2.4. Present Agriculture

2.4.1. Present Land Use

Based on the statistical data collected in the first and second stage studies, land use in the gross area of the AMRIS has been investigated by proportional allotment according to the extent of area of each municipality which lies across the project boundary.

The present land use is estimated as follows:

(Unit: ha)

Land Criteria	Present Service Area	Expansion Area	Total
Paddy	31,485	2,401	33,886
Upland	630	-	630
Forest/Orchard	1,580	-	1,580
Waste Land/Swamp	2,200	1,510	3,710
Right of Way	2,080	84	2,164
Residence/Other Areas	4,725	5	4,730
Total	42,700	4,000*	46,700

* Of this figure, service area is estimated at 3,480 ha.

Figure 2.4-1 shows the status of rice cropping in each Division of Working Stations based on the data of Crop Year 1981.

Double cropped land dominates in the middle and higher land of the Area where irrigation water is available for two seasons. While in the marginal areas, single crop land only in the dry season is the main type.

Efforts should be made to develop idle lands including marsh/fish pond areas into productive areas.

2.4.2. Farm Size and Land Tenure

(1) Farm Size

Average farm size decreased gradually from 2.5 ha in 1972 to 1.4 ha in 1980s. This trend seems to be progressing in farming areas located near big cities such as Metro Manila, and is probably being encouraged by the Land Reform Program, too.

According to the Division-wide survey conducted this time, farm size is 1.36 ha on average in the present service area. This is much smaller than the national average of 2.7 ha.

Figure 2.4-2 clearly indicates a wide range of size from 0.50 to 4.4 ha at the division level. Divisions having a smaller size of one ha or less are located mainly in the from densely populated Baliuag to Malolos area.

Another sample survey conducted for some divisions revealed the highest distribution of farm size falls between 0.5 and 1.0 ha, but in total farm area between 1.0 and 1.5 ha. Such small-sized farms are bottlenecks to economic crop production which must be advanced by improved farming practice in the future under rehabilitated irrigation facilities.

(2) Land Tenure

The Agrarian Reform Program promulgated under Presidential Decree No.27 since 1972 aimed at the transfer of land ownership to tenant farmers on rice and corn lands by providing up to three ha of irrigated area and five ha of rainfed area. The share tenants who accounted for 73 percent of are farmers in 1970 have remarkably decreased, turning to lease holders or amortizing owners. Recent trend in land tenure is as follows:

Farmers	Number of Farmers (%) 1977	1982
Owner-operators	8	18
Amortizing Owners	17	15
Lease Holders	67	64
Share tenants	8	3
Total	100	100

Source: Five-year Integrated Agricultural Development Plan, 1977 and the present agricultural survey

2.4.3. Crops and Production

(1) Rice

Bulacan Province has always maintained a high rice yield because of its enterprising spirit and introduction of modern techniques. The AMRIS Area is not an exception, attaining a high average yield of 4.5 tons per ha in 1982. This is twice the national average of 2.3 tons of irrigated paddy (1978). At present the existing service area can produce more than 220,000 tons of paddy per annum.

Table 2.4-1 presents the recent rice production and cropped area in the Area for the last seven years. Paddy yield has increased steadily at four percent per year on average. Service area and cropping intensity, however, have not made a marked progress. The intensity would be increased by introducing diversified or multiple cropping system under an appropriate irrigation program.

(2) Upland Crops

1) Diversified Upland Crops

In response to the government policy of diversified crop production, the Upland Crop Project has been implemented since 1981 by NIA, MA (BAEx) with the financial assistance of the Rural Banks and PNB. The Project aimed to diversify some upland crops after harvesting the dry season rice crop. The results, however, are discouraging because most of the crops failed due to poor farm management, outbreak of plant pests, and the occurrence of natural disaster such as typhoons.

To remedy this situation, it is recommended that an intensification of agricultural extension work coupled with action plan on the availability of farm inputs be carried out by the government agencies, particularly NIA and BAEx fieldmen, deployed in the AMRIS Area.

2) Crops of Uplands

Upland crops grown in the Area are corn, watermelon and other vegetables. Major vegetables are beans (sitao, peanut and mungo), eggplant, tomato, okra and ampalaya. These are planted rotationally in many small terraces scattered along the river or near the residential sites.

Watermelon is grown mainly on the Bulacan side, Malolos being the first followed by Guiguinto and Plaridel. These are sometimes planted in rotation with rice in the commercial farm.

(3) Fruit Crops

Bulacan Province has been known for many kinds of fruits, especially the best mangoes. Other major fruits are santol, coconut and nuts. Leading municipalities producing mangoes within the AMRIS gross area are Malolos, Pulilan and Guiguinto. The production of mangoes is estimated about 2,500 tons a year in both the Bulacan and Pampanga Municipalities concerned.

(4) Crop Damages

Because of the incomplete embankment system of the Pampanga River, lowlying rice fields of the Area have been submerged for a long period every two or three years because of big typhoon and/or flood.

Based on the official records of the crop failure since 1972, affected area and production are summarized as follows:

Records of Rice Crop Failure in AMRIS Area (1972 - 1981)

Cause of Damage	Times (Year)	Affected Area (ha)	Estimated Loss (ton)
Typhoon	6 (1972-80)	8,648	25,957
Drought	1 (1981)	466	655
Stemborer	1 (1980)	15	57
Tungro	1 (1980)	6	33
Rat Infestation	1 (1981)	163	668
Total	10	9,298	27,370

The total estimated loss in ten years amounts to 27,400 tons, which corresponds to more than one sixth of one year's production on the average. Due to lack of the record in 1974 when a big typhoon hit the country, the total damage is under estimated in the above table. The excess water problem should be urgently resolved to improve the situation.

2.4.4. Farming Practice

(1) General Practice for Rice

the wet season crop usually starts from May and extends until November or December. The dry season crop, the first crop for a Crop Year, is grown from November to late February. In case of a single crop in the lowlying field, planting is frequently advanced to September to October expecting higher yield with late maturing varieties.

Nursery bed making starts with land preparation which is finished within one month by using a hand tractor in most cases instead of carabaos. The Dapog nursery is rarely seen in these days. This technique was once wide spread in the 1960s, but decreased rapidly to five percent of the whole area after the big rat infestation around Baliuag in 1969.

Planting as well as harvesting lasts for almost two months between the earliest and the latest. Application of fertilizers is practiced twice by most farmers at basal and top dressing (panicle initiation stage) times with a total nitrogen dose of 60 to 72 kg per ha. First weeding is done at the time of land preparation by mixing grasses into the soil. Chemicals of weedicide and insecticide are commonly used during the rice growing period. Weeding is needed at least twice in the case of hand or rotary weeding instead of chemical application.

(2) Cropping Pattern

The present pattern is represented by three types which are shown in Figure 2.4-3. Pattern A is mostly followed in fairly well drained areas wherein late maturing rice varieties can be grown twice a year. Pattern B is common to poorly drained low-lying areas where only dry season rice can be grown using late maturing varieties due to submergence in the wet season. Pattern C covers a small area where double cropping with rice has been tried at a low intensity using early maturing varieties because of the insufficiency of irrigation water. As a result, only 74 and 92 percent of the total area in 1982 have been subjected to cropping in the wet and dry season, respectively.

(3) Planting Method and Variety

Three planting methods of rice have been practiced in the Project Area: Straight transplanting, ordinary transplanting and direct seeding. Of these, straight planting is believed to produce the highest yield. According to the present survey, however, it seems to be the same as or somewhat inferior to direct seeding and definitely superior to ordinary planting. Their extent and yield are summarized as follows:

	Extension of Planted Area (%)			Estimated Yield of HYV (%)		
Planting Method	Wet Season	Dry Season	Average	Wet Season	Dry Season	Average
Straight Transplanting	28	20	24	103	102	102
Ordinary Transplanting	41	29	35	92	91	91
Direct Seeding	31	51	41	105	107	106
Total/Average	100	100	100	100	100	100

It is also interesting to note the complete change in rice from the traditional local varieties to the high yielding variety (HYV), the majority of which is the IR Series. About 15 years ago extension of IR Series was only 18-24 percent with wet and dry season against 82-76 percent of local varieties. The ratio reversed two years later in 1969 and at present assumes almost 100 percent for the Series. The formerly introduced varieties, IR-8, IR-20, IR-22 and IR-24 have been thoroughly replaced by the more improved varieties, IR-36, IR-40, IR-42, IR-44 and IR-50. According to the same survey as mentioned above, IR-36, early maturing variety of 110 days, occupies approximately 50 percent of the whole planted area and IR-42 extends to 25 percent followed by IR-50, a very early maturing variety. Late maturing varieties such as IR-42 and 44 are grown more in the dry season and can produce more paddy than short period ones. Of the minor varieties, Wag-wag, a local variety producing fancy grains, is still cultivated in the dry season.

(4) Seed Production

Supply of high quality seeds to the farming population is very important to maintain high level of production of the crops. For this purpose, seeds of high yielding variety (HYV) must be multiplied for each of the principal crops under the government program. The Philippine Seed Board constituting of BPI, UPLB and other concerned authorities and private seed associations has been supervising the seed production programs since 1966.

At the provincial or municipality level, the certified seed paddy is produced by farmers who are members of the local seed growers association. They can receive registered seeds necessary to cover three ha at most.

2.4.5. Input Materials

According to the information collected by the AMRIS Office, most of the input quantities have increased very slowly without any noticeable change. The situation might be attributed to the recent escalation in unit prices of 10 to 20 percent every year; increased farm income can not always meet the household requirement.

Adequate input increase would be needed so as to get higher yield of paddy which enables a better balance to be kept. For instance, fertilizers presently applied at a comparatively high level can be increased more with a higher harvest provided that increases in other inputs are adequately combined.

2.4.6. Farm Labor and Mechanization

(1) Farm Labor Requirement and Balance

Assessment study on the present farming population and labor force in AMRIS Project Area has assumed the following figures based on the provincial statistics:

Number of farm household:	Present service area	23,180
	Expansion area	1,380
	Total	24,560
Labor force available: (Persons)	Farmers	31,920
	Land less farm workers	20,320
	Total	52,240
Monthly labor force: (Persons/25 days)	Farmers	798,000
	Land less farm workers	508,000
	Total	1,306,000

Monthly labor requirement in the Area has three peaks annually: Planting of wet season rice in July, its harvesting and succeeding land preparation for dry season rice from November to December, and its harvesting in April. Even the highest peak in December would not exceed 660,000 man-days, only a half of the monthly supply. The situation may be derived from comparatively higher density of farm household as well as population, resulting in abundant labor force of both farmers and landless farm workers.

(2) Farm Mechanization

A steady rundown of carabao population has been registered in the provincial statistics arranged on a municipal level. Moreover, a sudden decrease in 1977 due to the hoof and mouth disease rampancy led many farmers to adopt farm machinery. While the recent rapid progress in farm mechanization may be more or less attributed to their intention to find non-farm tasks in municipalities or in Metro Manila.

Available number of carabaos and other farm machinery in the Project Area is estimated as follows based on the statistical data provided by the Provincial BAEx Office and NFA (1981-1982).

Carabaos	4,380
4-Wheel tractor	175
3-Wheel hand tractor	1,850
Knapsack sprayer	23,000
Power thresher	136

Most of the service area is plowed and harrowed by tractors nowadays although carabaos are still used for land preparation. Carabao drawn implements have been found to be effective in final harrowing and levelling of the field after plowing by 4-wheel tractor. Carabaos may never disappear in the future because of their multiple usage. On the contrary, a breeding program has been revived by the Bureau of Animal Industry, MA aiming to supply more carabaos for farming operations.

2.4.7. Livestock and Poultry

As already described, a sudden decrease due to a disease out break in 1977 caused continuous decline of carabaos. Especially in Bulacan, the number decreased by 30 percent, where San Ildefonso has kept the top number. While in Candaba the number is still increasing probably due to the Carabao Breeding Center located in Candaba.

Cattle raising has been fairly constant despite some fluctuations by municipality and by year. As for poultry, chickens and ducks rank the first followed by pigeons in population. It is centered at Pandi, Calumpit and Candaba. Hog raising is most thriving at Pandi followed by Pulilan and Baliuag.

TABLE 2.4-1 RECENT RICE PRODUCTION AND CROPPED AREA IN AMRIS

Item	Season	1976	1977	1978	1979	1980	1981	1982	Average
Service area (ha)		29,375	32,000	32,033	31,526	31,335	31,370	31,485	31,303
Planted area (ha)	Wet	20,361	22,064	22,569	21,594	22,880	23,840	23,378	22,384
	Dry	26,952	28,175	25,111	28,441	28,694	28,195	28,904	27,777
	Total	47,313	50,239	47,680	50,005	51,574	52,035	52,282	50,161
Paddy yield (ton/ha)	Wet	3.58	3.45	2.90*	3.45	3.90*	4.11*	4.32	3.67
	Dry	3.80	3.95	4.15	4.05	4.13	4.47	4.57	4.16
	Average	3.69	3.70	3.53	3.75	4.02	4.29	4.45	3.92
Paddy production (ton)	Wet	72,892	76,121	65,450	74,499	89,143	97,982	103,039	82,733
	Dry	102,418	111,291	104,211	115,065	118,403	127,032	132,862	115,897
	Total	175,310	187,412	169,661	189,564	207,546	225,014	235,901	198,630
Cropping intensity (%)	Wet	69.3	68.9	70.5	68.5	73.0	75.9	74.3	71.5
	Dry	91.8	88.0	78.4	90.1	90.4	89.9	91.8	88.6
	Total	161.1	156.9	148.9	158.6	163.4	165.9	166.1	160.1
Annual increase of yield (%)	Wet	-	-3.7	-15.9	+19.0	+13.0	+5.4	+5.1	+3.8
	Dry	-	+3.9	+ 5.1	+ 2.4	+ 2.0	+8.2	+3.5	+4.2
	Average	-	+0.1	- 5.4	+ 8.3	+ 7.5	+6.8	+4.3	+3.6

Source : Production Reports of NIA, Region III Office (1976 - 1982) * Typhoon damage

