V. SELECTION OF FARM WORK MACHINERY

1) Tractor

In tractors which constitute the driving force in cultivating paddy, soybean and wheat, there are two types, i.e. crowler type and foil type. We adopted the foil type tractors, because this type enables us to drive the farm easier under the soil conditions of the area, and this type of a tractor has advantages in economization, activity and wide use, even though its pulling capacity is very less in comparison with a crowler type. We selected the kinds of this foil type tractor which are fitting for each work.

2) Machine for cultivation

As a cultivation machine for a tractor, we adopted a disk plow which is very prevalent around the survey area. In comparison with a bottom plow, a disk plow has less capacity in reversal and much less horse power, but it has higher adjustability to obstacles such as stones and roots, etc. Also a disk plow can cultivate the hard soil deeper without loading weight on the body of a plow, and breaks up soil into comparatively smaller pieces so that it enables the work of breaking soil easier. It also must have higher working standard, because it has been well extended in the survey area. For these reasons, we selected disk plows for cultivation work of paddy, soybean and wheat. We selected the kinds of size by considering the work volume of each management body.

3) Machine for harrowing

For harrowing, we adopted disk harrows which have been popularly extended in the area. A disk harrow was produced mainly for the purpose of harrowing. It also has high efficiency in levelling the ground and preparing the soil even in working on big clods of earth after works, if we adjust its body and repeat the number of its operation. It is thus more advantageous to adopt in comparison with the other kinds of harrow, and thus it is fitting for the purpose of harrowing in cultivating paddy, soybean and wheat. We selected the suitable kinds of disk harrow according to the land scale of each management body.

4) Machine for land levelling

In paddy culture, it required the precision of land levelling for the purpose of irrigating the field. We adopted a land leveller, which does not consolidate the on-farm after it is broken up and prepared, but levels up the soil effectively and efficiently by automatically adjusting its precision with the oil pressure device attached to the body. We judge a land leveller to be an efficient machine for the levelling work of a paddy field.

5) Fertilizing and planting machine

We adopt a grain drill which is capable to plant seeds in lines, and capable to ditch and cover it up, for planting and fertilizing in cultivating paddy, soybean and wheat. For planting soybean, we attach the device of a bean planter to the grain drill for planting wheat. In a grain drill, seeds and fertilizer are made to fall through respective hoppers into the ditches, which are then covered. It is therefore effective in preventing the movement of seeds and damage of eating them caused by wild birds. It is also efficient for performing fertilization work and planting work simultaneously. A grain drill was adopted here because of its efficiency stated above.

6) Subsoil breaking machine

We adopt this subsoil breaking operation for cultivating soybean and wheat. It is aimed at breaking up the soil at 45 ∿ 50 cm below the ground, for which we decided to adopt a subsoiler for deep cultivation that are commonly prevalent around the survey area. It is expected to perform this operation of subsoil breaking every once in four years in order to prevent the soil from getting hardened. We selected its kinds according to the land scale of each management body.

7) Machine for intertillage and weeding

We employ this operation of intertillage and weeding in cultivating soybean, and we adopted a cultivator with a view to performing intertillage and weeding efficiently through the lines of furrow where soybeans are on the way of growing. Generally speaking, a cultivator can be employed until the crops grow upto 30 ∿ 45 cm. It can be used for the work of intertillage and weeding, etc. by simply changing the angles and shapes

of blades and nails attached to the machine. A cultivator is thereby effective.

8) Machine for additional fertilizing, weeding, and control of disease and insect damage.

8-1) In paddy cultivation, we perform additional fertilizing weeding and control of disease and insect damage during the period when paddy is growing. However, these works are difficult to be performed from both sides of on-farm by sprayers, etc. due to the size of a plot (about 500 × 500 m).

We can also think about a method to attach basket wheels for paddy fields to a tractor and spray fertilizer and agricultural chemicals by sprayer, etc. It however spoils the paddy field and damages the ridges. Since it is not fitting to the case, we planned to use an airplane for the sake of this operation.

8-2) We selected a machine fitting for weeding and control of disease and insect damage in cultivating soybean and wheat.

For this purpose, we referred to the traditional way of cultivation adopted in the survey area, and decided to adopt a boom sprayer which is the one having a tractor as its driving force. It can proceed work efficiently in spraying herbicides and agricultural chemicals. We selected the kinds of this boom sprayer that are fitting for the area of each management body.

9) Harvesting machine

We referred to the traditional cultivation method of the survey area in deciding the machine for harvesting paddy, soybean and wheat. But since the harvest period is short due to the peculiarity of paddy, soybean and wheat cultivation, and due to the climatic conditions of the survey area, we adopted a combine (ordinary type) of high efficiency and planned it in the way the work efficiency will be promoted. The combine to be adopted for harvesting soybean corresponds to a kind of machine used for harvesting wheat by adjusting a part of it, so we combined them together.

10) Transporting machine

In the work of transporting crops, we use a foil tractor in an efficient way. Also we adopt a trailer for farming (bulk dump type),

upon our study made on the scale of farm roads (6 m in width without gravel), and we planned to use it in combination with the foil tractor for transporting agricultural materials and crops. It is planned to load crops inside on-farm or on a farm road immediately from the combine in bulk, and carry them straightaway to the drying and preparing equipment for promoting work efficiency.

VI. CALCULATION OF CRITERIA FOR THE STANDARD WORK EFFICIENCY OF MAIN AGRICULTURAL MACHINES IN CULTIVATING PADDY, SOYBEAN AND WHEAT

Work efficiency differs variously depending on the respective conditions such as the plot of on-farm, precision of work, method of work, mode of cultivation of crop, operators' technical standard and so on. However, with a view to framing a standard which will fit as much the conditions of locality as possible, we assumed criteria of the standard work efficiency as to each crop of cultivation and as to each machine for each type of work, by referring to the 'Farming Section' of "Practical Techniques for Agricultural Mechanizations (5)" (pub. by Nogyo Gijutsu Kenshu-kai, April 1983). Also we assumed the criteria of the standard work efficiency of machines that are not listed in the abovementioned works by studying the efficiency of similar machines. (Table 4-1-22)

Also as to the capacity of field work in the mechanization work of each farming pattern based on the above results, we computed it by multiplying working speed and on-farm work efficiency to the work range by the theoretical expression. (Tables 4-1-20 ∿ 4-1-21)

Table 4-1-20 On Farm Operation Hours Per Ha of Machine for Paddy Rice Culture

Item / Available tractor HP	On farm operation hours per ha														Remarks
	Plowing		Harrowing		Land levelling		Fertilization, sowing seeds		Ridging		Harvest		Transportation		
	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	
Tractor 45 PS	0.289	3.50	0.675	1.50	1.050	1.00	0.398	2.50		1.50			-	1.50	
Tractor 70 PS	0.403	2.50	1.073	1.00	1.350	0.75	0.535	2.00		0.80			-	1.50	
Tractor 80 PS	0.519	2.00	1.344	0.75	2.180	0.50	0.680	1.50		0.80			-	1.50	
Tractor 90 PS	0.560	1.80	1.443	0.70	2.352	0.45	0.720	1.40		0.80			-	1.50	
Tractor 100 PS	0.639	1.60	1.526	0.66	2.464	0.40	0.760	1.30		0.80			-	1.50	
Tractor 120 PS	0.801	1.25	1.650	0.60	3.248	0.30	0.968	1.10		0.80			-	1.50	
Combine 95 PS											-	1.50	-		

Table 4-1-21 On Farm Operation Hours of Machine for Soybean and Wheat Culture

Item / Available tractor H.P	On farm operation hours per ha																	
	Plowing		Harrowing		Subsoil crushing		Fertilization, sowing seeds		Intertillage (Weeding)		Weeding		Control		Harvest		Transportation	
	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha	ha/hr	hr/ha
Tractor 45 PS	0.289	3.50	0.990	1.00	-	-	0.569	1.75	1.015	1.00	1.020	1.00	1.020	1.00				
Tractor 70 PS	0.403	2.50	1.320	0.75	0.330	3.00	0.653	1.50	1.400	0.75	1.386	0.75	1.386	0.75				
Tractor 110 PS	0.801	1.25	2.652	0.375	0.673	1.50	0.990	1.00	1.980	0.50	2.070	0.50	2.070	0.50				
Combine 95 PS														Soybean Wheat	0.819 0.955	1.25 1.00	- -	1.25 1.00

Table 4-1-22- ⓐ Standard Table of Standard Operation Efficiency of Main Farming Machine for Paddy Rice Cultur

Works	Machine		Required tractor power	Work details	Operation efficiency						Operation times	Operation hours per ha	Remarks
	Name	Type, size			Operation width	Operation speed	Theoretical operation area per hour	On farm operation efficiency	On farm operation				
			PS		m	km/hr	ha/hr	%	ha/hr	hr/ha	time	hr	
Plowing	Disc plow	Direct attached type 26 HP× 3	45	Plowing depth 15 ∿ 25 cm gathering plowing ∿ Roundabout plowing	0.92	4.5	0.414	70	0.289	3.50	1	3.50	
	"	Pulled type 26 " × 5	70		1.28	4.5	0.576	70	0.403	2.50	1	2.50	
	"	28 " × 6	80		1.65	4.5	0.742	70	0.519	2.00	1	2.00	
	"	28 " × 6	90		1.78	4.5	0.801	70	0.560	1.80	1	1.80	
	"	28 " × 7	100		2.03	4.5	0.913	70	0.639	1.60	1	1.60	
	"	28 " × 8	120		2.29	5.0	1.145	70	0.801	1.25	1	1.25	
Harrowing	Disc hallow	Direct attached type 20 HP× 20	45	Roundabout plowing 2 times after plowing 1 time after levelling	1.80	5.0	0.90	75	0.675	1.50	3	4.50	
	"	Pulled type 20 " × 28	70		2.60	5.5	1.430	75	1.073	1.00	3	3.00	
	"	20 " × 32	80		3.26	5.5	1.793	75	1.344	0.75	3	2.25	
	"	20 " × 36	90		3.50	5.5	1.925	75	1.443	0.70	3	2.10	
	"	20 " × 40	100		3.70	5.5	2.035	75	1.526	0.66	3	2.00	
	"	20 " × 44	120		4.00	5.5	2.200	75	1.650	0.60	3	1.80	
Land levelling	Land Leveller	Pulled type, Oil hydraulic automatic type	45	2 times lengthwises and breathwise after crushing	2.80	5.0	1.400	75	1.050	1.00	2	2.00	
	"		70		3.60	5.0	1.800	75	1.350	0.75	2	1.50	
	"		80		4.20	6.5	2.730	80	2.184	0.50	2	1.00	
	"		90		4.20	7.0	2.940	80	2.352	0.45	2	0.90	
	"		100		4.40	7.0	3.080	80	2.464	0.40	2	0.80	
	"		120		5.80	7.0	4.060	80	3.248	0.30	2	0.60	

(Cont'd)

Works	Machine: Name	Machine: Type, size	Required tractor power	Work details	Operation efficiency: Operation width	Operation efficiency: Operation speed	Operation efficiency: Theoretical operation area per hour	Operation efficiency: On farm operation efficiency	Operation efficiency: On farm operation		Operation times	Operation hours per ha	Remarks
			PS		m	km/hr	ha/hr	%	ha/hr	hr/ha	time	hr	
Fertilization, sowing seeds	Grain drill	Direct attached type 11 ∿ 13	45	Continuous return plowing Work performed simultaneously with the fertilization and sowing seeds.	2.53	3.5	0.885	45	0.398	2.50	1	2.50	
	"	Pulled type 17 ∿ 19	70		3.40	3.5	1.190	45	0.535	2.00	1	2.00	
	"	17 ∿ 19	80		3.40	4.0	1.360	50	0.680	1.50	1	1.50	
	"	19 ∿ 21	90		3.60	4.0	1.440	50	0.720	1.40	1	1.40	
	"	19 ∿ 22	100		3.80	4.0	1.520	50	0.760	1.30	1	1.30	
	"	23 ∿ 25	120		4.40	4.0	1.760	55	0.968	1.10	1	1.10	
Ridging	Ridger	Direct attached type 28 HP× 2	45	2 times mounding, H = 40 ∿ 50cm for large ridge, H = 40 cm for small ridge.						1.50		1.50	
			70							0.80		0.80	
			80							0.80		0.80	
			90							0.80		0.80	
			100							0.80		0.80	
			120							0.80		0.80	
Harvesting	Combine	Ordinary type	95	Roundabout cutting ∿ return cutting	4.20	2.5	1.050	65	0.682	1.50	1	1.50	
Transportation	Trailer	3 ton loading in bulk	45	Loading in bulk on farming road from combine						1.50	(2)	1.50	
	"	6 ton	70 ∿ 120							1.50	1	1.50	

Table 4-1-22-ⓑ Standard Table of Standard Operation Efficiency of Main Farming Machine for Soybean and Wheat Culture

Works	Machine: Name	Machine: Type, size	Required tractor power	Work details	Operation efficiency: Operation width	Operation speed	Theoretical operation area per hour	On farm operation efficiency	On farm operation		Operation times	Operation hours per ha	Remarks
			PS		m	km/hr	ha/hr	%	ha/hr	hr/ha	time	hr	
Plowing	Disc plow	Direct attached type 26 HP × 3	45	plowing depth 15 ∿ 25 cm Gathering plowing ∿ Roundabout plowing 1 time each for soybean and wheat	0.92	4.5	0.414	70	0.289	3.50	1	3.50	
	"	Pulled type 26 HP × 5	70		1.28	4.5	0.576	70	0.403	2.50	1	2.50	
	"	28 " × 8	110		2.29	5.0	1.145	70	0.801	1.25	1	1.25	
Harrowing	Disc harrow	Direct attached type 20 HP × 24	45	Roundabout plowing ∿ 2 times each for soybean and wheat	2.40	5.5	1.320	75	0.990	1.00	2	2.00	
	"	Pulled type 20 HP × 28	70		3.20	5.5	1.760	75	1.320	0.75	2	1.50	
	"	20 HP × 48	110		5.20	6.0	3.120	85	2.652	0.375	2	0.75	
Subsoil crushing	Subosiler	Direct attached type 5 - 7	70	Crushing depth 45 ∿ 50 cm 1 time 4 years for soybean	2.45	3.0	0.735	45	0.330	3.00	1	3.00	
	"	9 - 11	110		3.85	3.5	1.347	50	0.673	1.50	1	1.50	
Fertilization, sowing seeds	Grain-drill	Direct attached type 13	45	Continuous return plowing, Work performed simultaneously with the fertilization and sowing seeds 1 time each for soybean and wheat	2.53	4.5	1.138	50	0.569	1.75	1	1.75	Equipped with attachment for soybean
	"	Pulled type 17	70		2.90	4.5	1.305	50	0.653	1.50	1	1.50	
	"	26	110		4.40	4.5	1.980	50	0.990	1.00	1	1.00	
Intertillage (Weeding)	Cultivator	Direct attached type 5 - 7	45	2 times Intertillage for soybean (Weeding)	2.90	5.0	1.450	70	1.015	1.00	2	2.00	Apply to soybean.
	"	7 - 9	70		4.00	5.0	2.000	70	1.400	0.75	2	1.50	
	"	7 - 11	110		4.80	5.5	2.640	75	1.980	0.50	2	1.00	

(Cont'd)

Works	Machine		Required tractor power	Work details	Operation efficiency						Operation times	Operation hours per ha	
	Name	Type, size			Operation width	Operation speed	Theoretical operation area per hour	On farm operation efficiency	On farm operation				
			PS		m	km/hr	ha/hr	%	ha/hr	hr/ha	time	hr	
Weeding	Sprayer (Boom sprayer)	Direct attached type 400ℓ	45	Continuous return plowing 1 time herbicide application for soybean 1 time herbicide application for wheat	6.80	3.0	2.040	50	1.020	1.00	1	1.00	
		Pulled type 2,000	70		8.40	3.0	2.520	55	1.386	0.75	1	0.75	
		"	110		11.50	3.0	3.450	60	2.070	0.50	1	0.50	
Control	Sprayer (Boom sprayer)	Direct attached type 400ℓ	45	Continuous return plowing 4 times elimination for soybean 3 times elimination for wheat	6.80	3.0	2.040	50	1.020	1.00	S4 W3	4.00 3.00	S: soybean W: wheat
		Pulled type 2,000	70		8.40	3.0	2.520	55	1.386	0.75	S4 W3	3.00 2.25	
		"	110		11.50	3.0	3.450	60	2.070	0.50	S4 W3	2.00 1.50	
Harvesting	Combine	Ordinary type	95	Roundabout cutting, Return cutting	4.20	3.0	1.260	65	0.819	1.25	1	1.25	Apply to soybean
	"	"	95		4.20	3.5	1.470	65	0.955	1.00	1	1.00	Apply to wheat.
Transportation	Trailer	3 ton loading in bulk	45 ∿ 110	Loading in bulk on farming road from combine.						1.25	1	1.25	apply to soybean
										1.00	1	1.00	apply to wheat.

1. Combination of cultivation implements in paddy rice culture and estimation of work capacity

Estimation formula of working capacity;
estimate based on a theoretical formula

Theoretical work amount (ha/hr) =

$$\frac{\text{working width (m)} \times \text{working speed (km/hr)}}{10}$$

Field work amount (ha/hr) =
theoretical work amount (ha/hr) × field operating efficiency (%) ÷ 100

(1) Cultivation area, 25 ha scale

Prime mover to be used, 45 PS class wheel-type tractor

1) Plowing work (single operation), plowing depth 15 ∿ 25 cm

Plowing implement to be applied, disc plow,
direct-equipped type 26 in × 3

Working width 0.92 m

Working speed 4.5 km/hr

Field working efficiency 70%

Theoretical work amount (ha/hr) = $\frac{4.5 \times 0.92}{10}$ = 0.414 (ha/hr)

Field work amount per hour = 0.414 × 70 ÷ 100 = 0.289 (ha/hr)

Field work amount per hectare = 1.0 ÷ 0.289 = 3.460 (hr/ha)
about 3.50 (hr/ha)

2) Harrowing (single operation)

Implement to be used, disc-harrow, direct-equipped type 20 in × 20

Working width	1.8 m	
Working speed	4 km/hr	
Field working efficiency	75%	
Theoretical work amount (ha/hr)	$= \frac{5.0 \times 1.8}{10} = 0.90$	(ha/hr)
Field work amount per hour	$= 0.90 \times 75 \div 100 = 0.675$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.675 = 1.481$	(hr/ha)
	about 1.50	(hr/ha)

3) Land leveling (single operation)

Implement to be used, land leveller, traction type (hydraulic automatic)

Working width	2.8 m	
Working speed	5.0 km/hr	
Field working efficiency	75%	
Theoretical work amount (ha/hr)	$= \frac{5.0 \times 2.8}{10} = 1.40$	(ha/hr)
Field work amount per hour	$= 1.40 \times 75 \div 100 = 1.05$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 1.05 = 0.952$	(hr/ha)
	about 1.00	(hr/ha)

4) Fertilizing and seeding (simultaneous work)

Implement to be used, grain drill, direct-equipped type 11 ∿ 13 lines

Working width	2.53 m	
Working speed	3.5 km/hr	
Field working efficiency	45%	
Theoretical work amount (ha/hr)	$= \frac{3.5 \times 2.53}{10} = 0.885$	(ha/hr)
Field work amount per hour	$= 0.885 \times 45 \div 100 = 0.398$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.398 = 2.512$	(hr/ha)
	about 2.50	(hr/ha)

5) Ridging

Implement to be used, ridger 28 in × 2 discs

Ridge height; wide ridge (double operation)	40 ∿ 50 cm
narrow ridge (double operation)	Approximately 40 cm

Though the catalogue say that the tractor to be used should be bigger than 55 PS class tractor, in this calculation the working speed and field working efficiency of the ridger were set as follows:

Working speed	0.80 km/hr	
Field working efficiency	30%	
Ridge length/ha	= 0.174 km	
Standard working capacity (km/hr)	$= 0.80 \times 30 \div 100 = 0.24$	(km/hr)
Actual working capacity (hr/ha)	$= (0.174 \div 0.24) \times 2 \approx 1.45$	(hr/ha)
	about 1.50	(hr/ha)

6) Harvesting

Implement to be used, combine, standard type, 95 PS class

Working width	4.2 m	
Working speed	2.5 km/hr	
Field working efficiency	65%	
Theoretical work amount (ha/hr)	$= \frac{2.5 \times 4.2}{10} = 1.05$	(ha/hr)
Field work amount per hour	$= 1.05 \times 65 \div 100 = 0.682$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.682 = 1.466$	(hr/ha)
	about 1.50	(hr/ha)

7) Transportation

Implement to be used, 3 ton bulk dump trailer

In accordance with Table 4-1-20, the working capacity is set at 1.50 hr/ha.

(2) Cultivation area, 50 ha scale

Prime motor to be used, 90 PS class wheel type tractor

1) Plowing work (single operation), plowing depth 15 ∿ 25 cm

Implement to be used, disc plow, pulling type 28 in × 6

Working width	1.78 m	
Working speed	4.5 km/hr	
Field working efficiency	70%	
Theoretical work amount (ha/hr)	$= \frac{4.5 \times 1.78}{10} = 0.801$	(ha/hr)
Field work amount per hour	$= 0.801 \times 70 \div 100 = 0.560$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.560 = 1.785$	(hr/ha)
	about 1.80	(hr/ha)

2) Harrowing (single operation)

Implement to be used, disc harrow, 20 in × 36

Working width	3.5 m	
Working speed	5.5 km/hr	
Field working efficiency	75%	
Theoretical work amount (ha/hr)	$= \frac{5.5 \times 3.5}{10} = 1.925$	(ha/hr)
Field work amount per hour	$= 1.925 \times 75 \div 100 = 1.443$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 1.443 = 0.693$	(hr/ha)
	about 0.70	(hr/ha)

3) Land leveling (single operation)

Implement to be used, land leveller, pulling type

Working width	4.2 m	
Working speed	7.0 km/hr	
Field working efficiency	80%	
Theoretical work amount (ha/hr)	$= \frac{7.0 \times 4.2}{10} = 2.94$	(ha/hr)
Field work amount per hour	$= 2.940 \times 80 \div 100 = 2.352$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 2.352 = 0.425$	(hr/ha)
	about 0.450	(hr/ha)

4) Fertilizing and seeding (simultaneous work)

Implement to be used, grain drill, pulling type 19 ∿ 21 lines

Working width	3.6 m	
Working speed	4.0 km/hr	
Field working efficiency	50%	
Theoretical work amount (ha/hr)	$= \frac{4.0 \times 3.6}{10} = 1.44$	(ha/hr)
Field work amount per hour	$= 1.44 \times 50 \div 100 = 0.72$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.72 = 1.388$	(hr/ha)
	about 1.40	(hr/ha)

5) Ridging

Implement to be used, ridger 28 in × 2 discs

Ridge height;	wide ridge (double operation)	40 ∿ 50 cm
	narrow ridge (double operation)	Approximately 40 cm
Working speed		1.2 km/hr
Field working efficiency		40%

(The working speed and the work efficiency are assumed.)

Ridge length/ha = 0.174 km

Standard work amount(km/hr) = 1.20 × 40 ÷ 100 = 0.48 (km/hr)

Actual work amount (hr/ha) = (0.174 ÷ 0.48) × 2 = 0.725 (hr/ha)
about 0.80 (hr/ha)

6) Harvesting

Implement to be used, combine, standard type 95 PS class

Working capacity is the same with (1) 6).

Field work amount per hour = 0.682 (ha/hr)

Field work amount per hectare = 1.50 (hr/ha)

7) Transportation

Implement to be used, 6 ton bulk dump trailer

Based on Table 4-1-20, the working capacity is set at 1.50 hr/ha.

(3) Cultivation area, 100 ha scale

Implement to be used, a combination of 1 80 PS class wheel type tractor and 100 PS class wheel type tractors.

