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AGRICULTURAL DEVELOPMENT IN BRAZIL

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CHAPTER XIV. AGRICULTURAL DEVELOPMENT IN BRAZIL

INTRODUCTION

Brazil in spite of the intense industrial development which has taken place during the first part of this century, continues to depend upon its agriculture. In 1940, 67 per cent ^{1/} of its gainfully employed population was engaged in agricultural work and 78 per cent of the total value of exports corresponded to 17 agricultural products. During the same year, the principal sources of raw materials for industry were agriculture and livestock, 66 per cent of the gross value of industrial production being derived from industries using raw materials of agricultural or animal origin. Nevertheless, agriculture has lost considerable ground in relation to the national income, as in 1948 it formed only 14.6 per cent of the estimated total for that year ^{2/ 3/}.

1/ If the whole working population were taken into account as shown under the heading "Principal Activities of the 'Sinopse do Censo Demográfico 1940'", IBGE 1947, including unremunerated occupations, only 33 per cent would correspond to agriculture. In calculating the figure estimated in the text, persons occupied in domestic, scholastic, ill-defined or non-declared activities were eliminated, together with all those not included in the remunerated sections. It is as well to indicate that among those engaged in domestic activities there are many who work temporarily in agriculture, either attending small farm industries or at harvest time.

2/ Conselho Nacional da Confederação da Indústria: "Sugestões para uma política econômica panamericana 1948" (Suggestions for a Panamerican Economic Policy).

3/ The various estimates of the National Income of Brazil have many defects and there are no two which are in complete agreement. Thus an estimate made by the United States Embassy in Brazil for 1938 and published in "Brazil - Basic Information" - indicates that agriculture contributed 40.6 per cent of the national income. This contribution is estimated at only 29.9 per cent for 1946.

Industry, with its accelerated rate of growth, has moved up to first place.

From 1940 until the present time the situation does not appear to have changed much. Industry has achieved a greater advantage over agriculture, since industrial production increased by about 80 per cent, while agricultural production increased by 18.7 per cent. Even so, more than 60 per cent of the gainfully employed population is still engaged in agriculture and as it is the branch of economy which contributes the major proportion of exports, it continues, as a result, to be the country's principal source of foreign exchange.

The marked decline of agricultural exports during the war was temporary and by 1946 these had recovered their former level and were accentuating their tendency towards absolute superiority; by 1948 these same 17 agricultural products formed 83.4 per cent of the total value of exports.

Within the vast territorial limits of Brazil, agricultural and livestock-breeding activities occupied only a small area in 1940, this area being in fact only 96,900 million hectares, or 12 per cent of Brazil's total area of 851 million hectares. Of this area, 18,800 million hectares were cultivated (2.2 per cent of Brazil's total area) and 88 million hectares represented pasture lands for cattle ^{1/} (10 per cent of the total area).

The cultivated area has increased steadily at a rate slightly greater than that of the population. Comparing the five-year period

^{1/} 5 million hectares of artificial pasture land are included in this figure.

from 1931-1935 (statistical series of cultivated areas were compiled only since 1931) with that of 1945-1949, it may be seen that the area sown with the 21 principal crops has increased by 32 per cent, while the population increased by only 27 per cent. In the same period of time the volume of agricultural production increased by 27 per cent.

Nevertheless, taking the quarter century from 1925 to 1949 as a whole, it may be seen that agricultural and animal production has increased in the last five-year period, 1945-1949, by 55.8 per cent more than in the first five-year period of that quarter century, 1925-1929; that is, it has grown more rapidly than the population, which only increased by 39 per cent. The development of agriculture was irregular, since in the last part of the 'twenties and the first part of the 'thirties the rate was accelerated, slowing down considerably during the middle of that decade, and increasing at a faster rate in the last three years. (See Chart 1).

The limitations of the international market, in the first place, and reduced domestic demand in the second, have prevented a more rapid evolution of agriculture. Moreover, efficiency of production has been retarded by factors of a social, technical and economic nature, some of which will be analysed carefully later on.

At the same time, it should be stated that in spite of its slow development as regards the total volume of production, Brazilian agriculture has, in the last 25 years, undergone structural changes which have converted it from an essentially one-crop agriculture to

/relatively diversified

relatively diversified farming, which has not only counteracted the effect of the crisis of coffee in foreign trade, but has also managed to supply a greater proportion of the food requirements of its growing population, as well as supplying Brazilian industry's requirements for raw materials derived from agricultural and livestock sources.

SECTION 1. BRAZIL'S AGRICULTURAL PRODUCTION SINCE 1920 AND ITS
EVOLUTION UNTIL 1949

Organised statistics for agricultural production in Brazil were only commenced in 1920. Nevertheless, these data suffer from serious deficiencies, particularly in the 'twenties and 'thirties, due to the system of collecting statistical data and the enormous difficulties resulting from bad communications and the immense area of Brazil's territory. For preceding periods no data is available, except for some isolated crops, principally coffee, cotton and sugar cane. It would be difficult to establish the degree of development which agriculture experienced during the last century; it is only possible to state that Brazilian economy was exclusively dependent on agriculture, not only on account of the number of people engaged in it, but also through its share in export trade. During the greater part of that century eight agricultural products formed more than 90 per cent of the total value of exports.

The agricultural structure of that period was more diversified, since, until the middle of the 19th century at least, the sugar crop constituted Brazil's principal source of income, being closely

/followed by

followed by cotton and livestock. These three products were more important than coffee as sources of wealth for the country. Cacao, yerba mate, tobacco, maize and beans were also relatively important and there was no exclusive predominance of one single product, as was to take place later.

Nevertheless, at the end of the 19th century, when the farmers became aware of the excellent soil and weather conditions for coffee growing existing in the State of Rio de Janeiro and the possibilities of this product on the export market, they intensified its cultivation. A greater incentive to production was provided by the high prices quoted for coffee on the Rio market. In this way, coffee exports, which were negligible at the beginning of the 19th century, by 1826 represented 20 per cent of world production ^{1/}. The cultivation of this crop spread rapidly, and by 1833 Brazil had become the world's biggest coffee producer, supplying nearly 40 per cent of total consumption. In spite of its persistent progress, the cultivation of sugar cane within Brazilian agriculture, was rapidly displaced in relative importance; the production of cotton, tobacco and cacao remained relatively stable, and stockbreeding progressed slowly. Coffee prices, which were proportionately higher than those of other products, the ease with which it was produced and the growing demand in the world market contributed greatly to this rapid progress.

The cultivation of coffee extended rapidly through the Paraiba valley, and later to the States of Sao Paulo and Minas Gerais.

^{1/} Robert Simonson - "Aspectos da Historia Económica do Café," Revista do Arquivo Municipal (Prefeitura do Municipio do Sao Paulo), Vol. XV, March 1940, page 161

Except in the first two decades of the last century, when exports of sugar and cotton were greater than coffee exports, this product enjoyed undisputable supremacy. Between 1890 and 1900 coffee contributed an average of 64 per cent of total exports, while sugar and cotton lost their relative importance. At the beginning of this century the production of both crops diminished appreciably and their contribution to export trade was small.

From 1920 onwards, when detailed estimates of agricultural production began to be made, its progress can be studied in more detail.

Thus, comparing the growth of agricultural production with that of the population of the country, it will be seen that, on the whole, the rate of growth of the former is somewhat greater than that of the latter, especially until 1934. From that year until 1942 it can be seen that production grew more slowly than population, and had in fact fallen behind the latter. This situation is principally due to the lower volume of coffee production, since this crop is of considerable relative importance in the general index.

In 1943, agriculture once more began a period of progress with a rate of growth similar to that of the population, becoming more intense during the years 1948 and 1949. Comparing the five-year period 1945-1949 with that of 1925-1949, it will be seen that while the population increased by 39 per cent, production increased by 58 per cent. (See Table 1).

A. Tendencies of different sectors of production

Agricultural production in Brazil can be divided into two

/distinct sectors

Table 1 Agricultural and Livestock ProductionIndex of Volume

Base 1937 = 100

Year	Exportable Products a/	Production for the do- mestic market, occasionally exported b/	Products for the domestic market (16 products) c/	Index of agricultural production (22 products) d/	Meat	General Index (25 products) e/
1920	45.5 f/	60.6	72.8 g/	58.5 h/	-	58.5 i/
1	54.3 f/	49.7	74.6 g/	63.9 h/	-	63.9 i/
2	48.3 f/	60.1	79.0 g/	62.9 h/	-	62.9 i/
3	48.7 f/	62.9	80.0 g/	63.6 h/	-	63.6 i/
4	56.7 f/	53.6	72.9 g/	64.5 h/	-	64.5 i/
1925	52.5	56.3	70.8	61.1	64.5	61.7
6	52.5	61.9	73.2	62.4	56.5	61.3
7	57.3	66.1	80.1	68.1	65.9	67.7
8	78.6	73.0	81.9	80.1	63.4	77.2
9	77.0	75.8	86.5	81.5	60.3	77.8
1930	76.9	81.0	86.4	81.4	67.5	78.9
1	66.0	89.1	88.7	76.8	66.4	75.0
2	72.4	94.2	98.1	84.6	60.0	80.3
3	87.9	97.1	97.1	92.3	77.0	89.6
4	96.0	101.5	95.5	95.8	83.2	93.6
1935	78.5	106.9	102.9	90.1	97.1	91.3
6	100.1	106.0	101.5	100.8	95.6	99.9
7	100.0	100.0	100.0	100.0	100.0	100.0
8	101.0	114.5	106.5	103.7	96.3	102.4
9	90.9	120.0	109.5	99.7	96.7	99.2
1940	88.7	117.6	104.9	96.4	87.3	94.8
1	90.7	130.0	116.3	102.8	90.5	100.7
2	73.3	136.8	117.8	94.5	84.5	92.7
3	89.4	138.9	121.9	104.8	75.5	99.7
4	87.0	149.5	130.7	107.8	70.2	101.2
1945	74.6	153.1	132.0	101.8	70.4	96.4
6	78.0	182.5	149.5	112.0	79.6	106.3
7	76.3	180.5	149.0	110.8	84.3	106.2
8	77.8	186.0	155.3	114.6	-	114.6
9	84.9	189.7	161.8	121.4	-	121.4

a/ 6 products - coffee, cacao, ginned cotton and cotton seed, castor oil and tobacco.

b/ 5 products - rice, sugar cane, bananas, oranges and pineapples.

c/ 16 products - alfalfa, rice, oats, bananas, potatoes, pineapple, sugar cane, barley, coconut, beans, oranges, manioc, maize, wheat, grapes, rye.

d/ 22 products - 16 for the domestic market and 6 for export.

e/ 23 products - 22 from the index of agricultural production, and meat.

f/ Excluding castor oil.

g/ Excluding grapes.

h/ Excluding castor oil and grapes.

i/ Excluding meat, castor oil and grapes.

Source: Conjuntura Económica, February, 1950.

distinct sectors which have different and independent tendencies, and which are regulated by factors of a completely different nature: agriculture for export and agriculture for domestic consumption. Included in the first group are all those products of which, on an average, more than 25 per cent of the harvest is exported (coffee, cacao, cotton, tobacco and castor oil), and in the second all those crops which are cultivated essentially in order to satisfy the country's own requirements. The exports of several of the latter have reached relative importance in some years (rice, sugar, oranges, pineapples, etc.), but on the whole they constitute only a marginal sector within exports.

1. Agriculture for export. The development of the group of five products included under this heading is governed principally by the fluctuations of the export market. Three of the five products, coffee, cacao and castor oil are cultivated almost exclusively for export, since the quantity utilised in the country is limited and relatively stable. The other two products, cotton and tobacco, must first supply the requirements of local industry, only the surpluses being exported. (See Table 2).

Taken as a whole, between 1920 and 1926, the export group of agricultural products maintained a volume of production showing a slight tendency to rise. A period of intensive growth began in 1927, which, with variation of a certain magnitude, especially in 1931 and 1935, lasted until 1936. It is as well to note that these oscillations were due principally to adverse weather conditions

/affecting coffee

Table 2 Export of Five Products as Percentages of Total Production

(Five-yearly averages)

Year	Coffee	Cotton	Cacao	Castor Oil	Tobacco
1920/24	87	18	96	-	47
1925/29	68	21	100	-	36
1930/34	58	26	96	-	32
1935/39	67	61	92	92 a/	35
1940/44	74	36	80	95	21
1945/48	98	75	84	80	33
1945	102	43	70	94	28
1946	95	93	107	61	45
1947	94	82	83	92	36
1948	101	81	74	71	22

a/ Average 1937/39

Source: Calculated from data obtained from the Statistical Annual of Brazil (IBGE) and from "Comercio Exterior do Brasil", Ministry of Finance.

affecting coffee which, at least until 1933, was the product whose predominant volume, value and growing expansion had the most influence on the group in question; the other products remained stable or showed moderate increases which had no real effect on the changes which took place.

Cotton did not begin to influence the total value of exports until 1933, when it served to counteract, in part, the sudden drop in coffee.

From 1936 on, when the group's volume of production had almost reached its peak, expansion ceased and production remained at that high level for three years, when it began a progressive decline until 1946, when it began to recuperate. Thus in the five years from 1935 to 1939 the average production of the group was 48 per cent more than in the five years from 1925 to 1929, while in the five years from 1945 to 1949 it had only increased 23 per cent. (See Table 1 and Chart 1).

The importance of the group in question within the aggregate of total agricultural production is manifest when it is realised that the five products included formed, in 1937, 52 per cent of the total volume. This percentage was only 42 per cent in the five years from 1920 to 1924. The importance of the group began to decline in 1938, until by 1937 it formed only 35.6 per cent of the total volume. It should be noted that in the five years from 1920 to 1924 the production of coffee formed 68 per cent of the five export products and 29 per cent of the volume of total agricultural production.

Coffee: In 1935 coffee began to lose its relative importance within the group as a result of the rapid growth of cotton. In 1937 it was

/only 55 per cent

only 55 per cent, whereas cotton formed 35 per cent (in 1928 the latter only represented 11 per cent of the group).

Considered within the total of agricultural production, it will be seen that the cultivation of coffee increased considerably from the last decade of the 19th century, rising from a production average of 735,000 tons in the period from 1899-1904 ^{1/} to 1,770,000 tons in 1933. In this same year coffee represented 38 per cent of the volume of agricultural production (21 products).

Due to several causes, which will be explained later, there was a slow contraction in the production of this crop during the succeeding years, until in 1944, it fell to 686,000 tons, the lowest point in the last thirty years, representing only 13 per cent of the total volume of agricultural production.

Later on, due to the increase in world demand and a progressive improvement in prices, production took an upward turn once more and in 1948 and 1949 it had again passed the million ton mark. Unprecedented prices in nominal U.S. dollars and the growing demand which was registered during the last few months appear to indicate that coffee production will once more be intensified to the maximum. (See Charts 2 and 3).

1/ The World's Coffee, International Institute of Agriculture in Bureau of FAO, Rome 1947.

/Cotton.

Cotton: Cotton, the second crop within the group of export products, was only relatively important in the 'twenties, its production being limited to long fibre cotton, with the principal centre of cultivation in the Northwestern States (Pernambuco, Paraiba, Rio Grande do Norte and Ceara).

In the first part of the 'thirties, thanks to the favourable prices of cotton in relation to coffee as a result of the drop in coffee prices, to the good prospects existing on the world market, to the growing demand of the domestic market (cotton textiles), to the successful experimental work which began to bear fruit, and to several favourable factors of a technical nature, etc., cotton production reached an extraordinary boom which in a short time placed Brazil among the principal producers in the world, and gave new life and direction to its agricultural economy. In 1934 the production of cotton had more than trebled in relation to the 1932 harvest, having risen from 76,000 tons to 285,000 tons. By 1944 production had risen to a peak of 592,000 tons, but in later years, due to the accumulation of large exportable surpluses and the deterioration of cotton prices in relation to those of other products, the cultivated area was reduced, particularly in the State of Sao Paulo, and production dropped sharply until it reached a minimum of 319,000 tons in 1948, recuperating a little in 1949. The State of Sao Paulo contributed to most of this crop. Between 1940 and 1944 this State produced 75 per cent of the total for Brazil and contributed more than 95 per cent of the total exported. (See Charts 2, 3 and 11).

