No.

MASTER PLAN
ON
THE IRRIGATION AND DRAINAGE PROJECT
IN
THE ADJACENT AREA TO THE YACYRETA DAM

PROGRESS REPORT

(THE SECOND YEAR)

DECEMBER, 1983

JAPAN INTERNATIONAL COOPERATION AGENCY

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CHAPTER 1 FOREWORD

1.1. Background to the Survey

The Government of the Republic of Paraguay has planned comprehensive agricultural development focussing on large-scale irrigated agriculture and grazing using the water from the adjacent Yacyreta Dam which is presently under construction. The fundamental objectives of this agricultural development are the achievement of the following four items.

(1) Expansion of productivity with modern agricultural methods and the improvement in the quality of agricultural and livestock products.
(2) Settlement programs to increase the regional population.
(3) Resettlement of the farm population of the submerged areas owing to dam construction.
(4) Expansion of productivity of agricultural and livestock products for export.

Last year marked the beginning of the survey necessary to compile the master plan for the execution of the comprehensive agricultural development required to attain these objectives.

1.2. Scope of Survey

The first year of the survey was spend in using the basic survey to determine the problem points important to gain an understanding of the present situation and to determine the outline of project area.

This basic survey was continued through this year and the analysis of the collected materials was begun. On base of these materials the outlining of development plan will be done in this year.

1.3. Fundamental Concept of Development Plan

(1) Socio-economic Conditions in Paraguay

The Republic of Paraguay extends over an area of 400,000 Km^2 and has a population of approximately 3,170,000 with the population density being about 8 persons to Km^2. About 45% of the population is engaged in agriculture and livestock, and the fact that agriculture occupies a 30% share of the G.N.P. illustrates the importance of agriculture to Paraguay.

The main crops are soy beans, maize, cotton and cassava. These four items comprise 58% of the total value of agricultural production. Furthermore, the primary export of Paraguay is cotton and the second is soy beans, followed by timber and oil cake. The growth of soy bean exports in recent years is particularly remarkable. The main imported agricultural item is wheat and plans to increase the production of wheat are one of the important measures of the government.

(2) Regional Situation

The Project area is a region of approximately 154,000 ha in area and which is located along the Parana River at a level of 60 ∿ 90 m above sea level. The rivers flowing through the project area are the Atinguy and the Yabebyry but both of these rivers are natural rivers having small effective cross-sectional areas for which the project area is flooded when rain falls.

The soils within the project area are planosols, gleysols and regosols.

The yearly rainfall for the Yacyreta observation site is 1,516 mm with the dry period being the three months of July, August and September where the monthly

rainfall is about 90 ∿ 109 mm. Thus the rainfall is fairly evenly distributed throughout the year. Irrigated cultivation is practised at one part of the Bolf Farm but most Area is used for ranching. Over 90% of the land of the project area is owned by large land-owners holding over 1000 ha each to result in the situation of land ownership where approximately 100,000 ha is owned by 20 land owners.

(3) Fundamental Concept

This region is a large expanse of lowland for which the improvement of the drainage is one of the conditions essential for its development and effective utilization. The construction of the Yacyreta Dam will provide inexpensive and stable water for irrigation which will give the area a merit which is not to be found in other projects. The project of providing large-scale irrigation/drainage is the first experience in Paraguay and so careful and adequate consideration of the Paraguayan economy, the technological level of agriculture, financial performance and the marketability of the agricultural produce are necessary to plan with a high degree of realizability.

Since the population density of Paraguay is sparse the development of such a large scale as this will require agricultural management through mechanized agriculture for the extensive type.

However, the resettlement of the population engaged in small-scale agriculture in the regions peripheral to the area and in the area submerged by the construction of the Yacyreta Dam will require small-scale farm management plans as well.

One of the methods for the development of low-lying land is to provide facilities such as drainage canals and pumps to creat all-purpose fields which can be used either as paddy fields or as upland fields. However, Paraguay is one country where the cost of agricultural land is relatively inexpensive and so the final plan for development must be one requiring a minimum of project cost which will give economic benefits to the project. Practically all of the project area is at a height above sea level of over 70 m and it is intended that the drainage condition will be improved through the rivers training and by the construction of drainage canals. However, the plan in which partial inundation is allowed must be mapped out, because the plan with no inundation will bring about enormous increase of project cost.

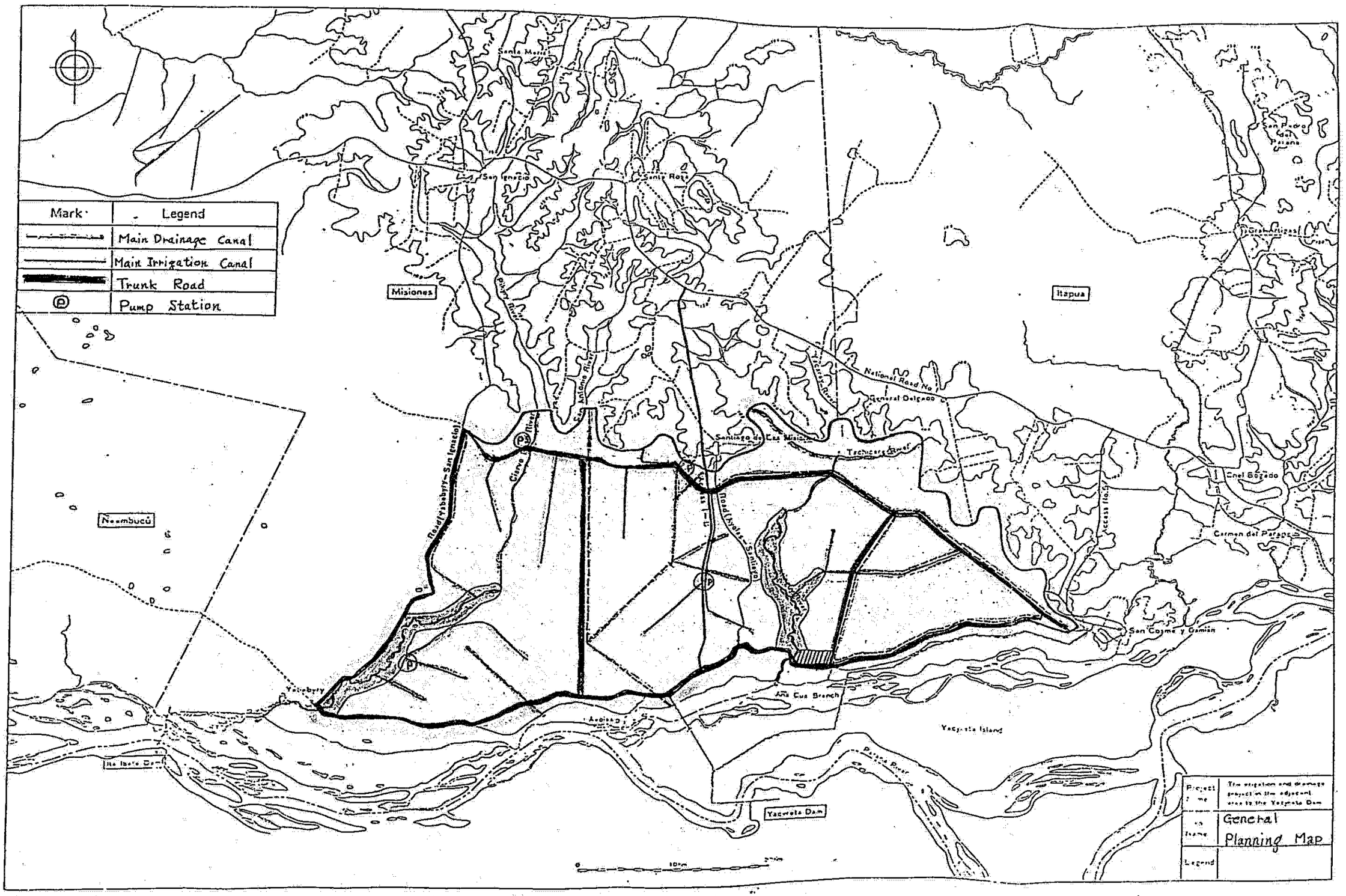
The crops cultivated under the extensive type in Paraguay which is grown even in areas where the level of groundwater is high, with temporary inundation include paddy rice, upland rice, maize and sugar cane, etc. However, after considering the profitability, paddy rice is selected as the crop to be cultivated in the lowlands. Over 22,000 ha of paddy rice is cultivated in Paraguay and in Itapua, Missiones it accounts for over a 77% share of paddy rice production and it is considered that the farmers in the surrounding area are skilled in the cultivation of paddy rice. As measures taken to maintain soil fertility, to prevent for red rice and also to control weeds, the rotation system between paddy rice and ranching is discussed as well as the system taken in surrounding area.

In the higher land improved drainage, soybean of one of Paraguayan most important product arable area of which remarkably increase recently, and wheat

of import crop are introduced. Small-scale production of vegetables and cotton is also planned.

Of the increased agricultural production in the project area, wheat is used for domestic consumption to lower the level of imports and the soybeans are channeled to the existing export routes. An increase in the domestic demand for rice is also foreseen but a considerable amount can only be sent to the export market. There is the necessity for management so the production cost and quality are on par with those of Argentina which is the largest rice exporting country in South America.

A standard farm management model must be set up in order to execute agricultural development and there is also the necessity to create a system for the execution of the large-scale drainage irrigation project. The land and settlement systems are items which require the administrative activities of the government of Paraguay and there is the necessity to closely consult between both parties in order to map out the plan with a very high degree of realization.


Mark
Legend
Main Drainage Canal
Main Irrigation Canal
Trunk Road
Pump Station
Misiones
Itapua
Neembucú
Santa Maria
San Ignacio
Santa Rosa
Pilcomayo River
San Antonio River
Ayolas
Santiago de Las Misiones
Trincheras River
Cnel Bogado
Carmen del Parana
San Cosme y Damian
Yabebyry
Asuncion
Alto Cua Branch
Yacyreta Island
Parana River
Yacyreta Dam
Alto Ibate Dam
Project Name
The irrigation and drainage project in the adjacent area to the Yacyreta Dam
Name
General Planning Map
Legend

CHAPTER 2 AGRICULTURAL PLAN

2.1 Cropping Program

2.1.1 Selection of crops to be cultivated

When considering crops to be introduced to this project, it is necessary to fully examine the natural and socio-economic conditions which constitute the background of this project.

That is,

(1) This is the agricultural development project following the construction of Yacyreta Dam and there is no need for the agricultural development side to bear the development cost for water resources. This means that stable amount of irrigation water can be obtained at an extremely low cost and that the project is economically advantageous in comparison with other projects.

(2) The area to be developed is vast and the population density within the project area and its vicinity is small. For the development of an intensive agriculture within the entire project area the labor source is scarce.

(3) Paraguay is an agricultural country and the population of the entire country is small, and except for wheat and other minor crops, almost all agricultural products are now being self-supported. And if a quick increase in domestic consumption is not expected, shipping of the main agricultural products from the project area to the international market has to be considered.

(4) In a large-scale agricultural development project,

the adoption of an entirely new crop as the main agricultural crop involves a high risk. The basic crops should be ones which have already been cultivated in Paraguay and ones for which basic techniques have been achieved by experiments, researches and the extensions.

Table 2-1-1 lists the potential crops to be introduced after the consideration of the above conditions. Their examinations are also given in the table. Meteorological conditions, such as temperature, rainfall, sunshine hours, essential for the cultivation of crops, are sufficient in the area for all the crops to be cultivated. All potential crops are cultivable in the project area. However, since upland rice, wheat and cotton may cause difficulties in the harvesting by machinery due to rainfall in the harvesting time, a full consideration should be given to the agricultural land development plan and road construction plan.

As for the soil type in the project area, the cultivation of all potential crops is possible except in regosols. Planosols are particularly suitable for the cultivation of paddy rice because of the existence of an impermeable layer in the subsoil, while greysols, representative soils in the floodplains of rivers, are good soils which can support intensive cultivation of crops if their good drainage conditions.

The proposed area is a swamp located in the northern edge of the Neembucu Great Swampland which spreads to the north and east from the confluence of the Paraguay River and the Parana River. For the agricultural development of the area, it is necessary to confine the development area and execute the drainage improvement. The present drainage condition is so poor as to produce a large-scale inundation in the area. This is because the two rivers

Table 2-1-1 Selection of Crops for Cultivation

Crop	Natural Conditions							Marketability	Necessity for Irrigation	Crop Conditions			General Judgement		Notes
	Temperature	Rainfall	Sunlight	Soil	*1 Groundwater	*2 Groundwater	Inundation Resistance			*3 Mechanization	*4 Large-scale	*5 Technology	Region A	Region B	
Paddy Rice	o	o	o	o	o	o	o	Δ	o	o	o	o	×	o	
Dry Rice	o	o	o	o	o	o	o	Δ		o	o	Δ	o	Δ	
Soy Beans	o	o	o	o	Δ	o	×	o		o	o	o	o	×	
Cotton	o	o	o	o	×	o	×	o		o	o	o	o	×	
Maize	o	o	o	o	Δ	o	Δ	Δ		o	o	o	o	Δ	
Porote Beans	o	o	o	o	×	o	×	o		o	o	o	o	×	
Sugar Cane	o	o	o	o	Δ	o	Δ	o		o	o	o	o	Δ	
Tobacco	o	o	o	o	×	o	×	o		×	×	o	o	×	
Potatoes	o	o	o	o	×	o	×	o		o	Δ	×	o	×	
Onions	o	o	o	o	×	o	×	o		Δ	Δ	Δ	o	×	
Peanuts	o	o	o	o	×	o	×	o		×	×	o	o	×	
Garlic	o	o	o	o	Δ	o	×	o		×	×	o	o	Δ	
Stevia	o	o	o	o	o	o	Δ	×		×	×	Δ	Δ	Δ	Necessity for a manufacturing plant
Vegetables	o	o	o	o	Δ	o	×	Δ		×	×	Δ	o	Δ	
Improved Pasture	o	o	o	o	Δ	o	×	-		o	o	o	o	Δ	
Fodder Crops	o	o	o	o	Δ	o	×	-		o	o	o	o	Δ	Maize and sorghum for fodder
Fruit Trees	o	o	o	o	×	o	×	o		×	×	×	o	×	
Wheat	o	o	o	o	×	o	×	o		o	o	o	o	×	

Notes
*1 Appropriate for when underground water is higher than 30 cm.
*2 Applicable when underground water is lower than 30 cm.
*3 Mechanized cultivation possible.
*4 Large-scale management possible; over 100 ha o, over 20 ha Δ, under 20 ha ×.
*5 Necessity for cultivation specialists to visit Paraguay.

o Favourable
Δ Dependent upon conditions
× Unfavourable

in the project area, the Atinguy and the Yabebyry, have insufficient cross-section compared with the catchment areas. If the improvement of this drainage condition be planned in full consideration of the relationship between the construction cost and the effect, it will be difficult to acquire a field condition with perfect ground water control and no inundation. Therefore, the examination was given to crops which can be cultivated in the soil condition of comparatively high ground water level and crops which are somewhat tolerant to the inundation. It was found that, except for paddy rice, unpland rice, corn, sugarcane and stevia, no crops can be cultivated under the conditions of high ground water and inundation. Of these crops, the one which absolutely requires irrigation under the present climatic conditions is only paddy rice.

Mechanized cultivation and large-scale cultivation are possible for crops which use large lands but difficult for crops which require intensive cultivation. As for the cultivation techniques, a certain technical level for cropping is expected to be attained in most aspects of cultivation by the experiments and researches and extension activities in the future.

After considering these various factors, crops to be introduced to Area A and Area B were examined. As a result, a crop rotation of soybeans and wheat has been decided to be the main practice of cultivation for the Area A in consideration of the drainage condition and the marketability of crops, and the introduction of cotton will also be considered to some areas. Although paddy rice will be the main crop in the Area B, the continuous cultivation of paddy rice is considered to be difficult in view of the conservation of fertility, weed control, and red rice problem. Therefore, a three-years rotation

system with three years' paddy rice production and three years' ranching will be established for overcoming the above obstacles.

Althougn crops to be introduced to small-scale farmers are not yet determined since the land distribution to them and the location of land are not yet determined, they should be determined in cultivable crops examined above after consideration of the labor plan, capital preparation, techniques and so on.

2.1.2 Cultivation plans

Proposed cropping patterns of paddy rice, soybeans, wheat, and ranching, which are to be introduced to the project, are shown in Table 2-1-2 Proposed features of these cultivation plans are shown below:

(1) Paddy rice:

Introduced variety; Cica 8 or 9. This is a high-yielding variety of IRRI type and has been planted widely in South America. It was originally developed at the International Rice Research Institute and improved at the International Tropical Agricultural Development Center. Argentina IR841-63-5-18, Brazil BR/IRGA-409.

Planned yield: 5 ton/ha.

A three-year cultivation experiment has been in progress at the Caacupe National Agricultural Experiment Station. Although 5 ton/ha of yield has been obtained according to the interim report, the value is likely to be changed in the final report.

Fertilization; 150 kg/ha.

Initial fertilization (20-10-10). Additional fertilization 60 kg/ha, Urea. Protection against disease and insects will be performed

Table 2-1-2 Proposed Regional Periodic Cropping Pattern

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Proposed Periodic Cropping Pattern for Area A	Soy beans (140 days growing period)		Har-vesting		Plant-ing		Wheat (120 day growing period)		Har-vesting	Plant-ing		Soy beans
Proposed Periodic Cropping Pattern for Area B	Paddy rice (140 day growing period)		Har-vesting							Plant-ing		
Production inside Area B	To be opened depending upon the success of paddy-field modification of grasslands											

if necessary. Although these are the features determined on the basis of the experiments performed at the experiment station, they may be changed in the final report.

(2) Soybeans:

Introduced variety; Parana, Bragg, Hampton Visoja.
Proposed yield; 2.0 ton/ha.
Fertilization; No manure applied.
Protection against stinkbugs and night crawlers will be performed.

(3) Wheat:

Introduced variety; Itapua, 281/60.
Proposed yield; 1.6 ton/ha.
Fertilization; Manuring, 100 ∿ 160 kg/ha (18-46-0)
Protection against aphids and night crawlers will be performed.

Standard cultivation systems have been established for soybeans and wheat by the execution of investigations and cultivation tests at the JICA Asunción Branch Office and JICA Agricultural Experiment Station.

Since the project area is similar in topographical and climatic conditions although there is a slight difference in soils, the standard cultivation system was used for the preparation of the cultivation program with no other data available.

(4) Ranching

Ranching of beef cattle has been planned in the rotation with paddy rice. Improvement work of pasture has not been performed in Paraguay except for some dairy farmlands. The main reasons are:

1) Beef-cattle stock farming can be operated only at the low production cost because of the low price of beef.
2) Since the prices of grass seeds and fertilizer are high and the price of beef is low, the high price of materials offsets the merit of increased production.
3) Since the production of grass is the indirect production, from which profit arises through the increased number of cattle, new investment to facilities is required for the increased profit. In other words, for the increased profit to be achieved from the improved pasture it is necessary to store grass in winter and release it to the market at the time of high price. Grass storage facilities will be required for this purpose. The grassland improvement program is attached as the optional program in full consideration with the bottleneck caused by the high prices of seeds and fertilizer.

