A Preliminary Look at the Potential for Increasing Both Food and Fiber Production in the Southeast Via Land Use Conversions

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by

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INTRODUCTION

The Center for Agricultural and Rural Development (CARD) is developing a model to examine land use changes and their associated environmental and economic implications for the Southeast region of the United States.[1] The model will be built as if there were two regions in the U.S. One region is the Southeast[1] with the other region containing the remainder of the 48 contiguous states. The driving force within the model will be assumed levels of demand for, or prices of, various agricultural and silvicultural products on a market region and national level. The CARD Southeast model will be a cost minimization linear program. It will allocate the land resources of the nation to alternative uses to produce the specified levels of crop, forest, and pasture/range products. The model will also incorporate constraints such as allowable erosion levels, regional shifts in production, and levels of government policy variables.

The basic hypothesis of this research is that future changes in national, including exports, and regional demand levels will cause substantial acreages of land in the Southeast to be converted to an alternative use. Such conversions could also occur as a result of government policy decisions. The land use conversions to be included in the Southeast are all directions between forest, crop, orchard, idle and pasture or range, and dryland to irrigated. In the remainder of the

[1]The states included in Southeast region are Alabama, Arkansas, Florida, Georgia, Louisana, Mississippi, North and South Carolina, Tennessee and Virginia, and small parts of Oklahoma and Texas.

nation allowable conversions will be forest and pasture to crop and dryland to irrigated. The model will be an extension of current CARD national models by including for the Southeast the land conversions noted above. Also the crops of apples, citrus, peaches, pecans, sweet-corn, tomatoes, tobacco, sugarcane, rye, rice, and sweet and irish potatoes will be included in the endogenous rather than exogenous crop sector for selected states as shown in Appendix 1. An overview of the model process is given in Figure 1.

The model will focus on the Southeast's unique economic contribution to and interaction with the remainder of the U.S. This paper will outline some of the production potential and natural resource use problems of the Southeast.

POTENTIAL AND PROBLEMS IN THE SOUTHEAST

Cropland

In 1975 the Soil Conservation Service (SCS) conducted a nationwide survey of the potential for adding to the nation's cropland. The Southern part of the U.S. was found to have a large amount of such land. The data on that region are summarized in Table 1 [Lee, 1978, p. 6]. Lee [1978] criticized the data in Table 1 and explained how the high, medium, and low classes are broken down into categories according to type of development needed. The categories are conversions possible through action by 1) individual farmers, 2) formal or informal cooperation between neighbors or groups of farmers, and 3) project actions requiring the cooperation of Corps of Engineers, Bureau of

