As existing computer system has insufficient performance for extensive use of proposed data management works, new computer system with adequate performance and capacity should be introduced by the MRIIS Head Office.

3.4.2. Improvement of O/M Organizations

Head Office

The organization of the MRIIS Head Office is not changed in principle, however, the function of the Head Office have need to strengthen for the following subjects:

- The Water Control Coordination Section (WCCS) will have the most important role for water control in system level, in this connection, the WCCS should have more staff and adequate facilities for water and hydrological data collection and management.
- The Engineering Section will also be strengthened a little taking into account the plan and design for the improvement works of system facilities as well as data management on maintenance works for facilities.
- The function of data management under the Operation Manager should be expanded with more staff and computer system with corresponding performance of future requirement.

The responsibility for water allocation work of the MRIIS Head Office in Maris main canal between the head gate and Lateral-D head gate will be transferred to Dam and Reservoir District Office.

Dam and Reservoir District

A Water control Section will be organized under the Office of Operation Manager in order to manage water by a synthetic organization.

The new organization will conduct water control from the dam and two diversion dams and hydro-meteorological management in the drainage area of the reservoir as well as water diversion control in the upper section of the Maris main canal under the direction of WCCS in the MRIIS Head Office.

Districts in Service Area

The staffing of WM Division will be reviced to have more performance for water management practice correspond with proposed improvement of water allocation system. The GK and DT will assist WM in all O/M works in charge of WM Division especially for the following activities:

- Two GKs and one DT will be assigned for every WM Division instead of existing staffing pattern of WM Division.
- The GKs are responsible for water management in each Division, who will practice water supply control of canal by the cooperation works with GKs assigned to adjoining WM Divisions and allocate water at every terminal turn-out.
- The DT will assist WM mainly for institutional works especially for federating and farmer assisting works. The position of DT will be terminated when proposed IA federation (IAF) is duly established.
- The responsibility for water control and distribution will be transferred to IAF when it is organized satisfactory so as to be able to manage water by themselves as well as desires to do it.

The Operation and Maintenance Section will be strengthened more taking into account the technical assistance for on-farm facilities development conducted by IAs as well as for preparation of updated cadastral map in WM Division level.

The function of Equipment Section will be expanded to deal with maintenance and rehabilitation work of mechanical facilities by utilizing mechanical staff and equipment for steel works in the cooperation works with heavy equipment.

3.4.3. Irrigation Fee Collection

The collection status at WM Division level will be monitored by proposed data management system on weekly basis for the use of evaluation on the performance of O/M staff and IAs as well as for preparation of future scheduling for O/m activity.

The insufficient capacity of post harvest facility provided by each District will induce to suspension of collection activity in the near future. Accordingly, the post harvest facilities of District Offices should be improved at the earliest period.

The amount of irrigation fee collection after the implementation of the proposed improvement work is estimated to be 75.4 million pesos as shown in the following table.

Target of Irrigation Service Fee Collection

(Unit: '000 pesos)

Season	Kind of System	Benefited Area (ha)	Rate (%)	Collectible	Collection	Rate (%)
Wet	Gravity	82,000	92	28,700		
	Pump	7,600	92	6,650		
	Sub-Total	89,600	92	35,350	28,280	80
Dry	Gravity	82,000	92	43,050		
	Pump	7,600	92	9,310		
	Sub-Total	89,600	92	52,360	47,120	90
Total Amount		179,200	92	87,720	75,400	86

3.4.4. Additional Income from Power Generation

(1) Cost Allocation of Magat Dam and Reservoir

The developed water resources by the Magat dam has been utilized for irrigation and power generation, and the benefit provided by irrigation and power will be equivalent for each

terminal value in the full irrigation development stage. Accordingly, the gross O/M expenditure for the Magat dam should be share at the rate of 50 and 50 by two agencies.

As the Magat dam is one of the most valuable infrastructure of the country not only for two agencies, in this connection, NIA should take effort to increase O/M budget allocation by the increase of income from NPC considering the following subjects into the item for the cost allocation:

- The all O/M expenditure of Dam and Reservoir District except for the Baligatan outlet works and related facilities,
- A part of O/M expenditure of the MRIIS Head Office concerned with the reservoir operation and data management inclusive of overhead.

(2) Income from Baligatan Power Plant

The generated power by Baligatan power plant will be utilized for three pump irrigation systems developed in the District III and IV areas at the first priority within Service Area. The surplus power generated by the plant will be sold to NPC according to the current agreement contracted by two agencies in September 1985.

The volume of power generated after the full irrigation development is estimated to be 17.7 GWH, and the amount is 18.6 million pesos which is estimated based on the assumed selling price of 1.05 pesos per kilowatt to NPC.

3.4.5. Proposed Income and Expenditure

Proposed income and expenditure after the implementation of improvement project is estimated and summarized in the following table, and the system will be managed properly with the developed

income, although it will be still insufficient in amount of irrigation fee collection and NPC cost allocation to cover the total operation budget.

Proposed Income and Expenditure for MRIIS O/M

(unit: ₱000)

Particulars	Head Office	Dam & Reservoir	4 Dist.	Total
Income				
Irrigation Service Fee	-	-	75,400	75,400
NPC Cost Share	-	7,300	-	7,300
Baligatan Power	-	18,600	-	18,600
Others	-	500	2,200	2,700
Total Income	-	26,400	77,600	104,000
Expenditure				
Personnel Service	3,100	6,100	18,800	28,000
Administration and General expenditure	1,890	1,840	4,770	8,500
Depreciation and Repair Cost	190	880	7,830	8,900
Fuel and Oil	70	80	720	870
Maintenance of Facilities	1,000	4,500	14,470	19,970
Power Cost for Pump	-	-	16,330	16,330
Contingency	550	1,300	5,580	7,430
Total Expenditure	6,800	14,700	68,500	90,000

3.4.6. Technical Assistance by Qualified Expert

In order to materialize proposed improvement works for operation and maintenance works, as proposed by the Study Team in this report, it is required to have a technical assistance by qualified experts to assist O/M staff with their planning and practice on the improvement works as well as technology transfer through the on-the-job training.

- NIA has extensive experience and staff in the planning, design and construction of irrigation projects through the number of foreign assisted project implementation since the agency was established. And these projects has been assisted by qualified experts those who have advanced technology and experience in the field of project development and implementation.

- On the contrary, O/M staff assigned to the systems of NIA has been few opportunity to receive the advanced qualified technology efficient for practical O/M works through technical staff, except only in the field of water management practices.

- The NIA has developed only two integrated irrigation systems having an irrigation area of about 100,000 ha, and the O/M experience is only in several years. And these projects was transferred to the O/M Department after its completion without any practical O/M manual.

The field of experts required for the assistance by the qualified experts will be irrigation and drainage, water management, application programming, design of on-farm facilities, design of irrigation facilities improvement and strengthening of irrigators' association, etc.

3.5. Improvement of Agriculture, Agro-Economy and Agricultural Institution

3.5.1. Improvement of Paddy Production

(1) Improvement of Cropping Pattern

According to the statistical data on the national-wise paddy production, the MRIIS area is most stabilized base not only in Region II but also in whole country to supply the surplus paddy to Region IV area, because the other Regions have small surplus amount or no possibility to increase the surplus amount. About 93 percent of total Service Area equivalent to 90,100 ha, are paddy lands which are suited for paddy cultivation exclusively, while the remaining area of 7,300 ha belongs to the Dual or diversified crop lands on the basis of land classification. Most of Dual class land will be used to grow paddy only because other crops except for minor crops like vegetables have less expected return than paddy in these lands.

Under the conditions, double cropping of paddy cultivation will be made exclusively in the paddy land and the most of Dual class land in the Service Area, where the area coverage of paddy double cropping area will be expanded in accordance with the improvement of irrigation and drainage.

As for the calendar of paddy double cropping, the delay of paddy planting in the wet season causes not only the low paddy yield with poor quality but also disturbance of cropping schedule in the dry season. Then, other disturbances like the increasing year-round infestation of pests and the decreasing soil bearing capacity, which would be derived from no-drying period of fields owing to two tight cropping schedules of wet and dry season paddy will be induced. Therefore, the following improvement would be required;

According to the collected data on the suitable paddy varieties from BPI research institutions, the growth period of recommendable varieties is 100 to 125 days from sowing to harvesting for

transplanted paddy (see Annex J). Then, the same durations of land soaking/preparation, crop maintenance to those in the existing O/M Manual, which are 35 days and 84 days are taken to prepare the standard proposed cropping calendar as shown in Figure 3-6. The lag period is 45 days, which seems to be proper target.

The planting time of the wet season paddy in the double cropping of paddy should be accelerated at early stage between May to June and its harvest should be completed at the end of August to September before continuous heavy rain months. The improved cropping calendar in each irrigation subsystem on the basis of the above said standard cropping calendar is proposed.

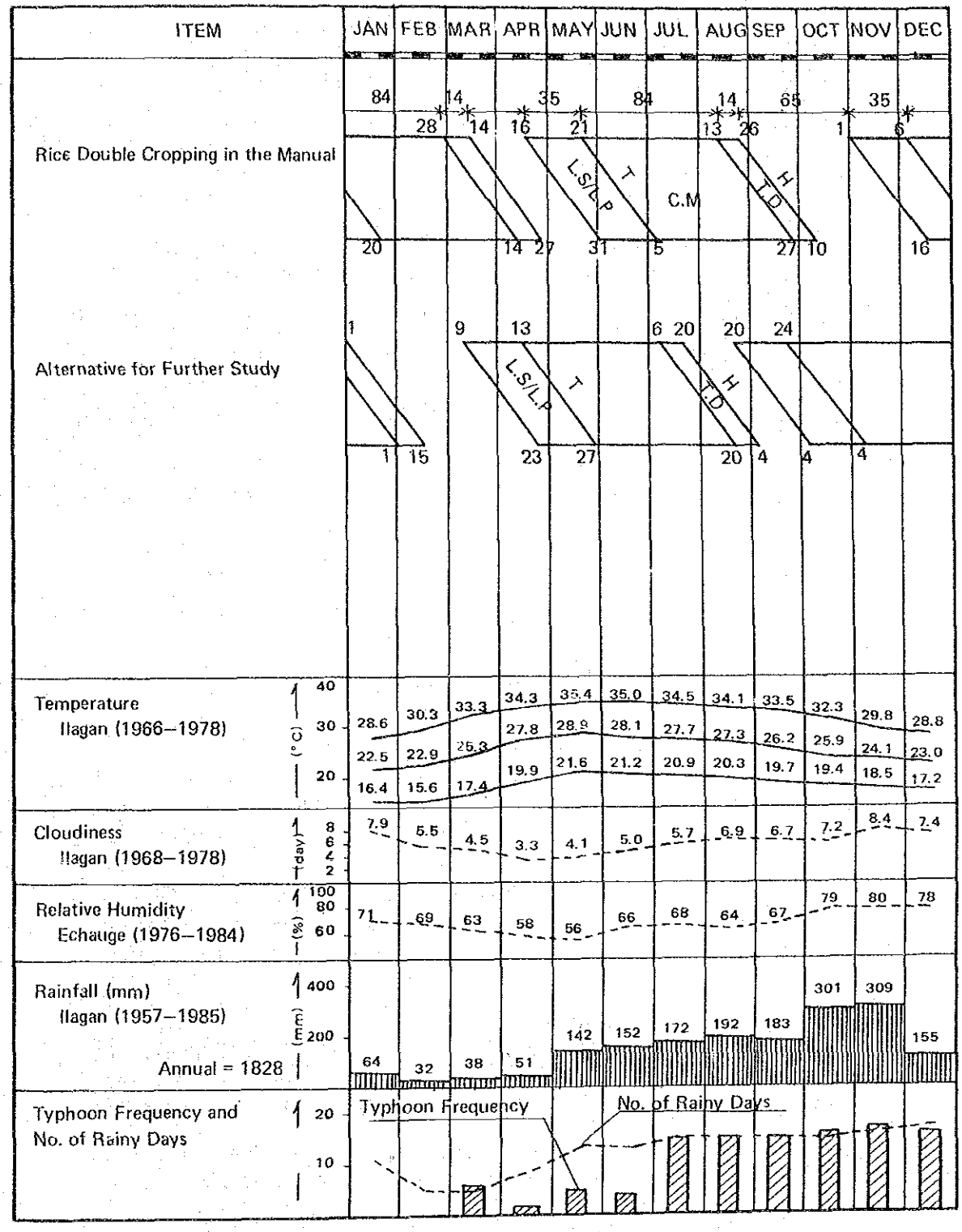
The present area coverage of direct seeding will be increased to minimize labor cost, especially in case of dry season crop. However, the applied area of direct seeding limits to the areas where precise water control in accordance with seedlings' establishment is possible to apply. Eventually, it is considered to counteract the increased water consumption of direct seeded paddy due to the prolonged irrigation period in the fields, by means of applying the shorter growth period varieties with less lag period than 45 days.

