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**CHARACTERIZATION OF SOYBEAN  
EXPANSION AND CONSEQUENT  
AGRICULTURAL CHANGES IN THE STATE  
OF PARANA, BRAZIL, 1970-1980**



**Empresa Brasileira de Pesquisa Agropecuária – EMBRAPA**

Vinculada ao Ministério da Agricultura

Centro Nacional de Pesquisa de Soja – CNPS

Londrina, PR





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CHARACTERIZATION OF SOYBEAN EXPANSION AND CONSEQUENT  
AGRICULTURAL CHANGES IN THE STATE OF PARANÁ,  
BRAZIL, 1970 - 1980

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## I. INTRODUCTION

One of the remarkable phenomena in international agriculture during the period of 1970-1980 was the explosion of soybean production in Brazil. Principally, two States have shared the bulk of this expansion, Rio Grande do Sul and Paraná. The main purpose of this report is to characterize the salient aspects of this recent soybean expansion in the State of Paraná. The study is derived almost entirely from Brazilian agricultural census data. Major cropping and production trends for Paraná (1970-1980) will be identified and the role of soybean expansion considered. Of special importance to this study is the identification of any possible agro-economic trends and consequences which were related to the soybean boom. Whether or not the expansion of soybeans had merely taken place upon idled or virgin land, or whether or not a significant substitution of established cropland (especially those of domestic food staples) had occurred, is the major objective of the analysis.

Most of the analysis will focus upon the period of 1970-1975. This was the most intense period of soybean expansion in Paraná, as well as in Brazil, and the data for this period are well documented. Data

from the 1980/81 harvest<sup>1</sup> in Paraná will enable a relatively up-to-date consideration of major production trends. Soybean expansion will be emphasized but the important contributions of wheat and coffee production in Paraná will also be discussed. The increase in wheat production in Paraná has paralleled that of soybeans and is crucial to the soybean picture due to the practice of double-cropping. The position of coffee is important to consider since it was the foremost export-earning crop in Paraná before the establishment of soybeans. Subsequent sections in the paper will consider important changes in the rural sector which have accompanied the soybean boom, such as changes in population and average farm size. The final area of analysis will concentrate upon the position of the domestic food staple crops relative to that of soybeans between 1970 and 1980. In the conclusion section, a comparison will be made of the major cropping trends in Paraná to those of Rio Grande do Sul, the other leading soybean production state.

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<sup>1</sup>In Paraná soybean production, plantings are performed in one year and harvests in the next.

## II. OVERVIEW OF CROPPING IN PARANÁ

Between 1970 and 1980, the area cropped to soy beans in Paraná increased by over 1.9 million hectares and the absolute change in production was greater than 4.8 million metric tons (Table 1). During this 10-year period, farmers in Paraná improved their average yield for soybeans by almost 1,200 kg/ha. No other crop planted in Paraná can claim such impressive gains in area, production, and yield. This seemingly exponential growth in soybeans is graphically depicted in Figure 1. With 1970 as a base year (index=100%), area cropped rose to an index of 800 and production rose to an index of 1,500 by 1980.

The other major crops which increased in area from 1970 to 1980 were wheat, coffee, sugarcane, corn and potato, whereas cotton, peanut, rice, black beans, and cassava all declined in area (see Appendix). Although peanut production decreased, all the other major crops had substantial production increases during the 1970-1980 period. All these major crops increased in average yield.

Agriculture in Paraná makes up a large percentage of the national totals in terms of production, value, and area (Table 2). In 1979, Paraná contributed 66.8%, 55.4%, 39.1%, and 25.6% of the national potato,

TABLE 1. INCREASES AND DECREASES IN ABSOLUTE AREA,  
PRODUCTION, AND YIELD FOR THE MAJOR AGRICUL-  
TURAL CROPS IN PARANÁ.

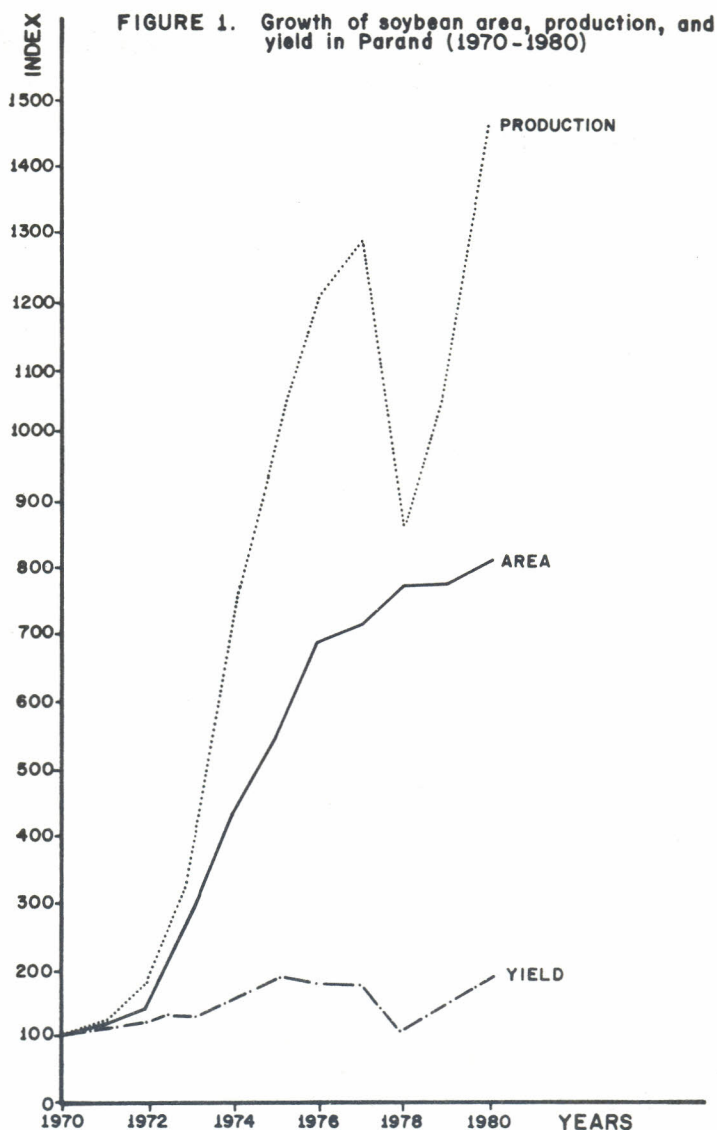
(1970-1980)

CROP	AREA (ha)	PRODUCTION (t)	YIELD (kg/ha)
Coffee	+ 316,403	+ 315,100	+ 314
Cotton	- 67,497	+ 183,937	+ 836
Peanut	- 80,617	- 98,517	+ 203
Rice	- 99,045	+ 267,895	+ 1,027
Potato	+ 13,214	+ 295,572	+ 5,418
Sugarcane	+ 39,965	+3,353,748	+15,857
Black Beans	- 76,200	+ 113,764	+ 178
Cassava	- 32,445	+ 20,484	+ 7,284
Corn	+ 31,794	+1,923,611	+ 870
Soybean	+1,954,516	+4,838,358	+ 1,193
Wheat	+1,189,787	+1,144,641	+ 118
Domestic Staples*	- 162,682	+2,621,326	+14,777

Sources: IBGE 1970, 1975

SEAG-PR/DERAL, 1981

\*Domestic Staples: Corn + Rice + Black Beans + Cassava  
+ Potato.