(5) Crop rotation system

A crop rotation system of soybeans and wheat is the traditional system which has been practiced in Paraguay. The advantage of this system included:

1) the interchangeability of equipment in the mechanized cultivation system and the least additional investment to equipment to start double cropping,
2) the effective use of expensive fertilizer by the utilization of the remaining strength of fertilizer applied in the wheat cultivation is done for soybean cultivation,

3) the effective conservation of soil fertility by the combination of the fertility-depriving crop of wheat and the fertility-conserving crop of soybeans.

Because of these reasons, there is no problem in adopting the present crop rotation system to the project. The cultivation techniques has reached a certain level in Paraguay and it is expected that the stable agricultural management can be achieved by the introduction of this system to the project area.

The crop rotation system of paddy rice cultivation ranching has been traditionally practiced making advantage of the above three reasons. Most of the large-scale paddy rice cultivation as practiced in various places in the world employs the rotation system because of these three reasons. Continuous cultivation of paddy rice without rotation in a large-scale operation is seen only in California in the United States. This is because:

1) the land is very fertile,
2) the rice has only slightly been affected by the red rice due to the short history of paddy rice production and also the red rice has been eradicated by the introduction and spread of excellent variety of rice plant,
3) the disease and insect damages are slight and the weed control is easy because of the arid climate.

The paddy rice cultivation in California accounts for only about 20% of the total rice cultivation in the United States and can be considered to be a special

case. The paddy rice planting rate of the paddy rice farms is 20 ∿ 40% in the entire United States and paddy rice and other crops are produced in rotation at the rate of 1 paddy rice to 2 other crops on average. These other crops are, in most cases, wheat, soybeans, corn and sorghum.

In South America, however, paddy rice is cultivated in rotation with pasture grass and rotation with other crops is scarce. According to the interview with farmers, the rotation between paddy rice and pasture at the rate of 1 rice to more than 1 pasture has been considered to be appropriate but it is also true that the ratio of 1 to 1 exists between the paddy rice and pasture. Anyhow, these values are considered to closely approximate the most effective use of land and water and, therefore, will be applied to the project.

2.1.3 Schedule of operations in Japan

(1) Basic crops were examined above. A complete double cropping has not been practiced because the harvesting time of soybeans and the seeding time of wheat are too close. Therefore, the reason of this time conflict will be studied and rational proposed cropping patterns will be prepared.

(2) The drainage condition in the Area B is not necessarily homogeneous. Where the drainage condition is good, other rotation systems such as paddy rice and soybeans, paddy rice and sugarcane will also be considered.

(3) Crops which will fit to the soil and drainage conditions will also be considered in addition to the basic crops.

2.2 Cattle Raising Program

2.2.1 Beef cattle management plan

The three-year rotation system of paddy rice → pasture grass → paddy rice shall be the major crop raising under the Agricultural Development Plan in Area Adjacent to Yacyreta Dam. In order to establish raising utilizing pasture grass, the following data shall be examined for formulation of the program.

Since Paraguay has a small population in comparison to the large area of national land, most of the land is used as pasture land for raising beef cattle. However, due to the climatic/resources conditions, there is a little improved pasture land, and, in general, her land is utilized as natural pasture land.

Consequently, her raising technique of beef cattle is low-level and there is productivity increase.

* See "Management of the Herd According to the Grass Growth" (Schematic diagram Fig. 2-2-1)

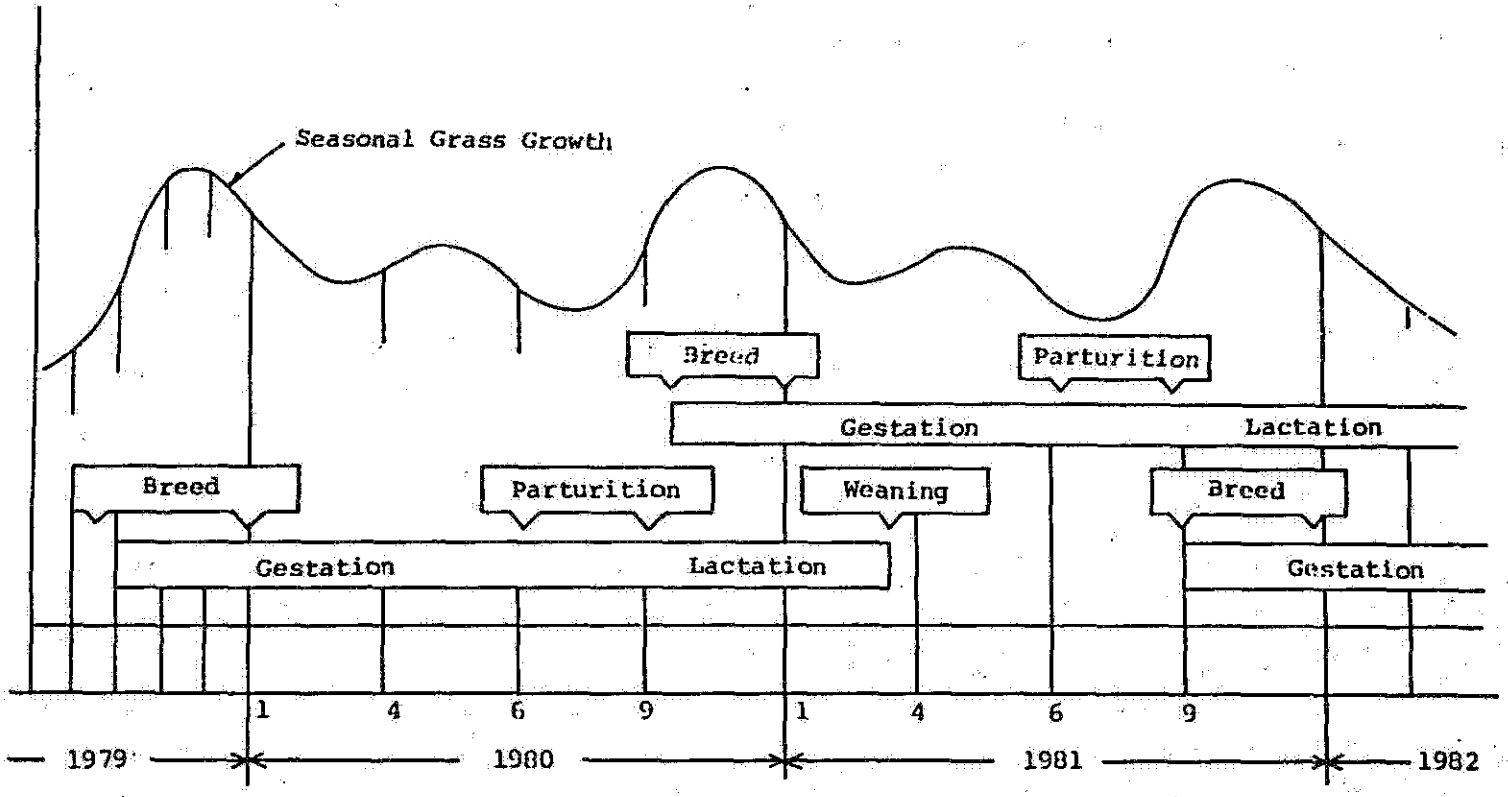


Fig. 2-2-1 Management of the Herd according to the Grass Growth (Schematic diagram)

2.2.2 Planned data of beef cattle

(1) Type of raising:

It shall be the through-operation of breeding/fatting centering around grazing.

(2) Species to be raised:

Basing upon existing cross breading cow herd of Zebu series, bull of Nerol and Brehman series shall plannedly be crossed.

(3) Age for breeding: 25-months old

(4) Weight for breeding: 300 kg

(5) Primipara age/weight: Approx. 350 kg at 35-months old

(6) Weight of adult bull for breeding: 380 ∿ 400 kg

(7) Delivery interval:

24 months shall be the standard, but shortening to 18 months shall be studied.

(8) Durable months:

Approx. 114 months (to be replaced after 4th or 5th delivery).

(9) Cows for replacement: To be domestically raised.

(10) Crossing:

Both artificial and natural insemination shall be used side by side.

(11) Rate of death and culling.

Calf	(1 ∿ 7 months old)	... 15%
Cattle under raising	(8 ∿ 24 " ")	... 3% (undelivered cow 1%)
" " "	(8 ∿ 35 " ")	... 5%

(12) Final weight/age of cattle under fatting:

400 kg, 35-months old

(13) Shipping manner of cattle under fatting:

Live body shipping (Dressing percentage: 48 ∿ 50%)

(14) Beef produced

For domestic consumption

(15) Raising standard:

US's NRC standard shall be used.

(16) Growth curve:

As per Fig. 2-2-2.

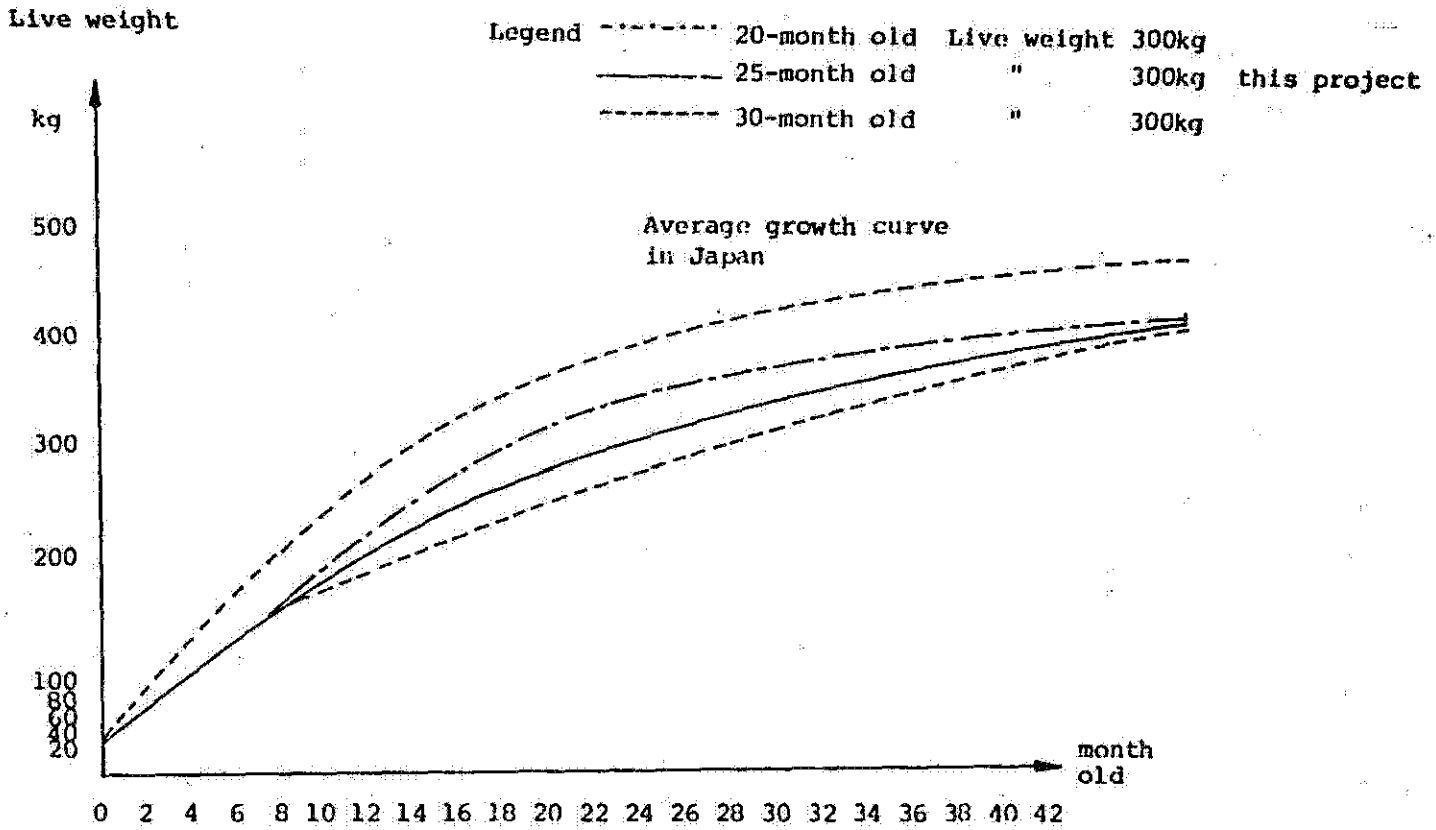


Fig. 2-2-2 Growth Curve of Beef Cattle

Table 2-2-1 Planned No. of Head Structure of Beef Cattle

Based upon Planned Data

Breakdown		24months of delivery interval		18months of delivery interval	
		On 100 delivered cow basis	Items of adult	On 100 delivered cow basis	Items of adult
	month	head	head	head	head
Calf	1 ∿ 3	11.3	0.63	15.0	0.83
	4 ∿ 7	14.2	2.37	19.0	3.17
Cattle under raising	8∿13	7.8	2.38	7.8	2.38
	14∿19	7.8	3.68	7.8	3.68
	20∿25	7.7	4.92	7.7	4.92
Undelivered cow	26∿32	9.0	7.50	8.9	7.50
	33∿35	3.8	3.59	3.8	3.59
Delivered cow	Milking period	35.4	35.4	44.3	44.3
	Dry period	53.2	53.2	40.5	40.5
	Final period of pregnancy	11.4	11.4	15.2	15.2
Cattle under fatting	Early stage	21.7	7.84	33.2	11.99
	Middle stage	19.1	11.67	29.3	17.91
	Late stage	18.9	16.28	29.0	24.97
Total		221.3	160.86	261.5	180.94

The head structure by age-group on 100 adult cow (delivered cows which are directly productive) basis is as shown on the Table 2-2-1 according to the planned data mentioned further above. According to the standard growth curve based upon the NRC standard, the nutrient requirement is computed out as shown on the table:

Table 2-2-2 Nutrient Requirement on 100 Delivered Cow Basis (Nutrient Requirement Based upon NRC Standard)

Breakdown	24months of delivery interval			18months of delivery interval		
	TDN	C P	D M	TDN	C P	D M
	kg	kg	kg	kg	kg	kg
Calf	15,937	3,735	24,328	21,280	4,984	32,486
Cattle under raising	30,318	5,201	55,805	30,317	5,201	55,805
Undelivered cow	19,528	3,037	38,399	19,376	3,014	38,103
Delivered cow	198,619	26,985	399,208	211,236	28,591	416,374
Cattle under fatting	117,548	22,204	194,432	180,190	34,034	298,030
Total	381,950	61,162	712,172	462,299	75,824	840,798

∴ Nutrition requirement per delivered cow (a delivered cow accompanied by calves, cattle under raising, undelivered cows and cattle under fatting) comes out as follows:

Table 2-2-2

Per delivered cow	kg 3,820	kg 612	kg 7,122	kg 4,623	kg 758	kg 8,408

Proposed grassland as the feed base for beef cattle shall utilize the former paddy rice field (in crop rotation). Examining the topography, species of grass and other conditions of project area, they are found to be similar to those of natural grassland in general.

The yield survey of pasture grasses in Paraguay is enforced by Barrerito, Sanlorenzo, Alto Parana and Chaco Experimental Stations of the Ministry of Agriculture and livestock. Major species of grass are Panicums, Setarias, Cenchrus Ciliaris, Brachiarias, Chloris Gayana, Hyparrenia rufa, Cynodous and Pennisetum.

In preparing the planned data based upon above survey result, we adoped the data surveyed by the Barrerito Experimental Station which is nearest to the project area and has similar conditions of climate, soil, etc. Thus, our data is as shown on the following Table 2-2-3.

Table 2-2-3 Dry Yield of Season (Barrerito : Average of 3yrs.)

(Unit:kg/ha)

	Jun-Sep	Oct-Jan	Feb-May	Yearly total	Remarks
Superior grass	2,000	3,400	4,700	10,100	Average of Setaria, Pangola, Ramirez, Yaragua
Natural grass	900	2,000	2,200	5,100	

The ratio of produced grass utilized by cattle (utilization ratio) varies according to the manner of utilization. Whenever utilizing grass which is collected by men, the rate is 90%. Whenever utilized by pasturing, the rate

is 50%. Whenever utilized after being prepared into silage, etc., in addition to the utilization rate, approx. 20% of fermentation loss, 2% of degeneration loss, 3% of drying loss and 5% of feeding loss shall be taken into account.

There are various methods for building up an improved grassland where superior species predominate. They should be subject to a precision examination of seeds, fertilizers, etc.

The buildup methods are classified into the following two:

(1) Full improvement: to be plowed all over, broken, sown and rolled.
(2) Half improvement: to dispose of original vegetation and be sown without plowing.

Considering the technological progress, etc. when this project will be enforced, and also as measures for the in between season, the adoption of the partial full improvement method shall be examined.

Meanwhile, the nutritive values of natural and improved grass are shown on the following Table 2-2-4.

Table 2-2-4 Nutritive Values of Pasture Grass, etc.
(% for Dry Grass)

	TDN	CP	Remarks
Superior grass	62.5	11.0	Average of 4 species
Natural wild grass	56.0	12.0	Average of Cynodon series wild grasses.

From above data, the head number of beef cattle raised on 100 ha of grassland is shown as follows:

(1) Utilization for pasturing of improved grassland (grassland utilization rate TDN)

100 ha × 10,000 kg/ha × 0.5 × 0.625 ÷ 3.820 = 82.6 heads

∴ No. of heads in terms of adult cattle = 82.6 × 1.6086 ≒ 133 heads

∴ Grassland area per head = 0.75 ha

(2) Utilization for pasturing of natural grassland

100 ha × 5,100 kg × 0.5 × 0.56 ÷ 3.820 ≒ 37.4 heads

∴ No. of heads in terms of adult cattle = 37.4 × 1.6086 ≒ 60 heads

∴ Grassland area per head = 1.67 ha

(3) In case where deliveries shall be made in a 18-month cycle using stored crude feed in order to improve the nutrition of beef cattle, about 1/8 of the grassland should be reserved for cutting. If this is practiced, the result is as follows (with respect to improved grassland):

100 ha × 7/8 × 10,100 kg × 0.5 × 0.625 ÷ 4.623 = 59.7 heads

100 ha × 1/8 × 10,000 kg × 0.9 × 0.7 × 0.625 ÷ 4.623 = 10.8 heads

(0.7: utilization rate of silage)

∴ 59.7 + 10.8 = 70.5 heads

70.5 heads × 1.8094 = 127.6 heads (in terms of adult cattle)

Annual head No. of cattle under fatting

Case of pasturing only

82.6 heads × 59.7 heads/100 heads × 12 months/28 months ≒ 21 heads

Case where stored feed is utilized

70.5 × 91.5 heads/100 heads × 12 months/28 months = 27.6 heads

∴ 27.6 - 21 = 6.6 heads

From the above, through improvement of nutrition by utilizing stored feed, the head number of adult cattle decreases by about 3, but the head number of fatted cattle shipped per year increases by 6.6.