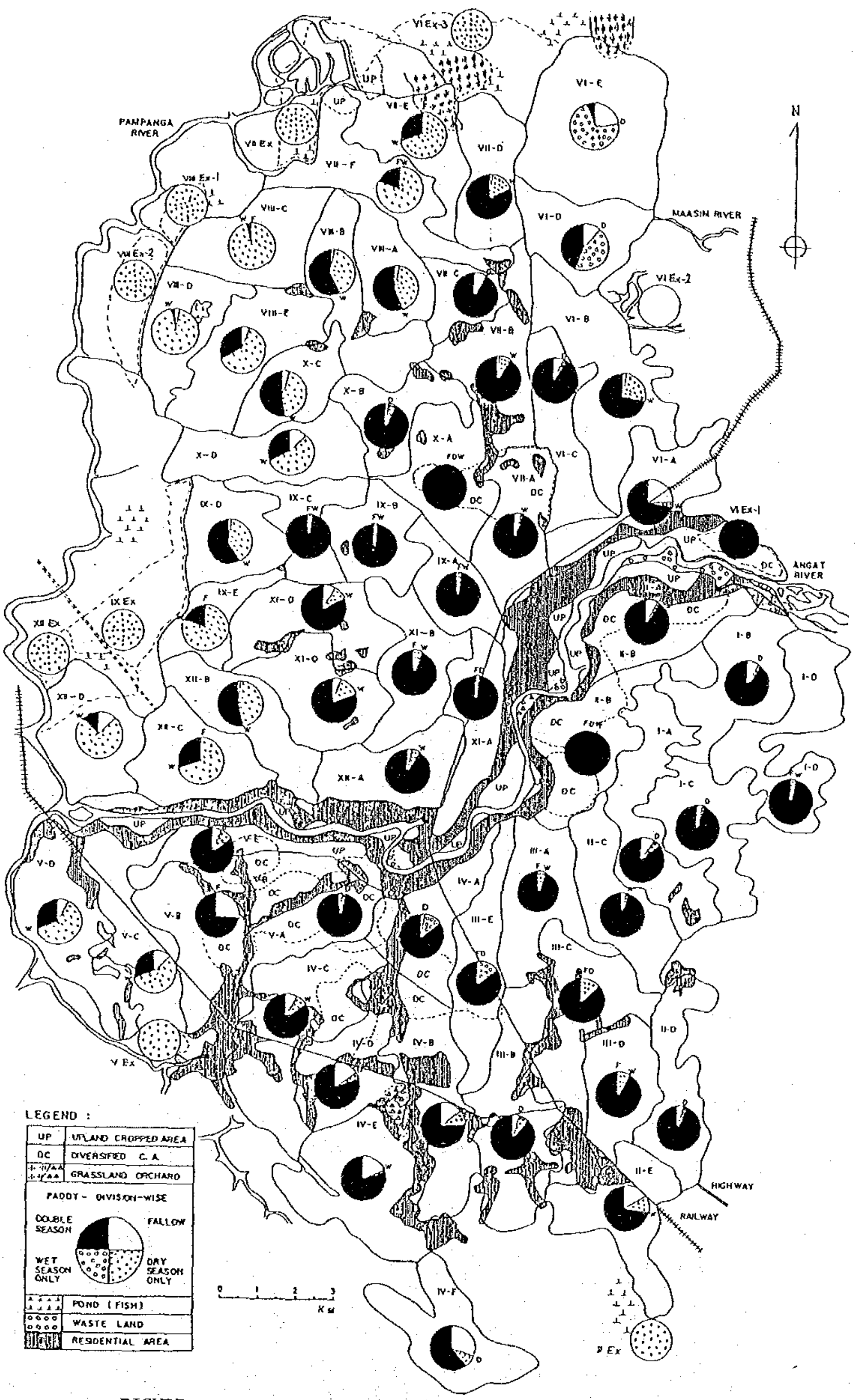


FIGURE 2.4-1 LAND USE MAP OF AMRIS AREA WITH RICE CROPPING INTENSITY (1981)

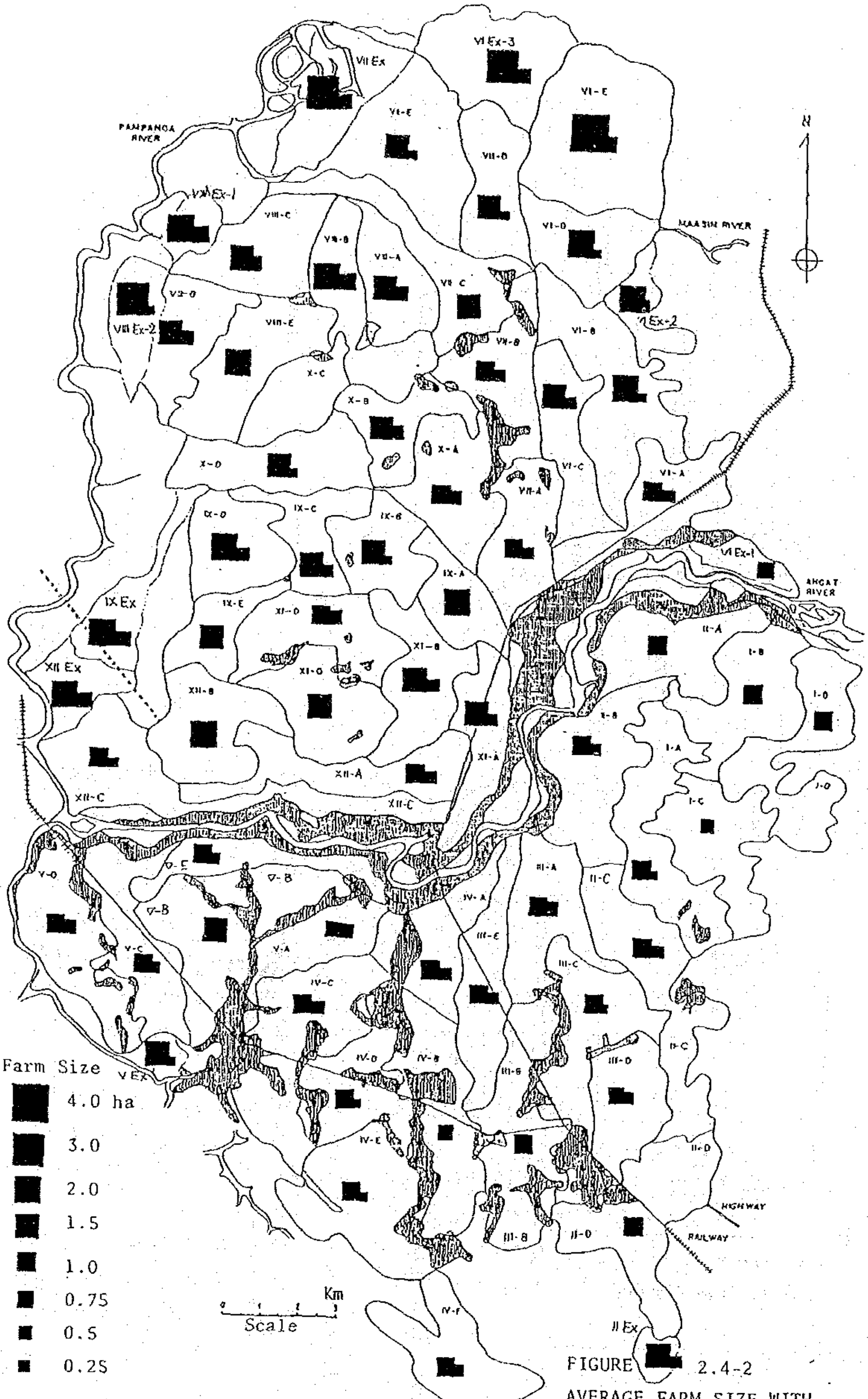


FIGURE 2.4-2
AVERAGE FARM SIZE WITH
WORKING STATION - DIVISION OF AMRIS

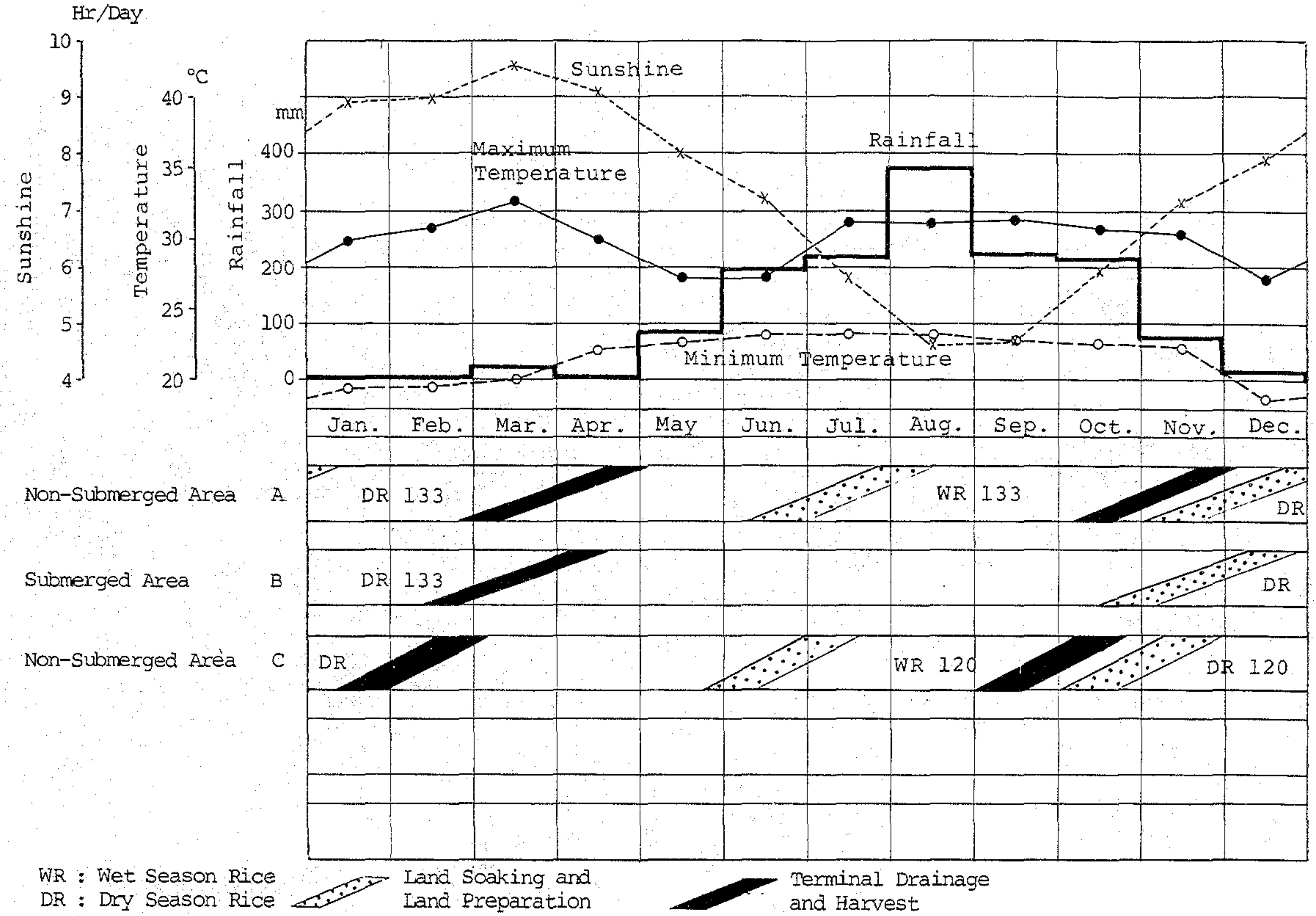


FIGURE 2.4-3 PRESENT CROPPING PATTERNS FOR RICE IN AMRIS AREA

2.5. Present Irrigation

2.5.1. Irrigation Service Area

The present service area, defined as the net irrigable area commanded by the existing irrigation facilities, is composed of 31,485 ha of paddy land. The service area is generally flat and low with an elevation of two to 14 meter above mean sea level, except for about 1,300 ha served by the pumping irrigation systems in the east part of the Project Area.

From the viewpoint of topography and water sources the Project Area is divided into five irrigation systems, namely; Angat North, Angat South, Tibagan Pump Irrigation System (TPIS), Upper Maasim and Lower Maasim.

The Angat North area is located on the right bank of the Angat River with a total service area of 14,968 ha. The irrigation water is diverted from the Angat River at the Bustos Diversion Dam and is conveyed by the Angat North Main Canal. The Angat South area, on the other hand, is located on the left bank of the Angat River with a total service area of 12,061 ha. The irrigation water is also diverted from the Angat River at the Bustos Diversion Dam and is conveyed by the Angat South Main Canal. Both Angat North and South areas are situated in the center of the Project Area occupying about 86 percent of the total service area of the Project.

The TPIS is located in the southeastern part of the Project Area with a total service area of 1,286 ha of relatively high elevation. The Area utilizes the Angat River water by the existing pumping station situated one kilometer upstream from the Bustos Diversion Dam with a maximum capacity of 3.24 cms. The diverted irrigation water is conveyed to the Area through two main canals of high and low lines.

The irrigated area situated on both the right and left bank of the Maasim River comprises the Upper and Lower Maasim areas depending on the existing diversion facilities. The Upper Maasim Diversion Dam serves 2,111 ha of paddy field by use of the Maasim River water. However, this area is subject to frequent damage by drought, especially in the dry season, mainly due to unfavorable distribution of the Maasim River water. The Lower Maasim Diversion Dam commands 1,059 ha of the existing paddy field receiving water from the Maasim River and supplementary from the Angat River. The Angat River water is conveyed to the Area through creeks and lateral canals making the Area whose it is possible to plant rice constantly even during the dry season.

Although the service area of the AMRIS slightly varies year by year mainly due to change in land use schedule, it is finalized by the field investigation and summarized as follows.

Present Service Area of the AMRIS

Irrigation System	Service Area (ha)	Water Resources
Angat North	14,968	Angat River
Angat South	12,061	"
TPIS	1,286	"
Upper Maasim	2,111	Maasim River
Lower Maasim	1,059	Maasim and Angat Rivers
Total	31,485	

The actually planted and irrigated area also varies annually depending on the amount of available water, submerged conditions in wet season and others. The presently irrigated areas in the AMRIS are summarized by season based on the Harvest Report prepared by each working station in the past three years, as follows:

Present Irrigated Area and Crop Intensity

Year	Irrigated Area (ha)		Crop Intensity (%)	
	Wet Rice	Dry Rice	Wet Rice	Dry Rice
1980	22,880	28,741	72.7	91.3
1981	23,845	28,144	75.7	89.4
1982	23,375	28,905	74.2	91.8
Mean	23,366	28,627	74.2	90.9

As is clear in the above table, almost 90 percent of the service area is actually planted and irrigated in the dry season. The remaining ten percent of the Area is mainly located in the Upper Maasim where irrigation water diversion is impossible due to lack of available water in the Maasim River. On the other hand only 74 percent of the Area is planted in the wet season. The remaining 26 percent mainly lies in the lower reaches of the service area and is a large scale of submerged area along the Pampanga River.

With regard to operation and maintenance of the irrigation systems, the Project Area is divided into 12 Working Stations. Each Working Station commands about 2,500 ha under management of the Supervising Water Management Technologist (SWMT). Working Stations are further sub-divided into three to five Divisions, each of which is controlled by the Water Management Technician (WMT) commanding about 500 to 750 ha of service area on average.

2.5.2. Water Resources

Major water sources of the AMRIS are the Angat and the Maasim Rivers. The Angat River, supported by the storage function of the Angat Reservoir, allows irrigation water diversion almost adequate to meet the needs in the AMRIS area at the point of the Bustos Diversion Dam.

The Maasim River, on the contrary, does not contribute well to the purpose of irrigation water supply because of inadequate distribution of runoffs during the dry season.