Source: SEAG-PR/DERAL, 1981

Note: Production losses in 1978 due primarily to a severe drought.

TABLE 2. QUANTITY, VALUE, AND AREA OF PARANÁ'S MAJOR AGRICULTURAL CROPS AS %'S OF BRAZIL AS A WHOLE (1979).

CROP	QUANTITY (%)	VALUE (%)	AREA (%)
Banana	1.7	1.5	1.8
Coffee	8.9	8.9	26.3
Orange	1.1	1.2	1.1
Grape	2.4	4.8	3.7
Cotton	3.2	31.9	22.3
Peanut	15.2	13.8	15.4
Rice	3.8	3.9	5.9
Potato	66.8	8.0	26.9
Sugarcane	2.3	2.0	2.0
Black Beans	23.0	16.1	17.7
Cassava	3.2	2.1	2.0
Corn	25.6	19.7	18.7
Soybean	39.1	38.1	28.4
Wheat	55.4	55.5	38.6

Source: IBGE, 1978, 1979, 1980.



wheat, soybean, and corn production, respectively. In terms of area, wheat in Paraná comprised 38.6% of Brazil's cropland, while the area cropped to soybeans, potato, and coffee represented 28.4%, 26.9%, and 26.3%, respectively. Paraná's wheat comprised 55.5% of the national agricultural value of this product, with soybeans and cotton at 38.1% and 31.9%, respectively. In terms of contribution to the national product, 1979 figures (Table 2) show that soybeans were second in importance to wheat in Paraná. This is a relatively recent phenomenon. As indicated in Tables 3 and 4, soybeans played a more important role than wheat in the national totals from 1970 to 1975. Additionally, recent figures (Table 3) indicate that Paraná's contribution to national soybean production in 1980 dropped 5% from that in 1979.

Whereas wheat held a significant lead over soybeans in terms of percentage of national totals, soybeans clearly dominated wheat on the local level in Paraná. Table 5 shows that in terms of percentage of total area in Paraná, soybeans have surpassed wheat ever since 1970. In 1980, soybeans were the most extensively planted crop in Paraná (11.8% of all Paraná land); corn was second (10.8%) and wheat was third (7.2%). In 1970, the soybean acreage was only 2%, and was even exceeded by crops such as rice and black beans. Thus, there was 494% increase in land area for soybeans be-

TABLE 3. AREA, PRODUCTION, YIELD OF SOYBEANS IN PARANÁ AND BRAZIL (1970-1980).

YEAR	BRAZIL			PARANÁ			
	AREA	PRODUCTION	YIELD	AREA	PRODUCTION	YIELD	PRODUCTION
	(ha)	(t)	(kg/ha)	(ha)	(t)	(kg/ha)	(Paraná / Brazil)
1970	1,914,000	2,278,000	1,190	395,484	411,462	1,041	18%
1975	5,824,000	9,893,000	1,698	1,615,302	3,103,049	1,921	31%
1979	8,256,096*	10,240,306*	1,240	2,340,460	4,000,000	1,709	39%
1980	8,698,900**	15,647,800**	1,799	2,350,000**	5,250,000**	2,234	34%

Sources: IBGE 1970, 1975, unless otherwise indicated.

\* IBGE 1978, 1979, 1980.

\*\* SEAG-PR/DERAL, 1981.

TABLE 4. AREA, PRODUCTION, YIELD OF WHEAT IN PARANÁ AND BRAZIL (1970-1980).

YEAR	BRAZIL			PARANÁ			
	AREA (ha)	PRODUCTION (t)	YIELD (kg/ha)	AREA (ha)	PRODUCTION (t)	YIELD (kg/ha)	PRODUCTION (Paraná / Brazil)
1970	1,186,204*	1,734,972*	932*	250,213	205,359	820	12%
1975	3,110,830*	1,582,587*	509*	596,939	380,000	637	24%
1979	3,830,544	2,926,764	764	1,476,476	1,621,416	1,098	55%
1980	3,122,107***	2,701,613***	865***	1,440,000**	1,350,000	938**	50%

Sources: IBGE 1970, 1975, unless otherwise indicated.

\* Knight 1971.

\*\* SEAG-PR/DERAL 1971.

\*\*\* IBGE 1978, 1979, 1980.

TABLE 5. AREA OF MAJOR AGRICULTURAL CROPS IN PARANÁ IN RELATION TO TOTAL LAND AREA OF PARANÁ\* (1970, 1975, 1980)

CROP	1970		1975			1980*		
	AREA (ha)	% of TOTAL	AREA (ha)	% of TOTAL	Δ % (70-75)	AREA (ha)	% of TOTAL	Δ % (70-80)
Coffee	360,896	1.8	920,885	4.6	+155	677,299	3.4	+ 88
Cotton	373,287	1.9	203,421	1.0	- 46	305,790	1.5	- 18
Peanut	110,167	0.6	25,635	0.1	- 77	29,550	0.2	- 73
Rice	441,645	2.2	551,777	2.8	+ 25	342,600	1.7	- 22
Potato	25,932	0.1	22,561	0.1	- 9	39,146	0.2	+ 51
Sugarcane	30,035	0.2	32,480	0.2	+ 8	70,000	0.4	+133
Black Beans	926,975	4.7	642,982	3.2	- 31	850,775	4.3	-8.2
Cassava	87,445	0.4	28,167	0.1	- 68	55,000	0.3	- 37
Corn	2,122,206	10.6	1,848,350	9.3	- 13	2,153,000	10.8	+ 2
Soybean	395,484	2.0	1,615,302	8.1	+308	2,350,000	11.8	+494
Wheat	250,213	1.3	596,939	3.0	+139	1,440,000	7.2	+476

Total area of Paraná: 19,955,400 ha

Sources: IBGE 1970, 1975, unless indicated otherwise.

