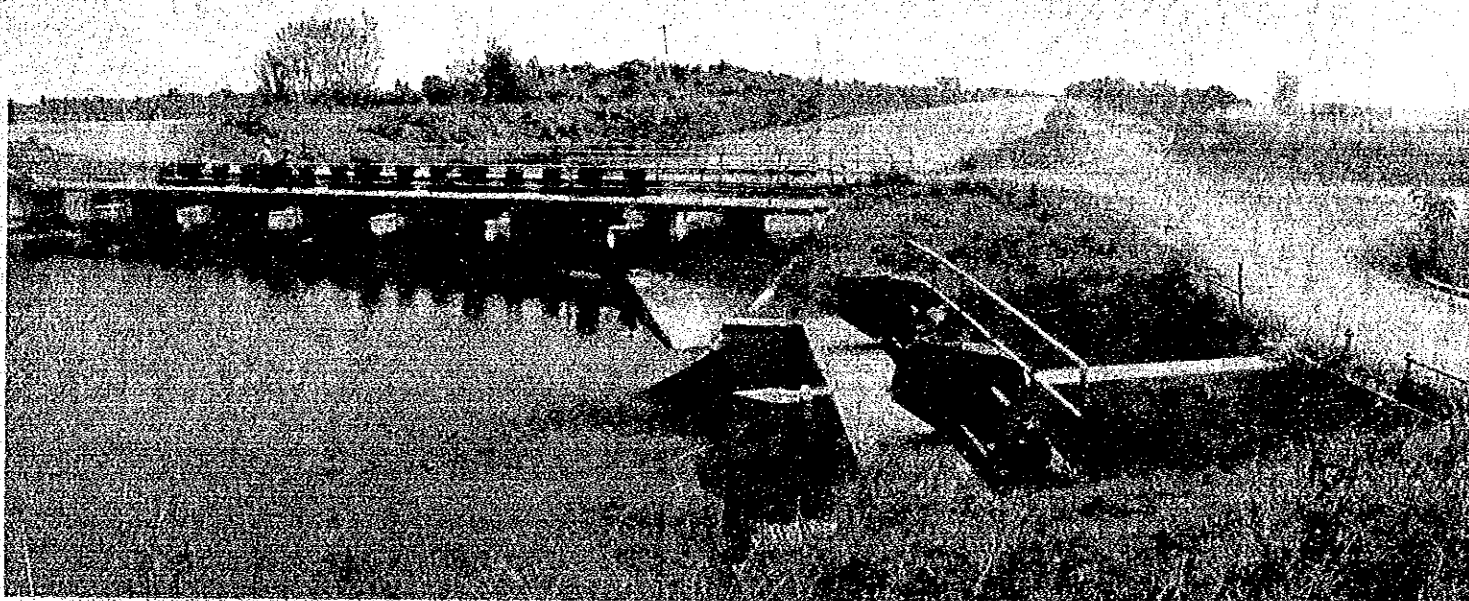



MASTER PLAN STUDY
ON
THE IMPROVEMENT PROJECT OF THE O & M
OF
MAGAT RIVER INTEGRATED IRRIGATION SYSTEM
IN THE
REPUBLIC OF THE PHILIPPINES