(2) Improvement of Farming Input

Although the upstream and middlestream areas start the cultivation of the wet season paddy at June to July at present, their paddy productions are still low as 3.0 to 3.5 tons/ha, except that in the upstream area in the District II. An average production of the dry season paddy is 3.5 tons/ha which is still lower than the target production of more than 4.0 tons/ha.

This reason is mostly caused by the low farming input such as low quality of seed, low amount of fertilizer and agro-chemical.

FIGURE 3-6. STANDARD PROPOSED CROPPING CALENDAR



Note. L.S:Land Soaking, L.P:Land Preparation, T:Transplanting
T.D:Terminal Drainage, H:Harvesting

The present fertilizer input is about 50 percent against the standard one instructed by the Bureau of Soil. To improve this problems, the increase of production loan is required.

The farming input shall be improved by the proper guidance of extension service staff under the Ministry of Agriculture and Food.

(3) Increase of Irrigation Area

As mentioned previously the present irrigation area in the MRIIS is about 71,000 ha and the area of about 26,400 ha is remained as the unirrigated area which cannot cultivate paddy.

Although the irrigation area might be increased a little in the case without the improvement of O/M works, its increasing growth rate will be very slow and the irrigation area never reach the target area of 97,400 ha. The increment of irrigation area with and without the improvement of O/M works is estimated on each District basis taking into account the present conditions of each District as follows;

- District I; There remain many unirrigated areas caused by the undevelopment and lack of on-farm facility, which occupies about 70 percent of total unirrigated area. The present irrigation area might be increased by 85 percent of the target area, depending on farmer's own effort in the case without the O/M improvement project.

- District II; Almost all service areas in the upstream area of District II have been developed with a few unirrigated area. The problem area is mostly concentrated in the downstream area which occupies about 50 percent of total unirrigated area and a part of the unirrigated area might also be developed by farmers own effort with a slow progress even in the case without the improvement project. However, the remained unirrigated area, which are caused by inundation, water shortage, etc. could not be improved in the case without the O/M improvement project. In this connection, the irrigation area without the improvement is estimated at about 90 percent of the target area of 97,400 ha with the improvement project at 1992.

- District III; The unirrigated area caused by undevelopment and lack of on-farm facility occupies a large portion of about 70 percent of total one, which are expanding in the pump irrigation area. This area has rather difficulty to reach the target irrigation area without the improvement of pumping facilities, cropping pattern and water management. Therefore, the irrigation area in 1992 is estimated at about 85 percent of the target area with the improvement project.

- District IV; The unirrigated area in this District occupies the largest one of about 9,300 ha among Districts, because the area meets presently many problems to cultivate with paddy, such as water shortage, inundation, insufficient canal system, etc. Therefore, this irrigation area at 1992 could not be reached to the area more than 75 percent of the target area without the improvement project.

In case of with the O/M improvement project, whole service area in each District will be utilized for the paddy cropping with cropping intensity of 100 percent in the wet season and 90 percent in the dry season.

The annual expanding area of paddy harvesting in the wet and dry seasons from 1986 - 1992 without and with the improvement project is estimated and summarized as follows;

Expansion of Harvesting Area

(unit: ha)

	1986	1987	1988	1989	1990	1991	1992
Without Improvement Project							
Dry Season Paddy	66,900	67,400	67,800	68,300	68,700	69,200	69,200
Wet Season Paddy	69,100	71,000	72,800	74,700	76,500	77,900	77,900
Total	136,000	138,400	140,600	143,000	145,200	147,100	147,100
With Improvement Project							
Dry Season Paddy	69,900	67,400	67,800	71,500	77,100	82,400	87,700
Wet Season Paddy	69,100	71,000	75,100	79,500	85,500	91,500	97,400
Total	136,000	138,400	142,900	151,000	162,600	173,900	185,100

(4) Increment of Paddy Production

The present paddy production per hectare will not increase without the improvement project, because the paddy cultivation applying proper farming practice with optimal cropping calendar could not be made. On the other hand, the paddy production per hectare with improvement project will reach the average target yield of 4.0 to 4.4 tons/ha for the wet and dry season paddy in the Service Area. The paddy yield per hectare with and without the improvement project is estimated in each District as the following table;

Paddy Yield Without and With Improvement Project
(Average of Wet and Dry Season Crop)

(unit: ton/ha)

	1986	1987	1988	1989	1990	1991	1992
1. Without Improvement Project							
District I	3.1	3.1	3.2	3.3	3.4	3.4	3.4
II	3.4	3.5	3.6	3.7	3.8	3.8	3.8
III	2.8	2.9	3.0	3.1	3.2	3.3	3.3
IV	2.9	3.0	3.1	3.1	3.2	3.3	3.3
2. With Improvement Project							
District I	3.1	3.1	3.5	3.5	3.7	3.8	4.0
II	3.4	3.5	3.9	3.9	4.1	4.2	4.4
III	2.8	2.9	3.3	3.3	3.6	3.9	4.1
IV	2.9	3.0	3.4	3.4	3.7	3.9	4.0

A annual growth of paddy production without and with the improvement project is estimated at about 250 thousand tons in 1992 based on the increment of the irrigation area and yield. The estimation result is summarized as follows;

Paddy Production Without and With Improvement Project

(unit: '000 ton)

Item	1986	1987	1988	1989	1990	1991	1992
Without Improvement Project	419	439	458	477	496	510	510
With Improvement Project	419	439	478	537	606	686	764

It is estimated that the rice demand in 2000, based on the NEDA forecasted population, will increase by 30 percent, 40 percent and 30 percent of the present amount for the country, Region IV which includes the Metro Manila area and Region II respectively (see Annex J). On the other hand, the increase of paddy production (middle rice) in 1980s has been limited to about 300 thousand tons, while the increase during 1970s was as much as about 1,700 thousand tons. Then, it is considered that the self-sufficiency of rice in the country will not be attained in 2000, if paddy production will be increased with the same rate which are recorded in 1980s. Therefore, it will be necessary to secure paddy production increase for the future (see Annex J).

3.5.2. Improvement of Paddy Production Cost

It is proposed to employ the following two ways of approach to minimize the production cost, which will contribute to increase farmers income. One is the application of a package of cost-reduced technology, and the other is the strengthening of agricultural supporting services to reduce the production cost for the hired labor and machinery services.

The cost-reduced technology includes such techniques as follows;

i) Proper variety selection and use of quality seeds,

ii) Improved soil fertility practices with saved fertilizer application, including the application of deep plowing, rice straw/compost and Azola.

iii) Intensified water control at plot level according to growth stage,

iv) Integrated pest management system.

Above techniques should be applied as a package technology. For a instance, the selection of proper varieties has close relationship to the integrated pest management, because it should be made on the basis of the latest information of pest occurrence in the Service Area, which are collected from the BPI forecasting system. The system to provide farmers with such extension services which is the proper package of technology applied in the specific paddy fields should be established between the concerned extension service agencies and the farmers' group such as Irrigators' Association (IA) through the coordination works of the MRIIS Institutional Development Division (IDD). The necessary guideline should be prepared to deliver to farmers by IDD. The related strengthening of agricultural supporting services for the establishment of IA Federations (IAF) is shown in the subsequent paragraph.

3.5.3. Improvement of Paddy Quality and Price

(1) Paddy Quality

The existing paddy quality situation is such that most of paddy deteriorates after harvesting in the wet season, especially when paddy is harvested later than the middle of October. To compete with other paddy producing area in marketing and also to raise farmers' income, it will be necessary to keep paddy quality at village level. For this purpose it is proposed to expand dry pavement and to install supplemental mechanical dryers and warehouse at village level through strengthening IAs/IAF, aside from the improvement of cropping calendar to avoid late planting. The proposed program to improve paddy quality in the Service Area is divided into the following two phases;

i) Phase One: Initially in the 24 IAs which covers about 7,200 ha of service area, paddy quality is improved at village level under the test project for the agro-service facilities provided in IAF (the details are shown in the later).

ii) Phase Two: In the remaining about 90,200 ha in the service area, the agro-service facilities are introduced through other IAF, taking into account the result of test project.

Furthermore, the following could be recommended to reduce the losses of the harvested paddy, that is, improvement of cropping calendar, introduction of powered thresher, installation of mechanical dryer and introduction of systematized farming technique.

(2) Paddy Price

The harvested paddy of about 420,000 tons in the MRIIS area is mostly sold to the private market through dealers except sold paddy to the NFA occupying about six percent of total paddy production. Although the selling price of paddy to the NFA is 3.5 pesos/kg in dry condition with moisture content of 14 to 17 percent, while that to be sold to the private dealers is 2.5 to 3.3 pesos/kg.

The paddy price being sold to the dealer from the farmers is generally fluctuated depend on its quality and market conditions as follows;

- Wet paddy with moisture content between 20 and 24 percent is cheap as 2.3 to 2.5 pesos/kg. Farmers in the MRIIS area are forced to sell the wet paddy harvested in October and November to dealers, because they have few chance to dry up paddy by dry yard.

- Dry paddy with moisture content of 14 to 17 percent and skin dry paddy with that of 18 to 20 percent are sold to dealer with a price of 2.8 to 3.2 pesos/kg.

In order to increase the paddy price and also rise up farmer's income, the paddy shall be dried up immediately after harvesting and threshing and kept its quality continuously.

3.5.4. Possibility of Crop Diversification

In the flood plain area where most of the land may be reclassified into the first class for diversified crops land, such upland crops like yellow corn, peanut, mungbean and tobacco will be planted exclusively because higher return from diversified crops than that of paddy double cropping is expected as described previously.