Some areas are irrigated by use of return flow from the upstream irrigated area, and others are served by the Pampanga water by use of pumping facilities.

(1) Angat River

There are three existing dams on the Angat River namely; the Angat Reservoir, the Ipo and Bustos Diversion Dams.

The Angat Reservoir is operated under the specified operation rule curve by NPC, in order to assure the water release from the reservoir is adequate to meet the requirement of water supply by MWSS, irrigation by NIA and additional water release for power generation by NPC even under a critical stream flow condition.

Concerning the administration of the Angat Reservoir, NWRC recommended in Memorandum dated 16 January 1979 the adoption of a specified operation rule curve, which was based on the reservoir operation studies extracted from the "Staff Report on the Cost Allocation and Operational Guidelines for Multipurpose Storage Project, Report No.34". At that time, the reservoir operation studies were made based on the MWSS water requirements as conceived in the "Supply Report" for water supply as well as on the irrigation water requirements which was prepared by NIA in 1978 through application of an anticipated long-range cropping calendar including considerable areas for upland crops.

The NWRC rule curve was further revised based on the actual water demand for irrigation as attached in Memorandum dated 17 March 1983, in which NWRC called the attention of NPC on the critical situation of the Angat Reservoir indicating the current shortages of inflow into the reservoir a lot less than the minimum stream flow used in the development of the rule curve and the low reservoir level below the rule curve.

On the other hand, NPC, in charge of controlling the reservoir, has been operating the reservoir with rule curves calibrated yearly so as to meet the current pattern of available water resources and various demands, based on the accumulated experiences of more than 15 years in operating the reservoir.

The Angat Reservoir receives an average 2,080 MCM of inflow per annum from the drainage area of 568 sq.km, in the past 11 years from 1972 up to 1982, of which 1,667 MCM are released from the reservoir through main power generators for the purpose of irrigation as well as additional power generation. Inflow into the reservoir is estimated by NPC based on the actual measurement of the reservoir water stage, released water through main and auxiliary power generators, and spillage. In addition to the water release through main power generators, the AMRIS area can utilize the runoff from the residual drainage area of the Angat River between the Ipo and Bustos Diversion Dams as available water resources for irrigation.

(2) Maasim River

On the Maasim River there exist two dams namely; Upper and Lower Maasim Diversion Dams. Discharge records of the Maasim River are available at the gaging station located 3.8 km upstream of the Upper Maasim Dam on a daily basis for only five years from 1970 to 1975 excluding 1972.

In order to generate the daily runoffs from the drainage area of 150 sq.km of the Maasim River at the gaging station for the missing period up to 1982, a rainfall to runoff conversion was made employing the Tank Model.

Annual mean runoff at the gaging station is estimated at 175 MCM in volume or 5.6 cu.m/sec in discharge. As regards the seasonal distribution of the Maasim River water which contributes to irrigation, almost 93 percent of the annual runoff is concentrated during the wet season from June to November. This means the discharge in the Maasim River is not well distributed for irrigation purpose especially during the dry season.

The Angat River provides supplemental irrigation water to the Lower Maasim area through the Lateral B of the Angat North Main Canal. Though the carrying capacity of the Lateral B limits the maximum supplemental water to 1.5 cms, the Angat River water covers mostly the required water in the said area during the dry season.

(3) Return Flow

In the lower reaches of the Angat North service area, along the existing drainage creeks such as Tenejeros, Balite, Duyang and Bitukang Manok, there has been a considerable expansion in the area receiving irrigation water from those creeks. Based on the actual observation of discharge conducted in February 1983, rough computation of water balance was made in the upstream portion of the Tenejeros creek for the purpose of estimating the amount of available water in the creek. Although data are too few to conclude the study, about 30 percent of irrigated water in the upstream is estimated to be re-used in the downstream as a return flow. From this value, it is estimated that about 1,010 ha are irrigated receiving water from the existing creeks.

In the North Candaba, adjacent to the Maasim River, there is about 680 ha of area temporarily served by an earth dam which was constructed downstream of the Lower Maasim Dam and maintained only during the dry season. Major source of water at this dam is considered to be return flow from the Area served by the Angat North Main canal. This area is proposed to be included in the AMRIS confirming the steady supply of irrigation water from the systems.

(4) Pampanga River

On the relatively high elevated area along the left bank of the Pampanga River, there are 22 local portions which utilize the Pampanga water by means of pumping up. In total 1,540 ha are irrigated in this manner costing ₱680 per hectare for operation and maintenance in the dry season. It is proposed that these areas should also be included in the service area of the AMRIS by converting pump irrigation systems to gravity systems.

2.5.3. Irrigation Water Supply and Availability

(1) Diversion Water Requirement

At present the service area of the AMRIS is irrigated by the river water diverted at four major intake facilities constructed along the Angat and Maasim Rivers.

Service Area Commanded by Each Intake Facility

Intake Facility	Main Canal	Service Area (ha)
Bustos Dam	North Main	14,968
Bustos Dam	South Main	12,061
Upper Maasim Dam	North Main	1,409
Upper Maasim Dam	South Main	702
Lower Maasim Dam	North Main	861
Lower Maasim Dam	South Main	198
Tibagan Pump Sta.	High Line	419
Tibagan Pump Sta.	Low Line	867
Total		31,485

Within the total service area, 23,366 ha and 28,627 ha are planted and irrigated by the existing irrigation facilities as well as available water during the wet and dry season, respectively. Regarding the cropping pattern presently adopted in the Area, three patterns were investigated in the field namely; Pattern A, B and C.

As a basis for estimation of diversion water requirement, the Modified Penman Method was employed to determine consumptive use of water over a ten-day interval. Percolation rates were actually measured in the AMRIS area by NIA during the course of investigation on Angat-Magat Integrated Agricultural Development Project (AMIADP) from January, 1977 to May, 1978 and their weighted averages came up to 1.9 mm/day for wet season and 1.6 mm/day for dry season.

In the operation and maintenance plan for irrigation systems management prepared for Region III, the water requirement for land soaking is calculated in detail by considering the soil moisture contents before land soaking and the standing water depth in the field. The result of such investigation shows 145 mm and 116 mm of land soaking water requirements for wet and dry season, respectively.

Effective rainfall was determined from the observed daily rainfall and the allowable flooding depth for the different stages of farming activities. The maximum allowable flooding depth was set at 80 mm during the crop growth stage in which the maximum standing water of 20 mm was taken into consideration.

According to the NIA standard, the overall irrigation efficiency was estimated by the following formula.

$$\frac{1}{IF} = \frac{1 + (FW + DL)}{1-CLt} = \frac{1.3}{1-CLt}$$

Where, IF: overall irrigation efficiency

FW: farm wast

DL: distribution losses

CLt: conveyance losses

In the above equation, FW + DL is assumed to be 30 percent of irrigation water requirement. Based on the actual observations prepared by the operation and maintenance plan for Region III, CLt was determined to be 30 percent. Consequently, the overall irrigation efficiency under the present irrigation condition was estimated at 54 percent.

Computation of diversion water requirement was thus done on a daily basis for 11 years from 1972 to 1982 and then summarized into ten-daily values for the purpose of water balance study.

Present Diversion Water Requirement (MCM)

Item	Upper Maasim	Lower Maasim	Tibagan PIS	Angat Main Canal North	Angat Main Canal South	Angat Main Canal Total
Maximum	13.2	15.4	23.6	241.5	196.5	489.9
Minimum	5.3	9.7	16.1	158.7	133.6	325.3
Mean	7.9	13.6	20.0	208.8	167.8	418.1

(2) Available Water for Irrigation

Water actually released from the Angat Reservoir for irrigation as well as for additional power generation, and intermediate runoff from the residual drainage area of the Angat River between the Ipo and Bustos Dam were put into the computation of water balance at the point of the Bustos Diversion Dam. As for the Maasim River, the generated runoff by the tank model was used as available water in the river.

The existing small scale irrigation systems which receive water by use of small pumping facilities for irrigation of 100 ha from the Angat River between the Ipo and Bustos Dams, and of 183 ha from the Maasim River between the gvaging station No.56 and the Upper Maasim Dam were taken into consideration gaging the first priority to utilizing the river water.

The maximum amount of the supplementary water supply from the Angat to the Maasim was, in the computation, limited to 1.5 cu.m/sec taking into account the available carrying capacity of the Lateral B.

A water balance study was made based on the irrigated area and the cropping pattern presently adopted on a ten-day basis for 11 years from 1972 up to 1982.

According to the computed results, shortage of irrigation water supply occurred twice during the wet season in October 1977 and in September 1979. They are, however, minor in terms of the volume of shortage and occurred less than once in a five year probability. On the other hand during the dry season, the Area suffered from shortage of irrigation water diversion as frequently as seven times in the recent 11 years.

The maximum monthly shortage of water thus computed is summarized in the following table.

Maximum Monthly Shortage During Dry Season

	Bustos Dam			Upper Maasim			Lower Maasim		
Year	M	S	R	M	S	R	M	S	R
1972		-		Oct.	1.1	60		-	
1973	Jan.	4.9	8	Jan.	1.2	84	Jan.	2.6	100
1974		-		Jan.	1.5	92		-	
1975		-		Dec.	0.8	66		-	
1976	Jan.	2.7	9	Jan.	1.6	99	Jan.	1.3	50
1977	Mar.	19.6	32	Dec.	1.2	85	Mar.	1.9	100
1978	Feb.	12.6	13	Jan.	1.6	100	Feb.	3.5	100
1979		-		Dec.	2.0	99		-	
1980	Jan.	7.2	23	Dec.	1.8	84	Feb.	2.5	100
1981	Jan.	5.5	17	Dec.	2.0	94	Jan.	1.3	100
1082	Jan.	6.6	21	Jan.	1.6	100	Feb.	1.4	100

Notes: (1) Symbol "M" stands for month of occurrence.
(2) Symbol "S" stands for shortage in MCM/Month.
(3) Symbol "R" stands for ratio of shortage to demand in percent.

Judging from the output of the study, inflow into the reservoir, and storage capacity and demands reported by MWSS and NPC for water supply and power generation, respectively, it could be expected that the presently irrigated area in the AMRIS would not suffer from lack of irrigation water supply even during drought of once in five years frequency, if the operation rule curve of the Angat Reservoir is slightly modified just to meet the actual demand for irrigation.

2.5.4. Water Management

The systems in the Project Area serving 31,485 ha in total consist of three main diversion dams, three pumping stations and conveyance canals of about 720 km long comprising main, lateral and sub-lateral canals including about 200 units of head-gates.

The irrigation plans are prepared based on the programed area, cropping patterns, farming practice, and soil and topographic conditions by the staffs of the Water Control Coordinating Section (WCCS) in the AMRIS Office.

Diversion water requirements of the Bustos Dam are requested of NPC by the Irrigation Superintendent of AMRIS through SMD in NIA Central.

Major rules and standards on water distribution to the terminal area from the dam are set up as below:

Availability at the Bustos	Standard
° 100 - 80% of designed discharge	° Simultaneous irrigation in the entire area
° 80 - 60% of designed discharges	° Rotational irrigation at the lateral or sub-lateral level
° 60 - 40% of designed discharge	° Rotational irrigation at the upper, middle and lower part of the respective main canal
° Below 40% of designed discharges	° Rotational irrigation between the North and South main canals

Water distributions from lateral level up to farm turnouts are taken care of by the respective working station staffs concerned and major changes in the distribution are directed to each working station by the irrigation Superintendent III through respective zone engineers.

One of the major requirements is more timely coordination between NIA and NPC on the water release especially in the dry season. According to the information received from the field office, when available water at Bustos Diversion Dam is less than diversion water requirements without any critical conditions at Angat Reservoir, no adjustment is made to meet the requirement. Accordingly, water distribution to the North and South Main Canal is being made within available water divided by the ratio of water demands required at that time in the service area of the North and South main canal. Therefore, it is difficult to promptly follow actual condition at the lateral and/or sub-lateral level.

Secondly, proper water management with appropriate distribution facilities such as check, headgates and measuring devices, farming practices in the service area should follow the programed watering schedule as much as possible and/or adjustment of the watering schedule should be made timely based on the actual practice by the staffs concerned.

Thirdly, data collection and record maintenance are comparatively well managed according to the regulations. The processing and evaluation of collected data, however, is not satisfactory and is not used effectively for the purpose of improving water management. It is desirable that those collected data should be analyzed and put into practice timely using the computers.

2.5.5. Main Irrigation Facilities

Main irrigation facilities may be divided into three categories namely; intake facilities, conveyance canals, and appurtenant structures. Present conditions and prevailing constraints of these facilities are summarized below.

(1) Intake Facilities

There are four diversion dams along the Angat and Maasim Rivers of which three are permanent dams and the other is a temporary dam, and three pumping stations situated along the Angat River and Angat Main Canal.

1) *Bustos Diversion Dam*

The Bustos Dam, which was completed in 1957, is equipped with six sector gates 79 m long and 2.5 m high. Automatic gates, however, were only operational for two years after installation of operational mechanisms. These mechanisms such as control panel, gate opening indicators and its accessories should be replaced in order to operate the gates stably and satisfactorily. The rubber gate sealer is also extremely old. It is affected by sedimentation of sand in the gate chambers.

2) Upper Maasim Diversion dam

The Upper Maasim dam which was constructed in 1949 is of movable type equipped with eight gates. With flood damage the operation of the gates became impossible and the flood way gates were fixed by concrete in 1963. At the same time, the upper portion of intermediate piers were demolished to make for a smooth flood flush-out.

3) Lower Maasim Diversion Dam

There are no remarkable constraints except for the flood way gates system of the dam which was constructed in 1967. Major constraint is the large leakage flow from the wooden gates and the fast that the gate can not be operated timely against flood.

4) Third Maasim Diversion Dam

The dam is temporarily constructed every year for the first period of the dry season crop in order to irrigate the service area of about 700 ha located on the right bank of the Maasim River. Permanent dam construction, therefore, is requested by the beneficiary farmers concerned.

(2) Conveyance Canal Systems

Irrigation canals are classified into main, lateral and sub-lateral. Irrigation canals are well developed within the entire area with a total length of 717 km; 53 km of main, 209 km of lateral and 455 km of sub-lateral canal. Major constraints to the irrigation canal are siltation, erosion of canal side slopes and vegetation control. Carrying capacity of the canals in several parts is decreased due to heavy siltation, erosion and poor maintenance works. On the other hand, grass cutting in and around canals is being carried out by ditch tenders on a regular basis but is not sufficient especially in the canal. As a result, grasses restrict flow, accelerate silt desposition, and create problems of delivery of water to the end users.

(3) Appurtenant Structures

A large number of appurtenant structures exist in the Project Area consisting of head gate, weir, pershall flume, flume, spillway, heck, diversion box, siphon and soon. Most of the existing structures function comparatively well except for some structures where damage mainly to gates and steel portion has been found. Some of the concrete structures are damaged mainly due to shortage of concrete and reinforcing bar.