Also, the effect if compared with natural grassland is 37.4 heads × 59.7/100 × 12/28 = 9.6 heads

∴ 27.6 - 9.6 = 18 heads

The limit of improvement on natural grassland is the amount within which the 18 heads pay.

The loss and profit computation of as well as the limiting amount for investment in the beef cattle operation shall be examined in fiscal 1984 because they are also connected with the drainage/irrigation project, etc.

2.3 Dairy Management Plan

Dairy farming in Paraguay is mostly operated around Asuncion, the capital and for the purpose of furnishing city milk. Other than this, Christian settlers of German Mennonite school in Filadelfia, Boquerón Department (so-called Chaco Province) operate dairy farming for producing/furnishing yogurt, cheese and other dairy products. Paraguayans prefer raw milk to dairy products. According to MAG's estimation, the annual per capita consumption is approx. 29.5 kg of whole milk/dairy products, of which approx. 27.5 kg or 93.3% is raw milk consumption.
For the purpose of increasing these yearly amounts of consumption and to further cover the demand taking the natural increase of population, etc. into account, there already is the production plan for Long Life Milk at Mennonita. Its L.L.M. processing plant is under construction on foreign money and expected to operate by the end of coming December.
Fortunately, since this project area is about 800 km from Filadelfia, and, in addition, the people prefer raw milk, so our project will be well operable in this area.
The data supporting the dairy farming in this area was found as follows through consultation with the counterpart on Paraguayan side:

2.3.1 Planning data of dairy farming

(1) Species to be raise:
Horstein (Highly hot-resistant Argentine and Uruguayan breeds)

(2) Age and weight for breeding:
20-months old, 320 kg

(3) Age and weight for primipara:
30-months old, 400 kg

(4) Durable months:
Approx. 113 months (to be replaced after milking following 6th delivery)

(5) Delivery interval:
15 months

(6) Milking period:
8 months

(7) Raw milk output:
2,500 kg per milking cow per period

(8) Skim rate:
Milk fat percentage 3.0%

(9) Weight of adult cow:
500 kg

(10) Crossing:
Artificial insemination

(11) Feeding standard:
US's NRC Standard shall be used.

* The milk produced shall be distributed raw. The maximum output shall cover Ayolas and its vicinity. (Milk consumption is 75.3 g per capita per day)
* Growth stage: Fig. 2-3-1
Consumption of net food: Table 2-3-1

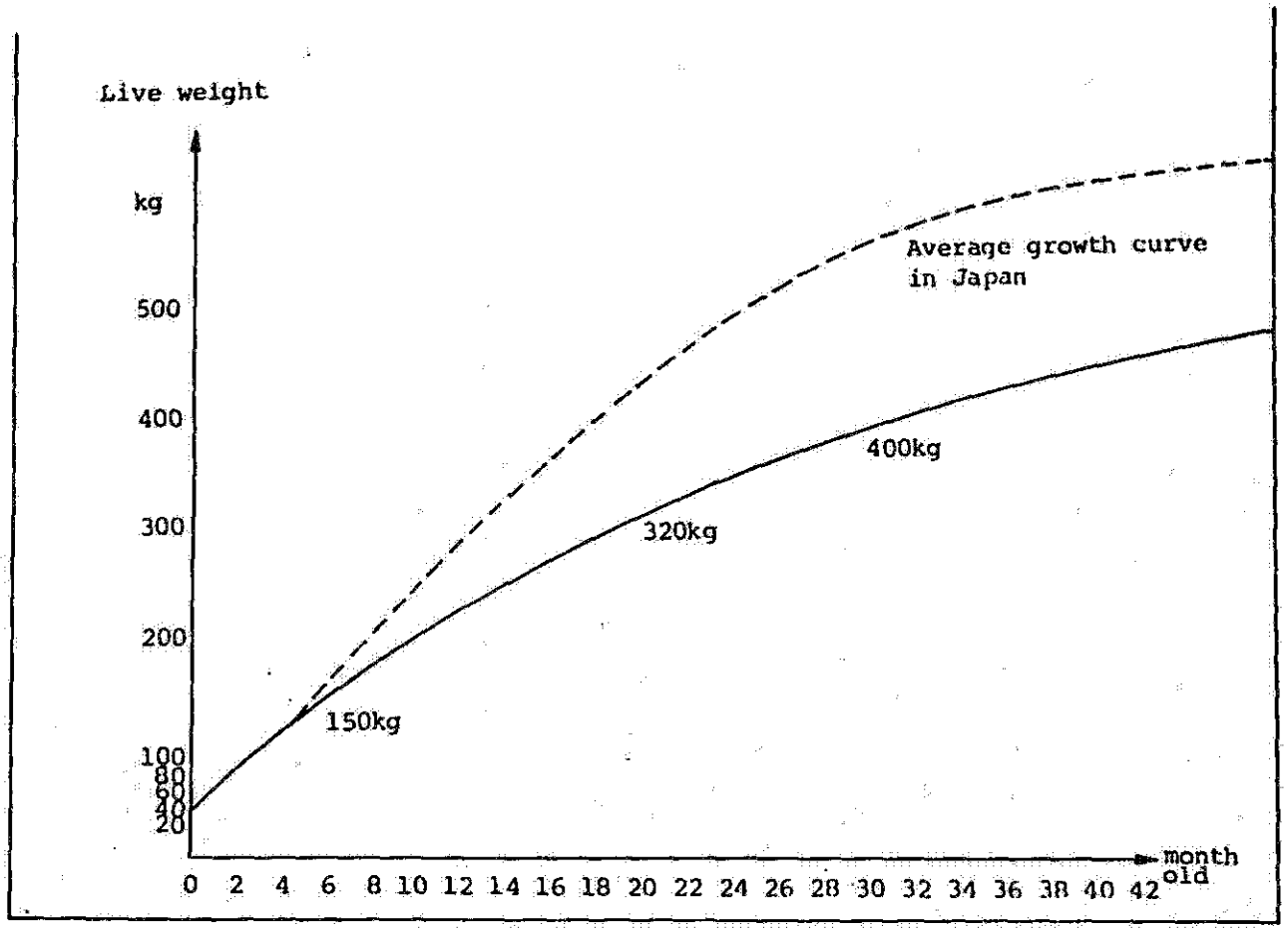


Fig. 2-3-1 Growth Curve of Milch Cow

Table 2-3-1 Per-Capita Per-Day Estimated Consumption and Nutrition of Net Food

(Estimate Based upon 1977~1982 Supply, MAG)

Item	Net food	Calory	Protein	Fat	
	g	Cal	g	g	
Cereals	224.9	819.5	21.1	2.5	
Potatoes/Taros	452.5	726.2	4.1	1.4	
Beans	53.0	122.7	7.3	4.3	
Vegetables	69.8	24.6	0.7	0.1	
Fruits	368.5	228.3	3.8	0.7	
Meats	177.8	488.5	29.7	26.8	Beef 95.0g
(of which, fish)	1.8	1.3	0.4	-	
Milk/Dairy products	80.7	66.2	3.4	4.1	Milk 75.3g
Eggs	28.7	42.5	3.2	2.8	
Fats and Oils	27.3	232.7	0.5	26.8	
Sugar	51.7	203.8	-	-	
Sub-total	1,534.9	2,955.0	73.8	69.5	
Soft drinks	55.4	17.1	2.4	0.5	
Liquors	52.2	46.6			
Total	1,642.5	3,018.7	76.2	70.0	

The dairy farming is really operable around Yacyreta Dam but has an operable limit. As arranged in the above data, the operational size under this plan shall be to cover 1/2 of the population within approx. 100 km radius centering at Ayolas.

The reason is, above all, that if milk is transported for a long distance, on rough road in addition, its solids and moisture separates (churning) resulting in deteriorated quality and non-drinkability.

For preventing churning, it is necessary to crush the solids especially fat balls of milk into fine grains (to homogenize). For this work, machine equipment called homogenizers is necessary resulting in extra investment. Furthermore, if homogenized, milk would lose its body and taste weaker because it would become watery.

Such being the case, the distribution area shall be within the range where high quality milk is furnishable. Furthermore, the reasons why the coverage shall unavoidably be 1/2 of the population is that beef cattle raisers are actually milking from their beef cattle for home use and that small-sized farming household are scattering.

Table 2-3-2 No. of Heads Structure by Age on Basis of 100 Undelivered Cows Based upon Dairy Farming Data

Item		Structure for every 100 undelivered cows	No. of heads in terms of adult cow	
Calf	month 1∿3 4∿7	heads 4.0 5.0	heads 0.26 0.97	Accident rate of calf shall be 5%.
Cow under raising	8∿14 15∿20	8.7 7.4	3.37 4.30	Accident rate of cow under raising shall be 3%.
Undelivered cow	21∿27 28∿30	8.6 3.7	6.66 3.46	Accident rate of undelivered cow shall be 1%.
Delivered cow	Milking period Dry period Final period of gestation	57.8 24.1 18.1	57.8 24.1 18.1	
Total		137.1	119.02	

The number-of-head structure at any time for cows using raised year round is computed planning data and as shown on above table.
The numbers of cows raised around the year are converted in terms of 31-months old adult cow in the right values on the Table 2-3-2.
Meanwhile, the yearly nutrient requirements for these numbers of year-round-raised cows computed out according to the NRC Feed Standard and the standard growth curve of dairy cattle in Paraguay is as shown on the following Table 2-3-3.

Table 2-3-3 Yearly Nutrient Requirement for Every 100 Delivered Cows according to NRC Standard

Item	T D N	Of which, concentrate	CP	DM
	kg	Mother's milk kg	kg	kg
Calf	7,118	(3,500)	896	10,549
Cow under raising	23,269	-	2,162	38,040
Undelivered cow	23,754	-	2,106	41,358
Cow once delivered	45,815	4,906	4,809	77,482
Cow twice or more delivered	200,334	24,630	20,172	358,419
Total	300,290	29,536	30,145	525,848

From above table, it is found that approx. 10% of TDN (Total Digestible Nutrient) should be concentrate. Therefore, 2,708 kg of pasture grass or other crude feed is necessary per year per delivered cow. {(300, 290-29.536) ÷ 100 head} .

Meanwhile, the dry yield per ha of grassland improved by superior grass species is 10,000 kg as already mentioned for beef cattle. Since the dry grass contains 62.5% of TDN, TDN produced is 10,000 kg × 0.625 = 6,312.5 kg per ha.

If it is scheduled that 17% of the TDN yield be stored for the in-between season while the remaining be used as soilage,it would be as follows:

TDN in soilage	= 6,312.5 kg × (1-0.7) × 0.9 ≒ 4,715 kg
TDN in stored feed	= 6,312.5 kg × 0.17 × 0.9 × 0.7 ≒ 676 kg
Total	= 4,715 + 676 = 5,391 kg

Therefore, the number of milch cows (delivered cows) feedable on 1 ha of pasture grass is 5,391 kg ÷2,708 kg = 1,991 ≒ 2 heads. However, since the number of milkable heads is computed as 1 × (8 months × 6 deliveries) ÷ (113 months - 30 months),

durable month Primapara age

it will be approx. 57.8% of delivered heads.

Planned maximum milk demand within 100 km radius of Ayolas

conditions for planning:

The population growth rate shall be equal to that of Paraguay as a whole. The growth rate of milk consumption per year shall be 1% per annum. (This should be examined considering qualitative change in view of that the energy consumption per Paraguayan exceeds 3,000 cal per day.)

The target year shall be 1994 - 10 years ahead.

The current total population within 100 kg radius of

Ayolas is estimated at 210,439 basing upon 1982 statistics. (See the following Table 2-3-4).

Population:

1994 ..... Amount growth rate of 3.2% 307,102

Milk consumption:

75.3 g per day ..... 30,970 g ≒ 31 kg

∴ 307,102 persons × 0.5 × 31 kg = 4,760,081 kg

Maximum consumption per year

Table 2-3-4 Population around Ayolas (within 100km Radius)

(1982)

Department	District	Population
Itapua	Encarnación	44.543
	Carmen del Paraná	5.911
	Cnel. Bogado	14.761
	Fram	10.099
	General Artigas	11.986
	General Delgado	7.011
	San Cosme	7.129
	San P. del Paraná	31.700
	Sub-total	133.140
Misiones	San J. Bautista	12.572
	Ayolas	5.825
	San Ignacio	17.255
	San Miguel	5.122
	San Patricio	3.053
	Santa Maria	6.625
	Santa Rosa	18.273
	Santiago	5.959
	Yabebyry	3.177
	Sub-total	67.861
Ñeembucu	Cerrito	5.408
	Laureles	4.030
	Sub-total	9.438
	Total	210.439

If the maximum output is 4,760,081 kg, the necessary number of milking cows would be 1,904, or 3.294 delivered cows. The latter would be the maximum number of cows in the project area.

And, approx. 1,655 ha of grassland will be necessary for raising this number of cows.

2.3.2 Outline on optimum size of individualized dairy farming

(1) Income obtainable from dairy farming:

2.4 million Gs
(200,000 Gs/month)

(2) Milk price:

80 Gs, the terminal price, shall be used.

(3) Rate of gain:

Since I heard in Mennonita that the production cost was 50 Gs, it shall be (80-50)/80 = 37.5%.

(4) Share of project cost:

It shall be somewhere around 7.5% of the gain rate.

(19,300 Gs × 0.578/1.991) ÷ (2,500 kg × 80 G × 0.375)

Annual redemption — Milking cow rate per ha

The optimum number of heads (per household) is roughly computed as follows:

2,500 kg × 80 Gs × 0.375 × (1-0.075) = 69.375 Gs
2,400,000 Gs ÷ 69.375 Gs = 34.6 heads
∴ 34.6 ÷ 0.578 = 59.9 ≒ 60 heads (delivered cows)

The number of dairy farming households to be created (settled or so) in the project area will be about 55.

The outlined operational plan of individualized dairy farming shall be as the following Table 2-3-5.

Table 2-3-5

Item		Per Individualized Household	Whole Area (55 households)
Goal income		2,400,000 Gs	132,000 thousand Gs
Species of milch cow raised		Holstein species	Holstein species
No. of cows raised	Delivered cow	60 heads	3,300 heads
	Milking cow	34.6 "	1,903 "
	No. of heads in terms of adult cow	71.4 "	3,927 "
Annual output of raw milk		86,500 kg	4,757,500 kg
Area of needed grassland (for Grass collection)		30 ha	1,655 ha
For soilage	Area	24.9 ha	1,370 ha
	Raw grass quantity	251,490 kg	13,837 ton
For storage	Area	5.1 ha	285 ha
	Raw grass quantity	51,510 kg	2,879 ton
Grass species introduced to grassland		Setaria, Pangola Ramírez, Yaragua	

Effects of fertilizers applied on pasture grass

Test Results at San Lorenzo Experimental Station

(Average of 3years.)

(kg/ha)

Item	Section covered	N:50kg	N:100kg	N:150kg	N:100,P:60	N:100,PK:60
Pangola	100	115.3	124.2	161.6	146.9	138.6
Buffel	100	120.3	124.9	138.2	168.0	170.3
Costal Bermuda	100	127.8	143.6	175.0	150.0	132.7
Ramírez	100	115.2	140.2	131.4	124.4	136.7
Guinea	100	113.4	109.8	125.4	137.4	138.4
Average	(8.938kg) 100	118.4	128.54	146.32	145.34	143.34

Fertilizing Effects on feed crops at

San Lorenzo Experiemental Station

		Section covered	N:25kg	N:50kg	N:75kg	N:75, P_2O_5:46	
	Species						100=
Sorgo (Cereal)	BR-64	100	155.5	140.1	143.3	142.0	3,911kg
	NK-145	100	94.4	139.9	145.4	199.3	2,792kg
	Savanna	100	-	-	-	-	836kg
Average (2)		100	124.95	140.0	144.35	170.65	
							100=
Sorgo (Soil-age)	NK-325	100	113.9	111.0	119.4	71.6	100,170kg
	Sordan70	100	98.4	92.8	71.6	103.4	69,590kg
	NK-367	100	149.1	141.7	180.1	198.6	40,400kg
Average		100	120.5	115.2	123.7	124.5	
							100=
Sudan g. (Soil-age)	SX-16	100	108.1	115.1	127.1	130.7	85,370kg
	Trudan2	100	92.0	99.0	104.4	73.7	50,450kg
	X-1,901	100	272.5	106.1	121.4	179.1	35,395kg
Average		100	157.5	106.7	117.6	127.8	

CHAPTER 3 FARM MANAGEMENT PLAN

In the farm management plan, the individual farm management target by the completion of the project will be set at first, and for the purpose of achieving the farm management target, planning dimension of the farm management plan, such as management size, proposed cropping pattern, labor force plan, mechanization, etc. will be determined.

The individual farm management target means the objective income of individual farm and after the determination of the objective income,

(1) Establishment of management size, proposed cropping pattern and planned agricultural machinaries,

(2) trial estimation of production cost,

(3) study of labor force plan, surplus power of machinaries, etc.,

(4) trial estimation of non-agricultural income,

(5) trial estimation of net income in accordance with the farm management balance calculated will be studied and suitable planning dimension for achievement of the objective income will be determined.

3.1 Objective Income

In accordance with the agricultural policies, the objective amount of income with the project should be determined primarily.

In other words, the objective amount of income is the target of farmer towards non-farmer, and it should mean the guarantee of farmer's sound life and the balance to non- farmer's income.

The value of the objective income wich is clarified by agricultural policy will be able to be set, but in Paraguay the value is not clarified.

And for the character of this area, it is necessary to set the objective incomes for each three categories of large scale management, core farmer's management and small scale management.

For these reasons it is difficult to set single objective income, therefore the incomes of several management types which are picked up from typical management patterns will be estimated.

On the other hand, the proper objective income has a close relation with national income policy,, for this reason the income evaluation of each calculated management types above mentioned will be done in accordance with indexes of national income per capita, legal minimum wages and so on.

This method is effective in the case of no-determination of objective income by agricultural policy and also the case of the enterprise - minded management introduced in this area and the management aiming at profitability besides objective income.

3.2 Management Categories

Multifarious management types of individual farm with the completion of the project are assumed and also changes of individual farm management with each year that goes by are presumed.

For these reasons it is necessary to make management categories with regard to imaginary standard farm management.

Management categories of this proposed area are defined as follows,

(1) Enterprise - minded farmer

In this category farming is comercialized and it is necessary to study the profitability, capital, equipment, etc., adding to the objetive income.

Farmers of this category cultivate followings,

1) Large scale paddy rice (Extensive type).

2) Large scale up - land crops (Extensive type).

3) Special crops (Intensive type).

4) Livestock (Grazing beef cattle).

