fallow	960
Nebraska	cropland	480	sorghum	240
	total land	560	wheat	120
			alfalfa	120
New York	cropland	160	milk cows [a]	50
	total land	300	alfalfa	30
			other hay	50
			corn	20
			corn silage	30
			pasture	30
North Dakota	cropland	760	wheat	320
	total land	960	fallow	320
			barley	120
Texas	cropland	680	cotton-irrigated	680
	total land	780		
Washington	cropland	1,080	wheat	540
	total land	1,280	fallow	540
Wisconsin	cropland	160	milk cows [a]	45
	total land	180	alfalfa	60
			green chop	20
			corn	30
			corn silage	30
			oats	20

[a] Number of head.
[b] Number of litters.

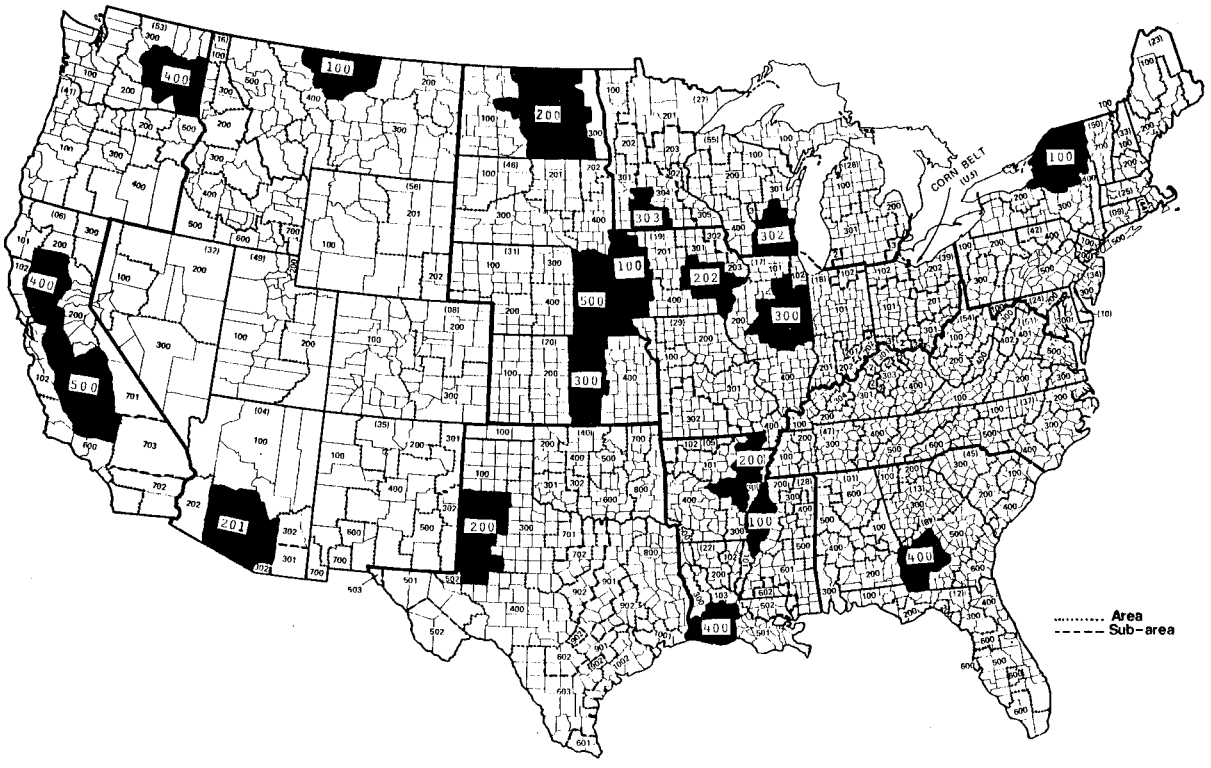

FIGURE 1. Location of Twenty Typical Farms in the United States

for up to three crops. Farms growing the most common crop mix were again placed in a new file.

(4) Process these remaining farms to identify numbers of tractors, combines, trucks, labor use, and any other items reported in the census questionnaire.

This determination of farm size and crop mix using census data eliminated a methodological weakness of earlier typical farm research, i.e., the lack of a standardized procedure for defining the size and enterprise mix for each of the farms.

Cost Information Derivation. The last step in defining the twenty typical farms was to specify input and product prices and quantities, and to derive a specific machinery complement for each of the farms. Enterprise budgets are based on Costs of Production (COP) surveys conducted by ERS (U.S. Department of Agriculture, 1978b). Respondent data from the Cost of Production Survey were also used to derive machinery complement information for the typical farms. Farm data from state survey files were searched in an effort to identify farms of approximately the same size, and having a similar crop mix to the farms defined with census data. In most instances, ten to thirty farms were reasonably close approximations. Averages for numbers and sizes of machines were computed from these survey farms, with emphasis placed on the primary enterprise. Other machines were added as required by any secondary enterprises. Representative machinery complements were determined, using the number of tractors, combines, trucks, and other self-propelled machinery derived from census data and the size information from the COP data.

