

# Way Rarem Irrigation Project (I) (II) (III) (IV)

Report Date : October, 2002

Field Survey : August, 2001

## 1 . Project Profile and Japan's ODA Loan



Location Map of the Project



Main Canal

### 1.1 Background

#### <Packages I, II & III>

Under the First (1969/70 to 1973/74) and Second (1974/75 to 1978/79) Five-Year National Development Plans, agricultural development was among the most important priorities for the Government of Indonesia. Agricultural development was essential, not only for curtailing the amount of foreign currency spent on importing rice, the country's staple crop, but also for developing commodities for export. Many irrigation projects for the purpose of improving rice production and developing paddy fields were implemented during this period. The Third Five-Year Development Plan (1979/80-1983/84) placed a priority on continued efforts in this area, especially:

- 1) Improvement of the irrigation system and construction of canals
- 2) New irrigation network development plan
- 3) Swamp land development plan

The project site, Way Rarem in the Province of Lampung, had been developed as farming area, following immigration trends in Indonesia. The majority of residents in the area had immigrated from Java Island between 1965 and 1975. These immigrants had previously cultivated paddy fields in Java and were eager to build paddy fields even in such a newly developed area. It was expected that the needed irrigation facilities would be constructed where the natural/topographical conditions were most suitable for paddy cultivation.

#### <Package IV>

Under the Fifth Five-Year National Development Plan (1989/90 to 1993/94), maintenance and rehabilitation of the existing irrigation facilities were considered more important than ever. The plan set a target of 500,000 ha for new irrigation development and 8,400,000 ha for

maintenance and rehabilitation of existing facilities nationwide.

Packages I & II of the Way Rarem Irrigation Project had been completed, and Package III was already in progress at the time and scheduled for completion by March 1992.

After the completion of Package III, the irrigation facilities were planned to be transferred from Directorate General of Water Resource Development (DGWRD), central government, to Lampung Provincial Government. The operation of the Way Rarem Irrigation before the Package IV, however, was not efficiently realized owing to the insufficient budget of DGWRD the operation and maintenance agency at that time. During the late 1980s, the coffers of the Indonesian Government were severely strained by a fall in oil prices, and DGWRD could not secure the necessary budget for maintenance. As a result, some of the facilities constructed under Packages I & II deteriorated, and irrigation water in some canals was decreasing.

## **1.2 Objectives**

### **<Package I & II>**

To establish year-round irrigation farming on 22,000 ha of reclaimed paddy field on the right bank of Way Rarem by utilizing the regulated flow from the Rarem dam and a canal system.

### **<Package III>**

To enhance irrigation networks, including construction of main, secondary and tertiary canals, in order to establish year-round irrigated paddy production over an acreage of about 22,000 ha.

### **<Package IV<sup>1)</sup>>**

To assure long-term effectiveness of the Project after transferring the irrigation facilities to the local government, through upgrading and rehabilitation works, procurement of equipment and training on operation and maintenance.

## **1.3 Project Scope**

### **<Package I>**

- 1) To construct the Way Rarem Irrigation Dam
- 2) To construct the upper reach of the main canal (5.4 km)
- 3) Additional Works (access road, office, etc.)

### **<Package II>**

- 1) To construct the remaining extent of the main canal (59.4 km)
- 2) To construct the secondary canal (159.3 km)
- 3) To construct the tertiary network (9,500 ha)

### **<Package III>**

- 1) To construct the secondary canal (35.2 km)
- 2) To construct the tertiary network (12,675 ha)
- 3) Procurement of facility and equipment for O&M

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<sup>1)</sup> Package IV aimed to reinforce the existing facilities constructed in Packages I to III.

4) Consulting Service

<Package IV>

1) Rehabilitation and upgrading of the existing irrigation facilities

Canal Lining (main: 13 km, secondary: 23 km, tertiary: 20 km) and Drainage Improvement (60 km), etc.

2) Training for O&M

3) Procurement of O&M equipment

4) Consulting Service

Figure 1 : Project Map



## 1.4 Borrower / Executing Agency

The Government of the Republic of Indonesia / Directorate General of Water Resource Development (DGWRD), the Ministry of Settlement and Regional Infrastructure (Former Ministry of Public Works)

## 1.5 Outline of Loan Agreement

Loan Amount	Package I	7,365 million yen
	Package II	10,245 million yen
	Package III	3,027 million yen
	Package IV	1,623 million yen
	Sub Total	22,260 million yen
Loan Disbursed Amount	Package I	7,361 million yen
	Package II	9,154 million yen
	Package III	2,034 million yen
	Package IV	1,558 million yen
	Sub Total	20,107 million yen
Exchange of Notes	Package I	December, 1978
	Package II	November, 1979
	Package III	December, 1987
	Package IV	September, 1991
Loan Agreement	Package I	March, 1979
	Package II	May, 1980
	Package III	December, 1987
	Package IV	September, 1991
Terms and Conditions		
Interest Rate	Package I	2.75 % p.a.
	Package II	2.50 % p.a.
	Package III	3.00 % p.a.
	Package IV	2.60 % p.a.
Repayment Period (Grace Period)	Package I	30 years (10 years)
	Package II	
	Package III	
	Package IV	
Procurement	Package I	Partially Untied
	Package II	
	Package III	
	Package IV	General Untied (Partially Untied for Consulting Service)
Final Disbursement Date	Package I	September, 1984
	Package II	November, 1987
	Package III	December, 1992
	Package IV	October, 1997

## **2 . Results and Evaluation**

### **2.1 Relevance**

Packages I to III were given high priority under the first, second and third Five-Year National Development Plans (REPLITA I, II and III), in the period from 1969/1970 to 1983/1984. Those plans aimed to increase rice production, improve food self-sufficiency, and increase farmers' income. Package IV was subsequently implemented to rehabilitate and upgrade facilities that had been constructed in the previous packages, for the purpose of maintaining their function over an irrigation area of 22,000 ha.

Given the above, it can be concluded that the Project's objectives were relevant at the time of project appraisal and still meet current policy requirements: to irrigate the area efficiently and effectively.

### **2.2 Efficiency**

#### **2.2.1 Project Scope**

There were some minor design modifications and subsequent works added to each package, mainly to adapt to actual topographical or geological conditions at the construction sites. However, in general, the overall scope was completed as originally planned.

#### **2.2.2 Implementation Schedule**

Package I was completed mostly as scheduled, although it was slightly delayed. Package II was completed 2.5 years behind schedule, according to the Project Office. Poor performance on the part of the sub-contractors constituted the main reason for the delay. Package III was completed 5 months behind schedule. Package IV was completed one year behind schedule.