But in this project area, pattern above mentioned will not be of a general character except large scale paddy rice and livestock.

(2) Core farmer

In this category the income of farmer should be balanced to the income of non - farmer and in other words, standard income of middle class people in the urban area will be the objective income of the core farmer.

Farmers of this category cultivate followings,

1) Middle scale paddy rice (Extensive type).

2) Middle scale up - land crops (Extensive type).

3) Dairy farming (Extensive type).

4) Special crops (Intensive type).

All of these pattern above mentioned will be able to be introduced in this project area.

(3) Small scale farmer

By increasing income, settlement of these small scale farmers will be promoted and it is planed to increase income by obtaining the non - agricultural income through labor force supply to another management categories.

Farmers of this category cultivate combined pattern of following,

1) Paddy rice (Extensive type).

2) Up-land crops (Intensive type).

3) Livestock (Grazing beef cattle).

4) Special crops (Intensive type).

3.3 Calculation of Poduct Cost

The product costs are calculated in following manage - ment types.

(1) Enterprise-minded farmer

paddy rice	500 ha

(2) Core farmer

paddy rice	50 ha,	100 ha
soy bean - wheat	50 ha,	100 ha

(3) Small scale farmer

paddy rice	25 ha
soy bean - wheat	25 ha

In case of paddy rice cultivation the real cropping area is described as though the rotation cropping will be done between paddy rice and ranching by the internal of three years.

Because it is possible to join together the benefit from paddy rice cropping and ranching after each individual calculation.

In another reason this is closely concerned with the landownership in the project area which may enforce tenunt farming.

It is very convenient to calculate separately the benefit from production in each pattern.

The real cropping area in upland farming is 75% of total holding area because green manure shall be cropped in each four years.

The results of calculation for production cost on the basis of program dimension which were determined in the cropping program, are shown as follows in Table 3-1, Table 3-2, and Table 3-3. The benefit characteristics are shown in Table 3-4, Table 3-5.

3.4 Schedule of Operation in Japan

(1) To calculate surplus labor capacity and lacking labor capacity in each management categories in which the productive cost was calculated.

(2) To calculate surplus machinery capacity and lacking labor capacity on the basis of mechanization program.

(3) To calculate the income taking out of agriculture.

(4) To autline farmer's the annual repayment on the basis of total project cost.

(5) To calculate the farmer's management balance.

(6) To discuss the individual farmer's net income in comparison with the index of target income such as the gross national production per capita, or legal minimum wage.

(7) To determinate the standard management scale and management pattern as for the enterprise-minded farmer and core farmer which cultivate extensive crops.

(8) To discuss the standard management scale and management pattern as for the small scale farmer, however, to concretely determine them in next year.

Table 3 - 1 Production Cost per Hectare for Rice Cultivation.

(Gs/ ha)

Item \ Management Scale		25 ha	50 ha	100 ha	500 ha	Remarks
		A	B	C	D	
Gross Income		Kg	Kg	Kg	Kg	
	Yield/ha	5.000	5.000	5.000	5.000	
		Gs	Gs	Gs	Gs	
	Value/kg	28.2	28.2	28.2	28.2	
	Gross Income /ha	141.000	141.000	141.000	141.000	
Primary production Cost	Material Cost					
	Seeding	10.400	10.400	10.400	10.400	
	Fertilizer	15.050	15.050	15.050	15.050	
	Weed Control	2.400	2.400	2.400	2.400	
	Agrochemical	8.850	8.850	8.850	8.850	
	Others	-	-	-	-	
	Sub-total	36.700	36.700	36.700	36.700	
	Operation Cost					
	Machinery Cost	69.711	65.231	64.818	62.396	
	(Air plane Cost)	16.800	16.800	16.800	16.800	
	Labour	10.070	7.438	7.407	6.867	
	Sub-total	79.781	72.669	72.225	69.258	
	Total	116.481	109.925	108.925	105.958	
	Land Rent	-	-	-	-	
	Capital Interest	7.379	6.929	6.900	6.712	
	Sub-Total	123.860	116.298	115.825	112.670	
Net Benefit/ha		17.140	24.702	25.175	28.330	
Rate of Benefit		% 12.1	% 17.5	% 17.9	% 20.1	

Table 3 - 2 Production Cost per Hectare for Soybeans Cultivation

(Gs/ ha)

Item	Management Scale	25 ha	50 ha	100 ha	Remarks
		A	B	C	
Gross Income	Yield/ha	Kg 2.000	Kg 2.000	Kg 2.000	
	Value/kg	Gs 28	Gs 28	Gs 28	
	Gross Income/ha	56.000	56.000	56.000	
Primary Production Cost	Material Cost				
	Seeding	5.200	5.200	5.200	
	Fertilizer	-	-	-	
	Weed Control	5.000	5.000	5.000	
	Agrochemical	2.760	2.760	2.760	
	Others	-	-	-	
	Sub-total	12.960	12.960	12.960	
	Operation Cost				
	Machinery Cost	34.327	31.822	28.843	
	Labour	4.900	3.720	2.820	
	Sub-total	39.227	35.542	31.663	
Total		52.187	48.502	44.623	
Land Rent		-	-	-	
Capital Interest		3.306	3.073	2.827	
Sub-total		55.493	51.575	47.	
Net Benefit/ha		507	4.425	8.550	
Rate of Benefit		% 0.9	% 7.9	% 15.3	

Table 3 - 3 Production Cost per Hectare for Wheat Cultivation

(Gs / ha)

Item \ Management Scale		25 ha	50 ha	100 ha	Remarks
		A	B	C	
Gross Income		Kg	Kg	Kg	
	Yield/ha	1.600	1.600	1.600	
		Gs	Gs	Gs	
	Value/kg	40	40	40	
	Gross Income/ha	64.000	64.000	64.000	
Primary Production Cost	Material Cost				
	Seeding	8.670	8.670	8.670	
	Fertilizer	9.100	9.100	9.100	
	Weed Control	1.200	1.200	1.200	
	Agrochemical	2.620	2.620	2.620	
	Others	-	-	-	
	Sub-total	21.590	21.590	21.590	
	Operation Cost				
	Machinery Cost	32.962	27.191	24.855	
	Labour	3.875	2.730	2.155	
	Sub-total	36.837	29.921	27.010	
Total		58.427	51.511	48.600	
Land Rent		-	-	-	
Capital Interest		3.701	3.263	3.079	
Sub-total		62.128	54.774	51.679	
Net Benefit/ha		1.872	9.226	12.321	
		%	%	%	
Rate of Benefit		2.9	14.4	19.3	

Table 3 - 4 Benefit in Rice Management

Item \ Cropping Scale	500 ha	100 ha	50 ha	25 ha	Remarks
Gross Benefit (1.000 Gs)	70.500	14.100	7.050	3.525	
Production Cost (1.000 Gs)	56.335	11.583	5.815	3.097	
Net Benefit (1.000 Gs)	14.165	2.517	1.235	428	
Rate of Benefit (%)	20.1	17.9	17.5	12.1	
Production Cost/Kg (Gs)	22.5	23.2	23.3	24.8	
	Kg	Kg	Kg	Kg	
Yield/ha	5.000	5.000	5.000	5.000	
	Gs	Gs	Gs	Gs	
Value/kg	28.2	28.2	28.2	28.2	
Machinery Investment					
Tractor	120 Hp 6	100 Hp 1	90 Hp 1	45 Hp 1	
Tractor	80 Hp 2	80 Hp 2			
Combine harvester	95 Hp 4	95 Hp 1	95 Hp0,5 Cooperative use. (2 house hold)	95 Hp0,25 Cooperative use. (4 house hold)	

Table 3 - 5 Benefit in Soybeans - Wheat Management

Cropping Scale / Item	100 ha			50 ha			25 ha			Remarks
	Soybean	Wheat	Total	Soybean	Wheat	Total	Soybean	Wheat	Total	
Gross benefit (1.000 Gs)	4.200	4.800	9.000	2.100	2.400	4.500	1.050	1.200	2.250	
Production cost (1.000 Gs)	3.559	3.876	7.435	1.934	2.054	3.988	1.040	1.165	2.205	
Net benefit (1.000 Gs)	641	924	1.565	166	346	512	10	35	45	
Rate of benefit (%)	15.3	19.3	-	7.9	144	-	0.9	2.9	-	
Production cost/Kg (Gs)	23.7	32.3	-	25.8	34.2	-	27.7	38.8	-	
	Kg	Kg		Kg	Kg		Kg	Kg		
Yield/Ha	2.000	1.600		2.000	1.600		2.000	1.600		
	Gs	Gs		Gs	Gs		Gs	Gs		
Value/kg	28	40		28	40		28	40		
Machinery investment										
Tractor	110 Hp 1			70 Hp 1			45 Hp 1			
Combine harvester	95 Hp 1			95 Hp 0.5			95 Hp 0.25			
				Cooperative use (2 house hold)			Cooperative use (4 house hold)			

CHAPTER 4 MARKETING

4.1 Rice

4.1.1 Outline of production

The 1980 world rice output stood at 398 million tons which comprised 25 % of the total output of crops (1,561 million tons). In these five years, the rice yielding area has scarecely changed but the output has increased by 11%.

By continent, Asian output shares 91% of the world output. South America shares 4%, 67% of which is by Brazil. (Table 4-1) The world yield per unit area of rice is on the increase. In South America, however, the growth yield rate per unit area is below the world average. The yield per unit area has scarecely changed in these five years for Argentina, Brazil and Paraguay.

Of the three countries, Argentine rice is paddy rice, and the yield per unit area is higher than that in Brazil or Paraguay. Brazilian rice is mostly raised on dry land. The southern state of Rio Grande do Sut registered more than 3.5 t/ha of yield on paddy fields. Nevertheless, the national average is as low as around 1.5 t/ha because of the low yield per unit area is dry rice areas.

Approx. 65% of Paraguayan rice is shared by paddy rice centering around both departments of Itapua and Misiones. Although their average yield stands at 2.3 t/ha, her national average remains 2.0 t/ha. (Table 4-2)

4.1.2 Trade

Since most of the major rice producing countries in Continental Asia have big populations which domestically consume the rice produced in their own countries, the world's trading volume of rice is extremely small.

The 1980 world export amount of rice stood at 12.7 million tons or 3% of the total output, which is far less

than the 22% for wheat in the same year. The world rice export, however, is on yearly increase and registered a 41% growth from 1976 to 1980. As for South America, partly due to the slackening growth rate of production, the export has scarecely changed in these five years registering only 4% of the world's total export in 1980. The Brazilian drought of 1979 drastically decreased the exports in this and following years. Paraguay exports rice, although in very small quantities. (Table 4-3)

On the other hand, Asia which produces overwhelmingly large amount of rice imports most - 54% (7 mil. tons) of the world's total import of 13 million tons - because it includes Indonesia, Iran, Iraq and Saudi Arabia which are suffering from rice shortage. Next comes Africa (18%) and Europe (12%).

Rice imported to South America was only in the small quantity of 0.1 million ton mark until 1979 when Brazil's import increased to 0.92 million tons all of a sudden due to the drought. In 1980, 0.57 million tons were still imported. In Paraguay, the per-capita consumption is small, and rice is self-supported. Hardly any rice is therefore imported. (Table 4-4)

4.1.3 Marketability study on rice whose production would be increased by developing Yacyreta District

1) Domestic Demand

Paraguay's per-capita per-year rice consumption of rice in these five years is not specifically on increase keeping 22.4 kg in terms of unhulled rice (14.6 kg in terms of hulled rice).

Assuming that there will be no change in per-capita per year rice consumption in the future, the 1990 demand is estimated at 95,000 tons since the population is estimated at 4.23 million, while 5.4 million people

demanding 124,000 tons in 2,000. Since the current output is 66,000 tons, rice production should increase by approx. 30,000 tons in 1990 and approx. 60,000 tons in 2,000. As there is no sign of production growth per unit area at present, the increased demands should be met by increasing the acreage.

2) Marketability

As stated above, the world's trade in rice accounts for just about 3%, mostly being imported by Asia, Africa and Europe. Of the Asian countries, Indonesia which is a major importing country and Malaysia are pushing the production increase of rice through foreign assistance, and their imports are forecasted to decrease. Furthermore, Asia has such rice exporting countries as Thailand, China and Pakistan, and it is difficult for non-Asian countries to export. Rice imports to South American countries are extremely small in amount except for Brazil in 1979 and 1980.

Argentine is a country which can afford to export rice, and is continuing rice exports to many countries even though the quantities are small. Major destinations are Europe, Africa and Middle-South America. Quantities by destination country are from 1,000 tons to tens of thousand tons at most. Also, such export fostering measures as the quality control and the reduction of export taxes are being taken. (Table 4-5)

There are many problems in the marketability of rice. Here we will examine the case, the neighboring country of Brazil, which has continued to import rice since some years ago.

Brazil had been the biggest rice producing country in South America and a rice exporting country. However, Brazil became a rice importing country since the drought of 1979. Most of the Brazilian rice is raised in dry fields and is

largely affected by the year's weather - no stabilized production is made. Furthermore, in order to protect the production is made. Furthermore, in order to protect the producers and to balance the demand/supply, minimum price guarantee systems are established for 42 kinds of crops including rice. This price is fixed before planting by the Production Finance Commission, and also plays an important role "to make farmers analyze and select the most profitable crop for the year". Thus, a farmer decides the crop to the planted considering prices of crops of the year. Therefore, planted crops vary by year and dry rice is not necessarily raised at the same acreage every year. If the price of soybean or kidney bean, major crop, is higher, dry rice would easily be replaced by such a profitable crop. In this way, the dry rice production in Brazil is not only affected by the weather but also raised in varying acreages each year. This unstabilized production of rice is treated as being unavoidable. As a matter of interest, Brazil's per-capita rice consumption is 70 ∿ 80 kg per year. Taking the future increase in population into accounts, it is also feared that future demands could not be met if the production is not considerably increased.

As the result of examination of Argentine's export promotion measures and of Brazil's production situation, it is forecast that rice could be well exportable if the rice of certain quality can be produced at international prices.

4.2 Wheat

Despite wheat being the indispensable foodstuff for livelihood, a large quantity is imported every year because of its small domestic production and it considerably affects the trade balance. Therefore, the Government enforces a price control policy. Wheat is raised as a secondary crop of soybeans which use the same machinery. Therefore, its cultivation over an extensive acreage is possible by rotation with soybean. Thus, the area of wheat-soybean raising is increasing. So far as wheat is concerned, the increased production in Yacyreta District is domestically consumed leaving little problem.

4.3 Soybean

Soybeans are the major export product of Paraguay after cotton, and the production has dramatically increased in these years. The 1980 output stood at 737,000 tons on 3.35 times the 1975 output (220,000 tons). Soybean to be produced in Yacyreta District are to be exported through the existing route. However, the production cost, export route, etc. of Brazil, another soybean exporting country, should also be studied.

4.4 Beef cattle

6.34 million head of beef cattle are raised in Paraguay. There would be few problems if the number of heads are increased in Yacyreta District, because of the scanty number.

4.5 Future work schedule

4.5.1

The output trend, production cost, etc. of rice in Brazil shall be examined. Also, the actual import situation of importing countries in Middle-South America shall be surveyed through reference materials. Thus, the export-ability shall be examined.

4.5.2

With respect to soybeans, and the output, production cost, export route, export policy, etc. of Brazil, a major exporting country, shall be examined.

Table 4-1 Rice Area and Production for the 5 Years from 1976 ∿ 1980
Major Producing Countries

Continent	Total and country	Harvested Area (1,000 ha)					Amount Produced (1,000 tons)				
	Item / Year	1976	1977	1978	1979	1980	1976	1977	1978	1979	1980
World		143,108	144,092	145,130	141,052	143,534	350,365	370,592	376,448	377,394	397,597
North and Central America	Total	1,813	1,717	2,020	1,876	2,022	7,062	6,431	8,152	7,983	8,614
	America	1,004	910	1,238	1,161	1,340	5,246	4,501	6,251	5,985	6,629
Asia	Total	128,107	129,802	130,654	126,607	128,045	317,765	338,993	344,351	343,590	360,876
	China	36,686	37,079	37,290	34,594	33,887	129,054	130,472	131,775	146,959	142,338
	India	38,511	40,001	40,000	39,414	39,773	63,052	79,094	79,010	63,476	79,930
	Thailand	8,463	7,947	8,288	8,651	9,145	15,068	13,910	17,000	15,758	17,366
	Japan	2,779	2,757	2,560	2,497	2,377	15,292	17,000	16,000	14.948	12,189
South America	Total	7,704	7,088	6,781	6,801	7,542	13,471	13,074	11,535	12,414	14,449
	Argentina	87	91	95	102	82	309	320	310	312	266
	Brazil	6,583	5,913	5,552	5,452	6,208	9,560	8,935	7,242	7,595	9,748
	Paraguay	28	34	38	30	38	57	69	75	57	73

Data: F.A.O.

Table 4-2 Unit Rice Harvest for the 5 Years from 1976 ∿ 1980
Major Producing Countries

Item / Continent / Total and Country / Year		Unit Harvest Amount (kg/ha)				
		1976	1977	1978	1979	1980
World		2,448	2,572	2,594	2,676	2,770
North and Central America	Total	3,896	3,746	4,030	4,255	4,261
	America	5,227	4,945	5,049	5,155	4,946
Asia	Total	2,480	2,612	2,636	2,714	2,818
	China	3,518	3,519	3,534	4,248	4,200
	India	1,637	1,977	1,975	1,610	2,010
	Thailand	1,780	1,750	2,051	1,822	1,899
	Japan	5,503	6,166	6,250	5,986	5,128
South America	Total	1,749	1,844	1,701	1,825	1,916
	Argentina	3,541	3,516	3,263	3,047	3,236
	Brazil	1,452	1,511	1,304	1,393	1,570
	Paraguay	2,020	2,044	1,974	1,890	1,901

Data: F.A.O.

Table 4-3 Rice Exports for the 5 Years from 1976 ∿ 1980
Major Producing Countries

Continent / Total and Country \ Item / Year		Export Amount (1,000 tons)				
		1976	1977	1978	1979	1980
World		8,987	10,819	9,686	11,856	12,713
North and Central America	Total	2,116	2,369	2,386	2,367	3,093
	America	2,107	2,287	2,279	2,301	3,054
Asia	Total	5,215	6,246	5,316	7,603	7,613
	China	1,436	1,123	1,678	1,459	1,311
	India	38	20	143	375	425
	Thailand	1,925	2,942	1,607	2,797	2,745
	Pakistan	782	945	777	1,015	1,087
	Japan	0.2	0.3	82	603	689
South America	Total	504	939	692	640	481
	Argentina	87	193	129	99	86
	Brazil	76	409	180	0.3	1.5
	Paraguay	0.9	0.8	0.5	0.1	-

Data: F.A.O.