Castor oil, cacao and tobacco. Another product which acquired

/considerable relative

considerable relative importance within this group was castor oil. Its production increased from 8,000 tons in 1928 to 231,000 in 1948.

The production of cacao, one of the products which is largely dependent on the international market, showed an appreciable and almost continuous increase until 1938, without apparently being affected by the world crisis, at any rate insofar as the volume of production is concerned. Then there was a drop which lasted until 1942. In 1943, thanks to exceptionally high yields, production reached its highest level with 178,000 tons, followed by another drop, while in the succeeding years it maintained relative stability.

The production of tobacco shows the least variation within the group and, in fact, it may be said to have remained relatively stable. Minimum production was registered in 1926 with 80,000 tons and maximum in 1946 with 119,000 tons. In recent years production dropped slightly due to the difficulties of selling the product in foreign markets as a result of its relatively high price. (See Tables 3 and 4 and Charts 2, 4 and 5).

2. Agriculture for domestic consumption. This group shows tendencies which differ from those of the preceding one, since more than 95 per cent of its total production is subject exclusively to the needs of the domestic market.

Production for domestic consumption increased between 1925 and 1931 at a faster rate than that of population. Between 1932 and 1943 it maintained, with slight variations, a rate of growth almost parallel to the increase of population, and only in 1944 did it initiate a new period

/of growth

Table 3 Cultivated Area for Five Export Products of Brazil
(Five-Year Averages)
(Hectares)

Periods	Cotton	Cacao	Coffee	Castor Oil	Tobacco
1931/34	962.435	171.270	3.760.290	-	92.879
1935/39	2.118.228	188.187	3.403.133	119.661	101.517
1940/44	2.413.590	238.221	2.347.538	159.615	101.082
1945/49	2.500.493	257.665	2.443.219	224.549	141.413

Source: Produção Agrícola do Brasil, del Serviço da Estatística da Produção (Department of Production Statistics), Ministry of Agriculture.

/Table 4

Table 4 Volume of Exports of Different Agricultural Products
(Five-Year Averages)
(Tons)

Periods	Cotton	Cacao	Coffee	Meat	Tobacco
1920/24	20.777	55.357	783.096	65.654	35.044
1925/29	23.595	68.267	846.656	49.325	31.057
1930/34	37.990	88.097	894.768	64.321	30.860
1935/39	233.476	119.740	902.977	76.646	32.657
1940/44	170.419	105.737	648.545	100.403	20.281
1945/48	212.277	96.154	914.984	41.764	37.604

Source: Ministerio da Fazenda, Tesorero Nacional, Serviço de Estatística Económica e Financeira, Comércio Exterior do Brasil (1946 - 1948)

of growth at a more accelerated rate which gave it an advantage over the population, particularly in the years 1948 and 1949. (See Chart 1).

In the five years from 1920-1924, the 16 products comprising this group represented 58 per cent of the total volume of agricultural production. Due to the growth of coffee and cotton, its relative importance decreased until 1937 it formed only 48 per cent. At the present time, agriculture for domestic consumption represents about 64 per cent of the total volume of agricultural production.

The index for this group in the five-year period from 1945 to 1949 had increased by 90 per cent in relation to the five years from 1925 to 1929, while the index for the group of export products increased only 23 per cent during the same period of time. (In the five-year periods 1940-44 and 1935-1939, the indices for this group had risen by 35 per cent and 48 per cent respectively). As was seen before, the population increased between these two five-year periods by only 39 per cent.

Within the group of products for the home market there were only a few which, by their volume and increase, were of major influence in maintaining the rate of growth already described. In accordance with the degree of their development, the products which grew most rapidly in importance were oranges, rice, sugar cane, bananas, manioc and wheat. Some others, such as potatoes, pineapples, grapes, coconuts and beans also underwent increases in production but only at a rate comparable with that of the population. Maize, a product with an important bearing on the total volume, together with rye and alfalfa, either declined or

/maintained their

maintained their production unchanged.

Sugar Cane; Among those products for domestic consumption, the production of which increased more rapidly than the population, the most important in volume is sugar cane. Its production rose from 12,500 million tons in 1925 to 31 million tons in 1948. There were several factors which influenced this increase, the most important among them being undoubtedly the greater demand for sugar by the growing population. At the same time the development of this crop was encouraged by the Government's policy of intervention in production by means of fixing the prices of cane and sugar in such a way as to guarantee the cost of production and normal profits, not only for the producers of the raw material but also for the manufacturers ^{1/}, and by fixing the quotas for processing sugar in accordance with demand, diverting the surplus production of cane to the manufacture of alcohol.

The cultivation of this product reached its greatest importance in the States of Pernambuco, Minas Gerais, Rio de Janeiro, Sao Paulo, Alagoas, Bahia and Paraiba. (See Charts 6 and 7).

Rice; Sugar is followed in importance of volume by rice, but it should be noted that both on account of its value and of the area occupied by its cultivation, this product is more important than the former. In 1948 it amounted to 13.3 per cent of the total value of

^{1/} "The price of the canes shall be calculated in proportion to the price of sugar or alcohol, according to whether it comes under the quota for transformation into sugar or alcohol, taking into account the coefficient of average industrial yield of the factories of each State, the sugar content and purity of the canes offered". Article 87 of Title IV, only chapter, Section 1 of Decree Law No. 3494 of 13 August 1941.

Source: Legislação azucareira e alcooleira 1943, page 540. (Sugar and Alcohol Legislation, 1943).

agricultural production (21 products) and occupied 10.5 per cent of the cultivated area.

The production of rice increased at a more pronounced rate than sugar and, consequently, than the population. In 1925 the total volume produced was 700,000 tons and in 1946 it was 2,700 million. The States of Sao Paulo, Minas Gerais and Rio Grande do Sul, and in part, Goias, were those which most intensified the cultivation of this cereal. (See Charts 6 and 7).

Manioc: The production of manioc remained practically stationary at around 5 million tons between 1925 and 1937. From 1938 it acquired greater importance as a result of Government attempts to include the flour of this product in elaboration of bread and due to its industrialisation for the manufacture of both starches and alcohol. Production increased steadily, and in 1949 passed the 13 million ton mark. All the States produce important quantities of this plant, but the principal growers are: Bahia, Santa Catarina, Pernambuco, Minas Gerais and Rio Grande do Sul. (See Charts 8 and 9).

Fruits: The production of bananas, a fruit grown to some extent for the export market, has also increased at a rate much higher than that of the population. Between 1925 and 1949 the volume produced increased from 540,000 tons to 3,100 million.

The cultivation of this fruit is most important in the States of Sao Paulo, Rio de Janeiro and Minas Gerais.

The production of oranges rose in 14 years (1922 to 1936) from 90,000 tons to 1,200 million, and has since remained at about that

/figure. The

figure. The States of Rio de Janeiro, Sao Paulo and Minas Gerais were mainly responsible for this increase. An important percentage of the new plantations consisted of lands formerly planted with coffee.

Wheat: Wheat is a cereal of prime importance to Brazil, since in 1947 and 1948 imports of wheat (and flour) constituted the item of greatest value among imports. The cultivation of wheat shows a volume of production lower than that of bananas and oranges, but the area sown is almost the same or higher than that devoted to both fruits.

Development of the crop is irregular due to difficulties of an ecologic nature. The volume of production increased on a scale more or less similar to that of the population between the years 1921 and 1937 (from 132,000 tons to 149,000 tons), later suffering a considerable drop for three consecutive years and afterwards recovering, until it reached 472,000 tons in 1949; meanwhile the cultivated area increased slowly until 1938, and then increased considerably, particularly in the years 1948 and 1949. (See Chart 10).

It is in the development of this crop that the results of Government stimulus can be seen most clearly. Until the end of the 'twenties and the beginning of the 'thirties the cultivation of this cereal was confined to certain zones, more as a result of tradition than for economic advantage. Only a small amount of experimental work had been carried out until then, and many difficulties, of an economic and technical nature, had hampered the extension and intensification of its cultivation. The Salte Plan, in its chapter on wheat ^{1/} sums up the causes which have determined Brazil's

1/ Salte Plan - Nutrition Sector, Volume 2.

/deficiency in

deficiency in this crop, as follows:

1. The low prices at which wheat was imported from Argentina before the First World War.
2. The lack of continuity in the different production campaigns, which were carried out at long intervals.
3. The insufficiency, if not the absolute lack of seed suitable for the different environments of the national production.
4. The ignorance on the part of the producers of agricultural machinery indispensable for the rational exploitation of this crop.
5. Lack of credit facilities.
6. Lack of ecologic studies which would determine the zones suitable for its cultivation and an adequate plan for storage and transport.
7. Lack of a stable market at prices which would at least cover the cost of production, and
8. The marked influence of the international "Trusts", which in the most varied ways have exerted a constricting effect on the domestic production of wheat.

Since the 'forties, thanks to the Government's policy of development, in the form of technical assistance (extension services), distribution and sale of seed of proved varieties from State or controlled private seed multiplication farms, of adequate credit and support prices, the production of wheat was intensified to a considerable degree, particularly in the States of Rio Grande do Sul, Santa Catarina and Paraná. The facilities offered for the transport and marketing of

/the grain

the grain also helped to encourage the producers.

Wheat was one of the crops which from the nature of its cultivation, contributed most towards modernising working methods in the country's agriculture, especially during the last two years.

In 1948 domestic production of this cereal covered 31 per cent of the total needs of the country (wheat and flour in terms of wheat).

The Salte Plan considers that Brazil has available a sufficient area to produce efficiently all the wheat required for domestic consumption, and indicates that even by cultivating only 3 million hectares, with an average yield of 700 kilogrammes, more than 2 million tons of grain could be produced. This area is distributed in the States of Rio Grande do Sul, the south of Mato Grosso, the north of Paraná, Sao Paulo, Minas Gerais and Goias.

It is important to note that the products previously mentioned have owed a part of their extraordinary increase in production either to an additional demand due to industrialisation of the product (in the case of wheat, there was also the difficulty of obtaining wheat from abroad and the need to save foreign exchange) or to a small incentive in the export market, since surpluses found ready acceptance in the world market. (See Tables 5 and 6).

An index calculated for the five products which found a certain inducement in the foreign market (rice, sugar, bananas, oranges and pineapples) shows a much higher rate of increase for this group than for the group of "export products" or for the group of "products for the domestic market". (This group includes among 16 products the

/five just

Table 5 Exports of Sugar, Rice, Bananas and Oranges as
Percentages of total Production

Year	Sugar	Rice	Bananas	Oranges
1920/24	18	7	-	-
1925/29	2	1	-	-
1930/34	3	4	-	-
1935/39	4	4	18 <u>a/</u>	14 <u>a/</u>
1940/44	3	4	4	12
1945/48	7	6	7	4
1945	2	4	5	3
1946	2	6	9	4
1947	4	8	6	5
1948	20	8	8	6

a/ Average 1937/1939

Source: Estimated from data obtained from the Statistical
 Annuals of Brazil (IBGE), Ministry of Finance.

/Table 6

Table 6 Volume of Exports of Sugar, Rice and Maize
(Five-yearly averages)

Year	Sugar	Rice	Maize
1920/24	53.945	144.199	18.301
1925/29	6.360	22.746	5.155
1930/34	42.668	37.076	12.995
1935/39	55.442	46.674	49.051
1940/44	74.247	43.947	8.590
1945/48	167.414	117.936	100.052

Source: Ministerio da Fazenda, Tesorero Nacional,
Serviço de Estatística Económica e
Financeira, Comércio Exterior do Brasil
(1946-1948).

five just mentioned, since on an average not more than 10 per cent of their production was exported). Comparing the five years from 1925 to 1929 with those from 1945 to 1949, the index of the group in question increased by 169 per cent, while it has already been seen that during the same period of time the group of "products for the domestic market" increased by 90 per cent and that of "export products" by only 23 per cent.

Potatoes: Another product which has shown considerable development, although on a lesser scale than the preceding ones, is the potato. In 1920 the production of this tuber amounted to only 145,000 tons; with certain notable variations in the 'thirties, due principally to changes in the cultivated area, production tended to increase, until it reached 600,000 tons in 1945, and remained stable from then until 1948. Production in 1949 reached the maximum figure of 728,000 tons. (See Charts 8 and 9).

Maize and Beans: The products of greatest importance in the diet of the Brazilian people, maize and beans, also show increases in production, but this has been on a scale very similar or slightly inferior to the increase of population. The production of maize rose from a minimum of 4,400 million tons in 1926 to a maximum of 5,900 million in 1935. Since then production has decreased slightly, remaining stable at around 5 million to 5,600 million tons. Between the periods from 1925-1929 and 1945-1949 the total yield of the maize harvests increased only by 14 per cent, that is, less than the population.

/The cultivation

The cultivation of maize is important in all the states, not only for human consumption but also for the feeding of animals. It occupies the greatest percentage of cultivated land in the country, between 27 and 34 per cent of the total. Coffee occupied a similar area in the first part of the 'thirties, but at present it only covers 16 per cent of the cultivated area.

The production of beans maintained a rate of growth almost identical with that of the population between 1925 and 1943. From 1945 onwards increases were less and the rate of growth dropped considerably. Even so, the average production in the five-year period from 1945-1949 was 60 per cent greater than in that of 1925-1929.

(See Charts 8 and 9).

Other products: All the other products within the group, oats, barley, coconuts, pineapples and grapes, showed relatively important production increases. The only ones which definitely declined were alfalfa and rye.

Livestock breeding and meat: Available statistics on the amount of livestock are contradictory, since estimates for the years 1935, 1938 and 1939 are very high in comparison with those of the 1940 census. Altogether, leaving on one side the figures before the census and taking into account the estimates made by the Serviço da Estatística da Produção (Department of Production Statistics) for 1946, a considerable increase can be noted in the number of head of cattle, hogs and sheep - from 34,400 million to 46,300 million for the first, from 16,800 million to 23,800 million for the second and from 9,300 million to 15,500 million for the third. This increase is partly the result of the

/enormous credit

enormous credit assistance granted to livestock breeding by the Banco del Brasil and other credit institutions, and partly to the more or less constant number of animals slaughtered, particularly cattle. Thus it would seem that the total annual number available for slaughter has not been fully utilised.

The production of meat (controlled by the official slaughterhouses) showed an increase between 1925 and 1937 - from 634,000 tons to 1,122 million tons, but after that it declined until it reached 788,000 in 1944. Since then production has again increased and in 1947 reached the figure of 946,000 tons. (See Table 1 and Chart 1).

II. CHANGES IN THE STRUCTURE OF PRODUCTION

In dealing with the development of agricultural production, it has been seen that the total volume has maintained a rate of growth very similar to that of the population. The description of production for export and production for domestic consumption showed how each sector developed in opposite directions, and how each product underwent variations of a different nature. A more detailed study of the behaviour of the different products makes it possible to observe the profound changes which have occurred in the agricultural structure of Brazil.

The coffee crisis, which began in 1929, was the starting point for a veritable revolution in the country's agricultural system. The drop in coffee prices and the economic and technical advantages offered by the cultivation of other products caused the farmers to make rapid changes in the planning of their crops, obtaining a greater /diversification.

diversification. For this reason, in spite of the slow decline in the production of coffee, the total volume of agricultural production continued to increase; in the latter part of the 'thirties Brazil had liberated itself from a one-crop economy. The intensification of cotton, rice, castor oil, potatoes, sugar cane and fruit contributed considerably to the diversification of the 'thirties. The inclusion from 1944 onwards of eight additional products to the current agricultural statistics, and their development between that date and 1949 suggest that they had contributed to that diversification for many years previously.

The most striking changes among the different sectors of agriculture are, without any doubt, those which took place in regard to cotton and coffee. Coffee was the product of most importance within the country's agriculture, and it is so again today, after having conceded the first place to cotton for a period of six years (1939-1944) and the second place to maize for a period of three years (1942-1944). In 1928 coffee produced 53 per cent of the total value of agricultural production (22 products), but since then its relative importance declined considerably until in 1943 and 1944 its production represented only 13.9 per cent of the total. In inverse ratio to the lessening importance of coffee, cotton acquired it to a remarkable degree. In 1930 this product represented only 3.6 per cent of the total value of agricultural production; its development was rapid and in 1939 it replaced coffee as the product of greatest importance, accounting for more than 20 per cent of the value of production. It retained this

/place for

place for a period of six years, reaching 23.4 per cent of the total value. Later its importance decreased considerably, recovering only partially in 1949.

