# 5. COST ESTIMATE

## 5.1 Conditions of Cost Estimate

Construction costs of the proposed project works were estimated on the unit price basis and under the following conditions:

(i) All the civil works of the project will be executed on the contract basis. Contractor(s) will be selected through international competitive bidding.

(ii) The physical contingency was assumed to be 15% of the direct construction cost.

(iii) Exchange rate used for the estimate is US$1.00 = Rp. 1,850 as of late 1990.

(iv) The annual escalation rate was taken at 3% for the foreign currency component and 8% for the local currency component.

The construction cost was estimated for the foreign currency component and local currency component in accordance with the origins of materials.

The currency for cost estimate is expressed in Indonesian Rupiah (Rp.) for local currency component and in the United States dollar (US$) for foreign currency component, respectively. The total construction cost is expressed in Indonesian Rupiah (Rp.).

The local and the foreign currency components include the following items respectively;

Local currency component

- Labour cost
- Cost of local materials such as cement, aggregate, reinforcement bars, fuel, oil, lubricants
- Project administration expenses
- Local portion of engineering services
- Cost of local mechanic and spare parts for repair of plant and equipment

Foreign currency component

- Cost of plant and equipment
- Cost of imported materials such as slide gate, metal form, concrete admixture
- Cost of foreign portion of local materials such as cement, reinforcement bars, fuel, oil, lubricants
- Cost of engineering services by consultant

## 5.2 Project Cost

### 5.2.1 General

The project cost is composed of (a) engineering cost for the detailed design of the project facilities, (b) land acquisition and compensation cost, (c) direct construction cost of civil works, (d) tax on civil works, (e) procurement cost of O&M equipment, (f) administration expenses, (g) engineering service cost for construction supervision, (h) cost for the training program for the government staff and farmers, and (i) physical and price contingencies.

### 5.2.2 Direct Construction Cost

The direct construction cost was estimated based on the calculated work quantities of the proposed project works and unit prices of the works. The wages and material costs, and unit prices of the main items used in the cost estimate are shown in Table C-14 and C-15, respectively.

The total construction cost was estimated at Rp. 66,628 million, of which the foreign currency portion is US$ 14.928 million and the local currency portion is Rp. 39,010 million as shown in Table 5.1.

### 5.2.3 Procurement Cost of O&M Equipment and Agricultural Machinery

The maintenance equipment consist of (a) heavy construction equipment and transportation vehicles for maintenance works, (b) operation equipment including ordinary vehicles and communication system and (c) agricultural machinery. Local currency cost is required for inland transportation of these machinery and equipment. The procurement cost of maintenance equipment is shown in Table C-16.

### 5.2.4 Fund Requirement

Based on the construction time schedule, the construction cost was assumed to be distributed as shown in Table C-17. Applied price escalation rates were 8% per annum for local currency portion and 3% per annum for foreign currency portion. The total fund requirement for the project over the period of 5 years was estimated at Rp. 74,962 million.

## 5.3 Operation, Maintenance and Replacement Cost

### 5.3.1 O&M Cost

The operation and maintenance costs will consist of salaries of O&M staff, cost of maintaining the project facilities, materials and labour cost for repairing works, and running cost of project facilities. The annual O&M costs were assumed at Rp. 666 million, 1.0% of the project cost.

### 5.3.2 Replacement Cost

The economic durable years of the civil work facilities and equipment under suitable maintenance were assumed as follows:

| | |
|---|---|
| Diversion gate | 30 years |
| Small gate on canal related facilities | 20 years |
| O&M equipment | 20 years |

The replacement cost for diversion gate, small gates and O&M equipment required during the project life was estimated to be Rp.1,335 million.

# 6. PROJECT IMPLEMENTATION

## 6.1 Implementation Program

The project works were planned to be implemented within the period of about 5 years including 1.5 years for project preparatory work such as detailed design, implementation program, financial arrangement and pre-construction arrangement.

The budgetary arrangement for the detailed design work is to be started in the beginning of 1991/92 and the detailed design work for one year will start from 1992/93. The detailed design will include review of the in-depth study and preparation of the tender documents. In the middle of 1992/93, the implementation program will be prepared for budgetary arrangement for the construction works.

The pre-construction arrangement consists of loan arrangement, selection of consultant and selection of contractor.

The total construction period of the project is scheduled to be about 3.5 years. The construction of irrigation and drainage facilities for the Mezawa and Mola areas will be started from the middle of 1993/94 and completed in 1994/95 after detailed design and pre-construction arrangement.

The construction of irrigation and drainage facilities for the How and Susuwa areas will start from the beginning of 1994/95. The construction works for the How area will be completed in the middle of 1995/96. The required time for construction of the Susuwa area is 3 years.

The irrigation agricultural coordination center was planned to be operated for about 5 years including one year for preparatory work. Rearrangement and/or new creation of P3As and KUDs will be made

within a period of 3 years including training of staff of these organizations.

The implementation time schedule of the project is shown in Fig. 6.1.

## 6.2 Organization and Management

### 6.2.1 Construction Stage

The Directorate General of Water Resources Development (DGWRD), Ministry of Public Works, will be the executing agency for the implementation of the project, coordinating all the activities of the governmental agencies and regional administrative organizations in connection with the project implementation.

The Directorate of Irrigation will have direct responsibility for the construction and supervision of the project works. For smooth and proper execution of the construction in the field, it is proposed to establish the project office in Tetehosi. The proposed organization structure of the project office is shown in Fig. 6.2.

### 6.2.2 Operation and Maintenance Stage

For operation and maintenance of the project facilities, it is proposed to establish the Project O&M office under the jurisdiction of the provincial irrigation service of North Sumatra. The office will be organized in three sections, namely (a) operation section, (b) maintenance section, and (c) administration section. It was presumed that the field level water management would be entrusted to the farmers; water users' associations with technical assistance and guidance of the office.

The operation section will be in charge of operation of the diversion intake weirs and irrigation canals down to the turnouts at the head of tertiary irrigation canals. The main functions of the section will include:

(1) To collect information and data on river discharges and water demands for irrigation.

(2) To prepare the water supply schedule to respective irrigation blocks.

(3) To operate and control gates of the diversion facilities and main and secondary irrigation canals so as to secure the scheduled delivery of irrigation water.

(4) To advise water users' associations (P3As) and farmers in the field level water management.

The maintenance section will be responsible for maintenance and repair of the project facilities including the diversion intake weirs, irrigation and drainage canals and farm roads. The main tasks of the section will be:

(1) To prepare the program for maintenance, repair and improvement of the facilities.

(2) To design the repair works needed and to estimate their cost.

(3) To execute the repairing and maintenance works by using the equipment and materials owned.

(4) To call tenders for major repairing works and supervise the contractor(s).

(5) To execute periodical and routine maintenance of the project facilities.

The proposed organization chart for the O&M office is presented in Fig. 6.3.