EXECUTIVE SUMMARY



JULY, 1987

JAPAN INTERNATIONAL COOPERATION AGENCY

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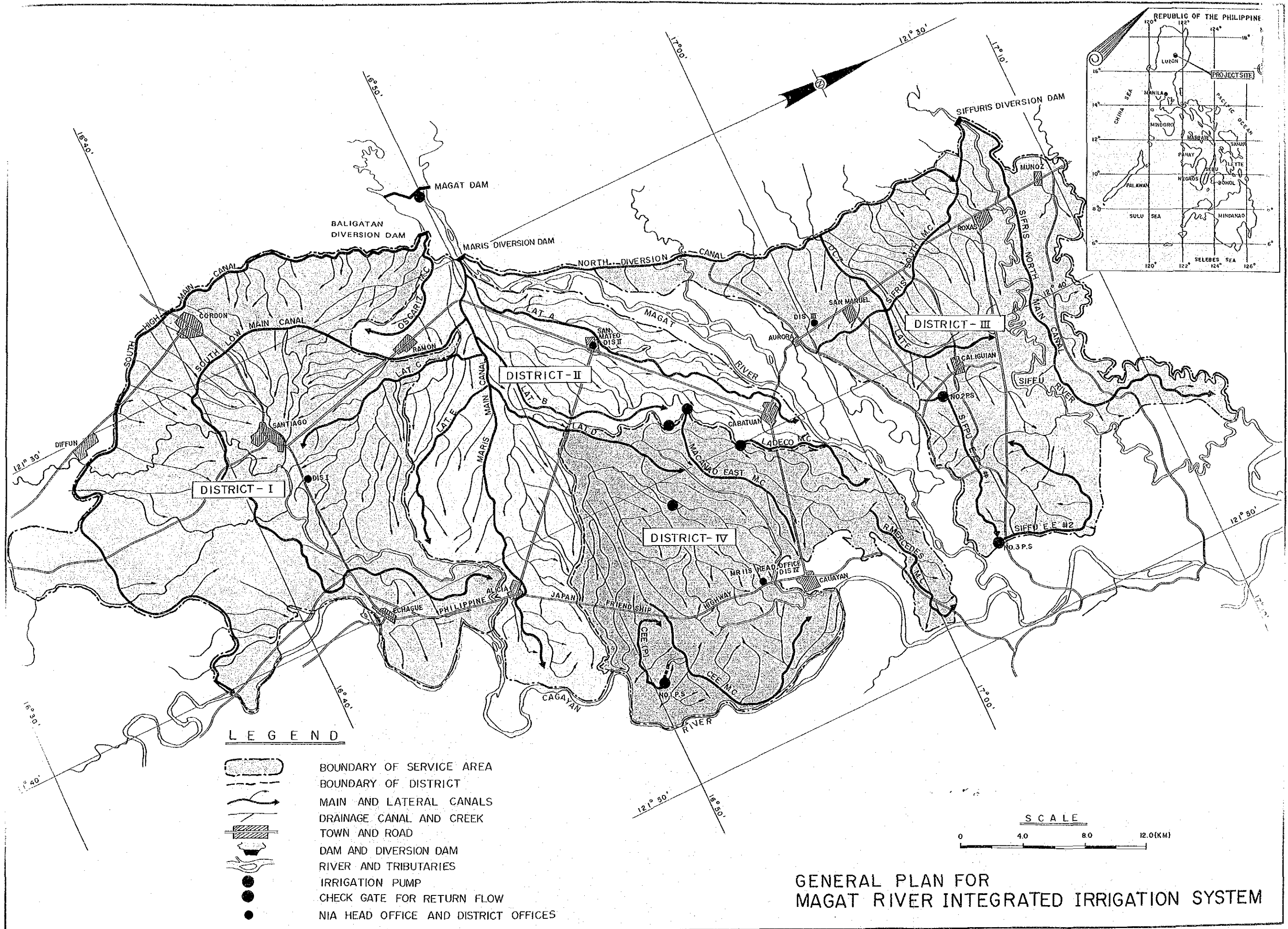
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JAPAN INTERNATIONAL COOPERATION AGENCY

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1. INTRODUCTION

1. INTRODUCTION

The Magat River Integrated Irrigation System (MRIIS) has been developed by the National Irrigation Administration (NIA) to make the better use of the water resources in the Magat river flowing through the Cagayan Valley in Luzon, the Philippines, and to contribute to the development of irrigation for 97,400 ha of paddy field and generation for 360 MW of hydroelectric power. The MRIIS is composed of such major facilities as the Magat reservoir with storage capacity of about 1,250 MCM, three diversion dams of Maris, Baligatan, and Siffuris, three pumping stations and irrigation canals of about 1,500 km in total.

NIA started construction of the system facilities in 1960's and made staged development to complete the construction of almost of the major facilities in 1983. The MRIIS, costing about 10 billion pesos in total investment in the present worth value, is one of the largest scale irrigation systems with hydroelectric power generation in the country.

The total irrigation Service Areas of about 97,400 ha extend over parts of three provinces of Isabela, Quirino and Ifugao, including 23 Municipalities and 462 Barangay, and about 569,000 beneficiaries in total.

The irrigation by the system is expected to enable the annual paddy production in the MRIIS area to reach about 760,000 tons by raise of cropping intensity to 200 percent throughout the wet and dry seasons. The said paddy production can fully meet not only the demands of the MRIIS Service Areas and Region II, but also about 23 percent of the deficit in the Region IV including Metro-Manila. Consequently, the paddy production by the MRIIS plays a vitally important role in preparing the national food supply policy of the Philippines.

In other respect, the hydroelectric power output by the Magat dam is about 1,000 GWH/annum, which occupies about 30 percent of the annual total output in the Luzon hydroelectric power generation as a major supplier of the power for peak load in the dry season and base load in the wet season.

The MRIIS Operation and Maintenance (O/M) Office was established in 1984 by NIA for practicing comprehensive O/M works for the system, and is staffed with about 910 personnel to render O/M services for those facilities of reservoirs, diversion dams, canals, etc, while the O/M works for the Magat hydroelectric power plant have been practiced by NPC independently from the MRIIS O/M Office.

Since, however, the MRIIS O/M Office has held many problems in routine services as discussed in Chapter II, "Present Status of MRIIS O/M", the Office has not functioned so well as expected in the original programme. And absence of water management and maintenance for the system facilities has resulted in advancing deterioration to lose their functions as time passes. Such deterioration will cause not only the losses of national properties but adverse effect to the paddy production in the MRIIS area, and finally may bring hindrances to make the national food supply policy.