\* SEAG-PR/DERAL 1981.

tween 1970 and 1980.

Although soybeans clearly surpassed wheat in terms of percentage of total land area in Paraná, in terms of percent increase (1970-1980), wheat experienced the same magnitude of expansion as soybeans (476% for wheat, 494% for soybeans). The amount of coffee land in Paraná has almost doubled since 1970, but appears, in 1980, to have equilibrated at the 1978 level. The large area planted to corn (2 million ha) has remained relatively constant between 1970 and 1980, whereas most of the other domestic staples have declined in area.

Paraná's total export income (Table 6) is highly dominated by agricultural products, particularly soybeans and coffee. In 1980, agricultural products comprised 85% of Paraná's total export worth. Soybean and coffee products comprised 38% and 40% of the total, respectively. However, it appears that despite the exponential growth of soybeans and wheat, the most valuable single product to the 1980 economy of Paraná was raw coffee beans (34% of the export worth). Processed soy cake and meal held a very strong second position at 25%, however.

The role of soybean expansion has been considerable in the overall pattern of land utilization in Paraná. From 1970-1980, agricultural cropland increased

TABLE 6. WORTH OF PARANÁ'S EXPORT PRODUCTS (1980).

EXPORT PRODUCTS	1980	
	U.S. \$ 1000 (FOB)	%
SOY PRODUCTS	807,481	38.03
Soy cake and meal	523,383	24.65
Crude Oil	127,128	5.99
Grain	156,970	7.39
COFFEE PRODUCTS	856,226	40.32
Beans	727,454	34.26
Processed	128,772	6.06
OTHER AGRIC. CROP PRODUCTS	141,745	6.68
TOTAL AGRIC. CROP PRODUCTS	1,805,452	85.02
OTHER	318,169	14.98
TOTAL EXPORTED	2,123,261	100.00

Source: SEAG-PR/DERAL 1981.

in area by 49.6%, pasture increased by 44%, and forest declined by 18.8% (Table 7). The details underlying these trends are of considerable importance. The increase in cropland was brought about by an 87.8% increase in annual crop area, accompanied by a 50% decline in perennial crop area. Additionally, the area of planted forest was increasing (98.8% increase, 1970-1975) whereas natural, virgin forest was decreasing (17.3% decrease, 1970-1975). The 6.4 million hectare increase (Table 7) in annual cropland between 1970 and 1980 was mostly due to 1.9 million new hectares of soybeans (Table 1). Soybeans alone, therefore, made up about 31% of the expansion of agricultural croplands. Wheat comprised about 19% of the expansion and was second in importance.

The cropping relationship between soybeans and wheat in southern Brazil is a special one. Although much attention is given to the expansion of soybeans from 1970 to 1980, wheat was a far more important crop during the 1950's and 1960's, and has been an extremely important crop in the early 1980's. Wheat was introduced into southern Brazil in the 18th century, becoming a crop of major importance after World War II, and in 1980 comprised 7% of Paraná's total land area (soybeans comprised 12%; Table 5). Soybeans became a crop of importance in the late 1950's, but the major expansion of the 1960's did not take until the advent of double



TABLE 7. AGRICULTURAL LAND UTILIZATION IN PARANÁ ( 1970, 1975, 1980 ).

LAND UTILIZATION	1970		1975			1980**		
	AREA (ha)	% TOTAL*	AREA (ha)	% TOTAL	Δ % (70-75)	AREA (ha)	% TOTAL	Δ % (70-75)
CROPLAND	4,718,606	23.7	5,627,535	28.2	+19.3	7,058,340	35.4	+49.6
Annual Crops	3,412,383	17.1	4,447,834	22.3	+30.3	6,406,912	32.1	+87.8
Perennial Crops	1,306,223	6.6	1,179,701	5.9	- 9.7	651,428	3.3	-50.1
PASTURE	4,509,710	22.6	4,982,840	25.0	+10.5	6,500,000	32.6	+44.0
Natural	1,809,429	9.1	1,683,815	8.4	- 6.9	1,959,750	9.8	+ 8.3
Planted	2,700,281	13.5	3,299,025	16.6	+22.2	4,540,250	22.8	+68.1
FOREST	2,570,563	12.9	2,363,253	11.8	- 8.1	2,086,185*	10.5	-18.8
Natural	2,365,400	11.9	1,955,393	9.8	-17.3	-	-	-
Planted	205,163	1.0	407,860	2.0	+98.8	-	-	-

Total Acreage of Paraná = 19,955,400 ha

Sources : IBGE 1970, 1975, unless otherwise indicated.

\* Estimate from source SEAG-PR/DERAL 1981, includes acreage of forest and "natural vegetative cover".

\*\* SEAG-PR/DERAL 1981.



cropping with wheat. It was found that soybeans yielded well when planted in the wheat stubble after the October wheat harvest. Additionally, soybeans enjoyed the benefits of residual fertilizer from the wheat production, and in many instances, the same planting and harvesting equipment could be used for both crops.

### III. CHANGES IN AGRARIAN STRUCTURE

What types of changes occurred in Parana farm structure during the years of soybean expansion? As shown in Table 8, the population growth rate of Parana declined from 4.4% for 1960-1970 to a rate of 0.97% for 1970-1980. However, during the 1970-1980 period, urban populations experienced a growth rate of 5.97% while rural populations declined at a rate of 3.32%. Importantly, this decline in rural numbers took place during a period of intense soybean expansion (1970-1980). Rural populations actually increased between 1960 and 1970 (growth rate of 3.68%) when soybeans were first becoming established.

It should be expected, therefore, that as rural establishments expanded over Parana lands from 1970-1980 (concomitant with a mild rural exodus) that average farm size would tend to increase. Typically, it would be the holders of small, inefficient mixed farms

TABLE 8. URBAN, RURAL, AND TOTAL POPULATION OF PARANÁ (1960, 1970, 1980).

POPULATION	1960		1970		1980		RATE OF GROWTH (%)	
	ABSOLUTE	%	ABSOLUTE	%	ABSOLUTE	%	1960/70	1970/80
Urban	1,438,018	31.8	2,504,378	36.1	4,473,541	58.6	+5.70	+5.97
Rural	3,082,517	68.2	4,425,490	63.9	3,156,925	41.4	+3.68	-3.32
Total	4,520,535	100.0	6,929,868	100.0	7,630,466	100.0	+4.40	+0.97

Source: SEAG-PR/DERAL 1981.

who would be expelled from the shrinking rural sector, not the larger landholders who were promoting the monocultural expansion of soybeans and wheat. Table 9 provides a detailed look at farm structure data for 1960, 1970 and 1975. Whereas many of the small farms (0-10, 10-20, 20-50 ha) increased in number from 1960 to 1970 (+215.9%, +100%, +23.4% ha, respectively), these same small farms decreased in number from 1970 to 1975 (-19.7%, -14.0%, -6.7%, respectively). As for the large farm categories (500-1,000, 1,000-10,000, > 10,000 ha), these establishments made solid gains in numbers, especially from 1970 to 1975 (+25.02%, +22.7%, +130.8%, respectively).