# 7. PROJECT EVALUATION

## 7.1 General

Project evaluation involves an assessment of the project feasibility from the economic and financial viewpoints. The economic feasibility was evaluated by calculating the internal rate of return. A sensitivity analysis was also made to elucidate the economic viability of the project against eventual changes in the project benefit and cost.

The financial evaluation was carried out by analyzing the effect of the project on the farm economy of the typical farmers and by preparing the repayment schedule for the project capital cost.

## 7.2 Economic Evaluation

### 7.2.1 Basic Assumption

The economic evaluation was made on the following basic assumptions;

(1) The economic useful life of the project is 50 years.
(2) All prices are expressed in constant 1990 prices.
(3) The exchange rate of US$1.00=Rp.1,850 is applied.

### 7.2.2 Economic Factors

Traffic and trade restrictions introduce a distortion in the price relationship between trade goods and non-traded goods. In order to evaluate the project costs and benefits with respect to world market prices, a standard conversion factor of 0.85 was applied to the price of non-traded goods and services.

From the viewpoint of international economy, the transfer payments such as contract tax, duty, subsidy and interest were

considered as a domestic monetary movement without direct productivity. These transfer payments were excluded from the project cost.

Economic prices of traded agricultural output (paddy) and farm inputs (urea, TSP and KCl) were estimated on the basis of IBRD projection of world market prices for 1995 in constant 1985 terms. The domestic cost elements such as transport, handling and processing down to the farm gate level were multiplied by the standard conversion factor (0.85).

Economic prices of paddy and inputs are shown in Tables 4.5 and 4.6.

### 7.2.3 Economic Benefits

Irrigation benefit to be expected is defined as the difference of primary profit from paddy production between future with project and without project conditions. Irrigation benefit is expected to increase year by year and reach the full benefit in certain year after the completion of irrigation facilities. The build-up period to the full benefit was assumed to be 4 years for the rainfed paddy lands and 7 years for the newly reclaimed lands. The build-up period for the irrigation project was determined by the ratio of land use as shown in Table 7.1.

As mentioned in chapter 6, the area-wise development for the project was planned to be carried out as follows;

| Construction Year | Developed Area (ha) | Accumulated Area (ha) |
|---|---|---|
| 1 | 0 | 0 |
| 2 | 0 | 0 |
| 3 | 0 | 0 |
| 4 | 1,005 | 1,005 |
| 5 | 1,175 | 2,180 |
| 6 | 2,920 | 5,100 |

As a result, irrigation benefit is expected to accrue from the 4th construction year. It will gradually increase and attain its maximum in the 11th year of project implementation. The annual irrigation benefit at the full development stage was estimated at Rp. 7,301 million as shown in Table 7.2.

### 7.2.4 Economic Costs

The economic project cost was estimated based on the financial project cost, taking account of transfer payments and standard conversion factor for non-traded goods within the financial construction cost. The economic project cost was estimated to be Rp. 56,408 million as shown Tables 7.3.

The total annual economic operation and maintenance cost at the full development stage was assumed to be one percent of the economic project cost. The estimated cost is Rp.528 million.

### 7.2.5 Economic Evaluation

The economic internal rate of return of the project was calculated on the basis of cost and benefit flow as shown in Tables 7.4. The calculated internal rate of return is 10.2 %. A sensitivity analysis was also carried out to evaluate the soundness of the project against possible adverse changes in the future under the following conditions: (1) cost overrun by 10% and (2) reduction of irrigation benefit by 10% due to unexpected decrease in forecast prices. The results are presented below;

| | | |
|---|---|---|
| Case-1 | cost overrun | 9.2% |
| Case-2 | reduction of irrigation benefit | 9.2% |
| Case-3 | combined effect of cases-1 and 2 | 8.3% |

From the above results, the project could be justified to be marginally economical. The sensitivity analysis indicates that the economic viability of the project would be rather insensitive to adverse changes.

## 7.3 Financial Analysis

The financial analysis of the project was made by analysis of the typical farm budgets and assessment for repayment of the project construction cost.

### 7.3.1 Farm Budget Analysis

In order to evaluate the project feasibility from farmer's household economy, typical farm budgets were prepared for the future with and without project conditions as shown in Table 4.8.

Upon completion of the project, the project will provide bases for introduction of improved irrigated farming through year-round irrigation. As a result, unit yield of paddy and cropping intensity will much increase. So farm income is expected to increase considerably. Further, it is expected that an area of 2,640 ha of bush/shrub land and upland crop fields will be converted to paddy fields under the project. Assumed that these newly reclaimed paddy fields are allocated to the farmers in the project area, the farm size of the farmers is expected to become 1.25 ha or about two times the present average farm size (0.58 ha). On the other hand , substantial increase of farm income can not be expected in the future without project condition. As a result, the net reserve or capacity to pay of the farmers will also increase as follows;

| | Typical Farmers | | |
|---|---|---|---|
| | Without Project Condition | With Project Condition | |
| | Farmer (0.58ha) | Farmer (0.58ha) | Farmer (1.25 ha) |
| Net income from crops | 512,800 | 2,238,300 | 4,896,200 |
| Other income | 86,700 | 86,700 | 86,700 |
| Total income | 599,500 | 2,325,000 | 4,982,900 |
| Living expense | 599,500 | 719,400 | 719,400 |
| Net reserve | 0 | 1,605,600 | 4,263,500 |

These net reserves will offer incentive to the farmers in the project area.

### 7.3.2 Repayment

Fund requirement for construction of the project was estimated as shown in section 5.2. The estimated fund requirement is Rp. 74,962 million for the whole project. Based on the estimated fund requirement, a cash flow statement was prepared under the following assumptions :

(1) 80% of fund requirement is financed by an international organization with a loan service fee of 2.5% per annum and repayment period of 30 years including a grace period of 10 years.

(2) Remaining local currency is financed by the Government budget with no interest and no repayment.

The cash flow statement is shown in Table 7.4.

The project will bring about a great improvement in farm budget and give an incentive to the farmers in the project area. The project would be justified from the farmer's viewpoint. Since no financial revenue is expected from the project, the Government should subsidize about Rp. 79 to 4,597 million including loan repayment, loan service fee and O&M cost per annum for the project during the repayment period of 30 years.

# 8. ENVIRONMENTAL ASSESSMENT OF THE PROJECT

## 8.1 General

Irrigation projects are generally considered influential in altering the environmental resources in and around the project area. The Ministry of Population and Environment (MOPE) worked out "Guidelines for preparation of Environmental Impact Analysis (EIA)" in 1987. The requirement to perform EIA of development projects in Indonesia is based on the Act No.4 of 1982 concerning the basic provisions for the management of the living environment and the Government Regulation No.29 of 1986 prescribing the EIA process. The overall impact on the environment aspects of any development projects to be implemented by the public and private sectors shall be assessed in accordance with the said guidelines. EIA carefully analyzes the potential significant environmental effects, positive and negative, generated by the project, identifies them and evaluates possible solutions.