Standard budgeting procedures were used to determine machine costs. A preliminary analysis was required to determine the hours of annual use for the machines on the typical farms. However, in this study, machinery values were determined differently from previous budget studies. The previous estimation procedure was first to value the machinery complement at current new prices and then lag these values over four years to reflect an average length of ownership. The new procedure used in this paper directly estimates the total value of the machinery complement through regression analysis on census data (Hatch et al.).

MISSISSIPPI DELTA COTTON-SOYBEAN FARM

The financial information on the typical farms includes annual income statements and balance sheets. These two financial statements are presented for the Mississippi farm for 1979, 1980, and 1981 in Tables 2 and 3 respectively. Other data are also available from the typical farm computer

TABLE 2. Income Statement for a Full Owner Farmer Under Two Different Equity Situations, 1979–81

Item	1979		1980		1981	
	Full Equity	Minimum Equity[a]	Full Equity	Minimum Equity[a]	Full Equity	Minimum Equity[a]
Cash Income						
Crop Receipts	$311,007	$311,007	$251,497	$251,497	$261,010[h]	$261,010[h]
Cash Farm Expenses						
Seed	8,513	8,513	7,195	7,195	9,932	9,932
Fertilizer	10,812	10,812	13,335	13,335	15,230	15,230
Ag chemicals	37,930	37,930	40,352	40,352	52,950	52,950
Fuel and lube	15,647	15,647	21,275	21,275	25,201	25,201
Machinery repairs	32,300	32,300	35,844	35,844	40,274	40,274
Farm services[b]	24,608	24,608	17,259	17,259	23,588	23,588
Personal property taxes	950	950	950	950	1,093	1,093
Wages for hired labor	16,242	16,242	16,242	16,242	18,686	18,686
Insurance	806	806	895	895	1,006	1,006
Interest on operating capital[c]	4,276	4,276	5,683	5,683	9,059	9,059
Interest on intermediate debt[c]	0	15,804	0	9,125	0	5,533
Interest on real estate debt[d]	0	109,435	0	53,648	0	26,487
Principal on real estate debt[e]	0	4,928	0	2,426	0	1,138
Other costs[f]	14,156	14,156	12,669	12,669	16,233	16,233
Total cash expenses	166,240	296,407	171,700	236,897	213,252	246,410
Net Cash Farm Income	144,767	14,600	79,798	14,600	47,758	14,600
Non-cash Expenses						
Depreciation-machinery	18,049	NA	20,030	NA	22,505	NA
Total Net Farm Income	126,718	NA	59,768	NA	25,253	NA
Allocations of net farm income						
Family labor (-)	1,661	14,600	1,744	14,600	1,911	14,600
Operator labor (-)	7,528	NA	7,906	NA	8,661	NA
Management (-)[g]	19,348	NA	20,138	NA	24,633	NA
Total Allocations	28,537	14,600	29,788	14,600	35,205	14,600
Return to Equity	98,181	NA	29,980	NA	-9,952	NA

[a] Minimum equity is defined as that level of equity for which interest and principal payments exactly exhaust any positive return to equity.

[b] Ginning cost of cotton.

[c] An interest rate of 10.2% is assumed in 1979, 14.5% in 1980, and 15.3% in 1981.

[d] An interest rate of 9% is assumed in 1979, 11% in 1980, and 11.1% in 1981 on a 30-year loan with the loan in its first year.

[e] The principal payment is 4.5% of the mortgage payment.

[f] General farm overhead.

[g] Management is assumed at 10% of total nonland costs.

[h] State average yields were used due to the unavailability of local yields at the time of submission.

program that separates input costs and income by crop, labor use by month, and provides a list of the machinery complement.

The income statements and balance sheets in Tables 2 and 3 present information estimated for the typical farm in an easily understood and standardized format for two equity levels on a fully owned farm. The full equity analysis, presented in the first column for each year, assumes that the operator owns all assets debt free. A standard income allocation procedure is used for non-cash expenses, and operator and farm family labor, management, and risk. The full analysis reflects the long-run situation in which farm income is used to pay both cash and non-cash expenses, and residual income is classified as return to equity.

The "minimum equity" analysis is presented in the second column for each year. The minimum equity (maximum debt) situation illustrates the financial status of the farm from a short-term viewpoint. The maximum amount of debt on land and machinery that the operator could carry is based on current-year cash income net of cash expenses and an allowance for family living.[1] The maximum interest and principal payments on a land mortgage and indebted machinery assets are calculated to exhaust exactly the residual net cash income above family living costs. It is assumed in this latter situation that land and machinery assets are carried at the same level of indebtedness. This concept of debt-load capacity is valid only in the short run and reflects a "worst-case" income scenario for the farm.