The cropping area of diversified upland crops, mainly vegetables and beans will be also expanded with improvement of on-farm drainage conditions. For vegetables cultivation, irrigation water may be applied in the dry season.

It is desirable to introduce the water-saving cropping patterns such as "the wet season paddy with diversified crops in the dry season", because the net return of dry season paddy is significantly and adversely affected by the expensive pump operation cost. Since soils in the pumping area consist of hard clay with slight acidity in reaction, which is not always suitable for upland crops plantation, soil improvement by deep plowing and use of lime will be considered. One of the suited crop in the area might be sweet potato which will be easily processed to swine feed.

3.5.5. Possibility of Livestock and Inland Fishery

(1) Livestock

The production of livestock and poultry should be promoted as one of the most promissing multiple farming elements in the Project

Area, which will contribute to raise farmers' income with mobilizing the local resources like yellow corn, paddy bran, straw and sliced sweet potato together with commercial feeds.

The back yard and also cooperative farming in the cattle fattening, swine fattening and broiler/layer raising will be promoted in the Project Area. The Bureau of Animal Industry (BAI) and CAVADECO will play important role in the promotion of these livestock and poultry farmings.

Recommended varieties of swine and cattle are dispersed together with the necessary extension services by BAI for the back yard typed farming. The CAVADECO which has been established by the federations of agricultural cooperatives under the project of crop diversification are operating a feed processing factory with the annual operation capacity of 2,000 tons. The CAVADECO also have the plan to provide farmers' group with extension services of establishing cooperative livestock and poultry farming.

(2) Inland Fishery

In accordance with the Fifth Plan (1987 - 1992) prepared by NEDA, the production amounts of inland fishes in Region II are estimated to reach about 1.8 times of present one and the consumption target amount per capita is 38 kg/annum. The present fish production amount in the MRIIS area is 955 tons/annum corresponding to 6 kg/capita, and will be considerably improved in future.

Many fishery ponds will be constructed on villages basis by farmers under the support of the MRIIS O/M Office. The water in the pond shall be introduced directly from the irrigation canal not so as to be polluted by fertilizer and agro-chemicals in the paddy field.

Fish production in pond will be about 4 to 5 tons/ha/annum, which can serve about 200 persons in village in case fish consumption is 20 kg/capita. If each village can construct three to four ponds with one hectare, the demand of village people of about 700 on an average will be satisfied.

3.5.6. Formulation of Model Irrigators' Association Federation (IAF)

(1) Improvement of Irrigators' Association (IA)

The present IA does not carry out its important function related to the water management on IA area basis. The following IA works shall be made sufficiently and accurately in accordance with the guidance and coordination with the Water Master.

- To judge and summarize the actual service area to be irrigated under the IA guiding and instructing FIG and to report its result to the Water Master.
- To judge and arrange the irrigation area and irrigation schedule requested by farmers through FIG on weekly basis and to report the Water Master.
- To manage the allocated water which is instructed by the Water Master on weekly basis so as to distribute it equally to each turn-out controlled by FIG taking into account the rotation irrigation water supply.
- To report the Water Master any change and problem relevant to the water management during irrigation water supply.
- To cooperate the MRIIS O/M Office for collection of irrigation fee.
- To maintain the turn-overed canal by the MRIIS O/M Office in good condition.
- To borrow the required fund to manage IA.

(2) Concept of Model IA Federation

As mentioned in Paragraph 3.5.7 "Improvement of Farmer's Income", the farmers engaging the paddy cultivation in the MRIIS area are placed still low income level, even if they receive sufficient irrigation water and increase the paddy production, so that the farm management on the contract basis with dealer prevailing in the MRIIS area shall be improved.

In order to improve the present farm management, especially to improve the agro-service works carried by dealers to retrench the production cost, it is necessary to establish the IA Federation consisting of three to four IAs which manage the agro-dealers, because individual farmer or one IA cannot have power to provide complete agro-service facilities by his or its own financial scale taking into account the investment cost of the facilities.

As for the scale of IA Federation, a little large scale federation consisting of three IAs covering the area of about 1,000 ha, 30 FIG and 700 farm households will be ideal from viewpoint of the present organized Division by the MRIIS O/M and the organization power to fulfill the following function;

- To request the cooperation for training of water management, repair and improvement of on-farm facilities, repair of agro-service equipment, etc. to the MRIIS O/M Office.
- To request the fund for procurement and operation of agro-service facilities to Banks and NFA.
- To request the improvement of farming practices and the introduction of new farming technology to extension service staff dispatched by MAF to the MRIIS area.
- To negotiate with dealers to procure agricultural equipment and input materials as well as to keep the high selling price of paddy product.
- To borrow the required fund to manage IA.

The organization of IA Federation should be composed of the presidents of IA and its representative is selected among them.

Since the IA Federation will be established to have only function to consider farmer's benefits, it should be operated with only farmers own intension without direct instruction and intension of the governmental agencies concerned, which have only function to carry out the supporting services to the Federation.

NIA should become the core of the supporting agency to IA Federation, because the MRIIS O/M Office is the biggest and the most important agency for farmers in the Service Area and has established, organized and guided to IA for not only the purpose of irrigation water supply but also practical farming activity and farming community.

In addition, the MRIIS O/M Office can easily support the following services to IA Federation under the present O/M organization;

- Repair of agro-service equipment facilitated in IA Federation could be made at O/M motor pool with low cost compared with market repairing cost.
- On-farm facility improvement required by IA Federation could be made with the support of the O/M equipment and staff.

The concept of IA Federation is the first trial in the Philippines, so that the Model of IA Federation should be established at first with the following reasons;

- Prior to establishment of the IA Federation and carrying out the successful operation in the Federation, the consolidated IA with many farmer's members and supported by them should be organized. There are, however, a few consolidated IA at present in the MRIIS area, because IA was established just recently. In this connection, the Model of IA Federation should be proceeded with selecting the consolidated IA.

- The operation of IA Federation may have such procedure so that the Model should be improved in accordance with the its operation result and then the most proper IA Federation will be expanded to the service area.

  The Model will be operated and monitored with full support of governmental agencies, especially with NIA Central Office and the MRIIS O/M Office in order to achieve the successful result.

In case IA Federation is rather difficult to be established at once due to lack of the consolidated IA groups in the MRIIS area, the Model will be made with only one IA at first and then gradually expanded to three to four IAs covering about 1,000 ha in one unit.

(3) Agro-Service Facilities Provided in IA Federation

The following agro-service facilities will be required for IA Federation in order to retrench the production cost of paddy and to keep the good selling price of paddy.

- Drying yard to dry up the harvested paddy by solar method will be constructed at each Barangay to carry out the work by farmer's family members.
- Mechanical dryer to meet about 50 percent of the wet season paddy will be provided at warehouse on IA basis, because of a few fine days in the wet season.
- Power tiller for land preparation will be provided at each Barangay, because of farmers convenience to operate it in the field.
- Power thresher for paddy threshing works at the field is to be provided on IA basis and lending to farmer in harvesting season.
- Warehouse will be constructed near IA President in Barangay to keep the dried paddy in good condition by house-keepers.
- Jeepney will be provided on IA basis to transport agricultural input materials and harvested paddy as well as transportation of construction material for improvement of on-farm works. Jeepney is also used for communication purposes between town and Barangay.

Although the agro-service facilities above mentioned are planned on one IA basis, it will be economized if mechanical dryer, power thresher, warehouse and Jeepney are managed by the IA Federation basis, because number of equipment including spare one and number of staff to control them could be reduced in case of large area management.

The required number on IA basis and operation cost per hectare are approximately estimated and summarized as follows;

Operation Cost per Hectare in IA

Item	Number	Investment Cost (₱)	Operation Cost/ha (4 ton/ha basis) (₱)
Dry Pavement	300 sq.m x 6 units	180,000	18
Grain Dryer	3 "	48,000	62
Power Tiller	25 "	750,000	864
Power Thresher	3 "	150,000	126
Warehouse	1 "	210,000	48
Jeepney	2 "	300,000	120
Miscellaneous	L.S	162,000	32
Management Cost of IA			130
Total		1,800,000	1,400

In accordance with the operation of agro-service facilities above mentioned, the paddy cultivation could be made based on proposed cropping calendar, harvesting paddy with good quality and sell paddy with a high price to market. The production cost of 500 to 600 Pesos/ha could be retrenched and the selling price per hectare of 1,500 to 2,000 Pesos (0.35 to 0.5 Pesos/kg x 4,000 kg/ha) could be increased.

(4) Fund of IA Federation Model

Since the present farmer cannot provide the required fund of IA Federation with the agro-service facilities due to poor financial status, it is recommendable that the fund for the Model IA

Federation will be provided by NIA, setting up particular countermeasures to stabilize farmer's income in the rural area with the assistance by Philippine Government agencies concerned.

In case the preparation of fund by NIA is difficult, the rural bank or other banks should provide the particular credit with a low interest and a long credit term of more than 10 years in accordance with the request of NIA and MAF.

Since two Models consisting of three IAs will be required in each District, the total budget of the Models for four Districts will be about 44 million Pesos (1.8 million Pesos x 6 IA x 4 Districts).

In addition, the particular production loan of about 22 million pesos[1/] will be provided by banks, in order to carry out the smooth and effective farming operation in the IA Federation Model. This production loan will be paid back to banks with six times installments during three years.

IA Federation should collect the repayment of 1,400 Pesos/ha for agro-service works at the end of cropping season and pay back to bank with responsibility.

Of course, the fund of IA Federation should be carefully studied depend on the farmers economic situation in the Model area. In case, some farmers have already some facilities and equipment for agro-service, their funds could be reduced. In case, some farmers have enough fund to carry out the farming operation, their production loans are also reduced.

1/: 3,000 Pesos/ha x 300 ha x 6 IA x 4 Districts = 22 million Pesos. 3,000 Pesos/ha is the cost to procure farming materials and to employ farm labor for transplanting and harvesting works.

3.5.7. Improvement of Farmer's Income

Farm households in the MRIIS area are mainly depend on paddy monoculture with an average farm size of 1.8 ha. The agricultural income of owner farmer is assumed to be 16,100 pesos without improvement project.

Upon implementation of the improvement project, owner farmers' agricultural income will become 21,500 pesos and 30,500 pesos for the outside and inside the IA Federation due to the increase in paddy yield and quality.

Farm Budget for Average Farm Household
(Farm Size 1.8 ha)

Items	Without Improvement Project	With Improvement Project: Outside IAF	With Improvement Project: Inside IAF
1. Paddy Planted Area (ha) Wet + Dry Season	1.6 + 1.8	1.6 + 1.8	1.6 + 1.8
2. Paddy Yield (tons/ha)	3.7 , 3.2	4.3 , 4.0	4.3 , 4.0
3. Paddy Price, Dry Matter (₱/kg)	3.0	3.0	3.5
4. Gross Income (₱)	35,000	42,200	49,300
5. Production Cost, excluded family labor (₱)	18,900	20,700	18,800
6. Cost of Land Rent (₱)	5,000	5,000	5,000
7. Agricultural Income (₱)			
- Total ° Owner Farmer	16,100	21,500	30,500
° Tenant Farmer	11,100	16,500	25,500
- Per Capita ° Owner Farmer	2,680	3,580	5,080
° Tenant Farmer	1,850	2,750	4,250

The farmers having the farm land less than average farm size of 1.8 ha, which correspond to about 47 percent of the total farmers, will not always enjoy the present benefit with the full independent upon the farm income only and result in the engagement such works for non-agricultural sectors.