In terms of the percent total area occupied by the different farm size groups, the smaller farms (0-10, 10-20, 20-50 ha) again showed percent increases from 1960 to 1970 (+200.6%, +97.6%, +19.9%, respectively) and percent decreases from 1970 to 1975 (-18.3%, -13.1%, -5.1%, respectively). The larger farms (500-1,000, 1,000-10,000, > 10,000 ha) all had considerable percent increases in total area from 1970 to 1975 (+24.9%, +21.1%, +51.0%). Farms greater than 10,000 ha actually decreased by 38.1% during 1960 to 1970. According to Table 9, the average farm size in Paraná fluctuated from 42.3 ha (1960), 26.38 ha (1970), to 32.67 ha (1975).

TABLE 9. AGRARIAN STRUCTURE IN PARANÁ (1960, 1970, 1975).

SIZE CLASS (ha)	1960		1970				1975			
	FARMS	AREA(ha)	FARMS		AREA (ha)		FARMS		AREA (ha)	
				$\Delta$ % of		$\Delta$ % of		$\Delta$ % of		$\Delta$ % of
	(Nº)	(Ave.)	(Nº)	1960 Total	(Ave.)	1960 Total	(Nº)	1970 Total	(Ave.)	1970 Total
0-10	93,477	5.6	295,272	+215.9	5.3	+200.6	237,068	- 19.7	5.4	- 18.3
10-20	63,422	14.1	127,021	+100.0	13.9	+ 97.6	109,243	- 14.0	14.1	- 13.1
20-50	74,215	31.1	91,604	+ 23.4	30.2	+ 19.9	85,501	- 6.7	30.7	- 5.1
50-100	21,450	71.7	22,311	+ 4.0	70.0	+ 1.5	24,142	+ 8.2	69.8	+ 7.9
100-500	14,351	196.5	15,608	+ 8.8	200.6	+ 11.0	18,273	+ 17.1	202.3	+ 18.1
500-1,000	1,216	710.7	1,550	+ 27.5	703.0	+ 26.1	1,940	+ 25.0	701.6	+ 24.9
1,000-10,000	894	2,157.2	1,074	+ 20.1	2,136.7	+ 19.0	1,318	+ 22.7	2,107.9	+ 21.1
> 10,000	21	24,118.1	13	- 38.1	33,663.5	- 13.6	30	+130.8	22,028.0	+ 51.0
Not declared	100	-	35	-	-	-	938	-	-	-
Total Farms (Nº)	269,146				544,488				478,453	
Ave. Farm Size (ha)	42.30				28.38				32.67	

Source: SEAG-PR/DERAL 1981.

It appears, therefore, that the number of small farms in Paraná decreased considerably during the period of intense soybean expansion (1970-1975). Small farms became less numerous and also declined in terms of percent of total area. Average farm size increased by more than 6 ha from 1970-1975 which represented a 23.8% increase.

Changes in average farm size become more important when they are related to crop type to the economic status of the farmer involved. The Brazilian "Censo Agropecuário" (1970 and 1975) has classified Brazilian farmers into four ownership levels. The "proprietário" is an outright owner or partial owner. The "arrendatário" pays a rent, either in a fixed cash amount or its equivalent in produce. The "parceiro" is similar to a share-cropper and is allowed to work the land of a percentage of whatever the crop he produces may bring. Finally, there are squatters or "ocupantes", who, with or without owner permission, occupy and farm lands (usually frontier-type) on a rent-free basis. During the 1970-1975 period, it was the farms of the "arrendatários" which increased the most (+27.7%) in average size over all crops (Table 10). The "proprietários" had a 17.4% increase, the "parceiro" farms were unchanged, and the "ocupante" farms decreased in size by an average 9.2%. With regard to farms produ-

TABLE 10. COMPARISON OF AVERAGE FARM SIZE CLASSIFIED BY OWNERSHIP LEVEL OF FARMERS IN PARANÁ BETWEEN 1970 AND 1975.

CROP	AVERAGE FARM SIZE (ha)											
	PROPRIETÁRIO			ARRENDATÁRIO			PARCEIRO			OCUPANTE		
	1970	1975	Δ %	1970	1975	Δ %	1970	1975	Δ %	1970	1975	Δ %
Agriculture*	26.9	31.6	+17.4	8.3	10.6	+ 27.7	8.4	8.4	0	11.9	10.8	- 9.2
Domestic Staples**	25.6	28.3	+10.6	7.3	13.4	+ 83.6	7.1	6.9	- 2.8	12.6	10.4	-17.5
Soybean	22.7	37.3	+64.3	9.6	21.3	+ 21.9	8.5	11.2	+ 31.8	10.7	13.8	+29.0
Wheat	52.6	91.9	+74.7	28.4	59.2	+108.5	12.8	59.8	+367.2	14.6	25.1	+71.9

\* All major annual and perennial crops.

\*\*Corn + Rice + Black Beans + Cassava + Potato

Source: IBGE 1970, 1975.



cing domestic staples, "proprietário" and "arrendatário" establishments increased in average size (up 10.6% and 83.6%, respectively), whereas "parceiro" and "ocupante" farms lost ground (down 2.8% and 17.5%, respectively).

In both soybean and wheat production, farmers in all economic classes experienced increases in average farm size from 1970 to 1975. However, in the case of soybeans, the expansion was slanted heavily towards the "proprietário" class (+64.3%); in the case of wheat it was the "parceiro" class which experienced the most drastic change in farm size (+367.2%). One salient fact is presented in Table 10: the soybean expansion in Paraná between 1970 and 1975 primarily took place on the larger farms of the wealthier landholders. Wheat expansion, on the other hand, reached farmers across all economic levels. All economic classes of wheat farmers had increases in farm size greater than 70%, with most of the gains experienced by the "parceiro" (+367.2%) and "arrendatário" (+108.5%) establishments.