1) Plowing work (single operation), plowing depth 15 ∿ 25 cm

(a) Implement to be used for 80 PS class tractor

Disc plow, pulling type 28 in × 6

Working width	1.65 m
Working speed	4.5 km/hr
Working efficiency	70%

Theoretical work amount (ha/hr) $= \frac{4.5 \times 1.65}{10} = 0.742$ (ha/hr)

Field work amount per hour = 0.742 × 70 ÷ 100 = 0.519 (ha/hr)

Field work amount per hectare = 1.0 ÷ 0.519 = 1.926 (hr/ha)

about 2.00 (hr/ha)

(b) Implement to be used for 100 PS class tractor

Disc plow, traction type 28 in × 7

Working width	2.03 m
Working speed	4.5 km
Working efficiency	70%

Theoretical work amount (ha/hr) $= \frac{4.5 \times 2.03}{10} = 0.913$ (ha/hr)

Field work amount per hour = 0.913 × 70 ÷ 100 = 0.639 (ha/hr)

Field work amount per hectare = 1.0 ÷ 0.639 = 1.564 (hr/ha)

about 1.60 (hr/ha)

2) Harrowing (single operation)

(a) Implement to be used for 80 PS class tractor

Disc harrow, pulling type 20 in × 32

Working width	3.26 m	
Working speed	5.5 km/hr	
Working efficiency	75%	
Theoretical work amount (ha/hr)	$= \frac{5.5 \times 3.26}{10} = 1.793$	(ha/hr)
Field work amount per hour	$= 1.793 \times 75 \div 100 = 1.344$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 1.344 = 0.744$	(hr/ha)
	about 0.750	(hr/ha)

(b) Implement to be used for 100 PS class tractor

Disc harrow, pulling type 20 in × 40

Working width	3.70 m	
Working speed	5.5 km/hr	
Working efficiency	75%	
Theoretical work amount (ha/hr)	$= \frac{5.5 \times 3.7}{10} = 2.035$	(ha/hr)
Field work amount per hour	$= 2.035 \times 75 \div 100 = 1.526$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 1.526 = 0.655$	(hr/ha)
	about 0.660	(hr/ha)

3) Fertilizing and seeding (simultaneous work)

(a) Implement to be used for 80 PS class tractor

Grain drill, pulling type 17 ∿ 19 lines

Working width 3.4 m

Working speed 4.0 km/hr

Working efficiency 50%

Theoretical work amount (ha/hr) $= \frac{4.0 \times 3.4}{10} = 1.36$ (ha/hr)

Field work amount per hour $= 1.36 \times 50 \div 100 = 0.68$ (ha/hr)

Field work amount per hectare $= 1.0 \div 0.68 = 1.470$ (hr/ha)

about 1.50 (hr/ha)

(b) Implement to be used for 100 PS class tractor

Grain drill, pulling type 19 ∿ 22 lines

Working width 3.8 m

Working speed 4.0 km/hr

Working efficiency 50%

Theoretical work amount (ha/hr) $= \frac{4.0 \times 3.8}{10} = 1.52$ (ha/hr)

Field work amount per hour $= 1.52 \times 50 \div 100 = 0.76$ (ha/hr)

Field work amount per hectare $= 1.0 \div 0.76 = 1.315$ (hr/ha)

about 1.30 (hr/ha)

4) Land leveling (single operation)

(a) Implement to be used for 80 PS class tractor

Land leveler, pulling type

Working width	4.20 m	
Working speed	6.5 km/hr	
Working efficiency	80%	
Theoretical work amount (ha/hr)	$= \frac{6.5 \times 4.2}{10} = 2.73$	(ha/hr)
Field work amount per hour	$= 2.73 \times 0.8 \div 100 = 2.184$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 2.184 = 0.458$	(hr/ha)
	about 0.50	(hr/ha)

(b) Implement to be used for 100 PS class tractor

Land leveler, pulling type

Working width	4.4 m	
Working speed	7.0 km/hr	
Working efficiency	80%	
Theoretical work amount (ha/hr)	$= \frac{7.0 \times 4.4}{10} = 3.08$	(ha/hr)
Field work amount per hour	$= 3.08 \times 80 \div 100 = 2.464$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 2.464 = 0.405$	(hr/ha)
	about 0.40	(hr/ha)

5) Ridging

Implement to be used, ridger, direct-equipped type 28 in × 2

Ridge height; wide ridge (double operation) 40 ∿ 50 cm

narrow ridge (double operation) Approximately 40 cm

(The same type and the same working capacity are used for both 80 PC class tractor and 100 PS class tractor.)

Ridge length/ha = 0.174 km

Working speed 1.2 km/hr

Field working efficiency 40%

(The working speed and the work efficiency are assumed.)

Standard work amount per hour (per one operation) = 1.2 × 40 ÷ 100 = 0.48 (km/hr)

Actual work amount per hectare = (0.174 ÷ 0.48) × 2 = 0.725 (hr/ha)

about 0.80 (hr/ha)

6) Harvesting

Implement to be used, combine, standard type 95 PS class

The work capacity is the same with (1) 6).

Field work amount per hour = 0.682 (ha/hr)

Field work amount per hectare = 1.50 (hr/ha)

7) Transportation

Implement to be used. For both 80 PS class tractor and 100 PS class tractor a combination with 6 ton bulk dump trailer is used. The working capacity is set at 1.50 hr/ha based on Table 4-1-20.

(4) Cultivation area, 150 ha scale

Prime mover to be used, a combination of a 70 PS class wheel type tractor, a 80 PS class wheel type tractor and a 120 PS class wheel type tractor.

1) Plowing (single operation), plowing depth 15 ∿ 25 cm

(a) Implement to be used for 70 PS class tractor

Disc plow, pulling type 26 in × 5

Working width 1.28 m

Working speed 4.5 km/hr

Working efficiency 70%

Theoretical work amount (ha/hr) $= \frac{4.5 \times 1.28}{10} = 0.576$ (ha/hr)

Field work amount per hour = 0.576 × 70 ÷ 100 = 0.403(ha/hr)

Field work amount per hectare = 1.0 ÷ 0.403 = 2.481 (hr/ha)
about 2.50 (hr/ha)

(b) Implement to be used for 80 PS class tractor

Disc plow 28 in × 6

The work efficiency and the work capacity are the same with (3) 1) (a).

Field work amount per hour = 0.519 (ha/hr)

Field work amount per hectare = 2.00 (hr/ha)

(c) Implement to be used for 120 PS class tractor

Disc plow, pulling type 28 in × 8

Working width 2.29 m

Working speed 5.0 km/hr

Working efficiency 70%

Theoretical work amount (ha/hr) $= \frac{5.0 \times 2.29}{10} = 1.145$ (ha/hr)

Field work amount per hour $= 1.145 \times 70 \div 100 = 0.801$ (ha/hr)

Field work amount per hectare $= 1.0 \div 0.801 = 1.248$ (hr/ha)

about 1.250 (hr/ha)

2) Harrowing (single operation)

(a) Implement to be used for 70 PS class tractor

Disc harrow, pulling type 20 in × 28

Working width 2.6 m

Working speed 5.5 km/hr

Working efficiency 75%

Theoretical work amount (ha/hr) $= \frac{5.5 \times 2.6}{10} = 1.43$ (ha/hr)

Field work amount per hour $= 1.43 \times 75 \div 100 = 1.073$ (hr/ha)

Field work amount per hectare $= 1.0 \div 1.073 = 0.931$ (hr/ha)

about 1.00 (hr/ha)

(b) Implement to be used for 80 PS class tractor

Disc harrow, pulling type 20 in × 32

The working width and the work efficiency are the same with Table 4-1-20.

Field work amount per hour = 1.344 (ha/hr)

Field work amount per hectare = 0.750 (hr/ha)

(c) Implement to be used for 120 PS class tractor

Disc harrow, pulling type 20 in × 44

Working width 4.0 m

Working speed 5.5 km/hr

Working efficiency 75%

Theoretical work amount (ha/hr) = $\frac{5.5 \times 4.0}{10}$ = 2.20 (ha/hr)

Field work amount per hour = 2.20 × 75 ÷ 100 = 1.65 (ha/hr)

Field work amount per hectare = 1.0 ÷ 1.65 = 0.606 (hr/ha)

about 0.60 (hr/ha)

3) Land leveling (single operation)

(a) Implement for 70 PS class tractor

Land leveler, pulling type

Working width 3.60 m

Working speed 5.0 km/hr

Working efficiency 75%

Theoretical work amount (ha/hr) = $\frac{3.6 \times 5}{10}$ = 1.80 (ha/hr)

Field work amount per hour = 1.80 × 0.75 ÷ 100 = 1.35(ha/hr)

Field work amount per hectare = 1.0 ÷ 1.35 = 0.740 (hr/ha)

about 0.750 (hr/ha)

(b) Implement to be used for 80 PS class tractor

Land leveler, pulling type

The working width and the work efficiency are the same with (3) 4) (a).

Field work amount per hour = 2.104 (ha/hr)

Field work amount per hectare = 0.50 (hr/ha)

(c) Implement to be used for 120 PS class tractor

Working width 5.80 m

Working speed 7.0 km/hr

Working efficiency 80%

Theoretical work amount (ha/hr) = $\frac{7.0 \times 5.8}{10}$ = 4.06 (ha/hr)

Field work amount per hour = 4.06 × 80 ÷ 100 =3.248 (ha/hr)

Field work amount per hectare = 1.0 ÷ 3.248 = 0.307 (hr/ha)

about 0.30 (hr/ha)

4) Fertilizing and seeding

(a) Implement to be used for 70 PS class tractor

Grain drill, pulling type 17 ∿ 19 lines

Working width 3.40 m

Working speed 3.5 km/hr

Working efficiency 45%

Theoretical work amount (ha/hr) = $\frac{3.5 \times 3.4}{10}$ = 1.19 (ha/hr)

Field work amount per hour = 1.19 × 45 ÷ 100 = 0.535 (ha/hr)

Field work amount per hectare = 1.0 ÷ 0.535 = 1.869 (hr/ha)
about 2.00 (hr/ha)

(b) Implement to be used for 80 PS class tractor

Grain drill, pulling type 17 ∿ 19 lines

The working width and the working efficiency are the same with (3) 3) (a).

Field work amount per hour = 0.68 (ha/hr)

Field work amount per hectare = 1.50 (hr/ha)

(c) Implement to be used for 120 PS class tractor

Grain drill, traction type 23 ∿ 25 lines

Working width 4.4 m

Working speed 4.0 km/hr

Working efficiency 55%

Theoretical work amount (ha/hr) = $\frac{4.0 \times 4.4}{10}$ = 1.76 (ha/hr)

Field work amount per hour = 1.76 × 55 ÷ 100 = 0.968 (ha/hr)

Field work amount per hectare = 1.0 ÷ 0.968 = 1.033 (hr/ha)
about 1.10 (hr/ha)

5) Ridging

Implement to be used, ridger, direct-equipped type 28 in × 2 discs.

Ridge height; wide ridge (double operation) 40 ∿ 50 cm

narrow ridge (double operation) Approximately 40 cm

The same type and the same working capacity of lister are used for 70 PS class tractor, 80 PS class tractor and 120 PS class tractor.

The working capacity is the same with (2) 5).

Working amount per hectare = for double operation 0.80(hr/ha)

6) Harvesting

Implement to be used, combine, standard type 95 PS class

The work capacity is the same with (1) 6).

Field work amount per hour = 0.682 (ha/hr)

Field work amount per hectare = 1.50 (hr/ha)

7) Transportation

Implement to be used. For 70 PS class tractor, 80 PS class tractor and 100 PS class tractor a combination with bulk dump trailer is used.

The working capacity is set at 1.50 hr/ha based on Table 4-1-20.

(5) Cultivation area, 250 ha scale

Prime mover, a combination of a 80 PS class wheel type tractor and 3 120 PS class wheel type tractors.

1) Plowing (single operation)

Plowing depth 15 ∿ 25 cm

(a) Implement to be used for 80 PS class tractor

Disc plow 28 in × 6

The working efficiency and the working capacity are the same with (3) 1) (a).

Field work amount per hour = 0.519 (ha/hr)

Field work amount per hectare = 2.00 (hr/ha)

(b) Implement to be used for 120 PS class tractor

Disc plow, 28 in × 8

The working efficiency and the working capacity are the same with (4) 1) (c).

Field work amount per hour = 0.801 (ha/hr)

Field work amount per hectare = 1.250 (hr/ha)

2) Harrowing (single operation)

(a) Implement to be used for 80 PS class tractor

Disc harrow, pulling type 20 in × 32

The working efficiency and the working capacity are the same with (3) 2) (a).

Field work amount per hour = 1.344 (ha/hr)

Field work amount per hectare = 0.750 (hr/ha)

(b) Implement to be used for 120 PS class tractor

Disc harrow, pulling type 20 in × 44

The working efficiency and the working capacity are the same with (4) 2) (c).

Field work amount per hour = 1.650 (ha/hr)

Field work amount per hectare = 0.60 (hr/ha)

3) Land leveling (single operation)

(a) Implement to be used for 80 PS class tractor

Land leveler, pulling type

The working efficiency and the working capacity are the same with (3) 4) (a).

Field work amount per hour = 2.184 (ha/hr)

Field work amount per hectare = 0.50 (hr/ha)

(b) Implement to be used for 120 PS class tractor

Land leveler, pulling type

The working efficiency and the working capacity are the same with (4) 3) (c).

Field work amount per hour = 3.248 (ha/hr)

Field work amount per hectare = 0.30 (hr/ha)

4) Fertilizing and seeding

(a) Implement to be used for 80 PS class tractor

Grain drill, traction type 19 lines

The working efficiency and the working capacity are the same with (3) 3) (a).

Field work amount per hour = 0.68 (ha/hr)

Field work amount per hectare = 1.50 (hr/ha)

(b) Implement to be used for 120 PS class tractor

Grain drill, pulling type 26 lines

The working efficiency and the working capacity are the same with (4) 4) (c).

Field work amount per hour = 0.968 (ha/hr)

Field work amount per hectare = 1.10 (hr/ha)

5) Ridging

Implement to be used, ridger 28 in × 2 discs

Ridge height; wide ridge (double operation) 40 ∿ 50 cm

narrow ridge (double operation) Approximately 40 cm

The same type and the same working capacity are used for 80 PS class tractor and 120 PC class tractor.

The work amount is the same with (2) 5).

The work amount per hectare = for double operation 0.80 (hr/ha)

6) Harvesting work

Implement to be used, combine, standard type 2 95 PS class

The working efficiency and the working capacity are the same with (1) 6).

Field work amount per hour = 0.682 (ha/hr)

Field work amount per hectare = 1.50 (hr/ha)

7) Transportation

Implement to be used. For both 20 PS class tractor and 120 PS class tractor a combination with 6 ton bulk dump trailer is used. The working capacity is set at 150 hr/ha based on Table 4-1-20.

(6) Cultivation area, 400 ha scale

Prime mover: A combination of 3 80 PS class tractors and 4 120 PS class tractors

The estimation of a combination of machineries and work capacity in a 400 ha scale cultivation area is omitted, because they are the same with those in the 250 ha scale cultivation area. See the section of cultivation area 250 ha scale.

(7) Cultivation area 500 ha scale

Prime mover: A combination of 2 80 PS class tractors and 6 120 PS class tractors

The estimation of the combination and work capacity of machineries for the 500 ha scale cultivation area is omitted, because they are the same with those for the 250 ha scale cultivation area. See the section of cultivation area 250 ha scale.

(8) Examination of transportation work and estimation of working hour

In order to perform an efficient and effective transportation by tractors to be introduced to each management body, the transportation is carried out by a combination of tractors and trailers, which convey the products in bulk loaded directly from a combine on a working road to a drying and preparation facility. The transportation distance to the drying preparation facility is assumed to be approximately 2 km for a group of small scale management bodies such as the 25 ha scale, while about 4 km for a group of medium to large scale management bodies such as more than 50 ha scale. Based on this assumption, the field work amount and yield of rice per ha are estimated. The efficiency standard is estimated on the basis of "The basic policy for introducing high-performance agricultural machinery and reference data" as follows.

Estimation of Transportation Hours for Paddy

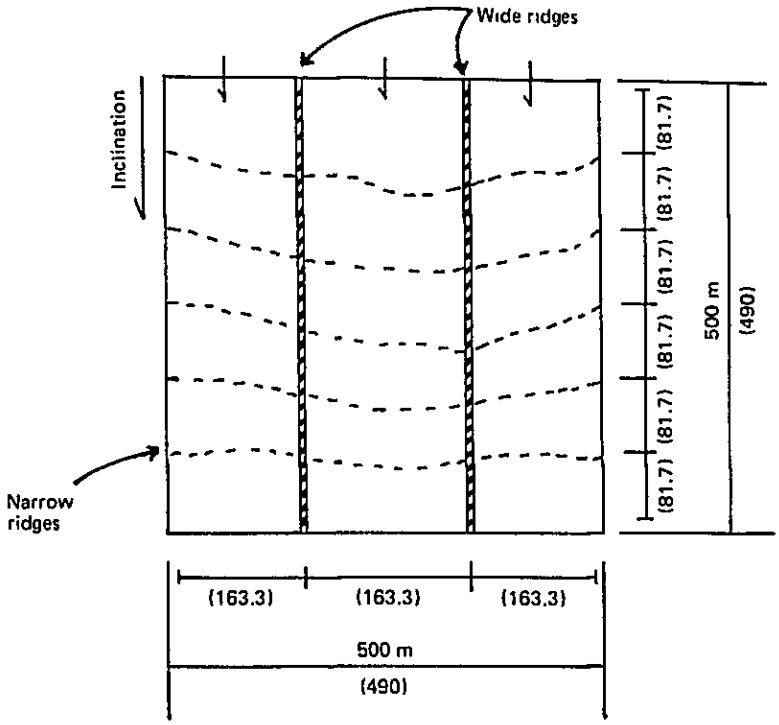
Item \ Cultivation scale / Machine / Unit	Unit	Management bodies with 25 ha scale Trailer (Combined tractor: 45 PS class)	Management bodies with 50 ha scale Trailer (Combined tractor: 70, 80, 90, 100, 120 class)	Remarks
Max. loading capacity	(ton)	3 (in bulk)	6 (in bulk)	
Bed type	-	dump type	dump type	
Running speed	(km/hr)	12	12	
Yield	(ton/ha)	5	5	Paddy
Condition of paddy	-	bulk	bulk	
Loadage	(ton)	2.5	5	
Hauling distance (one way)	(km)	2	4	
Necessary time for going and returning	(minute)	20	40	
Loading time	(")	13	25	Loading time of bulk paddy: 12 ton/hr
Dumping time	(")	4	9	Dumping type Weighing: 36 ton/hr
Weighing time	(")	5	5	
Idling time	(")	5	10	
Total time	(")	47	89	
Hauling times		2	1	
Efficiency	(hr/ha)	about 1.5	about 1.5	

(9) Examination of ridging plan and estimation of related amount

The ridging plan is made in reference to the ridging method adopted at the paddy rice field located in the Project area, taking account of the field condition, meteorological condition and water management condition in the project area.

Ridging of the paddy rice field located in the Project area is done by machines, and the ridge spacing is set depending upon 6 cm altitude difference of field surface as a standard, and the resultant ridge spacing divided by this method will be 30 to 40 m, although it differs by the accuracy of land leveling.

Since in the field plot plan of this project a 500 m × 500 m division with an effective area of about 24 ha is planned, good water management, prevention of seedling to float caused by wind and wave in floading, and breaking of ridge as well as operation efficiency of the machines have to be taken into consideration. For this reason two ridges (wide ridges with a some 40 to 50 cm height) were set in parallel to the field inclination (vertical direction). As to ridges crossing at right angles with the field inclination (vertical direction) (narrow ridges with a some 30 to 40 cm height), 3 narrow ridges with ridge spacing of about 123 m which produce a some 2.0 ha division are made on the assumption of a 1/3,000 field slope and on the base of a 6 cm altitude difference of field surface, but taking account of water management, prevention of seedling to float and ridge breaking additional 5 narrow ridges were set. In this case, the ridge spacing is approximately 82 m, the estimated altitude difference approximately 3.3 cm, and the small division area divided by the ridges approximately 1.3 ha, but they will vary according to the accuracy of land levelling. Ridging will be conducted by means of a ridger of tractor-directly connected type and with 28 inches × 2 discs. The wide ridges will have 40 to 50 height by double operation, while the narrow ridges will have 30 to 40 cm height by double operation in consideration of a rolling pressure. The method of ridging is shown in the following figure.



*1. The effective distance of long and short sides of the division is assumed to be 490 m taking account of the width of farm roads and canals.

*2. Estimation of amounts of ridging

wide ridges = 490 × 2 = 980 m

The narrow ridge is set on a contour line, and so its length is considered to be in a 30% increase.

narrow ridges = 490 × 5 × 1.30 = 3,185 m

2. Combination of cultivation implements in soybean and wheat culture and estimation of working capacity.

Estimation formula of working capacity;
estimate based on a theoretical formula

$$\text{Theoretical work amount (ha/hr)} = \frac{\text{working width (m)} \times \text{working speed (km/hr)}}{10}$$

Field work amount (ha/hr) = theoretical work amount (ha/hr) × field working efficiency (%) ÷ 100

(1) Cultivation area, 25 ha scale (soybean, wheat)

Prime mover to be used, 45 PS class wheel type tractor

1) Plowing (single operation), plowing depth 15 ∿ 25 cm

Implement to be used, disc plow, direct-equipped type 26 in × 3

Working width	0.92 m
Working speed	45 km/hr
Field working efficiency	70%

Theoretical work amount (ha/hr) $= \frac{4.5 \times 0.92}{10} = 0.414$ (ha/hr)

Field work amount per hour = 0.414 × 70 ÷ 100 = 0.289 (ha/hr)

Field work amount per hectare = 1.0 ÷ 0.289 = 3.46 (hr/ha)
about 3.50 (hr/ha)

2) Harrowing (single operation)

Implement to be used, disc-harrow, direct-equipped type 20 in × 24

Working width	2.40 cm	
Working speed	5.5 km/hr	
Field working efficiency	75%	
Theoretical work amount (ha/hr)	$= \frac{5.5 \times 2.40}{10} = 1.320$	(ha/hr)
Field work amount per hour	$= 1.320 \times 75 \div 100 = 0.99$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.99 = 1.01$	(hr/ha)
	about 1.00	(hr/ha)

3) Fertilizing and seeding (simultaneous work, for soybean and wheat)

Implement to be used, grain drill 13 lines, with attachment for soybean

Working width	2.53 m	
Working speed	4.5 km/hr	
Field working efficiency	50%	
Theoretical work amount (ha/hr)	$= \frac{4.5 \times 2.53}{10} = 1.138$	(ha/hr)
Field work amount per hour	$= 1.138 \times 50 \div 100 = 0.569$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.569 = 1.757$	(hr/ha)
	about 1.75	(hr/ha)

4) Intertillage (weeding) - (single operation, applied for soybean)

Implement to be used, cultivator, direct-equipped type 5 ∿ 7 rows

Working width	2.9 m	
Working speed	5.0 km/hr	
Field working efficiency	70%	
Theoretical work amount (ha/hr)	$= \frac{5.0 \times 2.9}{10} = 1.45$	(ha/hr)
Field work amount per hour	$= 1.45 \times 70 \div 100 = 1.015$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 1.015 = 0.985$	(hr/ha)
	about 1.00	(hr/ha)

5) Harvesting

(a) Harvesting of soybean

Implement to be used, combine, standard type, 95 PS class

Working width	4.20 m	
Working speed	3.0 km/hr	
Field working efficiency	65%	
Theoretical work amount (ha/hr)	$= \frac{3.0 \times 4.20}{10} = 1.26$	(ha/hr)
Field work amount per hour	$= 1.26 \times 0.65 \div 100 = 0.819$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.819 = 1.221$	(hr/ha)
	about 1.25	(hr/ha)

(b) Harvesting of wheat

Implement to be used, combine, standard type 95 PS class

Working width	4.20 m	
Working speed	3.50 km/hr	
Field working efficiency	65%	
Theoretical work amount (ha/hr)	$= \frac{3.50 \times 4.20}{10} = 1.47$	(ha/hr)
Field work amount per hour	$= 1.47 \times 65 \div 100 = 0.955$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.955 = 1.047$	(hr/ha)
	about 1.00	(hr/ha)

6) Weeding/control work (single operation)

Implement to be used, sprayer, direct-equipped type tank capacity 400 ℓ

Working width	6.80 m	
Working speed	3.0 km/hr	
Field working efficiency	50%	
Theoretical work amount (ha/hr)	$= \frac{3.0 \times 6.80}{10} = 2.04$	(ha/hr)
Field work amount per hour	$= 2.04 \times 50 \div 100 = 1.02$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 1.02 = 0.98$	(hr/ha)
	about 1.00	(hr/ha)

7) Transportation

(a) Transportation of soybean

Implement to be used, 3 ton bulk dump trailer

The working capacity is set at 1.25 hr/ha based on Table 4-1-21.

(b) Transportation of wheat

Implement to be used, 3 ton bulk dump trailer

The working capacity is set at 1.0 hr/ha based on Table 4-1-21.