Within the framework of the EIA procedure, the Ministry of Public Works prepared the general guidelines for execution of EIA performances for the projects implemented under DPU programme. The overall work flow chart of EIA study for DPU projects is shown in Fig. 8.1.

## 8.2 Prediction of Project Impact

The environmental assessment required by the EIA comprises many items of evaluation of the environmental impact predicted to be brought about by the implementation of the project in the Nias island. They are classified into three (3) categories as follows:

(1) Physico-chemical environment ; including climate, rainfall, humidity, physiography, topography, geology, quality of river and well

water, land use, soil erosion, river sedimentation, hydrology, air condition, noise level, etc.

(2) Biological environment ; including food and estate crops, natural and basic vegetation, fauna, mammalia, reptilia, amphibia, insects, plankton, bentos, fish, etc.

(3) Socio-economic/cultural environment ; including income, economic activities, labor absorption, perception of local people, transportation, social conflicts, land ownership, housing, socio-cultural organization, formal and non-formal institution, etc.

Assessment of the impacts of the irrigation project activities was made by effect identification matrix mentioned above. The project activities are divided into stages : pre-construction stage, construction stage and operation and maintenance stage. The project impact indicator constitutes a matrix that is a modified Leopold's matrix containing interaction between environmental component and activity component. The proposed activities for implementation of the project are as follows:

1) Pre-construction stage
   - decision of weir site and canal layout
   - land release
   - removal of people

2) Construction stage
   - mobilization of materials and heavy equipment
   - mobilization of man power
   - opening and clearing land
   - construction of access road
   - construction/operation of base camp, warehouse, etc.
   - management of quarry
   - drying of water source near the location of the weir
   - soil works in the weir construction
   - construction of weir and facilities
   - transportation of soil and material for the weir

- excavation and embankment of irrigation and drainage canals
- borrow pit for canals

3) Operation and maintenance stage
   - operation of weir and irrigation/drainage canals
   - maintenance of irrigation and drainage canals
   - application of fertilizer and agro-chemicals
   - water management

The predicted positive and negative impacts eventually exerted by various components of the activities proposed for the project were elaborated based on the data collected in the field and they were identified as shown in Table 8.1. Tables 8.2, 8.3 and 8.4 show the basic information on flora and fauna in the project area. The location of environmental assessment survey is indicated on Fig. 8.2.

Other significant environmental aspects such as archeological and specific assets, famous scenic view and disputed land were not identified in the proposed project activity sites and their surroundings.

Socio-cultural impacts of the project were predicted through the interview survey of sixty (60) farmers in the field for a period of about one month in February 1991. The sample farmers were selected on the basis of systematic purposive method from six (6) representative villages in the project area, i.e. Dahana Bawalato, Sisarahili Bawalato, Boboziolile lenea, Sitolubanua, Siafabanua and Hiliboru. The results of survey on the perception of the local people on the Irrigation Development are summarized as follows (details are shown in Table 8.5):

| | Questionnaire | Yes (%) | No (%) |
|---|---|---|---|
| (1) | Have ever heard of the Project | 100 | 0 |
| (2) | Know the purpose of the Project | 8 | 92 |
| (3) | Expect the Project will increase income level | 98 | 2 |
| (4) | Provide own land with adequate compensation, if requested for the Project | 97 | 3 |
| (5) | Cooperate for the Project during the Project implementation | 100 | 0 |
| (6) | Preparedness for maintenance of irrigation system | 93 | 7 |
| (7) | Preparedness for tparticipation in P3A activities | 95 | 5 |
| (8) | Preparedness fot practice of irrigated agriculture | 95 | 5 |
| (9) | Other agricultural activities to be expected under irrigated condition on the farm | | |
| | -aquaculture | 82 | |
| | -over work at other farm's land | | 18 |
| (10) | Good attitude to outside worker | 100 | 0 |

The results of the questionnaire survey show that most of the local people in the project area are highly cooperative for the proposed irrigation project. To keep their good impression and cooperativeness for the Project, precise explanation of the project purpose and adequate compensation for land acquisition are highly required.

## 8.3 Evaluation of Project Impact

### 8.3.1 Criteria

For the purpose of evaluating the importance of environmental impacts and to clarify those among them requiring adequate countermeasures, four criteria of evaluation of the negative impacts were applied based on the specification of EIA and the decree of MOPE No. 49/MENKLH/6/1987. The first criterion is the spread of predicted impacts of the project performance. The second one is the tolerance capacity of the environment against the impacts. The third one is the length of the period affected by the impacts. The last one is the reversibility of the impacts of the project. The evaluation criteria for negative impacts are summarized as follows:

| | | |
|---|---|---|
| i) spread of impacts | -very small/very limited | Class(a) |
| | -small/limited | Class(b) |
| | -substantially wide | Class(c) |
| | -wide | Class(d) |
| | -very wide | Class(e) |
| ii) tolerance capacity | -very high | Class(a) |
| | -comparatively low | Class(b) |
| | -decreasing | Class(c) |
| | -low | Class(d) |
| | -very low | Class(e) |
| iii) length of the period affected by the impact | | |
| | -very short time | Class(a) |
| | -short time | Class(b) |
| | -rather long time | Class(c) |
| | -long time | Class(d) |
| | -very long time | Class(e) |
| iv) reversibility of the impact | | |
| | -reversible | Class(a) |
| | -irreversible | Class(b) and over |

Definition of the importance of impacts, relationship between evaluation criteria and the necessity of countermeasure for the negative impacts are summarized as follows (details are shown in Table 8.6):

| Class | Importance | Standard | Necessity of countermeasures |
|---|---|---|---|
| (a) | not so important | spread of impact is very limited , tolerance capacity is very high, impact s proceed within a very short time, predicted impacts are reversible | basically no |
| (b) | important enough | spread of impact is limited, tolerance capacity is comparatively low, predicted impacts are irreversible | regulation of project performance |
| (c) | important | spread of impact is substantially wide, tolerance capacity is decreasing, predicted impacts are irreversible | in-depth study of countermeasures for the impacts |
| (d) | more important | spread of impacts is wide tolerance capacity is low predicted impacts are irreversible | estimated costs of countermeasure should be considered for project evaluation |
| (e) | most important | spread of impacts is very wide, tolerance capacity is very low, impacts are irreversible | re-formulation of development plan |

Results of environmental impacts evaluation by stages are mentioned in Table 8.7. Details are described below.

### 8.3.2 Physico-chemical Impacts

(1) Pre-construction stage

In the pre-construction stage, no impacts on the physico-chemical aspects, such as climate, physiography, hydrology, soil and land use are expected to occur.

(2) Construction stage

During the preparatory period of the construction, mobilization of heavy equipment such as heavy truck, dump truck, bulldozer, backhoe, etc., construction materials and labor will increase the level

of noise on the transportation strip area. In the construction stage, excavation and mining of materials and the transportation, construction of weir, drainage ditches and the related structures will also increase the noise level in the area. These impacts on the noise level, however, are rather unimportant since regulation of load weight and motor speed for transportation and regulation of operation hour for the construction works will solve the complaint by local people.