Under the circumstances, NIA, considering improvement of O/M services as important issues, has requested the Government of Japan for the technical cooperation on the Master Plan Study for Improvement Project of the O/M of the MRIIS. In response to the request, the Government of Japan carried out the said study in a period between March 1986 and March 1987 through the Japan International Cooperation Agency (JICA), the executing body of the government, and the Master Plan has been formulated in July, 1987.

And the Report summarizes the Project Plan for O/M improvement of the MRIIS according to the Master Plan Study.

2. PRESENT STATUS OF THE MRIIS O/M

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2.1. Present Irrigation Area

The targeted irrigation area in the MRIIS is defined to be 97,400 ha and the area is divided into four Districts from the viewpoint of the O/M works in the area as shown below. Each District is divided further into Divisions with an area of about 700 to 1,200 ha on an average.

District I	:	24,054 ha
District II	:	24,468
District III	:	24,793
District IV	:	24,087
<u>Total</u>		<u>97,402</u>

The irrigation area has been expanded year by year in accordance with the development progress of the MRIIS. Especially, after completion of the Magat dam in 1983, the irrigation area was rapidly expanded to the area of about 71,100 ha in 1986 in providing necessary irrigation facilities. However, about 26,300 ha of land still remains as unirrigated due to the following reasons;

i) Undeveloped	:	13,220 ha
ii) Lack of on-farm facilities	:	6,700
iii) High elevation to result in difficulty in irrigation	:	1,230
iv) Drainage problem	:	1,800
v) Financial problem	:	2,050
vi) Others	:	1,340
<u>Total</u>	:	<u>26,340</u>

2.2. Management of Irrigation Water

(1) Present Water Demand and Supply

The service area of 97,400 ha is irrigated presently by the following canal systems;

i)	Maris Main Canal System	:	46,000 ha
ii)	South High and Oscariz Main Canal System	:	12,700
iii)	South Low Main Canal System	:	7,900
iv)	North Diversion Main Canal System	:	13,600
v)	Siffu South Main Canal System	:	8,200
vi)	Siffu North Main Canal System	:	3,000
vii)	Macanao and Ladeco Return Flow System	:	6,000
	<u>Total</u>	:	<u>97,400</u>

The request and allocation of irrigation water have been conducted based on the following rule;

- Water Master (WM) shall grasp, at first, the acreage of paddy fields for irrigation services requested by Irrigators' Association (IA) and the irrigation schedules specified into four stages of land soaking, land preparation, vegetation and reproduction by Divisions and weeks.
- WM shall estimate the necessary irrigation water based on the requested areas and the unit irrigation requirement indicated in the existing O/M Manual after approval of District Manager on the weekly basis.
- The Water Control Coordination Section (WCCS) in the MRIIS O/M Head Office shall review the requested irrigation water taking into account effective rainfall, irrigation water depth at paddy fields and remaining reservoir water in the Magat dam, and then determine the final allocation of irrigation water for each District and the outflow from reservoir and diversion dams.
- The amount of the irrigation water to be allocated to the Diversion and the outflow from reservoir and diversion dams are instructed to each District Office by the MRIIS O/M Head Office manager, and the water management and control are to be made according to the instructions.

However, water request and allocation of irrigation water have not been properly made, and then the upstream area has a tendency to require much irrigation water in the dry season and the downstream area has always suffered from shortage of irrigation water. On the other hand, since the excess irrigation water is delivered to the downstream canal through the upstream canal in the wet season, inundation damage takes place in the downstream area.

Under such a poor irrigation water management, water shortage and inundation problems mentioned above will become critical year by year depending upon expansion of irrigation area from about 71,100 ha at present to the target area of 97,400 ha.

(2) Operation of Dam and Reservoirs

(a) Operation of Magat Dam

Water management performed at the Magat reservoir comprises hydrological monitoring to forecast floods entering into the reservoir and outflow control at the Magat hydroelectric power plant, Baligatan outlet and spillway. These works have been made mainly by the Dam and Reservoir District of the MRIIS except the outflow control at the Magat hydroelectric power Plant under direct administration of National Power Corporation (NPC).

The Magat reservoir operation is considered to be still in the initial or preliminary stage judging from the water level fluctuation in 1984 and 1985 to show the fact that the operation has not always been made in following the operation rule curve, although commenced at the beginning of 1983 in application of the operation rule given in the existing MRIIS O/M Manual.

(b) Water Management in Diversion Dam

The diversion dams, Maris, Siffuris and Baligatan, play an important function in the MRIIS to introduce the irrigation water in the Service Area. However, the water management in diversion dam except the Baligatan has not been done adequately due to some difficulties mentioned follow;

- The defects of the gates
- The defects of the measuring devices for water level and discharge
- The time-worn gate mechanism
- Unskillfulness of operators

Maris Diversion Dam

The function of the Maris diversion dam is to re-regulate the peak outflow released through Magat hydroelectric power plant and to divert the irrigation water into the both Maris and North diversion main canals with the maximum capacity of 121.5 and 59.0 cu.m/sec respectively. However, this outflow control is not always made properly and timely at present since the water level in the Maris re-regulation pond fluctuates considerably depending upon the magnitude of peak discharge released through the power plant, and therefore, the intake water into the Maris main canal and NDC also fluctuates remarkably.