(2) Cultivation area, 50 ha scale (soybean, wheat)

Prime mover to be used, 70 PS class wheel tractor

1) Plowing work (single operation), plowing depth 15 ∿ 25 cm

Implement to be used, disc plow, pulling type 26 in × 5

Working width	1.28 m	
Working speed	4.5 km/hr	
Field working efficiency	70%	
Theoretical work amount (ha/hr)	$= \frac{4.5 \times 1.28}{10} = 0.576$	(ha/hr)
Field work amount per hour	$= 0.576 \times 70 \div 100 = 0.403$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.403 = 2.481$	(hr/ha)
	about 2.50	(hr/ha)

2) Harrowing (single operation)

Implement to be used, disc harrow, traction type, 20 in × 28

Working width	3.20 m	
Working speed	5.5 km/hr	
Field working efficiency	75%	
Theoretical work amount (ha/hr)	$= \frac{5.5 \times 3.2}{10} = 1.76$	(ha/hr)
Field work amount per hour	$= 1.76 \times 75 \div 100 = 1.32$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 1.32 = 0.757$	(hr/ha)
	about 0.75	(hr/ha)

3) Subsoil breaking (single operation), breaking depth 45 ∿ 50 cm

Implement to be used, subsoiler, direct-equippped type 5 ∿ 7 rows

Working width	2.45 m	
Working speed	3.0 km/hr	
Field working efficiency	45%	
Theoretical work amount (ha/hr)	$= \frac{3.0 \times 2.45}{10} = 0.735$	(ha/hr)
Field work amount per hour	$= 0.735 \times 45 \div 100 = 0.33$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.33 = 3.03$	(hr/ha)
	about 3.00	(hr/ha)

4) Fertilizing and seeding (simultaneous work for soybean and wheat)

Implement to be used, grain drill, 17 lines with attachment for soybean

Working width	2.90 m	
Working speed	4.5 km/hr	
Field working efficiency	50%	
Theoretical work amount (ha/hr)	$= \frac{4.5 \times 2.9}{10} = 1.305$	(ha/hr)
Field work amount per hour	$= 1.305 \times 50 \div 100 = 0.653$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 0.653 = 1.531$	(hr/ha)
	about 1.50	(hr/ha)

5) Intertillage (weeding) - (single operation, applied for soybean)

Implement to be used, cultivator, direct-equipped type 7 ∿ 9 rows

Working width	4.0 m	
Working speed	5.0 km/hr	
Field working efficiency	70%	
Theoretical work amount (ha/hr)	$= \frac{5.0 \times 4.0}{10} = 2.00$	(ha/hr)
Field work amount per hour	$= 2.00 \times 70 \div 100 = 1.40$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 1.40 = 0.714$	(hr/ha)
	about 0.75	(hr/ha)

6) Weeding/control (single operation)

Implement to be used, sprayer, pulling type, tank capacity 2,000 ℓ

Working width	8.4 m	
Working speed	3.0 km/hr	
Field working efficiency	55%	
Theoretical work amount (ha/hr)	$= \frac{3.0 \times 8.4}{10} = 2.52$	(ha/hr)
Field work amount per hour	$= 2.52 \times 55 \div 100 = 1.386$	(ha/hr)
Field work amount per hectare	$= 1.0 \div 1.386 = 0.721$	(hr/ha)
	about 0.75	(hr/ha)

7) Harvesting

(a) Harvesting of soybean

Implement to be used, combine, standard type 95 PS class

The working efficiency and the working capacity are the same with (1) 5) (a).

Field work amount per hour = 0.819 (ha/hr)

Field work amount per hectare = 1.25 (hr/ha)

(b) Harvesting of wheat

Implement to be used, combine, standard type 95 PS class

The working efficiency and the working capacity are the same with (1) 5) (b).

Field work amount per hour = 0.955 (ha/hr)

Field work amount per hectare = 1.00 (hr/ha)

8) Transportation

(a) Soybean transportation

Implement to be used, 3 ton bulk dump trailer

The working capacity is set at 1.25 hr/ha based on Table 4-1-21.

(b) Wheat transportation

Implement to be used, 3 ton bulk dump trailer

The working capacity is set at 1.0 hr/ha based on Table 4-1-21.

(3) Cultivation area, 100 ha scale (soybean, wheat)

Prime mover to be used, combination of 1 45 PS class wheel type tractor and 1 70 PS class wheel type tractor.

1) Plowing (single operation), plowing depth 15 ∿ 25 cm

(a) Implement to be used for 45 PS class tractor

Disc plow 26 in x 3

The working efficiency and the working capacity are the same with (1) 1).

Field work amount per hour = 0.289 (ha/hr)

Field work amount per hectare = 3.50 (hr/ha)

(b) Implement to be used for 70 PS class tractor

Disc plow 26 in x 5

The working efficiency and the working capacity are the same with (2) 1).

Field work amount per hour = 0.403 (ha/hr)

Field work amount per hectare = 2.50 (hr/ha)

2) Harrowing (single operation)

(a) Implement to be used for 45 PS class tractor

Disc harrow 20 in x 24

The working efficiency and the working capacity are the same with (1) 2).

Field work amount per hour = 0.99 (ha/hr)

Field work amount per hectare = 1.00 (hr/ha)

(b) Implement to be used for 70 PS class tractor

Disc harrow 20 in x 28

The working efficiency and the working capacity are the same with (2) 2).

Field work amount per hour = 1.32 (ha/hr)

Field work amount per hectare = 0.75 (hr/ha)

3) Subsoil breaking (single operation), breaking depth 45 ∿ 50 cm

Implement to be used for 70 PS class tractor, subsoiler, direct-equipped type

The working efficiency and the working capacity are the same with (2) 3).

Field work amount per hour = 0.33 (ha/hr)

Field work amount per hectare = 3.00 (hr/ha)

4) Fertilizing and seeding (simultaneous work for soybean and wheat)

(a) Implement to be used for 45 PS class tractor

Grain drill, with attachment for soybean, 13 lines

The working efficiency and the working capacity are the same with (1) 3).

Field work amount per hour = 0.569 (ha/hr)

Field work amount per hectare = 1.75 (hr/ha)

(b) Implement to be used for 70 PS class tractor

Grain drill, with attachment for soybean, 17 lines

The working efficiency and the working capacity are the same with (2) 4).

Field work amount per hour = 0.653 (ha/hr)

Field work amount per hectare = 1.50 (hr/ha)

5) Intertillage (weeding) - (single operation, applied for soybean)

(a) Implement to be used for 45 PS class tractor

Cultivator, direct-equipped type, 5 ∿ 7 rows

The working efficiency and the working capacity are the same with (1) 4).

Field work amount per hour = 1.015 (ha/hr)

Field work amount per hectare = 1.00 (hr/ha)

(b) Implement to be used for 70 PS class tractor

Cultivator, direct-equipped type 7 ∿ 9 rows

The working efficiency and the working capacity are the same with (2) 5).

Field work amount per hour = 1.40 (ha/hr)

Field work amount per hectare = 0.75 (hr/ha)

6) Weeding/control (single operation)

(a) Implement to be used for 45 PS class tractor

Sprayer, direct-equipped type, tank capacity 400 ℓ

The working efficiency and the working capacity are the same with (1) 6).

Field work amount per hour = 1.02 (ha/hr)

Field work amount per hectare = 1.00 (hr/ha)

(b) Implement to be used for 70 PS class tractor

Sprayer, pulling type, tank capacity 2,000 ℓ

The working efficiency and the working capacity are the same with (2) 6).

Field work amount per hour = 1.386 (ha/hr)

Field work amount per hectare = 0.75 (hr/ha)

7) Harvesting

(a) Harvesting of soybean

Implement to be used, combine, standard type 95 PS class

The working efficiency and the working capacity are the same with (1) 5) (a).

Field work amount per hour = 0.819 (ha/hr)

Field work amount per hectare = 1.25 (hr/ha)

(b) Harvesting of wheat

Implement to be used, combine, standard type 95 PS class

The working efficiency and the working capacity are the same with (1) 5) (b).

Field work amount per hour = 0.955 (ha/hr)

Field work amount per hectare = 1.00 (hr/ha)

8) Transportation

(a) Soybean transportation

Implement to be used, 3 ton bulk dump trailer

The working capacity is set at 1.25 hr/ha based on Table 4-1-21.

(b) Wheat transportation

Implement to be used, 3 ton bulk dump trailer

The working capacity is set at 1.0 hr/ha based on Table 4-1-21.

(4) Cultivation area, 150 ha scale (soybean, wheat)

Prime mover to be used, combination of 1 70 PS wheel type tractor and 1 110 PS class wheel type tractor.

1) Plowing (single operation), plowing depth 15 ∿ 25 cm

(a) Implement to be used for 70 PS class tractor

Disc plow 26 in x 5

The working efficiency and the working capacity are the same with (2) 1).

Field work amount per hour = 0.403 (ha/hr)

Field work amount per hectare = 2.50 (hr/ha)

(b) Implement to be used for 110 PS class tractor

Disc plow, traction type, 28 in x 8

Working width 2.29 m

Working speed 5.0 km/hr

Field working efficiency 70%

Theoretical work amount (ha/hr) = $\frac{5.0 \times 2.29}{10}$ = 1.145 (ha/hr)

Field work amount per hour = 1.145 x 70 ÷ 100 = 0.801 (ha/hr)

Field work amount per hectare = 1.0 ÷ 0.801 = 1.248 (hr/ha)
about 1.250 (hr/ha)

2) Harrowing (single operation)

(a) Implement to be used for 70 PS class tractor

Disc harrow, pulling type, 20 in × 28

The working efficiency and the working capacity are the same with (2) 2).

Field work amount per hour = 1.32 (ha/hr)

Field work amount per hectare = 0.75 (hr/ha)

(b) Implement to be used for 110 PS class tractor

Disc harrow, pulling type, 20 in × 48

Working width 5.20 m

Working speed 6.0 km/hr

Field working efficiency 85%

Theoretical work amount (ha/hr) = $\frac{6.0 \times 5.20}{10}$ = 3.12 (ha/hr)

Field work amount per hour = 3.12 × 85 ÷ 100 = 2.652 (ha/hr)

Field work amount per hectare = 1.0 ÷ 2.652 = 0.377 (hr/ha)
about 0.375 (hr/ha)

3) Subsoil breaking (single operation), breaking depth 45 ∿ 50 cm

(a) Implement to be used for 70 PS class tractor

Subsoiler, direct-equipped type 5 ∿ 7 rows

The working efficiency and the working capacity are the same with (2) 3).

Field work amount per hour = 0.33 (ha/hr)

Field work amount per hectare = 3.00 (hr/ha)

(b) Implement to be used for 110 PS tractor

Subsoiler, direct-equipped type 9 ∿ 11 rows

Working width	3.85 m
Working speed	3.5 km/hr
Field working efficiency	50%

Theoretical work amount (ha/hr) = $\frac{3.5 \times 3.85}{10}$ = 1.347 (ha/hr)

Field work amount per hour = 1.347 × 50 ÷ 100 = 0.673(ha/hr)

Field work amount per hectare = 1.0 ÷ 0.673 = 1.485 (hr/ha)
about 1.50 (hr/ha)

4) Fertilizing and seeding (simultaneous work for soybean and wheat)

(a) Implement to be used for 70 PS class tractor

Grain drill with attachment for soybean, 17 lines

The working efficiency and the working capacity are the same with (2) 4).

Field work amount per hour = 0.653 (ha/hr)

Field work amount per hectare = 1.50 (hr/ha)

(b) Implement to be used for 110 PS class tractor

Grain drill with attachment for soybean, 26 lines

Working width	4.40 m
Working speed	4.5 km/hr
Field working efficiency	50%

Theoretical work amount (ha/hr) $= \frac{4.5 \times 4.4}{10} = 1.98$ (ha/hr)

Field work amount per hour $= 1.980 \times 50 \div 100 = 0.99$ (ha/hr)

Field work amount per hectare $= 1.0 \div 0.99 = 1.010$ (hr/ha)

about 1.00 (hr/ha)

5) Intertillage (weeding) - (single operation, applied for soybean)

(a) Implement to be used for 70 PS class tractor

Cultivator, direct-equipped type 7 ∿ 9 rows

The working efficiency and the working capacity are the same with (2) 5).

Field work amount per hour = 1.40 (ha/hr)

Field work amount per hectare = 0.75 (hr/ha)

(b) Implement to be used for 110 PS class tractor

Cultivator, direct-equipped type 7 ∿ 11 lines

Working width 4.80 m

Working speed 5.50 km/hr

Field working efficiency 75%

Theoretical work amount (ha/hr) $= \frac{5.5 \times 4.8}{10} = 2.64$ (ha/hr)

Field work amount per hour $= 2.64 \times 75 \div 100 = 1.98$ (ha/hr)

Field work amount per hectare $= 1.0 \div 1.98 = 0.505$ (hr/ha)

about 0.50 (hr/ha)

6) Weeding/control (single operation)

(a) Implement to be used for 70 PS class tractor

Sprayer, pulling type, tank capacity 2,000 ℓ

The working efficiency and the working capacity are the same with (2) 6).

Field work amount per hour = 1.386 (ha/hr)

Field work amount per hectare = 0.75 (hr/ha)

(b) Implement to be used for 110 PS class tractor

Sprayer, pulling type, tank capacity 2,000 ℓ

Working width 11.50 m

Working speed 3.0 km/hr

Field working efficiency 60%

Theoretical work amount (ha/hr) = $\frac{3.0 \times 11.5}{10}$ = 3.45 (ha/hr)

Field work amount per hour = 3.45 × 60 ÷ 100 = 2.07 (ha/hr)

Field work amount per hectare = 1.0 ÷ 2.07 = 0.483 (hr/ha)

about 0.50 (hr/ha)

7) Harvesting

(a) Harvesting of soybean

Implement to be used, combine, standard type 95 PS class

The working efficiency and the working capacity are the same with (1) 5) (a).

Field work amount per hour = 0.819 (ha/hr)

Field work amount per hectare = 1.25 (hr/ha)

(b) Harvesting of wheat

Implement to be used, combine, standard type 95 PS class

The working efficiency and the working capacity are the same with (1) 5) (b).

Field work amount per hour = 0.955 (ha/hr)

Field work amount per hectare = 1.00 (hr/ha)

8) Transportation

(a) Transportation of soybean

Implement to be used, 3 ton bulk dump trailer

The working capacity is set at 1.25 hr/ha based on Table 4-1-21.

(b) Transportation of wheat

Implement to be used, 3 ton bulk dump trailer

The working capacity is set at 1.0 hr/ha based on Table 4-1-21.

(5) Examination of transportation work of soybean (wheat) and estimatio of working hour

In order to perform an efficient and effective transportation by tractors to be introduced to each management body, the transportation is carried out by a combination of tractors and trailers, which convey the products in bulk loaded directly from a combine on a working road to a drying and preparation facility. Taking account of the field work amoun of the combine and the yield of soybean or wheat per ha the estimation i made. The efficiency standard relating to the estimation is calculated as follows in reference to "The basic policy for introducing high-perfor ance agricultural machinery and reference data". The transportation distance to the drying and preparation facility is assumed to be about 4 km for each management body.

Estimation of Transportation Hours for Soybean and Wheat

Item / Division / Machine / Unit	Unit	Soybean	Wheat	Remarks
		Trailer combined tractor	Trailer combined tractor	
Max. loading capacity	(ton)	3 (in bulk)	3 (in bulk)	Applied tractor's PS are 45, 70 and 110
Bed type	-	dump type	dump type	
Running speed	(km/hr)	12	12	
Yield	(ton/ha)	2	1.6	
Condition of soybean and wheat	-	bulk	bulk	
Loadage	(ton)	2	1.6	
Hauling distance (one way)	(km)	4	4	
Necessary time for going and returning	(minute)	40	40	
Loading time	(minute)	15	8	for soybean 8,000 kg/hr for wheat 12,000 kg/hr
Dumping time	(minute)	5	3	for soybean 25,000 kg/hr for wheat 36,000 kg/hr
Weighing time	(minute)	5	5	
Idling time	(minute)	10	5	
Total time	(minute)	75	61	
Hauling times		1	1	
Efficiency	(hr/ha)	1.25	1	

3. The estimation of fuel consumption relating to the calculation of the expenses for machine operation (reference data)

In calculating the operation cost of agricultural implements it is necessary to grasp appropriate fuel consumptions by different horsepower c prime movers such as tractor and combine. In spite of our effort to find out any standards to estimate at the Ministry of Agriculture and Livestock and the CEMA Mechanization Center of the Ministry, no data was obtained. For this reason, the fuel consumption is estimated by calculation. The estimation method and the estimation standards are based on the operation cost calculation standards of the standard implement running cost estimation standards of the calculation implementation list provided by the Agricultural Land Development Agency. The estimation standards are described below and the fuel consumption values by different horsepower of prime movers for tractor and combine are shown in Table 4-1-23 and Table 4-1-24.

Estimation standard

Fuel consumption per running hour = K × output of the engine × total load rate

K : a constant, in case of a gasoline-fueled engine 0.32

in case of diesel engine 0.23

Total load rate : light work 30%
ordinary work 45%
heavy work 60%

Table 4-1-23 Fuel consumption per horse power of tractor
(Diesel engine)

Machine (Standard)	Engine power	Unit	Fuel type	Fuel consumption (ℓ/hr)			Remarks
				Light duty	Ordinary duty	Heavy duty	
Tractor (Wheel type)	30 PS	HR	D		3.1	4.1	
"	35 PS	"	"		3.6	4.8	
"	40 PS	"	"		4.1	5.5	
"	45 PS	"	"		4.7	6.2	
"	50 PS	"	"		5.2	6.9	
"	55 PS	"	"		5.7	7.6	
"	60 PS	"	"		6.2	8.3	
"	65 PS	"	"		6.7	9.0	
"	70 PS	"	"		7.2	9.7	
"	75 PS	"	"		7.8	10.4	
"	80 PS	"	"		8.3	11.0	
"	85 PS	"	"		8.8	11.7	
"	90 PS	"	"		9.3	12.4	
"	95 PS	"	"		9.8	13.1	
"	100 PS	"	"		10.4	13.8	
"	105 PS	"	"		10.9	14.5	
"	110 PS	"	"		11.4	15.2	
"	115 PS	"	"		11.9	15.9	
"	120 PS	"	"		12.4	16.6	

* D: Diesel engine oil (Gas oil)

Table 4-1-24 Fuel consumption per horse power of conbine (Diesel engine)

Machine (Standard)	Engine power	Unit	Fuel type	Fuel consumption (ℓ/hr)			Remarks
				Light duty	Ordinary duty	Heavy duty	
Combine (Standard type)	60 PS	HR	D		6.2	8.3	
"	65 PS	"	"		6.7	9.0	
"	70 PS	"	"		7.2	9.7	
"	75 PS	"	"		7.8	10.4	
"	80 PS	"	"		8.3	11.0	
"	85 PS	"	"		8.8	11.7	
"	90 PS	"	"		9.3	12.4	
"	95 PS	"	"		9.8	13.1	
"	100 PS	"	"		10.4	13.8	
"	105 PS	"	"		10.9	14.5	
"	110 PS	"	"		11.4	15.2	
"	115 PS	"	"		11.9	15.9	
"	120 PS	"	"		12.4	16.6	
	125 PS	"	"		12.9	17.3	
	130 PS	"	"		13.5	17.9	

* D: Diesel engine oil (Gas oil)

Table 4-2-1 Production of Brazilian rice (Unhulled rice) by years

Year	Planted area ha	Production ton	Yield per unit area ton/ha	Remarks
1970	4,979,165	7,553,083	1,517	
1971	4,763,998	6,593,179	1,384	
1972	4,821,308	7,824,231	1,623	
1973	4,794,832	7,167,127	1,493	
1974	4,664,883	6,764,038	1,449	
1975	5,306,270	7,781,538	1,446	
1976	6,556,480	9,757,076	1,465	
1977	5,992,090	8,993,696	1,500	
1978	5,623,515	7,296,142	1,297	
1979	5,452,086	7,595,214	1,393	
1980	6,243,138	9,775,720	1,565	
1981	6,065,671	8,260,547	1,362	
1982	6,015,255	9,718,074	1,615	
1983	5,371,180	8,564,695	1,595	
Aver-age	-	-	1,479	

Data: IBGE (Ministry of planning)

Table 4-2-2-ⓐ Rice (Unhulled Price): Production Record 1973

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	20.300	34.290	1.689
Acre	4.930	7.052	1.430
Amazonas	1.579	2.444	1.548
Roraima	1.527	1.527	1.000
Pará	79.170	81.398	1.028
Amapá	461	314	681
Maranhão	598.230	765.249	1.279
Piauí	108.937	121.657	1.117
Ceará	67.886	96.881	1.428
Rio Grande do Norte	7.171	8.151	1.137
Paraiba	20.475	26.022	1.271
Perunambuco	4.991	9.098	1.821
Alagoas	13.615	29.773	2.187
Sergipe	10.756	24.706	2.297
Bahia	33.730	43.751	1.297
Minas Gerais	781.380	827.951	1.060
Espirito Santo	58.790	93.080	1.583
Rio de Janeiro	60.384	117.703	1.949
São Paulo	529.708	602.890	1.138
Paraná	472.339	661.184	1.400
Santa Catarina	107.184	222.326	2.074
Rio Grande do Sul	415.934	1.433.872	3.447
Mato Grosso do Sul	–	–	–
Mato Grosso	472.116	782.457	1.657
Goiás	923.000	1.165.880	1.263
Distrito Federal	239	480	2.008
BRASIL (Total)	4.794.832	7.167.127	1.493

Table 4-2-2-ⓑ Rice (Unhulled Rice): Production Record 1974

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	29.079	48.724	1.675
Acre	12.800	15.374	1.201
Amazonas	1.442	2.112	1.464
Roraima	1.519	2.177	1.433
Pará	73.212	76.882	1.050
Amapá	675	595	881
Maranhão	494.760	653.083	1.319
Piauí	106.000	57.240	540
Ceará	46.006	63.290	1.375
Rio Grande do Norte	6.753	4.723	699
Paraiba	18.173	20.585	1.132
Perunambuco	5.498	8.486	1.543
Alagoas	13.213	28.834	2.182
Sergipe	9.466	21.494	2.270
Bahia	37.530	51.484	1.371
Minas Gerais	713.908	760.581	1.065
Espirito Santo	46.000	69.000	1.500
Rio de Janeiro	44.119	70.663	1.601
São Paulo	464.700	582.000	1.252
Paraná	500.000	672.000	1.344
Santa Catarina	101.576	231.396	2.278
Rio Grande do Sul	435.600	1.550.000	3.558
Mato Grosso do Sul	–	–	–
Mato Grosso	503.054	813.507	1.617
Goiás	998.900	958.944	960
Distrito Federal	900	864	960
BRASIL (Total)	4.664.883	6.764.038	1.449

Table 4-2-2-ⓒ Rice (Unhulled Rice): Production Record 1975

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	76.331	122.770	1.608
Acre	12.260	15.958	1.301
Amazonas	2.198	2.978	1.354
Roraima	1.998	3.333	1.668
Pará	93.301	99.554	1.067
Amapá	503	495	984
Maranhão	617.837	907.482	1.468
Piauí	121.142	157.485	1.300
Ceará	60.000	90.000	1.500
Rio Grande do Norte	7.149	4.889	683
Paraiba	17.369	25.351	1.459
Perunambuco	6.460	9.894	1.531
Alagoas	10.050	15.336	1.525
Sergipe	11.361	26.147	2.301
Bahia	37.846	55.475	1.465
Minas Gerais	814.100	772.801	949
Espirito Santo	43.000	65.000	1.511
Rio de Janeiro	41.365	77.195	1.866
São Paulo	523.700	510.000	973
Paraná	492.800	850.573	1.726
Santa Catarina	124.975	292.735	2.342
Rio Grande do Sul	468.585	1.803.657	3.849
Mato Grosso do Sul	–	–	–
Mato Grosso	772.995	1.003.149	1.297
Goiás	947.942	868.237	915
Distrito Federal	1.003	1.044	1.040
BRASIL (Total)	5.306.270	7.781.538	1.466

STATISTICS OF BRAZILIAN RICE (UNHULLED RICE) (1)

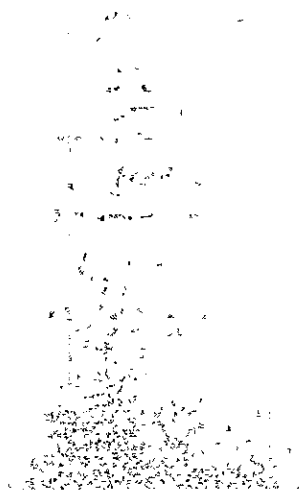


Table 4-2-2-ⓓ Rice (Unhulled Rice): Production Record 1976

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	80.976	130.221	1.608
Acre	14.382	21.573	1.500
Amazonas	1.666	2.500	1.500
Roraima	3.815	6.124	1.605
Pará	91.142	108.017	1.185
Amapá	586	555	947
Maranhão	667.868	953.071	1.427
Piauí	138.509	126.043	909
Ceará	59.850	59.850	1.000
Rio Grande do Norte	7.373	3.683	499
Paraiba	17.489	12.036	688
Perunambuco	5.419	11.033	2.035
Alagoas	9.500	10.146	1.068
Sergipe	8.889	18.670	2.100
Bahia	28.500	34.200	1.200
Minas Gerais	852.656	962.118	1.128
Espirito Santo	51.731	58.456	1.129
Rio de Janeiro	45.730	68.869	1.505
São Paulo	605.900	840.000	1.386
Paraná	621.860	1.088.822	1.750
Santa Catarina	156.089	318.283	2.039
Rio Grande do Sul	548.311	1.975.623	3.603
Mato Grosso do Sul	–	–	–
Mato Grosso	1.493.261	1.626.828	1.089
Goiás	1.144.128	1.319.458	1.153
Distrito Federal	850	900	1.058
BRASIL (Total)	6.556.480	9.757.079	1.465