In the original schedule set in 1978, all works were to be completed between 1979 and 1990. Although there were delays, as stated above, the key structures -- such as the dam, main and secondary canals -- were completed from 1979 to 1985, largely as scheduled.

#### **2.2.3 Project Cost**

Table 1 summarizes the planned and actual costs of the Project and the loan disbursement for each package.

**Table 1: Comparison of Original and Actual Cost and Loan Disbursement (10<sup>6</sup> Yen)**

	Package I		Package II		Package III		Package IV		Total	
	Orgnl.	Actual	Orgnl.	Actual	Orgnl.	Actual	Orgnl.	Actual	Orgnl.	Actual
<b>Foreign Currency</b>	6,373	6,726	7,313	7,180	2,138	1,480	1,089	1,504	16,913	16,919
<b>Local Currency</b>	3,681	5,565	9,767	2,203	889	607	844	159	15,181	8,445
<b>Total Cost</b>	10,054	12,291	17,080	9,383	3,027	2,087	1,933	1,663	32,094	25,364
<b>Loan Disbursement</b>	7,365	7,361	10,245	9,154	3,027	2,034	1,623	1,558	22,260	20,107

source : DGWRD

The total actual cost (25,364 million Yen) and loan disbursement (20,107 million Yen) were less than the original estimates of 32,094 million Yen and 22,260 million Yen, respectively. While there was a slight cost over-run in the foreign currency portion, there was an under-run in the local currency portion. When looking at each package, the cost over-run in Package I stands out. However, this over-run was cancelled out by the cost under-run of Package II, since these two packages progressed in parallel and some cost reallocations were made between the construction items.

## 2.3 Effectiveness

### 2.3.1 Agricultural Performance

#### 1) Land Development

Land reclamation (land cleaning and paddy field construction) and on-farm development were not included in the Project. These activities were undertaken by farmers with assistance and guidance from the Ministry of Agriculture and the provision of credit and incentives such as food or subsidies to villages, based on the policy of Indonesian Government for land development at that time. It was scheduled that farmers would incrementally reclaim land until the full 22,000 ha of paddy field would be developed.

The work was completed in 1997. The outcome was completion of 20,180 ha in 1997, out of the planned target of 22,000 ha (92% of the planned target).

**Table 2 : Progress of Paddy Field Development (ha)**

1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997 -- 2000
802	1,429	3,897	7,009	8,208	10,500	12,103	14,277	15,975	17,705	18,561	19,239	20,127	20,180

source: Way Rarem O&M Project Office

#### 2) Cropping Area

Table 3 shows the annual planned and actual paddy cropping areas in the Project. In the original plan, it was expected that a cropping area of 22,000 ha in the wet season, and 11,400 ha in the dry season (in total 33,400 ha p.a.) would be attained within the 9 years

after the completion of the Project. The Way Rarem O&M Project Office did not set any specific target for the planned cropping area on yearly basis until 1992 because the farmland (possible cropping area) were under development till 1992/93 in line with the project construction progress. After completion of package III in 1992, the Project Office started to set annual target for cropping area.

Until FY1992, paddy cropping area increased steadily, but started to decrease in 1993, and actual cropping area couldn't keep pace with the target figures. The achievement ratio against plan fell as far as 47% in 1997, its worst level, when there was an abnormally long dry season.

After 1997, the ratio improved gradually, and recovered to 87% in 2000. However, it should be noted that the planned cropping area for 2000 was reduced to 1992 levels<sup>2)</sup> by the Way Rarem O&M Project Office. Hence the latest performance level in 2000 is only 58 % (19,417 ha to 33,400 ha) if compared to the original target. Moreover, the average cropping area in dry seasons between 1992 and 2000 (excluding 1994, which is a deviation) is 6,261 ha, and the average achievement ratio for these dry seasons only is about 55%.

**Table 3 : Paddy Cropping Area**

Package I completed      Package II completed

			1984	1985	1986	1987	1988	1989	1990	1991	1992
ACTUAL	Wet Season	ha	802	1,429	3,899	7,009	8,208	10,500	12,103	14,277	15,975
	Dry Season	ha	--	--	--	5,250	6,172	7,576	7,457	7,167	8,385
	Total	ha	802	1,429	3,899	12,259	14,380	18,076	19,560	21,444	24,360

Package III completed

Package IV completed

Main Canal Sliding

Long Dry Season

			1993	1994	1995	1996	1997	1998	1999	2000
PLAN	Wet Season	ha	17,705	18,561	19,239	19,346	17,882	18,052	19,099	14,028
	Dry Season	ha	7,087	--	8,071	9,351	9,075	8,776	9,873	8,400
	Total (B)	ha	24,792	18,561	27,310	28,697	26,957	26,828	28,972	22,428
ACTUAL	Wet Season	ha	17,705	11,783	12,075	11,480	6,455	10,300	11,100	12,158
	Dry Season	ha	6,195	2,400	5,200	4,468	6,289	4,925	7,374	7,259
	Total (A)	ha	23,900	14,183	17,275	15,948	12,744	15,225	18,474	19,417
Achievement Ratio (A)/(B)		%	96	76	63	56	47	57	64	87

Source: Way Rarem O&M Project Office

<sup>2)</sup> In 1993 and 1994, the annual planned paddy cropping area was set by the Way Rarem O&M Project Office without consulting to farmers. However, since 1995 it has been set target for cropping area yearly by summing up each farmer's planned cropping area for the year, which is reported to the Office.

Note : Planned target for dry season in 1994 was not set by the Way Rarem O&M Project Office, since there was a main canal sliding just before entering the dry season so that the canal was closed from February to March.

Table 4 shows the actual cropping area of “Palawija”, or secondary crops cultivated in the dry season, for the period from 1992 through 2000 in project area. Since 1993, cassava has become a major secondary crop in terms of cropping area, even though the planting of cassava was not planned at the Project appraisal stage.