It would be difficult to maintain the diversion water requested by the MRIIS O/M Head Offices at the upper reach of the Maris main canal without any improvement of operation mechanism of intake gates in the diversion dam.

Baligatan Diversion Dam

The function of Baligatan diversion dam is to take the water released from the Baligatan outlet and to deliver it to the South High and Oscariz main canals. The outflow control at the Baligatan outlet as well as at the Baligatan diversion dam is made directly by the Dam and Reservoir District.

Baligatan hydroelectric power plant is under construction by NIA, but the outflow through the Baligatan outlet for hydroelectric power generations will be released in equivalent amount of water to irrigation diversion demand on the hourly basis without any fluctuation.

The present operation of intake gate for the both main canals is made satisfactorily by manual operation except interruption of current supply to the Baligatan outlet works of the Magat dam.

Siffuris Diversion Dam

The Siffuris diversion dam is constructed upstream of the Siffu river in order to take the river flow and to introduce it into the North and South main canals which have the maximum capacity of 13.6 and 5.2 cu.m/sec respectively.

The intake discharge amount at the Siffuris diversion dam has a considerable fluctuation due to non-control of the river water, so that insufficient water amount for irrigation to the South main canal service area can be covered by the water supplied from the Magat dam through the North diversion canal. Therefore, the important O/M works at the Siffuris diversion dam are articulated below;

- Adequate intake gate control for irrigation
- Observation and monitoring of river flow
- Decision and request of water demand for supplemental supply from Magat dam

(3) Water Management in Canal System

According to the general view of the MRIIS Area, the irrigation canal networks in the area extend like ribs of a fan headed by the Maris diversion dam for the vast service area. However, there still remain several difficulties in operation of the canal system as mentioned below;

- Water distribution control in the canal with a long distance of about 1,500 km is very difficult, because the discharge amount at each check, head and turn-out gate positions is not properly allocated on demand at the service area. The time lag in water delivery also occurs in the canal system because of the characteristics of water conveyance resulting from length of the canals.

- The end portion of the main canals is constructed as additional extension works by stages, and consequently there are inconsistency on standard of design and capacity of canals observed between the former and the latter extension works.
- Observation and measuring devices for water delivery and allocation are provided insufficiently.
- There are so many damaged canal facilities such as turn-out gates and road crossing structures over the canal systems.
- The collection, arrangement and management of information for water allocation are not made sufficiently.
- The water distribution techniques and method have not yet been mastered well.
- Paddy in the vast service area cannot be planted in order within planned period because some of the farmers have been in financial difficulty to plant paddy on time as well as suffered from water shortage in the early stage of planting.

According to the canal flow measurement and comparison of discharge in the field survey, the differences of discharges in the main and lateral canals between allocated irrigation requirement and actual canal flow range from 20 to 40 percent in the main canal and from 30 to 60 percent in the laterals.

(4) Water Management at On-farm Level

Irrigation water will be supplied finally to each farm plot by farmers under IA and Farmers Irrigators' Group (FIG), but at present, individual water distribution by plot-to-plot irrigation without any regulation prevails in the whole Service Area, because water users' group and their roles have not been established yet.

The field survey found out that the density of main and supplementary farm ditches at on-farm level is very low with only 25 m/ha. The fact causes an inadequate water management at on-farm

level, and therefore the on-farm facilities including farm ditches, farm drains and farm roads should be improved in the project.

2.3. Maintenance of System Facilities

(1) Dam and Diversion Dams

The construction of the Magat dam was completed in 1982 and reservoir operation has been made by NIA without any problems in terms of facilities. Therefore, no repairing works are found at present.

The original Maris diversion dam was constructed by the Ministry of Public Works in 1957 and reconstructed in 1979 as a re-regulation pond of the Magat dam. Although no particular problems are found on the structure, some of intake gates are time-worn and can not stand for operation. Furthermore, hourly fluctuation of reservoir water level is so remarkable that water intake control at the diversion damsite can not be done properly.

Baligatan diversion dam is maintained in good conditions, and there are no problems at all for operation. The sand sluice gates of the Siffuris diversion dam are deteriorated and their functions have been lost to result in difficulty in water management by diversion dam.

(2) Canal Systems

There are 15 main canals with the capacities ranging from 120 cu.m/sec to 0.5 cu.m/sec and a number of laterals and sub-laterals with the capacities ranging from 35 cu.m/sec for the largest canal and less than 0.1 cu.m/sec for the smallest. Due to lack of budget for O/M, silting and scouring of the canal are remarkably heavy, and therefore, rehabilitation/upgrading works are essential subjects to be implemented in the early stage. Some gates have been broken to need repair.

(3) Drainage Canals

Most of the drainage canals and creeks in the Service Area have come to malfunction due to lack of their maintenance works, and some areas along the drainage canals and creeks are distressed by inundation in the wet season.