Figure 1 Overview of the Southeast Model Process

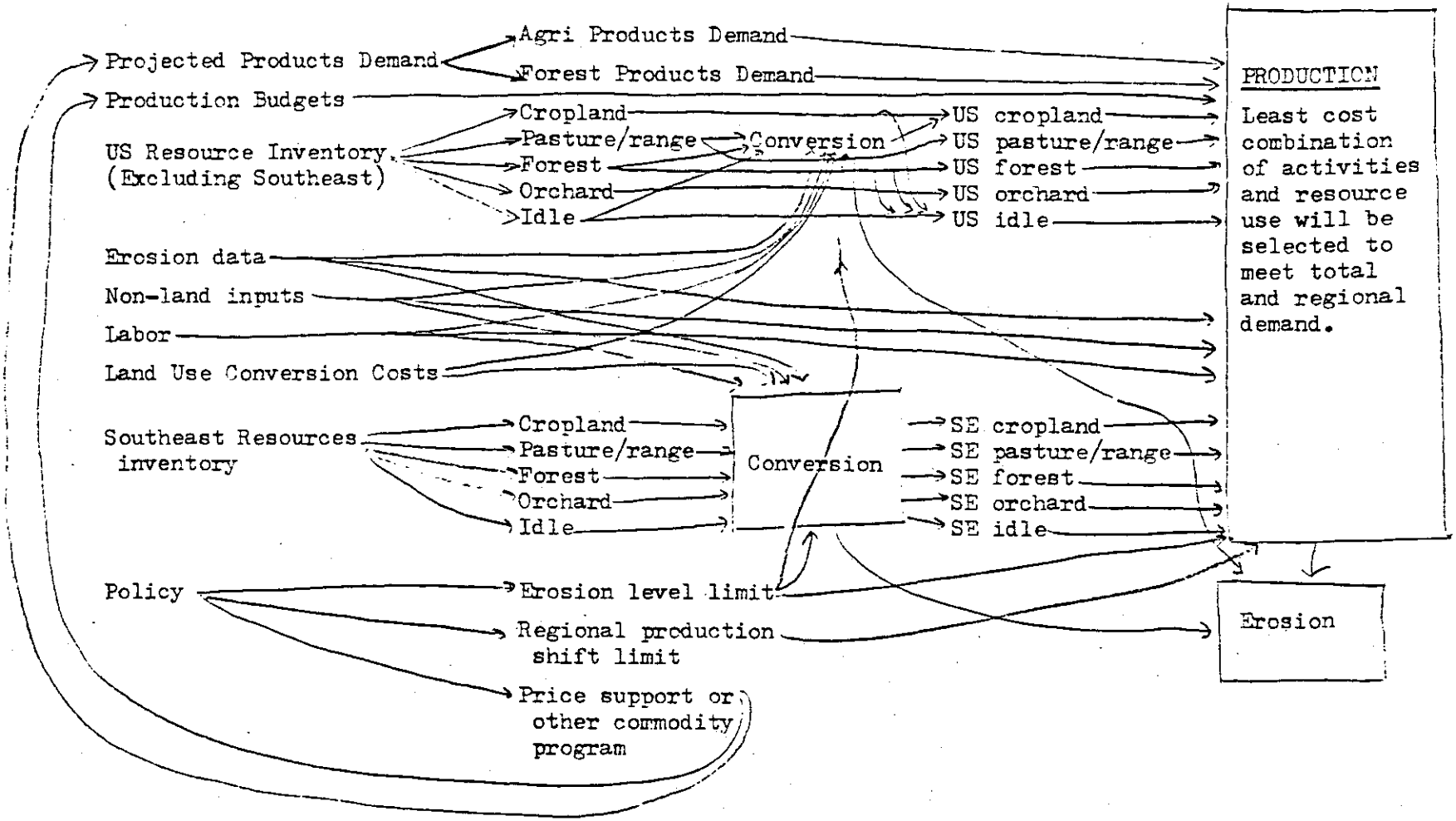

Table 1. Potential cropland in Southern United States by region and development needed.

Potential	Development necessary	Appalachian	Delta	Southeast
		----------1,000 acres----------		
high:	None	4,969	2,896	1,991
	On-farm	4,103	4,121	8,191
	Multi-farm	232	70	183
	Project	171	272	26
	Total	9,474	7,359	10,391
Medium:	None	255	433	366
	On-farm	1,679	2,504	6,946
	Multi-farm	145	111	450
	Project	26	224	679
	Total	2,105	3,272	8,441
Low:	None	1,488	881	519
	On-farm	19,021	19,094	27,270
	Multi-farm	2,388	1,261	1,810
	Project	570	4,275	5,401
	Total	23,467	25,511	35,000

Reclamation or SCS programs. That breakdown illustrates that the concept "potential cropland" must be interpreted carefully. Economic and non-economic factors leading to conversions and physical constraints must be carefully considered.

Another aspect of the Southeast's cropland potential is the past and present rate of cleared farmland development. Hart [1978] indicates that the major pattern of land use change in the South has been one of abandonment of poor land, because of productivity, steepness, or yield size, and specialization and concentration of harvested crops on the good land. That process has resulted in "islands" of harvested

crops separated by wide expanses of woodland. Hart gives the following facts:

1. A large number of counties had less than five percent of their land in crops and only one county in four had as much as one-sixth of its total area in harvested cropland in 1974.
2. The counties which had one-sixth or more of their land in harvested cropland accounted for only 26% of the total area of the 10 southern states in 1974, but these counties had 62.9, 75.3, 76.8, 80.4, and 93.5 percent of the harvested cropland, peanut acreage, soybean acreage, cotton acreage, and rice acreage, respectively.
3. Within the South during the period 1939 to 1974:
   a. acreage of rice nearly tripled;
   b. sugarcane acreage declined slightly;
   c. acreage of cotton and tobacco dropped by more than one-half.
   d. peanut acreage dropped by nearly two-thirds;
   e. a total decline of nearly eight million acres total for the above five traditional crops was offset by an increase of nearly 10 million acres in soybeans;
   f. the total area of cropland harvested reached a peak of 59 million acres in 1939, dropped to 36 million acres in 1969, and climbed to 38 million acres in 1974.

In his 1978 article Hart contends that his research on land use change concludes that the loss or abandonment of cropland in the south has been due to Mother Nature rather than federal government policies.

However, in other articles [1968, 1980] Hart states that government programs such as Soil Bank, acreage allotment, voluntary set aside, and commodity price support have had an impact. Hart also cites the decline of a locally important crop such as cotton or dark-fired tobacco as having great local impacts. Hart [1980] also discusses how the difficulty of a farmer acquiring additional land as family income needs increase leads farmers to leave their small pieces of land and take off-farm employment.

In conclusion, there is potential cropland in the South but many factors must be considered. A modeling process of future land change must consider required minimum economical field size, marketability of crop, land parcel ownership, allowable soil erosion levels, etc. Further, parts of this paper, discussing other potential uses of this Southern land base, will provide additional insight to the complexity of potential land conversions.

Pine Reforestation and Establishment

A conclusion of the USDA Forest Services' 1980 Resource Planning Act Assessment is that consumption of softwood roundwood in the U.S. will increase by 60 percent by the year 2000 and that the National Forest resource will not be capable of meeting that increase [Bell and Randall, 1982]. Also predicted is that the increased demand will cause stumpage prices to double. Hardwood demand is also estimated to double by the year 2000 but supply is predicted to keep prices from rising. Haymond [1983] states that the South currently provides 45% of the

nation's softwood and that southern forests will be called on to supply 55% of the doubled demand predicted for the year 2030.

Private landowners control a major portion of land in the Southeast. To emphasize the potential role of the private sector in meeting the increased demand for forest products the following facts by Williston [1979] are given:

1. There are 201,514,800 acres of commercial forestland in 13 southern states.[1]
    a. Independent landowners hold 72.8 percent of the total.
    b. They own 66 million acres of the forest in the pine timber type.
    c. They own 56 million acres of the forest in the oak-hickory type of which about one-half has soil and moisture conditions better suited to growing pines than hardwoods.
2. In 1976 the South produced 31, 37, and 76 percent of the nations softwood lumber, softwood plywood, and softwood pulpwood, respectively.
3. The regions net annual volume growth of softwood exceeds the drain by 45 percent and saw timber growth exceeds the drain by 30 percent.
4. Despite the current situation a shortage of softwood in 15-20 years could be pending.
    a. In the five southeastern states--Virginia, the Carolinas, Georgia, and Florida--one half of harvested pine stands are not being regenerated with pine. Such stands, left to

[1]The 13 states are Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North and South Carolina, Oklahoma, Tennessee, Texas, and Virginia.

natural regeneration, go to pine-oak and then or oak-hickory. The result is an average annual loss of roughly 50,000 acres of pine type forest.

b. The average annual of 788,000 acres of pine planted on private non-industrial land each year during the Soil Bank period of 1957-1961 had declined to 200,000 acres per year by 1970 and only reached 273,000 by 1977 under alternative government programs.

c. Recent studies in Louisianna and Mississippi reveal that only 56 and 53 percent of the landowners consider the primary use of their forests to be timber growing. Many understand that timber growing is profitable but either don't understand the process or think it conflicts with other ownership goals.