**Table 4 : Cropping Area of Other Crops, “Palawija” in Project Area**

		Package III completed					Package IV completed			
		Main Canal Sliding					Long Dry Season			
		Plan	1992	1993	1994	1995	1996	1997	1998	1999
Maize (Corn)	Ha	3,600	3,750	3,000	2,000	3,500	4,100	4,000	4,000	4,000
Soybeans	Ha	3,500	--	--	--	--	--	--	--	--
Peanut	Ha	3,500	2,500	3,000	3,500	4,000	4,200	4,200	4,225	4,300
Singkong (Cassava)	Ha	0	1,750	7,000	11,000	6,500	6,500	5,250	4,750	6,450
<b>Total</b>	<b>Ha</b>	<b>10,600</b>	<b>8,000</b>	<b>13,000</b>	<b>16,500</b>	<b>14,000</b>	<b>14,800</b>	<b>13,450</b>	<b>12,975</b>	<b>14,750</b>

Source: Way Rarem O&M Project Office

These secondary crops became major ones, especially in the lower reaches of the Project area, where irrigation water does not consistently reach the fields. During the field survey conducted in May 2002 for this evaluation, many farmers who cultivate these secondary crops in the lower reaches, i.e., Pulung Kencana Village and Daya Murni Village, reported to the Mission that they had abandoned cultivating paddy owing to unstable or unreliable irrigation water, and they affirmed that they still would prefer to cultivate paddy only if sufficient water had been available because rice were economically more profitable.

According to the Project Manager of the Way Rarem O&M Project Office, the irrigation water problems are probably caused by the following factors:

- More sedimentation in the reservoir than anticipated, which reduces the amount of intake water.
- More canal water loss (main, secondary and tertiary) than anticipated.
- Larger paddy water requirements than originally anticipated.

These issues are to be discussed below in detail in “2.5.4 *Toward the Sustainability*,” with reference to the results of the latest WATSAL (Water Sector Structural Adjustment Loan) Feedback Study in 2001 which was supported by a Japan’s ODA<sup>3)</sup>.

<sup>3)</sup> The feed back study for irrigation project financed by Japan’s ODA loan was conducted, in order to review the economic, technical, social outcome of the completed irrigation projects and to draw lessons to improve the efficiency and effectiveness of future irrigation project.

## 2) Paddy Yield and Production

The paddy yield has been gradually improving since 1991. The latest average annual paddy yield is 4.2 t/ha in the wet season and 4.1 t/ha in the dry season. The respective achievement ratios against the plans are, respectively, 93% and 82% of the planned average yield.

**Table 5 : Average Yield**

		Plan	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Wet Season	t/ha	4.5	3.0	3.1	3.2	3.4	3.5	3.9	4.1	4.5	4.5	4.2
Dry Season	t/ha	5.0	2.5	2.5	2.6	2.7	2.9	3.2	3.2	3.5	3.6	4.1

source: Way Rarem O&M Project Office

### 2.3.2 Recalculation of EIRR

At the time of project appraisal, EIRR was calculated at 11.4%. At this evaluation, since no appropriate data for actual project costs and benefits was available, the actual EIRR could not be recalculated<sup>4</sup>).

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<sup>4</sup> In the WATSAL Feedback Study report, EIRR was recalculated at 5.0% for rough estimation, using the figures just adjusted to 2001 price level. Therefore, it is likely that the actual EIRR can be much lower than 5%, if the actual archiving ratio is taken into consideration.

## 2.4 Impacts

### 2.4.1 Farmers' Income Increase

This project was expected to increase farmers' incomes as part of the ultimate goal of improving local living standards. Figure 2 illustrates "Farmer's Average Income/ Expense Status" in before and after the Project, based on an interview survey of beneficiaries<sup>5)</sup>. As shown in the figure, total income increased around 214%<sup>6)</sup> overall, with agricultural income becoming the major income source. Consequently, possible savings of the farmers increased 167 % on an average.

### 2.4.2 Environmental Impacts

#### 1) Borrow Pits

Along the main and secondary canals, there are wide, deep borrow pits where soil for embankment construction has been excavated. At the time of Project appraisal there was concern that these pits could cause drowning accidents, and even though Project staff warned local residents, it has been reported that 14 children have died from drowning. Sufficient attention to safety concerns should have been an indispensable part of this project. Except for this issue, no considerable negative impacts such as water quality deterioration has been recognized by the Way Rarem O&M Project Office.

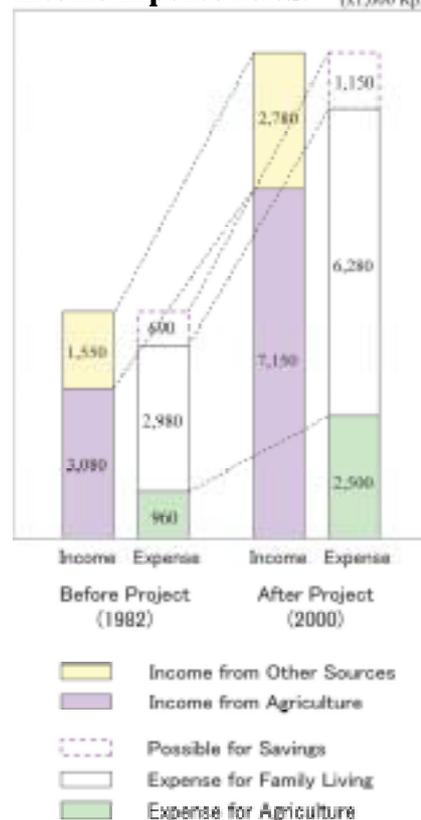
## 2.5 Sustainability

### 2.5.1 Operation and Maintenance

#### 1) The Dam, Main and Secondary Canal

Government of Indonesia is now conducting the Irrigation Management Policy Reform, which aims to improve the irrigation management through farmers' empowerment and management transfer. Based on decentralization and Presidential degree No. 3/1999 regarding irrigation management, the responsibility of O&M for irrigation facilities has been transferred gradually from central government to provincial, district government and WUA.