(4) Pumps

There are three pumping stations in the Service Area which have been in operation since 1984, although not in full. This is because of i) high cost of power, ii) yet-fully undeveloped area and iii) some mechanical defect in the pumps.

(5) Roads

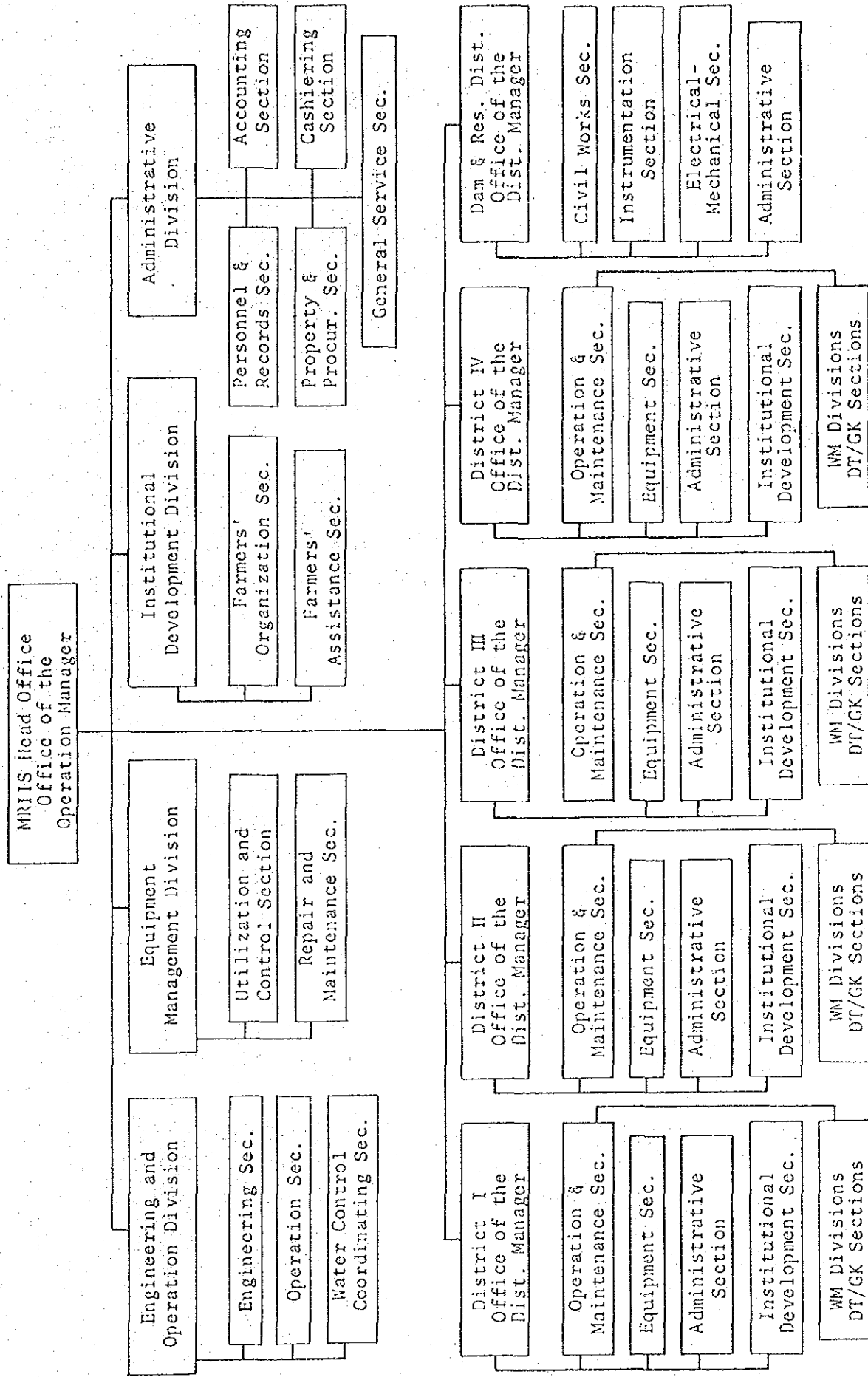
Although O/M road networks along irrigation canals have been established in the whole Service Area, the pavement of the existing roads is not well maintained due to lack of O/M budget. Therefore, the proper road paving works for the major roads will be needed to practice effective water management as well as operation and maintenance of the system facilities.

2.4. Operation and Maintenance Activities

(1) Organization and Functions

The organization for the MRIIS O/M was established in 1984 after completion of the major implementation works of the MRMP. The organization consists of MRIIS O/M Head Office to manage District Offices, Dam and Reservoir District to carry out the O/M works for the Magat Dam as well as Maris and Baligatan diversion dams, and the four District Offices working for O/M of the irrigation water supply in the canal system (see Figure-1).

FIGURE 1. ORGANIZATION CHART FOR THE MRIS



The present O/M works for the MRIIS cover i) water management and irrigation fee collection, ii) maintenance works of the system facilities, iii) assistance to farmers for on-farm facilities development and iv) establishment of IA. About 910 O/M staffs are assigned to the present organization of the MRIIS.