Table 4-2-2-ⓔ Rice (Unhulled Rice): Production Record 1977

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	73.678	117.084	1.589
Acre	13.000	18.200	1.400
Amazonas	1.666	2.500	1.500
Roraima	4.892	8.338	1.704
Pará	111.138	147.214	1.324
Amapá	362	325	897
Maranhão	753.608	1.137.609	1.509
Piauí	149.770	177.178	1.183
Ceará	60.000	84.000	1.400
Rio Grande do Norte	7.272	9.012	1.239
Paraiba	13.461	13.852	1.029
Perunambuco	3.962	6.803	1.717
Alagoas	9.570	13.398	1.400
Sergipe	8.967	18.831	2.100
Bahia	27.000	32.400	1.200
Minas Gerais	708.883	635.955	897
Espirito Santo	49.000	68.600	1.400
Rio de Janeiro	46.000	82.800	1.800
São Paulo	347.000	360.000	1.037
Paraná	564.070	904.865	1.604
Santa Catarina	148.164	332.950	2.247
Rio Grande do Sul	566.000	2.105.000	3.719
Mato Grosso do Sul	–	–	–
Mato Grosso	1.546.663	2.095.558	1.354
Goiás	777.360	620.472	798
Distrito Federal	604	752	1.245
BRASIL (Total)	5.992.090	8.993.696	1.500

Table 4-2-2-ⓕ Rice (Unhulled Rice): Production Record 1978

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	65.172	100.978	1.549
Acre	12.800	17.920	1.400
Amazonas	1.666	2.500	1.500
Roraima	4.083	5.648	1.383
Pará	99.141	136.668	1.378
Amapá	285	258	905
Maranhão	775.199	1.142.704	1.474
Piauí	143.803	144.964	1.008
Ceará	56.000	67.200	1.200
Rio Grande do Norte	6.616	6.212	938
Paraiba	12.297	8.295	674
Perunambuco	3.696	5.685	1.538
Alagoas	7.942	14.133	1.779
Sergipe	8.555	21.706	2.537
Bahia	28.000	33.600	1.200
Minas Gerais	631.943	644.219	1.019
Espirito Santo	46.000	82.800	1.800
Rio de Janeiro	41.300	94.900	2.297
São Paulo	341.900	246.300	720
Paraná	383.316	210.180	548
Santa Catarina	133.330	279.012	2.092
Rio Grande do Sul	538.800	2.009.103	3.728
Mato Grosso do Sul	746.493	420.150	562
Mato Grosso	780.004	976.454	1.251
Goiás	752.550	621.120	825
Distrito Federal	2.678	3.342	1.247
BRASIL (Total)	5.623.515	7.296.142	1.297

Table 4-2-2-ⓖ Rice (Unhulled Rice): Production Record 1979

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	70.516	115.435	1.637
Acre	12.800	19.200	1.500
Amazonas	3.344	4.890	1.462
Roraima	6.330	8.905	1.406
Pará	120.517	185.196	1.536
Amapá	725	653	900
Maranhão	853.779	1.070.190	1.253
Piauí	163.300	119.429	731
Ceará	44.553	49.548	1.112
Rio Grande do Norte	4.784	1.112	232
Paraiba	15.443	10.735	695
Perunambuco	3.273	5.320	1.625
Alagoas	6.064	13.323	2.197
Sergipe	9.662	25.437	2.632
Bahia	28.600	48.620	1.100
Minas Gerais	509.364	659.370	1.294
Espirito Santo	37.616	52.662	1.399
Rio de Janeiro	31.887	82.393	2.583
São Paulo	300.400	307.800	1.024
Paraná	323.916	286.676	885
Santa Catarina	117.594	259.794	2.209
Rio Grande do Sul	525.000	1.675.000	3.190
Mato Grosso do Sul	584.719	457.131	781
Mato Grosso	741.130	975.476	1.316
Goiás	931.110	1.155.080	1.240
Distrito Federal	5.660	5.839	1.031
BRASIL (Total)	5.452.086	7.595.214	1.393

Table 4-2-2-ⓗ Rice (Unhulled Rice): Production Record 1980

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	108.512	178.394	1.644
Acre	14.474	21.711	1.500
Amazonas	7.353	7.706	1.048
Roraima	17.314	25.718	1.485
Pará	122.112	154.663	1.266
Amapá	657	597	908
Maranhão	988.849	1.281.316	1.295
Piauí	180.326	76.807	425
Ceará	25.000	18.000	720
Rio Grande do Norte	5.200	878	168
Paraiba	14.585	7.221	495
Perunambuco	3.670	5.406	1.473
Alagoas	6.459	14.680	2.272
Sergipe	8.096	19.030	2.350
Bahia	43.000	60.200	1.400
Minas Gerais	593.268	833.829	1.405
Espirito Santo	33.053	57.942	1.753
Rio de Janeiro	30.299	84.085	2.775
São Paulo	300.000	420.000	1.400
Paraná	390.545	638.000	1.633
Santa Catarina	153.521	428.868	2.793
Rio Grande do Sul	598.982	2.293.386	3.828
Mato Grosso do Sul	501.333	504.212	1.005
Mato Grosso	896.513	1.175.041	1.310
Goiás	1.186.728	1.455.406	1.226
Distrito Federal	13.289	12.624	949
BRASIL (Total)	6.243.138	9.775.720	1.565

Table 4-2-2-ⓘ Rice (Unhulled Rice): Production Record 1981

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	125.264	217.083	1.733
Acre	17.009	24.884	1.463
Amazonas	6.535	7.234	1.107
Roraima	45.111	44.829	994
Pará	116.667	139.026	1.192
Amapá	–	–	–
Maranhão	1.007.582	721.966	717
Piauí	191.842	87.612	457
Ceará	15.000	30.600	2.040
Rio Grande do Norte	3.417	2.038	596
Paraiba	12.448	7.993	642
Perunambuco	4.682	10.207	2.180
Alagoas	5.530	13.103	2.369
Sergipe	7.204	16.180	2.246
Bahia	50.950	40.250	790
Minas Gerais	634.831	690.607	1.088
Espirito Santo	30.700	57.034	1.858
Rio de Janeiro	30.902	87.562	2.834
São Paulo	315.000	379.890	1.206
Paraná	275.000	495.000	1.800
Santa Catarina	145.876	404.068	2.770
Rio Grande do Sul	612.912	2.455.360	4.006
Mato Grosso do Sul	411.972	451.232	1.095
Mato Grosso	862.699	941.577	1.091
Goiás	1.117.840	920.710	824
Distrito Federal	18.715	13.849	740
BRASIL (Total)	6.065.671	8.260.547	1.362

Table 4-2-2-ⓙ Rice (Unhulled Rice): Production Record 1982

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	111.285	188.714	1.696
Acre	19.126	27.761	1.451
Amazonas	4.601	4.840	1.052
Roraima	15.680	18.524	1.181
Pará	132.195	167.526	1.267
Amapá	1.847	1.843	998
Maranhão	1.167.204	1.576.518	1.351
Piauí	231.108	213.103	922
Ceará	55.214	65.491	1.186
Rio Grande do Norte	4.451	1.782	400
Paraiba	9.337	7.666	821
Perunambuco	4.272	14.910	3.490
Alagoas	7.395	15.537	2.101
Sergipe	8.964	24.758	2.762
Bahia	80.000	57.280	716
Minas Gerais	562.798	729.684	1.297
Espirito Santo	30.410	71.790	2.361
Rio de Janeiro	30.972	92.420	2.984
São Paulo	309.000	463.500	1.500
Paraná	204.000	256.620	1.268
Santa Catarina	143,101	373.928	2.813
Rio Grande do Sul	624.254	2.589.885	4.149
Mato Grosso do Sul	315.036	339.315	1.077
Mato Grosso	794.607	999.041	1.257
Goiás	1.129.400	1.398.080	1.238
Distrito Federal	19.998	17.558	878
BRASIL (Total)	6.015.255	9.718.074	1.615

Table 4-2-2-ⓚ Rice (Unhulled Rice): Production Record 1983

Districts	Area (ha)	Production (ton)	Yield (kg/ha)
Rondônia	102.488	144.709	1.412
Acre	23.106	34.166	1.478
Amazonas	2.171	2.443	1.126
Roraima	10.396	12.287	1.182
Pará	89.112	118.682	1.332
Amapá	1.966	2.068	1.036
Maranhão	777.621	980.580	1.261
Piauí	187.666	110.196	687
Ceará	49.690	56.140	1.110
Rio Grande do Norte	15.812	4.908	844
Paraíba	11.091	18.653	1.882
Perunambuco	4.902	15.884	3.240
Alagoas	7.460	18.349	2.192
Sergipe	9.818	23,534	2.397
Bahia	76.047	82.816	1.089
Minas Gerais	620.180	764.636	1.470
Espirito Santo	29.382	75.026	2.653
Rio de Janeiro	31.298	90.764	2.900
São Paulo	318.300	445.600	1.400
Paraná	220.000	370.000	1.682
Santa Catarina	146.173	420.814	2.899
Rio Grande do Sul	664.151	2.089.592	3.194
Mato Grosso do Sul	309.790	459.908	1.486
Mato Grosso	734.412	984.816	1.341
Goiás	1.032.010	1.226.490	1.188
Distrito Federal	17.109	14.645	856
BRASIL (Total)	5.371.180	8.564.695	1.595

EXPORT AND IMPORT CONDITIONS OF BRAZILIAN RICE (2)

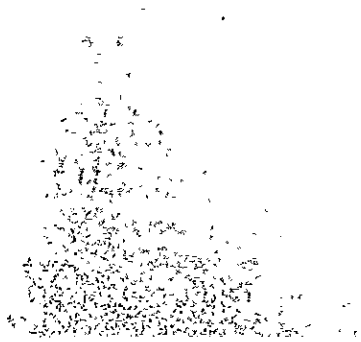


Table 4-2-3 Export and import balance of Brazilian rice (Summary)

	Export		Import C.I.F.		Balance 1,000t	Remarks
	Ton	US$1,000	ton	US$1,000		
1970	95,050	6,799	28	9	-95	
1971	148,829	11,469	1,231	127	-148	Data from CACEX, CFP(1)
1972	1,897	153	9,088	1,123	+7	
1973	33,431	4,233	10,967	1,555	-22	
1974	56,781	18,122	368	83	-56	
1975	2,600	1,236	62,318	23,437	+60	
1976	76,349	11,955	16,984	5,219	-59	
1977	408,434	88,522	824	304	-408	
1978	184,621	38,300	57,180	16,811	-127	CACEX, IBGE
1979	377	145	711,135	245,041	+711	Data from CACEX
1980	1,526	463	238,896	99,154	+237	
1981	49,766	19,838	142,524	66,605	+93	
1982	12,359	3,835	147,708	47,001	+135	
						(1) CFP ... Production finance auhtority (1) CFP "SUBSIDIOS PARA A FIXAGAO DOS PREGOS MINIMOS SAFRA 78/79" Edited 1979 (2) CACEX .. Trading department, Brazil bank

For balance, (-) shows export, (+) import.

(2) Classification number of Brazilian products for rice

NBM 10.06.01.00-ARROZ EM CASCA
(Unhulled rice)

NBM 10.06.02.00-ARROZ SEM CASCA
(Brown rice)

NBM 10.06.03.00-ARROZ POLIDO
(Milled rice)

NBM 10.06.04.00-ARROZ PARTIDO OU QUIRERA
(Broken rice)

NBM 10.06.04.00-ARROZ ESTUFADO ("PARBOILED")
(Parboiled rice)

NBM 10.06.99.00-ARROZ EM OUTRAS FORMAS
(Other rices)

Table 4-2-4-ⓐ Export 1979

NBM Export subject country	Exports (kg)	Amounts (FOB US$)	Price per ton (US$/ton)
10.06.01.00			
Bolivia	12,000	1,740	145
Total	12,000	1,740	
10.06.02.00			
Angola	1,530	802	542
Bolivia	323,620	141,995	439
Total	325,150	142,797	
All total	337 ton	144,537	

Table 4-2-4-ⓑ Export 1980

NBM Export subject country	Exports (kg)	Amounts (FOB US$)	Price per ton (US$/ton)
10.06.01.00			
Argentina	200,000	86,377	432
Bolivia	42,000	12,672	302
Total	242,000	99,049	
10.06.02.00			
Bolivia	952,500	268,840	282
Total	952,500	268,840	
10.06.02.00			
Bolivia	331,060	95,251	287
Total	331,060	95,251	
All total	1,526 ton	463,140	

Table 4-2-4- ⓒ Export 1981

NBM Export subject country	Exports (kg)	Amounts (FOB US$)	Price per ton (US$/ton)
10.06.02.00			
Bolivia	1,601,107	346,566	216
Korea	26,400,000	10,560,000	400
Portuguese	15,499,999	6,199,999	400
Total	43,501,106	17,106,565	
10.06.03.00			
Argentina	5,356,050	2,480,320	463
Total	5,356,050	2,480,320	
10.06.04.00			
Bolivia	909,486	251,333	276
Total	909,486	251,333	
All total	49,766 ton	19,838,218	

Table 4-2-4- ⓓ Export 1982

NBM Export subject country	Exports (kg)	Amounts (FOB US$)	Price per ton (US$/ton)
10.06.01.00			
Angola	150,000	135,000	900
Bolivia	600	89	148
Ivory coast	240	71	296
Total	150,840	135,160	
10.06.02.00			
Bolivia	1,518,500	252,405	166
Iraq	780,000	495,298	635
Mozanbique	1,020	714	700
Portuguese	6,000,000	2,280,000	380
Total	8,299,520	3,028,417	
10.06.04.00			
Bolivia	908,818	170,795	188
Netherland	3,000,000	500,740	167
Total	3,908,818	671,535	
All total	12,359 ton	3,835,112	

Table 4-2-5- ⓐ Import 1979

Import partners	kg	FOB US$	CIF US$	FOB/ton	CIF/ton
10.06.01.00					
Colombia	200	28	627		3,134
Philippine	42	100	531	2,380	12,640
Mexico	1	8	33	7,900	32,990
Urguay	497,500	230,753	245,400	463.7	493.2
Total	497,743	230,889	246,591	463.9	495.2
10.06.02.00					
Argentina	10,672,039	4,018,400	4,095,700	376.4	383.6
Chile	9,923,983	2,787,210	3,240,343	280.7	326.4
U.S.A.	257,142	75,513	109,946	293.5	427.5
Total	20,853,164	6,881,123	7,445,989	329.9	357.0
10.06.03.00					
Argentina	35,053,548	13,983,283	14,216,576	398.4	405.5
Australia	22,380,000	7,309,521	8,195,786	326.4	366.1
Burma	45,124,071	13,606,798	15,618,435	301.5	347.4
Costa rica	19,896,790	6,736,197	7,378,864	337.3	370.8
Philippine	23,219,540	6,974,862	8,129,548	300.2	350.0
Pakistan	167,436,593	38,505,747	44,080,876	229.9	236.2
Thailand	266,290,492	86,553,008	97,865,662	324.9	367.4
Urguay	95,361,347	36,779,711	36,849,110	385.7	386.3
Total	674,762,381	210,449,127	232,397,857	311.2	344.3
10.06.04.00					
Argentina	2,159,415	505,865	524,125	229.8	238.2
U.S.A.	1,868,898	413,004	513,374	220.9	274.6
Urguay	2,397,293	603,990	604,690	251.9	252.1
Total	6,465,606	1,522,859	1,642,189	235.3	253.9
10.06.99.00					
U.S.A.	104,370	34,871	48,177	334.0	461.5
Thailand	8,451,300	2,890,818	3,259,868	341.9	385.6
Total	8,555,670	2,925,689	3,308,045	342.1	386.5
All total	711,135 ton		245,040,671		

Table 4-2-5- ⓑ Import 1980

Import partners	kg	FOB US$	CIF US$	FOB/ton	CIF/ton
10.06.01.00					
Colombia	234	152	1,104	677.0	4,715
U.S.A.	24	15	314	624.8	13,080
Philippine	10	25	164	2,519	16,390
Nigeria	3	15	59	4,972	19,660
Urguay	750,000	375,000	389,438	499.8	519.0
Total	750,271	375,207	391,079	499.9	521.1
10.06.02.00					
Argentina	995,578	370,000	371,000	371.6	372.6
U.S.A.	64,108	32,103	41,273	500.2	643.5
Total	1,059,686	402,103	412,273	377.6	388.9
10.06.03.00					
Argentina	16,906,797	6,783,625	6,836,945	401.2	404.3
Burma	60,336,562	22,245,713	25,775,947	368.5	427.1
Costa rica	5,362,000	1,935,000	2,127,096	360.8	405.0
U.S.A.	19,950,255	8,119,754	9,074,045	406.9	454.7
Philippine	30,221,200	10,275,858	11,813,056	341.2	390.8
Finland	10,080,000	4,321,901	4,953,425	428.5	491.1
Pakistan	26,575,800	8,844,877	10,063,059	332.8	378.6
Thailand	22,197,360	9,294,910	10,521,495	418.4	473.7
Urguay	18,725,497	8,981,319	8,981,319	479.5	479.5
Venezuela	7,104,050	2,516,699	2,761,471	354.1	388.6
Total	217,459,521	83,319,656	92,952,858	382.3	427.3
10.06.04.00					
Argentina	6,786,857	1,574,391	1,736,333	231.9	255.8
U.S.A.	8,123,500	1,791,547	2,219,330	220.5	273.1
Urguay	2,700,000	729,000	782,127	269.8	289.5
Total	17,610,357	4,094,938	4,737,790	234.8	269.0
10.06.05.00					
Urguay	1,964,316	626,275	626,275	318.8	318.8
Total	1,964,316	626,275	626,275	318.8	318.8
10.06.99.00					
U.S.A.	52,299	26,618	33,995	508.7	649.7
Total	52,299	26,618	33,995	508.7	649.7
All total	238,896,450 ton		99,154,270		

Table 4-2-5- ⓒ Import 1981

Import partners	kg	FOB US$	CIF US$	FOB/ton	CIF/ton
10.06.01.00					
Colombia	52	20	260	378.9	4,997
Total	52	20	260	378.9	4,997
10.06.02.00					
U.S.A.	137,939	89,480	116,034	648.3	840.7
Total	137,939	89,480	116,034	648.3	840.7
10.06.03.00					
Burma	38,072,655	14,258,406	16,705,420	374.3	438.6
Philippine	31,500,000	12,594,750	14,552,651	399.7	461.8
Thailand	72,382,849	30,391,333	35,034,772	419.6	483.7
Total	141,955,504	57,244,489	66,292,843	403.1	466.7
10.06.04.00					
Urguay	300,000	81,000	86,903	269.8	289.5
Total	300,000	81,000	86,903	269.8	289.5
10.06.99.00					
Colombia	60	15	227	249.5	3,780
U.S.A.	129,549	85,205	108,639	657.3	838.1
Philippine	25	15	334	600.1	13,350
Total	129,634	85,235	109,200	656.6	841.7
All total	142,524 ton		66,605,240		

Table 4-2-5- ⓓ Import 1982

Import partners	kg	FOB US$	CIF US$	FOB/ton	CIF/ton
10.06.01.00					
Colombia	88	40	515	448.7	5,847
Philippine	41	22	508	568.4	12,370
France	8	16	98	1,987	12,240
Urguay	1,100,000	253,000	253,000	225.7	229.7
Venezuela	29,720,380	5,617,152	6,291,443	188.8	211.5
Total	30,820,517	5,870,230	6,545,564	190.4	212.2
10.06.02.00					
Argentina	30,000	9,300	9,330	309.8	310.8
U.S.A.	117,032	49,041	72,022	418.8	615.0
Urguay	116,740,000	40,174,200	40,374,859	343.6	345.4
Total	116,887,032	40,232,541	40,456,211	343.6	345.6
All total	147,708 ton		47,001,775		

DISTRIBUTION OF RICE IN BRAZIL (3)

I. DISTRIBUTION OF RICE IN DOMESTIC MARKET

The largest market of rice in Brazil is the state of São Paulo, where about 2.8 to 3 million tons of rice are reported to be consumed. The figure accounts for one third of the total domestic consumption of rice.

In an attempt to understand the general situation how rice is circulated in the domestic market, we made an estimation based on the assumption described below.

First, we use the IBGE statistics as the basic data with respect to the population per state and production of rice (unhulled rice) per state as of 1980. The demand for rice in Brazil is reported to be 800 thousand tons per month, that is, 9.6 million tons per year. Therefore, the annual consumption of rice per capita is taken as 80 kg.

Some objections may be raised to the application of this single national average of 80 kg per capita per annum, on the ground that consumption in the state of São Paulo where its population occupying only 21% of total national pupulation consume as much as 33% of total national consumption of rice is equally treated with those of such states in the Northwest where people have to eat the Manioc due to poverty. We, however, dared use the single national average figure, in view of our objective here which is only to grasp the tendency.

Next, we get the consumption quantity of each state by multiplying 80 kg by population of each state, and subtracting production quantity from the above consumption quantity gives us the quantity of surplus or shortage of rice in each state. Summing up each surplus or shortage in each state on the basis of region, we obtain the surplus or shortage quantity for individual regions of the North, the Northwest, the Southeast, the South and the Central-West, which are shown in the following.

Region	Shortage·Import (In 1,000 tons)	Surplus·Export (In 1,000 tons)
The North	87	
The Northwest	1,307	
The Southwest	2,744	
The South		1,837
The Central-West		2,544

The total consumption of rice in the state of São Paulo is reported to be met in the following ways:

15% : By self-supply

45% : By import from the states of Rio Grande Do Sul and Santa Catarina

40% : By import from other states (mainly from Goias) and overseas countries.

The above situation in the state of São Paulo is quite in line with the indication in the Table above.

In particular, 80% of rice consumed in the Greater São Paulo area centering São Paulo city is covered by the rice from the paddy field in the South. The rice is said to be the highest in quality in Brazil and inclination to the rice is high. Transportation of rice from the South to the Southeast, mainly to São Paulo, is carried out overload by trucks. Marine transportation as well is used to certain part of the Northeast.

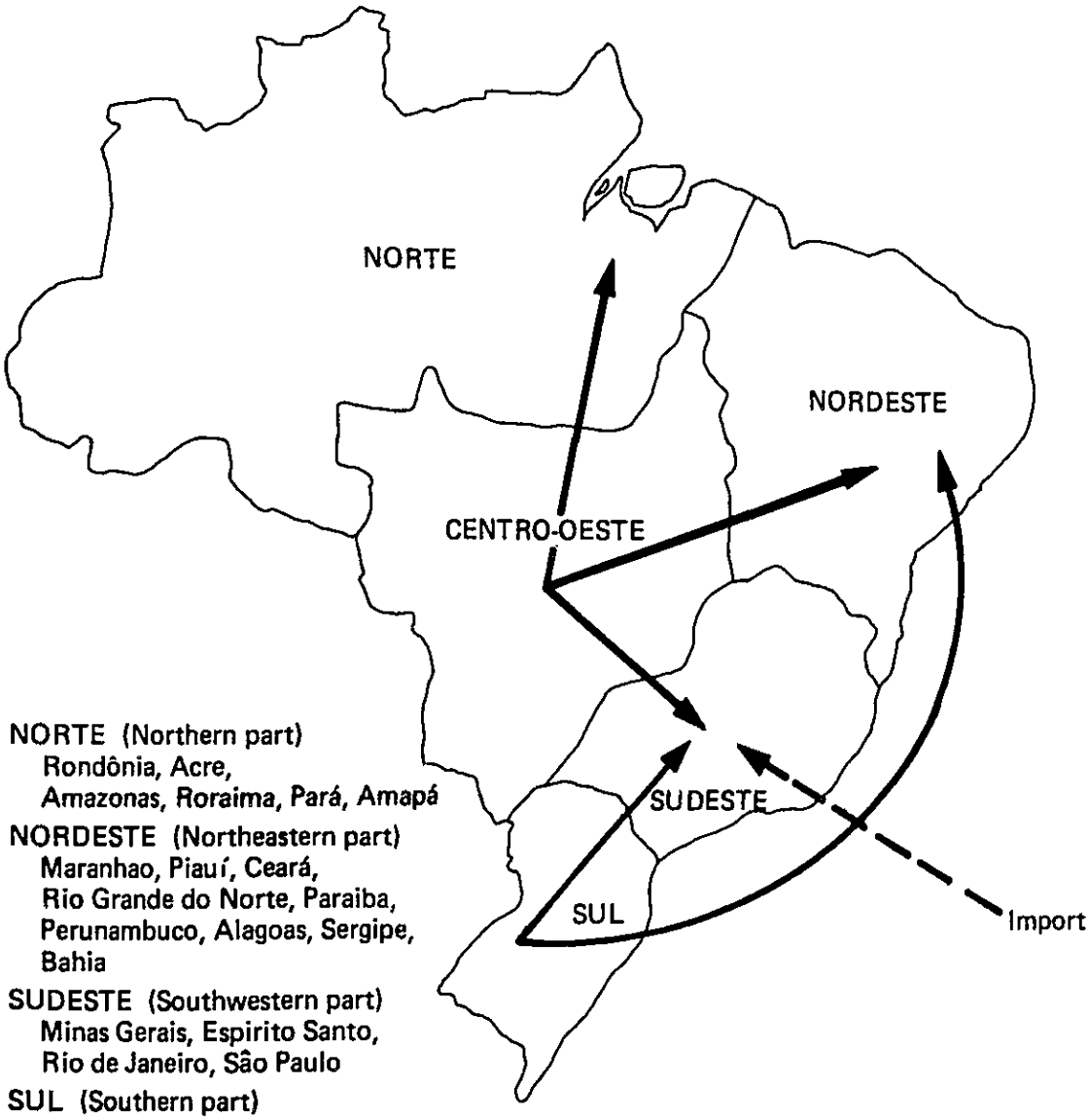
The shortage of rice in the Northeast is covered mostly by supply from the Central-West.