#### IV. CHANGES IN PRODUCTION OF DOMESTIC FOOD STAPLES

One of the consequences of soybean expansion in

Paraná may have been a significant reduced acreage and production of staple food crops. The major domestic food staples in the Brazilian diet are cassava, black beans, rice and corn. Cassava is most utilized as flour and the black beans are normally cooked whole. Rice is consumed directly. Corn is consumed directly as oil and meal, and indirectly as a livestock feed. In Paraná, potato should also be included in the list of important food staples; in fact, Paraná produced 66.8% of the Brazilian potato crop in 1979 (Table 2). Did these five crops (henceforth denoted as the "domestic staples" of Paraná) diminish considerably as a consequence of the soybean expansion between 1970 and 1980?

The answer to this question is not a simple one. Table 11 presents the actual areas, production, and yields for domestic staples<sup>2</sup>, soybeans, and wheat in

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<sup>2/</sup> Agronomically, it is an unrealistic situation to combine the production figures and yields of largely different crops such as corn, rice, black beans, and cassava. However, the more general, agroeconomic trends addressed by this report required such a simplification of production figures.



TABLE 11. AREA, PRODUCTION, AND YIELD OF DOMESTIC FOOD STAPLES, SOYBEANS AND WHEAT IN PARANÁ (1970, 1975, 1980).

CROP	1970			1975			1980**		
	AREA (ha)	PRODUCTION ( t )	YIELD (kg/ha)	AREA (ha)	PRODUCTION ( t )	YIELD (kg/ha)	AREA (ha)	PRODUCTION ( t )	YIELD (kg/ha)
Domestic Staples*	3,603,203	5,447,409	1,512	3,094,867	5,094,178	1,646	3,440,521	8,068,735	2,345
Soybeans	395,484	411,642	1,041	1,615,302	3,103,049	1,921	2,350,000	5,250,000	2,234
Wheat	250,213	205,359	820	596,939	380,600	637	1,440,000	1,350,000	938

\* Corn + Rice + Black Beans + Cassava + Potato

Source: IBGE 1970, 1975, unless otherwise indicated.

\*\* SEAG-PR/DERAL 1981.

Paraná for 1970, 1975, and 1980. When considered as percent of total crop and pasture area in Paraná between 1970 and 1980, the area planted to soybeans increased from 4.3% to 17.3%, wheat area increased from 2.7% to 10.6%, and domestic staples area decreased from 39% to 25.4% (Table 12). Therefore, expressed as a percent of total crop and pasture area, soybean area rose by 13% during the ten-year period while domestic staple area declined by 13.6%; wheat area increased by 7.9%.

Further analysis of the 1970-1980 period, however, reveals that the cropping trends between 1970 and 1975 were quite different than those between 1975 and 1980. Between 1970 and 1980, the area planted to domestic staples declined by 162,682 hectares, a decline of 5% (Table 13). However, there was actually an 11% increase in domestic staple area between 1975 and 1980 (soybean area increased by 45% during this period). Obviously, the important period of decline for domestic staples was between 1970 and 1975 when these crops decreased in area by 14%. Coincidentally, this was the most important period of soybean expansion. Soybean acreage rose by over 1.2 million hectares between 1970 and 1975, an increase of 308%.

When production figures (i.e., metric tons of produce) are considered, soybeans, wheat, and domestic staples all increased between 1970 and 1980 (up 1,175%, 557%,

TABLE 12. SOYBEANS, WHEAT, DOMESTIC FOOD STAPLES: CHANGES IN AREA AS PERCENTAGE OF TOTAL CROP AND PASTURE  
AREA IN PARANÁ (1970, 1975, 1980).

CROP	1970		1975			1980		
	AREA	%	AREA	%	Δ %	AREA	%	Δ %
	(ha)		(ha)		FROM 1970	(ha)		FROM 1970
Crops + Pasture	9,228,316	100.0	10,610,375	100.0	-	13,558,340	100,0	-
Soybean	395,484	4.3	1,615,302	15.2	+10.9	2,350,000	17.3	+13.0
Wheat	250,213	2.7	596,939	5.6	+ 2.9	1,440,000	10.6	+ 7.9
Domestic Staples*	3,603,203	39.0	3,094,867	29.2	- 9.8	3,440,521	25.4	-13.6

\* Corn + Rice + Black Beans + Cassava + Potato

Source: SEAG-PR/DERAL 1981.

TABLE 13. ABSOLUTE AND RELATIVE (  $\Delta\%$  ) CHANGES IN AREA, PRODUCTION, AND YIELD OF DOMESTIC FOOD STAPLES, SOYBEANS, AND WHEAT IN PARANÁ (1970 - 1975, 1975 - 1980, 1970 - 1980).

PERIOD	AREA (ha)		PRODUCTION (t)		YIELD (kg/ha)	
	(Absolute)	$\Delta\%$	(Absolute)	$\Delta\%$	(Absolute)	$\Delta\%$
<u>1970 - 1975</u>						
Domestic Staples*	- 508,336	- 14	- 353,231	- 7	+ 1,172	+ 26
Soybeans	+1,219,818	+308	+2,691,407	+654	+ 880	+ 85
Wheat	+ 346,726	+139	+ 174,641	+ 85	- 183	- 22
<u>1975 - 1980</u>						
Domestic Staples	+ 345,654	+ 11	+2,974,557	+ 58	+ 1,477	+ 26
Soybeans	+ 734,698	+ 45	+2,146,951	+ 69	+ 313	+ 16
Wheat	+ 843,061	+141	+ 969,400	+255	+ 301	+ 47
<u>1970 - 1980</u>						
Domestic Staples	- 162,282	- 5	+2,621,326	+ 48	+ 2,649	+ 58
Soybeans	+1,954,516	+494	+4,838,358	+1,175	+ 1,193	+115
Wheat	+1,189,787	+476	+1,444,641	+557	+ 118	+ 14

\* Corn + Rice + Black Beans + Cassava + Potato

Source: Calculated from other tables in the text.

and 48%, respectively) (Table 13). Despite a 5% loss in area, more domestic staples were produced in 1980 due to a 58% increase in yield. However, the 48% increase in domestic staple production was negligible relative to the gains made by soybeans and wheat.

Although the raw production of domestic staples increased by 48% between 1970 and 1980, when the period between 1970 and 1975 is considered alone, it is evident that production decreased by 7% (Table 13). It was between 1975 and 1980 that the production of domestic staples recovered and managed to reach a level that was 48% higher than the 1970 level. It is interesting that this period of recovery for staple food crops (11% increase in area, 58% increase in production, 26% increase in yield) corresponded to a period of relatively minimal soybean expansion (45% increase in area, 69% increase in production, 16% increase in yield). However, the 1975 to 1980 period was the best ever for wheat expansion (141% increase in area, 255% in production, 47% increase in yield).