Table 4-4 Rice Imports for the 5 Years from 1976 ∿ 1980

Item / Continent / Total and Country / Year		Amount Imported (1,000 tons)				
		1976	1977	1978	1979	1980
World		9,222	10,229	10,128	11,714	13,014
Africa	Total	1,009	1,723	1,943	1,998	2,347
	Ivory Coast	2.3	148	126	198	230
	Madagascar	100	100	125	175	161
	Nigeria	65	450	564	245	387
	Senegal	200	218	238	259	275
	South Africa	89	110	103	137	126
Asia	Total	5,555	5,652	5,364	5,958	7,028
	Bangladesh	396	196	305	59	719
	Hong Kong	362	341	344	361	359
	Indonesia	1,301	1,964	1,842	1,922	2,012
	Iran	260	600	367	440	470
	Iraq	194	235	290	320	345
	Malaysia	234	296	409	239	201
	Saudi Arabia	261	121	404	341	356
Europe	Total	1,538	1,569	1,758	1,624	1,602
	France	194	267	282	249	253
	West Germany	180	166	194	160	162
	Italy	58	124	307	178	120
	Holland	250	147	145	148	193
South America	Total	216	120	97	921	574
	Argentina	-	6	2	10	-
	Brazil	17	-	29	711	237
	Paraguay	-	-	0.7	-	-
	Chile	26	11	11	8	50
	Colombia	-	75	17	14	11
	Peru	82	-	26	151	251

Table 4-5 Rice Exports from Argentina

(Unit: ton)

Destination Country	1975	1976	1977	1978	1979
Holland	14,829	18,312	71,966	32,569	12,102
Soviet Union	13,837	-	13,984	-	10,380
Belgium	5,986	6,149	2,318	3,420	4,349
West Germany	3,898	9,362	1,314	2,059	3,135
Israel	3,952	13,488	18,392	5,517	2,710
Italy	-	-	1,914	35,163	1,091
Costarica	99	-	-	9,999	-
Dominica	-	-	21,553	-	-
Senegal	-	5,520	17,786	4,645	-
Japan	-	-	-	5,262	-
France	3,069	1,589	1,327	352	817
Chile	1,962	15,269	10,177	-	338
Cuba	-	14,687	18,862	-	-
Singapore	-	-	9,489	-	-
Other Countries	24,188	8,091	3,777	19,667	2,647
Total	71,820	92,467	192,859	118,653	37,569

Source: FAO "Livestock Production Distribution for Argentina"

CHAPTER 5 IRRIGATION PLAN

5.1 Basic policies of irrigation plan

The planned area is divided into Area A and Area B according to the land use plan: Area A is designed for wheat and soybean cropping, while Area B is designed for paddy rice cropping. Taking account of the meteorological and siting conditions in this area, irrigation is necessary for the paddy rice field in Area B to ensure stable production. Thus, this irrigation plan is set for the purpose of irrigated agriculture for paddy rice in Area B.

The water source for this irrigation plan is the Yacyreta Dam, and this plan is set based on the various parameters in the Yacyreta Dam Plan including the maximum intake water capacity (108 m^3/s),the altitude of water intake level (82 m) and the water intake sites which were settled by the agreement between Paraguay and Argentina.

5.2 Evapotranspiration

Typical evapotranspiration estimation methods are the Modified Penman Method, the Blaney-Criddle Method, the Radiation Method and the Pan Evaporation Method. In this plan, the Modified Penman Method, which is recognized as the most accurate method by FAO, is used.

5.2.1 Meteorological data

Meteorological data used for the evapotranspiration estimation have to represent the meteorology in project area.

Although 9 meteorological stations are under operation in the neighborhood of the project area, data at the Yacyreta station operated by the Department of Defense will be used because it has conducted long term observation and is located abutting on the project area.

The necessary data for the estimation by the Modified Penman Method include temperature, humidity, wind speed and the duration of sunshine, as shown in the table below. With respect to the duration of sunshine the data at the Encarnacion Station will be used, since the Yacyreta Station does not conduct the observation of sunshine.

Table 5-1 Parameters of Meteorological Data Used for the Estimation

Parameters	Name of Station	Data To Be Used
Daily mean temperature	Yacyreta Station	Mean values for ten years from 1971 to 1980
Daily mean relative humidity	"	"
Daily mean wind speed	"	Mean values for 6 years from 1975 to 1980
Daily mean duration of sunshine	Encarnacion Station	"

Table 5-2 Meteorological Data Used for the Estimation

Parameters	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Daily mean temperature (°C)	26.3	25.9	24.5	20.8	18.0	15.9	16.2	16.6	18.7	21.2	22.9	25.4
Daily mean relative humidity (%)	74	75	77	76	80	80	77	77	72	73	71	72
Daily mean wind speed (km)	6	6	5	5	6	6	7	7	7	7	7	6
Daily mean duration of sunshine (hr)	7.9	8.6	5.9	7.1	5.5	5.6	5.5	5.8	7.0	5.8	7.3	8.6

Mean maximum relative humidity	90%	Mean wind speed during daytime	2.0 km/day

Meteorological stations set by the Yacyreta Public Corporation and this study team are located within and in the adjacent of the project area, and then future accumulation of data will be joined for the analysis.

5.2.2 Evapotranspiration

The estimation by the Modified Penman Method yielded the following evapotranspiration values.

Table 5-3 Evapotranspiration by the Modified Penman Method (ET_o mm/day)

Month / Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
1971 to 1980 (average)	7.6	7.4	5.2	4.9	3.0	2.5	3.0	3.3	5.0	6.1	7.5	8.3

5.3 Crop coefficient

Crop coefficient, which relates crop water consumption with evapotranspiration estimated above, is set on the basis of FAO's Irrigation and Drainage Paper No. 24 Crop Water & Requirements. These values are shown in the following figure.

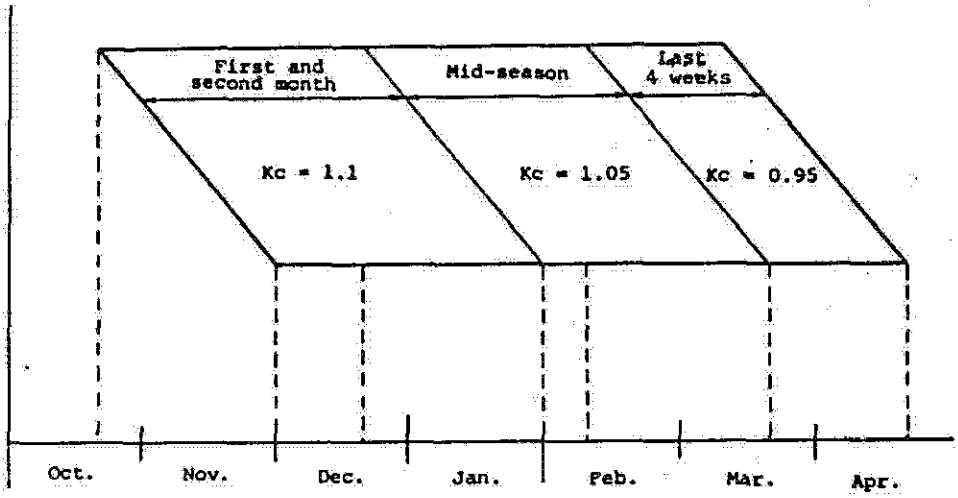


Fig. 5-1 Crop coefficient (paddy rice)

5.4 Crop water requirements

Crop water requirements is estimated by multiplying the evapotranspiration already obtained by the crop coefficient. The result is shown below.

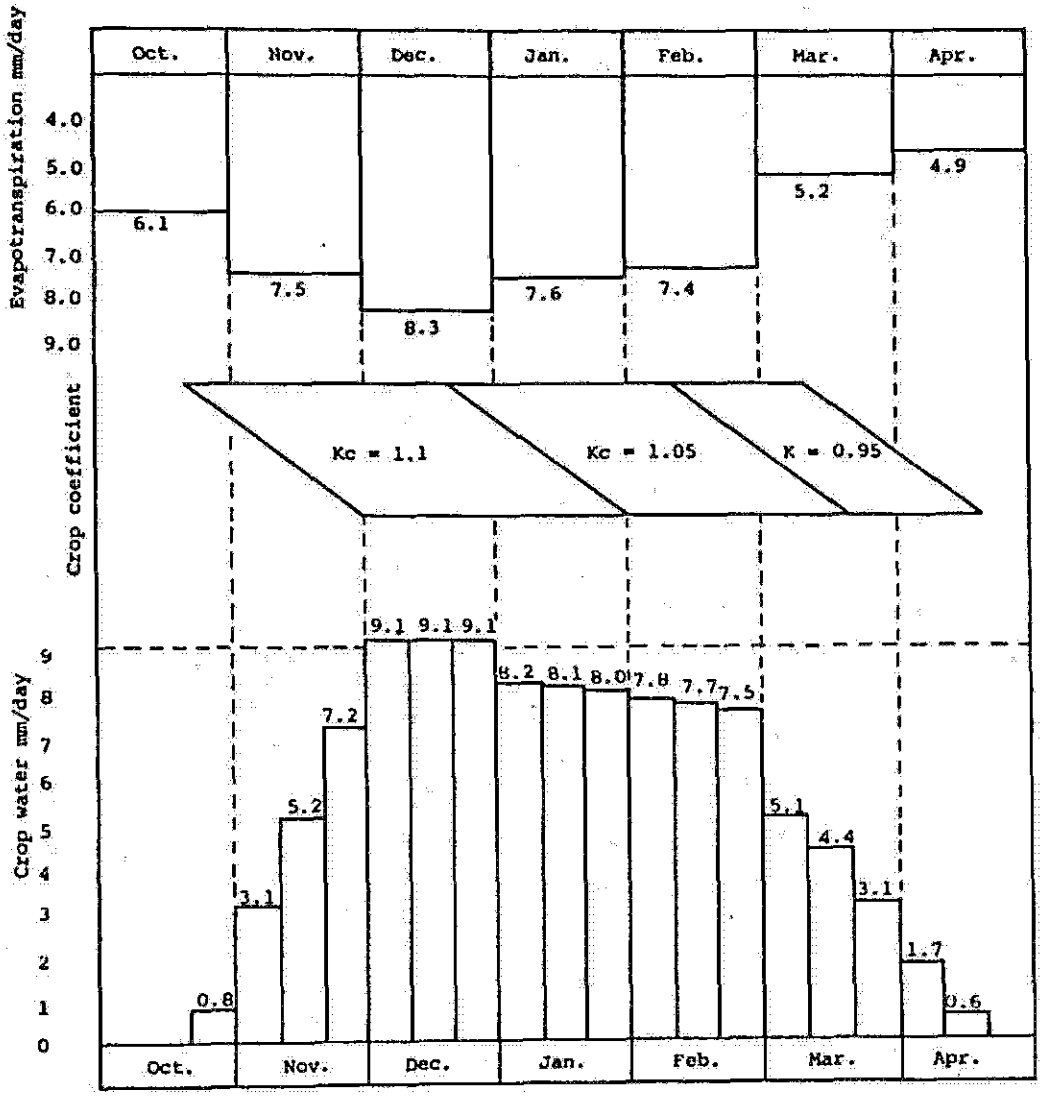


Fig. 5-2

5.5 Effective rainfall

Of precipitation on a field the part effectively utilized by crop is called effective rainfall, and precipitation of less than 5 mm is not regarded as effective rainfall in the calculation.

In case of precipitation of more than 80 mm, 80 mm is considered effective and precipitation exceeding this value is regarded as invalid runoff.

In case of precipitation between 5 mm and 80 mm, 80% is treated as effective rainfall.

The estimation of effective rainfall is performed by the following equations:

$R < 5$ mm, $Re = 0$ mm

$5 \text{ mm} \leq R \leq 80$ mm, $Re = 0.8 \times R$

$R > 80$ mm, $Re = 80$ mm,

where R: precipitation and Re: effective rainfall.

5.6 Irrigation efficiency

Intake water capacity is estimated from crop water requirements counting on water loss, and this water loss rate is set based on irrigation efficiency.

Irrigation efficiency is determined by many factors such as field size, shape, conditions of the irrigation system, and the water management system. In this plan the efficiency is divided into field efficiency, conveyance efficiency and application efficiency, and then each efficiency is set.

(1) Field efficiency

The efficiency is set taking account of irregularity of irrigation in the field, and set at 80%.

(2) Conveyance efficiency

This efficiency relates to water supply through a water channel from the water source to the field, and is set at 80%.

(3) Application efficiency

This efficiency is associated with the diversion of water in water channels, and set at 90%.

(4) Integrated efficiency

This efficiency means the integration of the field efficiency, conveyance efficiency and application efficiency, and is set at 57.6% (80% × 80% × 90%).

This irrigation efficiency will be further examined by the results of the water management study in the existing field.

5.7 Water balance estimation

Based on the irrigation parameters mentioned above the water balance estimation is performed for ten years from 1971 to 1980.

In this estimation, recycled water is taken account of , but the details of the recycled water will be further studied.

This water balance estimation will produce total water requirement for irrigation and irrigatable land area to prepare information for the study of the framework of the irrigation plan.

5.8 Design year

Based on the results of the above mentioned water balance estimation a year providing the basis for planning and designing the irrigation facilities will be set.

This design year will be determined by analyzing effective precipitation and the number of days in continuous drought weather during irrigation season.

Although many plans in developing countries have adopted 1/5 probability year, 1/5 and 1/10 probability years will be examined in discussion to be held in Japan

from the viewpoint of economy to set a design year after thorough consideration, since the maximum intake water capacity (108 m^3/sec) at the water source, the Yacyreta Dam, has already been settled by the agreement with Argentina.

5.9 Unit water requirement

On the basis of the results of the field investigation the examination will be further conducted in Japan. The current estimation by the above mentioned parameters has yielded 1.51/s/ha for unit water at the field level and 2.61/s/ha for unit water at the outlet works.

5.10 Total water requirement

Of the total area of Area B where paddy rice cropping is expected, 105.500 ha, 84.400 ha is planned to receive net profits.

As three year rotation of paddy rice and pasturing is planned in this area, the actual irrigation area for paddy rice is 42.200 ha.

As a result, the rough estimation of total water requirement for irrigation yields 2.61/s/ha × 42.200 ha = 109.7 m^3/s. The maximum potential water intake at the water source, the Yacyreta Dam, is 108 m^3/s, and water inflow from the hinter land of the planned area and recycled water will be further studied in Japan based on the results of the field survey.

5.11 Main irrigation canal

The main irrigation canal will be located from the east to the west in the northern part from the water inlet site already set by the Yacyreta Dam Plan (see the general Planning Map of the plan).

Based on the results of the route survey and the geological survey conducted in this study a further examination of the details will be carried out to choose a proper route and to calculate hydraulics. Currently, a main irrigation canal of about 100 m in width, 2 to 2.5 m in depth and 0.50 to 0.90 m/s in flow rate is planned.

5.12 Pumping station

Water distribution to Area B will be performed by a gravity irrigation method as much as possible, but for the impossible sections pumping by low head pumps is planned.

Home study in Japan will set gravity irrigation sections and pumping irrigation sections along with planning branch irrigation and terminal irrigation canal, and decide a plan relating to pumping stations.

CHAPTER 6 DRAINAGE PLAN

6.1 Basic Policies of Drainage Plan

In the northern and eastern parts of the proposed area of this project lies a hilly region with an elevation between 80 and 150 m, along the summit of which runs the national route No. 1, while the western side of the proposed area faces the flat Neembucu swampland and the southern side is bordered by the Parana River. The proposed area has an elevation of 60 to 80 m and constitutes a flat swampy lowland gently sloped from north to south. Pan-shaped landforms which are inundated all the time are the common features at the center of the area.

Large rivers draining from the area are the Atinguy and the Yabebyry, with a subsidiary drainage supported by a small river, the Yaguary and the artificial drainage canals, all flowing into the Parana River. However, the drainage capacity of these rivers and the canals has not been enough to accept all the flow-in water from the back land and runoff water from within the proposed area. Therefore, this area has always been subjected to the risk of inundation.

Items to be performed this fiscal year include the preparation of the framework of the drainage plan for the area which has subjected to inundation all the time, analysis of conditions and causes of inundation, preparation of draft drainage plans for various cases based on the analysis, modeling of initial conditions, and execution of the simulation analysis based on the numerical model.

6.2 Drainage Conditions in the Proposed Area

The following field studies were performed for the confirmation of the drainage conditions in the proposed area for the preparation of the drainage plan.

6.2.1 Inundated water level in the proposed area

The data which show the inundated water level in the proposed area include the records of the graduated staff gauges installed at 11 sites in the first-year study and the automatic water gauge in the Atinguy River operated by the Ministry of Defense.

The collection and analysis of these data have been proceeded. Furthermore, to help increase the accuracy of the drainage simulation which has been examined separately in Japan, two other staff gauges have been installed at the center of both the eastern and the western sections.

Also, an automatic water gauge has been installed near the border of the proposed area which is in the down-stream side of the Yabebyry River, the main drainage stream in the western section.

Although the data from the newly installed gauges will not be used for the analysis to be performed this fiscal year, they will become available for the third-year investigation and later investigations if continuous observations are performed.

6.2.2 Conditions of rivers in the proposed area

For the investigation on the cause of bad drainage, a survey was performed to find the general conditions of the present drainage system and a survey and discharge observation were performed at the following locations of the Atinguy and the Yabebyry, two main drainage rivers in the proposed area:

(1) River mouth of the Atinguy,

(2) Installation site of the automatic water gauge in the Atinguy River,

(3) Installation site of the staff gauge in the Atinguy River,

(4) River mouth of the Yabebyry,

5 Installation site of the automatic water gauge in the Yabebyry River,

6 Installation site of the staff gauge in the Yabebyry River.

Also, for the study of the amount of inflow from the back land, automatic water gauges have been installed at the following two locations and a survey and the observation of discharge were performed.

(1) Caje Cue River (where the river intersects with the road between Yabebyry and San Ignacion),

(2) Arroyo Ingua River (where the river intersects with the Access I-B road)

The data from these observations will be fully analyzed back in Japan and become the basic data for the drainage simulation.

6.3 Rainfall

6.3.1 Rainfall records

The basic rainfall for planning has to be determined carefully since it will become the basis for the preparation of the drainage plan.

There are nine rainfall observation stations in the proposed area and its vicinity, three stations operated by the Meteorological Bureau of the Ministry of Defense, five stations operated by the Yacyreta Public Corporation and one station installed by this study team in its first-year study. Two more rainfall stations were installed in the second-year study for the specific purpose of the analysis of the inflow amount from the land at the back of the proposed area.

For the reasons to be specified below, the rainfall data from the Yacyreta station will be used for the formulation of the master plan:

(1) The data covers a long period

The observation of rainfall at the station established by the Yacyreta Public Corporation started only lately in June 1981, while three stations operated by the Meteorological Bureau of the Ministry of Defense including Yacyreta Station have a long period of record.

(2) The observation station is located near the proposed area

The analysis of areal rainfall by the Thiessen method for the above three stations revealed that the use of data from Yacyreta station is most appropriate.