Under the circumstance, an intensive guidance and education on the farming technique and cropping pattern should be given to these farmers.

3.5.8. Improvement of Agricultural Credit

About 70 percent of the total farmers in the MRIIS area has been engaged in the paddy cultivation by the production loan of 2,000 to 3,000 ₱/ha, whereas the total production cost is estimated at 5,000 to 6,000 ₱/ha. This means that many farmers in the MRIIS area are in the serious financial status and cannot carry out the paddy cultivation by their own fund only.

These farmers borrow the fund from banks and dealers to manage farming inputs and employ working labor before the paddy cultivation, or borrow farming input materials such as fertilizer and agro-chemicals directly from dealers under the repayment conditions at harvesting time. In the case that farmers cannot borrow the fund or input materials before cultivation, they are forced to extend the cultivation until the fund and input materials are available, and this will result in the delay of cropping calendar and the low production yield.

According to the data of MAF, banks in the MRIIS area and the result of farm economic survey, it is estimated that 170 million pesos of the total amounts of production loan are 50 million pesos from official, 120 million pesos from informal sources.

The estimated amounts of loan interests for institutional and informal sources are about 7 million pesos and 48 million pesos respectively, totalling 55 million pesos (400 ₱/ha/crop). Assuming that the total amounts of loans are provided by the government, the total amounts of interest are estimated at 24 million pesos (180 ₱/ha/crop), which is 44 percent of the above 55 million pesos.

It is estimated that about 70 percent of total farmers engaging in the paddy cultivation with production loan inclusive informal one does not have the official loan services but informal loan. The reasons why such farmers are not provided with the formal loans are as follows;

- No repayment capacity by farmers
- Delay and low level of repayment from farmers to bank
- Insufficient fund of bunk
- Complicated procedure of bank loan
- Easy provision of production loan by dealers

Since the provision of project loan with low interest is the essential and important subject to stabilize the farming activities and farmer's income, the Philippines Government authorities and banks concerned should pay the particular attention to the improvement of production loan; otherwise, the farmer's income and the rural economy in the MRIIS area will never be ameliorated even after the MRIIS O/M improvement works could be implemented.

3.6. Project Cost and Implementation

3.6.1. Estimation Condition

Two construction methods for executing of the Project are introduced. One is contract basis and the other is force account basis. The force account basis works are as follows;

- Part of canal widening
- Desilting works
- Structure repair
- Drainage excavation
- Part of road maintenance
- Repair of compound facilities
- Repair of check and head gates
- Repair of turn-out gates

On the other hand, the following works are executed by contract basis;

- Enheightening of canal bank
- Remaining part of canal widening
- Repair of scoured canal
- Canal lining
- New canal construction
- Remaining part of road maintenance
- Other major civil works such as rehabilitation of Maris diversion Dam or revetment at Magat mini-hydroelectric plant
- Other mechanical works
- Provision of equipment

The unit cost of these works are estimated according to each method depending on the basic unit cost which is used in the MRIIS O/M Office. The unit cost for contract basis is based on the rental

cost and the unit cost of force account basis is composed of labor, material, repair and maintenance, fuel and oil, spare parts and overhead cost excluding equipment depreciation cost.

The quantities of works are carefully reviewed in cooperation with the MRIIS O/M Staff.

The exchange rate between Philippine Pesos and U.S Dollar is decided at ₱20.5/US$ (US$1.00 = 20.5 Philippine Pesos).

The construction cost is divided into the foreign and local currency portions. The local currency portion is estimated on the basis of current unit prices used in the MRIIS as of 1986 and the procurement of equipments or materials are estimated on the CIF prices at Manila. Breakdown of project cost is shown in Table I-3 in Annex.

3.6.2. Project Cost

The total project cost excluding price escalation is estimated at 1,060 million pesos, of which 705 million pesos is foreign currency and 355 million pesos is local currency.

Engineering and administration cost is considered as 20 percent of total construction cost and physical contingency with about 15 percent is also included in the project cost.

The summary of the project cost is shown in following table and the detail project cost is shown in Table F-1 and F-2 in Annex.

Summary of Project Cost

(unit: ₱'000)

Description	F.C.	L.C.	Total
Improvement of Water Control/Data Management System	137,860	10,470	148,330
Improvement of Mechanical Facilities	28,540	8,070	36,610
Procurement of Equipments	134,550	-	134,550
Rehabilitation Works of Canal System	225,280	124,540	349,820
Rehabilitation of Major Structures	43,320	19,870	63,190
Agricultural Development	4,500	43,200	47,700
Total	574,050	206,150	780,200
Engineering and Administration	50,000	106,050	156,050
Physical Contingencies	81,100	42,650	123,750
Grand Total	705,150	354,850	1,060,000
	(66.5%)	(33.5%)	(100%)

The disbursement schedule is prepared based on project implementation schedule, and the summary is shown in Table I-6 in Annex.

3.6.3. Operation and Maintenance Cost

The annual operation and maintenance cost is composed of salary and wage for O/M organization staff, equipment depreciation and repair, maintenance fuel and oil, office maintenance cost, power cost of pumping facilities and administration and general expenditures.

The annual operation and maintenance cost of the MRIIS is amounted at 14.7 million pesos of the Magat dam and reservoir, 75.3 million pesos of the MRIIS Head Office and four district offices and at 90 million pesos (920 pesos per hectare), respectively. Breakdown of O/M cost is shown in Annex I.

3.6.4. Implementation Program

(1) Execution Agency

The irrigation facilities and systems in the MRIIS area have been planned and developed by NIA, and those facilities belong to

NIA. As a matter of cause, therefore, the National Irrigation Administration (NIA) is the executing body of this Project. NIA has sufficient ability and abundant experience for planning, detailed design and implementation.

(2) Priority of Implementation

About 26,300 ha out of target area of 97,400 ha in the MRIIS area is left as unirrigated due to undevelopment, lack of on-farm facilities, ill-drainage, etc. The solution is first of all to rehabilitate/improve time-worned facilities in the upstream areas and to enhance the water management, so that the water can surely reach the terminal field in the downstream areas. Although aforementioned rehabilitation/improvement works are required for ensuring the benefited acreage to reach 97,400 ha, they are divided into three groups with priority.

The first priority group shall be urgently implemented, otherwise improvement of water management in the MRIIS could not be achieved. The implementation of these works will be made by technical and financial foreign assistance. Following works shall be urgently implemented;

(a) Centralized Control System for Maris Gate

The intake works provided on the right bank of the Maris diversion dam plays a really vital role to control the water to the crops grown in the service areas of about 53,900 ha. The Maris diversion dam has to constantly keep the gate opening to meet properly and incessantly fluctuating water level, so that the operation has become very intricated. Under the conditions, automatization of the gate operation is urgently required for appropriate water intake against fluctuating water level of the Maris diversion dam due to releasing water from Magat hydroelectric power plant.

The operation of check and head gates at the upstream section on the Maris main canal, which are of large scale and manually operated is very difficult, and maintained improperly due to time-worned structures. Excessive water intake and leakage by these old facilities have caused the water to hardly reach to the terminal fields of the downstream areas, resulting in losing chances for timely irrigation and planting. Such being the case, in other respect, the farm land development has been delayed in the downstream areas and the yield in the cropped fields has not been increased. Improvement of these facilities with electrified automatic operation system for centralized monitoring and control will permit the water distribution to the lateral canals to be made adequately. And such improvement will be required as the countermeasures to solve the problem urgently.

(b) Rehabilitation of Siffuris Diversion Gates

Since the sand sluice gates of the Siffuris diversion dam have become inoperative, repair of the devices is required quite urgently for keeping the safety of the diversion works. At the same time, the electrification of the intake gates will be an important issue in view of the appropriate water management by Siffuris diversion dam.

(c) Improvement of Weir

Among four Districts in the MRIIS, District IV is lowest in farm income as well as in agricultural productivity. These facts are considered that the development in District IV has been considerably delayed due to the location of the downstream area in the irrigation system, in addition heavy inundation by daming up of the creek water for using the return flow. To clear the problem, improvement of the Macanao and Ladeco weirs and withdrawal of the Minante weir are considered most effective.

(d) Improvement of Pump

About 3,000 ha of the undeveloped area within the pump irrigation area, occupying about ten percent of the total undeveloped area, will be developed as the fields available for cropping by irrigation with pumping facilities which shall be repaired as soon as possible.

(e) Procurement of Construction and O/M Equipment

Provision of construction equipments is needed urgently to execute the implementation of civil works in canal system. On the other hand, O/M works in the MRIIS area should be executed in parallel with construction, so that procurement of O/M equipments is also required as soon as possible. Furthermore these equipment will be very effective to assist farmers group for on-farm developing.

The second priority group is composed of rehabilitation works of canal system and several important structures.

Civil works in the canal system such as desilting, enheightening of canal bank, repair of scoured canal, drainage excavation or road metaling will be implemented by using construction and O/M equipments procured by the Project as periodical rehabilitation and maintenance works in the five-years program.

Mechanical works in the canal system are composed of rehabilitation of structures and repair or installation of check, head and turn-out gates using spare gates stocked in each District Office.

The third priority group is rehabilitation of several major structures such as diversion dam or weirs which is also important to maintain irrigation facilities in good condition.

(3) Implementation Schedule

NIA should implement the project under the assistance of Consultants in employing the sufficiently capable and well-experienced contractors on the contract basis. Civil works in the canal system are to be carried out by local contractors on the contract basis except some of them executed on force account basis.

The Project would be executed under five-years program because some civil works in the canal system could hardly be implemented within less than five years.