In Chart 1, "Percentage value of the production of cotton and coffee in relation to total agricultural production (22 products)", the negative correlation which has existed in the value of production of the two products may be clearly seen. The fact that the distance between the two curves decreases as time goes on, cotton being higher than coffee or vice versa, gives a clear idea of the disappearance of the supremacy of any one crop in Brazil.

Other products which acquired marked importance within the country's agricultural economy were rice, which in 1946 reached 10.7 of the value of production, oranges, which in 1935 formed 5.7 per cent of the total value, and castor oil, which within its small area of cultivation acquired relative importance. The sugar cane and manioc crops also improved their position within the value of agricultural production as a whole; the share of the former, amounted to 2.7 per cent of the total value in 1925, and reached 8.7 per cent in 1944, while the latter's share rose from 3.9 per cent in 1925 to 8.7 per cent in 1945. Fruit and wheat also increased in relative importance within the total value of production. (See Table 7 and Chart 12).

Food Production: Brazil is undoubtedly one of the countries which, with the exception of wheat, is most self-sufficient in Latin America. The variety of climate and soils existing in the country permit the cultivation of a great part of the food and raw materials of vegetable

/origin required

Table 7. Volume of Production of 21 Agricultural Products, Percentages of the Value and of the Cultivated Area of each Crop in Relation to the Total Value and Total Cultivated Area of the 21 Products, by Five Yearly Periods

Year	Coffee	Maize	Cotton	Rice	Beans	Sugar Cane	Manioc	Oats			Bananas		Alfalfa	
								Barley	Rye	Wheat	Oranges	Pineapples	Grapes	Coconuts	Potatoes	Castor Oil
VOLUME OF EACH CROP (1,000 tons)														
1925-29	1,239	4,782	119	876	680	13,672	4,934	158	155	1,313	533			
1930-34	1,580	5,289	144	1,113	704	16,416	5,058	194	189	2,562	596			
1935-39	1,347	5,677	384	1,565	823	17,407	5,529	174	222	3,087	727			
1940-44	880	5,275	485	1,779	888	22,498	8,456	224	228	3,155	795			
1944-45	954	5,465	365	2,541	1,092	28,634	12,016	371	232	3,939	1,062			
PERCENTAGE OF THE VALUE OF EACH CROP														
1925-29	47.1	16.5	6.5	5.2	5.2	3.5	4.7	1.1	4.4	2.8	2.9			
1930-34	35.1	16.1	8.2	5.7	3.4	6.0	7.1	1.2	4.6	8.1	2.5			
1935-39	24.0	15.5	20.1	8.6	4.4	5.5	6.4	0.6	4.0	6.7	3.6			
1940-44	15.1	16.5	21.3	11.3	5.8	7.8	7.2	1.5	4.1	4.8	2.7			
1944-45	19.9	16.4	12.8	12.6	6.6	7.8	7.3	2.7	3.9	4.8	5.1			
PERCENTAGE OF CULTIVATED AREA OF EACH CROP														
1931-34	32.8	32.9	8.2	7.0	6.4	3.4	2.6	1.7	2.3	1.6	0.8			
1935-39	25.5	30.6	15.8	7.2	7.1	4.3	3.0	1.5	2.2	1.7	1.8			
1940-44	17.5	30.5	17.9	8.2	7.9	4.4	4.8	2.3	2.5	1.7	2.2			
1944-45	15.6	27.5	16.0	10.5	10.2	4.8	5.9	3.0	2.5	1.3	2.6			

Source: Calculated from data obtained from the Sinopse do Censo Agrícola del Recenseamento Geral do Brasil, Serviço Gráfico do Instituto Brasileiro de Geografia e Estatística, Rio de Janeiro, 1948.

origin required by its population and industry. The foods and raw materials which have to be imported are few and of slight importance, and in fact do not represent more than a small percentage of the total value of imports. Moreover, this small percentage includes many foods which by their nature can scarcely be considered as agricultural, such as beverages, dried and canned fish, etc. Some luxury articles for the almost exclusive consumption of the high-income classes are also included in this group.

Among the imported products of a strictly agricultural nature (excluding wheat and wheat flour, which are the most important), those which are most important in regard to volume are malted barley (34,000 tons were imported in 1947 out of a total volume of 1,028 million tons), dessert fruits, especially pears, apples and grapes; and potatoes (19,000 tons of potatoes in 1947 and 64,600 in 1948; imports of pears, apples and grapes were 40,000 tons in 1947, while in 1948 the figure was 33,000 tons). Other foods were of relatively small importance, since in 1947 none reached more than 5,000 tons, and those which passed 3,000 tons were very few (olives, oatmeal and dairy sub-products).

Wheat is the most important product within food imports, for there have been some years in which it has constituted 95 per cent of the volume of food imports and 77 per cent of their value.

As regards raw materials of agricultural origin, the only one of any real importance is jute. Imports in 1947 and 1948, were 10,000 and 28,000 tons respectively. Wool, linen, hemp, etc., were only imported in quantities of less than 4,000 tons during those same years.

/The following

The following table gives an exact idea of the way in which per capita food imports tend to drop from 1939 onwards. Between 1942 and 1945, imports increased somewhat, but from 1946 to the present time, the tendency to drop has been more pronounced. (See Table 8).

The value of imports of foodstuffs, in comparison with the total value of Brazil's imports, has also shown a notable decline. Thus, in the five years from 1901-1905, 39 per cent of the total value of imports corresponded to foodstuffs; in the five years from 1944-1948 this percentage was only 20 per cent.

The fact that food imports have tended to decrease; that agricultural production for domestic consumption (which on the whole is composed of foodstuffs, although part of the sugar cane production is used for the manufacture of alcohol, part of the maize for fodder, and part of the manioc for industry, apart from exported quantities already indicated), has increased in greater proportion than the population; and that, in turn, other factors (such as the increased availability of consumer goods, a substantial increase in the industrial population, drawn principally from the agricultural population, etc.), indicate that there has been an increase in the purchasing power of the population (real income), all make it possible to assume that agriculture is not only supplying a larger quantity of foodstuffs to Brazil's inhabitants, but a greater proportion of the total which they consume.

The fact that meat production fell in the period from 1945-1948 in relation to the similar period of the previous ten years ^{1/} and that

^{1/} The index of meat production decreased by 20 per cent in 1946 and 16 per cent in 1947 in relation to the base year, 1937.

Table 8 Food Imports and Total and Per Capita VolumesFive-yearly Averages

Years	Total Imports	Imports of wheat and flour (000 tons)	Imports of foods excluding wheat and flour (000 tons)	Total imports per capita	Imports per capita excluding wheat & flour	Percentages of wheat & flour within the total volume.
1920/24	697	854	180	22.0	5.6	73.9
1925/29	1,055	812	249	36.0	7.2	76.7
1930/34	949	848	101	32.1	2.7	89.3
1935/39	1,070	996	74	27.3	1.8	93.0
1940/44	1,029	1,018	75	25.2	1.7	93.1
1945/48	998	808	190	21.2	4.0	78.9
1945	1,357	1,232	125	29.6	2.7	90.7
1946	670	455	215	14.3	4.6	67.9
1947	1,030	829	201	21.6	4.2	80.4
1948	933	715	218	19.2	4.4	76.6

Source: Statistical Annuals of Brazil for several years, and Comércio Exterior do Brasil, Ministerio da Fazenda, Tesorero Nacional, Serviço do Estatística Económica e Financeira (Foreign Trade of Brazil, Ministry of Finance, National Treasury, Department of Economic and Financial Statistics).

there are insufficient data to calculate exactly the total food production, prevents us from stating categorically whether the availability per capita has increased or decreased in relation to previous years.

Nevertheless, for various reasons, many of which have already been explained, we are inclined to believe that in general, the food situation in Brazil has improved, particularly during the last two years.

SECTION 2. ANALYSIS OF THE PRINCIPAL FACTORS WHICH DETERMINE THE
CHANGES IN PRODUCTION

I. Prices and Markets

We have already shown the importance of coffee in Brazilian economy, both in the past and the present, not only as one of the principal export products and sources of foreign exchange, but also as a principal source of income, not only for agriculture, but for the country as a whole. The marked changes which took place in its production and its influence on the changes in the agricultural structure, such as a marked diversification, the notable growth in the cultivation of cotton, castor oil and citrus fruits and the rapid increase of several other products destined as much to the export as to the home market, have also been indicated.

Influence of the prices of coffee on its cultivation: Undoubtedly the changes already described originated in the extraordinary development which took place in the cultivation of coffee since the end of the last century and, especially, since it became obvious that the production of this crop had extraordinary comparative advantages in relation to any other which was then known. The importance of this crop continued to increase within the country's economy and by 1880 domestic production represented 51 per cent of world production^{1/}. The physical conditions favourable to its cultivation (suitable soils, climate, etc.), the

1/ The World Coffee Industry - Special Technical Commission for the Inter-America Coffee Board.

/existence of

existence of cheap and relatively abundant labour, as well as the existence of various factors of a political and economic nature, accompanied by a growing demand in the international market, all had their influence on the greater intensification of production, so that in 1907 Brazil produced 75 per cent of world production ^{1/}. Moreover, coffee was the principal export product and represented more than 50 per cent of the total value of exports. Nevertheless, by the beginning of the century, the accumulation of exportable surpluses (1,500 million kilogrammes in 1902 ^{2/}), made it obvious that there was a lack of balance between production and consumption. As a result, a policy of intervention was initiated by the Government of the State of Sao Paulo - a State which in 1894 had become the principal producer of coffee in Brazil - with the object of maintaining prices at a favourable level and at the same time, limiting production. The result of this policy, which took the form of a prohibitive tax on new plantations (2:000\$000 per alqueire of new planting) at first for a period of five years, and later prolonged for five more years, did not show any immediate results in the limitation of production, but it contributed to maintain prices at a satisfactory level. Later, in 1906, the States of Minas Gerais and Rio de Janeiro united with Sao Paulo to outline a policy of "valorization" of coffee. Meeting at the Taubate Convention, they established measures destined to control crops and regulate prices, thus marking the beginning of State intervention in the production and marketing of coffee. The origin of

1/ The World Coffee Industry - op.cit.

2/ The World's Coffee - International Institute of Agriculture,
op. cit. page 467.

this agreement and of the direct intervention of the State in the market was principally due to the protests which the plantation owners had been presenting to the Governments, requesting that the State should assume the functions of intermediary in view of the considerably profits which the coffee traders and intermediaries obtained as a result of the already known nature of production, whose yields fluctuate considerably every other year. (It appears that under normal climatic conditions, the coffee plant is relatively exhausted every time it produces heavy yields, and takes a little time to recover, as a result of which the following year's crop is lower). This characteristic was cleverly taken advantage of by the intermediaries, who accumulated the surpluses during the years when the crop was abundant and prices were relatively low in order to throw them on the market in the years of scarcity, with resultant profits ^{1/}. This situation, which grew out of the inelasticity of the coffee market, prevented the plantation owners from obtaining all the profits which were really due to them, above all in the years of bad harvests, when the unit costs of production were higher. Thanks to the financial cooperation of English banking concerns, the Federal Government and local banking concerns, the Government intervention of the State of Sao Paulo with the object of "valorizing" the coffee had a sporadic success on several occasions, and the stocks withdrawn from the market with the object of regulating

^{1/} Henry W. Spiegel: The Brazilian Economy, page 172. (The Blakinston Company, Philadelphia, Pennsylvania, 1949).

the supply to foreign markets, could be easily sold at normal prices in the years of scarcity. These interventions took place principally in the years 1906, 1917 and 1921. Later, by different measures and new credits obtained in England, the policy of defence and price support was continued, and it was possible to maintain these at satisfactory levels, which never dropped to a point where they endangered the economy of the coffee producers.

The policy of "valorization" managed to keep prices at remunerative levels, and in spite of the efforts of the Government of the State of Sao Paulo to reduce the planted area, this continued to increase. Thus, of an average of 1,800 million hectares planted in the five years from 1910-1914, these increased to an average of 2,900 million in the five years from 1925-1929, the tendency to increase persisting after that date. (See Table 9).

Production naturally increased much more than demand, and as a result, considerable surpluses were accumulated. With the good harvest of 1927 and 1928 and the reduced exports of this last year, stocks reached the alarming quantity of 800,000 tons at the end of 1928 and 1,700 million tons at the end of 1929. (See Table 9).

1/ H.W. Spiegel, in his book The Brazilian Economy (Page 173) says: "But it is, to say the least, an open question of whether they have promoted expansion among other coffee producers, as is often claimed".

/It is

Table 9. Production, exportable production, exports, available
surpluses and destruction of coffee in Brazil 1925-1948

(In thousands of tons)

Year	Production	Exportable Production	Exports	Available surpluses	Destruction of Coffee
1925	888	875	809	205	..
1926	960	908	825	168	..
1927	1,101	951	907	172	..
1928	1,671	1,627	833	802	..
1929	1,576	817	857	1,747	..
Average	1,239	1,036	846		
1930	1,634	1,694	917	1,764	..
1931	1,302	994	1,071	1,559	170
1932	1,536	1,704	716	1,534	560
1933	1,777	1,191	929	1,242	821
1934	1,652	1,778	849	1,221	496
Average	1,580	1,472	896		
1935	1,136	1,089	920	98	102
1936	1,577	1,256	851	1,113	224
1937	1,461	1,582	727	419	1,032
1938	1,404	1,412	1,032	..	480
1939	1,157	1,395	1,000	..	211
Average	1,347	1,346	906		
1940	1,002	1,147	723	..	169
1941	962	987	663	..	205
1942	830	948	437	..	139
1943	922	817	607	..	77
1944	687	730	813	..	8 ^{a/}
Average	880	926	649		
1945	835	497	850	..	..
1946	917	575	734	..	..
1947	947	596	890	..	..
1948	1,037	676	1,050	..	..

Source: Until 1940 National Department of Coffee Anuario Estatístico do Café 1939-1940. From 1940 to 1945, reports of the D.N.C. as they are transcribed in the Study of the World Coffee Situation (from the Inter-American Coffee Board, 1948) 1946-1948, according to data published in the Anuario Estatístico del Brasil, 1948, and the Resumen Mensual (Comercio Exterior do Brasil, Ministerio da Fazenda, 1948) January to December 1947-1948.

For Available Surpluses, data taken from the Departamento Estatístico de la producción, Ministerio de Agricultura, Rio de Janeiro, Brasil and published in The World's Coffee (FAO, Rome 1947), page 448.

^{a/} 7 months: January - July. After that date no further information was published concerning any additional destruction of coffee.

It is important to note, also that the policy of "valorization" of coffee on the part of the Brazilian Government had begun to have repercussions on world production, especially on that of Latin America, enormously encouraging the production of mild coffees.^{1/} As a result, the relative importance of Brazil as an exporting country in the world was reduced, in spite of its production having increased considerably. In fact, after having contributed with 69 per cent of the world exports in the five years from 1910-1914, it only contributed 60 per cent in the five years from 1925-1929.

After the events already described and the marked tendency towards a drop in prices which began in 1925, it was perfectly logical that when the world economic crisis began at the end of 1929, prices should collapse completely.^{2/} The situation was further aggravated by the excellent harvests which followed and which were, in part, the result of the increases in the cultivated area which had taken place in the period from 1920-1923, and which contributed to the Government's decision to take drastic steps with the object of preventing disaster, not only for the coffee planting economy but also for the whole country. Among those measures was the tax of one cruzeiro per newly planted tree

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- 1/ H.W. Spiegel, in his book The Brazilian Economy (page 173) says: "But it is, to say the least, an open question whether they have promoted expansion among other coffee producers, as is often claimed".
- 2/ The official quotation in the Santos Market for coffee of Santos No.4 type, fell from 33\$500 per 10 kilos at the beginning of October to less than 20\$700 in December. "Brazilian Coffee, Special Memorandum No. 35", Studies in the Artificial Control of Raw Material Supplies, by J.W. Row, London and Cambridge Economic Service.)