The estimation on the shortage and surplus of rice is shown in page 362 and the flow chart showing circulation of rice is illustrated in the Figure in page 361.

It is extremely uneconomical that the places of production and places of consumption are located far distant from each other in such countries like Brazil which has vast expanse of land.

The Ministry of Agriculture has established a project to promote the self-supply of rice on the basis of each district. Mr. Claudio Braga, a cordinator of the project, said "The cost of the diesel oil used for transporting rice from the state of Goias to 60 disticts in the state of São Paulo amounted to US$1,606,560." And, continued he "The self-supply project may cut the number of brokers, which may increase profit for producers by 40 to 45 % and may reduce the consumer price by 30 to 40%."

Movement of Rice in Brazil



NORTE (Northern part)
Rondônia, Acre,
Amazonas, Roraima, Pará, Amapá

NORDESTE (Northeastern part)
Maranhao, Piauí, Ceará,
Rio Grande do Norte, Paraiba,
Perunambuco, Alagoas, Sergipe,
Bahia

SUDESTE (Southwestern part)
Minas Gerais, Espirito Santo,
Rio de Janeiro, São Paulo

SUL (Southern part)
Paraná, Santa Catarina,
Rio Grande do Sul

CENTRO-OESTE (Middlewestern part)
Mato Grosso do Sul,
Mato Grosso, Goiás

Estimation of Shorts and Overs of Rice by States and Areas

State	Population (1,000 persons)	Consumption (1,000 ton)	Production (1,000 ton)	Shorts and overs by states		Shorts and overs by areas (1,000 ton)
				Shorts, Import	Overs, Export	
Rondônia	490	39	178	-	139	Northern part
Acre	303	24	21	3	-	
Amazonas	1,428	114	7	110	-	-87
Roraima	79	6	25	-	19	
Pará	3,410	273	154	119	-	
Amapá	175	14	1	13	-	
Maranhão	4,000	320	1,281	-	961	Northeastern part
Piauí	2,139	171	77	94	-	
Ceará	5,298	424	18	406	-	
Rio Grande do Norte	1,902	152	1	151	-	-1,307
Paraiba	2,770	222	7	215	-	
Perunambuco	6,147	492	5	487	-	
Alagoas	1,990	159	14	145	-	
Sergipe	1,137	91	19	72	-	
Bahia	9,472	758	60	698	-	
Minas Gerais	13,390	1,071	834	237	-	Southeastern part
Espirito Santo	2,020	162	58	104	-	
Rio de Janeiro	11,301	904	84	820	-	-2,744
São Paulo	25,036	2,003	420	1,583	-	
Paraná	7,629	610	638	-	28	Southern Part
Santa Catarina	3,631	290	429	-	138	
Rio Grande do Sul	7,778	622	2,293	-	1,671	+1,837
Mato Grosso do Sul	1,367	109	504	-	395	Middle Western part
Mato Grosso	1,139	91	1,175	-	1,084	
Goiás	3,865	309	1,455	-	1,146	+2,544
Distrito Federal	1,174	94	13	81	-	
BRAZIL (Total)	119,070	9,526	9,776	-	-	

For population and production, Data 1980 is used.
Consumption is supposed to be 80kg unhulled rice a year per person.

II. DISTRIBUTION OF RICE FROM PRODUCERS TO CONSUMERS

As described in the chapter of AGF (Governmental Procurement) there is little governmental intervention with the distribution of rice. Consequently, as much as 90% distribution of rice is covered by private channels.

A producer sells his unhulled rice to a cooperative association or a wholesale dealer (called "Engenho" or "Maquina"). The cooperative association or the Engendo has facilities to:

① Produce the cleaned rice by applying a husker or a rice cleaning machine to the unhulled rice.

② Pack the cleaned rice into a plastic bag that contains 5 kg rice.

Needless to say, rice is sold by a bag containing 60 kg rice, as well.

There are two different routes that distribute rice to consumers from the wholesaler or Engenho.

1. Route 1: To consumers through supermarkets

A 5 kg cleaned rice bag selling in supermarket in São Paulo or in Rio De Janeiro was packed mostly at an Engenho in the state of Rio Grande Do Sul. This is why the supermarket had the Engenho packed and packaged the rice bags paying the cost for the plastic bags and other related expenses. This route is said to occupy 90% of whole rice distribution. As much as 70% of rice consumed in São Paulo city comes from the state of Rio Grande Do Sul.

2. Route 2: To consumers through retailers and Engenho

In the past, this route was main channel, but the supermarket route has taken this place at present.

Even in other rice growing districts, Engenhos or cooperative associations purchase the unhulled rice from the state of Rio Grande Do Sul, husk and clean the unhulled rice, then mix it with the locally produced rice together. The mixed-rice is to be sold to retailers with a higher grade label attached.

Demand for rice in the North and the Northeast are usually covered by rice produced in local states, especially, Maranhão. In poor harvest year, however, rice is transported by land from the states in the Central-West, such as Goias, Mato Grosso, or by sea from the state of Rio Grande

Do Sul. Normally, rice produced in the state of Mato Grosso is carried to the big consuming markets, such as São Paulo or Rio De Janeiro, through CFP, for consumption.

Function of CFP

CFP has its procured unhulled rice cleaned at cooperative associations or Engenhos, and sells it by auction at grain exchanges.

CFP submits quotation for the offering volume of rice, but the actual transaction price may fluctuate irrespective of the quoted price. Should the demand from buyers exceed the offered volume, the price would rise. Therefore, CFP would suspend its offer temporarily and make new offer for increased volume of rice for sale on such occasions.

On the other hand, buyers, being wholesale dealers usually, would consult each other and allocate the volume of each purchase among themselves thereby avoiding the purchase price hike.

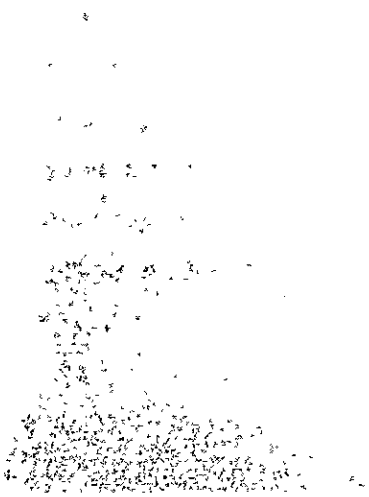
Though similar with CFP in its functions, IRGA (Instituto Rio Grandense De Arroz) is limited to operations within the state of Rio Grande Do Sul.

(The information pertaining to the distribution was obtained at the head office of Messrs. Fujiwara S. A. Argo Comercial.)

AGRICULTURAL POLICY IN BRAZIL (4)

(1) FLOOR PRICE GUARANTEE SYSTEM

(2) AGRICULTURE LOAN



I. FLOOR PRICE GUARANTEE SYSTEM

The production cost is one of important elements in technical analysis for determining the floor price in advance. The floor price depends not only on the production cost which is not necessarily the sole element in determining the floor price, but also on the market forecast and the social and economic policies of a nation.

In Brazil, two types of the price control system are applied to rice. One is the floor price guarantee system applicable to rice producers, and the other is the ceiling price system applicable to consumers.

The governmental purchase based on the floor price guarantee system and the governmental loan against mortgage on crop are carried out in the following procedures.

1. Governmental purchase (AGF-Aquisigas De Governo Federal)

In this system, a farm producer symply sells his crop to CFP (Production Finance Public Corporation). The price applicable to the purchase is the guaranteed floor price fixed for each crop.

2. Governmental loan against mortgage on crop (EGF-Emprestimo De Governo Federal)

This system provides a loan with a farm producer based on the floor price against mortgage on crop submitted to CFP, for the purposes of the borrower to obtain fund to settle his liabilities including the agricultural management finance and others. This loan can be divided into two types. One is subject to the condition that the mortgaged crop would be sold directly to CFP depending on the market price in future, and the other is without such condition.

2-1. For type subject to condition that the mortgaged crops would be sold directly to CFP

The loan is available up to the amount equal to 100% of the guaranteed floor price. On an occasion, however, that the market price for the crop is anticipated to hike due to less shipment to the market, the loan amount might be curtailed to prompt shipment of the crop to the market so that shortage of food may not take place. In an event that the market price of the mortgaged crop should rise during the contract period, the

borrower can take back his crop from the CFP warehouse by repaying the loan to CFP. If, on the contrary, the market price should not rise and the borrower should not repay the loan until the expiration date of the contract, the crop is automatically purchased and all expenses thereof are to be borne by CFP.

2.2 For type without condition that the mortgaged crop would be sold to CFP

In this system, the loan amount is limited up to 80% of the guaranteed floor price, in return to the advantage given to the borrower that the mortgaged crop can be kept in his own farm without being rated officially. On this occasion, CFP does not purchase the mortgaged crop automatically and requests repayment in cash upon expiration.

The Standard Price (PREGO-BASE) which is a base for the guaranteed floor price, is determined as shown in the following table. For both cases, the price of the unhulled rice is taken as an example.

Crop	'83/84 Agriculture Year		'82/83 Agriculture Year		Rise ratio %
	Unit	Price Crs	Unit	Price Crs	
Dry land rice	50 kg	5,600	50 kg	1,900	195
Paddy land rice	50 kg	6,664	50 kg	2,276.50	193
Adjustment to price	To be adjusted for the period of 7 months from August to February by ORTN.		To be adjusted by INPC (Consumer Price Index.)		

Price of ORTN (Value adjusting national bond) for the following month is to be announced at the end of each month. The prices of ORTN for the period from August to December in 1983 were as follows.

August, 1983	Crs 4,963.91
September, 1983	5,385.84
October, 1983	5,897.49
November, 1983	6,469.55
December, 1983	7,012.99

The price to be announced annually before planting, for example, Crs 5,600 of the upland paddy in the above, is called the PREGO-BASE (Standard Price). The very price is to be adjusted by ORTN for the period until February, 1984. The price at the time thus adjusted is the PREGO MINIMO BASICO(Standard floor price). Considerable confusion seems to exist in the working, as the PREGO-BASE described above is rather commonly referred to as the floor price.

Transition of Minimum Guaranteed Price of
Rice (unhulled rice) 50kg

Area	Middle Western part Southeastern part Southern part	Northern part Northeastern part
Standard state	Rio Grande do Sul	Maranhão
Farming year		
67/68	9.18	7.43
68/69	11.38	10.10
69/70	15.01	11.87
70/71	16.58	13.78
71/72	22.12	15.83
72/73	30.00	19.53
73/74	37.00	27.50
74/75	57.00	33.00
75/76	71.00	65.00
76/77	100.00	75.00
77/78	130.00	100.00
78/79	182.00	136.00
79/80	320.00	327.00
80/81	720.00	720.00
81/82	1,399.00	
82/83		
83/84		

Taking the 1981/1982 Agriculture Year as an example the PREGO-BASE announced before planting in 1981 was Crs 1,000 for 50 kg of the unhulled rice. The price was adjusted by the inflation rate against the period from July, 1981 (INPC = 431.0) to January, 1982 (INPC = 602.8) based on INPC (National Consumers Price Index) thereby making the floor price applicable after February 1st, 1982 fixed at Crs 1,399.

Accordingly, no one, as of December 1983, knows the figure of the floor price applicable to the year of 1984.

Suppose ORTN in February, 1984, is assumed to be Crs 8,200, the guaranteed floor price for the upland paddy in 1984, applicable from February 1, 1984, is obtained by the following:

$$\text{Crs } 5{,}600 \times \frac{(\text{ORTN in Feb. } 1984)}{(\text{ORTN in Aug. } 1983)} = 5{,}600 \times \frac{8{,}200}{4{,}963.91} = \text{Crs } 9{,}250.77$$

The price of Crs 9,250.77 is to be used in the governmental purchase (AGF) or the governmental loan (EGF) as the floor price.

In order to illustrate to what extent EGF and AGF were utilized, the table in the following page was prepared. Percentages of the tonnage of the rice related to EGF and AGF respectively against the total tonnage of rice production were calculated. It is our regret that we could not make up the table completely, since data of EGF and AGF in 1978 and 1976, as well as EGF data after 1980, were not available. Though incomplete, the table has indicated a certain tendency.

As is shown in the table, about 12% of rice production in average was used as mortgage for the governmental loan year to year, although the percentage of EGF varied within the range of 6.4 to 20% during 1970 to 1977.

Year	E G F		A G F		Production of Brazilian Rice (ton)
	(ton)	(%)	(ton)	(%)	
1970	636,516	8.4	517,800	6.9	7,553,083
1971	422,069	6.4	14,122		6,593,179
1972	646,597	8.3	-		7,824,231
1973	724,965	10.1	12,162		7,167,127
1974	603,745	8.9	6,548		6,764,038
1975	904,385	11.6	3,115		7,781,538
1976	1,960,415	20.0	649,302	6.7	9,757,076
1977	1,348,451	15.0	1,169,974	13.0	8,993,696
1978					7,296,142
1979					7,595,214
1980			184,025	1.9	9,775,720
1981			800,433	9.7	8,260,547
1982			733,343	7.5	9,718,074
1983					8,564,695

The percentage of AGF, on the other hand, showed very extensive fluctuation, which is thought to be related to the difference between the floor price (governmental purchase price) and the market price. It is quite understandable that many people might have utilized EGF, because the borrower can sell the mortgaged crop on the market by repaying the governmental loan if the market price should have risen.

Next, we have prepared a table showing a ratio of the EGF loan used in connection with rice against total EGF loan executed. The table shows the amount of mortgage on rice had been the largest until around 1973 but at present the loan connected with soybean has occupied the largest share, being followed by those connected with rice or cotton, either of which being 2nd largest or 3rd largest depending on year.

Then, study has been made as to what state has utilized EGF or AGF most. It was found that Rio Grande Do Sul is the state which used the largest amount of EGF by far than others, being followed by the states of Goias, Mato Grosso and São Paulo. For AGF, the state of Mato Grosso has always been in the group of the top borrowers, which may be accountable for its large share of rice supplied to the Northeast.

Proportion of Government Loan (EGF) of Production Mortage by Main Crops

	EGF Total		Rice (%)	Soybean (%)	Cotton (%)	Corn (%)	Others (%)
	Cr.$1,000,000	(%)					
1969	274	100	46.0	8.2	26.8	5.3	13.7
1970	397	100	47.4	10.9	17.5	12.3	11.9
1971	485	100	33.5	26.6	20.8	5.8	13.3
1972	977	100	30.4	27.2	29.2	6.1	7.1
1973	877	100	52.5	0.2	23.6	13.2	10.5
1974	2,620	100	19.2	33.8	23.8	15.4	7.8
1975	7,895	100	10.5	41.2	19.2	7.4	15.7
1976	11,910	100	25.8	34.1	13.5	11.0	15.5
1977	17,542	100	16.6	34.5	23.8	9.8	15.3
1978							
1979							
1980							
1981							
1982	117,279	100	14.0	42.3	23.9	6.6	13.2
1983	688,609	100	18.2	43.7	14.7	9.5	13.9

(As of Sep. 16, 1983)

EGF (Government Loan) by States Ranking of Amount Share

Ranking	1978		1979		1980	
	State	%	State	%	State	%
1	Rio Grande do Sul	60.6	Rio Grande do Sul	49.5	Rio Grande do Sul	53.1
2	Gojas	10.0	Gojas	17.1	Gojas	14.8
3	Mato Grosso	7.8	São Paulo	6.5	Mato Grosso	11.5
4	São Paulo	5.6	Mato Grosso	6.0	Santa Catarina	3.3
5	Santa Catarina	4.8	Santa Catarina	3.7	Minas Gerais	3.3
6	Minas Gerais	3.0	Maranhão	3.7	Mato Grosso do Sul	3.1
7	Maranhão	2.2	Minas Gerais	3.5	Maranhão	2.6

AGF (Government Purchase) by States Ranking of Amount Share

Ranking	1978		1979		1980	
	State	%	State	%	State	%
1	Mato Grosso	77.0	Rio de Janeiro	34.4	Mato Grosso	46.1
2	Maranhão	11.3	São Paulo	33.8	Rio Grande do Sul	31.5
3	Para	3.0	Mato Grosso	10.2	Gojas	8.0
4	Gojas	2.4	Pernambuco	7.0	São Paulo	5.4
5	Rio Grande Do Sul	1.6	Para	4.8	Mato Grosso do Sul	3.4

II. AGRICULTURE LOAN

Along with tighter financial situation of the government, the agriculture loan has become tighter for farm producers. History of the interest rate imposed on the loan indicates such situation as shown below.

1982	45% per annum
December, 1982	60% per annum
June, 1983	85% of ORTN (Value adjusting national bond)

The interest rate of 45% or 60% per annum for the agriculture loan in the above may safely be said to be very favorable to farm producers, as the annual inflation rate in the years of 1981 and 1982 was almost 100%. This was, on the one hand, one of causes for the public deficit. After the Brazilian government was put in under IMF supervision with regards to its financial policy in return to its application for relief from IMF, the beneficial system for agriculture was requested to be abolished by IMF.

ORTN as of December 1983 showed 156.57% rise during last 12 months. Consequently, the interest rate at present (as of Dec., 1983) will be:

$$156.75 \times 0.85 + 3 = 136.38\%$$

Compared with the general open market interest rate of 250% per annum, even the above interest may well be said to be very low. We understand, the National Currency Council is scheduled to revise the interest rate into 95% of ORTN plus 3% applicable from the next harvest, at its meeting to be held on December 14, 1983. Another source also reported all beneficial systems applicable to agriculture would be cancelled from the Agricultural Year of 1984/1985 and the interest rate would also be changed to be 100% of ORTN plus 3% (Reported in the Folhia Do São Paulo Newspaper, dated December 1, 1983). The loan amount to which the favorable interest rate is applied is decided on the basis of VBC (Valor Basico De Custeios - Agricultural management basic amount) and by the loan ratio depending on theclass of the farm producers, that is, the large, medium, small or petty farm.

The VBC is a standard, on the basis of which the governmental loan against the production cost is given. The VBC in case of the upland paddy, as shown in the table in the following page, divides the area into three categories, that is, burnt field, SUDAM (Amazon Development Agency) area and the rest, which are further classified depending on yield. The VBC (Crs/ha) is designed to become larger amount in proportion to the higher yield. In addition, payment of loan is also arranged to be made in installments in accordance with the timing when the borrower may need money. For example, in case of dry paddy, 59% of the loan amount will be paid in July 1983, 19% in October, 1983 and 22% in February, 1984.

In case of wet paddy, VBC is decided by dividing the irrigation facilities into the mechanized type and the natural type. Rules of VBC for 1983/1984 agricultural year are listed in the table in the following page.

This system was introduced from 1979 fiscal year based on the Central Bank, Decisions, 557/79 and 443/69. The yields to be used in VBC have to take into account the followings.

1) Average yield in past 2 to 3 years.
2) Average yield in the area
3) Yields that can be certified by an expert engineer.

VBC (Farming Base Amount) and Its Term day

Northern Part, Middle Western Part, Southern Part, South Eastern Part
Farming Year 1983 and 1984

	Frame of productivity (kg/ha)		VBC (Cr.$/ha)	Payment method					
				First		Second		Third	
	over	under		(%)	Term day (month)	(%)	Term day (month)	(%)	Term day (month)
Unland rice									
Burnt field	-	1,000	43,700	29	Jul.	9	Oct.	62	Feb.
	1,001	1,300	55,600						
	1,301	1,600	56,400						
	over 1,600		72,200						
Sudam area	-	1,000	56,800	59	Jul.	19	Oct.	22	Feb.
	1,001	1,300	82,300						
	1,301	1,600	103,600						
	over 1,600		124,600						
Other area	-	1,000	56,200	59	Jul.	19	Oct.	22	Feb.
	1,001	1,300	74,200						
	1,301	1,600	95,700						
	over 1,600		114,700						

VBC (Farming Base Amount) and Its Date of Payment

Nothern Part, Middle Western Part, Southern Part, South Western Part
Farming Year 1983 and 1984

	Frame of productivity (kg/ha)		VBC (Cr.$/ha)	Payment method					
				First		Second		Third	
	over	under		(%)	Term day (month)	(%)	Term day (month)	(%)	Term day (month)
Paddy rice									
Mechanical irrigation	-	3,000	187,400	34	Jul.	44	Oct.	22	Feb.
	3,001	3,600	214,900						
	3,601	4,200	251,900						
	4,201	5,000	287,900						
	over 5,000		299,900						
Natural irrigation	-	3,000	153,500	34	Jul.	44	Oct.	22	Feb.
	3,001	3,600	167,700						
	3,601	4,200	197,500						
	4,201	5,000	222,000						
	over 5,000		233,100						

The organizations authorized to decide the standards of VBC are specified to be CFP (Production Finance Public Corporation) and the Central Bank of Brazil.

Upon determination of the VBC standards and of the planted area, the total agriculture management loan amount thought necessary for the producer can be calculated. The actual loan amount is decided by the loan ratio described below.

Petty farm	100% of VBC
Small farm	90% of VBC
Middle farm	60% of VBC
Large farm	40% of VBC

The interest rate described before is applied to the loan amount specified above, but the interest rate of the current ORTN + 3% is applied to the amount exceeding over the above specified amount.

The current standard to classify farm producers into four categories of large, medium, small and petty farms, which was obtained at the Central Bank of Brazil in São Paulo, is presented in the following.

Standard to Classify Farm Producers into the Large, Medium, Small and Petty Farms in Agricultural Loan

Source: Central Bankof Brazil, São Paulo
Recri - Divisão Regional Do Crédito
Rural, Industrial e Programas Especiais.
Tel. 285-4292 Sr. Jaime
83/11/28

Base for classification

The following three items constitute a basis for classification of farm producers, irrespective of any classes of large, medium, small and petty ones.

A: Cost of production in this year (Custeio Veste Ano)

B: Output of production in previous fiscal year (Valor Da Produgao Do Anterior)

C: Maximum reference price (MVR - Maior Valor Da Referencia)

The MVR is to be announced in the official gazette as a circular letter at the beginning of May and November every year (two time annually).

The MVR for the period from November 1, 1983 to April 30, 1984 is specified to be Crs 28,294.80.

Formular for classification

$x = (A + B)/(\text{MVR of last December})$

where,

A = Production cost in this year

B = Production output in the previous year

The MVR to be applied is always the one for the period from November to April regardless the kinds of crops.

Standard to classify the farm producers into the large, medium, small or petty farms

Petty farm:	$x < 200$	Less than 200 MVR
Small farm:	$200 < x < 600$	200 ∿ 600 MVR
Medium farm:	$600 < x < 3,000$	600 ∿ 3,000 MVR
Large farm:	$x < 3,000$	More than 3,000 MVR

ECONOMY IN BRAZIL (5)

Brazil has continuously adopted the policy of economic growth in the 1970s. The economic growth during the period ranging from 1968 to 1973, called "a miracle of Brazil", was 11% a year on the average, and it was 6.5% a year on the average during the period of from 1974 to 1980 after the first oil shock. That economic growth was of a very high level, maintained during that period, from the worldwide point of view.

However, this high level economic growth was maintained by an enormous loan from foreign countries. Thus the accumulated overseas debt had rapidly increased. The banks in the developed countries unstingly gave loans from surplus funds expanded by oil money to Brazil.

On the other hand, the net interest of payment doubled from 2,700 million dollars in 1978 to 6,300 million dollars in 1980, and the ordinary red figure also doubled 6,000 million dollars in 1978 to 12,400 million dollars in 1980 because of the soaring oil price, the expanded trade red figure caused by the worldwide recession and the extraordinary high interest rate leading to rapid expansion of payment interest. This resulted in conversion into an economic-tightening policy in 1980, which entailed the minus 1.9% growth in 1981. The trade balance was turned into a slight black figure, over which, however, the interest of payment increased. The net interest of payment reached 10,800 million dollars, and the red figure of ordinary income and expenditure amounted to 14,500 million dollars. Despite such a situation, Brazil had maintained the trust of the international financial circle thanks to its recognition of Brazil's well-cared management of overseas debt. However, in the summer of 1982, fund raising suddenly fell in difficulty since large scale syndicate loans turned not to be gained due to influence of financial crisis in Mexico and Argentine.

Thus, Brazil sought relief from IMF. For concluding a financial relief consultation with IMF in December, 1982, the Brazil Government set up targets (1) to restrain the inflation rate in 1983 to 70% and (2) to secure a black figure of 6,000 million dollars in the trade balance in 1983. For achieving the targets, it decided (3) to improve the status quo of tax collection and cut some subsidies as well as to decrease the financial red figure by cutting the investment in the governmental enterprises (by 19% in real term relative to the investment in the previous

year), (4) to control severely the commodity price slide (indexation) of pay, and (5) to devalue the exchange rate to dollar by inflation rate plus 1%.

As large a scale of devaluation of exchange rate as 30% was carried out for import expansion in February, 1983.