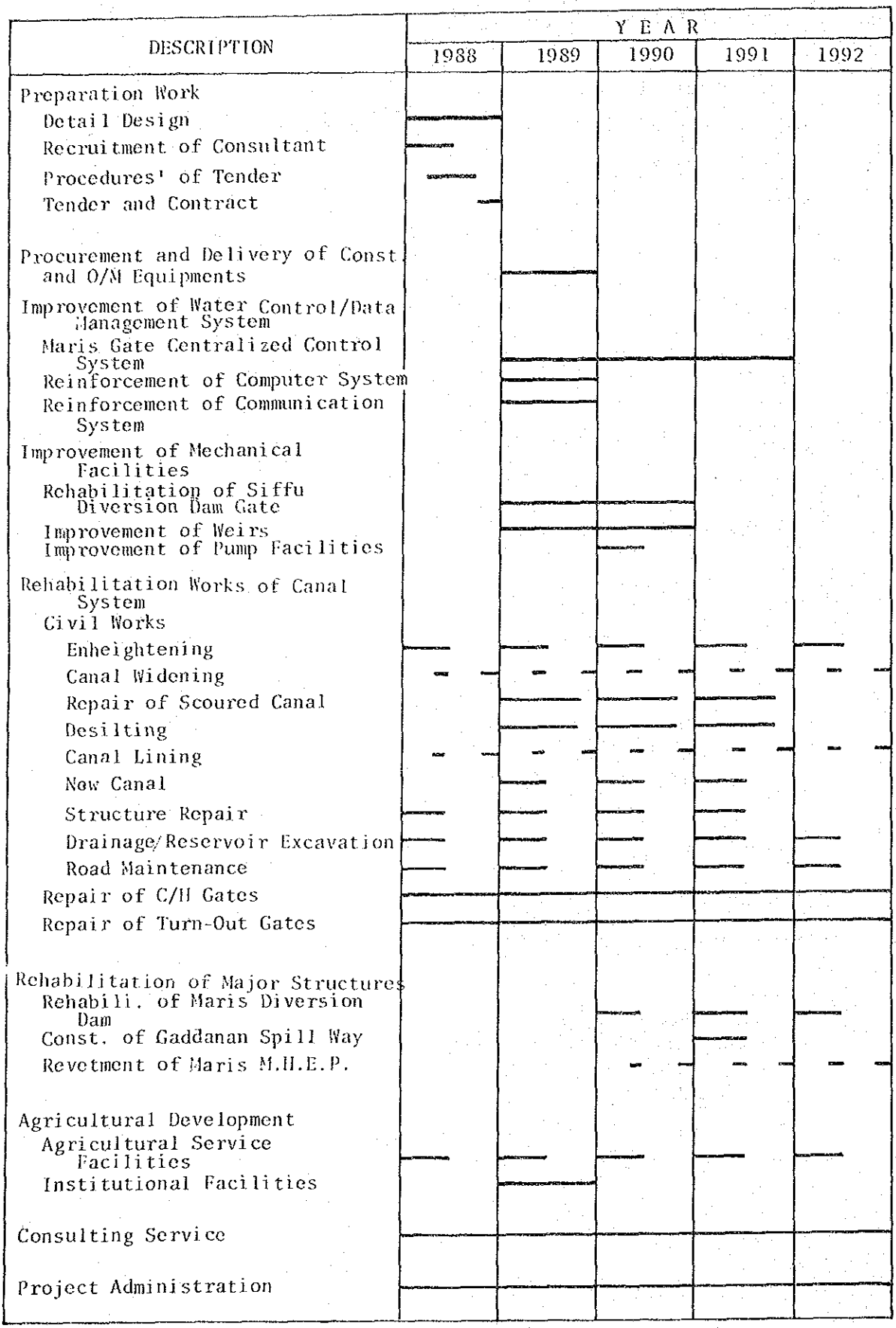
The main works such as automatization of water control system including improvement of gates should be executed within four years. The first year is for preparation work such as detailed design. The second year will be spent for manufacturing and delivering of machine or equipments, and the third and fourth year for installation.

For the execution of civil works in the canal system, design and implementation shall be carried out in parallel with the manner that the design will be made in the wet season and the implementation in the dry season for completion within five years.

The repair works for check, head and turn-out gates shall be made using the spare gates stocked in each District Office on force account basis. These works under the Project will be completed within five years.

Detail implementation schedule is shown in Figure 3-7.

FIGURE 3-7. IMPLEMENTATION SCHEDULE OF MRIIS O/M IMPROVEMENT PROJECT



CHAPTER IV. PROJECT EVALUATION

CHAPTER IV. PROJECT EVALUATION

4.1. Evaluation of the MRIIS Project

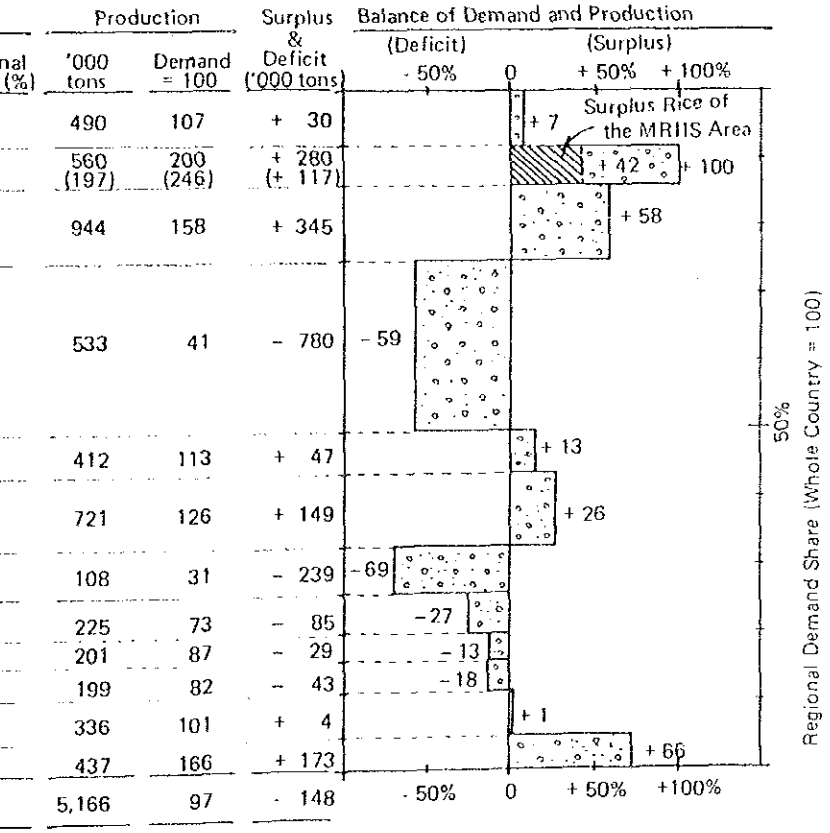
4.1.1. The MRIIS Project as the Rice Granary in the Philippines

As described in Chapter III, the marketable rice surplus in the MRIIS area in 1985 amounts to about 184 thousand tons (milled rice), equivalent to 58 percent of the total rice demand in the Cagayan Valley (315 thousand tons) or 23 percent of the deficit in the Region IV which includes the Metro Manila area (809 thousand tons). The following table shows the annual average of demand and production of rice for the last five years in the Philippines.

DEMAND AND PRODUCTION OF RICE

– Average for the last five years (CY 1981 to 1985) –

Region	Demand '000 tons	Demand Regional Share (%)	Production '000 tons	Production Demand = 100	Surplus & Deficit ('000 tons)
Region I	460	9	490	107	+ 30
" II (MRIIS Area)	280 (80)	5	560 (197)	200 (246)	+ 280 (+ 117)
" III	599	11	944	158	+ 345
" IV	1,313	25	533	41	- 780
" V	365	7	412	113	+ 47
" VI	572	11	721	126	+ 149
" VII	347	6	108	31	- 239
" VIII	310	6	225	73	- 85
" IX	230	4	201	87	- 29
" X	242	5	199	82	- 43
" XI	332	6	336	101	+ 4
" XII	264	5	437	166	+ 173
Whole Country	5,314	100	5,166	97	- 148



Source: Bureau of Agricultural Economics, MAF

4.1.2. Comparison of Benefit and Cost

The paddy production in the MRIIS area has been increased steadily, whereas the paddy production in the other producing areas has been stagnated. Thus, it is considered that the MRIIS area plays an important role not only for paddy supply area in Region II but also throughout the country.

The MRIIS irrigation Service Area has reached about 71,000 ha in 1986, and the new rehabilitation/improvement projects for the facilities are required inevitably to accomplish the development of the proposed target area of 97,400 ha. And also, the paddy production remains at 3.2 tons/ha on an average which is lower than the target of 4.1 tons/ha.

There are many subjects to be improved in the area such as system facilities, water management, farmers' organization and farm management for achieving the target production. Therefore, in case that the MRIIS Project does not take any improvement works in future, the Internal Rate of Return (IRR) of the Project will become considerably lower than that estimated in the Feasibility Study.

Subsequently it gives the result of the study in case of without improvement project based on the following conditions;

- The cost invested for the Project was estimated to obtain present value by using the actual annual expenditures from 1974 to 1986.

  As for Magat dam construction cost, however, 50 percent of the total cost was covered by irrigation sector, because the said dam could be considered to create the benefits evenly for irrigation and power generation. The present value of the project cost will be computed in using the cost escalation method based on the international and domestic price index and the foreign exchange rate at 20.5 pesos/US$.

- Actual O/M cost spent by Magat O/M Office was used for the study. According to the data, most of O/M cost is

utilized for the direct salary of the personnel for operation of the Project facilities, but little for the maintenance of services. Under the situation, the deterioration and time-wearing of the facilities are progressed year by year.

- The benefits to be generated from the Project was estimated by using the two kinds of net production value, one is obtained by "without Magat Project --- paddy production by rainfed cropping, and the other is obtained by "with Magat Project" --- paddy production by irrigated cropping. 3.0 ₱/kg of paddy price is applied to evaluate benefit.

- The irrigation Service Areas and paddy production were estimated in the premise that the Project will reach the full development in 1992. Without implementation of the Project, however, the irrigation Service Area would be estimated at 147,100 ha for both wet and dry seasons and 3.3 to 3.8 tons/ha of paddy production.

Land Use and Production

Year	Land Use (ha)			Paddy Production ('000 tons)
	Irrigated Area	Rainfed Area	Undevelop-ment Area	
1974	50,000	40,000	7,400	219
1986	69,100	23,600	4,700	420
1992(forecasted)	77,900	14,800	4,700	510

Based on the above conditions, the Project cost, benefit to be generated and IRR were calculated as follows;

(1) Present Worth Value of Project Cost

As tabulated below, the present worth value of the MRIIS Project is estimated at about 6,800 million pesos.

Annual Disbursement of Existing the MRIIS Project Cost

Year	Actual Expenses 1/				Present Value 2/		
	Canal & Others		Dam 3/		Canal & Others	Dam	Total
	LC	FC	LC	FC			
1974	15.0	2.1	-	-	132	-	132
1975	40.5	4.1	-	-	272	-	272
1976	49.1	2.6	-	-	227	-	227
1977	50.7	5.4	7.6	-	302	20	322
1978	54.9	8.1	87.6	-	324	212	536
1979	95.9	6.2	132.0	21.1	365	838	1,203
1980	55.2	11.5	287.8	14.7	354	850	1,204
1981	92.1	9.6	196.6	21.7	360	792	1,152
1982	67.3	16.9	153.9	9.5	473	436	909
1983	70.6	7.1	24.5	3.5	255	113	368
1984	29.5	7.2	16.5	2.1	204	69	273
1985	24.2	3.1	5.0	0.9	99	25	124
1986	17.4	2.4	1.8	0.7	66	16	82
Total	662.4	86.3	912.8	74.2	3,433	3,371	6,804

Note: 1/ ... LC: million pesos FC: million US$
2/ ... million pesos
3/ ... allocated cost

(2) O/M Cost

The actual O/M expenditures of the MRIIS O/M Office from 1974 to 1986 were applied, but the considerable amounts of maintenance cost of about 4,500 million pesos per annum were added to the said O/M cost after the year of 1986.

180 million pesos for the rehabilitation cost of MRIIS is, furthermore, needed to support the present production level by keeping paddy planted area and yield level.