/(later raised

(later raised to 5 cruzeiros per tree), various taxes on coffee exports, the destruction in various ways of enormous quantities of coffee (up to July 1944, 4,660,000 metric tons were destroyed, a quantity sufficient to supply the requirements of the world market for two and a half years) and finally a total prohibition of any new coffee planting.

The creation, first of the National Council of Coffee, and later of the National Department of Coffee, made more effective the application of measures tending to alleviate the disequilibrium between supply and demand and, in spite of the continued abundance of crops in the thirties, the complete collapse of the coffee industry was avoided.

The controls already outlined, and others that are not mentioned, the low price levels which prevailed from the end of 1929 until 1941, the growing depletion of the soils due to erosion, etc. brought about a decrease in production and the gradual abandonment of the great areas occupied by old trees with a low yield. The cultivation of coffee was no longer as remunerative as before, and there were many other products which were more profitable to the farmers.

From 1929, as a result of the crisis, the prices of all products began to fall violently. Nevertheless, they did not all fall with equal rapidity or to the same level. Coffee prices, due to the situation already described, fell more swiftly and to lower levels than those of other agricultural products. The ratio between the price of coffee and the price of other products continued to become more disadvantageous for the former, a circumstance which was logically taken advantage of by the farmers who began to intensify the majority of these other crops and in particular those whose price ratio was higher, such as cotton,
/rice, castor oil

rice, castor oil and oranges.

The following tables show the prices paid to the producer for different products and the indices (base: 1929 = 100) of the ratios between the prices of coffee and the prices of various other products in the State of Sao Paulo. A brief survey of these tables reveals clearly the principal reason both for the decrease in the production of the principal crop, coffee, and also for the rapid increase of the others and, above all, of those which could be considered as competitors. (See Table 10 and Charts 13 and 14).

Examining these tables in detail, it will be found that from 1929, particularly during the depression period, really important changes took place in the price ratio between coffee and other products. This ratio is much broader in the case of the export products, or with those which, like rice and meat, were partly influenced by the export trade, and is much narrower with articles which were strictly for domestic consumption.

The causes which brought about these changes originated principally in the fall in the price of coffee ^{1/} to levels much lower than those

1/ The drop in the price of coffee, as already explained, was due principally to the disequilibrium between supply and demand which had been appearing for many years back and which, in spite of the Government's efforts to improve it, reached its critical point in the last months of 1929. Other factors which also helped to worsen these unfavourable price ratios were the delays caused by the system of export permits in force at the beginning and which contributed to delay the movement of coffee between the areas of production and the ports and, more recently, the sacrifice quota which had to be handed to the Government for its destruction at prices much lower than the current ones (about 40 per cent of the price to the producer) before placing the coffee in port for export. This quota corresponded to 1/3 of the production and was formed by the coffees of poor quality, but in any case influenced the prices paid to the producer. In any case, it is obvious that at this time it was only possible to obtain current market prices for 70 per cent of production. The export taxes on coffee (around 45 milreis per sack) also influenced the fall in prices, since it was much greater than the tax for other products (for cotton it was only 10 reis per kilo).

Table 10. Indices of price ratios between selected products and coffee in the State of Sao Paulo. Average prices paid to the producer

Base: 1929 = 100.

Year	<u>Cotton</u> Coffee	<u>Rice</u> Coffee	<u>Maize</u> Coffee	<u>Beans</u> Coffee	<u>Meat</u> Coffee
1929	100	100	100	100	100
1930	84	83	74	79	118
1931	177	143	157	89	210
1932	190	128	140	95	164
1933	196	142	148	95	145
1934	202	189	165	111	166
1935	197	113	112	84	136
1936	187	208	132	127	178
1937	187	216	178	127	212
1938	183	212	187	127	223
1939	169	202	134	128	199
1940	159	200	165	131	187
1941	194	219	171	122	198
1942	160	192	159	95	199
1943	188	170	148	92	222
1944	90	160	139	109	112
1945	76	143	140	107	116
1946	97	104	106	113	95
1947	109	105	100	105	96
1948	122	153	147	158	
1949	108	148	148	153	

Source: Publications of the Servico da Estatística da Produção, organ of the IBGE. Ministry of Agriculture.
 For meat 1929-38, Lawrence W. Witt, "Changes in the Agriculture of South Central Brazil", Journal of Farm Economics, August 1943. Estatística da Produção Pecuária, (IBGE, 1948).

reached by the prices of the other products.

Naturally, the country's tendency towards inflation also contributed to this drop, but in a degree which was more or less the same for all agricultural products, together with certain changes in the habits of domestic consumption and in the demand, all of which came about as a result of the crisis.

The price ratio index shows a marked improvement for coffee in relation to other products, except meat, in 1930, but in the following year, 1931, the situation changed radically, for prices of cotton, rice, maize and meat were advantageously situated in relation to coffee. This situation continued until the post-war years, when cotton underwent a fall only a little less spectacular than that of coffee at the beginning of the depression. The price of beans rose less than any other product in relation to coffee. The price ratio of meat to coffee is included only for information purposes, since several sources have been used to complete it, and there is some discrepancy in their continuity.

The situation from 1940 onwards was naturally influenced by the conditions imposed by the war, the fixing of ceiling prices for coffee in the United States and the difficulties of the balance of payments. At present, the roles appear to be reversed once more, since the unprecedented rise in the prices of coffee in the last months of 1949 seem to indicate a considerable improvement in the prospects for its cultivation.

Undoubtedly, it was these changes in the price ratios which had most influence on the radical changes which took place in the

/structure of

the structure of agriculture of Brazil. For example, it can be clearly seen from the statistics of the cultivated area of the greater part of the products which could be considered relatively competitive insofar as labour and costs are concerned, that as the advantage of the other crops over coffee became more pronounced, so the cultivated area of the latter began slowly to decline. On the other hand, from 1932, and in some cases from 1931, considerable increases may be noted in the cultivated area of rice, which from 1931 to 1932 increased by 18 per cent; maize, which between 1931 and 1933 increased by 37 per cent; and cotton, which between 1932 and 1933 increased by 31 per cent. It is interesting to observe that while these crops may be competitive for land, only a small and insignificant portion of the lands abandoned by coffee were taken over by the expanding products. The greater part of these, and particularly cotton, occupied virgin land which had been recently cleared, and pasture lands.^{1/} An adequate account of the problem will be given later.

II. Influences of the prices of cotton on its cultivation. The increase in the cultivation of cotton is the most striking, since in a short time production reached an astonishing level, placing Brazil in an important position among the world producers and exporters of this fibre. In this case too it can be seen that among the principal reasons promoting its expansion were the favourable prices quoted not only in the domestic but in the export market, together with the ready acceptance met with by short fibre cotton, which comes chiefly from the State of Sao Paulo,

^{1/} Paul O. Nyhus: "Cotton Production in the State of Sao Paulo", Foreign Agriculture, January 1937 (U.S. F.A. pages 31-33).

/in the international

in the international markets, especially in Japan and Germany. In fact, cotton prices for Brazil in general, in relation to the prices predominating in 1929, only declined for two years, later rising to higher levels. This did not happen with any other product, least of all coffee. With regard to the State of Sao Paulo, the prices paid to the farmer for cotton dropped to levels lower than those existing in 1929 but never to those reached by beans and maize. By 1935 an obvious recovery had taken place, and the price of cotton was much higher than in 1929. The table which follows gives an exact idea of what happened to the prices of agricultural products competing against each other for land, labour and capital, for the 20 years from 1929-1949 (Base: 1929 = 100). (See Table 11).

During the thirties, cotton maintained an uninterrupted advantage not only over coffee but also over the majority of other products; later there were years in which rice had the advantage over cotton, while maize and beans reached better relative positions.

At constant costs these changes in price ratios and in the prices themselves caused the farmers' profits resulting from the cultivation of cotton to be greater than those coming from the cultivation of coffee, rice, beans or maize. In a study effected in 1940 by the Department of Statistics, Industry and Commerce of Sao Paulo on the profitability of the small farmer's agricultural activities, it was found, by means of a small sample that cotton and manioc yielded a net annual profit much greater than that of the crops mentioned before.^{1/}

^{1/} Mentioned by Nelson de Vicenzi - O Algodao na Economia Brasileira - Rio de Janeiro 1944, page 63 (Cotton in Brazilian Economy, Rio de Janeiro, 1944).

Table 11. Indices of Prices paid to the Producer

(Base: 1929 = 100)

Year	Coffee		Cotton		Rice		Maize		Beans	
	Brazil	Sao Paulo	Brazil	Sao Paulo	Brazil	Sao Paulo	Brazil	Sao Paulo	Brazil	Sao Paulo
1929	100	100	100	100	100	100	100	100	100	100
1930	80	85	72	71	82	70	82	62	79	67
1931	39	40	77	71	70	57	82	62	44	36
1932	45	44	110	85	66	57	73	62	50	42
1933	44	44	106	88	74	63	78	66	50	42
1934	44	44	105	91	92	85	86	74	56	50
1935	52	56	120	110	84	63	82	62	60	47
1936	54	56	124	105	140	117	86	74	69	71
1937	51	56	125	105	152	121	105	100	74	71
1938	54	57	126	105	139	121	105	107	77	72
1939	54	58	122	98	133	117	103	77	87	74
1940	52	58	116	93	131	117	110	96	99	74
1941	54	58	109	113	143	128	112	100	104	71
1942	61	67	140	110	155	130	127	107	102	64
1943	72	75	179	141	199	128	186	111	123	68
1944	132	170	195	153	253	272	256	237	179	186
1945	169	205	198	157	287	292	316	288	200	220
1946	221	262	309	255	292	270	324	277	219	201
1947	222	273	345	298	325	288	362	274	286	288
1948	236	269	401	329	408	413	425	396	408	426
1949		312		335				462		

Source: Anuarios Estadísticos del Brasil.

Such advantages resulted in the rapid expansion of the cultivation of cotton, even at the cost of displacing rice, maize and beans.^{1/}

The opposite occurred as the prices of these products increased, and their disadvantage in relation to cotton was consequently lessened.

As has already been indicated, two of the principal reasons for the favourable rise of cotton prices was the demand of the export market and a premium enjoyed until 1938 by Brazilian cotton type 5 over U.S. Middling 7/8 in Sao Paulo and Liverpool respectively.^{2/} The rapid growth of the domestic cotton textile industry was also an important factor in maintaining prices.

III. Other products. The remaining agricultural products have continued to show an advantageous price relation with regard to coffee and only beans and cacao were at a disadvantage for a few years. Nevertheless, during the last three years, that advantage was more accentuated. With the considerable price increases experienced by coffee since October of last year, such advantages must have been altered radically and if the high prices are maintained for a more or less lengthy period it is more than likely that it will result in a new intensification of coffee cultivation; however, due to the relative scarcity of land suitable for coffee in regions at present accessible to economic methods of transport, it will probably be very difficult to reach the levels of the twenties.^{3/}

As a result of the advantages described above and of the increased

^{1/} Nelson de Vicenzi, op. cit. pages 63 and 64.

^{2/} Spiegel, op. cit. page 181.

^{3/} Henry W. Snielman - The Coffee Future of Brazil - United States Consular Report, April 1946.

demand due to the growth of the population, and other factors of a technical nature, the volume of production and cultivated area of the other products continued to increase. Rice and sugar-cane are two crops which were greatly stimulated by the rise in prices and the availability of ample markets; the former constitutes one of the basic elements of Brazilian diet and moreover was assured of a secure market (especially during the war and the three following years) for the whole of its exportable surplus. The latter, as has already been explained, was stimulated by the Government's decision to use alcohol as a motor spirit mixed with gasoline, and by the policy of price guarantees which is in force to keep sugar prices high. Meat prices also reached high levels, especially during the war, due to the high prices it commanded in the export market; the domestic price did not vary much due to the ceiling prices established by the Government. The number of head of cattle appears to have increased mainly during the war, due not only to the high prices but also to the great credit facilities given to stockbreeding by the Bank of Brazil.

The necessary statistical data for the calculation of general indices for prices paid to the producer, wholesale and retail prices, are not available, so that it is not possible to establish the variation which occurred during the period 1925-1949 between each of these sectors, nor to show whether these have maintained a constant ratio or have diverged. Nevertheless, the Revista Brasileira de Estatística (Brazilian Review of Statistics) ^{1/} in two studies on the

1/ Sergio Nunes de Magalhaes Junior: Os preços do agricultor no período 1939-46 Revista Brasileira de Estatística No. 35. July - September 1948, page 487, and Números Índices do preços do productos de origen animal no período 1935-47 Revista Brasileira de Estatística No. 38, April - June 1949, page 244. /prices of

prices of agricultural products, publishes some indices of prices paid to the producer, of wholesale prices of agricultural products, of export prices of agricultural products, and various indices of livestock production from 1940 until 1946.

These indices (see Table 12) show that the prices paid to the producer have risen proportionately less than wholesale prices, which have been maintained at levels more or less similar to those of export prices. In fact, while the indices of prices paid to the producer for agricultural products reach 280 per cent and 264 per cent in 7 years, the index of wholesale prices rises to 313 per cent in the same period of time. (See Table 12).

If the preceding indices could have been calculated for a greater number of years, and if indices had been available for prices paid by the farmer (clothing, implements, agricultural machinery, fertilisers, disinfectants, etc.), it would have been possible to establish to what extent the real income of the farmer had improved or deteriorated and whether these differences have tended to retard or improve production. For the time being we have no index or estimate which enables us to apply this measurement. It will be necessary to resort to simple comparisons which will give us an approximate idea of what has happened.

The cost of living index of the working class in Sao Paulo includes the items of clothing, fuel, house cleaning utensils and furniture these being the only elements which the farmer uses directly. In nearly all cases (base: 1940 = 100) these indices rose more than the

/indices of prices

Table 12. Index of prices paid to the agricultural producer, general index of wholesale prices, and general index of export prices

Years	Index of prices of agricultural products paid to the producer <u>a/</u>	Index of prices of livestock products paid to the producer <u>b/</u>	Index of prices of livestock by-products paid to the producer <u>c/</u>	General index of wholesale prices	General index of export prices
1940	100	100.0	100.0	100	100
1941	119	107.5	118.7	134	125
1942	142	127.9	144.2	162	178
1943	170	156.8	178.3	208	190
1944	203	198.0	208.4	252	202
1945	243	230.0	228.6	281	211
1946	280	259.4	287.8	313	288

Sources: Revista Brasileira da Estatística (Instituto Brasileiro da Geografia e Estatística), Year IX, July - September 1948, page 495, and Year X, April-July 1949, page 261.

- a/ Includes coffee, cotton, maize, rice, manioc, beans and sugar-cane
b/ Includes beef, pork, mutton and goat meat.
c/ Includes hides, lard and dairy by-products.

indices of prices paid to the farmer and stockbreeder. Thus, while the latter in 1947 were 280 and 264, the former reached 351, 314, 271 and 272 respectively. ^{1/} On the other hand, Spiegel ^{2/} considers that the wages paid by the farmer in the cultivation of coffee have risen much more than the prices for this product. He indicates that it has been estimated that in the period from 1942-46 the cost of labour in the cultivation of coffee amounted to more or less 50 per cent of the price paid to the producer in the domestic markets. He estimates that the value in cruzeiros of this labour is around 3 times more than that estimated for 1926-1929. In order to discount the effects of inflation he underlines the fact that even making the estimates in dollars, the labour costs per sack of coffee appear to have increased by one third. ^{3/}

From the fragmentary information available it can be seen that possibly the prices paid by the producer have increased at a greater rate and in greater proportion than the prices paid to him. If this is correct, and if this situation is maintained for a more or less lengthy period, it can only be harmful to agricultural production in general, since the only stimulus for the greater investment of effort and capital is the prospect of reasonable and secure profits.

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- ^{1/} Indices ponderados do custo da vida da classe operaria nascida de Sao Paulo 1937-47, Anuario Estatístico do Brasil 1948, page 353.
^{2/} The Brazilian Economy, by H. Spiegel, page 177.
^{3/} The greater part of these data were obtained by Spiegel from the Consular Report of Henry W. Spielman, The Coffee Future of Brazil, 1946.