**Figure 2 : Farmer's Average Income/Expense Status** (x1,000 Rp.)



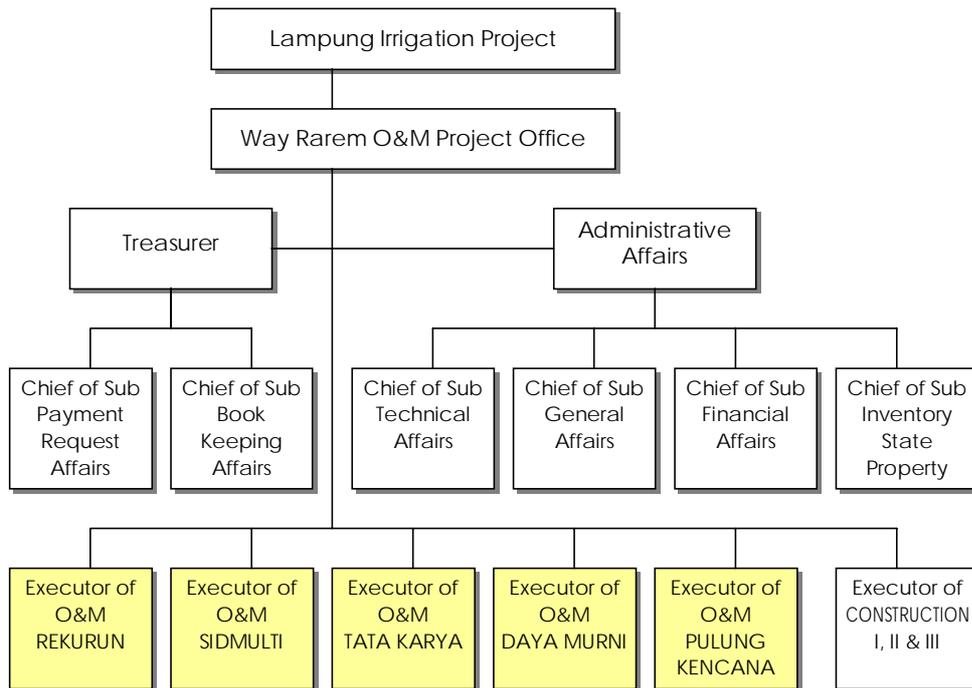
<sup>5)</sup> A questionnaire-based interview survey of beneficiaries was carried out in order to examine the project's effect/impact. A hundred (100) interviewees, roughly 0.3% to 0.4% of the total households in the project area, were selected randomly from the area with the cooperation of the Way Rarem O&M Project Office. The major items in the questionnaire include 1) utilization and accessibility of the facility, 2) farmers' participation in O&M activities, 3) women's participation, 4) impact of the project, 5) overall assessment of the project, and 6) further requirements and recommendations. Data in Figure 2 is an average per household based on the response to the questionnaire, and is all adjusted to the present value (2000).

<sup>6)</sup> Total income after deducting agricultural costs was predicted to increase 230% overall at the time of project appraisal.

As of August 2001, operation and maintenance of above mentioned facilities is the responsibility of the Way Rarem O&M Project Office, which is under the Lampung Irrigation Project (Dinas Pengairan Lampung Province)<sup>7)</sup>, an office of the Provincial Government of Lampung. The O&M Project Office has five executors of O&M units (UPT: Unit Pelaksana Teknis) in each Ranting (sub-office) as shown in Figure 3 below. The activities of the Executors<sup>8)</sup> include operation of water distribution (such as operation of intake gates, diversion gates at main canal, turnouts at secondary canals, etc.) and minor, regular maintenance (such as gate lubrication, painting, weeding, desilting and repairing minor defects).

**Figure 3 : O&M Organization of Way Rarem O&M Project**

**As of August, 2001**



## 2) Tertiary Canals and On-farm Irrigation Facilities

Water Users Associations (WUA) are responsible for O&M of the above facilities. There are 47 WUAs with a total of 18,658 members in the Project area (according to the latest list of WUAs from the Project Office). WUAs are formed on a village-basis, and one WUA has 397 members (though size of WUA varies from 17 members to 1,843 members) and 430 ha on average. All farmers in a village belong to WUA. Formally, the responsibility for O&M has been transferred to WUAs, but so far only 15%, or 7 WUAs in the project area actually work as expected, according to the data from the Project Office.

WUA activities include preparation and operation of a water distribution schedule, liaising between the government and farmers, and implementing both regular and

<sup>7)</sup> The Project facilities (dam, main canal, and secondary canal) were constructed and maintained by Way Rarem Sub-Project Office under the Ministry of Public Works until 1997. However, O&M was transferred and is now conducted by the Way Rarem O&M Project Office.

<sup>8)</sup> Each executor has office staff of 2 irrigation supervisors, 4 to 7 water masters and 11 to 19 gate keepers, according to 1998 records.

irregular maintenance of the facilities. Though the actual participation ratio of WUAs has remained low, at 15%, informally, farmers are participating in O&M activities through Gotong-Royong, a traditional mutual-supporting system in community. Regular maintenance is practiced generally twice a year by means of "Gotong-Royong," under which farmers do volunteer maintenance work for about 5 days per cropping season.

### **2.5.2 Current Facility Condition**

During the field survey, the Mission for this evaluation visited the dam site and the main, secondary and tertiary canals, and observed present conditions, as follows:

#### **1) Rarem Dam**

There are no effective quantitative data available indicating present actual sedimentation, because the progress of mad sedimentation in the water reservoir has not been monitored since 1993. An in-depth survey of the accumulated sedimentation was conducted by Japanese engineers during the Project Sustainability Study in 1993, which was realized under a Japan's ODA. According to the Study report, the progress of sedimentation was assessed still within the original designed range and not in a problematic situation at the time of the study.

At the time of this evaluation, the dam structure and its surrounding environment seem to be managed well so far. No serious land erosion in the catchment area nor sedimentation inflow were visible, despite concerns that the Sub-Project Office expressed to the Evaluation Mission regarding deforestation in the catchment area. In fact, WATSAL Feedback Study reports that so far watershed deterioration is only 280 ha or 0.85 % of the catchment area (328,000 ha).

#### **2) Main Canal**

There are 14 siphons installed along the main canal, which are big enough for O&M staff to enter for cleaning inside. So far they have carried out periodic cleaning at a frequency of once a year during the dry season, and no serious facility defects (e.g. water leakage, serious mad sedimentation) have been found.

Though the canal is not fully lined with concrete, critical canal sections such as outer curving points, including sections that were reconstructed after they collapsed in 1994, were lined effectively under Package IV (26.3% of the total length of the main canal, were rehabilitated/concrete-lined in Package IV). The facility was still in good condition at the time of this evaluation.

#### **3) Secondary and Tertiary Canal**

The Evaluation Mission also inspected some sections of the secondary and tertiary canals, where sufficient irrigation water used to flow, but no or insufficient amounts of water can be taken presently. The major reasons are summarized as follows:

- a) Dysfunction of siphon in Pulung Kencana and Tata Karya
- b) Water shortage in the tail reaches of secondary canal in Pulung Kencana and Sidmukti
- c) Water leakage in the aque-duct in Pulung Kencana

Facility defects such as siphon dysfunction were limited, and it is still to be questioned why enough water cannot reach to the tail reaches area where there is no such a physical facility problem as siphon dysfunction. Possible reasons will be discussed further in 2.5.4 *Toward Sustainability—Problem Analysis*.