Mobilization of heavy equipment, area opening and clearing, construction of roads, weirs and excavation of materials are predicted to have effects on hydrology such as changes in river discharge and the sedimentation. Mobilization of the equipment and materials on the narrow roads are forecast to cause landslides and damages to the existing roads especially during the rainy season, which in turn will cause sedimentation in the rivers.

The activities which will have an effect on the quality of the river water are opening and clearing of the project area, construction of main facilities such as roads, weir, canals and related structures. Opening and clearing of the project area will increase turbidity level of the river water as a result of the open condition of land and the occurrence of erosion. Physical quality of the river water will be a affected since the suspended solid (S.S.) and dissolved solid (D.S.) will increase, although still below the standard criteria for water group B on the basis of KEPMEN No. 2/MEN KLH 1988. The results of river water analysis showed that S.S. in water would be around 205-345 mg/l while D.S. would be around 186-315 mg/l.

This fact may give a negative impact on living organisms such as fish, plankton, aquatic biota, etc. and cause deterioration of drinking water.

Activities that will have impacts on the chemical composition of the water during the construction stage are mobilization of materials, heavy equipment and labor, construction of weirs, canals and drainage ditches, excavation of materials and operation of base camp. These activities would have an effect both on such chemical component as

Fe and Zn ions, BOD and COD that have already exceeded the standard quality criteria for water of group B, and also on the physical composition such as suspended solid. Due to these project activities, soil erosion also will occur and further deteriorate the water quality during the construction stage.

These negative impacts are, however, rather unimportant since the tolerance capacity of the river and well water is high and its physical condition is still good thanks to high rainfall throughout the year.

Mobilization of materials and heavy equipment, site clearing, construction of roads and weirs, excavation of materials, canals and drainage ditches and borrow pits are expected to produce impacts on soil erodibility and land use condition.

(3) Operation and maintenance stage

During the operation and maintenance stage of the project, utilization of fertilizer and agro-chemicals are expected to deteriorate the chemical quality of the river and well water. Therefore, proper farming practices and regulation of farm inputs applied should be prepared. Operation of weirs is anticipated to have negative impacts on the physical quality of the well water, due to fluctuation of penetration of water into the wells so as to increase the turbidity level of the well water. The suspended solid in the survey area has already been in a high group, ie. 366 mg/l in the village Togu-jitu, thus S.S. will increase under the condition of weir operation.

Operation of weirs and increase of cropping intensity to cover demands for irrigation water for paddy cultivation throughout the year will also have effects on the fluctuation of river discharge. Therefore, proper water management and utilization plans should be formulated through discussions with local water users in the downstream of Mezawa, How, Mola and Susuwa rivers.

### 8.3.3 Biological Impact

(1) Pre-construction stage

During the pre-construction stage, the activities of field surveys for decision of weir and canal sites would cause a reduction of biological resources. This is however a rather minor negative impact since the area affected by those activites will be limited.

(2) Construction stage

Activities expected to cause effect on biological aspects such as fauna, mammalia, reptilia as well as aquatic biota are opening and clearing land, construction of weirs and canals and mobilization of equiipment and labor in the project area. These activities will cause a reduction of serenity and habitat environment. These impacts on biological aspects are, however, rather not important since no conservancy resources and economic disadvantages for local people have been identified through the field survey.

It is also predicted that improvement and rehabilitation of the existing paddy fields will bring about some loss in food crop production due to cropping interuption by construction on farm. Appropriate construction schedule and methods should be applied for minimizing the losses.

(3) Operation and maintenance stage

Introduction of intensified paddy cultivation, especially application of agro-chemicals in the project area may affect the biological environment including health condition of local people in and around the project area due to their high toxicity against the plant disease and insects. Appropriate regulation on toxicity and kind of agro-chemicals and practice of application should be prepared based on the guideline of Department of Agriculture.

### 8.3.4 Socio-economic and Socio-cultural Impacts

(1) Pre-construction stage

During the pre-construction stage, it is anticipated that preparatory works for the implementation of the project such as field surveys for decision of weir and canal sites will create important positive impacts such as increase of employment opportunities including favourable perception of local people.

Activities which are expected to cause very important social conflicts are those causing effects on land release including loss of agricultural lands in the project area and relocation of local population under the construction plan due to unclearness of boundaries of lands owned by individual farmers in the project area. Land cadastral survey and adequate compensation for related farmers in the development area will solve the problems fairly.

(2) Construction stage

Activities during the construction stage of the project such as opening and clearing land, construction of irrigation facilities, mobilization of materials and equipment, opening of base camp and project offices are excluded to have very important positive impacts owing to increase of employment opportunities in and around the project area. Such a condition will increase farm income level and improve the poverty through the change in non-farm income sources of the local people.

Perception of the local population during the construction stage is expected to be positive, since the members of the community are confident that development will proceed and they expect that their income level will increase through the increase of paddy production under with project condition in the future.

Activity that is expected to have important social conflicts during the construction stage is mobilization of labor from the outside

area. Social conflicts may occur between the labors as a result of competition in seeking jobs and of their different behavior. In addition to this, utilization by skilled labors from outside, engineers, foreign consultants, etc. of vehicles and equipment which have never been brought into the site may cause social envy among the local people. A settlement of project workers should be placed in the particular location to prevent such problems.

Construction of weirs will produce an unstable water supply for bathing and washing to the people in the downstream of Mezawa, How, Susuwa and Mola rivers. Minimization of the fluctuation of river discharge should be taken into consideration in the weir design.

(3) Operation and maintenance stage

During the operation and maintenance stage of the project, the main activities such as operation of weirs, maintenance of canals, intensification of agriculture, increase of cropping intensity, water utilization from irrigation canals will create important impacts on the socio-economic and cultural condition of the project area such as increase in farm income level, increase of agricultural produces and increase of farm employment opportunities in the project area.

## 8.4 Proposed Solution to Negative Impacts

Based on the results of environmental evaluation study, solutions to the negative impacts of the project and environmental management and monitoring are proposed as shown in Table 8.8.

Important negative impacts classified as class B and over predicted to be generated by the project are social conflicts caused by land release and removal of people. Those important negative impacts on socio-cultural condition in the study area will be solved by clarification of boundaries of lands owned by local people through land cadastral survey and adequate compensation.

As mentioned in section 8.3, other negative impacts are rather unimportant and would not be serious to the local people in the project area, since adequate regulation on project performances would solve those impacts. These impacts are also classified as reversible impacts of the project activities.

# 9. ALTERNATIVE APPROACH TO REALIZATION OF THE PROJECT

As explained in the previous chapter, the project has an internal rate of return of 10.2% which indicates that the project is justified to be marginally feasible in terms of economic viability.