Consequently through the field investigation, major problems found are a) scour and bank erosion immediately below and around structure outlet transitions, b) gate maintenance due to lack of rust prevention, c) damage and missing spare parts and d) a large number of inoperable and illegal turnouts.

2.6. Present Drainage

2.6.1. Drainage Status

There exist two aspects of problem in drainage systems. Surrounded by the Pampanga, Angat, Maasim and other rivers, a large scale of submerged area lies in the lower reaches of the service area which used to suffer from frequent inundations. It is reported, on the other hand, that many local areas of relatively high elevation are situated along drainage creeks receiving local inundations mainly due to insufficient drainage facilities.

In the Angat North service area, there is a large expansion of submerged area where inundation reaches 4,000 to 14,000 ha with maximum water level of 2.73 to 6.81 m above mean sea level, accompanied by total submerged period of 27 to 128 days annually.

Because of the absence of a left bank levee of the Pampanga River, and also because right bank flood water running down the Pampanga River concentrates in the submerged area, the overflow of the North Candaba Swamp and the Maasim River, accelerate the effect on depth and duration of inundation of the Area. The high water stages during peak flood often allow flooding water to overflow into the Area, and at the same time, they function as high external water levels during the period of depression resulting in continuous inundation in the service area which continues over a long period of time.

In the Angat South service area, along the Labangan and Santo Nino, there extends a considerable scale of area which often suffers from inundation. Protection dikes are constructed along the Labangan River with a top elevation of four to six meter above mean sea level five kilometers in length from Calumpit to Hagonoy. the lower stream part of the Area, along the Santo Niño River from Hagonoy to Malolos, however, is bounded by a low elevated dike of around two meters allowing adverse flow of river water during high flood. Also in this area, continuous high water levels in the river prevent the inundated water from being drained by gravity.

Many local portions, which lie scattered within the service area, are reported in need of improved drainage facilities. Most creeks in the Area meander through fields, causing some restrictions on carrying capacities. Most drainage creeks need desilting, while others must be widened or reconstructed.

Although there was no examination conducted in the field because of the critical drought conditions prevailing in the entire country during the period of survey, damage to crops due to insufficient condition of drainage creeks are estimated, according to hearings and traces on the fields, not to be serious.

2.6.2. Inundation and Flood Damages

Water stages in the Pampanga River recorded at both San Simon and Sulipan Apalit fluctuate widely ranging from zero to seven meter above mean sea level, depending on runoffs from the drainage area of the river, which is reported as 7,715 sq.km at the confluence of the

Angat River. Probable high water stages during floods with some frequency of occurrence are estimated as follows.

Probable High Water Level in the Pampanga River

Return Period	San Simon	Sulipan Apalit
2 years	EL 5.0 m	EL 4.0 m
5	5.4	4.9
10	6.3	5.4
20	6.7	5.9

The Area usually inundated lies to the extreme west of the service area in an almost north to south direction, bounded on the north by the Maasim River, on the west by the Pampanga River and on the south by the Angat River. The left bank of the Pampanga River, by which the Area is bordered, has an elevation of 3.5 to 7.5 m above mean sea level.

One of the factors accelerating the inundation in the Area is overflow from the Maasim River. Because of insufficient carrying capacity of the river channel as well as malfunctioning gates systems of the Upper and Lower Maasim Dams, flood runoff from the river overtops both right and left banks when the river discharge exceeds 100 cu.m/sec.

The North Candaba Swamp is also known to be one of the water source which provide excess water to the Area. During the course of AMIADP the Maasim River was so designed that the excess water in the North Candaba Swamp was allowed to flow across the river.

Because of lack of records on hydraulic/hydrologic measurement of flood in the Area, a specified computation model for a flood simulation study was developed in order to reproduce a condition of flood in terms of flooding depth, duration and inundated area. Actual observation of hydrological data, such as rainfall in the field, water stages in the Pampanga River as well as in the North Candaba Swamp and the Maasim River discharge, were used in the model for the purpose of simulating the flood which would have occured in the Area over the past 16 years from 1960 to 1976. 1972 and years after 1977 were excluded from the study because of data deficiency.

According to the computation, inundations concentrated during four months from July to October, while some occurred in the past in the months of May, November and December. The biggest inundation occurred in May, 1976 with the maximum water level of 6.81 m above mean sea level and the maximum inundated area of 13,700 ha.

The Area suffers from inundations two to nine times a year with a total duration of 27 to 128 days. The maximum water level of inundation varies depending on the flood involved from 2.73 to 6.81 m above mean sea level, resulting in an inundated area of 4,100 to 13,000 ha, in which 1,500 to 9,000 ha lies within the service area.

The computed results were, then, put into the statistical evaluation and the following was obtained.

Probable Dimension of Flood (Angat North)

Return Period (Year)	Maximum Water Stage Pampanga (m)	N.Candaba (m)	The Area (m)	Inundated Area (ha)	Maximum Duration (days)	Total Duration (days)
2	5.12	6.07	4.29	8,790	41	81
5	5.86	6.93	5.25	11,000	65	116
10	6.34	7.48	5.88	12,250	82	140
20	6.82	8.03	6.47	13,330	89	163

Exactly the same procedure of analysis was used to simulate inundations in the Angat South service area. According to the computed results, the Area is inundated more frequently - seven to 16 times annually - with a total duration 27 to 114 days. The maximum water level of inundation varies from 1.09 to 2.10 m above mean sea level with an inundated area of 850 to 2,050 ha. The probable dimensions of flood obtained by the statistical evaluation is summarized as follows.

Probable Dimension of Flood (Angat South)

Return Period (Year)	Maximum Level Labangan (m)	Maximum Level The Area (m)	Inundated Area (ha)	Maximum Duration (days)	Total Duration (days)
2	2.83	1.40	1,250	24	87
5	3.40	1.97	1,970	30	98
10	3.75	2.02	1,990	34	106
20	4.11	2.13	2,030	40	117

2.6.3. Existing River Improvement Plan Related

In 1938 BPW started investigations for the initial plan of the Pampanga River control program, which was largely delayed by the three successive floods of 1935, 1936 and 1937. The plan was approved by the Flood Control Commission and the implementation started in 1939 for such structures as levees, floodways, cut-offs and channels.

After years of interruption due to the World War II, in 1950 BPW started the related studies in order to establish the optimal solution in developing the Area of the Pampanga River delta by means of constructing a storage reservoir for flood control as well as other multiple uses.

In 1962, BPW published a report on "Proposed Reclamation of the Candaba and San Antonio Swamps", containing two potential plans of reclamation of the swamps, namely Scheme I and II, and another plan, namely, Scheme III, which covered flood control features in the

Central Luzon area with limited reclamation program. All three schemes were reviewed and evaluated by the USAID experts and the Scheme III was chosen for further study.

The Angat and Pantabangan Multipurpose Dams were completed contributing to flood control of the river basins through ADB fund in 1967 and IBRD fund in 1974, respectively.

In 1977, UNDP prepared a report entitled "Pampanga Delta/Candaba Swamp Area Development Project". The report proposed, with regard to flood control, three major project components, namely, (1) West Diversion Channel, (2) San Antonio Reservoir and (3) East Diversion Channel.

The UNDP studies were further extended under the technical cooperation of JICA from 1980 to 1981, and the feasibility study report on the "Pampanga Delta Development Project" was prepared in 1982. The JICA report selected the channel improvement plan of the Pampanga River as the most optimum basic plan for flood control. According to the report, the improvement works mainly consist of embankment of levee, widening and excavation of the river channel in the 40 km stretch between Candaba and Manila Bay with the aim of protecting the land of the South Candaba Swamp and the lower stream of the Pampanga below Sulipan against flooding from both the Pampanga and the Angat Rivers.

At present, implementation of flood control works based on the BPW Scheme III has progressed intermittently since 1939, depending on the availability of funds, with completion of about 70 percent of the entire scheme by the beginning of 1980.

As for the Maasim River, the Upper Maasim Diversion Dam was completed in 1949 by BPW. The river channel of lower stream of the Lower Maasim Dam was improved during AMIADP from 1973 to 1978, excluding improvement of dams. It is noted that a plan for the improvement of the Maasim River from the confluence of the Pampanga River to 13 km upstream is also included in "Pampanga Delta Development Project".

2.6.4. Major Drainage Facilities

The drainage system over the entire service area is rather limited. Excess water in the field is usually drained through natural creeks and rivers.

There exist 136 drainage creeks with a total length of 447.5 km within the boundary of the service area.

Existing Drainage Canals and Creeks

River	No. of Drainage/Creek	Total Length (km)
Pampanga	58	173.1
Angat	5	12.6
Maasim	25	80.9
Labangan	8	21.8
Pamarawan	9	28.3
Guiguinto	7	24.9
Bigaa	14	62.3
Santo Niño	8	33.3
Others	2	10.3
Total	136	447.5

All the canals and creeks are earth canals with a side slope of 1:1 or more. The carrying capacity of the canals and creeks is rather small due to poor maintenance and many water lilies. These obstacles have helped being about inundation damage to adjacent farm lands during the heavy rainy season. In addition, most of the existing creeks meander with gentle hydraulic gradient.

In order to divert irrigation water during the dry season, a considerable number of appurtenant structures were constructed along creeks especially at the crossing points of rural roads. Check structures with wooden stop logs have helped raise the intake water level in a creek. Operation of the system by farmers, however, is not being sufficiently conducted and local floods are caused, to a great extent, by such bottlenecks situated along creeks.

In total 11 drainage outlets, consisting of one to three rows of culvert with flap or sluice gates, are situated at the end of drainage creeks along the Pampanga, Maasim and Labangan Rivers. Most of the control gates are reported not functioning well.

2.7. On-farm Facilities

2.7.1. Turnout

In the AMRIS area, there are about 1,000 existing turnouts with single or double gates. The service area of each turnout is about 30 ha on average. The density of turnout is sufficient to fulfill NIA's standard of 30-50 ha/unit. In many places, however, the gates installed in the existing turnouts are deformed and cannot function well enough for proper water management. It has also been found through the reconnaissance survey that canal water is illegally taken from lateral or sub-lateral canals by using temporary turnouts. In cases where turnouts were improperly installed in terms of location or height, the farm ditches on which such turnouts are provided, can not be utilized for irrigation, and the ditches were removed completely and the turnout left unused.

2.7.2. Farm Ditches

Farm Ditches comprise of Main Farm Ditch (MFD) and Supplementary Farm Ditch (SFD). The total length of MFD is 500 km and SFD is 760 km, totalling 1,260 km . The density of farm ditches is about 43 m per hectare. At present, the total length of farm ditches has been decreased compared with the time when the AMIADP was completed in 1978.

The main reasons for this can be enumerated as follows:

i) Land compensation costs were not paid to the land owner so the small land holding farmers in particular opposed the construction of farm ditches.

ii) The land holding farmers near the canal rejected the farm ditch construction, because they anticipated no benefit from the construction.

iii) Some of the farm ditches were improperly constructed in terms of location due to the difference in actual topographic conditions and the survey results. These farm ditches were removed by the farmers themselves.

According to the results of the questionnaire to the NIA, the water flowing capacity of farm ditches has decreased due to silting and collapse of embankments.

2.7.3. Drains

The existing drains are 390 km in total or about 13 m/ha. For the same reasons as for farm ditches, the drains were removed by the farmers themselves. The results of the questionnaire survey show that the flowing capacity of existing drains is insufficient.

2.7.4. Service and Access Roads

Total length of O/M roads constructed along canals and creeks is about 574 km, which corresponds to 55 ha/km. Part of road is passable for 4.W.D.V. though some other parts are very rough and narrow.

2.8. Operation and Maintenance Structures of the System

2.8.1. Present Organization and Staffing of AMRIS

(1) Present Organization of AMRIS O & M Office

AMRIS operation and maintenance office has been organized under the Regional Irrigation Office III in Bulacan Province and consists of main office and twelve working stations in the field.

AMRIS main office is headed by Irrigation Superintendent V. It has six sections: Administrative, Bill and Collection, Operation and Maintenance, Water Control Coordination, Equipment and Agriculture Coordinating Sections. The present organization chart is illustrated in Figure 2.8-1.

The Irrigation Superintendent III, as the chief of O & M section, supervises twelve working stations. Each working station is in charge of three to five Divisions of 500 to 750 ha each. Therefore, its total coverage of responsibility is 2,000 to 2,500 ha.

The total number of division is 55 and these are taken care of by 346 staffs in all. Each working station is directed by a Supervising Water Management Technologists (SWMT) as well as a Water Management Technician (WMT) or Water Master, who is stationed in each division. The Gate-keeper (GK), Ditch tender (DT) and Pump Operator (PO) are also stationed at respective working stations.

The main office and working stations are directly in charge of the O & M of such facilities as diversion dams, main, lateral and sub-lateral canals and turnouts. One turnout commands 30 ha on the average, and farm ditches therefrom are operated and maintained by farmers.

The major activity of the AMRIS main office inclusive of the working stations in operation is equitable and timely distribution of irrigation water to the service area. In addition to these functions, the office is also responsible for minor maintenance of the canal and its appurtenant structures.

The operation personnel in the working station under the operation section engage in irrigation fee collection particularly during the harvest time in cooperation with the personnel of bill and collection section.

According to the results of the sample survey on the activity of the field staff, about 31 percent of the total working time is spent on bill distribution to water users and collection of irrigation fee. Maintenance which is limited to minor grass cutting and manual work consumes only 13 percent. While the remaining 56 percent is expended on operation, reporting and consultation with farmers.

For the purpose of strengthening maintenance activities, the maintenance section should be separated from the existing operation section and responsible for keeping all systems facilities in good conditions with appropriate financial support.

Another important component of organization effort is training of farmers in irrigation practices and water management.

(2) Staffing

The assigned personnel of the AMRIS Office which is headed by Irrigation Superintendent V is summarized below.

A. Functional distribution

Irrigation Superintendent Office	4
Administrative Section	25
Bill, Collection Section	20
Agricultural Coordinating Section	6
Equipment Section	23
Water Control Coordination Section	11
Operation and Maintenance Section	352
Total	441

B. Profile

Managerial/Supervisory	18
Professional/Technical	87
Clerical	40
Manual	296
Total	441

According to the results of the personnel audit of the AMRIS conducted by the Management Service Department (MSD) in NIA Central, the total number of staffs in AMRIS Office was reduced to 382 persons from the existing 441. The major reason for this is non-fulfillment of MC No.2, 1982 which prescribes the work standards for Water masters/Water Management Technicians and Ditch tenders.

2.8.2. Farmers Organization and Activities

(1) Background of the Association

The formation of Compact Farm Associations, one of the irrigator's associations, was started in 1974, simultaneously with the construction activities of the AMIADP financed by ADB.

The formation of associations was accelerated and intensified along with the project construction schedule reaching a total of 1,016 associations. In 1979, just after the Project was implemented, an additional twenty five (25) associations were established. To date, AMRIS has a total of 1,041 compact farm associations.