SECTION 3. MECHANIZATION

Brazilian agriculture has recently entered a period of notable progress. Everywhere there is evidence of private and government concern to increase production and modernise the methods of cultivation. The Government, through the Banco do Brasil (Bank of Brazil), is granting credit facilities for the import of machinery and implements. Under a recent government decree the imports of agricultural machinery for the cultivation of wheat are exempt from customs duties for a period of five years. Furthermore, the necessary facilities are granted for the obtaining of foreign exchange to be utilized in the import of agricultural equipment.

"Lastly, in Brazil the Government has taken the initiative in making sums available to private enterprises for setting up farm machinery services which would be profit-making entities. The Brazilian Government has earmarked for this purpose 100,000,000 cruzeiros for loans to private enterprises on terms of 25 per cent down payment, 4 per cent interest and the balance due in four years"^{1/}

"In Brazil special courses have been given to State Agronomists and since 1948 the latter take courses on maintenance and operation of machines all over the country."^{2/}

^{1/} Economic Commission for Latin America, Report of the Joint Working Party ECLA/FAO, 1949, page 52.

^{2/} Ditto, page 55.

Finally, the SALTE Plan, considering "that the mechanization of agriculture constitutes one of the basic problems of the country, as important as that of petroleum and the equipment of transport, and that upon the solution thereof the reorganisation of Brazil's agricultural production principally depends", allocates, within the scope of the general plan, the sum of 725 million cruzeiros to the mechanization of agriculture within a five year investment plan.^{1/}

The achievements already described, and the future execution of the mechanization section of the SALTE Plan, will rapidly transform the present state of agriculture, which, to date, is characterised to a large extent by its pre-capitalist methods. Manual labour predominates in most types of cultivation, while the use of draught animals for ploughing, harrowing and other strictly agricultural work is uncommon. It may be stated, without fear of exaggeration, that the methods of cultivation employed in at least 50 per cent of the total agricultural production, differ little from those employed during the last century. It is still part of the yearly routine to abandon exhausted land, and replace it by using virgin land or rested land, which has become overgrown and which is cleared by the simple expedient of burning the overgrowth. The agricultural population has not yet established roots in its own land, and it is common practice for large numbers of these people to migrate annually or whenever opportunities of greater profits present themselves, either in search of better land or better paid work. It is calculated, for instance, that during the last decade alone,

^{1/} SALTE Plan, Sector Alimentación, Vol. III, 29 Mechanization of Agriculture.

some two million people have emigrated from other agricultural regions to the unworked lands in the north of the State of Paraná, in the west of the State of Sao Paulo and in the south of the State of Goiaz.^{1/}

The territory of Brazil is relatively underpopulated, the density of the population (according to the 1940 census) being only 4.85 per square kilometre, one of the lowest in Latin America. However, it is estimated that approximately 75 per cent of the present population of 48.5 million inhabitants live in a narrow strip along the coastline not more than 200 kilometres wide. Insofar as agriculture is concerned, the density of farm workers in proportion to cultivated area is the opposite of that of the total population; in 1940, for a cultivated area of 18.84 million hectares, there was an active agricultural population of 9.45 million people, or, 1.99 hectares per person.^{2/} Mexico in the same year had a figure of 2.5 hectares per person, and in Chile, in 1936, there were 2.34 cultivated hectares per person, while in the United States of America, in 1939, 12.8 hectares were cultivated for every person working on the land.^{3/} These comparative figures show clearly that Brazil is favourably placed as regards numbers of farm workers, for, in comparison she has a greater number of hands per unit of cultivated land. Nevertheless, due to the lack of mechanization and implements which make for greater output per worker, as well as to other factors of dietary and climatic order,

1/ Dwight R. Bishop, Brazilian Agricultural Policy; in Foreign Agriculture OFAR-USDA, Washington D.C., April 1949.

2/ Statistical Summary, Secretariat of National Economy, 1947.

3/ Calculated from Agricultural Statistics, Washington, D.C., 1942.

the productivity of the Brazilian worker is very low, and taking an average for the whole country, he can only work, at the present time, slightly over two hectares. This inefficiency, naturally, amounts to a relative scarcity of labour.

It is estimated that three quarters of the total agricultural output is produced by exclusively manual methods without any mechanical aid.^{1/} In immense sectors of Brazil, the hoe is still the implement most used for the clearing and preparation of new land, as well as for its cultivation.^{2/}

In order to gain a better idea of the efficiency of the agricultural worker, it would have been necessary to compare the volume and value of the output of each worker; unfortunately, complete production statistics are not available, since the 21 products for which yearly statistics are recorded form only a part of total production. In relation to acreage, these 21 products represent only 73 per cent of the total area cultivated during 1939. However, a calculation has been made, based upon the agricultural output (adjusted proportionally to acreage), livestock production and the output of wild vegetable products. This shows that each farm worker (over 15 years of age) produced on the average, in 1939, agricultural products to the value of 1,599 cruzeiros (calculated at prices paid to the producer). If only cultivated agricultural products are

^{1/} Dwight R. Bishop, op. cit. page 87

^{2/} T. Lynn Smith. Brazil: People & Institutions. Louisiana State University Press, Chapter II. Benjamin H. Hannicut; Brazil Looks Forward, Chapter IV, page 55. Serviço Gráfico de IBGE, Rio de Janeiro, 1945.

considered, this output becomes only 1,201 cruzeiros. If these figures are compared with those of the output of the farm worker in the United States they will prove to be very much lower; whereas there the farm worker produced an average of 537 dollars, the Brazilian produced only 71 dollars ^{1/} (calculated at the official exchange rate of 16,896 cruzeiros per dollar).

The figures for Brazil are only estimates, and are more likely to be too high than too low. However that may be, they give a clear picture of the backward state of agriculture in the country, and of the low productivity of its worker.

There is no doubt that one of the principal reasons for this low per capita productivity is the lack of machinery and farm implements. It has already been pointed out that the bulk of agricultural work is done manually, that the hoe is used almost exclusively for the cultivation and preparation of the land, and that all harvesting is done by hand. The plough even in its most primitive form, is virtually unknown in many regions, especially in the North and North-east. The use of draught animals, except

1/ In order that the comparison may be significant in both cases only the value of purely agricultural output has been considered. For Brazil, the total agricultural output for 1939 (adjusted in accordance with the cultivated area as shown by the 1940 census, and based on the value of the 21 principal products) was 11,362 million cruzeiros, with a working population of 9.45 million. For the United States the value of the 63 principal products for 1940 was 5,775 million dollars, representing the output of 10.7 million workers. For Brazil, Census and IBGE figures were used, and for the United States, figures from Agricultural Statistics, U.S. Department of Agriculture, Washington, D.C., 1942. It must be pointed out that this comparison is based upon the nominal prices of each country. If it were possible to express both values in terms of the prices of only one of the countries the difference would be less, but still significant.

for transport, is uncommon and often even resisted.

This type of agriculture, however, prevails principally in the self-supporting districts, among small land-owners, and among colonists who are given small pieces of land for the production of their own food as part payment for their work. In commercial agriculture and particularly in the cultivation of certain crops (rice, wheat, to some extent cotton, barley, etc.) there is a marked tendency towards the use of modern methods and mechanization.

However, it is necessary, within the country, to distinguish certain regions where conditions are totally different insofar as agriculture and livestock are concerned. For instance, the northern and northeastern states, some on account of climatic conditions, some through lack of inhabitants, and others through a combination of various factors, possess a primitive type of agriculture destined almost exclusively to the self-support of the settlers (with the exception of sugar and cotton in certain regions.) On the other hand, the southern states, and particularly Sao Paulo, Minas Gerais and Rio Grande do Sul possess a more modern and commercial type of agriculture. The following table gives a clear idea of the importance of each state in regard to the agricultural output of the whole country in 1940. This table shows that 14 states in the North, Northeast and Centre of Brazil produced only 19 per cent of the total, while 3 southern states, Sao Paulo, Minas Gerais and Rio Grande do Sul accounted for 57 per cent. (See Table 13).

There are several factors which, until quite recently, have

/prevented greater

Table 13: Total Value of Agricultural Production in 1940
 and Proportion Produced by each Brazilian State.

	Total value of production (in millions of cruzeiros)	Percentage of the total
BRAZIL	5,484	100
Acre	11	0.2
Amazonas	22	0.4
Pará	80	1.4
Maranhao	129	2.4
Piauí	41	0.7
Ceará	141	2.6
Río Grande do Norte	80	1.4
Paraíba	155	2.8
Pernambuco	324	5.9
Alagoas	106	1.9
Sergipe	47	0.8
Baía	337	6.1
Minas Gerais	742	13.5
Espírito Santo	102	1.8
Río de Janeiro	162	3.0
Distrito Federal	48	0.9
Sao Paulo	1,711	31.2
Sta. Catarina	247	4.5
Río Grande do Sul	163	3.0
Goiáz	707	12.9
Mato Grosso	92	1.7
	35	0.6

Source: Sinopse do Censo Agrícola del Recenseamento Geral do Brasil (1940), Servicio Gráfico do Instituto Brasileiro de Geografía e Estatística, Río de Janeiro, 1948.

prevented greater progress in agriculture and its technology.

The principal, and perhaps the first link in the chain of these factors concerns the availability of fertile land relatively easy to clear for cultivation, and the scarcity of roads and economical means of transport. This state of affairs obliged farmers to produce most of their own foodstuffs, and allowed them to change the land they cultivated as soon as they noticed a falling off in fertility, or as soon as the growth of weeds called for excessive work.

The existence of abundant cheap labour, and the cultivation of several crops unsuitable for mechanization, such as coffee, cacao, sugar cane (on a small scale), also helped to retard progress. The low wages paid to farm labourers supplemented to some extent by the almost universal custom of allowing them small tracts of land for the production of their own food, and pasture for a few head of cattle on the farm's grasslands, does not tend to improve the wage-cost/machine-cost ratio, which remains very much more favourable to labour. Finally, the prices of farm produce remained at relatively low levels as compared with the farmer's costs, and there was little incentive for investment in agriculture. The lack of capital, and the difficulty in obtaining financial aid in the form of credits also prevented progress towards mechanization. The farmer's initial investment in the purchase of modern equipment is very large, and there were few who had the capital or considered its investment justified. This point is especially important in

/regard to

regard to the large number of small landowners who have appeared during the past twenty years as a result of changes in the overall production structure. The small farmer is the least disposed to use machinery or implements on account of his lack of money, and on account of the small size of his holding, which can easily be cultivated by his own personal efforts and those of his family using only hoes.

As regards the technical and commercial aspects, it should be stated that the inefficient distribution and supply of spares and servicing for the machinery, has tended to limit mechanization, as has also the scarcity of competent operators and tractor-men, able not only to look after the machinery, but also to make effective use of it. A large percentage of the farm machinery, particularly tractors, do not do the amount of work annually necessary to justify the capital invested in them.

The industrialization of Brazil, and the diversification of agriculture, brought about, as has already been explained, by the sharp drop in the coffee market, has started a tendency toward its mechanization. It will now be shown how the situation has gradually changed, and the immediate factors which have brought about these changes.

The little available data from the 1920 census show the working population engaged in agriculture and livestock, the number of ploughs in use, and the percentage of properties (farms, cattle ranches and mixed farms) which possess ploughs. The 1940 census contains similar

/data which

data which permit interesting comparisons. Unfortunately it is not possible to state precisely the number of people engaged exclusively in farming with ploughs, and it has been necessary to include those working in livestock farms and mixed farming. Likewise the percentages of properties using machinery or implements do not present a clear picture, since the Servicio Nacional de Censos del Brasil (Brazilian National Census Service) instead of distinguishing specialized and mixed farms from livestock farms has placed under a single heading all the properties surveyed, and there is no means at hand for making the necessary adjustments. The figures giving the areas cultivated with the plough show a more correct picture of the situation.

In the following table it can be seen that in 1920, in Brazil, there was an average of one plough for every 45 people engaged in agriculture. This however, does not exactly reflect the availability of these implements throughout the country, since their distribution is very irregular. For example, the State of Pará with an agricultural population of 228 thousand, had only 38 ploughs, or a little over 6 thousand people per plough. Goiaz, one of the states with a large proportion of livestock ranches, had one plough for every 3,700 people, and the states of Maranhao, Piauí, Ceará and the Territorio de Acre, had one for a little over 2,000 people. In those states where most progress in agriculture has been made the situation is not much better, as, for instance in Rio Grande do Sul, with the greatest number of ploughs, the proportion is only one for /every six people.

every six people. Other well placed states were Santa Catarina, with 27 people per plough, Paraná with 22 and Sao Paulo with 31.

The 1940 Census figures show how farming has progressed during the 20 year period, but at the same time, they show that even now there is still a great shortage of ploughs, particularly in the northern and north-eastern states. Furthermore, the figures in Table 15 indicate that in the states of Amazonas, Sergipe, Maranhao and the Territorio de Acre, the situation has deteriorated, and the number of ploughs has decreased noticeably. In other states, and particularly in Minas Gerais, Rio Grande Do Sul, Sao Paulo, Santa Catarina and Paraná, there is evident a marked tendency towards the utilization of modern methods of operation. The number of ploughs in these states increased by 182 per cent, 203 per cent, 502 per cent, 250 per cent and 193 per cent respectively. Nevertheless, the ratio between cultivated area and number of ploughs remained low, particularly in 15 states where the number of hectares under cultivation per plough is over 100, and even more so in 10 of them where there was only one plough for more than 700 hectares under cultivation. The figure for the whole country dropped from 45 persons per plough in 1920 to 15 in 1940. At the present time, there is reason to believe that the use of the plough in agriculture has increased considerably, for, even if it is true that imports of these implements were very low during the war, it is also a fact that the manufacture of ploughs in the country has increased, and a high monthly output has been achieved. In 1944, in the State of

/Sao Paulo alone,

Table 14. Cultivated Area and Number of People Gainfully Employed in Agriculture, 1920 - 1940

	Cultivated Area in thousands of Hectares		Number of People Gain- fully Employed in Agri- culture, in thousands	
	1920	1940	1920	1940
Brazil	6,642	18,835	6,312	7,551
Acre	10	88	31	21
Amazonas	20	340	91	66
Pará	91	493	228	170
Maranhão	62	287	201	251
Piauí	62	359	123	172
Ceará	184	1,313	278	432
Rio Grande do Norte	25	397	110	168
Paraíba	89	734	215	351
Pernambuco	250	866	471	504
Alagoas	84	263	217	179
Sergipe	52	116	103	89
Baía	425	1,434	745	832
Espírito Santo	224	565	132	170
Minas Gerais	1,557	2,836	1,247	1,256
Rio de Janeiro	286	718	335	294
Sao Paulo	1,985	4,320	864	1,296
Paraná	223	764	155	180
Santa Catarina	117	471	163	224
Rio Grande do Sul	754	1,700	406	650
Goiás	114	353	117	183
Mato Grosso	20	374	53	46
Distrito Federal	4	30	27	15

Source: For 1920 Recenseamento do Brasil, 1920 "Agricultura"
 For 1940 Recenseamento Geral do Brasil, Sinopse do Censo Agrícola.

Table 15. Comparison of the Distribution of Ploughs in Brazil in relation to the Number of Persons Gainfully Employed in Agriculture and the Cultivated Area

	1920		1940		Area cultivated with the use of ploughs
	Number of Ploughs		Number of Persons per Plough		
	1920	1940	1920	1940	
Brazil	141,196	500,853	45	15	38
Acre	15	6	2,082	3,483	14,721
Amazonas	63	36	1,439	1,830	9,448
Pará	38	85	6,015	2,001	5,801
Maranhao	72	71	2,791	3,537	4,041
Piauí	43	132	2,863	1,303	2,720
Ceará	132	725	2,104	595	1,811
Río Grande do Norte	80	571	1,373	293	528
Paraíba	162	496	1,327	708	1,479
Pernambuco	2,368	3,213	199	156	270
Alagoas	267	1,007	813	178	261
Sergipe	678	569	152	156	205
Baía	532	1,645	1,401	505	872
Espírito Santo	140	708	942	240	798
Minas Gerais	17,513	49,373	71	25	57
Rio de Janeiro	4,234	8,248	79	47	87
Sao Paulo	27,922	168,073	31	7	25
Paraná	7,000	20,498	22	8	37
Santa Catarina	6,126	21,431	27	10	22
Rio Grande do Sul	73,403	222,657	6	2	8
Goiás	32	345	3,671	530	1,022
Mato Grosso	222	719	240	63	520
Distrito Federal	154	245	174	61	123

Source: Recenseamento do Brasil 1920, Vol III, Agriculture, as quoted by T. Lynn Smith in "Brazil"; People and Institutions, Table I, page 53, and Table LIV, page 499. (Louisiana State University Press, 1947); and Anuários Estatísticos do Brasil (IBGE, 1948).