Although both area and production of domestic staples declined between 1970 and 1975, yield increased by 26%, followed by a 26% increase (1975-1980) and 58% increase for the period between 1970 and 1980 (Table 13). Considering the emphasis given to soybeans and wheat between 1970 and 1980, these yield

gains are impressive and may suggest a determined effort by Paraná agriculturalists not to have neglected basic agronomic performance in the food staples sector at a time when soybeans were booming with introduced technologies and high cash inputs. On the other hand, there might have been a climate shift which heavily favored the management of staples relative to soybeans and wheat, or perhaps soybean and wheat were far closer to their maximum yield potential in 1970 relative to the food staples.

Domestic staples were actually a high value item in Paraná in 1970 relative to other crops (Table 14). In fact, staples comprised 58.1% of the total value of Paraná's agricultural crop output, and corn was the single most valuable crop of all (27.1% net agricultural worth). The situation changed rapidly, however, as coffee acquired the number one position in 1975 (39.8%), and soybeans led all other crops in 1979 (34.5%). The value of domestic staples fell from 58.1% in 1970 to 26.1% of the total in 1975, a level at which it appears to have equilibrated. The relative position of coffee (in terms of total agricultural worth) weakened considerably from 1975 to 1979 declined from 39.8% to 9.6%); however, in terms of export value, coffee products in 1980 comprised 40.32% of Paraná's export earnings followed by soybean products

TABLE 14. VALUE OF MAJOR AGRICULTURAL CROPS AND DOMESTIC STAPLES IN PARANÁ (1970, 1975, 1979).

CROP	1970		1975		1979	
	(CRUZEIROS x 1000)	%	(CRUZEIROS x 1000)	%	(CRUZEIROS x 1000)	%
Coffee	121,309	7.1	6,399,546	39.8	5,459,678	9.6
Cotton	260,031	15.1	587,997	3.7	4,718,087	8.3
Peanut	60,294	3.5	46,811	0.3	447,937	0.8
Rice	148,726	8.7	1,037,101	6.5	1,569,680	2.8
Potato	36,314	2.1	210,560	1.3	1,438,588	2.5
Sugarcane	34,950	2.0	143,083	0.9	958,818	1.7
Black Bean	281,553	16.4	715,070	4.5	3,706,411	6.5
Cassava	66,154	3.9	168,147	1.1	648,997	1.1
Corn	465,462	27.1	2,055,680	12.8	9,521,004	16.7
Soybean	132,810	7.7	4,056,224	25.3	19,690,918	34.5
Wheat	87,828	5.1	551,732	3.4	8,374,541	14.7
Domestic Staples	998,209	58.1	4,186,558	26.1	16,884,680	29.6
TOTAL WORTH OF ALL AGRICULTURAL CROPS IN PARANÁ*	1,717,310	-	16,065,338	-	57,038,598	-

\* This total also includes worth of banana, orange, grape, and other miscellaneous crops.

Sources: IBGE 1970, 1975, 1978, 1979, 1980.



with 38.03% (Table 6).

One final consideration of domestic staples should be made relative to agrarian structure. As Table 10 indicates, two important declines in average farm size occurred between 1970 and 1975 which involved domestic staples; "parceiro" farms which produced staples decreased 2.8% in size and the even poorer "ocupante" farms shrunk by 17.5%. This latter decrease was probably the main cause of the 9.2% decrease in farm size for all "ocupantes" in agriculture between 1970 and 1975 (Table 10). "Parceiros" and "ocupantes" who farmed soybeans actually had increases in farm size of 31.8% and 29%, respectively. Whether or not soybean production improved the income and food status of these poorer farmers, relative to what the increased farming of food staples might have achieved, is an important question which lies outside the scope of this report.

## V. CONCLUSIONS

Some of the major findings of this report are presented in index form in Table 15. All 1970 figures were given a base index of 100 and then the 1975 and 1980 indices were calculated. During the 10-year



TABLE 15. INDICES OF CROPPING AND POPULATION TRENDS  
IN PARANÁ (1970, 1975, 1980).

CROPPING	INDEX		
	1970	1975	1980
Annual Crops (ha)	100	130	150
Perennial Crops (ha)	100	90	50
Pasture (ha)	100	111	144
Forest (ha)	100	92	81
Domestic Staples (ha)	100	86	95
Soybean (ha)	100	408	594
Wheat (ha)	100	239	576
Coffee (ha)	100	255	188
Ave. farm size (ha)	100	124	138
POPULATION	1970	1975	1980
Rural	100	119	71
Urban	100	128	179
Total	100	122	110

Source: Calculated from other tables in the text.

period, agricultural production increased considerably in Paraná. The area planted to annual crops increased by 50% while that of perennial crops declined by 50%. As part of the recent soybean boom in Brazil, the area planted to soybeans (in Paraná 1970-1980) increased by an incredible 494% (increase of 1.95 million ha). Accompanying this soybean boom was a 476% expansion in wheat area as a result of 1.19 million new wheat hectares. Due to the double-cropping aspect in Paraná, we must assume that much of the expanding wheat area coincided with the expanding soybean area.

This 10-year period of soybean and wheat expansion (Table 15) was also characterized by declining acreages of most perennial crops (1980 index of 50), forest (1980 index of 81), and domestic staples (1980 index of 95). Average farm size increased due to the fact that a high proportion of the new soybean crop was planted by a landowning class ("proprietários") on large tracts of land. It is likely that the decline in rural population (1980 index of 71) was largely a result of the expulsion of small, inefficient "parceiro" and "ocupante" farmers to the urban centers. It is probable that many of these farmers were involved in the production of domestic staples and did not have the capital or other means to enable them to partici-

pate in the soybean boom. Additionally, the "parceiro" and "ocupante" farms which grew domestic staples decreased in size while those that cropped soybeans increased. This is not to suggest, however, that the rapid expansion of soybeans between 1970 and 1980 was the sole or principal cause of the rural exodus in Paraná. Many Brazilian agriculturalists lay the blame for this on a federal labor law (nº 5.889)<sup>3</sup> passed on June 8, 1973, which encouraged many landholders to dismiss their lowly-paid, rural laborers. The legislation attempted to alleviate exploitation of the rural laborers by creating fixed wages for services, fixed working hours, and other reforms. Many landholders found these terms very restrictive and instead of compliance opted for dismissal of some workers, thus contributing to the rural exodus.

Another major finding is that quite different cropping trends were prevalent between 1970 and 1975 vs. 1975 and 1980. It is quite clear that 1970-1975 was the period when soybeans expanded the most. During this period, 308%, 654%, and 85% increases in area, production, and yield of soybeans were achieved, respectively. On the other hand, between 1975 and

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<sup>3</sup>Personal communication, Antonio Carlos Roessing, Rural Economist, EMBRAPA/CNPS.