(2) Purposes of the Association Formation

Purposes of the associations formation are summarized as follows:

a. Association has the capability to maintain and clean the farm ditches.

b. Association has the capability to schedule and handle water distribution among members.

c. Association has the capability to campaign and collect irrigation fee from members.

d. Association has the capability to resolve conflict on water distribution and maintenance of farm ditches among members.

e. Association has the capability to negotiate and coordinate their problems with NIA and other government agencies.

f. Association has the capability to promote the modernized agricultural practices.

(3) Evaluation of Functions

In order to understand the current functions of the associations, questionnaire was conducted among 243 sample associations randomly selected in the Project Area. The survey showed that about 20 percent of the samples function well, about 68 percent partially well and the remaining not at all.

Integrated evaluation of their activities and functions through field inspection, survey, and discussions with officials concerned reveals the following:

a. The associations were hurriedly established during the construction period and farmers were not given adequate orientation as to the proposed role and function of the associations.

b. The associations were not organized on a formal basis and there were no written rules and regulations to bind the members of the associations.

c. Most of the beneficiary farmers were practicing traditional farming without sufficient irrigation facilities at the on-farm level.

d. The associations were not given adequate incentive and continuous support from concerned government agencies, since they also have farmers associations of their own, where the composition is different from compact farm associations.

e. Efforts were made by the water management technician and other OM staff concerned but they are still insufficient for the acceleration of support for farmers.

2.8.3. Major Activities of the AMRIS Office

(1) General

Duties and responsibilities for the operation and maintenance work at main office and each working station is stipulated in the rules, regulations and memorandum circulars of the government. Major activities of the works are general affairs, bill and collections of irrigation fees, operation and maintenance of the systems, and agricultural coordination among beneficiary farmers. The major activities of respective sections are discussed in Appendix B. Summary of the field operation and maintenance work is described as follows.

(2) System Operation and Maintenance

The existing irrigation facilities in the Project Area consist of three (3) diversion dams, three (3) pumping stations and serveral main, lateral and sub-lateral canals and appurtenant structures. Besides, on-farm facilities such as main and supplemental farm ditches, turnouts and drains are generally consolidated compared with other national irrigation systems.

System operations from diversion dams to turnout level are being performed successfully by staffs of operation and maintenance section headed by Irrigation Superintendent III, water control coordination section and working stations. On the other hand, operations of on-farm level facilities are executed by the beneficiary farmers concerned.

The sector gates of the Bustos Diversion Dam are not being operated automatically because the mechanical system has not been functioning well since 1959.

Gate operation of the Upper Maasim Diversion Dam which was constructed in 1949 became impossible so that gate was fixed with concrete in 1963 to keep the water level. Accordingly, the dam is seriously affecting the upstream area during the flood period, though it still functions as the intake facility.

Irrigation canals inclusive of appurtenant structure are functioning well with some exceptions. However, pumping systems are maintained well and many farmers appreciate the efforts.

The annual system operation plan, which comprises program of area and crops, cropping patterns, water delivery schedules, headgate diversions, target irrigation efficiency and extent of the Area to be excluded from irrigable area, is being prepared based on the regulation and memorandum circulars.

Preparation and submission of the reports at the system level, however, seems to take a lot of hard work and time. Accordingly, the work should be reduced and simplified in order to execute more effective implementation for operation and maintenance works.

Present maintenance work in the Project is being performed by the staff of the operation and maintenance section, equipment section and each working station. Major tasks of diversion dams and pumping stations are replacement of spare parts, overhaul and painting.

Grass cutting on main and lateral canals is usually carried out by permanently assigned ditch tenders. Present practice of vegetation control, however, is very costly and not uniformly effective.

What is essential for better water management is the equitable delivery of water to each farm land at the proper time. Concurrently, the amount delivered must be equal to cropping water requirements taking various stages of crop growth and effective rainfall into consideration.

In the case of the AMRIS Project, however, proper distribution does not seem to be conducted successfully. This is obvious from the fact that integrated irrigation efficiency, which will be discussed in Chapter III, is only about 34 percent for the wet season.

In many instances operation of the canal systems and farm turnouts has been taken over by the farmers. They have dealt with manipulating gates, checking canals with banana logs or bamboos, and making their own diversions, through unauthorized and/or improperly located turnouts. The reasons for these are to serve high areas within service area, right of way or maintenance problems among farmers using the same farm ditch, and more convenience to them.

Measuring devices in the Project Area are being operated in comparatively good conditions except some facilities since the consolidation has been completed during the AMIADP implementation of 1978.

In many irrigation and drainage canals, there are sedimentation and siltation problems due to bank erosion and sloughing. Desiltation works are unsatisfactory because of the very small budget allocated to this.

Heavy growth of aquatic vegetation and siltation has significantly reduced canal carrying capacity. Drainage and creeks are not cleaned of vegetation.

Major problems of canal structures are lack of gate at some structures, scour and bank erosion below and around structure outlet transitions, gate problems due to damage, missing parts and general lack of routine maintenance.

Service roads along main canals and some laterals are kept in good condition as compared with those along laterals and sub-laterals. Overtopping of the canal bank and road occurrs frequently as a result of upstream over-checking. Besides, some road embankment along the canal is so low that it becomes saturated and unstable from lateral over-checking.

To keep the road passable all year round it must be paved for as long a stretch as is possible. The need for gravel pavement will depend upon volume of traffic, availability of alternative routes and requirements of beneficiary farmers.

2.8.4. Collection Status of the Irrigation Fee

(1) General

NEDA Resolution No.20 (Series of 1978) states the policy on the level of irrigation fees as follows:

Irrigation fees are to be established at levels that will:

1) Provide for total reimbursement of public investments on irrigation facilities within the maximum fifty years but excluding interest costs which the government will subsidize;

2) Provide for total coverage of working expenses incurred in the operation and maintenance of irrigation systems:

3) Not be a disincentive to farmers to avail of the benefits of irrigation systems;

4) Be within the farmers capacity to pay.

Irrigation fees are set in cavans of palay or its cash equivalent at the prevailing government support price at the time of payment. Current fee rates stated in cavans (50 kg) of palay are as follows:

Systems	Wet Crop	Dry Crop	Third Crop
Gravity systems	2	3	3
Pump systems	3	5	5

(2) Status of Irrigation Fee Collection

Based on the information received from the AMRIS Office concerned, the status of irrigation fee collection during the last six years is summarized below.

(Unit: Thousand peso)

Fiscal Year	Collectable Irrigation Fee	Collected Irrigation Fee In Current	In Back Account	Total
1977	6,541 (100)	2,890 (44)	636 (10)	3,526 (54)
1977	6,281 (100)	2,640 (42)	1,017 (16)	3,657 (58)
1979	7,940 (100)	3,446 (43)	1,021 (13)	4,467 (56)
1980	8,835 (100)	3,543 (40)	1,055 (12)	4,598 (52)
1981	10,046 (100)	4,953 (49)	1,383 (14)	6,336 (63)
1982	10,837 (100)	5,302 (49)	1,345 (12)	6,647 (61)

Source: Data in 1977, 1978 and 1979 from Status Report of Agricultural Development in AMRIS (1980 to 1982 from Bill and Collection Section)

(3) Major Reasons of Delinquency in Irrigation Fee Payment

The following are the resons and related figures obtained directly by collectors through questionnaires filed by 196 farm households and twenty four compact farm associations randomly selected in the Project Area.

Major Reasons	No. of Delinquent Households	Percentage Distribution (%)
Financial or Economic Condition	86	44
Plenty of Loans	10	5
Low Production or Harvest	18	9
Drainage Facilities or Higher Land Level	40	20
Habitual or Institutional	13	7
Others (No. Answer)	29	15
Total	196	100

The above results show that delinquency because of low income accounts for the highest 44 percent. It amounts to 58 percent if those farmers with large loans and poor harvest are included. Because of dissatisfaction with insufficient canal facilities, 20 percent of the farmers refused to pay. Included among those who cited lack of drainage facilities are the farmers who are not able to benefit from the supply of irrigation water since their farm land are located in the Area usually inundated throughout the year. Some farmers find it difficult to irrigate their lands because of the higher land level than the water level in the canal.

2.8.5. O & M Facilities and Equipment

(1) Building Facilities

The building facilities for O & M works include the main office, working stations, dam operation stations, and main canal maintenance houses, etc.

(2) Equipment and Transportation Vehicles for O & M Works

The equipments section of the main office manages the supply and maintenance of all heavy equipment for construction and the transportation vehicles utilized for O & M services of irrigation facilities under the control of NIA. These contain 30 units of heavy equipment such as bulldozers, 47 light machines, 8 jeeps, and 150 motorcycles. Of these 46 units of equipment are operable excluding the motorcycles.

2.8.6. Budget and Expenditures

AMRIS' expenditure are the last four years from 1979 to 1982 is given in Table 2.8-1. The average deficit ratio of balance between revenue and expenditure is about 27 percent. This is of course affected by the low irrigation fee collection efficiency. Major items of annual expenditure are summarized below:

Item	Amount*	Percentage
1. Personnel services	₱ 5,467,000	70.9
2. Supply & materials	164,000	2.1
3. Water illumi. power	1,310,000	17.0
4. Gasoline, oil	419,000	5.4
5. Others	350,000	4.6
Total	₱ 7,710,000	100.0

* Amount indicates average value during the last four years from 1979 to 1982.

** Amount includes electric power for three pumping facilities as well as office water supply and illumination costs.

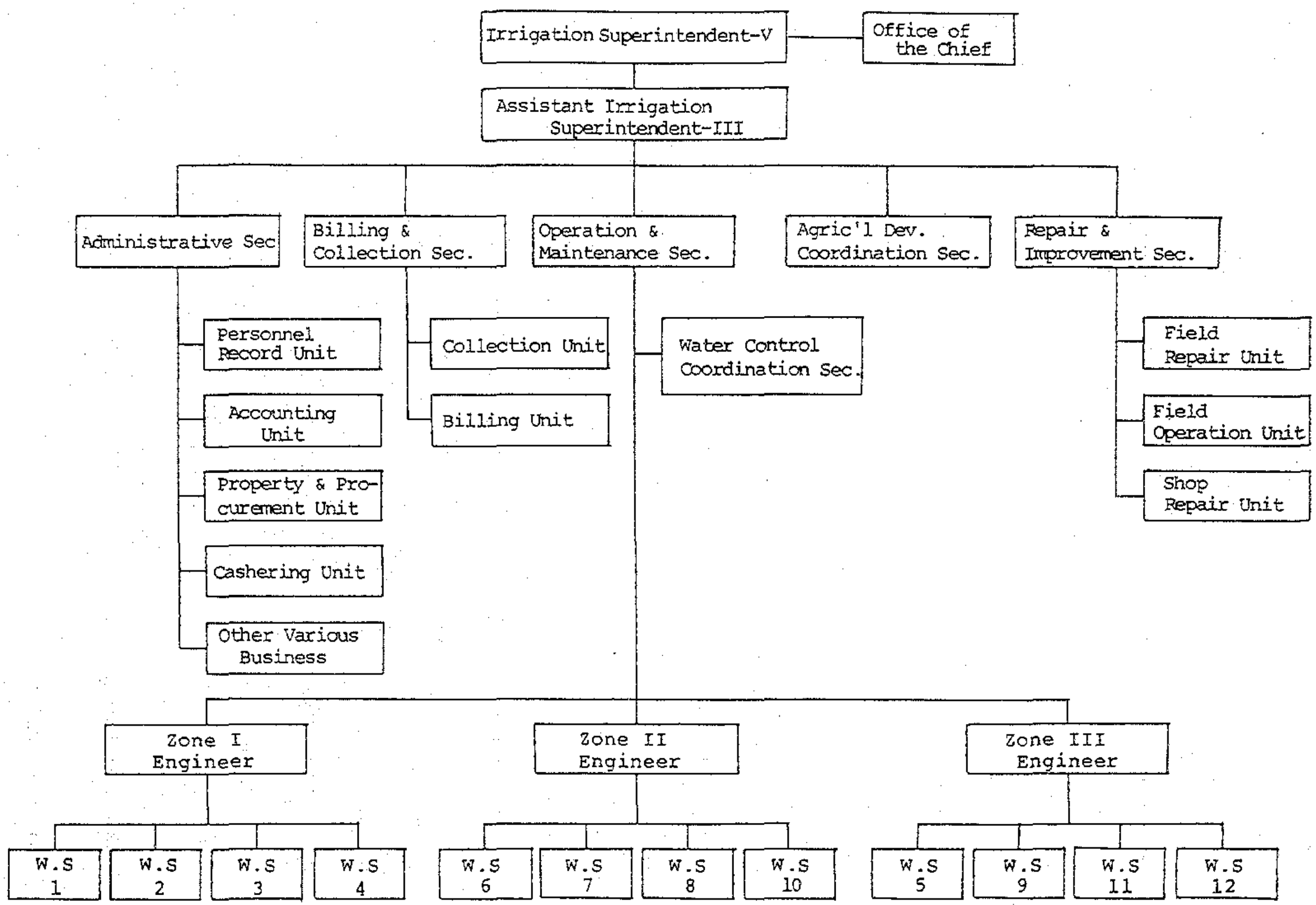
A large share of the annual expenditure is accounted for by personnel service of about 71 percent as compared with supplies and materials of two percent. For the provision of proper irrigation services, proportional increases of maintenance and reduction of personnel services within the limited budgets is required. Necessary measures must be instituted from physical, financial and organizational viewpoints.

TABLE 2.8-1 REVENUE AND EXPENDITURE OF OPERATION AND MAINTENANCE IN AMRIS

(Unit : Thousand Pesos)

Item	1979	1980	1981	1982
A. Revenue				
1. Irrigation fee	4,347	4,598	6,336	5,332
2. Others	98	14	16	1,700
Total (A)	4,445	4,612	6,352	7,032
B. Expenditure				
1. Personnel services	3,986	5,250	6,386	6,244
2. Travel expenses	33	43	59	32
3. Communication services	4	4	4	4
4. Repres't. transt. allowance	11	6	11	6
5. Insurances	40	0	101	192
6. Supply & materials	79	188	132	256
7. Water, illum. power service	548	1,538	1,415	1,738
8. Gasoline, oil	377	368	419	510
9. Special counsel allowance	196	80	190	373
10. Uniform allowance	0	8	8	0
Total (B)	5,274	7,485	8,725	9,355
C. Balance (A)-(B)=(C)	(-) 829	(-) 2,873	(-) 2,373	(-) 2,323
D. Deficit ratio $\frac{(C)}{(B)} \times 100$	15.7	38.4	27.2	24.8

FIGURE 2.8-1 EXISTING ORGANIZATION CHART OF AMRIS



2.9. Agricultural Institution

2.9.1. Extension and Training Services

Agricultural extension services are rendered by BPI (Bureau of Plant Industry), BAI (Bureau of Animal Industry), BS (Bureau of Soils), and BCOD (Bureau of Cooperative Development). These departments all belonging to the Ministry of Agriculture.