Sao Paulo alone, there were 176 manufacturers of agricultural machinery and implements, and of these 122 manufactured ploughs or other similar implements. The value of the output of these 176 factories reached 76.3 million Cruzeiros. 1/

By way of comparison, it may be mentioned that in Mexico, according to the 1940 census, there were 2.3 persons per plough (including mouldboard ploughs and colonial type wooden ploughs). 2/ (See Tables 14 and 15).

The degree of farm mechanization can also be judged by the number of tractors in use in relation to cultivated area. According to the 1940 census, there were 3,380 farm tractors of different powers in use, but the majority (judging from statistics of exports of tractors from the United States to Brazil) were of the medium or heavy types (between 23 and 50 H.P.). In the same year, the cultivated area was 18.8 million hectares, giving an average for the country of one tractor per 5,572 hectares. The insignificant degree of mechanization in Brazil may be appreciated if it is considered that in the same year (1939), Mexico had 4,604 tractors for a cultivated area of 9.6 million hectares, 3/ or one tractor for every 2,093 hectares, and that in the United States in that year, there were 1.6 million tractors for 138 million hectares under cultivation, or an average of one tractor for every 80 hectares 4/

The degree of mechanization in Brazil is so low that according to the 1940 census, there were 15 States with more than 10,000 hectares

1/ Revista Industrial de Sao Paulo, No. 30 May 1947, page 31.
2/ Statistical Report, Secretaria de Economia Nacional, 1947.
3/ Compendio Estadístico, Secretaria de Economia Nacional, 1947.
4/ Agricultural Statistics, USDA, 1948.

under cultivation per tractor, apart from the Acre territory, where there was not a single tractor for the 88,000 cultivated hectares. The most mechanized State in that year was Rio Grande do Sul, which had 1,104 tractors with 1.7 million hectares under cultivation, or an average of 1,540 hectares per tractor. The state of Sao Paulo had one tractor per 3,064 hectares. (See Tables 14 and 16).

It is evident that over the 20 year period, 1920-1940, there has been progress both as regards the number of machines and the number of farms which possessed them. In 1920, taking Brazil as a whole, only 15 per cent of farm properties surveyed in the census possessed some type of implement or machine; in 1940, this figure had risen to 27 per cent, in spite of the fact that the number of properties had trebled. In 1920, there were 9 states in which less than 1 per cent of the properties possessed some type of implement, and only in the State of Rio Grande do Sul were there over 40 per cent. In 1940, the number of States in which less than 1 per cent of the properties possessed some form of mechanization has been reduced to 3. Rio Grande do Sul remained at the head of the list, while the percentage of mechanized properties had risen to 83 per cent. The States of Sao Paulo, Santa Catarina and Paraná showed machinery or implements in more than 20 per cent of their farm properties. (See Table 17).

For the reasons already explained, progress in mechanization between 1920 and 1940 was slow; this is shown by the fact that according to the Census there were 1,706 tractors in 1920. Between 1940 and 1946, the position deteriorated considerably, due to the difficulties during the war years. The countries which manufacture agricultural machinery,

/and in particular

Table 16. Distribution of Tractors in Brazil, by States, in relation to the number of persons gainfully employed in Agriculture and the cultivated area

Year	Number of Tractors		Number of Persons per Tractor		Area cultivated per tractor
	1920	1940	1920	1940	1940 (hectares)
Brazil	1,706	3,380	3,700	3,006	5,572
Acre	---	---	---	---	---
Amazonas	5	5	18,142	17,177	68,028
Pará	2	21	114,285	10,813	23,482
Maranhão	4	7	50,248	48,244	40,135
Piauí	---	4	---	59,436	89,770
Ceará	2	37	138,904	16,870	35,481
Rio Grande do Norte	---	10	---	22,903	39,668
Paraíba	12	13	17,916	36,254	56,438
Pernambuco	36	72	13,083	8,951	12,027
Alagoas	2	34	108,510	6,766	7,729
Sergipe	4	31	25,732	4,079	3,760
Baía	12	43	62,102	27,022	33,359
Espírito Santo	1	24	131,872	9,327	23,554
Minas Gerais	153	253	8,149	6,573	11,219
Rio de Janeiro	58	140	5,772	2,881	5,126
Sao Paulo	401	1,410	2,155	1,238	3,064
Paraná	95	65	1,631	3,464	11,760
Santa Catarina	94	71	1,733	4,120	6,633
Rio Grande do Sul	817	1,104	496	784	1,540
Goiás	1	13	117,484	1,891	27,128
Mato Grosso	1	15	53,245	5,012	24,953
Distrito Federal	6	8	4,454	2,146	3,780

Source: For 1920 - Recenseamento do Brasil, 1920 "Agricultura"
 For 1940 - Recenseamento Geral do Brasil, Sinopse do Censo Agrícola.

TABLE 17 — BRAZIL

MACHINERY IN SERVICE IN BRAZILIAN AGRICULTURAL ESTABLISHMENTS, BY STATE — 1920 - 1940

S T A T E S	Total Number of Farm properties census surveyed		Total Number of Farms possessing machinery		Tractors		Ploughs		Harrowes		Grain drills		Mowing Machines		Cultivators	
	1920	1940	1920	1940	1920	1940	1920	1940	1920	1940	1920	1940	1920	1940	1920	1940
Brazil	648,153	1,904,589	a) 97,301	a) 433,914	1,706	3,350	141,196	500,853	58,255	127,728	11,343	156,383	14,199	5,805	25,386	227,643
Acre	1,170	1,047	13	41	—	—	15	6	5	3	—	—	9	—	5	1
Amazonas	4,946	21,897	40	58	5	5	63	36	44	21	26	10	6	5	85	16
Pará	26,907	58,135	80	1,491	2	21	38	85	17	25	66	2,356	2	3	68	729
Maranhão	6,674	95,228	23	111	4	7	72	71	42	36	19	44	8	15	40	102
Piauí	9,511	32,496	21	743	—	4	43	132	11	52	5	129	5	1	11	1,454
Ceará	16,223	93,382	66	6,203	2	37	132	725	59	318	49	159	14	114	48	5,359
Rio Grande do Norte	5,678	34,382	25	4,760	—	10	80	571	46	317	18	140	3	81	29	5,984
Paraná	18,378	65,137	83	3,548	12	13	162	496	97	211	38	138	34	178	153	2,016
Pernambuco	23,336	123,266	1,089	4,812	36	72	2,368	3,213	1,513	2,119	121	305	55	32	508	5,943
Alagoas	8,840	32,781	112	1,096	2	34	678	1,007	146	502	64	35	10	19	40	1,128
Sergipe	8,202	34,579	137	3,976	4	31	678	569	133	118	6	696	4	13	128	1,170
Baía	65,181	226,343	237	5,898	12	43	532	1,645	201	275	73	473	34	86	83	710
Minas Gerais	115,655	284,685	12,244	40,697	153	253	17,513	49,373	2,647	3,538	911	3,752	190	576	1,183	6,781
Espirito Santo	20,941	41,919	98	2,257	1	24	140	708	61	205	19	49	8	18	26	117
Rio de Janeiro	23,699	48,389	1,779	6,194	58	140	4,234	8,248	2,079	1,477	418	229	162	86	539	965
Distrito Federal	2,088	7,994	125	316	6	8	154	245	80	140	15	30	14	10	36	62
Sao Paulo	80,921	252,615	13,716	120,086	401	1,410	27,922	168,073	8,376	32,502	1,284	64,484	1,232	1,932	10,597	83,037
Paraná	30,951	64,397	5,672	20,772	95	65	7,000	20,498	5,681	12,380	316	5,759	835	322	903	7,766
Santa Catarina	33,744	88,469	5,887	23,402	94	71	6,126	21,431	3,903	7,934	1,157	4,961	777	654	1,631	4,433
Rio Grande do Sul	124,990	230,722	55,660	186,028	817	1,104	73,403	222,657	3,014	65,322	7,696	72,334	10,780	1,362	9,200	99,467
Mato Grosso	3,484	10,022	159	1,007	1	15	222	719	87	120	36	128	16	52	62	320
Goiás	16,634	55,908	36	416	1	13	32	345	13	113	6	192	1	46	11	88

a) Including figures relating to the region of Sierra dos Simones, Territory in dispute between the State or Minas Gerais and Espirito Santo.
SOURCE: Directoria Geral de Estatística, Recenseamento do 1920; and Serviço Nacional do Recenseamento, 1940.

and in particular tractors, restricted their exports to the maximum, especially between 1940 and 1945, and this not only put an added burden on the existing equipment, but also made its renewal and normal maintenance impossible. During the five years from 1935 to 1939, Brazil imported 1,501 units from the United States, while in the 1940-1944 period only 633 units, or 42 per cent, were imported. Against this, the cultivated area increased by 14 per cent between 1935 and 1944. If the average life of a tractor be considered at between 13 and 15 years 1/ 2/, it can be seen that during the war, and taking as a basis the number of tractors available in 1940, the imports of new tractors were insufficient to replace those machines which dropped out of service every year. Thus, taking the number of tractors in service in 1940, and considering 14 years as the average life of a tractor, it would have been necessary to import at least 240 tractors per year to avoid a decrease in the number of tractors in service. This did not occur, but the situation was partly remedied by overworking the existing equipment, and maintaining the tractors in service for longer than their normal life. This procedure has, without doubt, brought about losses in the efficiency of the machines, and higher operating costs.

The imports of other types of machines also diminished considerably during the war, and in some cases, notably that of grain drills, fell to an almost insignificant level. The following table, though incomplete,

1/ Average tractor life in the U.S.A. For Brazil, the figure must surely be less.

2/ Orlin J. Scoville, Fixed and Variable Machine Depreciation, Agricultural Economics Research BAE - USDA, Washington, D.C., No. 3 July, 1949.

/gives a rough

gives a rough idea of the extent to which these imports diminished. The number of tractor units exported from U.S. to Brazil is reproduced in preference to the tonnage figure given in the Brazilian Exchange Control statistics, as the former presents a clearer picture of the situation. (More than 95% of Brazil's imports of tractors come from the U.S.) (See Table 18).

After 1945, when a greater volume of farm machinery was available in the export market, and as Brazil's quotas were enlarged, the imports increased rapidly in order to meet the enormous demand which had accumulated during the war, and on account of the marked tendency towards mechanization in certain sectors of production. The imports of tractors in 1947, for example, were 456 per cent greater than in 1945, and imports of ploughs increased by 382 per cent, during the same period. Detailed data for imports in 1948 and 1949 are not available, but the item "Instrumentos y Máquinas Agrícolas" (Farm Implements and Machines) of the Resumen Mensual del Comercio Exterior (Foreign Trade Monthly Summary) indicates that the total imports during 1948 were 22 per cent higher than in 1947. In the first 8 months of 1949, these imports were 178 per cent higher than during the same period of 1948. Nevertheless, it should be borne in mind that imports of agricultural machinery represent only a small and insignificant percentage within the total value of Brazil's imports, since they never, from 1937 to 1948, rose higher than 0.7 per cent of the total value, and similarly, they only represent a slightly higher proportion within the imports of machinery and equipment in general. It is absurd that only

/0.4 per cent

Table 18. Imports of tractors and agricultural implements 1925 - 1947

Year	Tractors (units) <u>a/</u>	Ploughs (tons)	Threshers (tons)	Grain drills (tons)	Other farm machinery and implements (tons)
1925	946	1,295	--	--	--
1926	179	803	--	--	--
1927	240	355	--	--	--
1928	272	782	--	--	--
1929	316	1,160	--	--	--
1930	112	662	--	--	--
1931	6	34	--	--	--
1932	16	23	--	--	--
1933	54	93	--	--	--
1934	72	564	--	--	--
1935	118	694	--	--	--
1936	208	1,036	--	--	--
1937	333	3,574	44	40	399
1938	333	2,121	105	70	1,518
1939	509	1,571	--	--	--
1940	131	487	--	--	--
1941	256	265	17	7	637
1942	135	183	13	2	129
1943	49	213	28	4	293
1944	62	247	32	8	370
1945	290	285	13	20	358
1946	578	743	35	50	920
1947	1,613	1,375	135	92	2,195

a/ Exports of tractors from United States to Brazil in units.

Source: For tractor exports: Foreign Commerce & Navigation of the United States.

Others: Comercio Exterior do Brasil - Ministerio da Fazenda.

0.4 per cent of total imports should be allotted to an activity which in 1946 produced 29 per cent of the national income, and 72 per cent of the exports.

If the capital invested in agriculture in the year 1940 is examined, the small and insignificant degree of mechanization which existed in Brazil in that year will be seen even more clearly. According to the census figures the average value of agricultural machinery and implements amounted only to 46 cruzeiros per hectare cultivated. In the most highly mechanized state, Rio Grande do Sul, this value rose to 100 cruzeiros per hectare, while at the other extreme, in the least mechanized states, the value of agricultural machinery varied between 12 and 14 cruzeiros per hectare (Acre, Amazonas, Piauí, Baía and Mato Grosso). In the same year (1940) the value of agricultural machinery and implements existing in the United States was equivalent to 375 cruzeiros per hectare (22.18 dollars at the official exchange of 16.89 cruzeiros per dollar)^{1/}. Investments in agricultural machinery and implements within the real capital of agriculture are relatively small and show once more that, at any rate until 1940, human labour was predominant. Taking into account the total real capital ^{2/} the value of machinery and implements represented only 2.5 per cent. This figure, however, may give rise to errors of interpretation since together with cultivated lands it includes

^{1/} Bureau of the Census, Statistical Abstract of the United States, 1944-1945.

^{2/} Including the value of the land and its improvements, constructions, animals, enclosures, agricultural machinery and implements and transport vehicles.

uncultivated lands, woodlands, etc. Considering that of the total area in farms, only 9.5 per cent corresponds to cultivated lands, only the value of improvements, constructions, animals, machinery and vehicles has been included in real capital. Of this capital, which is itself very low, the part corresponding to machinery and implements as an average for Brazil, reaches only 5.7 per cent.

In summary, the following conclusions may be drawn from the foregoing:

1. Brazilian agriculture is on the whole in a pre-capitalist state. Capital investments in agricultural machinery and implements are insignificant, and these are concentrated in only 23 per cent of the agricultural properties. The remaining 77 per cent totally lack any working tools which would economise labour.
2. From the scarcity of ploughs, harrows and other farm machinery and from their concentration, it may be deduced that the use of draught animals for tilling the ground and for other strictly agricultural tasks is on a very small scale. Consequently it is possible to conceive that more than 75 per cent of the crops are obtained by the exclusive use of human labour, with the resulting low yield.
3. During the last four years there has been a considerable increase in imports of agricultural machinery to replace equipment which was overworked during the war due to the lack of imports. In any case, adding to these imports the machinery and light implements manufactured in Brazil, a marked tendency towards intensification of mechanization can be noted.

/Forces which

Forces which are opening the way to mechanization

By degrees, within the slow agricultural development of Brazil, certain phenomena have become evident, which open the way for technological changes and in many cases forcibly impose them. This is the case with the use of draught animals and mechanization in Brazil.

Already, from the data for the census of 1920 and 1940 it may be observed that the population gainfully employed in agriculture has increased proportionately less than the cultivated area. Thus, while the cultivated area increased by 183 per cent in the space of 20 years, the population gainfully employed in agriculture only increased by 50 per cent; as a result the area cultivated per agricultural labourer increased from 1 to 1.9 hectares. It is possible that due to the margin of error to which the census data of 1920 are subject, the difference is not so great, but in any case, it can be seen that there has been a marked increase in the area which, on an average, each agricultural labourer has to tend. This means, then, that in that period of time either the efficiency of the agricultural labourer has improved, or else that there were too many workers in 1920, who have since slowly emigrated to the cities.