Thus, the master plan will be prepared on the basis of the data from Yacyreta station. However, in the feasibility study for the second stage of the project, a full analysis will also be conducted on the data from eight stations installed by the Yacyreta Public Corporation

and the study team, and the possible use of the data from any appropriate station for each sub-project has to be formulated depending on the local conditions since the proposed area is very wide.

6.3.2 Calculation of probability rainfall

Eighteen years of rainfall data from 1963 to 1980 were collected at Yacyreta station.

Daily rainfall, two-day continuous rainfall, three-day continuous rainfall for each year for the period of 16 years from 1965 to 1980, excluding 1963 and 1964 when there were many missing data, are listed in the Table 6-1 titled "Rainfall Data".

The Iwai method was applied to these data for the calculation of probability and the results are listed in the Table titled "Probability Rainfall".

In the drainage simulation which will be performed this time the inundation analysis will be performed for two cases, i.e., 1/5 and 1/10 probability rainfalls. Depending on the results, the inundation condition will be additionally checked by the use of other probability years.

Table 6-1 Rainfall Data

Year	Days with Rain	Order	2-day Consecutive Rainfall	Order	3-day Consecutive Rainfall	Order
	mm		mm		mm	
1965	120.0	8	130.0	8	156.0	7
1966	160.2	2	160.2	5	223.7	1
1967	78.5	15	84.0	15	84.0	15
1968	73.0	16	73.0	16	81.0	16
1969	140.6	5	140.6	7	140.6	9
1970	93.0	10	123.0	9	123.0	12
1971	189.5	1	191.5	2	196.5	4
1972	120.8	7	196.7	1	202.1	2
1973	156.2	3	178.1	3	181.1	5
1974	92.0	11	98.6	13	114.8	13
1975	135.0	6	174.0	4	197.4	3
1976	88.0	13	92.2	14	106.6	14
1977	94.6	9	117.8	10	141.4	8
1978	88.4	12	114.6	11	124.4	11
1979	152.2	4	160.2	6	174.6	6
1980	81.8	14	108.8	12	131.0	10

Table 6-2 Probable Rainfall

Probable Years	Daily Rainfall	2-day Consecutive Rainfall	3- day Consecutive Rainfall	Notes
	mm	mm	mm	
2	110.6	130.8	148.0	
5	125.9	148.1	166.8	
10	164.4	186.3	204.6	
15	176.4	197.1	214.5	
20	184.8	204.4	221.0	

6.3.3 Continuous rainfall days

For the preparation of the drainage plan, it is necessary to examine which rainfall data, daily rainfall, two-day continuous rainfall or three-day continuous rainfall, will be used as rainfall for planning, depending on the objective, scale, and the economy of a project. Therefore, the occurrence of continuous rainfall was checked by the use of the past 18 years of rainfall data of Yacyreta station and the result was obtained as listed in Table 6-3. For this analysis the day with rainfall of more than 5 mm is considered to be the rain day. The result is that one-day rainfall accounts for about 78% of the total number of rainfall days, two-day continuous rainfall accounts for about 16%. This means that the probability of one-day rainfall is very high. The amount of rainfall was also checked and it was found that the rainfall of about 150 mm, which is planned to be used for the project, occurred in the single event in one day in many cases.

Thus, the formulation of this plan will be based on the daily rainfall.

Table 6-3 Numbers of Days with Rain

Continuous Days with Rain / Month	One day	Two days	Three days	Over four days	Total	Notes
Jan.	55	5	7	1	68	
Feb.	56	8	1	1	66	
Mar.	59	12	1		72	
Apr.	50	14			64	
May	38	10	4		52	
Jun.	33	8	4	1	46	
Jul.	38	10	1		49	
Aug.	38	12	1	1	52	
Sep.	41	11	4		56	
Oct.	55	8	8	1	72	
Nov.	46	8	3	2	59	
Dec.	50	8	5	1	64	
Total	559	114	39	8	720	
Percentage	77.7	15.8	5.4	1.1	100	

6.4 Water Level Outside the Proposed Area

The proposed area is located along the Parana River and water of all rivers and drainage canals in the proposed area flows into the Parana River. Therefore, for the preparation of the drainage plan, it is necessary to analyze the water level of the Parana River carefully and to establish an appropriate basic water level for the outside proposed area.

6.4.1 Record of water level of the Parana River

There are two water level observation stations operated by the Ministry of Defense along the Parana River near the proposed area, one on the Yacyreta Island near the river mouth of the Atinguy, the main river in the proposed area and the other at Ayolas, and data were collected from these stations.

The water level of the Parana River as well as that of the Atinguy within the proposed area is being analyzed for the study of its effect on the drainage in the proposed area.

6.4.2 Basic water level outside the proposed area

The construction of the Yacyreta Dam in the Parana River has been planned at the location about 25 km upstream from Ayolas. The Yacyreta Public Corporation has a plan to construct the Ita Ibate Dam about 85 km downstream of the Yacyreta Dam for regulating the water level and to facilitate the passage of 2,000-ton class ships. Since the proposed drainage canal has been planned to be located between the Ita Ibate Dam and the Yacyreta Dam, the planned water level for the Ita Ibate Dam should be used as the basic water level outside the proposed area.

6.5 Planned Drainage System

The following two cases of the proposed drainage system were planned on the basis of the geomorphological conditions and the present drainage system in the proposed area. A plan advantageous to the proposed area will be outlined by performing the drainage simulation for these two cases.

(Case I)

In this case, water from the back land and from most of the land within the proposed area is expected to flow in the north-south direction as much as possible. Water will be drained by two drainage canals as well as by the present Atinguy and Yabebyry Rivers.

(case II)

In this case water from the back land and most of the land within the proposed area will be drained through the present Atinguy and Yabebyry Rivers and a large amount of water will flow in east-west direction compared with the case I

6.6 Structure and Cross-Section of the Drainage Canal

Two types of cross-sections will be examined as shown in "The Standard Cross-Section of the Main Drainage Canal", type I being the single cross-section and type II the compound cross-section.

The structure of the canal will be of the plain excavation type and since the geology of the ground is such that the upper layer is sandy silt and the lower layer is sand, the excavation slope for the single cross-section should be 1:1.5 and the one for the compound cross-section should be 1:1.5 for the upper excavation and 1:2.0 for the lower excavation.

The selection of the cross-section type should depend on the drainage amount, and the planned canal gradient should be determined with the present landform gradient as a reference, while the cross-sectional sizes, such as the planned bottom width, canal depth and others should be determined by the Manning formula.

The following five cases of the cross-section of the canal should be simulated and the best one should be selected.

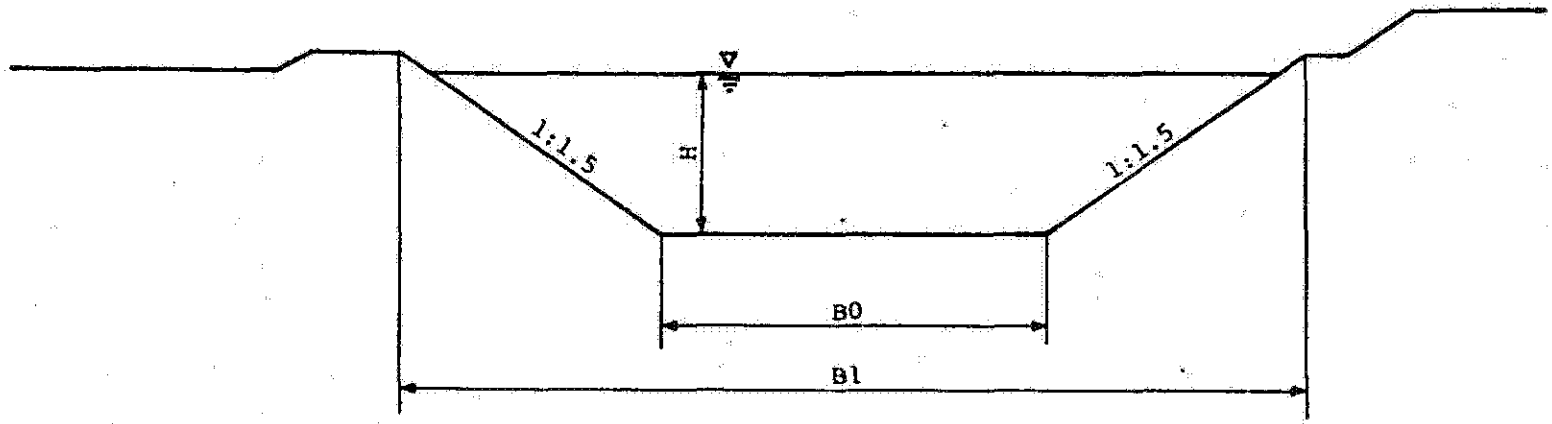
Case 1: Cross-section with the unit drainage amount of 0.25 $m^3/s/km^2$

Case 2: Cross-section with the unit drainage amount of 0.5 $m^3/s/km^2$
(This is equivalent to the cross-section which can drain 1/10 probability rainfall in two days.)

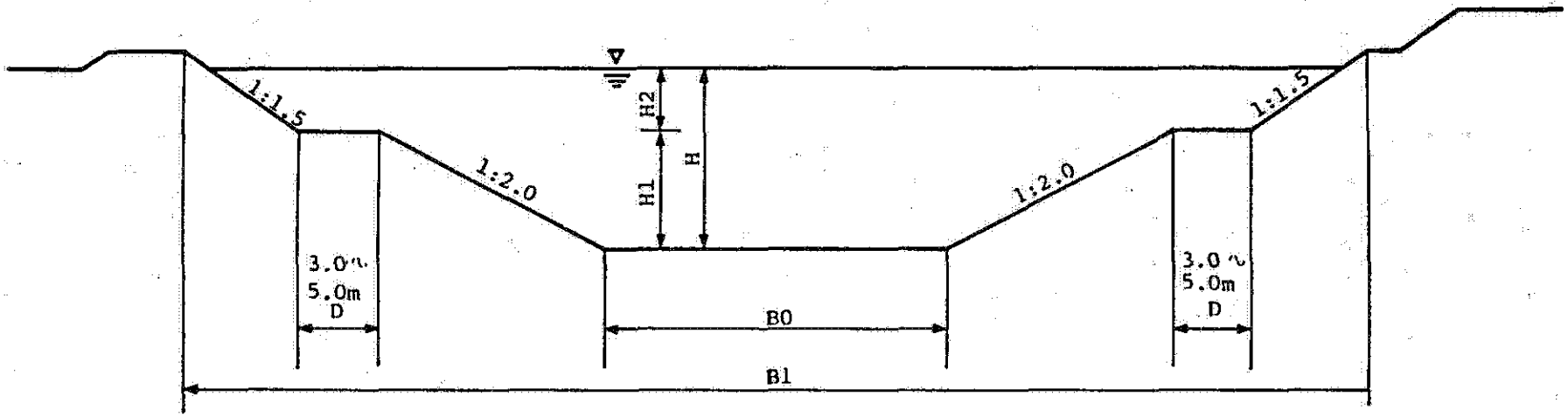
Case 3: Cross-section with the unit drainage amount of 1.0 $m^3/s/km^2$

Case 4: Cross-section with the unit drainage amount of 2.0 $m^3/s/km^2$

Case 5: Cross-section with the unit drainage amount of 3.0 $m^3/s/km^2$.



Type I



Type II

6.7 Drainage Simulation

A mathematical model of runoff from within the proposed area and from the back land will be prepared and simulation will be performed for each case mentioned above. Based on the results of the simulation the inundation conditions, such as the inundation depth, inundation time, and so on, will be obtained for accurately estimating the drainage effect after the completion of the project; the best drainage system and cross-section of the drainage canal will be established; and at the same time the basic data for the preparation of the execution plan of the project including the determination of sub-projects and their priorities will be obtained.

CHAPTER 7 ON-FARM DEVELOPMENT PLAN

7.1 Basic Policies of On-Farm Development Plan

The cultivation plan in this project is paddy rice-pasture in Area A and wheat-soybean in Area B. Two types of individual farmland consolidation program are thus conceivable. One is the Area A type where irrigation canals will not be established, the other being Area B typ with canals. Except for canals, however, the two programs are roughly fixed, based upon the same conception for farmland layout, drainage canals and farm roads.

For farmland layout in particular, the study should fully reflect such conditions as the topography of the site, the water management plan, the settlement/operation size per household.

Furthermore, grassland improvement will also be studied in this on-farm development plan.

7.2 Buildup of Individual Farmlands

7.2.1 Layout of farms

The layout of farms will be studied in the light of the actual situation of existing paddy rice farms, local topography, on-farm water management, and settlement/farming size per household.

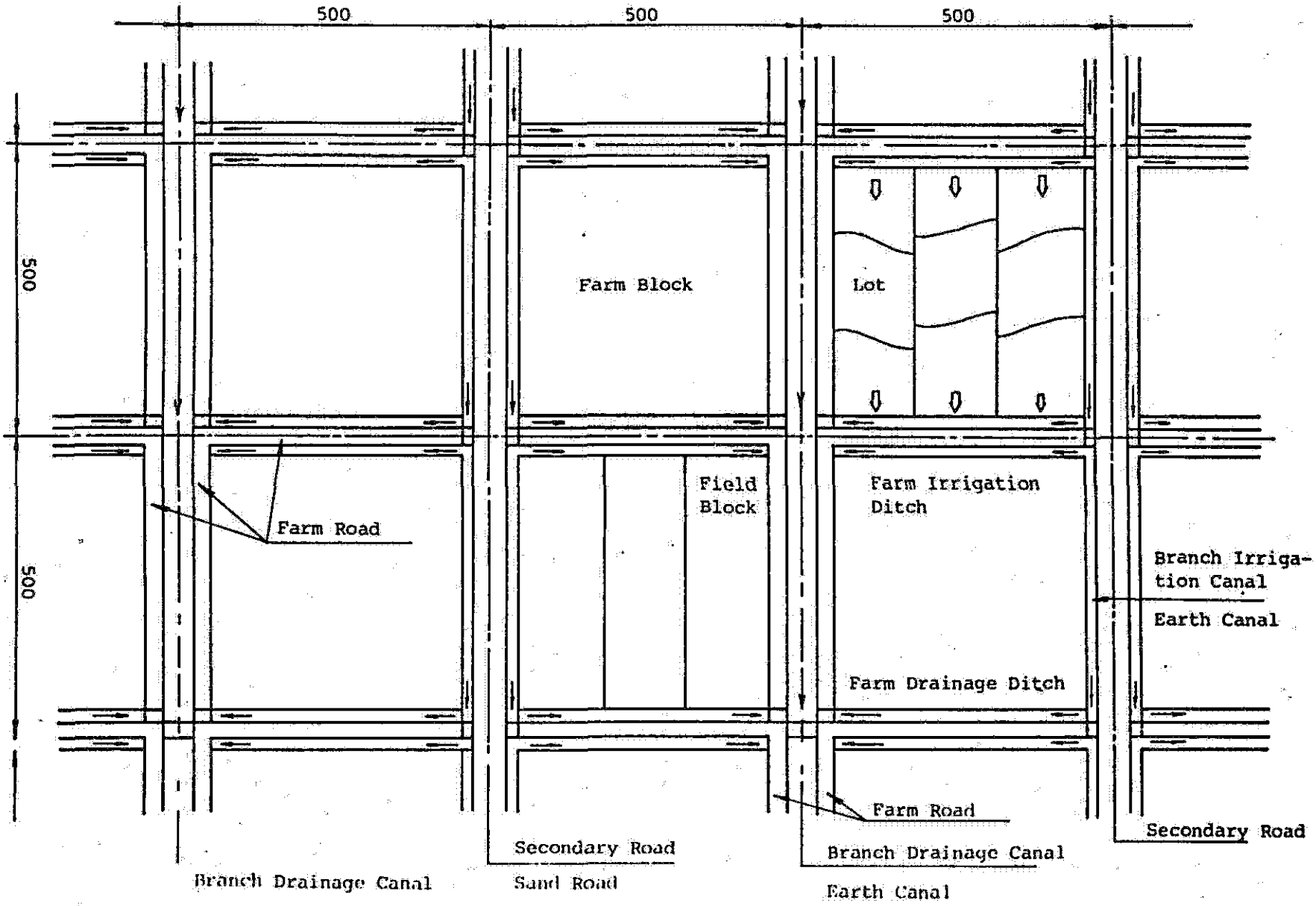
First, the actual situations of existing paddy rice farms. The standard for Bolf Farm in this project area is a 800 m × 800 m lot, which the manager complains is slightly too large for carrying out farm work easily. Also, Papalarddo Farm in the suburbs of Asuncion has redivided its original 400 m × 2,500 m lots into 200 m × 2,500 m lots in the light of water management and farm production. The current topography of the site is so flat - approx. 1/3,000 ∿ 1/5,000 - that the topographical conditions of the site will not affect the size-fixing of lots which will be subdivided into field blocks or lots.

When considering water management, since the irrigation will be the continuous flow type, the size of a field block cannot be made too big though further study will be made based upon the result of this soil survey.

A few farm sizes per household are proposed by crop. Of them, the smallest one is 25 ha, which the others are its multiples of this. Therefore, 25 ha may be taken as the basic figure for fixing the farm layout.

In view of the above, the farm size will be 500 m x 500 m as shown on the "Layout of On-farm Plan".

Furthermore, there will be field blocks or lots in a farm demarcated by earth according to the crops being grown. This sub-dividing will be executed every year in the course of farming.



LAYOUT OF ON-FARM PLAN

7.2.2 On-farm irrigation canal

Brand canals should be aligned on both sides of branch roads which must be aligned with the farming field. The branch canals should be parallel at 1 km interval (equivalent to 2 farm blocks).

A farm irrigation ditch should be aligned on the upstream side of each farming block. Weather branched from a branch canal will flow into the paddy field through the cutout of a level which demarcates the farm ditch from the paddy field.

Both farm ditch and branch canals will be earth canals which cross roads by pipe.

Farm ditches, especially small ditches should be remodelled every year before irrigation.

7.2.3 Farm drainage ditch

A farm drainage ditch will be aligned on the downstream side of each farm block. Water flowing into it from a paddy field through the cutout of a level flows into a branch drainage canal.