Water sources for the project are dependent on four rivers. An inter-basin transfer of the Susuwa river water to the other three river basins of the Mezawa, the Mola and the How in the project was planned for effective use of land and water resources, because water sources of these rivers are insufficient to irrigate the lands in their respective basins as shown below:

| River | Possible Intake Discharge ($m^3/s$) | Possible Irrigable Land by Discharge (ha) | Suitable Land for Paddy Cultivation (ha) | Area to be Irrigated (ha) |
|---|---|---|---|---|
| (1) Mezawa | 0.42 | 282 | 1,380 | 280 |
| (2) Mola | 2.16 | 1,471 | 2,720 | 1,450 |
| (3) How | 0.68 | 463 | 1,000 | 450 |
| (4) Susuwa | 5.19 | 3,527 | 0 | 2,920 |
| Total | | 5,743 | 5,100 | 5,100 |

However, the inter-basin transfer of the Susuwa river water will require long conveyance canals of about 25 km and a huge amount of construction cost, resulting in adverse effect to the economic feasibility of the project. The economic feasibility for each irrigation system commanded by each river was examined to assess such low economic viability of the project. The result is shown as follows:

| | Mezawa | Mola | How | Susuwa |
|---|---|---|---|---|
| Irrigation Area (ha) | 280 | 1,450 | 450 | 2,920 |
| Const. Cost * (million Rp.) | 3,137 | 15,787 | 5,283 | 42,354 |
| Cost/ha (US$/ha) | 6,056 | 5,885 | 6,345 | 7,840 |
| EIRR (%) | 12.1 | 12.4 | 12.4 | 8.9 |

* Details are shown in Table 9.1 and cost for the irrigation agricultural coordination center is not included.

An alternative irrigation development plan was studied without considering an inter-basin transfer of the Susuwa river water. The suitable land for paddy cultivation within the river basin was planned to be irrigated by water sources of the respective rivers. Three irrigation projects were identified : the Mezawa, the Mola and the How irrigation projects. The irrigation plan of these project was formulated so as to be cost effective.

The general layouts of the irrigation systems for these areas are illustrated in Fig. 9.1. The principal features of the plan for these three irrigation systems are basically as same as those of the Mezawa/How irrigation project. The features of the three irrigation systems are shown in Table 9.2. The construction costs are shown in Table 9.3 and summarized below:

| | Mezawa | Mola | How |
|---|---|---|---|
| Irrigation area (ha) | 280 | 1,450 | 450 |
| Project cost * (mill. Rp.) | 3,393 | 12,283 | 5,283 |
| Const cost/ha (US$/ha) | 6,550 | 4,579 | 6,345 |

* Excluding construction cost for the irrigation agricultural coordination center

After implementation of the project, it is expected that the target yield of paddy, 5 tons/ha, will be obtained at the full development stage. The total incremental production of paddy for each irrigation project is shown below:

| | |
|---|---|
| Mezawa project | 2,300 tons |
| Mola project | 12,300 tons |
| How project | 4,100 tons |

The irrigation benefits of the three irrigation projects were estimated based on the procedure used in Chapter 7. The benefits were estimated at Rp. 376 million for the Mezawa project, Rp. 1,991 million for the Mola project and Rp. 653 million for the How project.

The economic costs were estimated at Rp. 2,857 million for the Mezawa project, Rp. 10,407 million for the Mola project and Rp. 4,484 million for the How project.

The economic internal rates of return of each project and the project combined by three projects as a whole were calculated based on the irrigation benefits and economic cost as shown in Table 9.4. The concluded internal rates of return are shown below:

| | |
|---|---|
| Mezawa project | 11.2% |
| Mola project | 15.3% |
| How project | 12.4% |
| Combined project | 14.0% |

The above figures indicate that the Mola project has the highest economic viability for realization of the project. Also the figure shows that the combined project has a higher economic viability.

# 10. CONCLUSIONS AND RECOMMENDATIONS

The water sources for the Mezawa/How irrigation project are four rivers : the Mezawa, the Mola, the How and the Susuwa. Since the river discharge of the Mezawa, the Mola and the How is insufficient to irrigate the potential suitable land within their respective basin, an inter-basin transfer of river water of the Susuwa is a prerequisite to ensure efficient use of land and water resources. However the cost required for inter-basin transfer of water is very expensive, resulting in a very low economic viability of the project,with an internal rate of return of only 10.2%.

Three irrigation projects were formulated without considering an inter-basin transfer of water of the Susuwa.: the Mezawa, the Mola and the How irrigation projects. As a result, these projects have high economic viability.

It is recommended that three irrigation projects for the Mezawa, the Mola and the How without an inter-basin transfer of the Susuwa river water should be implemented as early as possible.

The total demand for paddy in the Nias island was forecast to be 93,500 tons in the year 2010, the target year for attaining self-sufficiency in rice. The expected incremental paddy production under the three irrigation projects was estimated to be 18,700 tons or 20% of the total demand for paddy in the year 2010. It is recommended that actions aimed at realizing self-sufficiency in rice in the Nias island should be taken promptly in accordance with the priority sequence of the projects proposed in the agricultural development plan.

The Feasibility Study on
The Nias Island Irrigation Agricultural Development Project

Vol. III

**FEASIBILITY STUDY FOR THE MEZAWA/HOW IRRIGATION DEVELOPMENT PROJECT**

# *TABLES*

Table 2.1 GROSS REGIONAL DOMESTIC PRODUCT IN KABUPATEN NIAS

| KECAMATAN | 1983 | | 1984 | | 1985 | |
|---|---|---|---|---|---|---|
| | GRDP Kecamatan (Rp.1,000) | GRDP per Capita (Rp.) | GRDP Kecamatan (Rp.1,000) | GRDP per Capita (Rp.) | GRDP Kecamatan (Rp.1,000) | GRDP per Capita (Rp.) |
| 1.P.P.Batu | 8,080,322 | 371,937 | 10,398,229 | 472,948 | 10,079,521 | 442,414 |
| 2.Teluk Dalam | 9,146,792 | 167,465 | 9,989,615 | 175,948 | 11,109,798 | 190,563 |
| 3.Lahusa | 1,646,754 | 83,481 | 2,087,647 | 104,975 | 2,260,561 | 112,187 |
| 4.Gomo | 1,960,857 | 57,984 | 2,176,373 | 64,205 | 2,450,151 | 69,510 |
| 5.Idanogawo | 6,805,283 | 176,385 | 7,656,350 | 196,382 | 8,269,792 | 210,540 |
| 6.Lolowa'u | 3,140,669 | 77,199 | 3,415,767 | 83,994 | 4,048,012 | 97,965 |
| 7.Sirombu | 2,696,545 | 174,839 | 3,188,522 | 203,909 | 3,393,341 | 214,091 |
| 8.Mandrehe | 2,922,073 | 78,231 | 3,496,441 | 91,655 | 4,238,274 | 105,027 |
| 9.Gido | 8,688,770 | 143,346 | 9,102,085 | 140,116 | 9,816,603 | 146,748 |
| 10.Gn.Sitoli | 20,442,473 | 253,799 | 24,396,766 | 295,575 | 26,975,093 | 324,095 |
| 11.Alasa | 4,903,692 | 151,911 | 5,520,466 | 164,129 | 6,171,534 | 176,158 |
| 12.Lahewa | 8,294,190 | 245,645 | 9,403,014 | 271,921 | 10,359,034 | 298,428 |
| 13.Tuhemberua | 8,783,160 | 203,102 | 9,182,987 | 213,419 | 9,673,487 | 219,011 |
| Total | 87,511,581 | 2,185,324 | 100,014,263 | 2,479,175 | 108,845,200 | 2,606,737 |