The process of industrialization through which Brazil is passing has created a great demand for workers in the cities and, in nominal terms at least, industry has offered and continues to offer higher wages than agriculture, as well as less exhausting work. The peasant, anxious to improve his lot, has not hesitated to accept the conditions

/offered by

offered by industry and other activities, and is emigrating to the cities, thus creating more or less serious difficulties in agriculture.^{1/} At the same time it is as well to point out that the differences in real wages between the city and the country (especially in the case of the important agricultural centres) are not so great as the nominal wages would lead one to believe, since the agricultural worker receives, generally, his house, some land for growing his food, either as the absolute owner of the crop or on shares, and, at times, pasture rights for his animals. Nevertheless, there are few regions in Brazil where one does not hear complaints about the shortage of labour.

This shortage of workers, together with the rising cost of living and the constant attraction of workers to industry during the last two decades, has brought about a considerable increase in rural wages. We have no data available to prove this statement, but practically all the authors who write on Brazilian agriculture emphasise this point. Spiegel, among others, indicates that rural wages have trebled in the last ten years ^{2/}. Nevertheless, this tendency did not show itself until the depression of the thirties, for one of the few studies on the subject shows that agricultural wages in the State of Sao Paulo, between 1913 and 1934, increased more slowly than urban wages, and never at any time equalled them. In 1929 and 1930, the index of the first (Base: 1913=100)

^{1/} Report of the Joint Brazil-United States Technical Commission, Rio de Janeiro, Brazil, February 1949, page 69. T. Lynn Smith, Brazil, People and Institutions, Louisiana State University Press, 1945.
Benjamin H. Hannicutt, Brazil Looks Forward, Rio 1945, pages 41 and 86.

^{2/} Spiegel, op. cit. page 183.

only reached 235, while that of the second had risen to 297; for 1934 they had dropped to 165 and 228 respectively. 1/

The shortage of labour, added to the constant increase of agricultural wages, has forced the farmers to seek means of improving the efficiency of their workers and to increase the rate of work. On the one hand, they have sought to use simple machinery and implements, which would be relatively cheap and drawn by animals. The appreciable increase in the number of mules and donkeys is an indication of this tendency, since while there were 2.2 million head of these animals in 1940, the figure had risen to 4 million by 1945, an increase of 81 per cent. The use of cattle as draught animals for strictly agricultural work has also increased. At the same time, though to a much smaller degree, motorised mechanization has been introduced. Nevertheless, in spite of the fact that the wage-cost, machine-cost ratio has been constantly narrowing, this has not been adopted to any great extent to the relatively heavy initial investments required to purchase the equipment.

Any effort to speed up the work or improve the yield of the worker is of great benefit to the farmer, since with the hoe system, an average worker could in 1940 cultivate less than two hectares. 2/ Some tasks are very difficult and require a great deal of work. Thus, for example, in

1/ Mario Cadim, *Ensaio de Análise de Fatores Económicos e Financeiros de Estado de São Paulo e do Brasil no período 1913-1914*. Method of index numbers, São Paulo, Secretaria de Agricultura, Industria y Comercio 1936.

2/ Report of the Joint Brazil-United States Technical Commission, op. cit. page 74.

order to clear and fell the trees of a hectare of wooded land, an average of 25 man-days is required 1/. Mr. Spielman 2/ estimates that the production of a bale of cotton requires 640 man-hours, while in the United States a maximum of 240 man-hours is required for the same work. The harvesting of one hectare of rice requires 14 man-days and costs 330 cruzeiros while the mechanised harvesting of the same area would require only three men and would cost 81 cruzeiros 3/.

On the other hand, the high prices reached by agricultural products, have brought the advantages of mechanization more within reach of the farmer. The index of prices paid to the farmer for Brazil as a whole (Base 1937=100) had risen in 1947 to 311, whereas the index of export prices of the United States for tractors (in cruzeiros) only reached 243. One would imagine that such a great difference might induce the producers to invest greater capital in the acquisition of mechanized equipment and implements, especially if these contribute towards reducing the costs of production and relieving the scarcity of labour.

It has already been seen that the drop in coffee has brought about important changes in the agricultural structure of Brazil; the production of some crops has acquired greater importance and new ones have been introduced. Many of them, such as rice, wheat, barley, oats, and even cotton require some mechanical assistance in order to be produced efficiently. Rice is undoubtedly the crop which has been most mechanized,

1/ T. Lynn Smith, Brazil, People and Institutions, op. cit. page 45.

2/ Quoted by Spiegel, The Brazilian Economy, op. cit. page 182.

3/ Salte Plan, Volume 3, Mechanization.

particularly in the States of Rio Grande do Sul, Minas Gerais and Sao Paulo. The recent great expansion of wheat has required the assistance of mechanical means not only for the preparation of the soil but also for the harvest. The same is happening in the case of other cereals. Cotton, in order to be able to compete in the world market, will have to intensify its degree of mechanization, as its cost of production is relatively high. In Sao Paulo, the principal producer for export, 58 per cent of the area sown with this fibre in 1943-44 was planted and cultivated by hand, 5 per cent with machinery and 37 per cent in a combination of both 1/.

There is no doubt that under present circumstances, one of Brazil's principal problems is that of agricultural mechanization. Any programme of intensification of production must be based on greater productivity per man and on lower production costs. This objective can only be achieved by means of improved technology and the use of proper implements. It should be stressed that much can be achieved solely by using more suitable and more easily handled tools, the use of draught animals and of simple, low-cost implements. Mechanization on the basis of tractors should be used only where these machines can develop their maximum efficiency not only in relation to the area and working time, but also in relation to efficiency in handling, servicing and the supply of spares.

1/ United States Tariff Commission, Agricultural, Pastoral and Forest Industries in Brazil, 1946.

SECTION 4. PRODUCTIVITY OF BRAZILIAN SOIL AND THE USE OF FERTILIZERS

Brazil is possibly one of the few Latin American countries which is not faced with serious problems concerning the availability of new areas of cultivation, and where there is no pressure of population on the land. Apart from the North-eastern region, which suffers from periodic droughts, and one or two states in the south of the country, there are still great expanses of virgin soil which could be broken to the plough. In other words, Brazil's agricultural potential has not yet been fully utilized.

In 1948 the cultivated area occupied only a small proportion of Brazil's vast territory. If it be assumed that the cultivated area for the 21 principal crops bore the same relation to the total cultivated area as in 1940, this would mean that some 21,000,000 hectares were cultivated, that is, 2.7 per cent of the total area of the country. According to the 1940 census, 88,141,000 hectares were covered with pasture. This area may be supposed to have remained relatively stable, since on the one hand some pasture lands have been given over to crops, and, on the other hand, relatively impoverished or eroded agricultural lands were planted with grasses. Taking into account the areas occupied by grasses not only on agricultural estates but also on the fiscal lands, it is considered that these constituted around 19 per cent of the total area of the country, with 165,000,000 hectares.^{1/} On the other hand, it has been estimated that the area covered with forests amounts to 496,000,000 hectares and forms 58 per cent of the country's total area.

Within this enormous area the reserves of land suitable for cultivation are considerable and are still partly unexplored. However, it is necessary

^{1/} Brazil - Basic Information - F.A.O.

to note that these reserves are limited. The Abbink Commission, in its report on Brazil, chapter on agriculture, states: "The country cannot continue to permit itself the luxury of believing that there will always be unlimited extents of fertile land beyond the zones at present exploited. The good quality soils whose existence is known, but which are not exploited, are not very great, and they are in the full process of colonization and development. Brazil has never possessed great areas of fertile agricultural lands, flat and easily populated like the Argentine pampas, the Ukrainian Steppes or the plains of the Middle West of the United States". ^{1/} Moreover, it becomes increasingly difficult to reach the zones of fertile soils due to their distance from the centres of population and the lack of economic means of transport. All new expansion implies the investment of considerable capital in irrigation works, roads, transport services, supplies, etc., etc. As an example of these possibilities it is sufficient to cite the rehabilitation and recovery projects in the valley of the San Francisco River in the semi-arid zone of the Northwest and the Fluminense lowland surrounding the Federal District in the State of Rio de Janeiro.

However, taking these projects into account and making a realistic estimate of the country's potentialities in agricultural lands, the conclusion is reached that Brazil can only double its present cultivated area in the next few decades. ^{2/}

A marked movement of farmers in search of new and richer lands for cultivation has been noted in the last 20 years. About two million people have emigrated from the traditional agricultural regions to the relatively

^{1/} Report of the Joint Brazil-United States Technical Commission, op.cit. page 7

^{2/} Report of the Joint Brazil-United States Technical Commission, op.cit. page 7.

unexploited regions with rich soils and a favourable climate to the west of the State of Sao Paulo, the north of the State of Paraná and the west of Goiás. ^{1/} This emigration and colonization has even reached the North-eastern section of the State of Mato Grosso. ^{2/}

These movements of the agricultural population have been accompanied and, to a certain extent, preceded by a marked tendency towards the subdivision of the lands at present cultivated, by a considerable rise in land values and by the intensification of agricultural work on some of the states in the South, and particularly in the State of Sao Paulo.

I. Erosion and loss of fertility of soils

For many reasons a large part of the soils which are at present under cultivation are rapidly losing their fertility, to the detriment of the agricultural economy of the country. The nature of this progressive impoverishment of the soils, and in particular of those of the zone which includes the States of Rio de Janeiro, Sao Paulo, Paraná Norte, and parts Goiás and Minas Gerais, constitutes at present one of the main problems with which agriculture is faced. The yields of agricultural production in general tend to decrease and in some regions the extreme has been reached of having to abandon extensive areas because their cultivation became uneconomic (principally lands cultivated with coffee, oranges and cotton).

The physical characteristics of a large part of Brazilian soil, its broken topography, the methods of cultivation and the crops themselves have all contributed to the progressive impoverishment of the soil.

^{1/} Report of the Joint Brazil-United States Technical Commission, op. cit. page 70

^{2/} Report of the Joint Brazil-United States Technical Commission, op. cit. page 70

The latheritic formation of a considerable proportion of the soils at present exploited in Brazil endows them with good physical conditions for cultivation, but in turn causes them to be easily washed away: Thus they do not retain their productivity for long, since the soluble elements in the soil are easily dissolved in the heavy rainfalls. Moreover, this rainwater, alternating with the strong tropical sun and the fire usually used for forest clearance, contribute towards the rapid oxidisation of the abundant organic matter which accumulates in the greater part of the soils covered with tropical vegetation. It is this rapid loss of fertility which explains one of the most common characteristics of the country's agriculture, that is the cultivation of a given area for a few years until the yields commence to decline, when it is abandoned and the preparation of new virgin lands commences, using fire as the principal method for clearing the forests.

In some regions where the soils are more consistent and fertile, as in the sugar producing zone in the Northwest and others used for general cultivation, particularly in the extreme Southern zone, the lands have been cultivated for many generations without losing much of their fertility.^{1/}

On the other hand, the conditions already described for soils with a latheritic formation, added to the disadvantages of topography and cultivation, have helped to favour erosion. In fact, the disastrous effect caused by erosion may be seen in many regions of the country. The regions most affected are undoubtedly those which were planted with coffee during the last century and the beginning of this century in the States of Espiritu

1/ Report of the Joint Brazil-United States Technical Commission, op.cit.
page 69

Santo and Rio de Janeiro, which had to be abandoned as the yields declined and caused their exploitation to be uneconomic. In the greater part of this region coffee was cultivated on sloping surfaces and even relatively pronounced gradients, where the lines of trees were planted following the slopes, and where no precautions were taken to prevent the land being washed away. (Unfortunately, at the present time, the majority of new plantations continue to be laid out in exactly the same manner). This characteristic was even further aggravated by the necessity or custom of constantly weeding the soil between the lines of coffee shrubs. Many of the lands formerly planted with coffee have been left so impoverished that they were practically barren and there was nothing to be done but to abandon them. Some were sown with grasses and others were planted with fruit trees (oranges and bananas), trees (especially eucalyptus) or other crops of lesser importance. This progressive abandonment was compensated by the development of new lands in the State of Sao Paulo and later, by the rich soils to the west of this same state, the north of Paraná and the south of Goiás.

The fruit plantations in the different states have not had very encouraging results for the soil, neither have the majority of weeded crops (crops planted in rows, which require the soil to be kept free from weeds). Among these, cotton is one of the crops which has contributed most towards loss of fertility of the soil above all in the State of Sao Paulo. This plant has been cultivated chiefly on loose virgin soils, of secondary quality, and on land previously given over to maize and grasses.^{1/} This crop is usually planted on gentle slopes. The looseness of the majority of soils on which cotton is grown, added to the slope of land and the

^{1/} Lawrence C. Witt, op. cit. page 628

necessity of keeping the lines between the plants free from weeds, plus the repeated planting of this same crop has contributed towards reducing fertility and opening the way to both surface erosion and furrow erosion. From time to time the control of the cotton borer, which is achieved by burning the weeds and plant residues, contributes even further towards reducing the organic matter content of the soil. Just as in the case of coffee, the result of reduced yields in some zones of the State of Sao Paulo has helped to bring about the replacement of this crop by pasture,^{1/} and even the cultivation of new lands not only within the present zone of cultivation but also in the West of this state and the North of Paraná.^{2/}

The problem of erosion has been further heightened by the antiquated methods of cultivation and the ignorance of the technique of soil preservation. Ordered and scientific crop rotation is only carried out on a very small scale and only in very few exceptional cases are cover crops included in that rotation. The practice of following the slopes with the line of planting has undoubtedly contributed more than anything else to the loss of fertility and erosion. In an experiment carried out by the Instituto Agronômico de Campinas, at the Pindorama Experimental Station, under the direction of the Secção de Conservação de Solos, it was demonstrated that the sowing of maize, in lines following the direction of the slope, produced a loss of 33 tons of soil per hectare, while, when sowing the lines with a lesser incline on similar land, the loss of soil was only 13 tons.^{3/}

In order to make known the tremendous magnitude of the problem of erosion in the State of Sao Paulo, Señor Joao Quintiliano de Avelar Marques,

^{1/} Lawrence C. Witt, op.cit. page 629

^{2/} Henry W. Spiegel, op.cit. page 183

^{3/} Salte Plan, "Sector de Alimentación", Vol. 2 Conservación de suelos

Head of the Seção de Conservação de Solos of the Instituto Agronômico de Campinas, writes: "On the whole, if the approximate individual losses of our principal methods of exploiting the soil are considered, in accordance with data so far obtained by the Seção de Conservação de Solos of the Instituto Agronômico de Campinas, and also those of the cultivated areas in the State of Sao Paulo, it is estimated that the annual losses due to erosion in the State of Sao Paulo amount to 69 million tons of land. Thus, in this land, easily assimilated nutritive elements to a global value of almost 650 million cruzeiros are washed away in the rivers".

"Considering that the waste of a layer of only 15 centimetres thick leaves the land unproductive, the result is that annually some 14,000 alquerias (29,880) hectares of land or 140 estates of 100 alquerias (242 hectares) each, with a commercial value of nearly 65 million cruzeiros ^{1/}, are rendered unproductive due to erosion in the different methods of cultivating the soil in the State of Sao Paulo".

The immediate consequences of this loss of soil and fertility is a decline in the crop yields.

Unfortunately, due to the few years for which statistics of yields are available, and the manner in which these are calculated, ^{2/} it is not possible to reach definite and categoric conclusions. Nevertheless, the data available permit some generalizations and make it possible to note the beginning of a tendency.

For the country as a whole, from 1932 until the present time, 17 of

^{1/} J. Quintiliano Marques: "Sugestoes para a solucao do problema da Conservação do Solo Colheitas", e.g. Mercados, month of July and August 1948.

^{2/} Laurival Câmara: "The yield per hectare is the result of a simple division of production by the cultivated area" - "Aspectos Estruturais da Agricultura Brasileira" O observador Economico e Financeiro (Number 168, page 46).

the 21 principal products have varying degrees towards a decline in yield. Nine of these crops - potatoes, rye, tobacco, pineapple, wheat, maize, manioc, sugar cane, beans and castor oil - seem to have followed a tendency towards a decline in yield from the very year in which statistics of yield began to be compiled. Coffee, cacao, barley and oils improved during the first part of the thirties, but later yields began to decline and this tendency persisted until last year. Cotton behaved differently, since its yields improved progressively until 1944, when the highest yield since 1932 was obtained, with 703 kilos per hectare. From 1945 onwards, the average production per hectare fell sharply, remaining at a low level in comparison with the year of maximum production, or the majority of the former years (see Table 19 and Charts 15, 16, 17 and 18).