Nevertheless, the Brazil Government could not keep the promise as to the conditions for the loan from IMF. Thus the second IMF loan scheduled to be given at the end of May was stopped, and new loans from private banks were automatically stopped, too. The delay in payment of interest of 3,000 million dollars has arisen up to now. In such a situation, the IMF general assembly at the end of September turned into one just for only Brazil, where a relief loan of 11,000 million dollars was somehow agreed.

On the other hand, a bill of pay made public in accordance with the order of the president and constituting one condition for the loan was voted down in the lower house on October 19. This broke the built-up blocks of support. Immediately on that day, the Brazil Government submitted an amended bill, which was passed in the lower house in November 9, as a result of vote-collecting maneuvering despite the fact that the number of the Government Party members was below the majority of the assembly members. Thus the coming-into-being of a new law of pay was certain.

On June 9 before that, the Government issued a new economy-tightening policy, which comprised (1) an increase in preferential interest for agriculture and small-to-medium-sized enterprises, (2) a cut of subsidies for oil and wheat, (3) an increased cut of investment in public enterprises (a cut of 19% to 25% in real term), (4) tax imposition on the benefit in the capital market, and (5) payment in advance of income tax of the financial business circle. More important was that (6) it comprised no incorporation of the increased parts of wheat and oil prices due to the cut of subsidies into the slide index (the corresponding restraint of pay raise).

The relief loan of 11,000 million dollars was composed of 6,500 million dollars from the syndicate of private banks on condition of loan unfreezing of IMF, and 4,500 million dollars borne by governments, of which

2,000 million dollars was supposed to be handled as the part of risk (deferred repayment) by Paris Club. However, there remained a problem of whether or not 2,000 million dollars was reasonable and a problem of how to partition and handle the remaining new grant of credit (2,500 million dollars according to the plan).

IMF accepted a prospectus of the Brazil Government on November 22 on which day the ascertained sum of loans from the syndicate of private banks amounted to about 6,000 million dollars. On November 23, the negotiation on a risk of 3,800 million dollars with Paris Club was concluded. A new grant of credit amounting to 2,500 million dollars of the Governments' burden is supposed to be supplied as a supplier's credit under the leadership of U.S. Export and Import Bank, 500 million dollars of that sum is supposed to be borne by the Japanese Government.

The syndicate of private banks allowed a loan of 1,800 million dollars, which was promised for 1983 but has been frozen since May, and assured a loan of 6,500 million dollars for 1984 to be supplied in so far as the promise of it with IMF is observed.

Brazil Central Bank anticipates the following overseas debt.

At the end of 1983	83,265 million dollars
At the end of 1984	91,913 million dollars
At the end of 1985	100,813 million dollars

Morgan Bank anticipates the following overseas debt and red figure of ordinary income and expenditure.

Year	Overseas Debt (million dollars)	Red Figure (million dollars)
1982	86,300	16,300
1983	94,900	7,200
1985	104,700	6,000
1990	121,900	3,500

In any event, there is no doubt about an unsolved state of a problem of Brazil's overseas debt to be continued for a long period of coming years.

The Brazil Government gave a promise to IMF as regards attainment of black-figure due to the following surplus export that may serve as a plus factor in the Brazil's international balance of payments.

Year	Export (million dollars)	Import (million dollars)	Surplus (million dollars)
1983	22,300	16,000	6,300
1984	25,000	16,000	9,000

The Brazil Government has a domestic debt amounting to 26,000,000 million cruzeiros converted into 29,000 million dollars at the beginning of November, 1983 and corresponding to 16% of the gross national product besides the overseas debt.

The policy from now on must be planned under various restrictions derived from these overseas and domestic debts. So, an anticipation of future demand for rice and a possibility of import of rice from Paraguay must be examined with these conditions being taken into consideration.

As is apparent from the above, the Brazil's economy, which has continuously grown during the past decade or so, is now at the turning point.

SOYBEAN PRODUCTION OF BRAZIL (6)

Table 4-2-6 Soybean Production of Brazil

	Planted area (ha)	Production (ton)	kg/ha
69/70	1,318,809	1,508,000	1,143
71	1,716,420	2,077,000	1,210
72	2,191,455	3,222,631	1,470
73	3,615,058	5,011,614	1,386
74	5,143,116	7,876,209	1,531
75	5,823,735	9,892,299	1,698
76	6,292,461	11,075,193	1,760
77	7,069.884	12,512,963	1,770
78	7,782,187	9,540,577	1,225
79	8,256,096	10,240,306	1,240
80	8,774,023	15,155,804	1,727
81	8,693,400	15,484,800	1,781
82	8,202,181	12,834,624	1,565
83			

Table 4-2-7 Soybean Production by States (1,000 ton)

	Gojas		Mato Grosso*		Minas Gerais		Parana		Rio Grande Sul		Catarina		São Paulo		Total	
		(%)		(%)		(%)		(%)		(%)		(%)		(%)		(%)
1971	41	2.0	16	0.7	1	-	462	22.2	1,393	67.1	78	3.8	86	4.1	2,077	100
1972	50	1.8	28	1.0	9	0.3	688	25.4	1,655	61.2	99	3.7	175	6.5	2,704	
1973	90	1.8	103	2.1	36	0.7	1,326	26.5	2,872	57.3	254	5.1	330	6.6	5,012	
1974	99	1.3	307	3.9	58	0.7	2,589	32.9	3,870	49.1	431	5.5	522	6.6	7,876	
1975	73	0.7	273	2.8	87	0.9	3,625	36.6	4,689	47.4	467	4.7	678	6.9	9,892	
1976	49	0.4	290	2.6	106	0.9	4,500	40.0	5,107	45.5	410	3.7	765	6.8	11,227	
1977	90	0.7	695	5.6	106	0.8	4,700	37.6	5,678	45.4	476	3.8	768	6.1	12,513	
1978	100	1.0	479	5.0	137	1.4	3,150	33.0	4,568	47.9	355	3.7	745	7.8	9,533	
1979	282	2.8	853	8.6	195	2.0	4,000	40.2	3,354	33.7	425	4.3	848	8.5	9,949	
1980	465	3.1	1,441	9.5	263	1.7	5,400	35.6	5,738	37.9	742	4.9	1,108	7.3	15,157	
1981	407	7.6	1,613	10.4	285	1.8	5,256	34.0	6,115	39.6	686	4.4	1,088	7.0	15,452	100
1982																
1983																
81/71	9.9 times		100.8 times		285		11.4		4.4		8.8		12.7		7.4	

* Total of Mato Grosso state + Mato Grosso do Sul state

Table 4-2-8 Soybean Production by Areas and States 1980

Area and state	Planted area (ha)	Production (ton)	Yield per unit area (ton/ha)
Nothern part	-	-	-
Northeastern part	1,986	2,320	1,168
Maranhão	80	96	1,200
Bahia	1,906	2,224	1,166
Southeastern part	723,156	1,388,600	1,920
Minas Gerais	162,389	289,542	1,783
São Paulo	560,767	1,099,058	1,959
Southern part	6,918,703	11,856,126	1,713
Paraná	2,410,800	5,400,192	2,240
Santa Catarina	520,401	718,764	1,381
Rio Grande do Sul	3,987,502	5,737,170	1,438
Middle Western part	1,130,178	1,908,758	1,688
Mato Grosso do Sul	806,559	1,322,082	1,639
Mato	70,431	117,173	1,663
Gojas	246,066	455,794	1,852
Federal control state (Brasilia)	7,122	13,709	1,924
Whole Brazil	8,774,023	15,155,804	1,727

CONDITIONS OF SOYBEAN (PULSE) IMPORT OF BRAZIL (7)

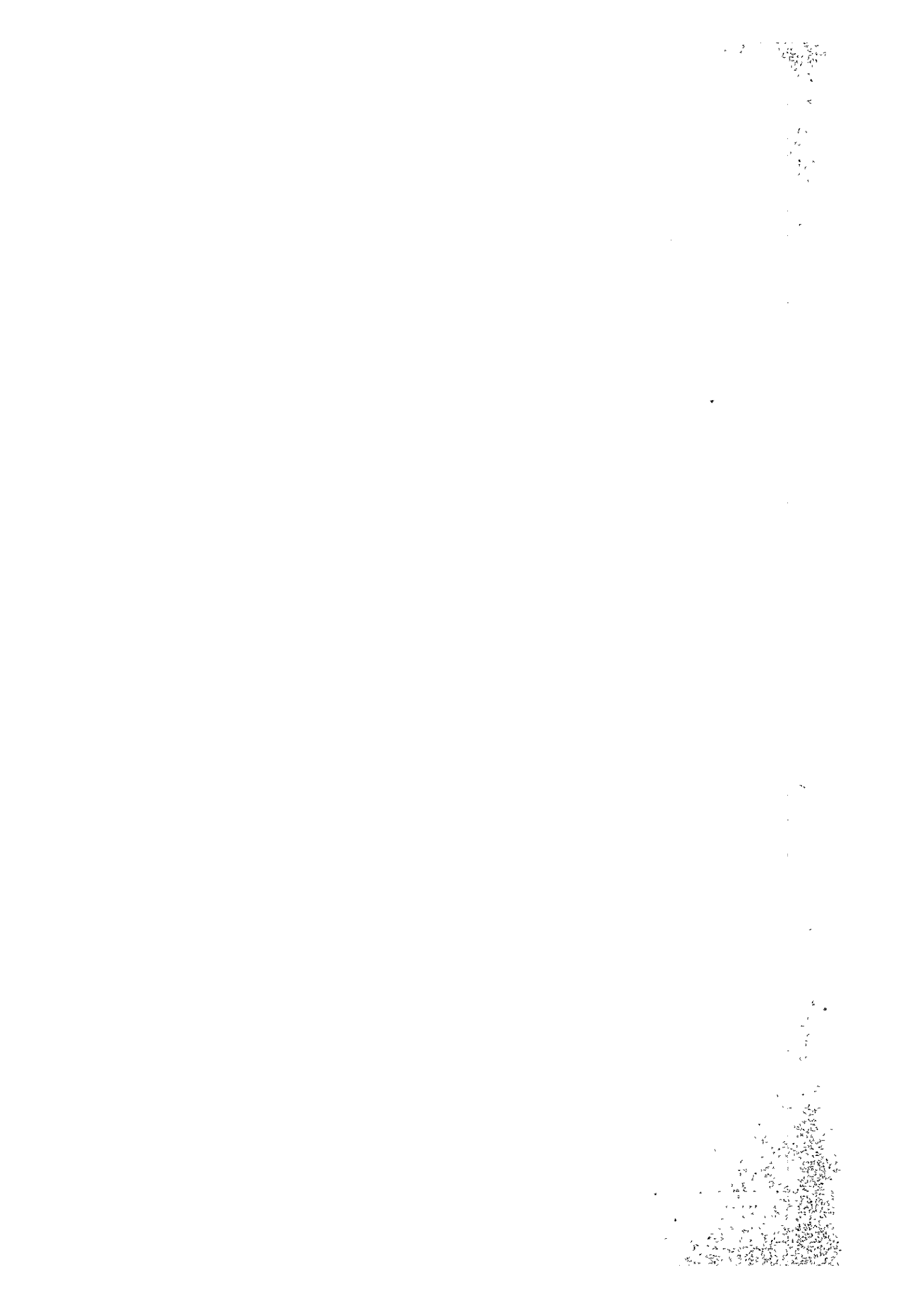


Table 4-2-9 Soybean (Pulse) Production and Import of Brazil
(1,000 ton) (Summary)

	Domestic production (1,000 ton)	Import (1,000 ton)					Paraguay(1) domestic production (1,000 ton)
		Argentina	USA	Paraguay	Urguay	Total	
1979	10,240	78	47	87	2	213	450
	(%)	37	22	40	1	100	
	CIF US$/ton	276.7	294.3	92 246.9	263.1	100 268.3	
1980	15,156	272	19	160	9	461	650
	(%)		4	35	2	100	
	CIF US$/ton	290.3	299.3	84 224.0	213.0	266.2	
1981	15,485	260	78	573	21	931	880
	(%)	28	8	62	2	100	
	CIF US$/ton	297.8	344.5	97 286.3	290.4	294.6	
1982	12,834	468	202	561	20	1,251	750
	(%)	37	16	45	2	100	
	CIF US$/ton	254.9	260.9	94 229.9	248.1	244.3	

(1) Data of Paraguay Central Bank

Table 4-2-10-ⓐ Soybean (Grain) 1979

Import partners	Amount (ton)	Amount of cost		Unit cost	
		FOB US$	CIF US$	FOB US$/ton	CIF US$/ton
Argentina	78,453	20,570,560	21,723,730	261.3	276.7
USA	46,509	12,367,205	13,694,125	265.8	294.3
Paraguay	86,712	20,590,894	21,413,730	238.7	246.9
Urguay	1,760	463,200	463,200	263.1	263.1
Total	213,474	53,911,859	57,294,785	252.7	268.3

Table 4-2-10- ⓑ Soybean (Grain) 1980

Import partners	Amount (ton)	Amount of cost		Unit cost	
		FOB US$	CIF US$	FOB US$/ton	CIF US$/ton
Argentina	272,349	73,687,160	79,114,714	270.2	290.3
USA	19,402	5,254,278	5,808,667	270.8	299.3
Paraguay	159,629	30,307,428	35,779,861	190.0	224.0
Urguay	9,215	1,959,260	1,963,860	212.5	213.0
Total	460,595	111,208,126	122,667,102	241.8	266.2

Table 4-2-10-ⓒ Soybean (Beans) Import 1981

Import partners	Quantity	Amount of money		Unit cost	
	(ton)	FOB (US$)	CIF (US$)	FOB (US$/ton)	CIF (US$/ton)
Argentina	259,597	71,069,122	77,341,728	273.4	297.8
USA	77,500	24,454,934	26,717,673	315.4	344.5
Paraguay	572,815	144,074,254	164,142,297	251.2	286.3
Urguay	21,402	6,032,020	6,220,805	281.9	290.4
Total	931,314	245,630,330	274,422,503	263.6	294.6

Table 4-2-10-ⓓ Soybean (Beans) Import 1981

Import partners	Quantity	Amount of money		Unit cost	
	(ton)	FOB (US$)	CIF (US$)	FOB (US$/ton)	CIF (US$/ton)
Argentina	468,041	109,879,651	119,370,568	234.6	254.9
USA	202,067	48,867,602	52,655,503	241.4	260.3
Paraguay	561,182	128,182,440	129,187,989	228.0	229.9
Urguay	20,208	4,997,172	5,015,722	247.1	248.1
Total	1,251,499	291,926,865	306,229,782	232.6	244.3

Table 4-2-11 Soybean (Beans) Import of Brazil 1982 Traders, Quantities and Amount of Money (1/2)

		Ton	US$ 1,000	US$/ton
ANDERSON CLAYTON S.A. IND. E COM.				
	Switzerland	42,300	9,416	223
BERTOL S.A. IND. E COM. E EXPORTAGAO				
	Argentina	44,500	10,586	238
	Paraguay	13,000	3,123	240
	Total	57,500	13,709	
BIANCHINI S.A. IND. E COM.E AGRICULTURA				
	Argentina	30,000	6,802	227
BRASWEY S.A. IND. E COM				
	Panama	14,000	3,168	226
	Paraguay	43,000	10,396	242
	Total	57,000	13,564	
CARGILL AGRICOLA S.A.				
	Panama	55,000	11,975	218
	Paraguay	29,300	6,207	212
	Total	84,300	18,182	
CENTRAL DE COOP. PROD. RURAIS DO. R.G.S LTDA.				
	Argentina	205,000	48,975	239
CEVAL AGRO INDUSTRIAL S.A.				
	Argentina	54,000	13,053	242
	USA	94,000	23,047	245
	Paraguay	113,000	26,783	237
	Total	261,000	62,884	
CIA. BRAS. DE ENTREPOSTOS E COM.-CEBEC				
	USA	72,500	17,221	238
FAROL S.A. IND. E COM. E EXP.				
	Argentina	45,200	10,791	239
	Urguay	760	179	236
	Total	45,960	10,971	

Table 4-2-11 Soybean (Beans) Import of Brazil 1982 Traders, Quantities and Amount of Money (2/2)

		Ton	US$ 1,000	US$/ton
GRANOLEO S.A. COM. IND. DE SEMENTES OLEAGI NOSAS				
	Argentina	15,000	3,629	242
	Paraguay	40,000	10,193	255
	Total	55,000	13,822	
INDS. J.B. DUARTE S.A.				
	Paraguay	14,250	3,277	230
OLVEBRA S.A. IND. E COM. DE OLEOS VEGETAIS				
	Paraguay	77,000	19,761	257
KASPER E CIA. LTDA.				
	Paraguay	2,000	481	241
REFINADORA DE OLEO BRASIL S.A.				
	Paraguay	20,000	4,146	207
RESEGUE IND. E COM. S.A.				
	Paraguay	15,000	3,543	236
SANBRA SOC. DE ALGODOEIRA DO NORDESTE BRASILEIRO S.A.				
	Paraguay	57,000	12,261	215
	Total	1,023,510		
	Paraguay Total	423,550	100,171	237

CONDITIONS OF EXPORT OF BRAZILIAN SOYBEAN (PULSE, BRAN AND CAKE, OIL) (8)

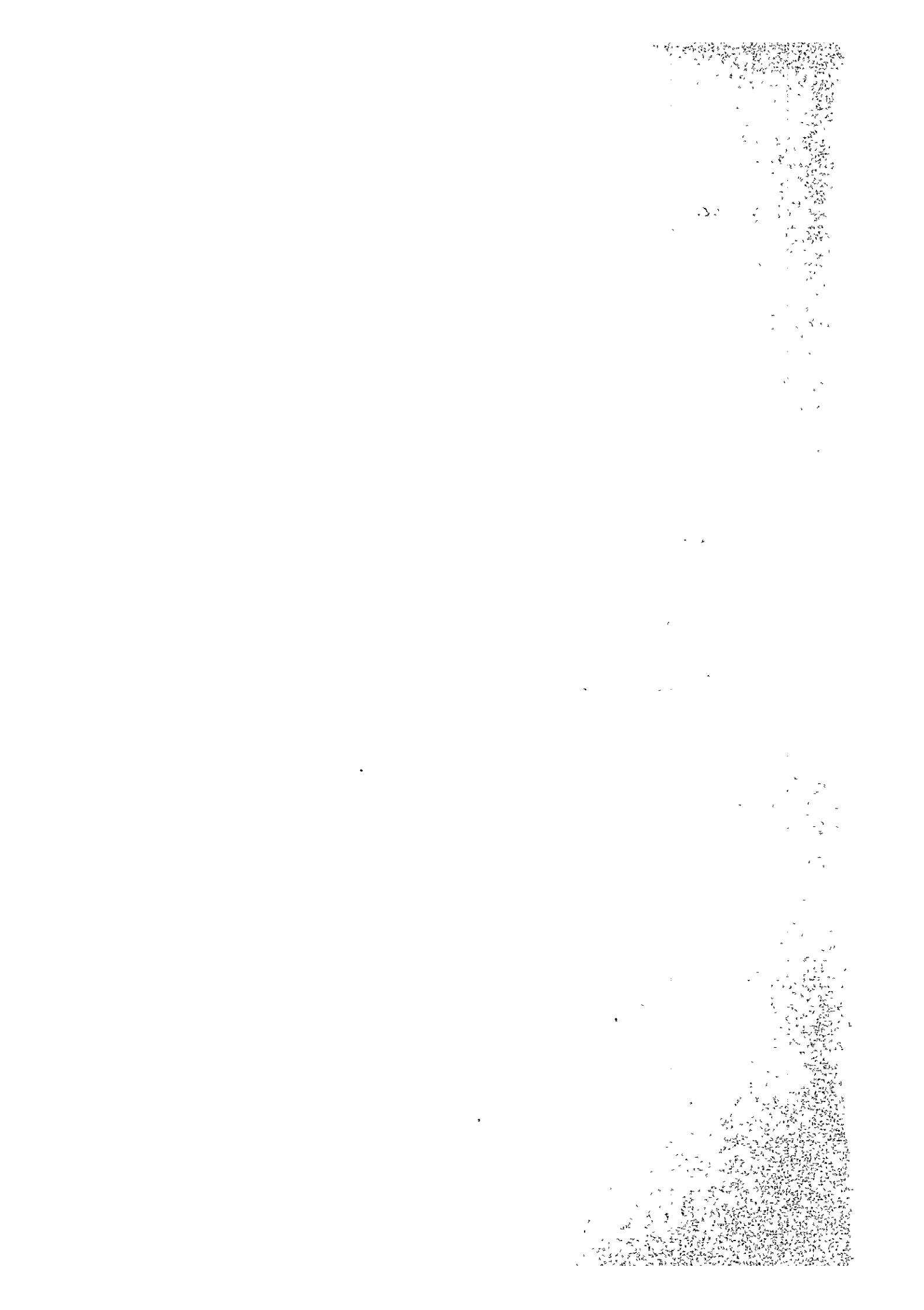


Table 4-2-12 Export Data of Soybean Group 1/2 (Summary)

	Soybean (BEANS)			Soybean (CAKE)		
	Quantity (ton)	Amount of money (US$ 1,000)	US$/ton	Quantity (ton)	Amount of money (US$ 1,000)	US$/ton
1968	65,859	6,291	95.5	234,530	18,931	80.7
69	310,147	29,249	94.3	295,366	23,415	79.3
70	289,623	27,084	93.5	525,365	43,637	83.1
71	213,426	24,309	113.9	911,407	81,532	89.5
72	1,037,273	127,927	123.3	1,405,329	152,348	108.4
73	1,786,139	494,153	276.7	1,581,493	422,635	267.2
74	2,730,426	586,271	214.7	2,030,942	303,044	149.2
75	3,333,334	684,901	205.5	3,133,581	465,774	148.6
76	3,639.497	788,538	216.7	4,373,867	795,004	181.8
77	2,586,866	709,606	274.3	5,353,663	1,150,152	214.8
78	658,527	169,886	258.0	5,418,999	1,049,908	193.8
79	638,467	179,506	281.2	5,175,808	1,138,008	219.9
80	1,548,882	393,930	254.3	6,581,924	1,449,013	220.2
81	1,449,731	403,671	278.4	8,889,363	2,137,429	240.4
82	500,804	123,457	246.5	7,800,150	1,637,132	209.9

Source: CACEX

Table 4-2-12 Export Data of Soybean Group 2/2

	Soybean oil (CRUDE OIL)			Soybean oil (REFINED OIL)			Soybean group
	Quantity (ton)	Amount of money (US$ 1,000)	US$/ton	Quantity (ton)	Amount of money (US$ 1,000)	US$/ton	Total amount of money (US$ 1,000)
1968							25,222
69							52,664
70							70,721
71	72	27	375.0				105,868
72	600	160	266.7				280,435
73	61,408	23,808	387.7				940.596
74	2,277	1,890	830.0	12	9	750.0	891,214
75	263,183	152,442	579.2	1,294	1,147	886.4	1,304,264
76	452,889	174,642	385.6	4,767	21,782	486.6	1,779,996
77	487,225	274,216	562.8	4,938	8,699	582.3	2,142,673
78	487,824	283,156	580.4	5,778	11,755	745.0	1,514,705
79	524,528	326,798	623.0	9,206	7,111	772.4	1,651,423
80	731,852	411,111	561.7	12,069	10,139	840.1	2,264,193
81	1,107,622	544,871	491.9	173,645	106,125	611.2	3,192,098
82	509,324	222,359	436.6	340,055	156,657	460.7	2,139,605
83							

Source: CACEX

Table 4-2-13-ⓐ Export of Soybean (Beans) 1982

Export partners	Quantity (ton)	Total amount of money (US$ 1,000)	Average unit (US$/ton)
West German	12,481		
Argantina	50		
Ivory coast	175		
Spain	27,040		
Italy	2,000		
Malaysia	12,600		
Mexico	178,050		
Netherland	4,010		
Paraguay	8,923		
USSR	255,475		
Total	500,804	123,457	246.5
Loading ports			
Santos - SP	1,685		
Foz De Iguagu - PR	8,923		
Paranagua - PR	244,456		
Rio Grande - RS	245,690		
Uruguaiana - RS	50		

Table 4-2-13-ⓑ Export of Soybean (Crude Oil) 1982

Export partners	Quantity (ton)	Total amount of money (US$ 1,000)	Average unit (US$/ton)
Australia	4,635		
Bolivia	2		
Chile	8,258		
China	10,700		
Colombia	7,200		
Korea	340		
Hong kong	650		
India	200,267		
Iraq	18		
Iran	170,370		
Ireland	2,500		
Japan	1,500		
Morocco	23,183		
New Zealand	1,000		
Netherland	7,055		
Pakistan	16,267		
Panama	1,530		
Peru	7,560		
Poland	1,000		
Singapore	3,200		
South Africa	1,080		
Turkey	1,500		
USSR	38,850		
Urguay	700		
Total	509,324	222,359	436.6
Loading ports			
Guajara-Mirim - RO	2		
Santos - SP	940		
Paranagua - PR	160,965		
S.Franc.Sul - SC	16,335		
Chui - RS	400		
Rio Grande	330,683		