1980, far smaller gains were made (45%, 69% and 16%, respectively). Importantly, it was only between 1970 and 1975 that domestic staples lost ground relative to soybeans (14% loss in area, 7% loss in production). Domestic staples actually increased between 1975 and 1980 (11%, 58% and 26% gains in area, production, yield; Table 13). The major period of wheat expansion in Paraná was between 1975 and 1980, however. In 1975, the average wheat farm in Paraná was two to three times larger than the average soybean farm. Wheat expanded in area by 140% during both five year periods but there was a 22% yield decrease between 1970 and 1975 vs. a 47% yield increase between 1975 and 1980. Poor agronomic performance in wheat from 1970 to 1975 was probably related to adverse weather and disease and insect problems.

Did the expansion of soybeans in Paraná between 1970 and 1980 replace significant acreages of domestic staple crops? Tables 16 and 17 present a framework which tries to answer this question. At the top of Table 16 are listed the increases in soybean acreage during 1970-1975, 1975-1980 and 1970-1980. Below these figures are listed all of the major crop or land groups which lost significant acreage during these periods.

As indicated in Table 16, between 1970 and 1975

TABLE 16. INCREASES AND DECLINES IN MAJOR CROP SECTORS IN PARANÁ (1970 - 1975, 1975-1980, 1970-1980).

	ABSOLUTE CHANGES IN AREA (ha)		
	1970-1975	1975-1980	1970-1980
Soybeans	+1,219,818	+ 734,698	+1,954,516
Wheat	+ 346,726	+ 843,061	+1,189,787
-----			
Domestic Staples	- 508,336	(no losses)	- 162,682
Peanuts and Cotton	- 254,398	(no losses)	- 148,114
Perennial Crops	- 162,522	- 528,273	- 651,428
Coffee	(no losses)	- 243,586	(no losses)
Forest	- 207,310	- 277,068	- 484,378
-----			
TOTAL DECLINES	1,096,566	1,048,927	1,446,602
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Source: Calculated from other tables in the text.

TABLE 17. REDUCTIONS IN DOMESTIC FOOD STAPLE AREA IN RELATION TO SOYBEAN EXPANSION IN PARANÁ (1970-1975, 1970-1980).

CROPPING PERIOD	SOYBEAN	DOMESTIC STAPLES	
	AREA EXPANSION (ha)	AREA LOSS (ha)	MAXIMUM CONTRIBUTION (%) TO SOYBEAN EXPANSION
1970-1975	1,219,818	508,336	42*
1970-1980	1,954,516	162,682	8

Source: Table 16

\* Sample calculation:

$$\frac{508,336 \text{ (domestic staple losses)}}{1,219,818 \text{ (soybean expansion)}} \times 100 = 42\%$$



the crop sector which suffered the heaviest losses in acreage was that of domestic food staples (-508,336 ha). During the 1975-1980 period, domestic food staples increased in area, resulting in a net loss of 162,682 ha for the 10-year period. The biggest "losers" in terms of land area were perennial crops (other than coffee) and forest which declined by 651,428 and 484,378 ha, respectively, between 1970 and 1980.

As shown in Table 17, the maximum percentage of the expanded soybean area between 1970 and 1980 that might have resulted from a decline in domestic food staple area would be 8%. The figure is probably even lower because the calculations assume that all the lost area in domestic staples were replaced by soybeans. It is quite likely that a fair portion of the 162,682 ha lost to domestic staple production was simply idled. As for the 1970-1975 period, intense period of soybean expansion, 42% (Table 17) would represent the maximum percentage of the expanded soybean area which could have resulted from lost, domestic staple area. Since soybeans were expanding very rapidly in Paraná at this time, it is quite likely that a high percentage of the 508,336 ha previously cropped to domestic staples was actually replaced by soybeans.

It is, therefore, the conclusion of this report



that between 1970 and 1980 in Paraná, the most probable means by which soybeans increased by almost 2 million hectares was by reduction in perennial crop areas (other than coffee), expansion into virgin land areas, and the clear-cutting of established forests. Domestic staple production did not diminish appreciably due to the expansion of soybeans between 1970 and 1980. Domestic staples may have lost considerable ground to soybeans between 1970 and 1975, but between 1975 and 1980 these losses more than adequately compensated for. However, these calculations do not suggest that there was an adequate local supply of domestic staples in the period considered. Despite the 5% reduction in domestic staple area, domestic staple production increased by 48% (Table 13) during the 10-year period. Whether or not this level of domestic food production was able to adequately meet the food demands of a rising Paraná population, which experienced a growth rate of 0.97% between 1970 and 1980 (Table 8), is beyond the scope of this study.

Two important phenomena which accompanied the "soybean boom" in Paraná were a 30% reduction in rural population (Table 8), and a 24% increase in average farm size (Table 9). In general, in order to satisfy the food demands of a growing urban sector, the shrinking rural sector must produce and distribute large amounts of produce as efficiently as possible. In

fact, if there is significant underemployment in the rural sector, the "rural expulsion" can be quite a beneficial process as it provides surplus manpower to other sectors of the economy which are in greater need of a work force. But, if the production efforts (and ultimately, the incomes) of the rural sector are related to crops whose value depends highly upon external market conditions, the entire economy of a country, or in this case, a state, can be unsettled by factors totally out of its control. Export-dependency becomes especially risky due to the largely monocultural tendency of agriculture in Paraná. Even if external markets are good, Paraná's heavy reliance upon two principal crops, soybeans and coffee, could be disastrous should a sudden climatic shift or increase in pests strike either one of these two crops. If the long-run international forecast for soybeans and/or coffee appears to be pessimistic, then Paraná might have to mobilize its farmers to diversify agricultural production by planting increasingly higher amounts of food staples relative to high export-earning crops.

What of the leading soybean producing State in Brazil, Rio Grande do Sul (RS)? Recently, a study was completed on the patterns of agricultural change in RS between 1970 and 1975 by Soskin (1980). Both the Soskin study and this study rely primarily on the "Censo

"Agropecuário" as a data base, therefore, providing an excellent opportunity for comparative study. Table 18 presents some data and calculated indices to compare agriculture in both States in 1975. RS is 25% larger than Paraná but only had 4% more inhabitants in 1975. In terms of both hectares planted and metric tons harvested, RS exceeded Paraná in soybeans and especially in wheat. The average soybean yield in Paraná was 39% better than in RS, but the average wheat yield in Paraná was lower (by 9%). The farms in RS tended to be 35% larger than those in Paraná. Interestingly, Paraná planted 34% more hectares to domestic staples (corn, cassava and black beans) and produced an 18% larger crop of staples, even though staples yielded better in RS by 12%.