### **2.5.3 Financial Status**

#### **1) Way Rarem O&M Project Office**

Table 6 indicates the actual O&M budget for the Project. From FY1984/1985, when partial operation commenced, through FY1996/1997, O&M funds came from the Central Government. Since FY1997/1998, when the O&M responsibility was transferred to the Provincial Government Project, funds have come mainly from the Provincial Government. The shortage of O&M budget is supplemented by funding from the Central Government. The budget allocated from the Central Government is about Rp. 80 million, while from the Provincial Government, it ranges, annually, from Rp. 200 million to Rp. 500 million. In FY2000/2001, the allocation was Rp. 100 million from the Central Government and Rp. 488 million from the Provincial Government. Assuming that the annual total O&M budget is Rp. 588 million and irrigation area is 22,000 ha, unit maintenance cost amounts to Rp. 26,700/ha, which is less than half of the target of Rp. 57,130/ha p.a. set in the aforementioned Sustainability Study in 1993.

Given these financial conditions, the average monthly salary for gate operation staff is only Rp.180,000, less than a quarter of the average rate for permanent official staff (Rp. 800,000). Such payment conditions compel workers to run their own business on the side (e.g. paddy cultivation), and, consequently, may decrease staff motivation to work in the fields, causing less than prompt and accurate gate operation.

**Table 6 : O&M Budget Allocation for Dam, Main and Secondary Canals**

<b>FY</b>	<b>National Budget Rp. 1,000</b>	<b>Local Budget Rp. 1,000</b>	<b>Total Rp. 1,000</b>
1984/1985	71,362	--	71,362
1985/1986	144,850	--	144,850
1986/1987	98,181	--	98,181
1987/1988	40,806	--	40,806
1988/1989	41,900	--	41,900
1989/1990	42,000	--	42,000
1990/1991	333,250	--	333,250
1991/1992	305,000	--	305,000
1992/1993	195,884	--	195,884
1993/1994	175,400	--	175,400
1994/1995	247,275	--	247,275
1995/1996	176,900	--	176,900
1996/1997	187,400	--	187,400
1997/1998	--	240,000	240,000
1998/1999	80,000	200,000	280,000
1999/2000	80,000	373,000	453,000
2000/2001	100,000	488,000	588,000

source : Way Rarem Sub-Project Office

## 2) WUA (Water Users Associations)

According to the WATSAL Feedback Study in 2001, WUA membership fees range from Rp. 1,000 to Rp. 5,000 (about Rp. 3,500 on average). The associations' major source of income is not the membership fee, but actually annual or seasonal paddy contributions from members. After harvesting (twice a year), members contribute 60 to 80 kg/ha of paddy (equivalent to Rp. 66,000 to Rp. 88,000/ha at the current price of Rp. 1,100/kg). WUA collects and processes paddy, and spends up to 35% of the money from its sale on the honoraria for the office bearers (i.e., leader, secretary, treasurer, water master), up to 20% on office expenses, and up to 45% on maintenance of canals and structures. In addition to in-kind contributions, an ISF (Irrigation Service Fee) is collected, at a rate of Rp. 11,400/ha in the wet season and Rp. 9700/ha in the dry season, and paid to the District Government (Kabpaten). The average collection rate is 80% in the wet season and 38% in the dry season, according to data provided by the Provincial Government. The reason for this low collection rate in dry season is that farmers cannot get enough irrigation water from the canal to cultivate their paddies, so they cannot afford to pay the ISF.

Given this situation, measures should be taken to ensure that sufficient irrigation water

reaches farmers' paddies in the dry season, and to strengthen the ISF collecting system.

#### **2.5.4 Toward Sustainability**

##### **<Problem Analysis>**

A major problem of the Project is a "Water Shortage Phenomenon" in the tail reaches, which is causing low performance in paddy cropping and unexpected increases in other secondary crops. The Project Manager of the Way Rarem O&M Project Office pointed out possible causes for these unexpected results, as follows:

- A) Sedimentation in the reservoir has progressed more rapidly than anticipated, causing the amount of intake water to decrease.
- B) Canal water loss (main, secondary and tertiary) is greater than anticipated.
- C) Actual paddy water requirements are greater than originally anticipated.

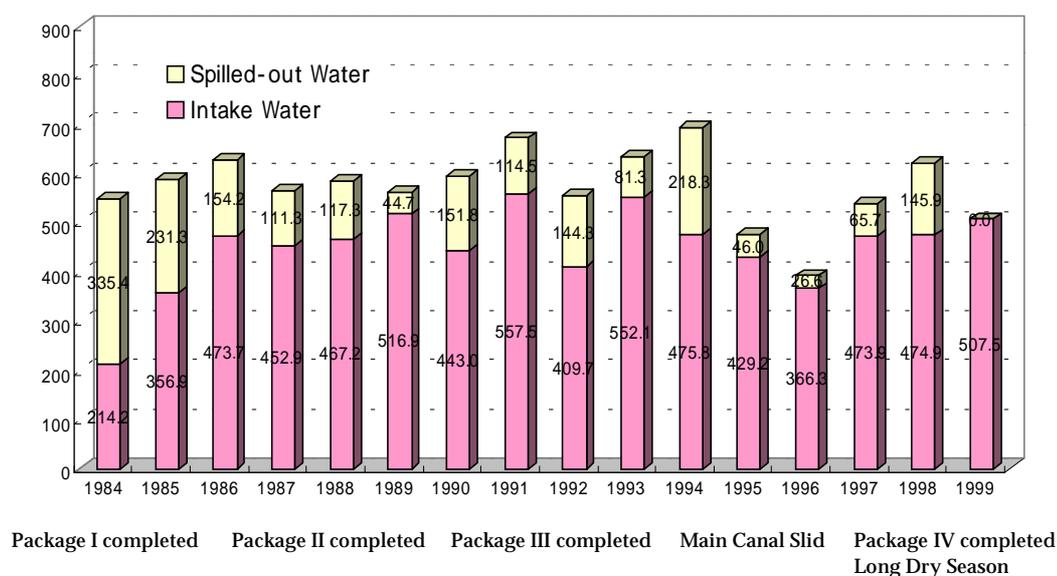
These factors are analyzed critically below.

##### **A)Water Supply from Rarem Dam**

Figure 4 illustrates the amount of actual intake water (irrigation water supply) and spilled-out water from the reservoir. The record of water diversion from the dam shows that there has been no decrease in the volume of intake water, except 1995 and 1996, when there was a remarkable decrease in the regulation of water diversion for the rehabilitation period under Package IV. Consequently, it is possible to conclude that there was no considerable degradation in storage capacity after the completion of Rarem Dam.