A USDA study team led by Fedkiw [1983] investigated whether or not and to what extent it would be economically feasible to convert low productivity southern cropland to southern pine plantation. Based on 1979 average prices and cropping patterns it was found that a maximum of 17 million acres of cropland in the South were capable of yielding higher average annual returns per acre from pine plantations than from crop or pasture use. That acreage ranged from 2-13 million depending on the discount rate and price trends assumed. About 6 of the 17 million acres is currently used for crops and the remainder for pasture and range. The study concluded that such a conversion would:

1. Have little impact on the cropland needed to meet future crop and livestock demands since the marginal soils to be converted are in SCS soil classes 3e and 4e, highly erosive, and 6 and 7, generally low in productivity, and

2. in the South there is 25 million acres of potential cropland in SCS class 2 which could be used for crop production.
3. Conversion of marginal croplands would reduce erosion on SCS land classes 3e, 4e, 6e, and 7e, where erosion now measures 17.9 tons per acre annually to about 2 tons per acre (4 million acres involved).
4. Erosion on forage lands averages 5.4 tons per acre but would only be 2 tons per acre if converted to pine.
5. Such a conversion would bring little savings to commodity prices support programs because the production involved is a small part of national production and any conversion would likely be gradual.

The study by Fedkiw didn't seek to explain why none of this potential cropland had been or was in the process of being converted to pine plantations. Perhaps the deferred investment returns and lack of knowledge about commercial forestry are contributory factors. Fedkiw notes that a high proportion of producers and landowners in the south are over 55 years hold. That would be a factor against forest investment.

Pasture Utilization and Potential

The study led by Fedkiw [1982, page 33] gave the following summary of pasture usage conditions in the South:

"The amount of pasture, idle, and other land that is estimated to be marginal is a maximum of 11 million acres. Allowing 10 percent adjustment for idle and other uses, this is about half the pasture in eight Southeastern States [Alabama, Arkansas, Georgia, Louisiana, Mississippi, North and South Carolina, and Virginia]... Forage utilization in 1979 was 67 percent in the Southeast but this varied widely among the states. The cattle herd in the eight Southeastern States was at its lowest level in 1979 - 11.8 million cattle and calves at 10.6 percent of national total. In 1982 cattle numbers increased to 13.1 million or 11.3 percent of the U.S. total. So, utilization might be closer to 80 percent assuming no improvement in productivity. ... it appears that shifting 5 to 7 million acres of pasture, idle, and other land to trees would require significant improvements in pasture utilization and productivity to maintain the 1982 number of cattle in the study area.

Improvements in pasture productivity appear to have been significant in the past. From 1969 to 1975 when the number of cattle in the eight Southeastern States increased 28 percent, from 12.7 million to 16.2 million, the non forested pasture in these states decreased 22 percent, from 26.2 million acres to 20.4 million acres, indicating substantial forage productivity enhancement resulting from rising demands and prices for cattle.

Conversion of 11 million acres of pasture, nevertheless, implies some reduction in cattle numbers in the South at current demand and price levels and a shift of production to other regions and perhaps some price increases. Historical data indicate an unused capacity of about 12 percent outside the Southeast at 1975 prices. That is greater than the total cattle numbers in the eight southeastern states. ... in recent years there has been a decline in consumer preferences for beef for various reasons and an increase in demand for other protein sources. It appears unlikely for the next decade or so that there will be any major increases in cattle prices. Thus, a reduction in the Southeastern herd that could be associated with conversion of pasture to pine plantations could be salutory for the cattle industry and would not be likely to cause any major increases in beef prices to consumers. It appears economically feasible, therefore, to convert 11 million acres of marginal pasture, idle, and other land to trees without serious national impacts on beef production and prices."

Another possibility in the South is forest grazing. Fedkiw [1983, p. 40] states that, "In 1978, 42% of the forested farmland in the South was grazed." Byington et al [1984] found that management objectives of

the farmers who were grazing cattle in their timber included 1) reduction of brush and understory vegetation and so improved fire control, 2) to maintain wildlife habitat, 3) to get higher returns per acre, and 4) for good public relations. Currently there seems to be a scarcity of technical literature about concurrent use of land for forestry and pasture.

Other Unique Aspects of the Southeast's Resources

A factor expected to have great influence on land conversion rates is field scale. Aggregate totals of land in various use and potential categories ignore the physical incidence of the actual parcels. Fedkiw [1980, p.38] gives the following caution.