Table 4-2-13-ⓒ Export of Soybean Oil (Refined Oil) 1982 1/2

Export partners	Quantity (ton)	Total amount of money (US$ 1,000)	Average unit (US$/ton)
Angola	12,815		
Barbados	19		
Bolivia	234		
Caneroon	78		
Chile	9,423		
China	14,425		
Colombia	3,400		
Ecuador	31		
Hong kong	2,940		
India	120,058		
Iraq	23		
Iran	86,341		
Malagasy	1,050		
Morocco	13,000		
Nigeria	11,734		
Nerherland	3,137		
Pakistan	15,818		
Panama	3		
Papua New Guinea	500		
Paraguay	317		
Peru	1,000		
Poland	4,000		
South Africa	850		
Tanzania	3		
Turkey	1,810		
USSR	35,525		
Uruguay	1,522		
Total	340,055	156,657	460.7

Table 4-2-13-ⓒ Export of Soybean Oil (Refined Oil) 1982 2/2

Export partners		Quantity (ton)	Total amount of money (US$ 1,000)	Average unit (US$/ton)
Loading ports	State			
Guajara-Mirim	- RO	234		
Santos	- SP	9,999		
Sao Paulo air port	- SP	(180 kg)		
Foz Do Iguagu	- PR	303		
Guaira	- PR	14		
Paranagua	- PR	96,859		
S.Franc.Sul	- SC	43,262		
Chui	- RS	1,340		
Jaguarao	- RS	181		
Rio Grande	- RS	187,854		
Uruguaiana	- RS	8		

Table 4-2-13-ⓓ Export of Soybean Bran and Cake (Raw Powder) 1982 1/2

Export partners	Quantity (ton)	Total amount of money (US$ 1,000)	Average unit (US$/ton)
West German	233,622		
East German	396,883		
Saudi Arabia	2,500		
Belgium Luxembourg	149,679		
Bulgaria	53,175		
Chile	14,540		
Korea	61,542		
Ivorycoast	998		
Denmark	6,735		
Egypt	2,000		
Spain	55,970		
Philippine	276,378		
France	1,936,841		
Grenada	200		
Hungary	366,409		
Indonesia	70,950		
Iraq	13,232		
Iran	248,217		
Ireland	33,200		
Italy	195,918		
Yugoslavia	34,025		
Japan	49,272		
Jordan	44,761		
Malta	3,000		
Mexico	3,000		
Mozambique	2,565		
Nigeria	6,800		
Netherland	1,719,307		

Table 4-2-13-ⓓ Export of Soybean Bran and Cake (Raw Powder) 1982 2/2

Export partners	Quantity (ton)	Total amount of money (US$ 1,000)	Average unit (US$/ton)
Pakistan	2,500		
Papua New Guignea	5,000		
Porland	282,431		
United Kingdom	24,342		
Romania	15,300		
Singapore	18,400		
South Africa			
Sweden	23,750		
Switzerland	3,000		
Thailand	103,431		
Czechoslovakia	196,186		
Tunisia	41,550		
USSR	930,379		
Uruguay	400		
Venezuela	16,390		
Total	7,720,763	1,619,165	209.7
Loading ports State			
Santos - SP	611,491		
Foz Do Iguagu - PR	3,000		
Paranagua - PR	3,162,424		
S.Franc. Sul - SC	781,679		
Chui - RS	400		
Porto Alegre - RS	164,800		
Rio Grande - RS	2,996,969		

Table 4-2-13-ⓔ Export of Soybean Bran and Cake (Solidity) 1982 1/2

Export partners	Quantity (ton)	Total amount of money (US$ 1,000)	Average unit (US$/ton)
Poland	600		
Total	600	117	195.0
Loading port			
Rio Grande - RS	600		

Table 4-2-13-ⓔ Export of Soybean Bran and Cake (Others) 1982 2/2

Export partners	Quantity (ton)	Total amount of money (US$ 1,000)	Average unit (US$/ton)
West German	8,029		
East German	20,000		
Belgium	3,000		
France	20,284		
Hungary	10,000		
Italy	2,600		
Netherland	13,310		
South Africe	499		
USSR	1,000		
Total	78,787	17,850	226.6
Loading ports State			
Santos - SP	6,500		
Paranagua - PR	42,587		
Rio Grande - RS	29,700		

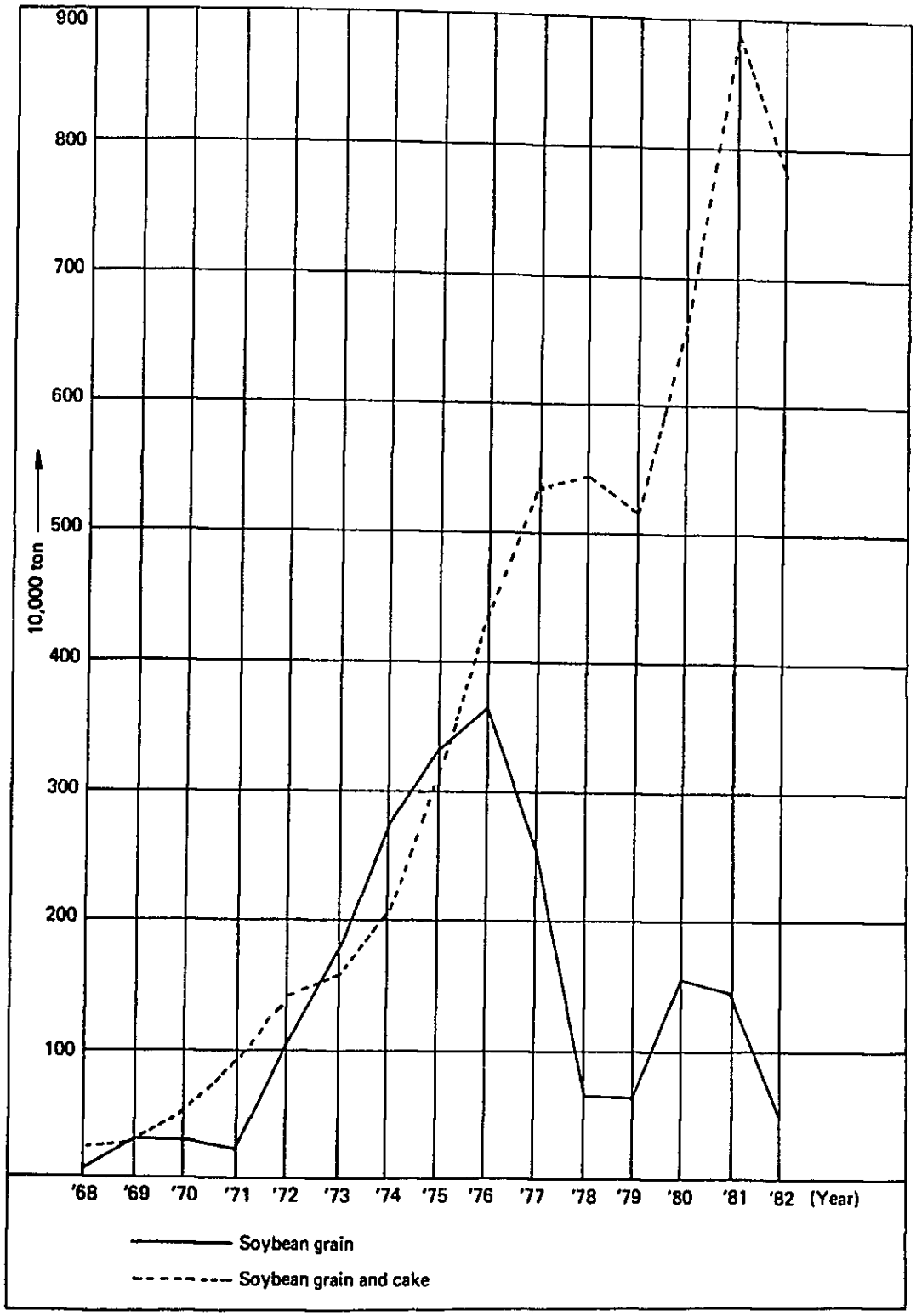


Fig. 4-2-1 Export of Soybean Grain and Soybean Bran and Cake

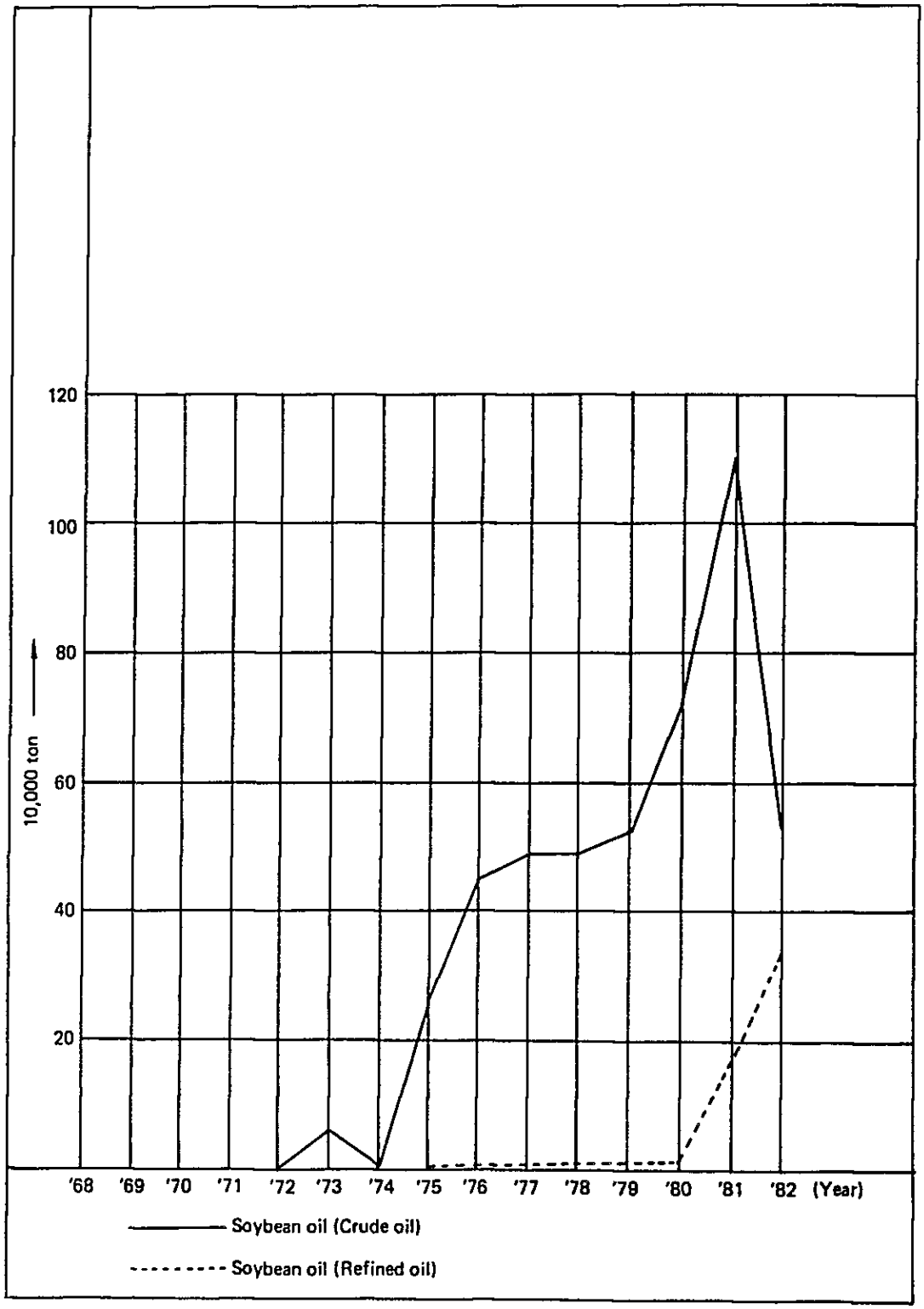


Fig. 4-2-2 Export of Soybean Oil (Crude Oil and Refined Oil)

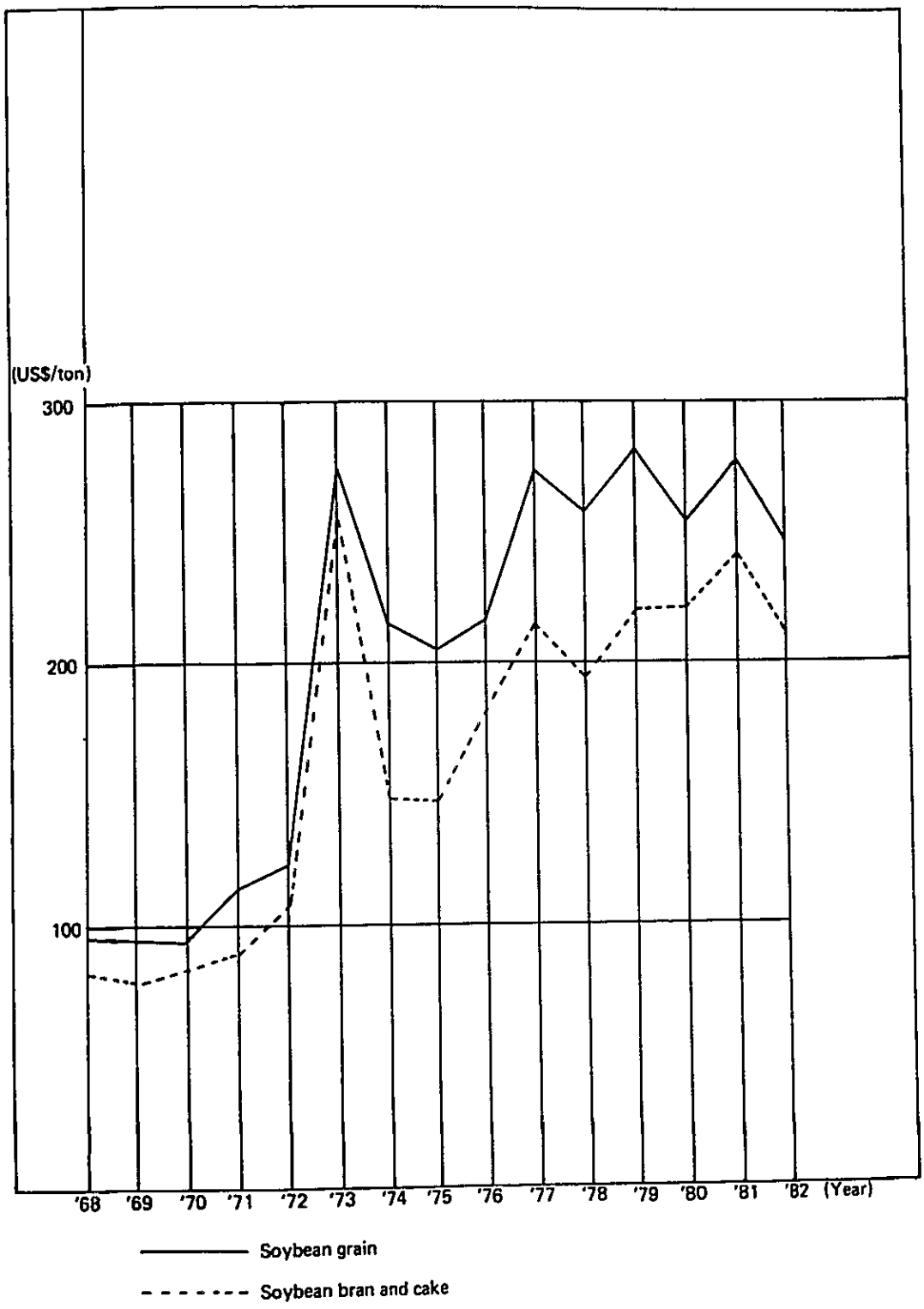


Fig. 4-2-3 Average Export Price of Soybean Grain and Soybean Bran and Cake (FOB US$/ton)

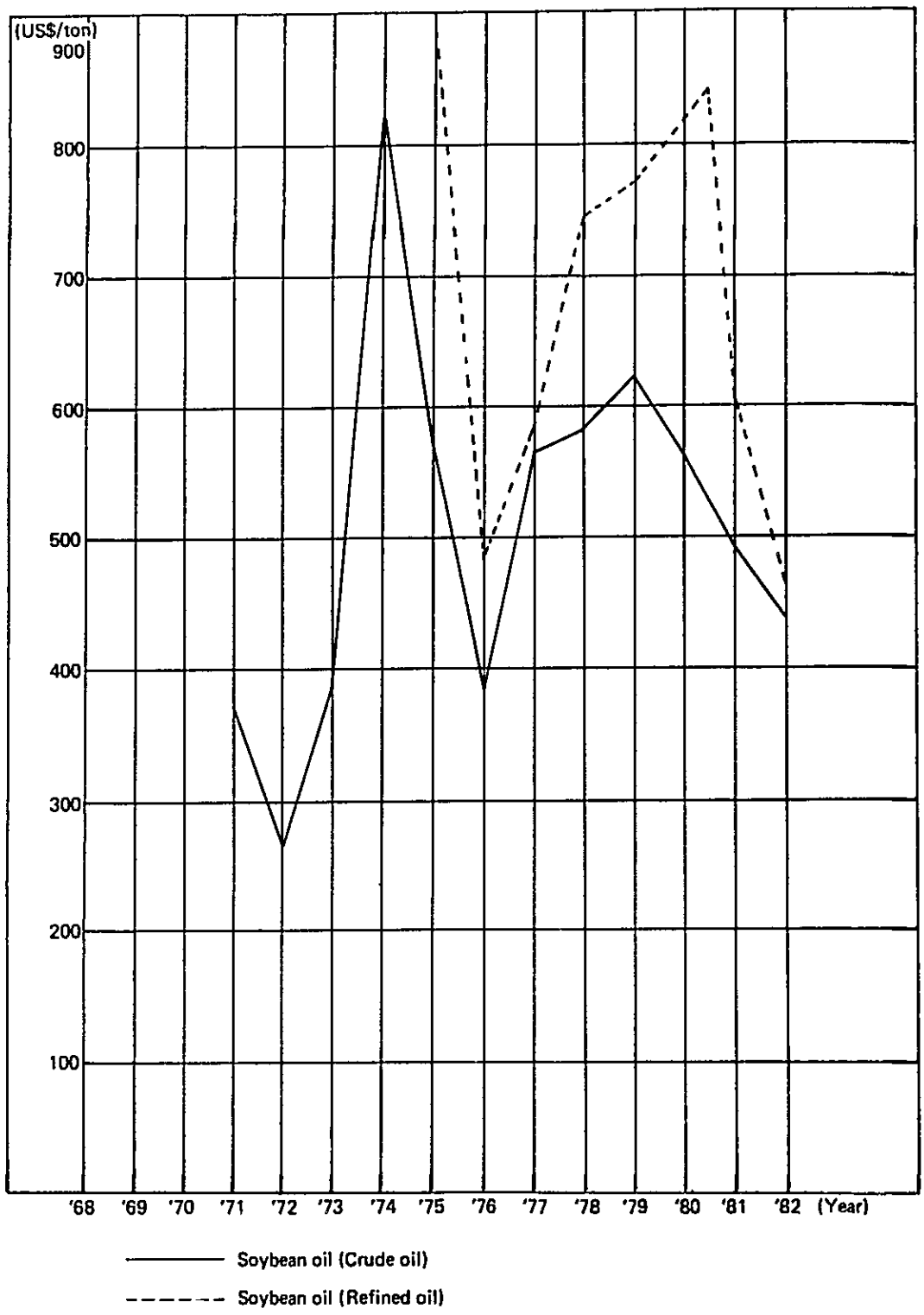


Fig. 4-2-4 Average Export Price of Soybean Oil (Crude and Refined Oil) (FOB US$/ton)

Table 4-2-14 Percentage of Soybean and by Products Occupying in Total Export Amount of Brazil

	Total export amount (US$ 1,000,000)	Export amount of soybean group (US$ 1,000,000)	Percentage (%)
1971	2,904	105	3.60
72	3,991	289	7.23
73	6,199	945	15.25
74	7,951	890	11.19
75	8,670	1,320	15.02
76	10,128	1,777	17.54
77	12,120	2,138	17.64
78	12,658	1,513	11.95
79	15,244	1,641	10.77
80	20,132	2,264	11.25
81	23,293	3,191	13.35
82			
83			

DOMESTIC MARKETING OF SOYBEANS IN BRAZIL (9)

(1) CONSUMPTION OF SOYBEANS

(2) CAPACITY OF SOYBEAN OIL EXTRACTION

I. CONSUMPTION OF SOYBEANS

Soybeans are consumed as such in only a few cases. They are separated into oil and oil cake in oil extraction factories in most cases. The oil is consumed as edible oil, and the oil cake as feed.

As to the share of soybean oil in the edible oil consumption of Brazil, soybean oil occupies 90% of the apparent edible oil consumption in 1978. Thus the edible oil consumption is heavily dependent on soybean oil.

The per capita edible oil consumption in the above-mentioned year is 10.47 kg per year, of which 9.45 kg is dependent on soybean oil.

Regarding the variation in the domestic consumption of soybean oil cake from 1970 to 1978, the per capita consumption of soybean oil cake is about 10 kg in 1978, which is substantially the same as that of soybean oil. Oil extraction of soybeans gives 18.5% of soybean oil and 77.5% of soybean oil cake. When consideration is given to the fact that soybean oil and soybean oil cake are substantially the same in terms of weight in per capita consumption, it is easily understood that Brazil's export of soybean oil cake is very great.

As to the supply and consumption of soybean, soybean oil and soybean oil cake in a 1977/1978 agricultural year, soybean production in that year was 9,120,000 tons. This datum will serve for presumption of the capability for export in the case of increased production on the assumption that the per capita consumptions of soybean oil and soybean oil cake may not change so much.

Share of Soybean Occupying in Edible Oil

	Production (1,000 ton)		Virtual consumption (1,000 ton)		Consumption per person (kg/person)	
	Whole(1)	Soybean(%)	Whole(1)	Soybean(%)	Whole	Soybean
1970	600	34	541	36	5.79	2.09
71	702	45	664	44	6.92	3.09
72	875	50	693	51	7.02	3.61
73	834	63	656	62	6.47	3.99
74	1,019	76	973	79	9.33	7.38
75	1,298	81	983	80	9.17	7.33
76	1,574	81	1,008	87	9.15	8.00
77	1,717	89	1,100	89	9.72	8.61
78	1,687	86	1,218	90	10.47	9.45

Source: FGV, CFP (1) Soybean oil, Cotton seed oil, Peanut oil

Virtual Domestic Consumption of Soybean Bran and Cake

	Virtual consumption (ton)	Consumption per person (kg/person)
1970	281,521	3.01
71	361,404	3.76
72	410,585	4.16
73	701,672	6.92
74	925,861	8.88
75	1,112,621	10.38
76	1,079,643	9.80
77	1,146,181	9.98
78	1,250,000	10.74

Supply and Consumption of Soybean and the Products in Farming Year 1977 and 1978

Item	Quantity (1,000 ton)
Soybean (beans)	
Supply	
Preseason stock	495
Production	9,120
Import	86
Total	9,701
Consumption	
Oil extraction	8,156
Seeds and loss	800
Export	641
Total	9,597
Post season stock	104
Soybean (bran and cake)	
Supply	
Preseason stock	192
Production (1)	6,321
Total	6,513
Consumption	
Domestic consumption	1,250
Export	5,128
Total	6,378
Post season stock	135
Soybean (oil)	
Supply	
Preseason stock	166
Production (2)	1,509
Total	1,675
Consumption	
Domestic consumption	1,100
Export	465
Total	1,565
Post season stock	110

(1) Yield ratio 77.5%

(2) Yield ratio 18.5%

Source: CFP

II. CAPACITY OF SOYBEAN OIL EXTRACTION

The capacity of oil extraction in Brazil has greatly increased in compliance with rapidly increasing production of soybeans.

It is said that the extraction capacity has now reached 22,000,000 tons a year. The peak volume of soybean oil extraction up to now was 15,480,000 tons in 1981. This will indicate surplus equipment for oil extraction even if oil extraction of cottonseeds, peanuts and the like occupies 10% of the total oil extraction. Such surplus equipment is the cause of need of soybean import from the neighboring countries though Brazil is a country of large production of soybeans.

The cost of oil extraction treatment of soybeans lowers with an increasing scale of equipment. It is said that extraction capacities of (1) 599 tons or less, (2) 600 to 1,499 tons and (3) 1,500 tons or more a day classified according to the quantity of raw soybeans materials, entail relative costs of (1) 250, (2) 139 and (3) 100, respectively.

The introduction of foreign capitals into Brazil has promoted scaling-up of equipment. A comparison in extraction capacity between Brazil and Euroamerican countries is as follows.

Proportion of Extraction Amount (%)

Expression Capacity tons/day	West European Countries	U.S.A.	Brazil	
			1977	at the end of 1978
(1) 599 or less	15	9	46	30
(2) 600 to 1,499	47	52	32	33
(3) 1,500 or more	38	39	22	37

It is certain that the proportions of extraction amounts as mentioned above in Brazil today are on the same level as those of Euroamerican countries due to further scaling-up of equipment.

As to the extraction capacities of factories dependent upon the scale of them, the extraction capacity of the factories in operation in 1978 was 14,386,800 tons a year. As of February, 1979, the additional extraction capacity of the newly-built factories was 3,270,000 tons a year, and the extraction capacity of the factories not in operation but not dismantled

was 1,653,000 tons a year. Thus the total extraction capacity was 19,309,800 tons a year, which corresponds 64,366 tons a day.