The possibility of A) is discussed in detail in the WATSAL Feedback Study, and it concludes that there is "No Problem"; the decrease of storage capacity is marginal. Gross storage capacity decreased from the original 72.4 MCM to 70.5 MCM -- by 1.95 MCM or 0.3 % in the 10 years after completion, though its conversion to the catchment area is only 590 m<sup>3</sup>/year/km<sup>2</sup>, much less than the design value of 750 m<sup>3</sup>/year/km<sup>2</sup>. The Mission for this Evaluation also concludes that sedimentation in the reservoir has not seriously progressed, refuting the Project manager's claims.

**Figure 4 : Intake and Spilled-out Water from Rarem Dam (MCM)**



source: Way Rarem O&M Project Office

## B) Water Leakage of Canals

To evaluate the volume of B), canal water loss, the Project Office conducted a study on water leakage in the main canal (the headrace) in 2000, measuring a 17.6% rate of leakage, which is higher than the 15% of the original design. The office subsequently proposed to the Central Government that the canal be reinforced with concrete lining. However, in WATSAL Feedback Study in 2000, sufficient irrigation efficiency<sup>9)</sup> is secured at 58%, which is generally assessed as relevant in terms of gauging irrigation technology. Therefore, the possibility of water leakage should not be considered a major contributing factor of the “Water Shortage Phenomenon”.

## C) Paddy Water Requirement

There are two ways of explanation of water requirement, i.e., “Underestimation of Unit Discharge” and “Excessive Water Intake”, which are discussed below respectively.

### C)-i Underestimation of Unit Discharge

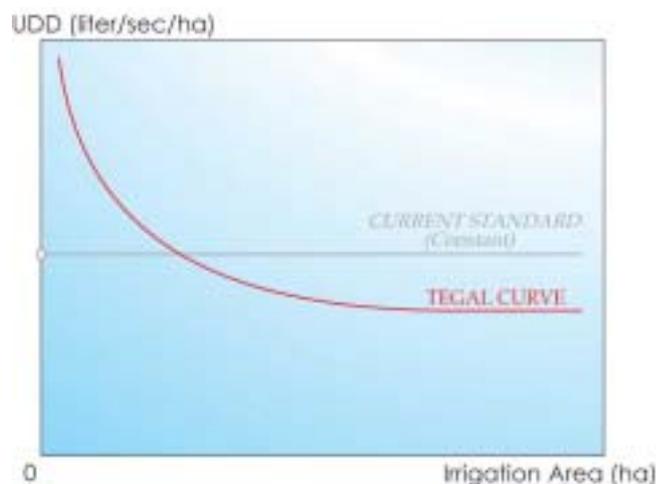
There is a prevailing argument with respect to the water shortage problem, that the planned irrigation area (33,400 ha p.a.) could be too large to be irrigated by the project facility. This assumption follows from the idea that the Unit Discharge (1.0 lt/sec/ha) applied in the Project design may be smaller than the Unit Discharge currently applied to irrigation schemes (roughly 1.5 lt/sec/ha).

The Way Rarem Irrigation scheme was originally designed before 1986, in compliance with the facility design standard required to incorporate the two elements: 1) the Tegal

<sup>9)</sup> Irrigation efficiency is defined as the effective amount of irrigation water coming from the original intake through water distribution facilities. Irrigation efficiency= Water Supply Coefficient x Operation Coefficient.

Curve Coefficient<sup>10)</sup>, which requires relatively small Unit Discharge in a large irrigation area (as illustrated in Figure 5), and 2) Gate-operation-based water distribution management, which requires frequent and accurate gate operation (about 600 mechanical gates such as Romin Gate and Slide Gate installed in the Project) in order to optimize water use under the Unit Discharge set in line with the Tegal Curve Coefficient.

**Figure 5: Concept of Tegal Curve**



### C)-ii Excessive Water Intake

Table 7 indicates the actual amounts of water intake in the upstream area. The figures were recorded in the WATSAL Feedback Study in July 2001. Through the course of the study, it became clear that haphazard and excessive water distribution occurs at several turnouts near the first diversion point.

**Table 7: Water Distribution Data in the Upstream Area in 2001**

Turnout	Gate Type	Irrigation Area (ha)		Discharge (l/sec)		Unit Discharge (l/sec/ha)	
		Design	Actual	Design	Actual	Design	Actual
B.Br.1	Sluice	4,021	1,333	4,061	6,120	1.0	4.6
B.Br.1 kika	Romijn	66	22	67	205	1.0	9.3
B.Propau 1	Sluice	332	99	335	729	1.0	7.4
B. Br.2.ka	Romijn	5	3	5	48	1.0	16.0
B.Br.2 ki	Romijn	10	5	10	40	1.0	8.0
B.Br.6 kaki	Romijn	23	5	23	37	1.0	7.4
B.Br.6 ki	Romijn	17	6	17	13	1.0	2.2
B.Propau 2	Romijn	139	19	140	94	1.0	4.9

source : WATSAL Feedback Study

<sup>10)</sup> The Tegal Curve had been used as a canal design standard for years in the irrigation field in Indonesia, and was omitted from the Irrigation Scheme Design Standard of the DGWRD in December 1986, being replaced by the current standard, under which constant amount of water is required no matter how large the irrigation area is.

The amount of actual water intake at these turnouts is averagely 4.9 times larger than originally designed. Unreasonable/excessive water distribution could also be occurring in the remaining project area. It seems that irrigation water is being accessed without restriction from the most upstream of the main and secondary canals, possibly causing inequitable water distribution between the upper and lower reaches.

For the lack of data on the amount of drained water in the same turnouts, it is difficult to determine how much paddy water was really needed in the turnouts. However, for the actual unit discharge seen in Table 7, it is certain that unreasonable/excessive water distribution does occur in upstream areas, and it seems to be a major factor in the chronic water shortage in the tail reaches and, more generally, for low paddy production in the Project.

### <Overall Assessment>

As discussed above, POSSIBILITY [A], "Sedimentation in the Reservoir Causing Intake Water Decrease" is considered irrelevant in light of the actual time-series of data on dam water diversion and the assessment of actual sedimentation in the previous Sustainability Study. POSSIBILITY [B] is not relevant, as the current irrigation efficiency is sufficient. POSSIBILITY [C], being comprised of two elements of Unit Discharge and Water Intake, is further to be considered; it can be a major problem in the current Project performance. POSSIBILITY [C] can be explained as an inappropriate water distribution, which is caused by a combination of water distribution management capacity (farmers' attitude/behavior and the Project office's limited resources for O&M) and characteristics of the original facility design requiring a complex gate operation, in compliance with the previous irrigation scheme design standard in Indonesia.