(2) Water Management

The planning and execution of irrigation water allocation at the system level are conducted by the MRIIS O/M Head Office according to the diversion requirement of the District Offices after summarized in weekly farming progress on each turn-out basis. The water management in the District area is practiced under the responsibility of Water Master (WM) in dividing WM Division into two sections of Ditch Tender (DT), Gate Keeper (GK) and IAs by contract.

The water management is not always performed well due to following major reasons; the first is the deteriorated canal facilities, and the second is inadequate staffing in WM Division for systematic water control practices, and the last is absence of practical operation manual on water measurement and control.

(3) Maintenance of Facilities

The maintenance works for the system facilities are not made properly due to shortage of budget allocated. As a result, many aged facilities are deteriorated considerably, and therefore, it is necessary to rehabilitate these facilities.

On the contrary, the Magat dam and two diversion dams at Maris and Baligatan are maintained properly by the Dam and Reservoir District Office, supported financially by NIA Central Office.

(4) Institutional Development

There exist about 240 IAs in the MRIIS Service Area, and most of which were organized during the period of MRMP construction. About 140 IAs out of them have been engaged in the O/M works of the facilities along the canal systems on the contract basis instead of the MRIIS O/M staff.

The institutional development by the MRIIS organization has not been made actively due to the insufficient number of staffs, shortage of operation budget and equipment, poor agri-supporting activities by government agencies as well as water management service has been inadequate.

(5) Irrigation Fee Collection

The irrigation fee collection efficiency in the MRIIS Service Area is relatively low by 60 to 70 percent against the target amount. There are two major reasons of the low collection efficiency; one is low income of farmers due to high production cost, and the other is low farming productivity due to unsuccessful irrigation service by the existing time-worn system and improper water management in the area.

The total amount of collected irrigation service fee in 1985 was 29.5 million pesos, while the target amount was 49.6 million pesos, and collection efficiency was 66.1 percent. The collected amount is not sufficient to cover the annual total O/M expenditure of the MRIIS.

(6) Income and Expenditure

The total income of the MRIIS O/M in 1985 was 35.4 million pesos, the major sources of which are 29.5 million pesos of irrigation service fee, 3.0 million pesos of cost share from NPC for

Magat dam O/M, and 2.9 million pesos by others. The total expenditure for the MRIIS O/M in 1985 was 45.1 million pesos which is broken down as 5.5 million pesos by the Head Office, 25.0 million pesos by the four District Offices and 14.6 million pesos by the Dam and Reservoir District Office.

The total incomes and expenditures for the MRIIS O/M Head Office and four District Offices in 1985 exclusive of Dam and Reservoir District Office were 32 million pesos and 30.5 million pesos respectively, and balanced approximately. However, the total of incomes and expenditure for the MRIIS O/M inclusive of Dam and Reservoir District in 1985 resulted in large deficit by 9.7 million pesos.

2.5. Agriculture, Agro-Economy and Agricultural Institution

(1) Present Land Use and Soils

The area distribution by land use in the Project Area is as follows;

Paddy Field	:	92,700 ha
Upland Field	:	21,600
Grassland, Woodland	:	22,000
Residential Area	:	5,600
Road, River Course	:	6,400
Canal, Creek	:	3,900
Others	:	12,600
<u>Total</u>		<u>164,800</u>

According to the MRMP Feasibility Study Report (1973), it is estimated that about 93 percent of the MRIIS Service Area with 97,400 ha is classified into the first to third class paddy land, while the remaining areas are in Dual class land. Most parts of the flood plain area are not classified as 2R or 3R class paddy land in the above Feasibility Report, although it is observed that most of these lands are permeable in nature of soil for paddy fields with the large amount of irrigation water requirement and reclassified into the first class land suitable for diversified crops.

(2) Agrarian Reform and Land Ownership

According to the data of Ministry of Agrarian Reform (MAR) and the MRIIS O/M Offices, about 15 percent of cultivators in the MRIIS are the beneficiaries in the program of the Operation of Land Transfer (OLT), who have to amortize the cost for the operation lands.

Then, the owner cultivators including amortizing owners under the MAR agrarian program occupy about 47 percent of the total in the Service Area. One of the causes may be that the accomplishment of program of the OLT for more than seven hectares of rice and corn land is still 54 percent of target area.

The other problems on the land tenure are summarized as follows;

- About one third of owner cultivators are the amortizing owners who have to pay for amortization cost of lands. But few amortizing owners pay for said cost because their incomes are not sufficient.
- The number of landless farm laborer households occupies about 20 percent of the total households in the Service Area. These households have no stable income sources nor benefits from the agrarian program.

The average size of paddy field per farm in 1985 is estimated at 1.9 ha according to the farm economic survey. The data on the distribution of farms by sizes of irrigated areas show that the number of paddy cultivators with the farms of 1.0 to 2.0 ha has the largest share.