It was anticipated that the total extraction capacity at the end of 1979 might be 20,218,800 tons a year. Therefore, the total extraction capacity today of 22,000,000 tons a year may be quite reasonable.

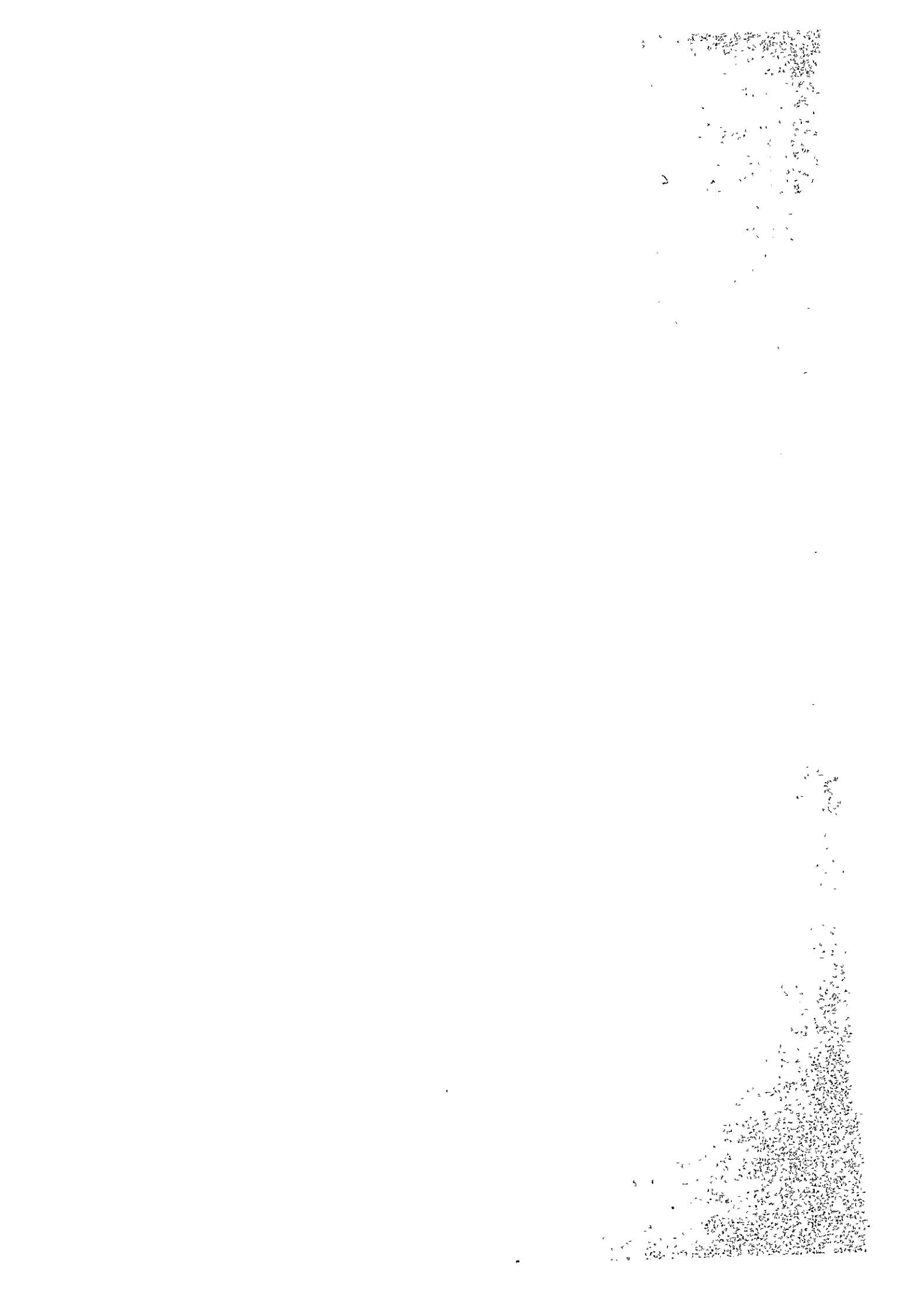
Oil Extraction Capacity by Factory Scales

Dealing capacity (ton/day)	1976	1977	'76/'77 increasing rate (%)	1978			
				Under operation	'77/'78 increasing rate (%)	Under suspension	Under planning
Under 599	19,282	19,117	-0.9	17,036	-10.9	4,510	300
600 ~ 1,499	9,150	13,150	43.7	13,920	5.9	1,000	5,600
Over 1,500	6,300	9,300	47.6	17,000	82.8	-	5,000
Total (a daily production) (ton/day)	34,732	41,567	19.7	47,956	15.4	5,510	10,900
Total (a yearly output) (ton/day)	10,420,000	12,470,000		14,386,800			

POLICY ON SOYBEANS IN BRAZIL (10)

(1) MINIMUM PRICE ASSURANCE SYSTEM

(2) LOAN FOR AGRICULTURE



I. MINIMUM PRICE ASSURANCE SYSTEM

The base price (prego-base) of soybeans which is used as a base for the minimum assured price was made public to be 4,338 cruzeiros per 60 kg in a bag in a 1983/1984 agricultural year.

The base price is subjected to amendment with ORTN (national loan with value amendment) during the period ranging from August, 1983 to February, 1984 to become the minimum base price (prego minimo basico) which is the base price in February, 1984.

The ORTN of next month is made public at the end of every month. The ORTNs during the period ranging from August to December in 1983 are as follows.

1983,	August	4,963.91 cruzeiros
	September	5,385.84
	October	5,897.49
	November	6,469.55
	December	7,012.99

The trial calculation of the price as of December is made with amendment of the base price, 4,338 cruzeiros with the ORTN to give the following price.

$$4{,}338 \times \frac{7{,}012.99}{4{,}963.91} = 6{,}128.71 \text{ cruzeiros}$$

On the other hand, the market price is the cereal exchange as of December 6, 1983 was 15,500 to 16,000 cruzeiros in São Paulo. The government assured price was only about 40% the market price.

In such a situation, it is not expected that the producer may utilize the AGF (purchase by the government) system. Most of the producers would rather accept a loan using their product as a security for EGF (loan from the government), and await a time to release their product while watching the market price.

The United States were attacked by heat wave in 1983, leading to decreased production of soybeans. The market price of soybeans in Chicago suddenly rose by 50% in August while the market price of soybeans in Brazil, which had been just below 4,000 cruzeiros per 60 kg in a bag in

March, rapidly increased to 18,000 cruzeiros in August, which was, of course, partly attributable to the influence of inflation. The market price in Brazil has now fallen to about 15,000 cruzeiros. This price fall is smaller than that in Chicago. The reason for this is that the market price in Brazil is not always linked with that in Chicago because the Government has stopped acceptance of new application for soybean export since the end of September.

In general, the market price in Brazil changes in accordance with that in Chicago. However, Government's intervention such as export inhibition may sometimes give a different behavior of the domestic market price, which causes the dealers to fall in troubles. The producers borrow an inventory fund from the Government according to the EGF system, and await a rise of the market price. So, the EGF system is sometimes criticized by those having an opinion that the Government loans only a speculation fund, and, therefore, is acting against inflation restraint. The minimum price assurance system can be said not to function properly apart from the EFG system.

So, it can be said that soybeans occupies the first place in the proportions of EGF given for the main products.

II. LOAN FOR AGRICULTURAL PRODUCTION

The national currency consultation supposed to be held on December 14, 1983 was delayed until December 20, so that what to be the ratio of a Government grant for paying a fixed rate of interest is pending.
It is said that the ratio will be a plus interest of 3% by full application of ORTN.

The distribution of loans with this interest is based on VBC (Valor Basico de Custeios; prime farming cost). The loaning rate is varied according to the scale of farming unit belonging to a large, medium, small or petty one classified. This system is the same as that in rice.

Introduction shall be made of the data of IEA, Agricultural Affairs Bureau of São Paulo State, as to whether or not the VBC is proper.

Trial calculation was made as regards the soybean production in Ribelon Pretto district of São Paulo State. The proportions of VBC to actual farming cost are shown in the table. The yield per unit area is 1,800 kg/ha.

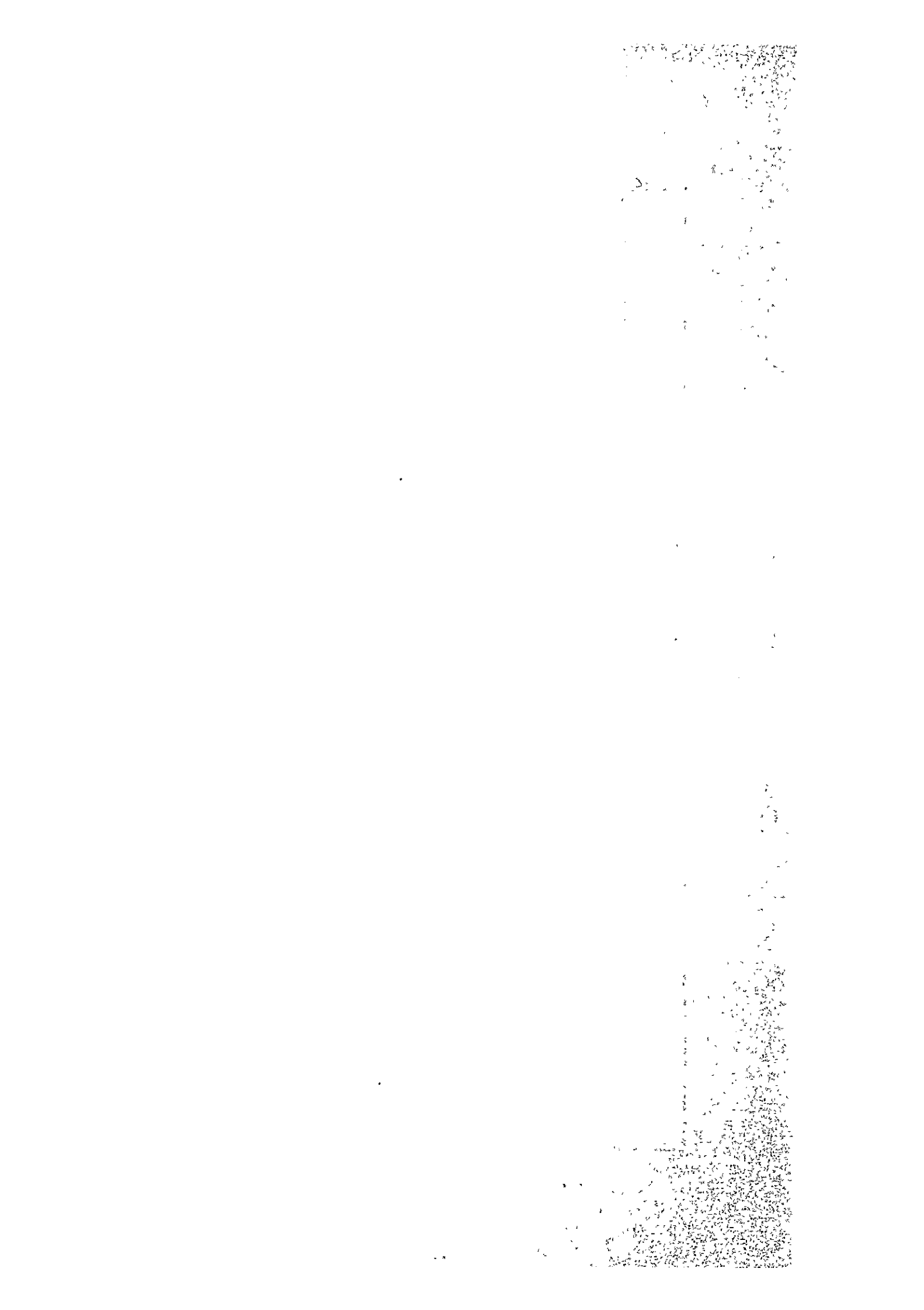
	1982/1983 Agricultural year	1983/1984 Agricultural year	Proportion of cost up
Actual farming cost (cruzeiros/ha)	53,121	135,982	156
VBC (Base farming cost) (cruzeiros/ha)	46,900	106,700	128
VBC/Actual farming cost (%)	88.3	78.5	-

The VBC is set a little low without the inflation rate taken sufficiently into consideration, and, therefore, disadvantageous for the producers.

VBC (Farming Basement Cost) and the Date of Payment
Northern Part, Middle Western Part, Southern Part, Southeastern Part
Farming Year '83 and '84

	Frame of production (kg/ha)		VBC	Payment method					
				First payment		second payment		Third payment	
	Over	Under	(Crs/ha)	(%)	date (Month)	(%)	date (Month)	(%)	date (Month)
Soybean									
SUDAM area	-	1,250	82,300	50	7	30	11	20	2
(Amazon Development	1,251	1,500	89,200						
Authority)	1,501	1,750	108,400						
	1,751	2,000	117,500						
	2,001	2,400	136,200						
	Over 2,400		142,900						
Other areas	-	1,250	74,500	50	7	30	11	20	2
	1,251	1,500	80,100						
	1,501	1,750	98,200						
	1,751	2,000	106,700						
	2,001	2,400	124,600						
	Over 2,400		131,300						

IRRIGATION PLAN



I. EFFECTIVE RAINFALL

The effective rainfall is defined, in this survey, to be as follows. Calculation of effective rainfall is made as regard a cultivation period.

R: Daily rainfall	$0 < R < 5$	Re = 0	(mm)
Re: Effective rainfall	$5 \leqq R < 80$	Re = 0.8*R	(mm)
	$R \geqq 80$	Re = 64	(mm)

On the other hand, "FAO IRRIGATION AND DRAINAGE PAPER 24" illustrates a method of calculating the effective rainfall from the relationship between the average monthly rainfall and the average monthly irrigation requirement of crops.

According to the irrigation plan (Chapter 3-4, of this report), the water requirement of crops and the effective rainfall are calculated for every five days to find the peak net irrigation requirement. For comparison with the above-mentioned method, they are herein calculated for every month. The results are as follows.

a. Rate of effective rainfall in this report	58.1%	Table 5-1-1
b. Rate of effective rainfall by the FAO method (in the same year as in calculation in this report)*	74.4%	
c. Rate of effective amount of rainfall according to the FAO method (in the average year)*	69.6%	

For effectively utilizing rainfall, the irrigation system must be of a structure capable of stopping diversion just before rainfall and piling up the outlet for irrigation water, from which water is supplied to next plot as a continuous irrigation, to reserve water in a plot of paddy field. However, the allowable flooding, depth must be set at such a level as not to bring about a decrease in crop yield with the stages of plant growth taken into consideration, and as not to spoil the stability of the ridge set at each plot of paddy fields. Room for irrigation is

set about 80 mm in this report, while consideration is not given to water storage in a paddy field but to only a water storage capacity of soil (TRAM) according to the FAO system. The unit period of time for calculation in this report is five days, while that for calculation according to the FAO method is one month, resulting in an increase in rate of effective rainfall.

The irrigation requirement calculated in this report peaks at the time of drought, and, therefore, is not directly related to the ups-and-downs of effective rainfall. Continuous drought during the cultivation period appears for at least 6 days during the period of December to January when the irrigation requirement of crops peaks. The peak irrigation requirement is affected by the continuous drought days.

As large a water storage of rainfall just before arrival of the peak of irrigation requirement as possible favorably correlates closely with the labor force for water management and the cost of ridging of the plot. A large setting of allowable flooding, depth should not be simply made.

As described above, calculation of effective rainfall is to be made thus in this report. Additionally stated, choice and examination are required to be made of a method most suitable for the project site of those various methods shown in Table 5-1-3.

II. METHOD OF MEASURING WATER REQUIREMENT IN DEPTH

(1) Object: The amount of evapotranspiration and the amount of infiltration are measured to provide data for examination of irrigation requirement.

(2) Observation Station: The paddy field in Bolf Farm

(3) Observation Period: December, 1983 to March, 1984 (the day of start of flooding to the day before harvesting)

(4) Observation Time: AM 9:00

(5) Items of Observation:
1) Water requirement in depth a day
2) Air temperature
3) Water temperature
4) Ground temperature (in a depth of 5 cm)
5) Plant height
6) Stage of growth
7) Groundwater table
8) Weather

(6) Measurement Instrument: N-type Instrument of Measurement of Water Requirement in Depth

(7) Installation of Instrument:

1) In the case of water requirement in depth a day (amount of evapotranspiration plus amount of percolation)

The measurement instrument is so installed as to make well-grown paddy rice plants placed in it.

2) In the case of water requirement in depth a day (amount of percolation)

The measurement instrument is so installed as not to make paddy rice plants in it. Evapotranspiration is prevented by covering the top side of frame with a vinyl sheet or the like.

3) Well for observation of groundwater

A hole of 2.5 m depth is digged by an auger of 10 cm in hole diameter. A steel pipe of 5 cm caliber is erected

at the center of the hole, followed by filling the hole with gravel up from the bottom to 50 cm below the ground surface. The space of 50 cm between the ground surface and the gravel surface is filled with clay to prevent surface water from direct infiltration. The steel pipe has a proper slit formed.

(8) Method of Observation:

1) Water requirement in depth: Use of the attached hook gage

2) Groundwater table: Use of a scale

(9) Recording: The data as to the items of observation mentioned at (5) are arranged, and recorded every day.

(10) Others: Variety of paddy rice: Blue Belle
Seeding: November 6

Table 5-1-1 Monthly Effective Rainfall (1)

	Month							Total
	10	11	12	1	2	3	4	
Monthly rainfall 1977.10 ∿ 1978.4 (mm)	34.0	191.6	145.8	71.2	123.7	51.8	19.0	637.1
Average monthly ETcrop (mm)	9.4	166.7	379.6	345.1	299.9	232.3	44.1	1,477.0
Effective rainfall (mm)	2.0	93.0	104.3	51.6	77.9	37.2	3.9	369.9
Montyly Water Requirement (mm)	7.4	73.7	275.3	293.5	222.0	195.1	40.2	1,107.2
Dairly Water Requirement (mm/d)	0.7	2.5	8.9	9.5	7.9	6.3	2.0	-

(E-R): Effective Rainfall R: Dairly Rainfall

$0 < R < 5$ (E-R)=0

$5 \leqq R < 80$ (E-R)=R*0.8 mm

$R \geqq 80$ (E-R)=64.0 mm

Table 5-1-1 Monthly Effective Rainfall (USDA(SCS)) (2)

	Month							Total
	10	11	12	1	2	3	4	
Monthly rainfall 1977.10 ∿ 1978.4 (mm)	34.0	191.6	145.8	71.2	123.7	51.8	19.0	637.1
Average monthly ETcrop (mm)	9.4	166.7	379.6	345.1	299.9	232.3	44.1	1,477.0
Mean monthly effective rainfall (mm)	7.0	133.0	145.0	71.0	123.0	48.0	13.0	540.0
Strage factor	0.88							
(mm)	6.0	117.0	128.0	62.0	108.0	42.0	11.0	474.0
Net Water Requirements	3.4	49.7	251.6	283.1	191.9	190.3	33.1	1,003.1
Dairly Water Requirement (mm/d)	0.3	1.7	8.1	9.1	6.9	6.1	1.7	

Effective storage 40 mm

Strage factor = 0.88

10/20 ∿ 4/20

Effective rainfall rate 74.4 %

Table 5-1-1 Monthly Effective Rainfall (USDA(SCS)) (3)

	Month							Total
	10	11	12	1	2	3	4	
Monthly mean Rainfall (mm)	103.8	117.4	143.3	116.8	120.1	150.4	79.3	831.0
Average monthly ETcrop (mm)	9.4	166.7	379.6	345.1	299.9	232.3	44.1	1,477.0
Mean monthly effective rainfall (mm)	16.0	88.0	143.0	116.0	120.0	130.0	46.0	659.0
(Strage factor)	0.88							
	14.0 (5.6)	77.0	126.0	102.0	105.0	114.0	40.0	578.0
Net Water Requirements	0	89.7	253.6	243.1	194.9	118.3	4.1	
(mm/d)	0	3.0	8.2	7.8	7.0	3.8	0.2	

Effective storage 40 mm

Storage factor = 0.88

10/20 ∿ 4/20

Effective rainfall rate 69.6 %

( ) net

Table 5-1-2 Average Monthly Effective Rainfall as Related to Mean Monthly Rainfall and Mean Monthly Consumptive Use (USDA, SCS)

Monthly mean rainfall (mm)	Mean monthly consumptive use (mm)													
	25	50	75	100	125	150	175	200	225	250	275	300	325	350
	Mean monthly effective rainfall (mm)													
12.5	7.5	8.0	8.7	9.0	9.2	10.0	10.5	11.2	11.7	12.5	12.5	12.5	12.5	12.5
25.0	15.0	16.2	17.5	18.0	18.5	19.7	20.5	22.0	24.5	25.0	25.0	25.0	25.0	25.0
37.5	22.5	24.0	26.2	27.5	28.2	29.2	30.5	33.0	36.2	37.5	37.5	37.5	37.5	37.5
50.0	25	32.2	34.5	35.7	36.7	39.0	40.5	43.7	47.0	50.0	50.0	50.0	50.0	50.0
62.5	at 41.7	39.7	42.5	44.5	46.0	48.5	50.5	53.7	57.5	62.5	62.5	62.5	62.5	62.5
75.0		46.2	49.7	52.7	55.0	57.5	60.2	63.7	67.5	73.7	75.0	75.0	75.0	75.0
87.5		50.0	56.7	60.2	63.7	66.0	69.7	73.7	77.7	84.5	87.5	87.5	87.5	87.5
100.0		at 60.7	63.7	67.7	72.0	74.2	78.7	83.0	87.7	95.0	100	100	100	100
112.5			70.5	75.0	80.2	82.5	87.2	92.7	98.0	105	111	112	112	112
125.0			75.0	81.5	87.7	90.5	95.7	102	108	115	121	125	125	125
137.5			at 122	88.7	95.2	98.7	104	111	118	126	132	137	137	137
150.0				95.2	102	106	112	120	127	136	143	150	150	150
162.5				100	109	113	120	128	135	145	153	160	162	162
175.0				at 160	115	120	127	135	143	154	164	170	175	175
187.5					121	126	134	142	151	161	170	179	185	187
200.0					125	133	140	145	158	168	178	188	196	200
225.0					at 197	144	151	160	171	182				
250.0						150	161	170	183	194				
275.0						at 240	171	181	194	205				
300.0							175	190	203	215				
325.0							at 287	198	213	224				
350.0								200	220	232				
375.0								at 331	225	240				
400.0									at 372	247				
425.0										250				
										at 412				
450.0	25	50	75	100	125	150	175	200	225	250				

Multiplication Factors to Relate Monthly Effective Rainfall Value Obtained from Table 6.13 to Net Depth of Irrigation Application (d)

d (mm)	Factor	d (mm)	Factor	d (mm)	Factor
10.0	0.620	31.25	0.818	70.0	0.990
12.5	0.650	32.5	0.826	75.0	1.000
15.0	0.676	35.0	0.842	80.0	1.004
17.5	0.703	37.5	0.860	85.0	1.008
18.75	0.780	40.0	0.876	90.0	1.012
20.0	0.728	45.0	0.905	95.0	1.016
22.5	0.749	50.0	0.930	100.0	1.020
25.0	0.770	55.0	0.947	125.0	1.040
27.5	0.790	60.0	0.963	150.0	1.060
30.0	0.808	65.0	0.977	175.0	1.070

Table 5-1-3 Relative Merits of Different Methods for Determining Effective Rainfall

Methods	Factors taken into account				Special equip-ment	Accuracy	Relative costs	Remarks
	Run-off	Soil	Aridity	Crop				
2.1 Field studies of soil moisture changes	+	+	+	+	+	Very high	Medium	Good for verifying other methods; cumbersome practicability low
2.2 Daily soil water budget with ETa	-	+	+	-	+	Very high	Medium	Praciticability medium
2.3 Integrating gauge	-	+	+	+	+	Medium	Medium	Needs careful standardization
2.4 Ramdas apparatus	-	+	+	+	+	High	Medium	Practicability good
2.5 Lysimeters	-	+	+	+	+	Very high	Very high	Praciticability medium, good as a check on other methods
2.6 Drum technique (rice)	+	+	+	+	+	Very high	Low	Practicability high
3.1 Renfro equation	-	B	+	-	+	Low	Negligible	Too empirical
3.2 U.S. Bureau of Reclamation method	+	-	-	-	-	Low	Negligible	Not suitable for wide use
3.3 Ratio of ETp to precipitation	B	B	+	-	-	Medium	Low	Satisfactory for very preliminary planning purposes
3.4 USDA, SCS method	-	B	+	B	-	Medium	Low	Good for areas with low intensity of rainfall and high soil infiltration rate
3.5.1 Empirical methods (other than rice)	B	B	B	B	-	Low to high	Negligible	Practicability very high
3.5.2 Empirical methods (rice)	B	B	B	B	-	Medium	Negligible	Needs verification; practicability high

+ = positive; - = negative; B = first approximation
Ref.: IRRIGATION AND DRAINAGE PAPER 25 (FAO)