As discussed above in 2.5.3 Financial Status, the Project has had difficulty in motivating the O&M staff to operate the facilities (i.e., gates) effectively as originally planned, mainly because of the small O&M budget. This situation seems to be aggravated by farmers' natural desire to secure enough water into their field, resulting in excessive water use in the upper reaches and water shortage in the lower reaches.

In order to further analyze the problem and promote the project effectiveness, a detailed survey is now carried out in 2002/2003 under Project Type Sector Loan in Water Resources Development II (PTSL2) assisted by Japan's ODA loan<sup>11)</sup>. Loan Agreement for PTSL2 was concluded in July 2001, and it aims to rehabilitate/renovate the water resources facilities and contributes to increase the rice production. PTSL2 covers 19 subprojects in west and central Indonesia, including the rehabilitation of Way Rarem Irrigation.

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<sup>11)</sup> Detailed studies are now carried out in 2002/03 under PTSL2. Possible survey items for Way Rarem Irrigation are: 1) Verifying data on water volume in the reservoir, water discharge and water spilled out recorded during the past years, 2) Researching sedimentation volume and effective storage volume of water in the reservoir, 3) Inspecting physical conditions of main, secondary and tertiary canals (water leakage, percolation, erosion, function of siphon, etc.), 4) Studying historical water leakage and percolation in paddy field, 5) Reviewing plan and actual cropping pattern, 6) Studying non-gate based water distribution system, 7) Strengthening farmers association and diffusion of knowledge on equitable water use, and 8) Strengthening O&M by farmers.

### **3 . Lessons Learned**

In irrigation projects, capacity building for O&M and water management by WUA, farmers and O&M agencies, and coordination between them, are indispensable to the project's sustainability. Such efforts should be included in the project scope from early in the project cycle.

### **4 . Recommendations**

**(1) O&M strengthening and water distribution improvement should be carried out to cope with the low Project performance.**

To cope with the present problems, an improvement of the water distribution system is essential. Conceivable measures are as follows:

- 1) Promote farmers' understanding regarding to the efficient water management in order to reduce excessive water use.
- 2) Establish a realistic, consistent and comprehensive distribution method with demand-based dam operation included.

**(2) Existing Borrow-pit should be cared for properly so as to prevent further drowning incidents. For instance, water in the borrow pit can be drained out to the rivers, which also will protect the canal dike toe from sliding.**

## COMPARISON OF ORIGINAL AND ACTUAL SCOPE

### Packages I & II

Item	Plan	Actual
<b>(1) Project Scope</b>		
<b>1. <u>Dam and Reservoir</u></b>		
- Type of dam	Rock fill type (central core)	as planned
- Dam height	31.0 m	32.0 m
- Dam embankment volume	1,050,000 m <sup>3</sup>	1,340,000 m <sup>3</sup>
- Total storage capacity	72.4 million m <sup>3</sup>	70.45 million m <sup>3</sup>
- Effective storage capacity	56.9 million m <sup>3</sup>	as planned
- Catchment area	328 km <sup>2</sup>	as planned
<b>2. <u>Main Canal</u></b>		
- Total length	64.8 km	63.5 km
- Earth canal	61.2 km	58.7 km
<b>3. <u>Secondary Canal</u></b>		
- Total length	159.3 km	158.9 km
- Tertiary canal	36 m/ha	15.3 m/ha
- Drainage canal	12 m/ha	33.9 m/ha
<b>(2) Implementation Schedule</b>		
<b>&lt;Package I&gt;</b>		
1. Preparatory Works	Apr. 1979 – Jan. 1980	May 1979 – Aug. 1981
2. River Diversion Works	Jun. 1980 – Nov. 1981	Feb. 1981 – May 1982
3. Main Dam	Sep. 1980 – Mar. 1983	Apr. 1981 – Jan. 1984
4. Spillway	May 1981 – Oct. 1983	Mar. 1981 – Oct. 1983
5. Intake	May 1981 – Aug. 1983	Dec. 1981 – Nov. 1983
6. Road Relocation	Jan. 1981 – Oct. 1983	Apr. 1982 – Jan. 1984
7. Main Canal	Jan. 1981 – Dec. 1982	Apr. 1981 – Dec. 1983 (completion in Jan. 1984)
<b>&lt;Package II&gt;</b>		
1. Preparatory Works	Sep. 1980 – Nov. 1981	} n.a.
2. Main Canal	Apr. 1981 – Feb. 1985	
3. Secondary Canal	Apr. 1981 – Feb. 1985	
4. Tertiary Networks	Dec. 1981 – Feb. 1985	
<b>(3) Project Cost</b>		
<b>&lt;Package I&gt;</b>		
Foreign currency	6,373 million yen	6,726 million yen
Local currency	3,681 million yen	5,565 million yen
Total	10,054 million yen	12,291 million yen
ODA loan portion	7,365 million yen	7,361 million yen
<b>&lt;Package II&gt;</b>		
Foreign currency	7,313 million yen	7,180 million yen
Local currency	9,767 million yen	2,203 million yen
Total	17,080 million yen	9,383 million yen
ODA loan portion	10,245 million yen	9,154 million yen

**Package III**

Item	Plan	Actual
<b>(1) Project Scope</b>		
<u>1. Civil Works</u>		
a) Main System	35.2 km	as planned
b) Tertiary Networks	12,675 ha	12,122 ha
<u>2. Procurement of O&amp;M</u>		
Equipment		
- Equipment	<i>see Note</i>	as planned
- Spare Parts	Approximately 20%	0
<u>3. Consulting Service</u>		
- Professional A	Total 298 M/M	as planned
- Professional B	(Foreign : 149 M/M)	as planned
	(Local : 149 M/M)	as planned
<b>(2) Implementation Schedule</b>		
1. Signing of L/A	Sep. 1987	Dec. 1987
2. Selection of Consultant	Jun. 1987 – Dec. 1987	
3. Civil Works		
i) Main System (maintenance period included)	Jun. 1987 – Dec. 1990	Mar. 1988 – Dec. 1991
ii) Tertiary Networks	Sep. 1987 – Sep. 1990	Mar. 1988 – Dec. 1990
iii) O&M Facilities Construction	Dec. 1987 – Jan. 1989	Jun. 1988 – May 1991
4. O&M Equipment	Apr. 1988 – Mar. 1989	Aug. 1990 – Oct. 1990
5. Consulting Services	Jan. 1987 – Dec. 1990	Jun. 1990 – Oct. 1990
	(Completion in Dec. 1990)	(Completion in May 1991)
<b>(3) Project Cost</b>		
Foreign currency	2,138 million yen	1,480 million yen
Local currency	889 million yen (9,460 million Rp.)	607 million yen
Total	3,027 million yen	2,087 million yen
ODA loan portion	3,027 million yen	2,034 million yen
Exchange Rate	1Rp = 0.094 yen (Feb. 1987)	