BCOD in particular aims to establish farmers' organizations such as Samahang Nayon.

The staff of BPI and BAEx are primarily production technicians and farm management technologists, respectively. Masagana 99, the program for increased palay production, is being carried out by BAEx and BPI.

The roles of respective staffs are as follows:

a) Staffs of the BPI (Production Technician)

- ° Guidance on techniques of prevention of plant pests and insect damage.
- ° Various experiments on the seed production and the prevention of plant pests and insect damage.

b) Staffs of the BAEx (Farm management Technologist)

- ° Assistance in agricultural production.
- ° Enlightenment of farmers through various demonstrations.

c) Staffs of the BS

- ° Analysis and classification of soils.
- ° Guidance on techniques of optimal fertilization.

d) Staffs of the BAI

° Guidance on techniques of livestock and poultry breeding.
° Operation of artificial insemination.
° Prevention of livestock disease.

e) Staffs of the BCOD

° Establishment of farmers' organizations such as Samahang Nayon, Kilusang Bayan.
° Promotion of systematization and efficient management of farmers' organizations.

All staffs belong to the offices of the Ministry of Agriculture which are situated in 19 municipalities in the Project Area and deal with the farmers directly to carry out their duties.

The extension activities for the existing 1,041 compact farms in the Project Area are managed by the aforesaid five bureaus, but mainly BAEx and BPI. In particular, staff of BAEx play an important role in agricultural extension. Staff of BAI and BS are very limited in the Project Area.

Meanwhile, training programs for the farmers in the compact farms were carried out from 1973 to 1978 as part of the agricultural extension activities and 500 farmers took part in the programs in 1980 but since 1977 the number of trained farmers has declined substantially owing to the reduction of the training staffs.

The farmers to be trained are selected by the WMT (Water Management Technologist) of each working station. Staffs of NIA, WMT, and at times, dealers of fertilizers and agricultural machinery give some lectures and guidance in agricultural techniques, agricultural management, distribution of irrigation water, operation and maintenance of the irrigation facilities, and so on.

The number of staff in the AMRIS Area is as follows and each staff is responsible for taking care of about 100 farmers in the Project Area.

Bureau	Number of Staffs (1980)
BPI	50
BAEx	166
BS	7
Total	223

2.9.2. Research

The authority responsible for agricultural research is the Ministry of Agriculture's Bureau of Plant Industry. It has a network of experiment stations all over the country. The Maligaya Rice Research and Training Center has been a leading institute among them for rice research and technical training in intimate collaboration with other research institutes such as the International Rice Research Institute (IRRI) and the College of agriculture, the University of the Philippines (UPLB). Moreover, mention must be made of the activity of the Philippine Council for Agriculture and Resources Research and Development (PCARRD), formerly PCAAR established in 1972.. This is organized into three main bodies: the Governing Council (GC), Technical Program Planning and Review Board and the Secretariat. It formulates the national research program and reviews all of the research centers and line agencies, developing the national research capabilities in terms of facilities, manpower and operation technology.

2.9.3. Agricultural Credit

Farmers have access to loans from such banks as the local government banks and private banks which receive some assistance from the Philippine Central Bank (PCB).

There is one PNB (The Philippine National Bank), one LB (The Land Bank), 19 RB's (The Rural Bank), and one CRB (The Cooperative Rural Bank) in the Project Area. The RB is disposed in each municipality. The ACA (The Agricultural Credit Association) used to provide loans to small farmers and farmers' organizations like Samahang Nayon, but recently was absorbed by the Land Bank. Farmers make use of credit for agricultural production through compact farms.

The Masagana 99 program for advancement of new techniques for paddy production was started in 1973 as an agricultural credit program for small farmers. The loans for agricultural production are provided at the rate of 12 percent per year and require the prior approval of BAEx. Masagana 99 extends credit to farmers with a repayment period of six months. The maximum amount of credit differs in different provinces (1,600 pesos/ha or 1,700 pesos/ha) and in the case of Bulacan and Pampanga Province, the maximum is 1,600 pesos/ha. The ceiling area covered by credit in the Masagana 99 program is five hectares. PNB, RB, LB, and CRB handle the financing for Masagana 99.

Farmers have access to such credit as short-term, medium-term, and long-term credit. The short-term credit is used for purchasing agricultural input materials with a repayment period of six months and an annual interest of 12 percent. The medium-term credit is used for financing agricultural machinery and pumps, etc. and the long-term credit is used for the construction of warehouses and stables and improvements to canal, and so on. Annual interest for medium- and long-term credit is 15 percent.

AMC's (Area Marketing Cooperatives) have been established, through financing from ACA, as marketing cooperatives to promote an efficient marketing of agricultural products but except for the Bostos Marketing Cooperative established in 1981, they have not been activing thus objective.Cooperative established in 1981.

2.9.4. Processing and Marketing

(1) Palay

Palay produced in the AMRIS area is sold to the NFA (National Food Authority) or local buyer after harvesting, threshing, and drying. About 80 percent of palay produced is dealt with by local dealers because the NFA does not have enough vehicles to transport palay or warehouses and budget for purchasing palay. Another reason is that farmer can not get much on the spot when they sell palay to the NFA.

According to the NFA, about 60 percent of palay produced in the AMRIS area is distributed to the Metro Manila area.

Problem of processing centers for drying of palay. Palay harvested in the dry season can be dried on roads and concrete floors to adjust moisture content to the rate of 14 percent. But in the wet season palay is sold without adequate drying and unit price per kg ranges from 1.1 to 1.4 pesos which is below the government support price of 17 pesos. Although there are 16 mechanical driers in the Area, total capacity is only 1,075 cavans per 12 hours and, consequently, palay is dried by sunlight.

(2) Vegetables

Main vegetables produced in AMRIS area are fruit vegetables and corn. These crops are planted at river front and cultivable area located at higher elevation and around residential areas. Though there are no data available on vegetables production in the Area, production is considered very small and vegetables in the Area are transported from other areas like Bagiuo.

Marketing is dealt with by local dealers. Some dealers buy vegetables before harvesting after negotiating about price with farmers on the field.

Since 1978, the AMRIS area has been promoting an upland crop farming program for which the paddy field is used between first and second palay. But the program has not been successful owing to lack of farming techniques, quality agricultural machinery and capital, and to various insects and diseases.

Therefore, in introducing and expanding vegetable farming in the Area, it is necessary to establish demonstration farms to promote the extension of farming techniques.

2.9.5. Associations Related to Agricultural Production

(1) Samahang Nayon

Samahang Nayon is an association of some 25 to 200 farmers in a barangay. Its broad objective is to help advance the living standard of the farmers toward the national level. It serves as an educational institution, a means of generating savings and a way of instituting discipline.

Started in 1973 by PD 175, the membership gained by farmers has increased yearly and numbered 21,609 in 360 units as of 1980. This means that almost all farmers were already organized in the system. A tenant-tiller must become a member before he can receive the Certificate of Land Transfer. The sources of savings consist of the first compulsory one of three percent (3%) of loans obtained by members from the financial institutions and the second one of one cavan paddy per hectare per harvest. Each field-worker assigned by the Ministry of Local Government and Community Development (MLGCD) recruits and trains the volunteer barrio workers who can organize Samahang Nayon.

(2) Area Marketing Cooperative (AMC)

This is a fully-fledged cooperative established by Samahang Nayon to serve as its marketing arm. Two AMC's and three Marketing

Cooperatives were set up in AMRIS Area as of 1980. It plays a major role in procuring production equipment, supplies and inputs needed by farmers and in processing, storage, transportation and in selling farm produce to the NFA at the set support price.

Other group of Kilusang Bayan (economically viable Samahang Nayon) and KKK are being adopted as a current priority program although little information is available on these in the Area.

Though favored with these organization systems, there have been many inconveniences and problems pointed out by farmers. For instance, most programs are weak in training in modern techniques, timely delivery of agricultural inputs (seeds and fertilizers) as well as in provision of credit sources. Natural calamities beyond their control may also interfere with the possible development of the farmers associations.

(3) Government Administration

For planning or administration of many food production programs, the National Economic and Development Authority (NEDA) functions as the central body of the government. It is responsible for the formulation and coordination of the program implementation in the national development projects.

In connection with NEDA, the National Food and Agriculture Council (NFAC) was created in 1969 by EO No.183 as the responsible body with broader scope, jurisdiction and authority over all government food production programs. The National Farm Authority, a government corporation attached to the Office of the President, plays an important role in price support and massive procurement duties.

2.10. Farm Economy

2.10.1. Income and Expenditure by Land Tenure

AMRIS Area is known for its advanced palay production, its unit yield both in dry and rainy seasons being four ton/ha which is nearly twice as much as the national average. The irrigation network system is well developed in the Area, though part of it requires some repair works. Farm management in the Area has been experiencing a difficult time due to the continuous inflation and, in particular, increased price of input materials since 1978.

The economic survey of 150 farm households shows that about 80 percent of them supplement household income by non-farm income sources.

The palay income accounts for a large portion of farm household income and its production in the Area is relatively stable with a high unit yield. Thus, the farm gate price of palay that is an important determinant of the size of farm income.

In spite of the government's support price of palay, its rate of increase is smaller than that of inflation and NFA falls short of capital for purchasing palay, and also of warehouses and vehicles.

Land tenure in the Area is classified into lease-holder 73 percent, amortizing owner three percent, owner operator 21 percent and the rest three percent.

The lease-holders cultivate 1.9 ha on average and are liable to pay the land owner a rent of 9.9 cavans (495 kg) of palay in dry season and 9.4 cavans (470 kg) in wet season.

The farm survey has been conducted for 150 households in the existing area and for 60 households in the expansion area. The detailed results are presented in Chapter IV. Farm Economy Appendix C. The summary of survey results is given in Tables 2.10-1 and 2.10-1.

2.10.2. Disposable Income

The tables reveal the differential in household disposable income by type of land tenure. Lease-holders in the existing area who are liable for a high rent and dependent on hired field labor earn the lowest disposable income of 4,167 pesos, whereas the amortizing owners earn 7,488 pesos, and owner operator 7,769 pesos. On the other hand, in the expansion area lease-holders earn 4,726 pesos and owner operators 6,661 pesos.

TABLE 2.10-1 RESULT OF FARM MANAGEMENT SURVEY IN THE EXISTING AREA

Item	Lease Holder	Amortizing Owner	Owner Operator
1) Average Farm Size	1.91 ha	2.54 ha	2.3 ha
2) Gross Income	38,530	50,860	45,670
Farm Income (₱)	24,380	27,430	29,820
Off-farm Income (₱)	14,150	23,430	15,850
3) Expenditure	30,570	31,840	27,800
Cost for Production (₱/year)	16,830	18,100	14,060
Living Expenses (₱/year)	13,740	13,740	13,740
4) Disposable Income (₱)	7,960	19,020	17,870
5) Disposable Income per ha (₱)	4,167	7,488	7,769

TABLE 2.10-2 RESULT OF FARM MANAGEMENT SURVEY IN EXPANSION AREA

Item	Lease Holder	Owner Operator
1) Average Farm Size	3.0 ha	1.7 ha
2) Gross Income	35,085	30,036
On-farm (₱)	20,874	16,978
Off-farm (₱)	14,211	13,058
3) Expenditure (₱)	20,907	18,732
Cost for Production (₱)	7,167	4,992
Living Expenses (₱)	13,740	13,740
4) Disposable Income (₱)	14,178	11,324
5) Disposable Income per ha (₱)	4,726	6,661

CHAPTER III. THE PROJECT

CHAPTER III. THE PROJECT

3.1. Objectives and Components of the Project

3.1.1. Objectives and Scope

The Government has been actively instituting the policy of rehabilitation, upgrading and expansion of national irrigation systems since 1967. The main goal of all these efforts is to enhance the agricultural production and disperse benefits to a large number of small farmers throughout the country.

The development plan aims at the expansion of new irrigation and drainage systems, rehabilitation of irrigation and drainage systems, development of on-farm facilities and road systems, turnover of marginal national irrigation systems to capable irrigators' associations, and promotion of upgrading collection efficiency of irrigation fees.

The Project Area is one of the most advanced paddy cropping zone in the Philippines. Its strategy of the development for the Project comprises two specific aspects: one is the development of the natural and social potential in the Area to the fullest extent and the other is establishment of a more advanced agricultural zone as a model in the country.

In line with the national policy and area potentiality, the Project envisions an increase in cropping intensity, upgrading of system management inclusive of irrigation efficiency, rehabilitation of the existing facilities, expansion of irrigation service area with appropriate irrigation and drainage facilities, upgrading of collection efficiency of irrigation fees, and partial turnover of operation and maintenance works to capable irrigators associations.

Furthermore, the Project will promote the extension of crop diversification through agricultural supporting services in the Area.

3.1.2. Project Components

In order to fulfill these objectives, the Project service area of about 35,000 ha including some 3,500 ha of new expansion areas involves the following components:

(1) Rehabilitation and upgrading of existing irrigation and drainage facilities including some expansion of these facilities in the existing service area of about 31,500 hectares;

(2) Construction of irrigation and drainage facilities for the new expansion area of about 3,500 ha with the same level of upgrading standard;

(3) Upgrading of existing roads and construction of additional service and access roads;

(4) Consolidation of on-farm facilities in the new expansion areas as well as in part of the existing service area;

(5) Strengthening of NIA operation and maintenance structures through joint operation between NIA and capable irrigators associations;

(6) Establishment of capable irrigators associations (IAs) and the gradual turnover of operations and maintenance works of the systems below sub-lateral canals level to the IAs taking development stage and capability of the IAs into consideration;

(7) Establishment of demonstration farm for crop diversification programs and the promotion of scheme extension and;

(8) Procurement of equipment and vehicles for construction of on-farm facilities, and instrument for operation and maintenance works.

3.2. Project Formulation

In order to realize the Project components discussed previously, the following measures should be considered for the Project.

3.2.1. Improvement of Irrigation Systems

1) Rehabilitation and Construction of Diversion Dam

- The gate operation mechanism of the existing diversion dams will be rehabilitated to realize adequate operation and to prevent flood damage in the upper stream of the dam.

- A permanent diversion dam will be constructed in the Third Maasim area to replace the dam which was temporarily built every year with soil materials.

- Riverbed protection works against rapid flow will be conducted at the scoured riverbed immediately below the downstream apron.

- In addition to these plans, the present intake facility of the Upper Maasim dam shall be reconstructed to secure sufficient capacity to meet the proposed water requirements.

2) Improvement of Irrigation Canal

- The Project will rehabilitate canal systems and improve insufficient canal sections and related structures. The rehabilitation work will include excavation and reshaping of canal sections and improvement and reconstruction of existing structures for ideal operation and maintenance of the systems.

- The Project will also provide additional farm ditches and necessary structures to distribute water directly to about 80 percent of the farm lots in the existing area.