> "...many of the poorer soils are comingled with more productive soils. The added net returns (lower unit operating costs) from farming large fields in a common cultivating system often more than offset any net losses associated with including the cultivation of limited areas of poor soils in such fields."

Another factor of land use conversions in the Southeast is land ownership. Most of the land is broken into small ownership parcels, each of which is too small to form an economically efficient unit [Hart, 1978,1980]. A lot of managerial skill and capital is required to assemble enough of those units into an economically sized farm or forest parcel of land. The problem is compounded by the current ownership parcels being small enough that city dwellers purchase them for use as hedges against inflation [Hart, 1980].

The last 50 years have brought large increases in irrigated acreage throughout the U.S. and the Southeast has been no exception. In 1978 Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North

Carolina, South Carolina, Tennessee, and Virginia each had 1.24, 21.65, 3.91, 8.08, 13.34, 5.01, 1.44, 0.46, 0.00 and 0.90 percent of their cropland irrigated, respectively [1980 Census of Agriculture]. That irrigation has good and bad effects. Some of the bad effects are increased environmental loadings of chemicals, encroachment of salt water in coastal acres as fresh water is pumped for irrigation, and increased erosion on some lands as cropping intensification occurs. In some areas, such as Florida agriculture is competing with other uses for scarce water supply [Kiker and Lynne, 1981].

Finally, there are the unique environmental characteristics of the Southeast that allow rice, vegetables, sugarcane, citrus, pecans, and peaches to be produced. Those environmental characteristics are for the most part not reproduceable elsewhere in the U.S. Constraints to account for that should be included in any policy analysis model of the Southeast.

Some Empirical Results of Land Use Conversion Studies

White and Flemming [1980] used data from 1945 to 1975 to develop an econometric model of land use allocation in Georgia. Their model, based on the economic theory of land rent, incorporated crop acreage, pasture acreage, and forest acreage as endogenous variables in a three equation simultaneous system. A fourth class of land, idle, is the residual after the above 3 classes are accounted for. Exogenous variables were lagged crop acreage, lagged land in farms, lagged net income, lagged beef price, lagged forest price, long-term contracts,

short-term government programs, long term government programs, and lagged farm income to personal income (%). The regression results of the model are shown in Table 2. Table 2 indicates that a one acre

Table 2. Regression results explaining land use changes in Georgia

Variables	Regression Equations		
	Crop Acreage	Pasture Acreage	Forest Acreage
Intercept	3297.990 (3.403)	441.840 (1.023)	-696.311 (-0.947)
Crop Acreage		-0.391 -6.331	-0.633 -11.902
Pasture Acreage	-1.026 (-3.849)		-1.112 (-4.430)
Forest Acreage	-0.058 -1.727	-0.619 (-7.218)	
Lagged Crop Acreage	0.698 (9.696)		
Lagged Land in Farms		0.434 (6.024)	0.734 (30.589)
Lagged Net Income	16.892 (3.185)		
Lagged Beef Price		-7.203 (-2.106)	
Lagged Forest Price			-5.232 (-1.121)
Long-Term Contracts	-0.536 (04.072)		
Short-Term Government Programs	-1.894 (-0.992)		
Long-Term Government Programs	-1.008 (-1.565)		
Lagged Farm Income to Personal Income (%)		4.791 (4.609)	7.224 (5.018)

increase in crops is associated with a reduction in pasture and forest acreage by 0.39 and 0.63 acres, respectively. So such a change in cropland is taken directly from forest or pasture with little affect on idle land. Also a one acre increase in forest is associated with a reduction in pasture and cropland by 0.62 and 0.06 acres, respectively. So the increases in forest came mainly from pasture and idle lands. Similarly, a one acre increase in pasture is found to be associated with a 1.02 and 1.112 acre decrease in crop and forest, respectively. That seems to indicate that the economic or other conditions giving an increae in pasture also give an idling of crop and forest.