Selected data from Tables 2 and 3 are given in

TABLE 3. Balance Sheet for the Mississippi Delta Typical Farm for a Full Owner Under Two Equity Situations, 1979–81

Item	1979		1980		1981	
	100% Equity	Minimum Equity[a]	100% Equity	Minimum Equity[a]	100% Equity	Minimum Equity[a]
Assets						
Land and buildings[b]	$1,398,617	$1,398,617	$1,533,656	$1,533,656	$1,463,944	$1,463,944
Machinery	178,275	178,275	197,836	197,836	222,287	222,287
Total Assets	$1,576,892	$1,576,892	$1,731,492	$1,731,492	$1,686,231	$1,686,231
Liabilities						
Land debt	0	$1,215,924	0	$487,703	0	$238,623
Machinery debt	0	154,921	0	62,912	0	36,162
Total Liability	0	$1,370,845	0	$550,615	0	$274,785
Net Worth	$1,576,892	$206,047	$1,731,492	$1,180,877	$1,686,231	$1,411,446
Debt/Asset Ratio	0.000	0.869	0.000	0.318	0.000	0.163

[a] Minimum equity is defined here as that level of equity for which interest and principal payments exactly exhaust any positive return to equity.

[b] 1,280 acres at an average $1,093 per acre in 1979; $1,198 per acre in 1980; and $1,144 per acre in 1981.

[1] The 1975 non-metropolitan median income for Mississippi (U.S. Bureau of Census, 1978a) was indexed to 1980 using the CPI.

TABLE 4. Measures of Farm Financial Position for the Mississippi Delta Typical Farm with Alternative Equity Situations, 1979–81

Farm Situation	1979 Product Prices and Yields	1980 Product Prices and Yields	1981 Product Prices and Yields
Full Equity			
Net Cash Farm Income($)	144,767	79,979	47,758
Depreciation Allowance($)	18,049	20,030	22,505
Allocation for Family and Operator Labor and Management($)	28,537	29,788	35,205
Return to Equity from Current Income($)	98,181	29,980	-9,952
Percent Return to Equity	6.23	1.73	-0.59
Debt/Asset Ratio	0.00	0.00	0.00
Minimum Equity			
Net Cash Farm Income($)	14,600	14,600	14,600
Depreciation Allowance($)	0	0	0
Allowance for Family Living($)a/	14,600	14,600	14,600
Return to Equity from Current Income($)	-32,086	-35,218	-57,710
Percent Return to Equity	-15.57	-2.98	-3.05
Debt/Asset Ratio	0.869	0.318	0.163

[a] Median family income in Mississippi in 1980 was $14,600.

Table 4. Table 4 illustrates the rapidly changing financial position of the farm from 1979 through 1981. Receipts decreased substantially in 1980 from 1979, and then slightly decreased again in 1981. Cotton and soybean yields fell sharply in 1980, and lower prices in 1981 offset more than normal yields. Nevertheless, cash expenses rose from $166,240 in 1979, to $213,252 in 1981 (more than 28 percent) for the full equity farm. Cash incomes available to be allocated to farm income and depreciation consequently fell from $144,767 in 1979, to $47,758 in 1981, a decline of more than 67 percent. The percent return on equity for this farm, under debt-free ownership, varied from 6.23 percent in 1979 to −0.59 percent in 1981.

The relationship between cash farm income and the maximum debt that can be serviced is also illustrated in Tables 3 and 4. In 1979, the operator could service almost $1.4 million debt from current cash income. By 1980, the same operator could pay only interest and principal payments on $.55 million debt and $.27 million debt in 1981. These debt levels correspond to debt-to-asset ratios of 0.869, 0.318, and 0.163 in 1979, 1980, and 1981, respectively. Mississippi farmers who significantly expanded their farms, as a result of favorable conditions in 1979 and earlier, or who entered the 1980s with high debt levels, faced severe cash flow problems in 1980 and 1981.

SUMMARY AND CONCLUSIONS

Farm level impacts of alternative economic environments and agricultural policies can be evaluated through the use of Typical Farm Analyses. Twenty typical farms have been presented that will be monitored as an ongoing research function in ERS/USDA. These farms have been objectively and consistently defined, using a multi-stage estimation process. In some circumstances, farm characteristics were established, using the subjective judgment of the authors when modal sizes, enterprise, and machinery mixes were not readily apparent after repetitive data analyses were conducted.

A comparative static analysis was performed for a Mississippi cotton-soybean farm, using data for 1979–1981. This farm situation was examined in detail to demonstrate the usefulness of the typical farms data for assessing the financial strength of full equity and minimum equity farm situations. The analysis demonstrates the increasing financial pressure accumulating on a typical operator as a result of low prices, low yields, or a combination of both factors. Although the typical farm situations may not be representative of every farming situation, their geographical and technological homogeneity and derivation from census data provide adequate assurance of their credibility in applied agricultural research.

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