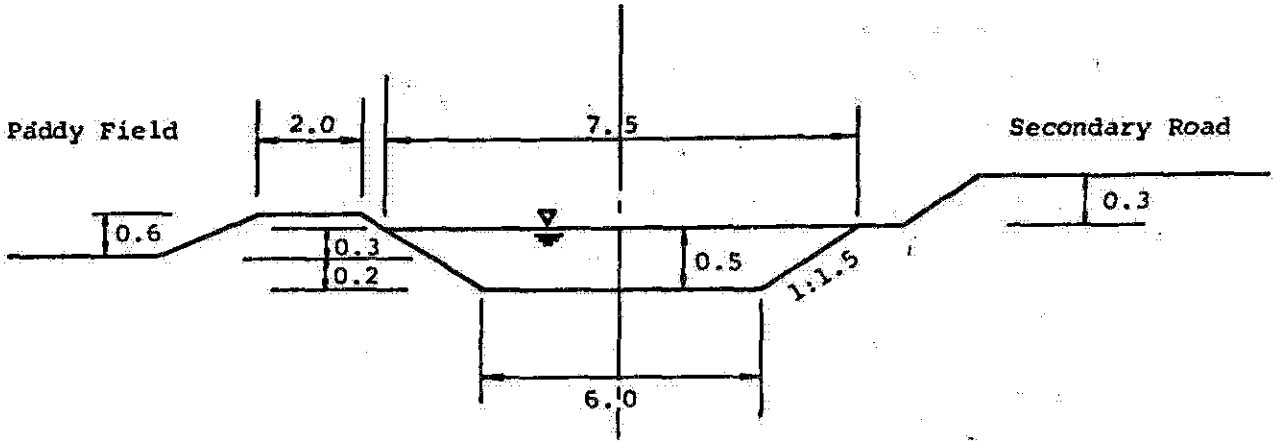
Branch drainage canals should be aligned at 1 km intervals (equivalent to 2 farm blocks) with farm roads on both sides.

The sturucture of either canal should be earth canals crossing roads by pipe, or if the section size requires, by a box culvert.

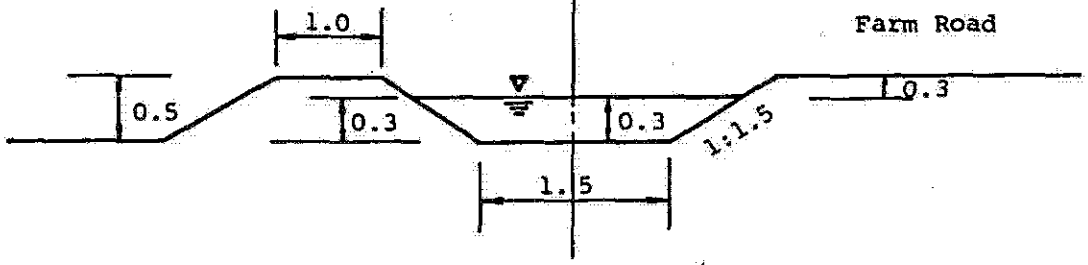
7.2.4 Farm road

Farm roads should be aligned along the three sides of a farm block excluding the side along the branch canal.

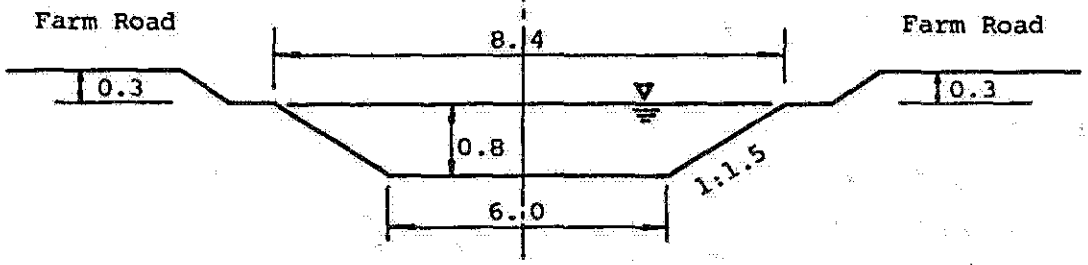
These roads will be mostly used for such farming operations in the field as turning or temporary packing of large farming machines. For this reasons, they should be 6 m-wide dirt roads, on which the earth obtained by excavating drainage canals, etc. should be piled up as thick as about 30 cm.



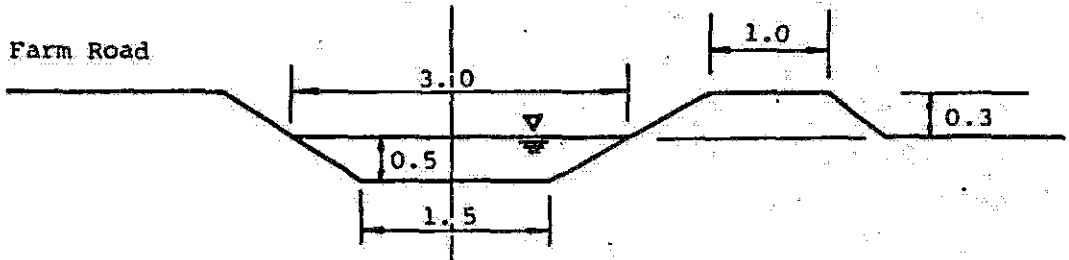
BRANCH IRRIGATION CANAL STANDARD SECTION
(Unit: m)



FARM IRRIGATION DITCH STANDARD SECTION
(Unit: m)



BRANCH DRAINAGE CANAL STANDARD SECTION (Unit: m)



FARM DRAINAGE DITCH STANDARD SECTION (Unit: m)

7.3 Improvement of Grassland

The pasture will be grown in Area B, so based upon the result of a soil survey, the necessity of subsoil improvement will be studied in future.

On the pasture land, fences and farm roads will be laid out. The farm road in this case, however, will not specifically be banked, but will simply have the existing grass cut and the surface levelled by bulldozer.

7.4 Road Plan

7.4.1 Basic policy for road plan

The alignment of roads will most effective after clarifying their necessity, appropriateness and use in the light of(1)cultivation,(2)carrying-in of materials, (3)carrying-out of products and(4)facilities management through comprehensive examination of the natural conditions of the area concerned, alignment/usability/density of existing national/local highways and access roads to Yacireta Dam, and the layout of agricultural facilities.

In this plan, the roads will be classified into trunk, main and secondary roads, in line with whose respective functions the alignment and structure will be designed.

The purpose of trunk roads is to connect the project district with surrounding cities/villages, while that of secondary roads which are adjacent to farms is to carry in materials and to carry out products. Main roads will play an auxiliary role to trunk roads or connect trunk roads to secondary roads.

7.4.2 Trunk road

(1) Alignment

Existing roads around the project district include local roads Ayolas-San Cosme and Yabebyry-Ayolas along the south boundary, the local road

Yabebyry-San Ignacio along the west boundary, the local road Ayolas-Santiago and the access road I-B to Yacyreta Dam both piercing through the middle of the district from south to north. Of them, the access road I-B is asphalt paved and is used as a main road even at present.

Therefore, of the existing roads, Ayolas-San Cosme Road, Yabebyry-Ayolas Road, and Yabebyry-San Ignacio Road will be improved into main roads.

An east-west main road in the north of the project area and north-south main roads in the middle of the West and East Areas will also be constructed. They will be built along main irrigation and drainage canals as shown on the Main Road Network Plan. These main roads to be constructed will concurrently serve as maintenance roads for main drainage/irrigation canals.

(2) Structure and section

To make operable large trailor-trucks for carrying in materials and carrying out products, the roads will be 15 m in full width, 10 m in effective width, and be asphalt/gravel/crushed-stone paved.

Earth obtained by excavating nearby drainage canals will be used as road construction materials, and rolled by bulldozer or type-roller.

At crossings of trunk and main roads, bridges will be constructed. The construction design of the bridges will be based upon the geological survey.

7.4.3 Main roads

(1) Alignment

The main roads will connect the trunk roads with secondary roads while playing an auxiliary role to the trunk roads.

The existing Ayolas-Santiago Road will be improved into a main road, while all the other main roads will be newly built.

The main roads to be newly built will be aligned along the main irrigation/drainage canals so as to connect the trunk roads to the secondary roads, while being built so as to concurrently serve as maintenance roads for the irrigation/drainage canals.

(2) Structure and section

In order to enable large farming machines to pass each other, the roads will be 10 m in full width, 7 m in effective width, 1 m in fill height, and gravel/crashed-stone/mountain-sand paved.

Earth obtained by excavating nearly drainage canals will be used as road construction material, and rolled by bulldozer or tyre-roller.

7.4.4 Secondary roads

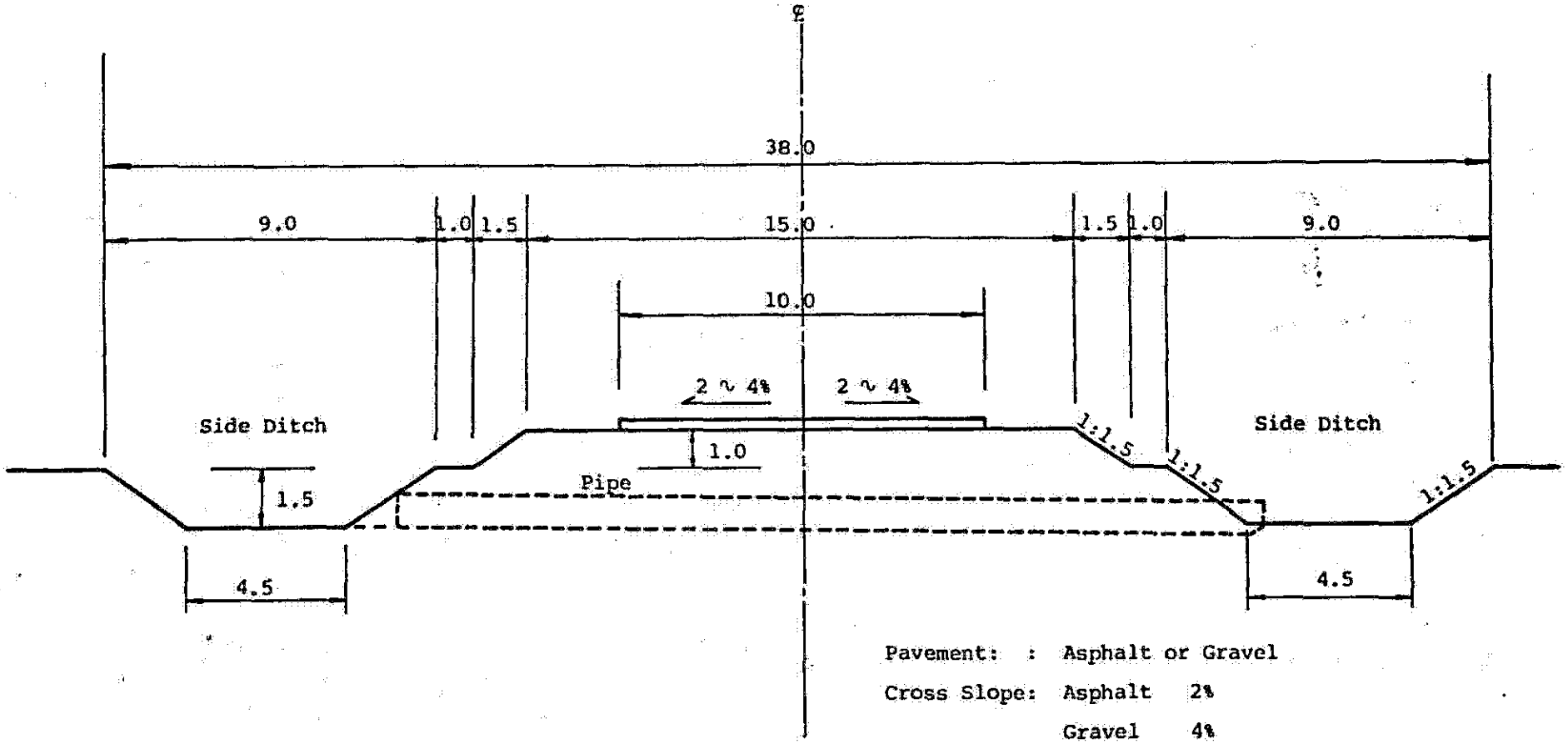
(1) Alignment

The secondary roads are those which connect individual farms with main roads. As shown on the Layout of On-farm Plan, they will be constructed adjacent to the secondary irrigation canals while being aligned in parallel at 1 km (equivalent to 2 farm blocks) intervals.

(2) Structure and section

In order to take large farming machines, the roads will be 8 m in full width and 6 m in effective width. And, in order to facilitate entrance into farms, the fill height will be less than 30 cm.

Earth obtained by excavating nearly drainage canals will be used as road construction materials, and rolled by bulldozer or tyre-roller.

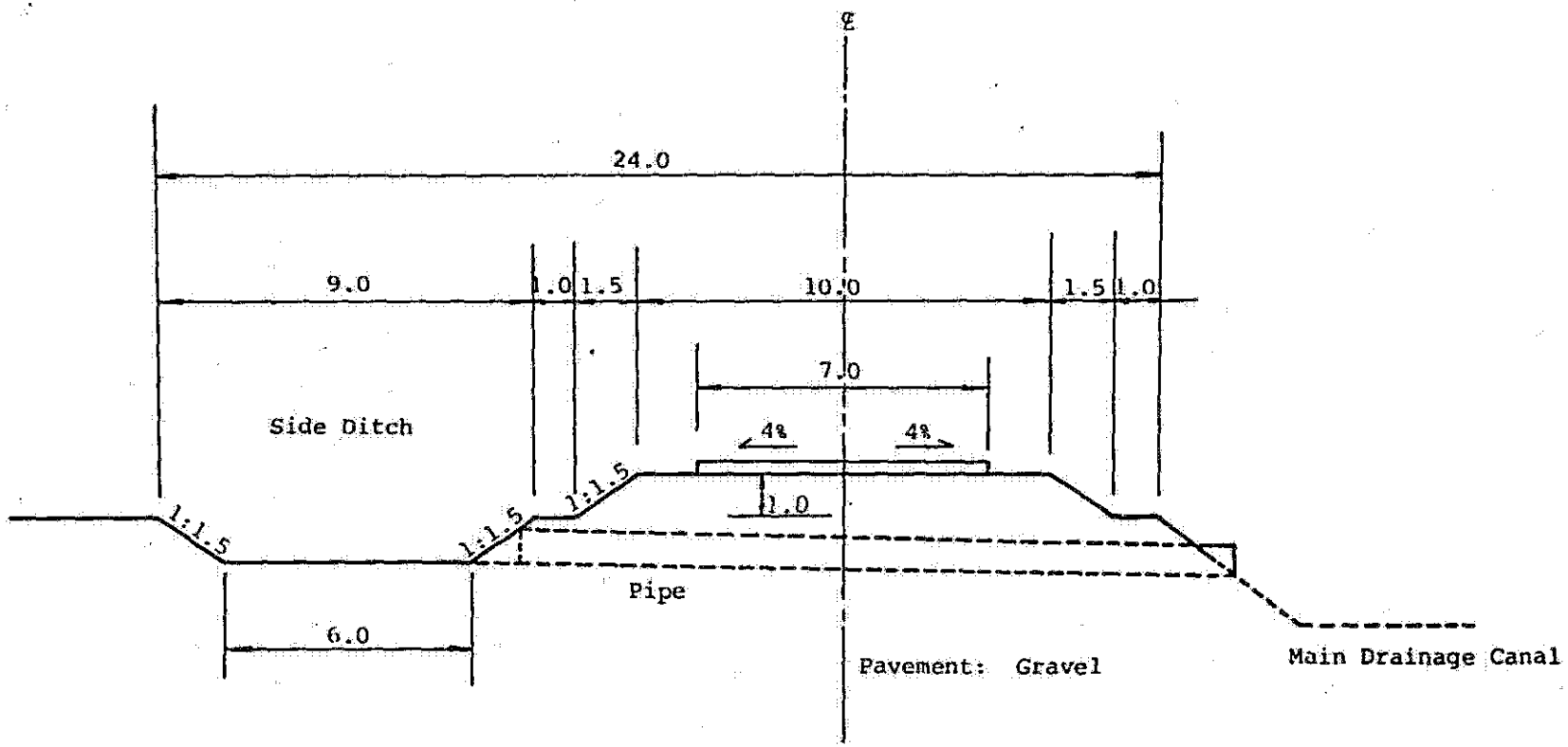


Pavement: : Asphalt or Gravel

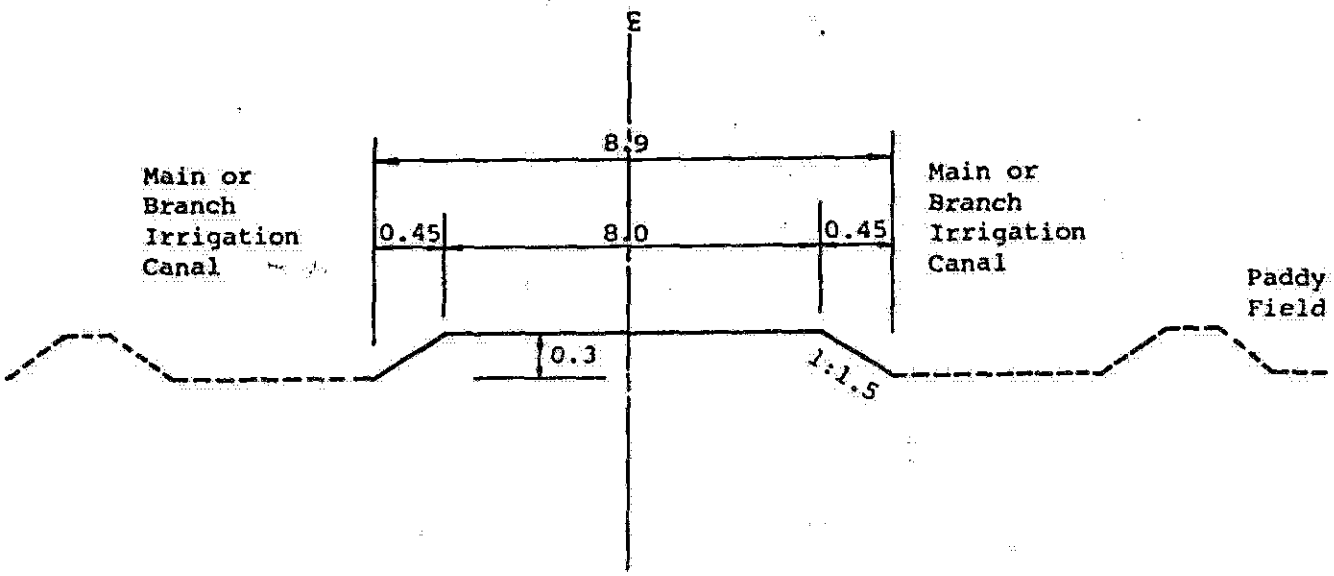
Cross Slope: Asphalt 2%

Gravel 4%

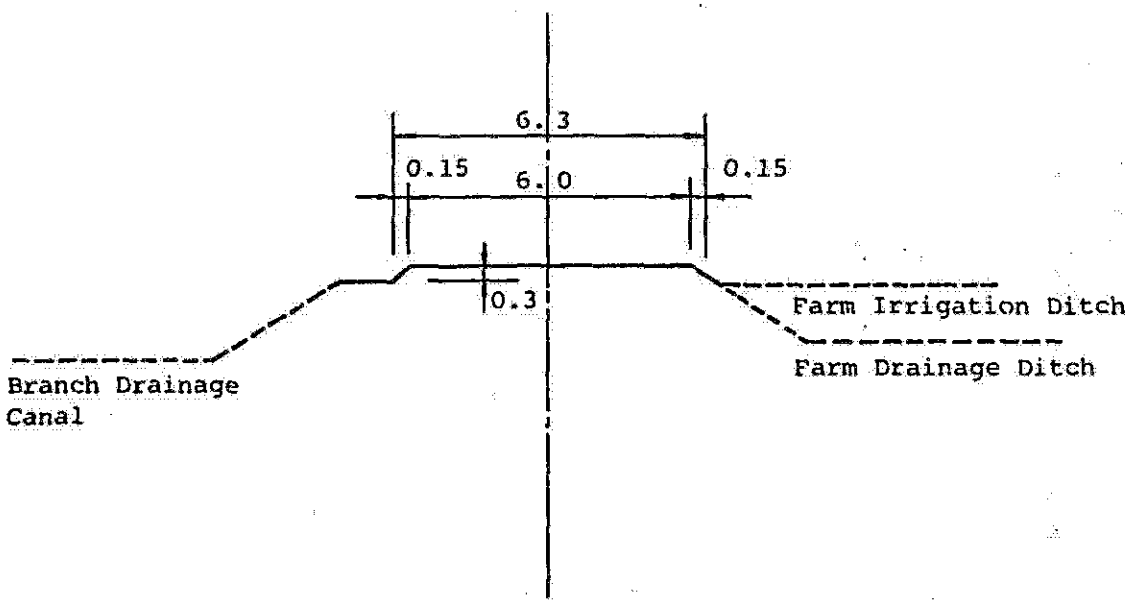
TRUNK ROAD STANDARD SECTION (Unit: m)



MAIN ROAD STANDARD SECTION (Unit: m)



SECONDARY ROAD STANDARD SECTION (Unit: m)



FARM ROAD STANDARD SECTION (Unit: m)

CHAPTER 8 LAND USE

8.1 Concept of Land Use

The major purpose of this project is to comprehensively develop agriculture by effectively utilizing the water after the construction of the dam and the vast unused or poorly-used land which extend on the right bank of Yacyreta Dam. In establishing the concept of land use, the effective utilization of water and land should be fully considered.