(3) Present Cropping Pattern and Farming Practices

The double cropping of paddy is planned to be introduced in the whole Service Area according to the MRMP Project Design Report. However, irrigated paddy cropping is carried out in 1985 in

the area of only about 65,500 ha in the wet season and 65,700 ha in the dry season. And the triple paddy cropping is practiced in the fields of about 200 ha with annual intensity of 148 percent for existing irrigation area, where the irrigated area by the MRIIS are registered at 69,100 ha in the wet season of 1985. The irrigated area increased to 71,100 ha in the wet season of 1986, while the data on the cropped area was not yet obtained at the end of November in 1986.

The difference in annual planting acreage between the target and the actual is derived from the less irrigation service area and also less cropping intensity in the irrigation service area. The cropping intensity for the paddy planting area in the actual service area is as high as more than 175 percent in the upstream areas of the MRIIS, while that in the downstream area is 95 percent on an average, by 23 percent at the lowest. Paddy plantation in the downstream area tend to delay by about one to two months as compared with the projected cropping calendar.

One of major problems on the paddy cultivation practices in the area is that, most farmers sell paddy undried because of i) delayed harvest of wet season paddy, ii) inefficient works from reaping to harvesting, and iii) absence of suitable drying yard. The farmers used to carry out traditional sun-dry for paddy drying only frequently to lead spoiling paddy quality in the wet season.

(4) Crop Production and Productivity

High yield in paddy cropping is attained only in the upstream areas, where the average yield ranges from 4.0 to 5.0 tons/ha in terms of paddy converted to dried paddy for both the wet and dry season crops, whereas the average paddy yields in most of the downstream areas is as low as less than 2.0 tons/ha (see Figure-2). An average paddy yield in the whole Service Area is 3.2 tons/ha. The total paddy production in 1985 is estimated at about 420,000 tons including 193,000 tons for wet season paddy and 227,000 tons for dry season paddy, respectively.