(3) Project Benefit

(unit: million pesos/year)

Items	Financial Benefit		Economic Benefit	
	NPV	Benefit	NPV	Benefit
Without Project	159	-	366	-
With Project (Without Improvement)	636	477	1,001	635

(4) Internal Rate of Return

Although the Project includes some rehabilitation works for the facilities, the estimated financial IRR (FIRR) and economical IRR (EIRR) are comparatively low by five and nine percent, respectively.

4.2. Evaluation of the MRIIS Improvement Project

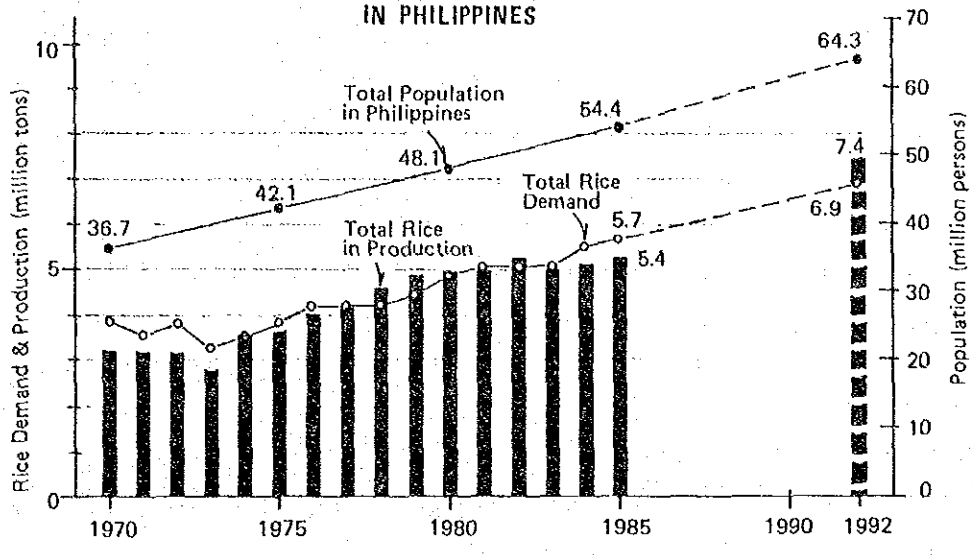
4.2.1. Role of the MRIIS Improvement Project for Rice Supply

As indicated in the previous chapter, the MRIIS area has been playing a vital and important role as a base of the rice supply for nation and region. In details, the paddy production was increased by 30 percent between 1970 and 1980, but the said increase rate is sharply reduced with seven percent in a period between 1980 and 1985. On the other hand, the population growth rate could be foreseen by 25 percent on the national average in a period between 1980 and 1990, while 31 percent in Region IV, and also the rate between 1990 and 2000 is forecasted to be 16 percent on the national average and 21 percent in Region IV. The population growth rate will not decrease so much as compared with the paddy production. Therefore, the paddy self-sufficiency will become difficult if the paddy production remains at the present level.

According to the next National Development Plan (1987 - 1992), the Philippine Government aims to produce at 11.3 million tons of paddy (=7.4 million tons of milled rice) in the whole country in the target year of 1992. The target paddy production in the Philippines is of 38 percent increase of present production level of 8.2 million tons in 1985.

The MRIIS area has also a future potential to increase the surplus amount of paddy when the MRIIS area reaches the target area of 97,400 ha which can produce the paddy production of about 760,000 tons (=500,000 of milled rice) per annum after completion of the MRIIS O/M Improvement project. The surplus amount of rice to supply Region IV will increase to 380,000 tons per annum. This surplus amount is really very attractive and important one to guarantee the future increasing demand at about 900,000 tons of deficit rice in Region IV in 1992, especially to the demand of rice in Manila.

FORECAST OF RICE DEMAND AND PRODUCTION IN PHILIPPINES



Source: – Population ..... NCSO, NEDA
– Rice Demand and Production ..... BAEcon, MAF
– Population and Production Forecasted ..... "Philippine Development Plan, 1987–1992", NEDA
– Demand Forecasted ..... based on MAF & NEDA datas

Forecast of Rice Surplus and Deficit

(unit: '000 tons)

Area	Year	Demand	Production	Surplus and Deficit
1. Whole Country	1985	5,740 1/	5,360 1/	- 380
	1992	6,900 2/	7,400 2/	+ 500
2. Region IV	1985	1,410 1/	600 1/	- 810
(Southern Tagalog)	1992	1,680 3/	780 3/	- 900
3. Region II	1985	315 1/	680 1/	+ 365
(Cagayan Valley)	1992	430 2/	1,230 2/	+ 800
4. MRIIS Service Area				
- Present	1985	89	273	+ 184
- Without Improvement Project	1992	120	330	+ 210
- With Improvement Project	1992	120	500	+ 380

Source: 1/ ... Bureau of Agricultural Economics, MAF
2/ ... Based on "National Development Plan, 1987 - 1992" NEDA
Note : 3/ ... estimated

If the MRIIS area, however, is left as it is without any improvement for the O/M, the system facilities would lose its function for irrigation at rather early stage, as the result of that, the MRIIS could not get the projected paddy production and could also not supply the surplus amount to be expected.

In this connection, the improvement project for the MRIIS O/M should be implemented urgently with the top priority among the national development projects in the Philippines, because the MRIIS having a potentiality for the surplus rice of 380,000 tons should be stabilized from viewpoints of the national policy of food supply and the national economy for the maximum and effect utilization of the present completed system.

4.2.2. Comparison of Benefit and Cost

The improvement project was evaluated in the following conditions;

i) The present worth value of the MRIIS project in 1986 is about 6,800 million pesos.

ii) The necessary project cost is about 1,060 million pesos and the project will be implemented for five years from 1988 to 1992.

iii) The necessary O/M cost is estimated at 90 million pesos per annum.

iv) The benefit by the Project will be achieved by the following conditions;

- The irrigation Service Areas is 97,400 ha.
- Paddy yield will reach the target of 4.1 tons/ha on an average.

- It is expected that upgrading of the paddy quality will allow to raise farm-gate price of 3.5 pesos/kg.

- The Federation of IAs will serve to raise the paddy price of 640 pesos per hectare.

Benefit with Improvement Project

(unit: million pesos)

Items	Financial Benefit		Economic Benefit	
	NPV	Benefit	NPV	Benefit
Without Project	159	-	366	-
Without Improvement Project	636	477	1,001	635
With Improvement Project	1,582	1,423	1,983	1,617

The Internal Rate of Return in the above case was estimated at 10 percent of FIRR and 14 percent of EIRR, of which EIRR is deemed to reach the target rate provided for the Feasibility Study (12 percent) and can be considered to give the high priority for implementation as the national project.

4.2.3. Statement of Profit and Loss for the MRIIS

The Statement of Project and Loss for MRIIS has been prepared, and in detailing, the relevant calculation was made for two cases of "without" and "with" improvement project in taking the project benefit as profit while the capital cost and O/M cost as loss.

The estimation of the Profit and Loss for MRIIS with the income (profit) and expenditure (loss) coverted into current prices has resulted into that the project management would be turned to black from red in balance in 1983, the ninth year from commencement of the construction works in 1974, and even in both cases of "without" and "with" improvement project, the Project management as a whole would be turned into black in 1988, the 14th year from commencement in blotting out all the accumulated losses. It shows the significant meaningfulness of the MRIIS Project that the accumulated losses could be blotted away at the 14th year of the Project which falls within one third of 50 years as the life span of the Project.

The accumulated red figures could be resoluted in the same year for the both cases of "without" and "with" improvement project. The case study of "without" and "with" improvement project on the long-term balance of income (profit) and expenditure (loss) for 48 years from 1974 when the works commenced to 2021 when the loan repayment is over will find that the MRIIS Project as a whole will be more profitable in case of "with" improvement works than in the case of "without". In other words, the MRIIS Project, when implemented with the improvement works, will result in 1.5 time larger expenditure, 3.7 times larger income and 3.5 time larger net profit than those when implemented without improvement works.

(unit: million Pesos)

Project	The Sum of Income	The Sum of Expenditure				The Sum of Profit and Loss
		Capital Cost		O & M Cost	Total	
		Foreign Currency	Local Currency			
- Without Improvement Project	27,300	2,500	1,600	6,600	10,700	16,600
- With Improvement Project	73,900	3,700	2,100	9,700	15,500	58,400
	(270)	(147)	(135)	(146)	(145)	(351)

Note: The figures in the parenthesis are the percentage of with Improvement Project to without Improvement Project.

4.2.4. Increase of Farm Income

The average farm income in 1986 is shown as in following table on the basis of the standard farmers land holding of 1.8 ha.

(unit: ₱/farm)

Items	Area A	Area B	Area C
Owner Farmer	21,100	12,400	8,900
Tenant Farmer	16,100	7,400	3,900

On the other hand, the average living expense of the farm household is in a range from 10,000 to 12,000 pesos per annum. The farmers in Area "B" and "C" have suffered from shortage of annual income by paddy cropping only and tried to gain the subsidy income from animal breeding/selling and labor wages to overcome difficulty in living life.

In case the improvement of the project was implemented, the farm income is expected to be largely increased to 24,800 pesos/household on an average even in the lowest class of tenant farmer in the District IV. Therefore, the improvement project is considered to give a remarkable and favorable effect to the farmers in the area.

Farm Income

(unit: ₱/farm)

Items	District I	II	III	IV
- Without Improvement Project				
Owner Farmer	16.1	19.1	15.4	15.4
Tenant Farmer	11.1	14.1	10.4	10.4
- With Improvement Project				
Owner Farmer	29.8	32.5	30.4	29.8
Tenant Farmer	24.8	27.5	25.4	24.8

4.2.5. Upgrade of Water Use and Hydroelectric Power Generation

The improvement of water management will reasonably enable to control the water in the Magat reservoir, and the present annual release of water about 3,700 MCM from the reservoir, which is planned in the O/M Manual could reduce to 2,660 MCM. Furthermore, annual spilled water from the spillway is reduced from 760 MCM to 414 MCM, according to the observed and estimated data in 1985. Consequently, the improvement of the project will result in the increase of water availability for more effective use.

In the other respect, there will not be so large difference between the present generation power of 1,183 GWH presented in O/M Manual and that with improvement of 1,075 GWH on an average. The power generation in the dry season, however, will be increased as shown in the following table, and the value of the power generated by the Project will be largely increased to the national economy.

Month	Projected Power by NPC (GWH)	Improved Power by the Project (GWH)
Jan.	56	58
Feb.	54	68
Mar.	30	45
Apr.	21	44
May	38	70
Jun.	50	80
Total	249	365

4.2.6. Impacts by the MRIIS Improvement Project

In addition to the above mentioned tangible benefits, the MRIIS improvement project is envisioned to give the following socio-economic impacts.

(1) Impacts on the Project Area

The realization of the improvement project will improve the farmers' living standard through an increase in the farm income. The increase in the farm income means the increase in consumption and saving. The magnifying of the farm family economy will improve the villagers' living standards in terms of quantity and quality.

The improvement project will influence on the technical uplevelling of crop cultivation and farm management of the farmers around the MRIIS area as well as in the Project Area.

Through post-harvesting facilities to be used in the IA service unit, the Project will enable the beneficiaries to keep close communication with each other as well, resulting in giving fair knowledge of irrigated agriculture, farm management and buying of agricultural inputs and outputs as well as the promotion of agricultural cooperative activities as a whole.