3.2.2. Improvement of Drainage Systems

- The Project will rehabilitate drainage canals, natural creeks and related structures. The rehabilitation work will include not only dredging and widening of the canal section but also appurtenant structures such as outlet culvert with flap gates and check gates used for both irrigation and drainage.

- The Project will provide additional farmdrains at minimum standard density as necessary structures.

3.2.3. Improvement of Service Roads

- Service roads along one side of irrigation and drainage canals will be so constructed that vehicles necessary for the operation and maintenance and pathway of agricultures will be able to use them.

- Existing roads will also be rehabilitated and restored to NIA design standard.

- Dimension of road cross section, as a rule, will be 3.50 m wide with gravel pavement of 0.15 m.

- To avoid dead ends, all service roads will be connected to the nearest road in the vicinity whenever possible.

3.2.4. Expansion Area Development

- The Project has a possible expansion areas of about 3,500 ha adjacent to the present service area. The area proposed could either be served by extending and/or improving existing irrigation canals or constructing new ones.

- The Project will also provide drainage facilities, road networks and on-farm facilities as in the existing area.

3.2.5. Agricultural Development

- Proper cropping calendars will be established to utilize available water resources in order to increase both actual area cultivated and cropping intensity.

- The ultimate aim of the project investment is to increase agricultural production and increase farmer's income in the Project Area. In parallel with execution of the above-mentioned schemes, diversified agriculture will be promoted as much as possible in the Project Area.

3.2.6. Strengthening of Operation and Maintenance Structures

1) Physical Improvement Aspect

- Upgrading the irrigation efficiency is very important in making for effective use of the limited water resources.

For this purpose, it is necessary to keep the facilities in the Area in a satisfactory conditions so as to facilitate proper water management.

- Maintenance work on the facilities must be fully supported by a reasonable re-allotment of the O & M budget.

2) Organizational Aspect

- Establishing the irrigators association in the Project Area will be the first priority of the institutional development in order to partially turnover O & M work to the IAs.

- In parallel with institutional development, the organization of NIA on the operation and maintenance will be gradually reorganized so as to solve major constraints of O & M structures.

- Regarding to the re-organization of AMRIS office in NIA, ordinary O & M tasks can be simplified and computerized in order to upgrade management efficiency.

3) Agricultural Development Aspect

- Increased agricultural production shall be expected as a result of stabilized allocation of irrigation water and improvement of existing facilities.

- The Project will be expected to increase cropping intensity and service area, so that collectable amounts of the irrigation fees will inevitably be increased.

4) Financial Support

- Overall O & M expenditure on facilities under the NIA system is to be balanced with the irrigation fees collected from the beneficiary farmers.

- Required operation and maintenance cost of the roads serving many unspecified people shall be subsidized by the government, and/or authorization as barangay road of service road existing in the Project Area will be attempted to reduce O & M cost.

3.3. Agricultural Program

3.3.1. Proposed Land Use

For upgrading irrigation efficiency and crop production in the Project Area, systematic usage of the water resources, improved operation and maintenance of the irrigation facilities, and future trend of the farm produce marketing have been intensively studied by the feasibility study team throughout the two survey stages from 1982 to 1983.

As a result, future improvement in land use is proposed as follows:

(1) Expansion of new irrigable areas to the extent that the irrigation capacity can support crop growth.

(2) Increase in cropping intensity both in the wet and dry seasons through drainage improvement.

(3) Introduction of an upland crops diversification scheme in well-drained areas, leading to a higher income among the farmers.

As has already been described, the expansion areas are confined mostly to the low-lying submerged areas which can be served by gravity irrigation.

Land use of the Project Area in terms of cropping system is proposed in Table 3.3-1 and is summarized by season as follows:

	Crop Season	Future Without Project	Future With Project	Difference
Service Area (ha)		33,886 (2,401)	34,965	+ 1,079
Planted Area:	Wet	23,746 (380)	26,573	+ 2,827
(ha)	Dry	30,798 (2,171)	37,215	+ 6,417
	Total	54,544 (2,551)	63,788	+ 9,244
Cropping Intensity:	Wet	70.1 (15.8)	76.2	+ 5.9
(%)	Dry	90.9 (90.4)	106.4	+ 15.5
	Total	161.0 (106.2)	182.4	+ 21.4

Figures in parenthesis are those of expansion areas, which are not yet served by AMRIS in the stage without project.

The planted area with project shall be increased totally by 9,244 ha. Cropping intensity will reach 76 and 106 percent in the wet and dry season, respectively, totalling 182 percent per crop year. A large increase in the dry season intensity owes to expansion of the diversified cropped areas.

3.3.2. Proposed Cropping Pattern

(1) Pattern Formulation

Pattern formulation in the AMRIS Project Area largely depends on topographical features as well as soil characteristics of the land, which may affect irrigability, drainability and submergence during the wet season. Each cropping calendar must be decided following the irrigation program of water resources which is also controlled by the allotment program of the Angat Reservoir. A fallow season of about two months is needed, that is, from April to May for the repair and maintenance of the canals and other appurtenant structures.

Cash crop marketing is another aspect that requires careful attention. Moreover, for the diversified croppings to be viable extension activities would have to be further intensified by NIA and BAEx. Many constraints identified in the Upland Crop Project conducted from 1981 to 1982 gave useful lessons regarding the introduction of upland crops into paddy field.

(2) Proposed Patterns

Considering the above-mentioned circumstances, five cropping patterns have been planned as shown in Figure 3.3-1 together with the climatic conditions. The land conditions adaptable to each pattern are summarized in Table 3.3-2.

Pattern A - Double cropped rice with late maturing varieties; the major pattern covering far more than half the total planted area; stable and higher yield.

Pattern B - Ditto, but with early maturing varieties; area suffered from drought due to the shortage in water supply; the dry season rice must be planted in October to advance harvest (October Rice).

Pattern C - Triple cropped, once with late maturing rice in the wet season and twice with diversified upland crops in the dry season; formerly pattern A area.

Pattern D - Double cropped for rice with early maturing varieties; the wet season rice crop must be planted in March to finish harvest before July in order to avoid the typhoon season; poorly drained area.

Pattern E - Single cropped with late maturing rice in the dry season; common in submerged lands including expansion areas.

Area distribution of each pattern is outlined in Figure 3.3-2. Crops selected as appropriate for pattern C are watermelon and pole sitao in combination with green and yellow corn, respectively for first and second crops, in view of their high demand in market.

3.3.3. Improved Farming Practices

To attain a higher level of crop production, the existing farming practice should be improved in the following points:

a. Suitable variety and planting method
b. Effective fertilizer application
c. Intensive plant protection
d. Integrated water management

Use of recommended varieties which have been approved by the Seed Board is firstly important for rice culture. Among HYV commonly grown in Philippines, IR36 and IR42 have gained reputation almost all over the country, and are the most extensive varieties. The IR36 early maturing variety is particular has given outstanding yield under direct seeding. Area with straight transplanting and direct seeding shall be extended by stopping ordinary transplanting. Extent of each method is predicted below:

Planting Method	Future without Project		Future with Project	
	Wet	Dry	Wet	Dry
Ordinary transplanting	40	30	0	0
Straight transplanting	30	20	50	20
Direct seeding	30	50	50	80
Total	100	100	100	100

To project future paddy yield, the production efficiency curves with the applied fertilizer nitrogen have been made by analyzing the results of field trials conducted in AMRIS Area (1974 - 1977). As a result, the most efficient volume of nitrogen per ha was found to be around 80 kg for the wet season and 100 kg for the dry season crop. These are far more than the present dosages by 20 to 30 kg per ha, have been shown by production cost analysis to give an adequate economic return.

The use of agrochemicals shall be increased in quantity as well as in quality, particularly for upland crops. Proper irrigation and drainage must be executed following the Philippines Recommendations for Water Management, 1978.

TABLE 3.3-1 PROPOSED LAND USE AND PLANTING PROGRAM IN AMRIS

(Unit : ha)

Land Use Criteria	Service Area		Planted Area					
			Wet Season		Dry Season		Total	
	Without Project	With Project	Without	With	Without	With	Without	With
1. Present Service Area								
Pattern A	22,082	19,982	21,255	19,982	20,732	19,982	41,987	39,964
B	2,111	2,111	2,111	2,111	603	2,111	2,714	4,222
C	0	2,100	0	2,100	0	4,200	0	6,300
D	0	2,000	0	2,000	0	2,000	0	4,000
E	7,292	5,292	0	0	7,292	5,292	7,292	5,292
Sub-total	31,485	31,485	23,366	26,193	28,627	33,585	51,993	59,778
(Cropping Intensity)	(100)	(100)	(74.2)	(83.2)	(90.9)	(106.7)	(165.1)	(189.9)
2. Expansion Area*								
Pattern A	380	230	380	230	150	230	530	460
C	0	150	0	150	0	300	0	450
E	2,021	3,100	0	0	2,021	3,100	2,021	3,100
Sub-total	2,401	3,480	380	380	2,171	3,630	2,551	4,010
(Cropping Intensity)	(100)	(100)	(15.8)	(10.9)	(90.4)	(104.3)	(106.2)	(115.2)
Total	33,886	34,965	23,746	26,573	30,798	37,215	54,544	63,788
(Cropping Intensity)	(100)	(100)	(70.1)	(76.0)	(90.9)	(106.4)	(161.0)	(182.4)

Note: * Not yet served by AMRIS at the stage without Project.

TABLE 3.3-2 LAND CONDITIONS AND PROPOSED CROPPING PATTERNS FOR AMRIS AREA

Submergence during Wet Season	Cropping Pattern	Topography	Drainage	Major Soil Series	Soil Types	Land Class
Non-Submerged	A	Almost flat	Imperfectly drained	Bigaa	Clay loam (3)	1R
		Flat to slightly undullating	Moderately well to imperfectly drained	Quingua	Silt loam (5)	1R
				"	Silty clay loam (285)	1R
				"	Silty clay (899)	1R
				Calumpit	Silty clay loam (18)	1R
				Prensa	Silty clay loam (66)	1R
	B	Undullating to rolling	Moderatly well drained	Prensa	Silty clay loam (66)	1R
				Buenavista	Silt loam (9)	1R
	C	Almost flat	Imperfectly drained	Bigaa	Clay loam (3)	2d
		Flat to slightly undullating	Well to moderately well drained	Quingua	Fine sandy loam (4)	1
				"	Silt loam (5)	1
Submerged	D	Flat to slightly sloping, partly swampy	Imperfectly to poorly drained	Obando	Fine sandy loam (2)	2Rdf
				Bigaa	Clay loam (3)	2Rdf
				Calumpit	Sandy loam (17)	2Rs
				Candaba	Silt loam (69)	2Rdf
				"	Clay loam (70)	2Rdf
	E	Flat to slightly depressed	Imperfectly to porrly drained	Quingua	Fine sandy loam (4)	2Rst
				Calumpit	Silty clay loam (18)	2Rf
				Candaba	Clay loam (70)	3Rdf

Note : Refer to APPENDIX - A for soil and land classification.