Source: Statistic Office of North Sumatra Province

| KECAMATAN | 1986 | | 1987 | |
|---|---|---|---|---|
| | GRDP Kecamatan (Rp.1,000) | GRDP per Capita (Rp.) | GRDP Kecamatan (Rp.1,000) | GRDP per Capita (Rp.) |
| 1.P.P.Batu | 11,641,500 | 524,109 | 19,157,220 | 792,013 |
| 2.Teluk Dalam | 12,766,915 | 200,798 | 14,450,789 | 224,828 |
| 3.Lahusa | 2,501,877 | 116,032 | 2,976,784 | 133,404 |
| 4.Gomo | 2,632,733 | 74,637 | 3,056,929 | 85,866 |
| 5.Idanogawo | 9,280,465 | 220,282 | 10,297,976 | 232,224 |
| 6.Lolowa'u | 4,624,178 | 106,139 | 6,130,753 | 137,025 |
| 7.Sirombu | 3,844,870 | 244,824 | 4,581,015 | 282,100 |
| 8.Mandrehe | 4,341,789 | 108,021 | 5,812,257 | 143,166 |
| 9.Gido | 11,047,066 | 161,396 | 14,072,221 | 201,495 |
| 10.Gn.Sitoli | 30,819,134 | 369,893 | 35,626,889 | 414,165 |
| 11.Alasa | 6,996,426 | 198,036 | 7,666,629 | 210,975 |
| 12.Lahewa | 10,889,897 | 318,204 | 11,674,987 | 333,247 |
| 13.Tuhemberua | 10,284,706 | 222,512 | 12,565,367 | 260,352 |
| Total | 121,671,556 | 2,864,882 | 148,069,816 | 3,450,861 |

Source: Statistic Office of North Sumatra Province

Table 3.1 POPULATION IN KECAMATAN IDANO GAWO AND PROJECT AREA (1990)

| No. | Name of Village | Total Population | Land Area (km2) | Density (per km2) | Household | Average Household Size | male/female ratio | Ratio of adult/children | Population classified by religion Protestant (%) | Catholic (%) | Islam (%) | Literacy rate (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Gazamanu | 832 | 20 | 41.6 | 160 | 5.2 | 105.4 | 1.94 | 96.9 | 0.6 | 2.5 | 69.1 |
| 2 | Hiliganoita | 591 | 8 | 73.9 | 116 | 5.1 | 99.7 | 2.14 | 98 | 2 | 0 | 72.3 |
| 3 | Sisarahili Bawolato | 1,528 | 20 | 76.4 | 267 | 5.7 | 96.1 | 1.65 | 97.2 | 2.8 | 0 | 70.4 |
| 4 | Dahana Bawolato | 971 | 21 | 46.2 | 177 | 5.5 | 92.7 | 0.95 | 99 | 1 | 0 | 65.4 |
| 5 | Hilihoru | 624 | 6 | 104.0 | 110 | 5.7 | 105.9 | 2.84 | 100 | 0 | 0 | 71.6 |
| 6 | Hilialawa | 435 | 6 | 72.5 | 80 | 5.4 | 110.1 | 2.49 | 100 | 0 | 0 | 67 |
| 7 | Hilifaosi | 1,440 | 9 | 160.0 | 171 | 8.4 | 92.3 | 2.06 | 80.7 | 19.3 | 0 | 79 |
| 8 | Tetegeonaai | 784 | 6 | 130.7 | 135 | 5.8 | 110.8 | 1.66 | 100 | 0 | 0 | 59.4 |
| 9 | Hililawae | 280 | 4 | 70.0 | 50 | 5.6 | 107.4 | 1.81 | 100 | 0 | 0 | 67.6 |
| 10 | Ahedano | 623 | 16 | 38.9 | 90 | 6.9 | 103.6 | 1.34 | 98.5 | 1.5 | 0 | 93.9 |
| 11 | Hilianaa Tafuo | 1,671 | 16 | 104.4 | 259 | 6.5 | 107.1 | 1.48 | 100 | 0 | 0 | 94.3 |
| 12 | Sitolu Banua | 1,285 | 15 | 85.7 | 248 | 5.2 | 125 | 1.26 | 90.2 | 9.8 | 0 | 72.8 |
| 13 | Hili Warokha | 737 | 6 | 122.8 | 120 | 6.1 | 99.7 | 2.45 | 991 | 0.8 | 0 | 74.6 |
| 14 | Siofa Ewali | 3,111 | 8 | 388.9 | 529 | 5.9 | 104.9 | 1.25 | 74.2 | 25.8 | 0 | 69.9 |
| 15 | Sohoya | 439 | 8 | 54.9 | 92 | 4.8 | 106.1 | 2.57 | 52.6 | 47.4 | 0 | 72.8 |
| 16 | Tagaule | 482 | 18 | 26.8 | 102 | 4.7 | 131.7 | 1.29 | 3.9 | 56.7 | 39.4 | 66 |
| 17 | Orahili | 758 | 12 | 63.2 | 138 | 5.5 | 92.4 | 2.07 | 100 | 0 | 0 | 79 |
| 18 | Mondrali | 618 | 12 | 51.5 | 112 | 5.5 | 98.1 | 2.36 | 100 | 0 | 0 | 72 |
| 19 | Boto Haenga | 248 | 16 | 15.5 | 49 | 5.1 | 98.4 | 1.63 | 8.2 | 0 | 91.6 | 66.1 |
| 20 | Hiliono Zega | 676 | 6 | 112.7 | 129 | 5.2 | 111.9 | 1.54 | 100 | 0 | 0 | 74.2 |
| 21 | Awoni Lauso | 907 | 40 | 22.7 | 157 | 5.8 | 102.5 | 1.26 | 84.7 | 15.3 | 0 | 71.1 |
| 22 | Bobozioli Loloanaa | 1,743 | 23 | 75.8 | 279 | 6.2 | 110.3 | 1.39 | 99.4 | 0.6 | 0.6 | 86.2 |
| 23 | Tetehosi | 2,146 | 16 | 134.1 | 367 | 5.8 | 106.1 | 1.42 | 73.8 | 16.8 | 9.4 | 99 |
| 24 | Maliwaa | 2,479 | 35 | 70.8 | 516 | 4.8 | 98 | | 93.4 | 6.6 | 0 | 70.9 |
| | Project Area | 25,408 | 347 | 73.2 | 4,453 | 5.7 | 103.9 | 1.66 | 93.4 | 9.8 | 2.6 | 76.5 |
| 25 | Saiwahili/Hiliadulo | 946 | 4 | 236.5 | 159 | 5.9 | 94.3 | 1.01 | 81.5 | 17.9 | 0.6 | 79 |
| 26 | Oladano | 813 | 6 | 135.5 | 131 | 6.2 | 104.8 | 3.02 | 85.1 | 14.2 | 0.7 | 96 |
| 27 | Hilimo'asio | 792 | 15 | 52.8 | 113 | 7.0 | 107.9 | 2.59 | 98.5 | 1.5 | 0 | 76.7 |
| 28 | Sisobahili Ir.Hura | 826 | 14 | 59.0 | 134 | 6.2 | 95.7 | 1.3 | 100 | 0 | 0 | 73.8 |
| 29 | Tuhewaebu | 324 | 6 | 54.0 | 52 | 6.2 | 101.2 | 1.06 | 100 | 0 | 0 | 62.9 |
| 30 | Onodalinga | 366 | 4 | 91.5 | 70 | 5.2 | 114 | 2.27 | 100 | 0 | 0 | 66.5 |
| 31 | Holi | 1,037 | 14 | 74.1 | 202 | 5.1 | 102.1 | 2.29 | 100 | 0 | 0 | 67.9 |
| 32 | Sisobahili Ulu Gawo | 758 | 15 | 50.5 | 137 | 5.5 | 92.9 | 1.84 | 84.9 | 15.1 | 0 | 65.3 |
| 33 | Siforo'asi Ulu Gawo | 752 | 16 | 47.0 | 126 | 6.0 | 102.7 | 1.18 | 97.5 | 2.5 | 0 | 69.4 |
| 34 | Hilibadalu | 554 | 14 | 39.6 | 84 | 6.6 | 101.5 | 1.73 | 77.4 | 22.6 | 0 | 59.7 |
| 35 | Hilimbowo | 1,385 | 16 | 86.6 | 244 | 5.7 | 105.5 | 2.04 | 90.5 | 9.5 | 0 | 69.2 |
| 36 | Fatodano | 2,028 | 12 | 169.0 | 381 | 5.3 | 98.2 | 2.37 | 92 | 8 | 0 | 57.7 |
| 37 | Fahandona | 865 | 4 | 216.3 | 166 | 5.2 | 104.5 | 0.93 | 100 | 0 | 0 | 77.6 |
| 38 | Biouti | 1,682 | 14 | 120.1 | 305 | 5.5 | 95.4 | 2.42 | 98.2 | 1.8 | 0 | 93.4 |
| 39 | Bozihona | 941 | 15 | 62.7 | 174 | 5.4 | 110.5 | 2.7 | 45 | 18.3 | 36.7 | 59.8 |
| 40 | Laowo Hilimbaruzo | 1,837 | 8 | 229.6 | 279 | 6.6 | 96.1 | 1.73 | 83.6 | 16.4 | 0 | 94.7 |
| 41 | Sifaoro'asi Ulu Hou | 2,052 | 16 | 128.3 | 365 | 5.6 | 94.1 | 2.69 | 52.3 | 47.7 | 0 | 66.6 |
| 42 | Si'ofabanua | 1,403 | 8 | 175.4 | 214 | 6.6 | 99.6 | 3.09 | 100 | 0 | 0 | 78.7 |
| | Kecamatan Idano Gawo | 44,769 | 548 | 81.7 | 7,789 | 5.7 | 102 | 1.77 | 88.2 | 9.4 | 2.4 | 75.6 |