To more clearly show the affects of exogenous variables on the endogenous variables White and Flemming [1980] calculated the reduced form multipliers given in Table 3. These multipliers can be interpreted as giving both the direct and indirect change in acreage for a particular land use resulting from a one unit change in an exogenous variable. Note that a one dollar increase in previous years net income per acre of cropland is associated with increases in crop acreage by 17.47 acres (in thousands) and decreases in forest acreage by 11.12 acres (in thousands). Other coefficients in the table are not so intuitive such as a one dollar increase in lagged forest pine resulting in thousand acre changes of -10.05, 10.37, and -10.41 in crop, pasture, and forest acreage, respectively.

The regression results given above may not be clearly interpretable because of incomplete model specification. Other factors may

Table 3. Reduced form coefficients explaining land use changes in Georgia

Endogenous Variables	Endogenous Variables		
	Crop Acreage	Pasture Acreage	Forest Acreage
Lagged Crop Acreage	0.7217	0.0024	-0.4595
Lagged Land in Farms	0.0208	-0.0648	0.7926
Lagged Net Income	17.4738	0.0581	-11.1249
Lagged Beef Price	23.0295	-23.0629	11.0733
Lagged Forest Price	-10.0466	10.3746	-10.4114
Long-Term Contracts	-0.5546	-0.0018	0.3531
Short-Term Government Programs	-1.9588	-0.0065	1.2471
Long-Term Government Programs	-1.0426	-0.0035	0.6638
Lagged Farm Income to Personal Income (%)	-1.4521	1.0214	7.0069

cause the land use conversion to occur as they do. A geographer who has documented many of the land use changes in the South gives a possible historical sequence of land use change [Hart 1980, p. 495-496]:

> "In the 1920's the farmer grew cotton on this land, but the bottom dropped out of the cotton during the Depression. After 1933 the government restricted the acreage he could grow, so he began using his old cotton land to grow fodder crops such as corn, hay, oats, winter wheat, or soybeans (which were cut for legume hay, not harvested for beans). Then along came WWII, the boys all marched away, and the farmer had so much trouble finding the help he needed he turned his cropland into pasture. He got himself a job in town and gradually he began to lose interest even in his pasture land. He allowed it to grow up in brush and second growth hardwood, or he sold it to a paper company to be planted in pine."

SUMMARY

Aggregate resource data for the Southeast indicate a high potential for simultaneous increase of both food and fiber production in the area. Such increases would come from land use condversions between cropland, forest, range or pasture, and idle uses. A model to simulate such changes must incorporate realistic constraints representing landowners preferences and as much as possible disaggregation of the land use totals by physical characteristics of the land. Such characteristics as field size, accessability and size of ownership parcels aren't accounted for in SCS land capability classification.

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Appendix 1 Crops Included in Southeast Model by State

Crops Included in Southeast Model by State[a]

	AL	AR	FL	GA	LA	MS	NC	SC	TN	VA
Barley				D			D	D		D
Corn grain	DI	D	DI	DI	D	D	D	DI	D	DI
Corn silage	D		D	D	D	D	D	D	D	
Cotton	D	DI		D	DI	DI	D	D	D	
Oats	D	D	D	D		D	D	D	D	D
Peanuts	DI		DI	DI			D	D		D
Potatoes (Irish	D		DI							D
Potatoes (sweet)					D		D			
Rice		I			I	I				
Rye				D				D		
Sorghum grain	D	D	D	D	D	D	D	D	D	D
Sorghum silage	D			D	D	D	D	D	D	D
Soybeans	DI	DI	DI	DI	DI	DI	D	DI	D	D
Sugarcane			D		D					
Tobacco				DI			DI	DI	D	DI
Wheat	D	D	D	D	D	D	D	D	D	D
Legume hay	D	D	D	D	D	D	D	D	D	D
Nonlegume hay	D	D	D	D	D	D	D	D	D	D
Apples				D			D	D		D
Peaches	D		D	D			D	D		D
Pecans	D		D	D	D	D		D		
Grapefruit			D							
Oranges			D							
Tangerines			D							
Sweet corn			D							
Tomotoes			D							

[a] D and I correspond to dry and irrigated, respectively.