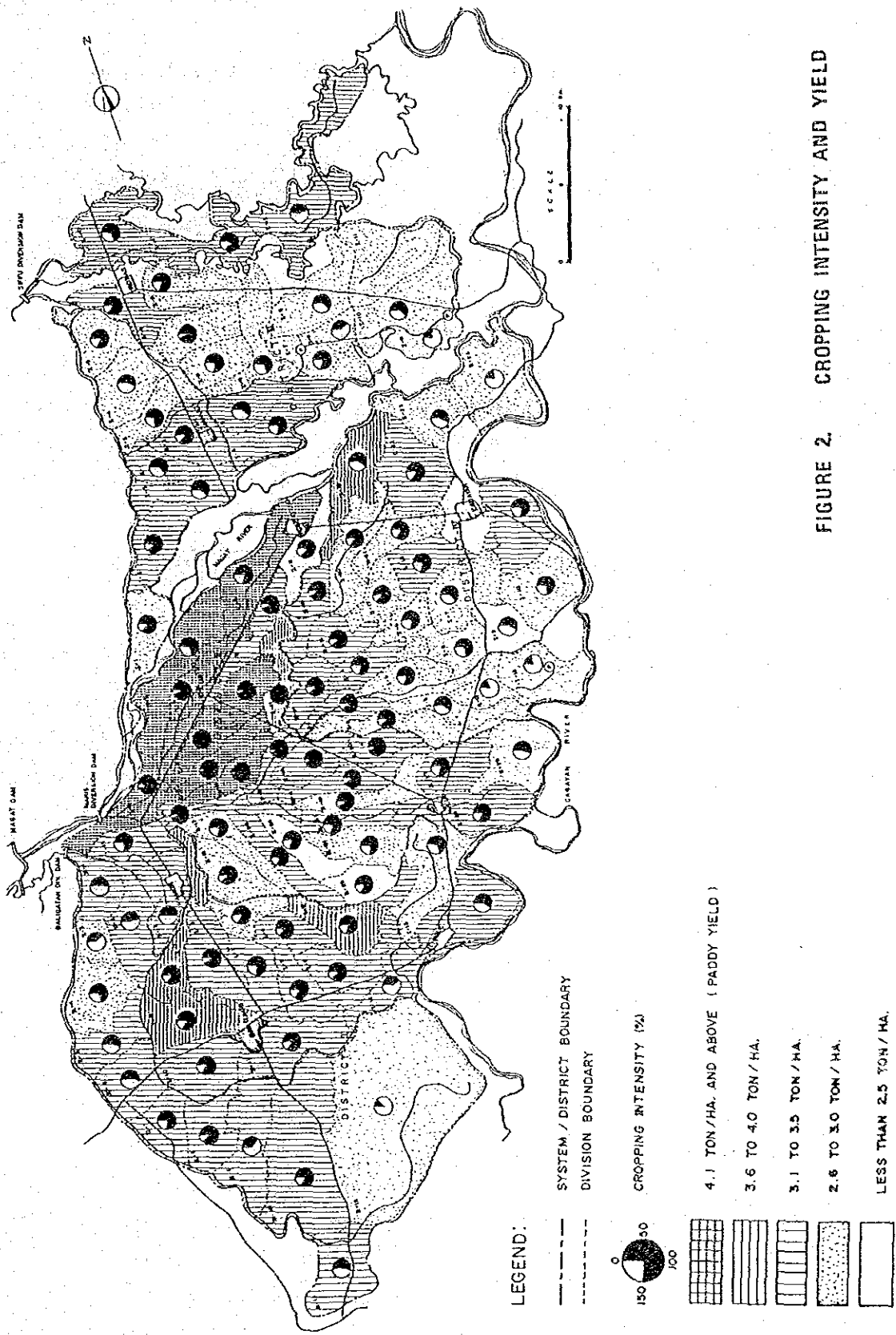


FIGURE 2. CROPPING INTENSITY AND YIELD

(5) Demand and Supply of Rice

The estimated surplus of rice in the MRIIS area is about 184 thousand tons, which occupies about 50 percent of the surplus in Region II in 1985 and can cover about 13 percent of the rice demand and 23 percent of the deficit in Region IV. Therefore, the MRIIS area is considered most stable as a base to supply the surplus rice in Manila at present not only in Region II but in whole country.

Region II is also one of the large corn producer with surplus in the country. But, the other products than grains, sugarcane and beans, especially fruits/vegetable and fish are deficient. The paddy procured by NFA is only six percent of the total production at present.

(6) Paddy Production Cost

Average paddy production cost for owner farmers is 6,720 pesos/ha, in which the costs of machinery and hired labor hold a large share. The average labor requirement for paddy cultivation is estimated at 90 to 100 man-days/ha in the MRIIS area. About 60 percent of the total labor requirement is supplied by hired laborer for transplanting and harvesting works.

(7) Farm Income and Family Expenditure

Based on the field survey and collected data, the MRIIS area could be divided into the following three areas from the viewpoint of farm income;

- i) Area "A": The upstream area of District II, which has favorable conditions of soils of Dual class land for paddy cultivation and can be irrigated firstly in the MRIIS area. The area coverage is about ten percent of the total MRIIS area. The average farm income from paddy cultivation is estimated at 21,100 pesos per farm by the average yield of 4.6 tons/ha.

- ii) Area "B": The upstream and middle-stream of the MRIIS area except for the above Area "A", which has the relatively favorable soil productivity for paddy cropping. Most of the paddy fields have been reclaimed recently and the area coverage is about 60 percent. The average farm income is 12,400 pesos per farm by the average yield of 3.2 tons/ha.

- iii) Area "C": The downstream area of the MRIIS area, where the on-time irrigation cannot be practised for most of the paddy fields due to some problems with operation and maintenance of the irrigation facilities. The area also has a drainage problems in crop cultivation and farming works. The area covers about 30 percent of the MRIIS area. The average farm income is low at 8,900 pesos per farm by the average yield of 2.7 tons/ha.

The living cost is estimated at 10,000 pesos at minimum per annum per household based on the per capita minimum annual living cost at 2,000 pesos. For the farmers in the area "C", the minimum living expenditure can not be covered only by the income from paddy cultivation.

(8) Farm Inputs Supply and Processing

There are many registered agricultural input dealers handling fertilizer, agro-chemicals and farm machinery in the MRIIS area. However, price of agricultural inputs, especially the rental charge of machinery supplied by dealers is considerably high. Therefore, farmers can not obtain enough income.

It is estimated that there is enough capacity of rice mills and warehouses of NFA and various facilities by private sector. But most of the existing rice mills and warehouses except for those facilities owned by NFA and large scaled rice mills are already old and deteriorated and remoted from the facilities.

(9) Farmer's Organization

Three kinds of water-based farmers' organizations have been established in the Service Area. They are FIG, IA and District Federation of IA (DFIA). The present status and problems of these organizations are summarized as follows;

- The number of cultivators of IA is still little by 40 percent of the total cultivators. In the MRIIS area, the existing IAs cover only about 40,760 ha or about 50 percent of the whole MRIIS Service Area.
- As of July 1986, 150 IAs out of existing 240 IAs accepted lateral turnover contracts covering an area of 27,300 ha, equivalent to 66 percent of 40,760 ha.
- The result of the evaluation of activities of the existing 240 IAs shows that 57 percent of IAs is relatively active but the remaining 43 percent is inactive.
- The DFIA is established in each District, however, its functions are limited because the members of IAs are scattered in each District area and full participation of cultivators is not attained in most IA, which is substructure of DFIA.

(10) Agricultural Credit

According to the farm economic survey in the MRIIS area, the paddy production loan is supported by public financial institution as well as by informal sources. It is observed that about 70 percent of the sample farms has the debt for both wet and dry season cropping. Out of 70 percent, 50 percent of farms gets credit from informal sources, and the remaining 20 percent receive credit from banks and NFA.

The interest rate by informal sources is 35 to 45 percent per one cropping season for three to four months. This high interest rate by informal sources is a burden to the borrower farmers.