Note : Such equipment as Motor Grader, Road Roller, Dump Truck, Wheel Loader, Truck with crane, Hand Roller, Rammer, Generator, Submergible Pump, Portable Compressor, Turbine pump, Chain Block with support, Engine Welder, Concrete Mixer, Echo Sounder

**Package IV**

Item	Plan	Actual
<p><b>1. Project Scope</b></p> <p><u>1. Civil Works</u></p> <p>a) Upgrading works for Rarem Dam</p> <ul style="list-style-type: none"> <li>- Replacement of trash room</li> <li>- Repair of electric facilities</li> <li>- Afforestation on the green belt area</li> </ul> <p>b) Upgrading works for Main Canal</p> <ul style="list-style-type: none"> <li>- Lining of canal</li> <li>- Masonry lining of side ditch</li> <li>- Improvement of inspection roads</li> </ul> <p>c) Upgrading works of Secondary Canals</p> <ul style="list-style-type: none"> <li>- Improvement of existing borrow pits</li> <li>- Lining of canal</li> <li>- Improvement of inspection roads</li> </ul> <p>d) Upgrading works of Tertiary Networks</p> <ul style="list-style-type: none"> <li>- Improvement of existing borrow pits</li> <li>- Lining of canal</li> <li>- Improvement of approaching roads</li> </ul> <p>e) Upgrading works of Natural Drains</p> <p>f) Machine pool</p> <p>g) Training Building</p> <p><u>2. Procurement of Equipment</u></p> <p>a) O&amp;M Equipment</p> <p>b) Equipment for Training</p> <p><u>3. Consulting Service</u></p> <ul style="list-style-type: none"> <li>- Professional A (Foreign)</li> <li>- Professional B (Local)</li> </ul>	<p>2 nos.</p> <p>--</p> <p>300 ha etc.</p> <p>13 km</p> <p>30 km</p> <p>45km etc.</p> <p>62 km</p> <p>23 km</p> <p>38 km</p> <p>44 km</p> <p>20 km</p> <p>22 nos. etc.</p> <p>60 km</p> <p>1 no.</p> <p>1 no.</p> <p><i>see Note 1</i></p> <p><i>see Note 2</i></p> <p>Total : 146 M/M (Foreign : 44 M/M) (Local : 102 M/M)</p>	<p>1 no.</p> <p>1 no.</p> <p>1,030 ha</p> <p>32 km</p> <p>31.65 km</p> <p>32 km</p> <p>as planned</p> <p>48 km</p> <p>67 km</p> <p>68.3 km</p> <p>22 km</p> <p>23 km</p> <p>59.4 km</p> <p>as planned</p> <p>as planned</p> <p>as planned</p> <p>as planned</p> <p>as planned</p> <p>Total : 159.86 M/M (Foreign : 46 M/M) (Local : 114 M/M)</p>
<p><b>(2) Implementation Schedule</b></p> <p>1. Signing of L/A</p> <p>2. Selection of Consultant</p> <p>3. Civil Works</p> <p>4. Procurement of O&amp;M Equipment</p> <p>5. Consulting Services</p> <p>6. Training</p> <p>7. Land Acquisition</p>	<p>Sep. 1991</p> <p>Jul. 1991 – Jun. 1992</p> <p>Jan. 1991 – Jan. 1996</p> <p>Aug. 1991 – Nov. 1993</p> <p>Jul. 1992 – Jan. 1996</p> <p>Apr. 1992 – Mar. 1995</p> <p>May 1993 – Apr. 1994 (Completion in Jan.1996)</p>	<p>as planned</p> <p>Sep. 1991 – Aug. 1992</p> <p>Sep. 1992 – Nov. 1996</p> <p>Jan. 1992 – Dec. 1994</p> <p>Aug. 1994 – Dec. 1996</p> <p>Dec. 1992 – Mar. 1993</p> <p>n.a - Jun. 1993 (Completion in Dec. 1996)</p>
<p><b>(3) Project Cost</b></p> <p>Foreign currency</p> <p>Local currency</p> <p>Total</p>	<p>1,089 million yen</p> <p>844 million yen (12,423 million Rp)</p> <p>1,933 million yen</p>	<p>1,504 million yen</p> <p>159 million yen</p> <p>1,663 million yen</p>

ODA loan portion Exchange Rate	1,623 million yen 1Rp = 0.068 yen (Apr. 1991)	1,558 million yen
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Note 1 : Such equipment as Swamp dozer, Back hoe, Portable Grass Cutter, Shop Tool, Inspection Car of Pick Up Type, Motorcycle, Current Meter, Telecommunication System, Meteorological Equipment, Supersonic Discharge Meter, Floating Weed Cutter, Sand Pump, Generator, Motor for Speed Boat

Note 2 : Such equipment as Minibus, Mobile Training Unit, AV Equipment for Training, Furniture for Training Building

**Independent Evaluator's Opinion on  
Way Rarem Irrigation Project (I) (II) (III) (IV)**

**Revrisond Baswir, Professor of Economics and Accountancy,  
Gadjah Mada University**

1. The objectives of the project are still relevant to the priority and needs of the farmers in Way Rarem area and the development policy of Indonesian government. However, as concluded in the evaluation report, in order to improve the effectiveness of the project and to guarantee its sustainability, the capacity building of the target groups and O&M agencies should have been an integral part of the project objectives starts from the beginning.

2. The project is basically failed in the accomplishment of Indonesia's middle and long term agricultural development plans. The failure of the project is not simply because of its failure in the achievement of its own objectives. The failure of the project is also related to its failure in the improvement of the target group capacity building and in the improvement of Indonesian food self-sufficiency. As stated in point (1), the main reason for the failure is the failure of the project in defining its objectives in a more comprehensive way. The objectives and the scope of the project are simply too narrow.

3. The economic impact of the project on farmers' living standards is questionable. This is not simply because there are so many variables contributed to farmers' incomes and expenses, the involvement of the O&M office in the evaluation process must have biased the final result for the benefit of the government. In addition, significant decrease in the project EIRR, from 11.4% to lower than 5%, sent a contradictory signal about the economic impact of the project.

4. Special attention needs to be put on the effectiveness of the project. The achievement ratio for paddy cropping area in the year 2000, which was only 58% of the original target, should bring into a very serious question about the reliability of the project proposal.

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JBIC View

**Regarding "biased evaluation process"**

The selection of samples and the interview survey were carried out by local consultants without presence of O&M officers with due attention not to be biased.