Source: Kantor Statistik Propinsi Sumatera Utara (1990 Census Data)

Table 3.2 SOCIAL INFRASTRUCTURES

| Desa | School | Religious Facilities | | Post Office |
|---|---|---|---|---|
| | | Mosque | Chutch | |
| 1 Gazamanu | 2 | | 3 | |
| 2 Hiliganoita | 2 | | | |
| 3 Sisarahili Bawolato | 2 | | 2 | |
| 4 Dahana | 2 | | 3 | |
| 5 Hilihoru | 2 | | 1 | |
| 6 Hilialawa | | | 2 | |
| 7 Hilifaosi | 2 | | 3 | |
| 8 Tetegeo Naai | 2 | | 2 | |
| 9 Hililawae | | | 1 | |
| 10 Ahedano | | | 1 | |
| 11 Hilinaa Tafuo | 2 | | 9 | |
| 12 Sitolu Banua | 2 | | 4 | |
| 13 Hiliwarokha | 2 | | 4 | |
| 14 Siofaewali | 2 | | 8 | |
| 15 Sohoya | | | 2 | |
| 16 Tagaule | 2 | 1 | | |
| 17 Orahili | | | 2 | |
| 18 Mondrali | 2 | | 2 | |
| 19 Botohaenga | 2 | 1 | | |
| 20 Hilionozega | | | 1 | |
| 21 Awoni Lauso | 2 | | 2 | |
| 22 Boboziolo Loloana | 2 | | 4 | |
| 23 Tetehosi | 4 | 1 | 4 | 1 |
| 24 Maliwa'a | 2 | | 8 | |
| project area | 38 | 3 | 68 | 10 |
| 25 Fahandrona | 2 | | 1 | |
| 26 Siefabanua | 2 | | 4 | |
| 27 Sifaerasi Ulu Hou | 3 | | 8 | |
| 28 Laowo Hilimbaruzo | 2 | | 3 | |
| 29 Hilibadalu | 1 | | 1 | |
| 30 Fatodano | 2 | | 5 | |
| 31 Hilimbowo | 2 | | 4 | |
| 32 Sisobahili Ulu Gawo | | | 1 | |
| 33 Holi | 2 | | 5 | |
| 34 Sifaoroasi Ulu Gawo | | | 1 | |
| 35 Onodalinga | | | 1 | |
| 36 Tuhewaebu | 2 | | 1 | |
| 37 Sisobahili Iraono Hura | 1 | | 3 | |
| 38 Hilimoasio | 2 | | 2 | |
| 39 Oladano | 2 | | 1 | |
| 40 Saiwahili/Hiliadulo | 2 | | 1 | |
| 41 Biouti | 2 | | 4 | |
| 42 Bozihona | 2 | 1 | 6 | |
| Total | 67 | 4 | 120 | 1 |

Table 3.3 MEDICAL FACILITIES

FACILITIES

| | Public Hospital | Public Health Center | Public Health Sub-center | Family Planning Clinic | Mother+ Child Clinic | Villages Clinic | Private Clinic | Apothacary | Drug Store |
|---|---|---|---|---|---|---|---|---|---|
| KABUPATEN NIAS (without Pulau-Pulau Batu) | 2 | 21 | 75 | 44 | 19 | 931 | 10 | 4 | 12 |
| KEC. IDANO GAWO | - | 1 | 7 | 3 | 1 | 67 | 1 | - | - |