A few products - bananas, rice, oranges and grapes, appear to have maintained a general tendency to increase their yields.

Undoubtedly the declining yields of many of these crops may be due to factors other than loss of fertility of the soils, such as bad weather conditions, diseases, lack of efficiency in cultivation, etc. However, only a few specific diseases could have attacked this or that crop in a permanent and progressive form, and it is highly improbable that such diseases could have influenced all the crops mentioned. It may therefore be fairly accurately stated that the loss of fertility in the soils was in the greater part of the country the principal cause of the declining unit yields in agriculture.

The Salte Plan shows quite clearly the disastrous effects which erosion is having on the country, and considering this problem as of prime importance, requiring urgent attention, it was placed among the principal projects of

/the Plan with

Table 19: Agricultural Yields - Three-yearly Averages

(Units per hectare)

Years	Cotton (Kil o g r a m m e s)	Rice	Oats	Bananas Bunches	Potatoes (Kil o g r a m m e s)	Cacao	Coffee
1932/4	523	1,413	950	1,407	9,147	587	440
1935/7	587	1,393	1,367	1,117	6,230	673	400
1938/40	632	1,485	849	995	5,785	664	393
1941/3	671	1,694	865	996	5,791	583	393
1944/6	523	1,529	750	1,265	5,189	476	342
1947/9	444	1,545	703	1,407	4,823	444	406

Years	Sugar cane	Barley	Beans	Oranges	Manioc	Maize	Wheat	Tobacco
	(.....K i l o g r a m m e s.....)							
1932/4	38	997	850	340	15,220	1,390	923	1,030
1935/7	37	1,347	903	323	13,687	1,483	953	830
1938/40	38	1,223	806	309	12,876	1,263	602	1,002
1941/3	39	1,136	867	289	13,228	1,279	799	952
1944/6	37	898	725	358	12,661	1,288	655	857
1947/9	38	1,106	686	399	13,504	1,276	808	807

Source: Serviço da Estatística da Produção Ministério da Agricultura e Instituto Brasileiro de Geografia e Estatística.

the Plan with a budget of 1,572 million cruzeiros, extending from the creation of the Departamento Nacional de Conservação do Solo to effective assistance to the farmer in the form of machinery, credits and technical co-operation.

II. Utilization of fertilizers

Very little has been done in Brazil to counteract the effects of erosion and the loss of fertility in the soils. Difficulties of different kinds have prevented the establishment of a national service of soil preservation which would cover the whole territory. The few existing institutions are mainly of an experimental nature, and have been able to achieve little in comparison with the country's enormous area and the magnitude of the problem.

Until now, one of the few practices which have been followed in order to counteract the loss of fertility and to improve yields, is the fertilization of the soils, and even this has been carried out only on a small scale in certain zones and for a limited number of crops.

The necessary data are not available to make a careful analysis of the use of fertilizers and their influence on production. It is only possible to cover certain aspects regarding the extent of their use and the reasons why this has not been more intensified.

The use of fertilizers appears to have reached a high point in 1929 when, due to the high price of coffee, it was advantageous to do so. As soon as the prices of this product dropped, at the end of the same year, the total consumption of fertilizers fell simultaneously. ^{1/} Since 1930, the year from which statistics are available covering imports of fertilizers

^{1/} Report of the ECLA/FAO Working Party - E/CN.12/83, page 118.

for the State of Sao Paulo, a slight decrease in volume can be noted until 1932, when only 4,300 tons were imported. In 1933, principally due to the intensification of cotton cultivation, imports increased to 7,600 tons and in 1937 they reached 53,300 tons. For Brazil as a whole, data are only available from 1937 on; they show that between that year and 1939, imports remained at a high level, but that after 1940, as a result of the difficulties brought about by the war, imports, and consequently consumption, decreased progressively and reached their lowest point in 1943 when only 20,800 tons were imported. After 1944, as soon as the supplying countries increased their deliveries, imports increased once more, this time at a mounting rate until they reached 147,400 tons in 1947. (See Table 20).

Of the total amount of fertilizers imported, the State of Sao Paulo consumed between 70 and 85 per cent annually, and this proportion only dropped in 1946, to 54 per cent.

As regards the nature of the imported fertilizers, the largest proportion corresponded to nitrogen, which was certainly due to the fact that a part of these (nitrate) was used for industry. (During the war years, and particularly in 1942 and 1944 sodium nitrate represented more than 70 per cent of the total imports of fertilizers). In the year 1947, nitrogenous fertilizers amounted 57 per cent of imports, phosphates to 26 per cent, potassiums to 14 per cent, while the remaining percentage corresponded to organic and unspecified fertilizers. (See Table 21).

Domestic production of chemical fertilizers is still small in comparison with the country's requirements. However, in 1947 the three factories of phosphate fertilizers in the State of Sao Paulo produced 41,000 tons, principally based on the apatites of Ipanema and Jucupiranga. The Volta

Table 20: Imports of Fertilizers into Brazil and the State of Sao Paulo

(Volume and Value)

Years	x Sao Paulo total volume tons	B R A Z I L		
		Volume for agricultural purposes - tons	Volume of total imports - tons	Value cruzeiros
1930	5,861	...	...	..
	4,957	..	..	..
	4,337	..	..	..
	7,656	..	..	..
	16,257	..	..	..
1935	20,527	..	..	..
	34,284	..	..	..
	53,319	53,174	62,615	28,701
	36,484	44,675	52,361	35,705
	51,525	47,379	62,484	30,615
1940	31,978 <u>a/</u>	21,573	42,821	30,171
	31,978 <u>a/</u>	33,342	41,011	31,863
	31,978 <u>a/</u>	29,531	40,713	27,337
	31,978 <u>a/</u>	6,626	20,865	21,082
	31,978 <u>a/</u>	46,371	59,940	55,132
1945	31,978 <u>a/</u>	50,455	60,592	59,834
	40,707	63,221	74,807	79,569
	..	132,168	147,431	180,267
1949	..	82,977	94,981	114,714
	..	..	69,306 <u>b/</u>	88,366 <u>b/</u>

a/ Annual average for the years 1940/45
b/ January to August.

Source: Comercio Exterior do Brasil - Ministerio do Fazenda, 1937-1949.
 Economic Commission for Latin America. Report of the ECLA/FAO
 Joint Working Party.

O.J.T. Etori: Situaçao dos fertilizantes em Sao Paulo
 (Secretaria da Agricultura, Sao Paulo, 1947).

Table 21: Imports of fertilizers by groups and as a percentage of total Imports.

Years	Phosphates		Nitrogens		Potassiums		Organics		Unspecified		TOTAL tons
	quantity tons	%	quantity tons	%	quantity tons	%	quantity tons	%	quantity tons	%	
1937	31,159	30.9	17,434	40	8,387	17.6	530	1	5,635	11.4	63,145
1938	23,630	31.8	14,080	39.4	6,376	17.8	873	2.3	4,015	10.7	48,974
1939	..	..	..	..	..	..	..	..	..	..	..
1940	..	..	..	..	..	..	..	..	..	..	..
1941	20,205	36.6	13,307	41.6	3,445	15.1	73	2.4	779	4.4	37,809
1942	4,112	7.0	30,371	80	1,694	7.6	860	3.9	772	1.5	37,764
1943	6,805	27.5	9,064	43.8	3,632	21.7	23	..	1,303	6.9	20,827
1944	6,348	8.5	38,159	70.7	2,468	5.9	271	0.8	9,115	14	56,361
1945	22,372	26.3	28,278	50.6	3,472	7.7	804	1.7	8,005	13.7	62,931
1946	31,877	24.0	36,550	58.0	4,188	8.1	419	4.	2,193	3.1	75,229
1947	55,626	25.6	71,905	57.7	18,149	13.8	75	1.1	1,759	1.8	147,514
1948	39,034		37,372								

Source: Comercio Exterior do Brasil - Ministerio do Fazenda.

Redonda plant placed 3,000 tons of sulphate of ammonia at the disposal of farmers. ^{1/} Since that year until the present time, the production of fertilizers appears to have increased considerably, for apart from the three chief factories - Serrana Sociedad Anónima, Citra Sociedad Anónima, and Wendel in the State of Sao Paulo, other smaller factories have helped to increase domestic production. Fortunately the country has adequate reserves of phosphates in the deposits of Serote, Jucupiranga and Ipanema in the State of Sao Paulo, those of Araxá in the State of Minas Gerais, those of Ipirá in the State of Bahia, those of Monteiro in the State of Paraíba and those of Taura in the State of Maranhao.

Apart from chemical fertilizers, considerable quantities of organic fertilizers are used, principally in the form of bone meal, oil cake (sub-product of oil extraction), dried blood, tankage, compost, ashes, etc. It is estimated that in 1946 the following fertilizers entered the trends of Sao Paulo: 50,000 tons of cottonseed cake, 10,000 tons of bone meal, 20,000 tons of "Serrano" (organic) fertilizers, 20,000 tons of different ashes, 7,000 tons of tankage and 1,500 tons of blood meal, ^{2/} that is, a total of 88,500 tons which it is assumed were incorporated into the soil almost in their entirety. There is no additional information to estimate more accurately the use of organic fertilizers in this State, and even less in relation to the country as a whole. It is known, however, that the use of fertilizers in the form of barn and green manure is small and insignificant.

^{1/} Data obtained from the Relatorio de Subcomissao da Agricultura da Comissao Mista Brasileira, February 1949.

^{2/} O.J.T. Etori: op.cit. page 12

As a general rule, the use of fertilizers in Brazil is limited to certain crops. In the State of Sao Paulo, which, as has been indicated, consumes about 80 per cent of the chemical fertilizers imported into Brazil, some 40 per cent of these is absorbed by the cultivation of cotton, 25 per cent by the cultivation of potatoes, 15 per cent by vegetables, and the rest by other minor crops. ^{1/} It should be noted at the same time that, in spite of cotton being the most fertilized crop from 1938 to 1944, only between 6.6 and 8.9 per cent of the total area sown with this fibre received the benefit of fertilizers.

An idea of the insignificant use of fertilizers in Brazil may be gained from the following comparison: in 1947 Chile, a country where the practice of fertilizing is limited, consumed a total of 197,400 tons of chemical fertilizers, for a total cultivated area with annual crops and fruit trees of 1,400,000 hectares. In the same year, Brazil with over 20 million hectares under cultivation consumed a total of only 176,000 tons.

The S.A.L.T.E. Plan states: "taking as a basis the present per capita consumption of the United States, which has not yet reached the theoretically recommendable limit, we should consume 1,654,848 tons of superphosphates, 856,800 tons of nitrate and 430,934 tons of potassium salts.

"These fertilizers at present prices would cost us 2,429,647,770 cruzeiros. If we deduct from this total the sum which we are at present spending on the purchase of fertilizers, leaving on one side our insignificant domestic production, we can estimate our deficit as follows:

Cr. \$2,429,647.774 - Cr. \$39,042,857 ^{2/} - Cr. \$2,390,604.886

^{1/} Report of the ECLA/FAO Joint Working Party, op. cit. page 115

^{2/} The value of imports of fertilizers from 1944 has exceeded this amount from 1944 to the present time.

"Until we return to our cultivated soil at least the quantities mentioned, we are on the road to ruin". ^{1/}

III. Forces preventing the greater use of fertilizers

Undoubtedly the principal reason for the limited use of fertilizers is their high cost, placed on the farm, in comparison with the relatively low value of agricultural products.

The price of fertilizers, in general, is high, and at times prohibitive. A moderate application of fertilizers would require an extraordinary increase in yield in the majority of crops solely to pay for the fertilizer, its transport to the estate and the cost of applying it. Any failure in yield, either due to bad weather conditions, the attack of any disease, etc., could cause considerable losses to the farmer.

The fertilization of one hectare of rice in Sao Paulo in 1945, with 400 kilos of superphosphates, 60 kilos of potassium sulphate and 125 kilogrammes of Chilean nitrate ^{2/}, would have cost about 1,300 cruzeiros (calculated at the rate of 2 cruzeiros per kilogramme of superphosphate, 2.55 cruzeiros per kilogramme of potassium sulphate, and 1.12 cruzeiros per kilogramme of nitrate placed in the city of Sao Paulo, ^{3/} plus costs of transport and application, and interest on capital). Production, calculated at prices paid to the producer in that year, would have had to increase by a minimum of 1,000 kilogrammes per hectare solely in

^{1/} Salte Plan - Sector de Ali. Section covering Nutrition, Fertilizers and Amendments.

^{2/} Quantities considered ideal in a report of the Agricultural Sub-Commission of the Abbink Commission.

^{3/} O.J.T. Ettori, op. cit. pages 9 and 10

order to pay for the cost of applying the fertilizer. The average yield for that year was 1,394 kilogrammes per hectare. In the case of maize, the value of fertilization (only superphosphates and potassium sulfate)^{1/} would have been over 1,000 cruzeiros per hectare and would have required an increase of 1,300 kilogrammes over the average yield in order to pay the cost of fertilization alone. Such increases in yield are probable, but the risk is great, and in many cases the results are disheartening.

To the high price of fertilizers must be added the immensely high cost of transport, a factor which in many cases is sufficient to prevent its use. In the same State, "the transportation of a ton of fertilizers by rail for a distance of only 200 kilometres increases its price by 12 per cent. This situation is even more acute in those places in Brazil which lack good means of communication".^{2/} Another factor which prevents the greater use of fertilizers is the lack of knowledge on the part of the farmers of the technique of fertilization, the requirements of the soils and crops and the proper quantity to apply in each case. In addition, the low level of agricultural practices, the insecurity of the harvests due to climatic factors, etc.etc., have to be taken into account.

After the last war the situation regarding the possibility of intensifying the use of fertilizers improved considerably, and it has already been possible in part to see the results. In fact, the prices of agricultural products have been increasing in greater proportion than the prices of fertilizers. No information is available regarding the prices paid by the farmer at the farm or in the city for fertilizers, but

^{1/} Quantities considered ideal in a report of the Agricultural Sub-Commission of the Abbink Commission.

^{2/} Report of the ECLA/FAO Joint Working Party, op. cit. page 161

/the changes in

the changes in the import prices of fertilizers are known. Assuming that the difference between the import prices and the retail prices have remained stable, the former have been used to calculate the indices of the price ratio between certain agricultural products (prices paid to the farmer) and imported chemical fertilizers (average import prices C.I.F.) with 1937 as base year. (See Table 22).

It can be seen from these indices that since 1944 the prices of coffee, beans and maize rose in greater proportion than the prices of imported fertilizers. The same has occurred with cotton since 1946, and with rice in 1948. Only tobacco prices rose in lower proportion than those of fertilizers.

These differences, while they do not prove that the use of fertilizers is economic, at least make it clear that the difference between the prices of the one and the other have been reduced and that there are greater possibilities that the cost of buying and applying fertilizers may be amply paid for with a lower increase in production.

IV. Other factors obstructing agricultural development

There are other numerous and complex factors which have retarded the agricultural progress of Brazil and which have not been analysed here. The four principal factors which require more immediate attention have been indicated. Others, such as the system of land tenure, agricultural credit, control of agricultural and livestock pests and diseases, transport, warehousing, colonization, irrigation, etc., etc., are also factors of great importance which have contributed to a greater or lesser degree towards hindering the development of Brazilian agriculture. The study of each of these factors should be carried out in detail in the near future.

Table 22: Index of the price ratios between fertilizers
and various agricultural products

(1937 = 100)

Years	FERTILIZERS					
	Cotton	Rice	Coffee	Beans	Maize	Tobacco
1937	100	100	100	100	100	100
1938	150	162	138	142	148	152
1939	114	122	100	90	111	114
1940	164	178	150	113	146	176
1941	195	180	162	123	162	190
1942	130	142	120	105	120	143
1943	153	168	156	132	103	176
1944	139	128	82	90	89	124
1945	136	113	65	79	72	100
1946	83	105	47	68	66	86
1947	91	123	59	68	77	105
1948	82	96	56	47	65	110

Source: Prices of agricultural products: Statistical Annual IBGE.
 Prices C.I.F. of fertilizers: Estadística de Comercio Exterior,
 Ministerio de Fazenda.