(2) Impacts on National Socio-Economy

When the improvement project is carried out, about 340,000 tons of additional paddy production will be realized in the Project Area which will help to improve self-sufficiency and to increase the export.

The improvement project is of the effective socio-economic development type, not only for promoting rural public welfare but also alleviating the disparity in living standards between the regions.

CHAPTER V. RECOMMENDATION

CHAPTER V. RECOMMENDATION

The Magat River Integrated Irrigation System (MRIIS) had been developed stage by stage since 1960's and its facilities were mostly completed in 1983. This system is the biggest national irrigation project invested the total construction cost of about 10,000 million pesos (US$500 million) and has the largest irrigation area of 97,400 ha in the Philippines.

The paddy production produced by the MRIIS area is about 420,000 tons per annum at present but is expected to be increased as about 760,000 tons per annum in case of full development stage. This paddy production covers not only the rice demand in Region II including the MRIIS area but also supports 25 to 30 percent of total rice deficit in Region IV holding the capital area of Manila. Namely, the MRIIS area is the most important rice supplying base to the capital area from viewpoint of national food supply.

In this connection, the improvement of operation and maintenance works of the MRIIS should be implemented in order to i) achieve the largest paddy production by using the system effectively, ii) keep and utilize the system as longer as possible by carrying out proper maintenance and iii) increase the farmer's income and stabilize the regional economy and peoples' livelihood by increasing an agricultural products.

However, the MRIIS O/M works face to following many subjects at present and are placed under the condition that the system cannot achieve the target as mentioned in the above. It is recommendable, therefore, to improve urgently several subjects related to the MRIIS O/M works mentioned below; otherwise the big losses for national economy will be caused.

i) Expansion of irrigation area; The achievement of projected target area of 97,400 ha from the existing irrigation area of about 71,100 ha.

ii) Improvement of water management; The allocation of irrigation water to the upstream and downstream area equally on demand and on schedule.

iii) Revision of Magat Reservoir Operation Rule Curve: Reservoir outflow control based on the revised operation rule curve prepared by the Study Team.

iv) Improvement of system facilities; The rehabilitation and new construction for the improper facilities from viewpoint of water management.

v) Improvement of On-Farm Facilities; The improvement and development of on-farm facilities in the irrigated fields well as newly developed area with the assistance by the MRIIS O/M Offices and other Government agencies concerned.

vi) Strengthening of O/M organization and repletion of its function; The establishment of effective countermeasures and proper management activity to carry out the water management and maintenance of facilities in the O/M organization.

vii) Provision of operation and maintenance cost for the MRIIS; The increase of irrigation fee collection and allocation of maintenance cost of the Magat dam by NPC based on hydroelectric power benefit in the Magat hydroelectric power plant.

viii) Improvement of paddy cultivation; The countermeasures to increase the paddy production from the present yield of 3.2 tons/ha to the target yield of 4.1 tons/ha as well as to increase the farmer's income by retrenching the paddy production cost.

ix) Strengthening of farmer's institution; The strengthening of farmer's institution to carry out the proper water management and economical farming management.

x) Improvement of governmental supporting services; The establishment of technical and financial aid to farmers by NIA, MAF and other governmental agencies concerned especially by agricultural bank to provide production loan.

The detailed recommendation for the improvement plan of the MRIIS mentioned in the above is described as follows;

5.1. Recommendations for Improvement of the MRIIS O/M

(1) Achievement to Development Target of Irrigation Area

The target irrigation area in the MRIIS is 97,400 ha, however, the present irrigation area in 1986 is about 71,100 ha and about 26,300 ha remains as unirrigated area. The unirrigated area is mainly consisting of no land preparation for paddy field and no/not well functioning on-farm facilities for irrigation water supply to paddy fields.

Under the situation, the following implementation should be urgently recommended.

i) NIA and the MRIIS O/M Office shall help the Irrigators' Association (IA), which is the executing organization for carrying out the land development and constructing on-farm facilities in the following manners;

- Planning and designing for the land development and on-farm facilities shall be made by the MRIIS O/M Office.

- Construction equipment for land development for preparation of paddy field shall be provided by the MRIIS O/M Office under the conditions that fuel, construction materials and labour except equipment operators shall be provided by IA.

- Land development works shall be completed along with five-year plan for District I, III and IV, and two-year plan for District II.

ii) Administrative cooperation will be made by Governmental agencies concerned such as the Ministry of Agrarian Reform (MAR), etc. to allocate the land to the farmers, in accordance with the Governmental policy on land reform.

iii) Financial support by the Government will be given to provide the credit to the farmers' activities for the land development.

iv) Assistance will be given for establishment of IA by NIA and other Governmental agencies concerned to promote the farmland development smoothly.

(2) Fulfillment of Proper Water Management

The present irrigation water allocation is not properly made, so that the upstream area has a tendency to introduce much irrigation water in the dry season and the downstream area is always suffered from a shortage of irrigation water. On the other hand, since the excess irrigation water is delivered by the upstream canal to the downstream one in the wet season, inundation damage takes place in the downstream area. Accordingly, the production yield of paddy and farmer's income in the downstream area are considerably lower than those of the upstream area.

This problem is caused by the following poor water management;

- The water level in the Maris re-regulation pond presents a big fluctuation, which makes difficult of intake control to the canal systems.

- Since the outflow control at each diversion dam, especially at the Maris diversion dam is not properly made in accordance with irrigation demand, the discharge to be delivered to the main canal is changed an hourly and daily basis.

- The operation of check and head gates in the main and lateral canals is not made well at present, namely, the upstream area introduces much irrigation water in the dry season by opening gates as large as possible and releases the surplus irrigation water to the downstream area in the dry season by closing gates in canals and passing through paddy fields.

- Distribution of water at on-farm level is made mostly by plot-to-plot method with a long distance of 500 to 600 m between plots, so that a long period is required to irrigate the plot area and irrigation losses in the plot area are increased.

- Water request and allocation rules taking into account effective rainfall have not been established yet and therefore, water distribution control at head and turn-out gates can not be properly made by Water Masters and Gate Keepers.

In order to improve above mentioned water management conditions, following subjects are recommended to be implemented.

i) Water request and allocation procedures on weekly basis for each irrigation block and canal section shall be formulated by using the computer.

ii) Outflow control from the Magat reservoir shall be made adequately based on the revised operation rule curve of the Magat reservoir.

iii) An automatic water control system in the Maris diversion dam shall be provided and the intake gates shall be properly operated depending upon the fluctuation of water level and demand, and furthermore an automatic monitoring system in the Maris main canal shall be newly provided.

iv) Following measures shall be taken to improve the distribution control in canal systems;

- To keep the constant water level in each canal section controlling the check gates depend on the allocated discharge.
- To install automatic water level recorders and staff gauges to control the running discharge in canals.
- To check regularly the running discharge in the canals against the allocated discharge.

v) The proper guidance for farm ditch construction by farmers' institution shall be made by the MRIIS O/M Office to improve the present water management at on-farm level. Furthermore, rotational irrigation method shall be made at on-farm level by the guidance of the MRIIS O/M staff during the land soaking periods requiring much irrigation water.

(3) Improvement of Outflow Control of Magat Reservoir

As the Magat reservoir operation rule presently adopted was based on the inflow expected in an ordinary year and given with a single line showing the reservoir stage at the end of each month, and as the reservoir is operated for the dual purpose of irrigation and power generation competing with each other, the reservoir necessarily allows its surface elevation to be maintained just on the line consequently resulting in frequent occasions for the agriculture side that the water supply from the reservoir is interrupted when disappointing small amount of inflow comes into the reservoir.

As a matter of fact the reservoir has experienced storage deficits in most years in 1985, 1986 and 1987 since its commencement of operation in 1984.

In view of the remarkable irregularity of the Magat inflow, it is also important that water releases are rather restricted intending preservation and restoration of the storage in preparation for the present and future unforeseen drought. It is therefore recommendable to employ the operation rule established through this study, which will maximize effective use of the limited water source from the Magat drainage basin as well as power energy to be generated and will minimize waste of water through the spillway.

(4) Improvement of System Facilities

The facilities of the Magat Integrated Irrigation System has been developed in steps by series of projects taking about 30 years since 1960's. The system facilities were almost constructed in 1982 and transferred to the MRIIS O/M Office in 1983. However, since these irrigation facilities have been operated for a long period, the structures or gates constructed 20 years ago have become time-worn to lose their functions gradually, and some canals do not have enough capacities due to serious scouring, settlement or siltation. These conditions cause many problems on the proper water management at present.

In order to maintain the present irrigation area and to achieve the development of the target area of 97,400 ha, following rehabilitation or improvement of time-worn facilities, the construction of new canals in the undeveloped area, on-farm development and etc. shall be made in the Project.

i) Civil Works in Canal System

- Heightening of canal bank
- Widening of canal cross section
- Desilting of sedimented materials
- Repair of scoured canal
- Canal lining
- Drainage canal

ii) Civil Works of Diversion Dam and Others

- Rehabilitation of Maris diversion dam
- Revetment at downstream of Magat mini-hydropower plant
- Construction of Gaddanan spillway

iii) Mechanical Works

- Repair of check and head gates
- Rehabilitation of turn-out gates
- Improvement of intake gate at Siffuris diversion dam
- Repair of sand sluice gates at Siffuris diversion dam
- Improvement of Macanao and Ladeco weirs
- Pump facilities

iv) Centralized Discharge Control System

- Provision of centralized discharge control system
- Provision of monitoring system
- Improvement of gate operation mechanism at Maris diversion dam
- Improvement of check and head gates along Maris canal
- Improvement of check gate at mini-hydroelectric power plant

v) Improvement of Computerized Data Management in Head Office

vi) Procurement of Construction and O/M Equipment

The improvement works of the system facilities mentioned above were recommended to be implemented for the period of five years, 1988 to 1992, with the following implementation priority.

i) First Priority Group:

- Centralized automatic and remote control system in Maris diversion dam and canal
- Intake and scouring sluiceway gates at Siffuris diversion dam
- Macanao and Ladeco weirs
- Pump No.1, No.2 and No.3
- Procurement of construction and O/M equipment
- Reinforcement of computer system at the MRIIS Head Office

ii) Second Priority Group:

- Civil works in canal system
- Mechanical works in canal system

iii) Third Priority Group:

- Rehabilitation of scoured portion of Maris diversion dam
- Construction of Gaddanan spillway
- Revetment of Magat mini-hydroelectric power stations

In the implementation of civil works in canal system mentioned in the Second Priority Group, the works for widening of canal section, desilting drainage canal in District IV should be preferentially and urgently carried out, because since the area of District IV faces to many problems caused by defected canal structures, its paddy production drops into the lowest level among four Districts.

(5) Improvement of On-Farm Facilities

Most of on-farm facilities such as main and supplementary farm ditches, farm drain and farm roads, etc. at terminal fields covering an area of 20 to 30 ha on an average are not provided at present

even in the irrigated area of about 71,000 ha, except for a part of area, and these situations cause following many problems on water management and farming practices; increase of irrigation water losses and delay of reaching of water to the terminal area due to plot-to-plot irrigation to the long direction with 500 - 600 m on an average, increasing of staggered cropping schedule and inconvenient of hauling agricultural inputs and products.