The climate of the district is warm with proper rainfall, and is generally favorable for agriculture. The annual average rainfall is approx. 1,500 mm, the annual average temperature is 21.0 °C, the maximum average temperature is 26.8 °C, the minimum average temperature is 15.9 °C, and the average number of rainy days is 7 (5 ∿ 8). There is no absolute necessity for irrigation, except for the special crops such as paddy rice and vegetables. The soil condition of the project area is Planosols which covers most of the area, Gleysols and Regosols. Excepting the Regosols, the soils are suitable for paddy rice, pasture, horticulture and upland farm crops.Regosols are sand soils in which the soil development is hardly seen, and which are difficult to use for agriculture except for such extremely extensive farming as wild grass land.

Meanwhile, the most prevalent type of land ownership in the project area is of big lands owned by a few landowners. The fragmentation of the land ownership by the farmland reform - to subdivide the whole area to be distributed among minor farmers - is not considered appropriate in view of the necessity for the production oriented toward farm products for export and of the enterprise-operated farming. In other words, farm products for export shall be produced at internationally competitive prices by enterprises or nuclear owner-farmers. At the same time, in view of the current situation of Paraguay where manpower is short,

minor farmers living in the area shall be settled permanently to run stabilized farming while their surplus labor is effectively utilized.

Considering the above conditions of water and land, the project area shall be divided into two and a concept of land use shall be established.

8.2 Area A

Area A is on the north side of the main irrigation canal and is situated in the higher portion of the project area. Area A shall be provided with favorable drainage conditions by constructing drainage canals and developing the farmland. That is, the drainage canals are being planned to such an scale so as not to disturb the cultivation of soybean, wheat, vegetables and other upland-farm/horticultural crops under the rainfall of approx. 1/10 of the probability - a favorable drainage condition for upland-farm cultivation.

The soils in this area are mostly Planosols and Greysols and only partially Regosols. Other than the Regosols, the soils are suitable for cultivating upland-farm/horticultural, and paddy-field crops. The crops to be introduced here may be roughly broken down into two. One is crops of the land-extensive type which enterprise-minded operator and nuclear owner-farmers can operate - soybean, wheat, corn and sugar-cane. The other is crops of the land-intensive type suitable for minor farmers - cotton, vegetables and root-crops.

Taking these conditions, the land-use concept of Area A shall be as follows:

Land-use Concept of Area A

(1) Size of Area 34,500 ha

(2) Net beneficial Area 27,600 ha

80% of the area shall be for farmlands, other than which being for roads, canals, hamlets, facilities and uncultivatable lands.

(3) Land-use

1) Land-extensive type:
Crop rotation of soybean and wheat

2) Land-intensive type:
Cotton, vegetables and rootcrops.

Provided, that the operation plan shall be established after the settlement plan and land distribution/sizes would have been fixed.

3) Grassland utilization type:
Improved grassland needed for dairy farming.

Details of the above three types of land-use shall be mapped out through examining the following points:

1) In the area of Regosol soil, no farmland shall be established but the effective utilization shall be intended as lots for hamlets, facilities and grass-lands.

2) Fully utilizing soil maps, land-grading maps, optimum crops to be cultivated shall be allocated.

3) Considering the situation of land ownership, farming/using sites for the land-extensive type, land-intensive type and grassland utilization shall be respectively decided.

8.3 Area B

This area is located on the south side of the main irrigation canal covering most of the project area. Its altitude is lower than that of Area A and it is ill-drained by natural rivers, therefore, the drainage improvement is a prerequisite for the stabilized cultivation. The area is near the mouth of the Atinguy River, and the Yabebyry River and an artificial canal, covering approx. 2,600 km^2 in total of basins, (which is nearly the size of the Chikugo River in Kyushu, Japan). Currently, most of the rainfall in the basins flows into the Parana River after being temporarily stored in the project area, because their flow-sections are very small.

Large-scale drainage canals should be constructed in order to fully improve the drainage condition and create suitable conditions for upland farming. In the project plan, a proper drainage program should be mapped out after examining the cost and the drainage conditions to be improved.

Meanwhile, in view of the local weather conditions of the project area, except paddy rice, no crop for which the irrigation is necessary can be raised on a large scale. Furthermore, paddy rice raising allows for flooding at certain periods and up to a certain depth. Therefore, an introduction of paddy rice to this area is the optimum plan.

Taking above things, the land-use concept of Area B shall be as follows:

Land-use Conception of Area B

1)	Size of Area	105,500 ha
2)	Net beneficial Area	84,400 ha
3)	Land-use	
	3 year crop rotation of paddy field and pasture	

Details of the types of land-use shall be mapped out through examining the following points:

1) Soils not suitable for paddy rice shall possibly be used for hamlet lots, wild grass land,

2) Examining the topography, we found regions where no canal waterheads for irrigation are available because of the extreme flatness. Therefore, some regions need pump irrigation. The land-use shall be mapped out so as to minimize the area of such regions.

8.4 Establishment of Project Boundary

In the west side of the project area, the irrigation/drainage beneficiary or not is clearly demarcated by the road connecting Yabebyry and San Ignacio. In the south side of the project area, it is partially adjacent to the dam site and in other portion demarcated by the Ayolas - Yabebyry Road. South side of the Road is already landused. Therefore, the San Cosme - Ayolas - Yabebyry Road shall be the project boundary.

All lands on the north side of the project area (basins of the Atiguy and Yabebyry Rivers) are drainage beneficiaries. If viewed topographically, however, the approx. 90 m contour is the inflection line and the portion higher than it have steeper slopes and better drainage. Furthermore, most of this portion is already well-utilized as established farmland, and so it is not necessary to be included and redeveloped as beneficial land.

Hence, the boundary on the north side of the project area shall be established by including such lands whose altitude, which are non-used or little used, is lower than about 90 m and whose sizes are big enough to formulate farming blocks.

8.5 Schedules of Operation in Japan

(1) Land grading maps shall be prepared using soil maps and various grading maps.

(2) Using soil maps and land grading maps, prospective crop-raising maps shall be prepared, in accordance with the "fit crop on fit land" policy.

(3) The effective use of Regosols zones in particular.

(4) The north side boundary of the project area shall be established considering the land-use situations.

CHAPTER 9 ADMINISTRATION SYSTEM

In executing this agricultural development project, it is not only necessary to make a technological examination but also to examine the administrative steps which should be taken by the administrative agencies for the execution of this project.

Items to be examined here shall be:

(1) Legal system for the execution of irrigation/ drainage project;

(2) Financial for the execution of this project;

(3) Settlement plan;

(4) Land system;

(5) Such supporting services as farmer's credit, extension, and farmers' organizations, and

(6) Operation and maintenance plan for facilities.

Some of the above are so unfamiliar in Paraguay that some new systems may have to be established.

9.1 Project System

This project is the first large-scale irrigation/drainage project in Paraguay, where there is no experience of performing such large-scale irrigation projects as a national project in the past. Therefore, the legal system for the execution of such a project is yet to be arranged. The only exception is the "management of Public Water Regulation" enforced in 1944 concerning the management of public water, i.e., water originating in and flowing out of privately-owned land.

Meanwhile, the requisition of unused farmlands, and the settlement system, are covered by the "Agricultural Land Law".

Nevertheless, whenever a large-scale irrigation/drainage project is to be executed, the following points should be backed up by law.

9.1.1 Project promoter

A remarkable difference between an irrigation/drainage project and such other public projects as road and port projects is that the beneficiaries of the former are specified persons or organizations, and that the former project must proceed preserving the ownership of lands. (Though it is possible to execute the project after buying up the whole area, but this is not a common practice.) Therefore, in any case where the government, governmental agency, cooperatives or any other organization executes the project, the legal authority clearly stating the necessary rights and obligation for executing the project should exist.

9.1.2 Project area

Even in a fully technically examined project, it is not feasible to arbitrarily establish the project area on topographical and locational grounds. In other words, lots will emerge which will unavoidably be included in the project area. Therefore, the project area must be designated by law, and the land lots in the area will be entitled to the benefit arising from the project while being subjected to any obligations arising from the execution of the project.

9.1.3 Designation of beneficiaries

Now that it has been made clear that the land lots in the project area will be subject to the rights and the obligations concerned with the project, it is necessary to designate persons subject to such rights and obligations. Cases in Rio Grande do Sur State of Brazil show that more than 60% out of approx. 0.6 million ha of its paddy field is operated on tenant basis. Meanwhile, even in the United States of America, a considerably high percentages of farmlands are operated on leased land. (nearly 60% in Arkansas, nearly 70% in California)

In view of these cases and of the landlord system in the area, it is likely that the landowner and the farmer are not necessarily the same in this project. In such a case, there will have to be a discussion as to whether the land owner or the farmer should be the beneficiary (a person subject to rights and obligations of the project). It is desirable in this project, however, that the land owner should be the beneficiary.

In other words, it can be seen that in both South and North America, the general method is that the costs including rent and irrigation are borne by the tenants. According to the Agricultural Land Law, however, the right

to cultivate an occupant of unused land is authorized. Nevertheless, if the tenant is the beneficiary, his rights will expand and thus obstruct the enforcement of the project in view of the current landlord system.

9.1.4 Participation in the project

Now that the area and the beneficiaries are fixed, all beneficiaries should participate in the project. In an irrigation/drainage project there may be such areas which inevitably emerge the benefit due to the topographical conditions or so, or which cannot be excluded from the project area on economical grounds.

In order to efficiently enforce the project taking these things into consideration, the participation of all beneficiaries in the project area is essential. The enforcement of the project necessitates legal backup which can compel all people to participate in the project under a certain condition (for example, consent by 2/3 majority).

9.1.5 Obligation of beneficiary

Since the beneficiaries are entitled to the benefits brought about by the enforcement of the project, they are obligated not only to share the project costs but also to share the operation and maintenance costs, to farm in line with the purposes of the project and so forth. It is necessary to build up a legal system which can compel the fulfillment of such obligations.

9.1.6 Operation and maintenance

After the completion of the project, a organization to manage the completed facilities should be appointed. It should operate the facilities by collecting irrigation fees from beneficiaries. Since no-one is experienced in a large-scale irrigation systems in Paraguay, it is

desired that this system be managed/operated by a public organization.

The following things should be set up in this system:

(1) Organization for O & M

A reasonable water distribution system must be established, from intake amounts at the Dam, through distributing water, and down to managing water on farms. The major facilities shall be managed by a public organization, and on-farm facilities by farmers.

(2) Collection of irrigation fees

The cost necessary for managing the facilities should be collected from beneficiaries in the form of an irrigation fee. A series of calculations from the estimation of management costs through the computation of levies on individual farmers should be made.

(3) Operation and maintenance

The facilities must be maintained/repaired satisfactorily. The costs needed for devaluating/repairring the facilities should be collected as part of the irrigation fee.

9.1.7 Finance for enforcing project

In general, an irrigation/drainage project has a public side, in that it enforces the regional development and the agricultural policy of the government, while paving a side where the beneficiaries are limited and they alone received its benefits.

Therefore, it is common practice that the cost of the project be jointly shared by the government, etc. and the beneficiaries in a certain ratio.

The precedents are as follows:

(1) Brazil
Work by the Federal Public Project Ministry was 50% borne by the Federal Government.

(2) Argentina
Such basic facilities as dams and water-head work are borne by the Federal Government.

(3) Thailand
In land consolidation, basic facilities are totally borne by the government, and on-farm facilities partially. As in the above cases, the governments share should be set at a certain ratio.

At what ratio the government should share the project cost in this area will be studied when the details of project costs are clarified.

9.2 Settlement Plan

Matters concerning national private settlements are provided for in the Agricultural Land Law (Law No. 854), whose purpose is to encourage the private ownership of land as a real estate for farming, to fairly distribute lands, to assist farmers socially and technologically, and thus to foster the socio-economic development of the nation.

The spirit of this law is to restrict the private ownership of lands which are not reasonably developed and are not utilized as farmland, to fairly distribute them aong those who intend to operate farms, and thus to further the agricultural use of land.

The farmers in this area can be classified as follows according to their land owning status, settling, status, etc.:

(1) Farmers who already owns land

This is a case where a land owner before the enforcement of the project becomes a farmer after enforcement. The land area he owns is not necessarily equal to his farming area. This category is subdivided into the following three:

1) A landlord who, after enforcement, farms on a part of his land while selling or lending the remaining land;
2) A person who farms on the land he owned before enforcement,
3) A person who farms on the land he owned before enforcement plus the land bought or borrowed after enforcement.

(2) Farmer who owns no land

A farmer who farms on the land lended from a landowner. A considerable portion of the core farmers in the area may be in this category.

(3) Settler

Farmers who settle by buying land under the settlement program of IBR (Farming Village Welfare Authority).

The settlement plan shall be mapped out for the settlers under(3) above. Settlement projects enforced in and around this project area are as shown on table 9-1.

As seen from the table, the national settlement projects in and around this project area are small-size. With the enforcement of our project, 20 ha-size will be the basic practice because more intensive farming than other areas will be feasible.

However, the plan must be mapped out through full consultation with IBR, because the settlement plan is closely connected with IBR policy.

Table 9-1 Settlement Projects in and around our Area

Department	Setting site	Town/Village	Project area (ha)	No. of lots	Remarks
Itapua	Tiburcio Bogado	San Cosme y Damian	5,163	217	National Average 23.8 ha
"	Yacyreta	"	48,000	-	" " 23.8 ha
Misiones	Alejo Ramirez	Santiago	200	27	" " 7.4 ha
"	Pachito López	Yabebry	1,177	123	" " 9.6 ha
"	Mbareté Pora	"	3,900	43	" " 9.1 ha
"	Coé-yú	Ayolas	3,930	118	" " 33.3 ha
"	Estero Bellaco	"	9,500	50	" " 190 ha
"	Caguazu-mi	Santiago	544	19	" " 28.7 ha

9.3 Land Problem

Currently, most of the land in the area is owned by a small number of landlords. Before enforcing the project, the current status of landownership (including the rental system) should conceivably be changed. In other words, the enforcement of irrigated farming on all land lots owned by land owners necessitates so enormous an amount of capital investment that its probability of realization is extremely low.

Nevertheless, in view of the current socio-economic status of Paraguay, such a drastic reform of the land system as one accomplished by land requisition is not desirable. It is necessary to enforce the project within the framework of the current land system or through a mild reform which would not changing the basis of the current land system.

For this reason, the following measures must be studied:

(1) Freezing of land prices

A land price hike with the enforcement of project is forecast. Since the land price hike acts to hinder the transfer of ownership, the progress of the project will be obstructed. Therefore, before starting the project, the land price should be frozen to facilitate the transfer of land from landlords to farmers.

(2) Payment in kind (in land)

A big economic burden will be borne by a landlord in paying the project cost imposed upon his land according to its area. This burden should be eased of order also to facilitate the transfer of landownership to farmers.

(3) Lease relationship

In view of cases in neighboring Brazil or in U.S.A., it is possible to raise paddy rice on rented land. Whenever the project beneficiary is the landowner, the lease will pay the rent including the irrigation fee to the landowner. It is desirable that the rent and the irrigation fee be set at a certain ratios of yield.

(4) Obligation to farm

A landowner shall be obligated to use the land benefiting from the project for irrigated farming. For this reason, the irrigation fee should not be imposed in proportion to the quantity of water used but be in proportion to the area.

Furthermore, penal provisions, including requisitioning whenever no irrigated farming is done for a certain period or longer, must be provided in order to push the effective use of land and irrigation facilities, and also to have unused land transferred to farmers.

9.4 Future Work Schedule

Since the items examined in this chapter are not a mere technological problem but are closely interrelated with the administrative policy of Paraguay, no planning can be made solely on one side sole discretion. The draft final recommendation must only be made after examination of several trial drafts through consultation with authorities of the Government of Paraguay.

This fiscal year's work in Japan will be the preparation of a trial draft in anticipation of consultation. However, those parts concerning project costs will be examined in the next fiscal year.

CHAPTER 10 SUB PROJECT

The project area of 147,500 ha will require a considerable project cost and period for implementation and therefore it is suggested that the project area is divided into several subprojects, concept plans put forward for each of the subprojects, and the order for execution of project will be proposed.

The block division is to be in units of drainage blocks and the order of project implementation is to be from the east where the intake is located.

CHAPTER 11 WORK SCHEDULES IN JAPAN

The basic structure of the master plan's outline is as stated in the previous chapters. The work schedules for each division for this year are set out separately.

Concerning the work in Paraguay, because each division's survey and draft plans are not always properly regulated and assimilated, adjustments will be made in the preparation of the information booklet and a detailed study of Japan. Also, because there is a close relationship between necessary project cost and the sub-project's outline, it is thought that this should be left to next year's study of this point. However, from a study of technical aspects a tentative plan will be drafted.

The Interim Report through domestic operation in Japan from December 1983 to February 1984 will be drawn up and presented to the Government of Paraguay.