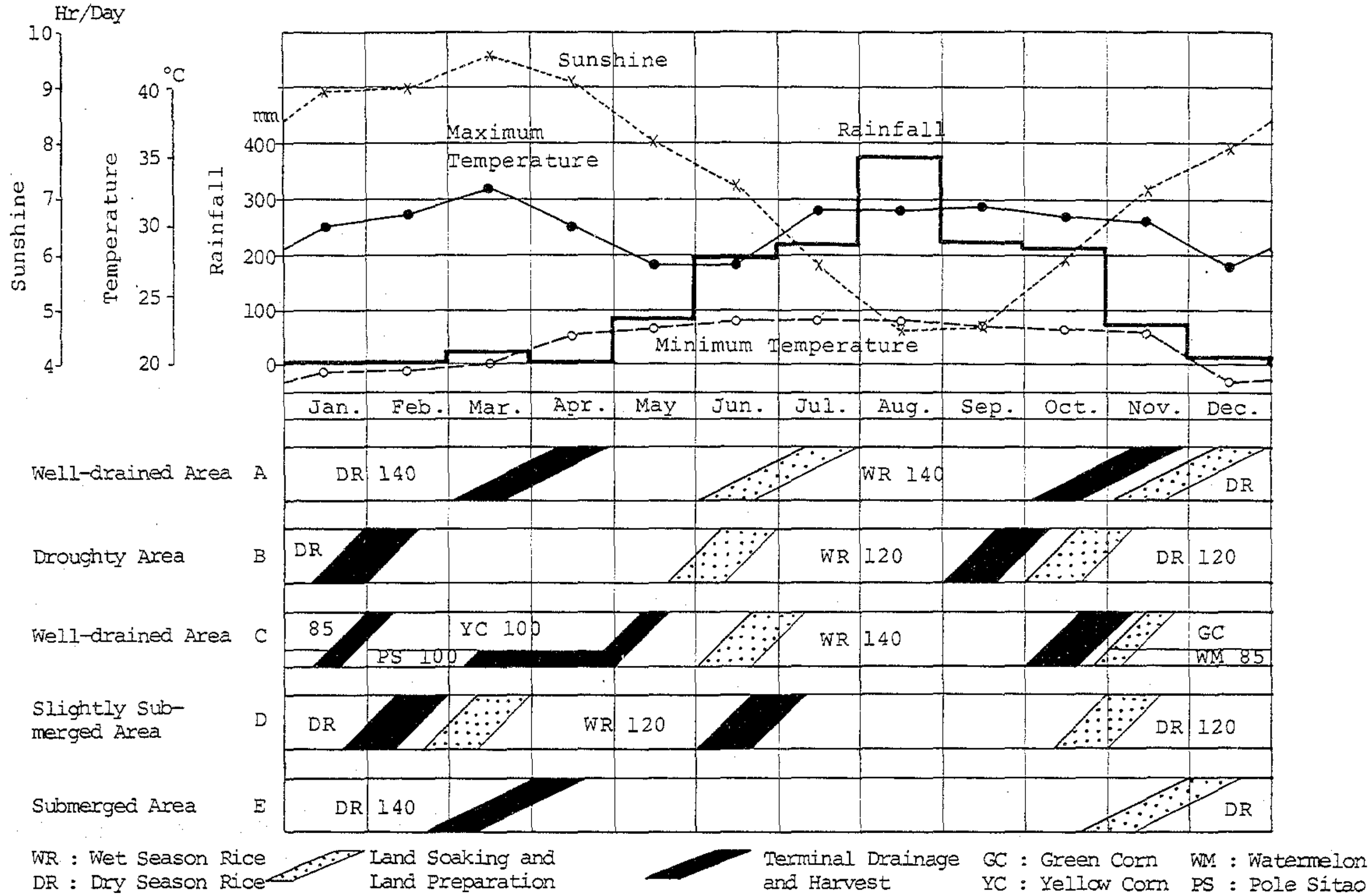


FIGURE 3.3-1 PROPOSED CROPPING PATTERNS FOR AMRIS PROJECT AREA

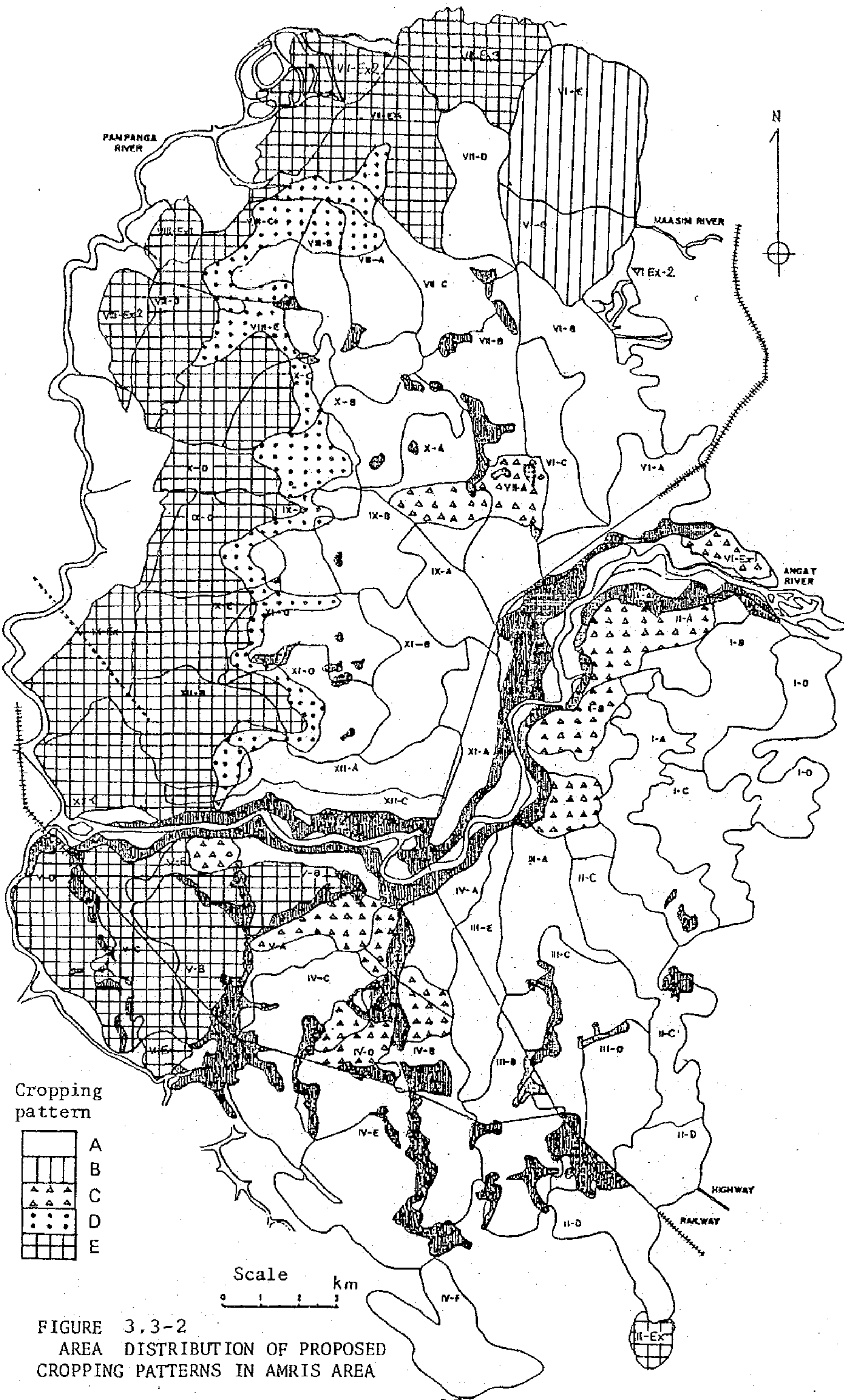


FIGURE 3.3-2
AREA DISTRIBUTION OF PROPOSED CROPPING PATTERNS IN AMRIS AREA

3.4. Irrigation Plan

As discussed in 2.5.3., the present AMRIS service area frequently lacks in irrigation water diversion at the Bustos Dam especially during the dry season. The study on water balance under the present condition of the Area estimates that the Area would encounter no shortage of water in critically droughty period of once in five years occurrence, if the operation rule curve for the Angat Reservoir is modified slightly to meet actual demand in the Area.

It was also presumed from the study that the expansion area proposed by the Project would be covered by the water of the Angat Reservoir after a proper rule curve for operating the reservoir was established.

3.4.1. Upgrading Irrigation Efficiency and Water Management

Improved water management is expected only by the integrated processes of diversion, conveyance, regulation, measurement, distribution and application of water in time and space. To maximize water utilization and promote increased farm production, the following items are subject for discussion.

1) To Maximize Water Utilization

- Supply proper amount of water to meet crop requirement
- Control and reduce conveyance, distribution and farm application losses
- Deliver irrigation water in time
- Maximize effective use of rainfall
- Maximize effective re-use of water or return flow
- Systematyze a suitable scheme of distribution and application of irrigation water

2) To Promote Increased Farm Production

- Plan a proper land use scheme
- Improve farm management techniques
- Accelerate active participation of irrigator's associations

Factors affecting the parameters of irrigation water requirement are a) evapotranspiration which varies with respect to the plant growth stage under the influence of temperature, sunlight, humidity, wind, soil and water supply condition, b) percolation which is governed by the texture and structure of soil layer, soil permeability and depth to impervious layer or water table, and c) effective rainfall which is affected by rainfall intensity, depth of submergence, size of levee and other topographic conditions. Among them, effective rainfall can be maximized when the following are undertaken.

- Improvement of farm dikes to increase pondage
- Adoption of irrigation suspension schedule
- Application of shallow depth of irrigation water
- Practice of intermittent application of irrigation water

Farm application losses of irrigation water are considered to be on-farm losses mostly due to farmer's capacity of farm management as well as farm activity. Conveyance losses are, on the other hand, due to physical factors such as seepage, leakage and evaporation losses, and non-physical factors which are rather related to operational factors such as over-application of irrigation water in the field, unscheduled drainage and illegal diversion losses.

A study on the integrated irrigation efficiency observed in the Project Area was made selecting 10 routes of irrigation canals which cover approximately 45 percent and 50 percent of presently irrigated area in the wet and dry season, respectively, during the crop year of 1981 to 1982.

Integrated Irrigation Efficiency in AMRIS
(Under Present Condition)

(Unit: %)

Main Canal	Lateral	Wet Season 1981	Wet Season 1982	Wet Season Mean	Dry Season 1981	Dry Season 1982	Dry Season Mean
Angat South	D	37.3	34.8	36.1	47.9	43.4	45.7
	E	42.2	29.2	35.7	54.1	61.6	57.9
	F	30.0	39.5	34.8	53.9	65.8	59.9
	J	31.5	-	31.5	34.5	37.3	35.9
Angat North	A	41.4	28.3	34.9	65.2	53.0	59.1
	B	48.8	20.8	34.8	59.5	59.0	59.3
	C	21.8	26.3	24.1	48.7	67.6	58.2
	D	47.7	22.3	35.0	70.1	66.6	68.4
	E	40.3	37.8	39.1	67.6	60.7	64.2
	G	27.3	35.7	31.5	64.8	63.7	64.3
	Average	36.8	30.5	33.7	56.6	57.9	57.3

The study indicates that the diverted water did not correspond to the actual water demand in the field because effective rainfall was not fully considered in operating irrigation diversion.

Conveyance losses of canals were also computed based on the observed rate of conveyance losses, actual irrigated area, and length of canal.

Conveyance Losses Observed in AMRIS

Main Canal	Working Station	Irrigated Area Dry (ha)	Irrigated Area Wet (ha)	Canal Length (m)	Conveyance Loss Dry (%)	Conveyance Loss Wet (%)
Angat South	1	2,018	2,018	56,148	24.9	19.5
	2	2,591	2,572	63,390	32.6	25.8
	3	2,655	2,684	59,209	29.1	27.4
	4	3,040	3,040	65,180	29.0	25.0
	5	2,536	1,717	38,088	20.8	19.3
	(Mean)				(27.3)	(23.4)

Main Canal	Working Station	Irrigated Dry (ha)	Area Wet (ha)	Canal Length (m)	Conveyance Dry (%)	Loss Wet (%)
Angat North	6	1,833	1,833	40,408	27.0	21.9
	7	2,949	1,800	66,851	28.7	28.9
	8	2,695	1,055	44,946	19.5	24.0
	9	2,300	1,365	36,924	22.0	20.2
	10	2,222	1,545	32,617	18.9	22.4
	11	2,334	2,228	32,820	17.5	16.6
	12	2,028	835	29,672	18.0	22.8
	(Mean)				(21.7)	(22.4)
	Average				24.0	22.8

Among various losses which determine overall irrigation efficiency, farm application losses are assumed to be about 30 percent of the crop water requirement as one of the standard criteria given in the Operation and Maintenance Plan for the Irrigation System Management of NIA. Thus, distribution losses were calculated back based on the observed values of overall irrigation efficiency as well as conveyance losses.

Present Condition of Irrigation Efficiency and Losses (%)

Season	Losses Farm Appli.	Conveyance	Distribution	Irrigation Efficiency
Dry	23	19	8	57.3
Wet	23	19	46	33.7

Note: All losses are expressed in division form.

As the result of evaluation, distribution efficiency in wet season was shown to be quite low mainly due to a lack of consideration of effective rainfall and the undeveloped system of water management.

For the purpose of effective utilization of limited water resources, the integrated irrigation efficiency should be increased both technically and economically.

Upgrading farm application efficiency, however, seems to be difficult when the actual situation of on-farm development and farmers attitude are taken into consideration. To prevent leakage losses from the paddy field and to prevent illegal diversion and so forth, greater attention should be paid by the farmers concerned.

Although preventing conveyance losses in canals by means of concrete lining is considered to be rather difficult because of the availability of funds, it would be to some extent possible to improve conveyance efficiency by undertaking careful supervision and maintenance of canal systems.

The only way of upgrading integrated irrigation efficiency is to increase distribution and farm application efficiencies through good water management supported by the farmers' cooperation and improvement of water control as well as on-farm facilities.

The goal of integrated irrigation efficiency will be expected to be more or less 60 percent with increasing distribution and farm application efficiencies of about two and three percent, respectively.

3.4.2. Irrigation Water Requirement

(1) Proposed Cropping Schedule

The proposed acreage of the Area for irrigation is 26,573 ha and 34,965 ha for wet and dry season, respectively. In comparison with presently irrigated area, an increase of 3,207 ha in the wet season contains 380 ha of new expansion area (WS-Ex.1 & Ex.2) and 2,827 ha of existing area which is not planted with rice at present because of poor drainage conditions but will be able to be planted when the proposed cropping pattern D is applied.

As much as 6,338 ha of area is expected to be newly irrigated in the dry season, containing 3,480 ha of expansion area proposed as WS2-Ex, WS5-Ex, WS6-Ex.1 to 3, WS7-Ex, WS8-Ex.1 to 2 and WS9-Ex, and 1,508 ha of the existing area which belongs to the Upper Maasim but is not irrigated due to the frequent lack of available runoff water in the Maasim River.

The above proposed area includes some local areas which could be served by use of return flow. 680 ha served by the proposed Third Maasim Dam and 1,010 ha by the North Main Canal of the Angat fall into this category.

Two proposed alternatives were planned considering the characteristics of return flow area, as;

- Alternative Case-1

  In this case all proposed areas are served mainly by the Angat water, supplementally by the Maasim water.

- Alternative Case-2

  1,690 ha were subtracted from the proposed area of Case-1.

2) Cropping Pattern

Regarding the cropping calendar, five types of the proposed cropping patterns were applied to the Project namely; the proposed patterns A, B, C, D and E. The Areas are summarized as follows.

Proposed Irrigation Area by Cropping Pattern

Irrigation Block	Season	Proposed Cropping Pattern (ha) A	B	C	D	E	Total
Upper Maasim	Wet		2,111				2,111
	Dry		2,111			900	3,011
Lower Maasim	Wet	299					299
	Dry	299				760	1,059
Third Maasim	Wet						-
						(-)	(-)
	Dry					680	680
Angat North	Wet	9,147		550	2,000		11,697
						(4,011)	(15,708)
	Dry	9,147		550	2,000	5,021	16,718
Angat South	Wet	9,480		1,700			11,180
	Dry	9,480		1,700		1,031	12,211
TPIS	Wet	1,286					1,286
	Dry	1,286					1,286
Total	Wet	20,212	2,111	2,250	2,000	-	26,573
						(6,702)	(33,275)
	Dry	20,212	2,111	2,250	2,000	8,392	34,965

Note: Figures in parenthesis are for Case-2.

3) Diversion Water Requirement

The only procedures which differ from those employed in estimation of the present irrigation water requirement are 1) adoption of the upgraded integrated irrigation efficiency of 0.60, as previously discussed in 3.4.1, and 2) introduction of diversified upland crops as designated by the proposed cropping pattern C.

In the Project, a total area of 2,250 ha is planted with diversified crops such as green corn, yellow corn, water melon and pole sitao. In estimating the consumptive use of such diversified crops, the feasibility report on the Improvement of 18 National Irrigation Systems, NIA, was referred to in which potential evapotranspiration of crops by the Modified Penman Method was calculated based on the climatorological condition observed in the Central Luzon.

Effective rainfall covers a considerable percentage of the farm irrigation requirement, and its magnitude ranges from ten percent to 43 percent of the annual rainfall on the irrigated field in the wet season, and from five percent to 13 percent in the dry season depending on the growing stage of crops designated by each cropping pattern and the seasonal fluctuation of rainfall.

Diversion water requirements were thus estimated as summarized for the proposed alternative Case-1.

Diversion Water Requirement for Alternative Case-1

(Unit: MCM)

Year	Maasim Upper	Maasim Lower	Maasim Third	Angat Main North	Angat Main South	Tibagan P.I.S.	Total
1972	33.0	12.2	7.6	210.3	140.8	15.8	419.7
1973	26.8	11.3	7.1	195.8	133.5	14.4	388.9
1974	18.4	9.0	5.0	175.1	133.2	14.8	355.5
1975	27.2	11.7	7.3	204.6	135.7	15.1	401.6
1976	33.7	12.8	8.0	219.0	149.6	16.5	439.6
1977	32.5	11.6	7.1	209.2	143.6	15.9	419.9
1978	28.0	13.6	7.9	244.4	183.5	20.6	498.0
1979	42.4	14.4	8.4	262.3	194.0	21.5	543.0
1980	41.4	13.1	7.5	241.5	181.7	20.1	505.0
1981	38.3	13.0	7.4	247.7	183.8	20.4	510.6
1982	36.9	13.7	8.4	236.6	164.3	18.3	478.2
Maximum	42.4	14.4	8.4	262.3	194.0	21.5	543.0
Minimum	18.4	9.0	5.0	175.1	133.2	14.4	355.5
Mean	326.	12.4	7.4	222.4	158.5	17.6	450.9