Under the conditions, improvement and development of on-farm facilities are one of the most important subject to strengthen operation and maintenance activities in the MRIIS area. These improvements and developments of the on-farm facilities have been conducted by the Irrigators' Association as a rule in NIA. However, the areas lacking the on-farm facilities have been increased since 1985 because of the following reasons:

- The on-farm facilities are not properly constructed by farmer's institution due to the lack of technical and financial support by NIA. Therefore, some facilities constructed do not function to deliver the irrigation water from lateral canals to terminals and are easily broken after releasing the irrigation water, especially at the facilities located in undulated hilly area.
- The on-farm facilities are not constructed, while the undeveloped areas are converted to paddy fields, because farmer's institution has no techniques and funds for the construction of facilities.
- Farmer's institution such as Irrigator's Association has not fully established yet in the whole Service Area.

The improvement and development of on-farm facilities should be carried out by the Irrigators' Association as mentioned above, however, NIA and the MRIIS O/M Office should carry out technical assistant to construct the on-farm facilities by supplying O/M equipment, materials and operator on the repayment basis, in the same way as those works in land development.

The MRIIS O/M Office, furthermore, should prepare the annual programs in each Division for the works and management of farmer's activities. It is also necessary to carry out the proper maintenance of the completed on-farm facilities, so that the MRIIS O/M Office can study the farmers' maintenance method and give proper advices and helps to farmers.

(6) Improvement of the MRIIS O/M Organization and Function

Although the present O/M organization including staff members and function defined in the present O/M Manual are mostly suitable, the O/M works for water management and facility maintenance are not carried out well because of insufficient equipment for the O/M works. It is recommended to provide urgently necessary equipment to carry out the proper O/M works.

In addition, it is recommendable to train many staff members engaged in the O/M works in order to improve their technology by introduction of skilled and experienced experts in the O/M works under the international grant technical aid.

The experts in the field of irrigation, water management, application programming, design of on-farm facilities, design of irrigation facility improvement and strengthening of irrigators' association, etc. are recommendable to be introduced for the training of staff.

(7) Provision of O/M Expenditures in the MRIIS

The expenditures for the MRIIS O/M works are presently provided mainly by incomes from the irrigation fee collection without any supplemental budget by the Government. Since the present incomes in the MRIIS O/M Office are only about 35 million pesos in 1985, which is mainly used for expenditures for salary of staff members. No fund to carry out the maintenance of irrigation facilities is

available at present. In this connection, the existing irrigation facilities in the MRIIS area are decrepit at early stage and lose their function at present.

Since the proper operation and maintenance cost for the irrigation facilities with a huge canal length of about 1,500 km and the facilities' cost of about 3,400 million pesos will be assumed as about 90 million pesos, the provision of expenditure's budget should be made with the following manners.

- Irrigation fee collection should be increased gradually from the present amount of 29 million pesos to the target amount of 75 million pesos by the improvement works of the MRIIS such as the land development, on-farm facilities, water management, system facilities, etc.

- Although the allocation expenditures by NPC to NIA for the operation and maintenance of the Magat dam are presently only three million pesos per annum, NIA should request NPC to increase this allocation expenditures taking into account the gross benefits brought from the irrigation and hydroelectric power in the MRIIS which is mostly served as about 600 million pesos.

  Since the present O/M cost of the Magat dam spent by the MRIIS Office is 14.6 million pesos, the cost of 7.3 million pesos corresponding to half of the present O/M cost should be born at least by NPC.

- Since the Baligatan power plant will be operated by the MRIIS O/M Office near future, new income of 19 million pesos will be obtained from the produced power energy and should be utilized for the O/M operation in the MRIIS O/M Office.

5.2. Recommendations for Agricultural Sectors

(1) Assessment for Accurate Irrigation Area

The improvement of paddy cultivation under irrigation should be made with the adherence of programmed cropping calendar in the Service Area. For this purpose, the irrigation area should be accurately assessed by the MRIIS O/M Office, because any improvement

activity to adhere the programmed cropping calendar is based on the accurate irrigation area.

(2) Improvement of Paddy Production

i) Increase of Paddy Production and Retrenchment of Production Cost

The present paddy yields for both the wet and dry seasons are 2.9 tons/ha and 3.4 tons/ha on an average, respectively. However, these yields could be improved to be 4.1 tons/ha on an average after making improvement on water distribution, cropping calendar, inundation problems, etc.

Furthermore, it is necessary to strengthen an agricultural supporting services to promote packaged paddy production technique, in order to retrench paddy production cost.

ii) Increase of Paddy Quality

About 18 percent of purchased paddy by NFA in 1985 is graded to be unqualified paddy with discoloured paddy due to high moisture content, therefore, the paddy quality in the MRIIS area is not always satisfactory at present due to high moisture content, mixture of foreign matters, etc., and then the paddy price is as low as 2.5 to 3.0 ₱/kg, while 3.0 to 3.5 ₱/kg in the other areas. In order to keep a better price of paddy, an improvement project to provide dry yard, mechanical dryer, warehouse, etc. should be necessary to equip these facilities on Barangay or IA basis. In this connection, due attention should be paid among the Governmental agencies concerned to the related problems such as an increase of paddy procurement by NFA, improvement of paddy marketing system, stabilization of paddy price, etc.

Furthermore, the post-harvest facilities of the MRIIS O/M Office for collected paddy as irrigation service fee shall be improved to secure the steady increase of paddy in accordance with the improvement of the Project. The items required for improvement are as follows;

- Introduction of powered thresher,
- Drying pavement with shed and mechanical dryer,
- Warehouse specially for paddy stock,
- Purchasing of light track etc. for collecting agricultural products,
- Quality measurement equipment such as moisture meter and scale.

iii) Introduction of Crop Diversification

In the pump irrigation area in District III, the more detail study shall be made on the possibility to introduce water-saving cropping pattern such as the introduction of diversified crops in the dry season after harvesting the wet season paddy, because the net return of the dry season paddy is significantly and adversely affected by the expensive pump operation cost.

(3) Improvement of Farmers' Institution

To achieve the project target like a high degree of effective water use, cropping intensity and adequate yield, full participation of functional water-based farmers' organization (institution) to the water management at on-farm level would be needed. Under the conditions, three kinds of water-based farmers' organizations are presently established in the Service Area, that is, Farmers Irrigators' Group (FIG), Irrigators' Association (IA) and District Federation of IA (DFIA). The organized IA reaches 70 to 80 percent of the target one, but cultivator joining into IA are still low as 29 to 56 percent of the target by District.

These IAs organization are presently based on the voluntary membership with some non-members in a certain IA, but the proposed O/M improvement needs compulsory full participation of water users. Since IA without joining cultivators can not fulfill properly, the IA function to carry out the water management and collection of irrigation fee, the MRIIS O/M Office, especially IDD-MRIIS shall accelerate the farmer's participation to IA.

In order to support IAs in strengthening the organization, the following issues have to be given by NIA under favorable consideration.

- The reasons why there are some water users who do not want to join IAs have to be clarified duly.
- The data on progress of land reform program at FIG level should be prepared for the proper coordination between NIA and MAR to promote the program.
- The full support of local governments from Province to Barangay for the MRIIS O/M improvement have to be promoted by NIA, especially for the coordination of water allocation between the upstream and the downstream and the development of IA organization.
- In order to execute the cooperative farming and proper water management in the area, communication among farmer themselves and information exchange between farmers and IA leaders, O/M Staffs of the MRIIS Offices and Barangay captain should be done closely. For this purpose, it is recommendable that rural communication systems should be provided in the project.

Any other special farmers' organization than Irrigators' Association (IA) is not proposed for the MRIIS area. However, post-harvest facilities and farm machinery are proposed to be introduced to IA Federations in order to increase farm income from paddy cultivation. Prior to formulation of IA Federations, the selected IAs have to be consolidated in their membership based on the criteria as shown below. Furthermore, more detail study especially on the post-harvest facilities and farm machinery should be made on the IA Federation Model Project which was proposed in this Project.

- Duly registered organization
- Satisfactory level of water management and farming practices
- Leadership of IA Officer
- Contiguity of the members' farm land and residence
- Completeness and function of on-farm facilities

(4) Improvement of Production Loan

From the result of the study, it was found out that the production loan with low interest rate would be prerequisite for the MRIIS area to improve farming practices and to raise effective water utilization, irrigation fee collection and farm income, and therefore NIA should make following studies with the cooperation given by MAF, other Governmental agencies concerned and related banks;

- Necessary amount of production loan requested by IA organization and its repayment methods,
- Financial arrangement for production loan taking into account fund by other country or international development agencies,
- Simplification of loaning procedures for the production loan.

5.3. Recommendations for Project Implementation

Implementation of the MRIIS O/M improvement works, consisting of two categories classified largely such as improvement of system facilities and water management in the Service Area and strengthening of farmers' institution, are planned to be a five-year program from 1988 to 1992, and these works should be implemented in accordance with the proposed implementation priority under the close cooperation among the MRIIS O/M Offices and other Governmental agencies concerned such as MAF, MAR, NPC, NFA, etc.

In the above works for improvement of system facilities, improvement of check and head gates in the canal system should be replaced or newly installed at the early stage in order to carry out effective distribution and control of water. Furthermore, development of undeveloped area of about 13,200 ha and provision of on-farm facilities at the area of 6,700 ha, which are major items to improve the present unirrigated area of about 26,300 ha would be implemented essentially and urgently for the MRIIS Project to achieve the development target of the projected irrigation area of 97,400 ha; otherwise the project benefit of the MRIIS will not be generated any more and increment of irrigation fee collected as the fund for O/M services in the MRIIS can not be expected.

The required costs for the improvement works are estimated at 1,060 million pesos, of which 705 million pesos of foreign currency and 355 million of local currency, and for the implementation of the Project NIA should take necessary countermeasures and procedures for the financial arrangement and procurement of necessary Consultants having sufficient experience for O/M works in the large scale of irrigation system.

5.4. Recommendations for Operation and Maintenance Activities

After the completion of improvement works for the MRIIS O/M, operation and maintenance activities of the MRIIS, which mainly consist of water water management, maintenance of system facilities, irrigation fee collection, assistance to farmers' organization for on-farm development, establishment of IA, etc. should be properly conducted by the MRIIS O/M Offices under the direction of the MRIIS O/M Head Office.

In the works mentioned above, the MRIIS O/M Head Office should carry out the following data management for administrative works and daily data processings by using a computer.

i) Data Filing

- Hydrological and meteorological data
- Water management data
- Equipment and materials
- Staff and employees
- Agricultural land and cadaster

ii) Processing and Analysis

- Irrigation fee collection
- Statistical processing
- Cost price analysis and budget control
- Diversion water requirement computation
- Water allocation among sources and demands
- Simulation for periodic updating of optimal reservoir operation rule
- Simulation for optimal cropping schedule

In addition to these data management, the MRIIS O/M Head Office is requested to make monitoring of annual data and progress of O/M activities which will be illustrated on the O/M Drawings, in order to grasp prevailing O/M conditions in the Service Area.

As same as the recommendation in project implementation, qualified Consultant experts would be procured by NIA to assist the MRIIS O/M works at the initial stage of the O/M work.

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