Of greater interest, however, is the extent to which both States underwent similar changes in cropping trends between 1970 and 1975. Table 19 presents an indexed account where degree of change (not absolutes) to certain agricultural parameters are compared for both States. Many of Paraná's 1975 indices were higher than those of RS, for example, soybean area (index of 408 vs. 200), soybean production (index of 754 vs. 341), wheat area (index of 239 vs. 95), and wheat production (index of 185 vs. 70), indicating that the relative rate of soybean and wheat expansion was far

TABLE 18. AGRICULTURAL INDICES COMPARING PARANÁ AND RIO GRANDE DO SUL IN 1975.

	1 9 7 5		
	RIO GRANDE DO SUL	PARANÁ	INDEX* (PARANÁ)
Land Area (ha)	26,752,000	19,955,400	75
Soybean (ha)	3,195,977	1,615,302	51
Soybean (t)	4,419,465	3,103,049	70
Soybean (kg/ha)	1,383	1,921	139
Domestic Staples (ha)**	1,878,110	2,519,529	134
Domestic Staples (t)	3,501,989	4,138,949	118
Domestic Staples (kg/ha)	1,865	1,643	88
Wheat (ha)	1,592,726	596,939	38
Wheat (t)	1,120,144	380,600	34
Wheat (kg/ha)	703	638	91
Average Farm Size (ha)	50.18	32.67	65
Population	7,457,600	8,449,200***	113

\* Index for RS = 100 for all variables

\*\* Domestic staples = Corn + Cassava + Black Beans

\*\*\* IBGE, 1972, 1978.

Source: All RS data provided by Soskin 1980. Paraná data from other tables in the text unless otherwise indicated.

TABLE 19. INDICES OF AGRICULTURAL CHANGE FOR PARANÁ  
AND RIO GRANDE DO SUL, 1970-1975. (all 1970  
indices = 100).

	1975	
	PARANÁ	RIO GRANDE DO SUL
Soybean (Area)	408	200
Soybean (Production)	754	341
Domestic Staples* (Area)	86	80
Domestic Staples (Production)	86	81
Wheat (Area)	239	95
Wheat (Production)	185	70
Average Farm Size	124	108
Population	121**	110

\* Domestic Staples (Paraná)= Corn + Cassava + Black Bean + Rice + Potato.

(Rio Grande do Sul)= Corn + Cassava + Black Bean.

\*\* IBGE, 1972, 1978.

Source: All RS data provided by Soskin 1980. Paraná data from other tables in the text.



more striking in Paraná than in RS between 1970 and 1975. Additionally, the increase in average farm size was more drastic in Paraná than in RS (124 vs. 108) (Table 19).

One of Soskin's major conclusions is that 32% of the increase in soybean area in RS (1970-1975) came from reductions in domestic staple area. This report (Table 17) arrived at a maximum figure of 42% for the same parameter in Paraná.

Regardless, it appears that in the two premier soybean producing States of Brazil, impressive soybean expansion occurred between 1970 and 1975, accompanied by a 14-20% reduction in area planted to domestic food staples (Table 19). In the case of Paraná, between 1975 and 1980, domestic food staples recovered greatly, both in area, production, and, therefore, yield. Whether or not domestic staples in RS made a similar recovery in the 1980's, and whether or not the rate of soybean and wheat expansion in both Paraná and RS has begun to diminish recently, are questions worthy of further investigation. If and when these two agricultural states exhaust their supply of arable land suitable for soybeans and wheat, the fate of the more traditional crops (such as domestic staples) may at that point, be extremely critical to the food demands of shrinking rural sectors and expanding urban sectors.

In conclusion, considerable gains in agricultural productivity were made in Paraná (1970 - 1980). These gains were made largely through the addition of new cropping area and by increasing input intensity to attain higher yields per unit area. Another general way in which agricultural productivity can be increased is through increasing pattern intensity on land already in use. This report examined that possibility and found that in Paraná (1970-1980), there was not a significant replacement of lower value crops (such as domestic staples) by higher value crops such as soybeans or coffee. In fact, the biggest possible, "loser" in terms of area substituted by soybeans and wheat would have to be perennial crops (other than coffee). Whereas domestic staples declined by 5%, these perennial crops declined by 50% (down 651,428 ha) between 1970 and 1980 (Tables 15 and 16).

And what of the future of soybean production in Paraná? The possibility now exists for Paraná to shift away from the high costs of land clearance and crop establishment towards a general improvement of agricultural infra-structure. Investments in improved agrarian structure, marketing, transportation, and distribution of agricultural products, as well as investments in agricultural research and extension activities, may prove far more lucrative to Paraná than at



tempting to crop every remaining hectare of arable land to soybeans or wheat. Providing that Paraná's soybeans and coffee continue to command high prices on the international market, and if local food demands can be adequately met by both imports and domestically grown staples, Paraná should continue to enjoy the fruits of agricultural development in the years ahead.

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## VII. APPENDIX: AREA, PRODUCTION, AND YIELD OF SELECTED AGRICULTURAL CROPS IN PARANÁ (1970, 1975, 1980).

CROP	1970			1975			1980		
	AREA (ha)	PRODUCTION (t)	YIELD (kg/ha)	AREA (ha)	PRODUCTION (t)	YIELD (kg/ha)	AREA (ha)	PRODUCTION (t)	YIELD (kg/ha)
Coffee	360,896	116,900	324	920,885	1,195,013	1,298	677,299	432,299	638
Corn	2,121,206	3,426,389	1,615	1,848,380	3,429,737	1,856	2,153,000	5,350,000	2,485
Cassava	87,445	1,024,516	11,716	28,167	346,697	12,309	55,000	1,045,000	19,000
Potato	25,932	163,803	6,317	23,561	263,701	11,192	39,146	459,375	11,735
Rice	441,645	375,605	851	551,777	691,528	1,253	342,600	643,500	1,878
Black Bean	926,975	457,096	2,028	642,982	362,515	1,774	850,775	570,860	671
Peanut	110,167	142,825	1,296	25,635	28,589	1,115	29,550	44,308	1,499
Cotton	373,287	397,063	1,064	203,421	272,923	1,342	305,790	81,000	1,900
Sugarcane	30,035	1,686,252	56,143	32,480	1,689,534	52,018	70,000	5,040,000	72,000

Sources: IBGE 1970, 1975.

SEAG-PR/DERAL 1981.

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