STAFF

| | General Doctor | Specialist Doctor | Nurses | Midwives | Trained Lay Midwives |
|---|---|---|---|---|---|
| KABUPATEN NIAS (without Pulau-Pulau Batu) | 19 | 3 | 169 | 44 | 483 |
| KEC. IDANO GAWO | 1 | - | 8 | 1 | 42 |

Source: Data collected by JICA team

Table 3.4 (1) RESULTS OF WATER QUALITY ANALYSIS

| Items of Quality Analysis | | Location of water sampling | | | | | | | | Standard<1 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Upper Mezawa R. | Lower Mezawa R. | Upper Mola R. | Lower Mola R. | Upper How R. | Lower How R. | Upper Susuwa R. | Lower Susuwa R. | Drinking Class-B | Irrigation Class-C |
| I.Physics | | | | | | | | | | | |
| 1. Temperature | oC | Normal | Normal | Normal | Normal | Normal | Normal | Normal | Normal | Normal | Normal |
| 2. Suspended Solid | mg/l | 316 | 238 | 189 | 309 | 319 | 345 | 334 | 315 | 500-1,500 | 0-2,000 |
| 3. Dissolved Solid | mg/l | 186 | 198 | 189 | 202 | 223 | 228 | 212 | 205 | - | - |
| II.Chemistry | | | | | | | | | | | |
| 1. pH | - | 6.75 | 6.50 | 7.10 | 7.05 | 7.05 | 7.25 | 7.25 | 7.15 | 5 - 9 | 6 - 9 |
| 2. COD | mg/l | 23.2 | 25.5 | 20.2 | 24.4 | 19.8 | 23.2 | 20.1 | 21.4 | 10 | - |
| 3. BOD | mg/l | 14.1 | 18.9 | 15.4 | 18 | 14.9 | 17.3 | 15 | 16.6 | 6 | - |
| 4. Chloride (Cl-) | mg/l | 13.3 | 13.3 | 10.0 | 10.0 | 13.6 | 16.6 | 13.3 | 16.6 | 200-600 | 500 |
| 5. Sulphate (SO4) | mg/l | 17.0 | 17.0 | 15.0 | 11.0 | 14.0 | 15.0 | 13.0 | 11.0 | 200-400 | - |
| 6. Nitrite (NO2) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 1 | 0 - 0.06 |
| 7. Nitrate (NO3) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 5 - 10 | - |
| 8. Cyainide (Cn) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.05 | 0 - 0.02 |
| 9. Ammonium (NH4) | mg/l | n.d. | 0.01 | n.d. | n.d. | 0.05 | n.d. | n.d. | n.d. | 0.01 - 0.03 | 0 - 0.016 |
| 10. Iron (Fe) | mg/l | 1.10 | 1.25 | 0.18 | 0.90 | 0.61 | 0.74 | 1.05 | 1.10 | 1 - 5 | - |
| 11. Lead (Fb) | mg/l | 0.06 | 0.08 | n.d. | n.d. | 0.08 | 0.08 | 0.08 | 0.07 | 0.05 - 0.1 | 0 - 0.03 |
| 12. Copper (Cu) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 15 | 0 - 0.02 |
| 13. Zinc (Zn) | mg/l | 1.15 | 1.80 | 1.70 | 1.35 | 1.05 | 1.01 | 1.90 | 1.85 | 1 - 15 | 0 - 0.02 |
| 14. Manganase (Mn) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.05 | - |
| 15. Arcen (As) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.05 | 0 - 1 |
| 16. Chromium (Cr) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.05 | 0 - 0.05 |
| 17. Mercurry (Hg) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | - | 0 - 0.002 |
| 18. Dissolved Oxygen | mg/l | 6.35 | 6.20 | 6.30 | 6.25 | 6.30 | 6.10 | 6.45 | 6.40 | - | 0 - 3 |
| 19. Sulhide Acid | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | - | 0 - 0.002 |
| 20. Grease and Oil | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 | 0 - 1 |
| III.Bacteriology | | | | | | | | | | | |
| 1. Caliform group | MNP/100ml | (+) | (+) | (+) | (+) | (+) | (+) | (+) | (+) | 10,000 | - |
| 2. Caliform fecal | MNP/100ml | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 2,000 | - |
| IV.Pesticide | | | | | | | | | | | |
| 1. Organo phosphat | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.1 | - |
| 2. Carbemate | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.1 | - |
| 3. Chlor nimated | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.001 | - |

<1:Water Quality Criteria (KEPMEN No. 02/MEN KLH/'86)
Class B=Drinking Water
Class C=Irrigation Water

Table 3.4(2) RESULTS OF WATER QUALITY ANALYSIS

| | Unit | Name of village for water sampling | | | | | | Standard<1 |
|---|---|---|---|---|---|---|---|---|
| | | Huno | Siafabanua | Sitolubanua | Togu-jitu | Hilimbaruzo | Togizita | Class-B |
| I.Physics | | | | | | | | |
| 1. Temperature | oC | Normal | Normal | Normal | Normal | Normal | Normal | Normal |
| 2. Suspended Solid | mg/l | 101 | 175 | 153 | 366 | 289 | 269 | |
| 3. Dissolved Solid | mg/l | 82 | 83 | 82 | 275 | 173 | 109 | 500-1,500 |
| II.Chemistry | | | | | | | | |
| 1. pH | - | 7.05 | 6.65 | 6.60 | 6.75 | 6.85 | 6.80 | 5 - 9 |
| 2. COD | mg/l | 57.4 | 59.7 | 60.5 | 70.7 | 69.2 | 54.3 | 10 |
| 3. BOD | mg/l | 43.5 | 44.6 | 45.1 | 52.4 | 51.3 | 42.6 | 6 |
| 4. Chloride (Cl-) | mg/l | 10.0 | 13.3 | 16.6 | 39.8 | 36.5 | 16.6 | 200-600 |
| 5. Sulphate (SO4) | mg/l | 3.0 | 3.0 | 1.0 | 7.0 | 6.0 | 3.0 | 200-400 |
| 6. Nitrite (NO2) | mg/l | 0.05 | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 1 |
| 7. Nitrate (NO3) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 5 - 10 |
| 8. Cyainide (Cn) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.05 |
| 9. Ammonium (NH4) | mg/l | n.d. | 0.01 | 0.01 | 0.1 | n.d. | 0.01 | 0.01 - 0.03 |
| 10. Iron (Fe) | mg/l | 2.15 | 2.05 | 1.20 | 1.05 | 2.10 | 1.70 | 1 - 5 |
| 11. Lead (Fb) | mg/l | 0.06 | 0.08 | 0.06 | n.d. | n.d. | 0.06 | 0.05 - 0.1 |
| 12. Copper (Cu) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 15 |
| 13. Zinc (Zn) | mg/l | 1.05 | 1.02 | 0.80 | 0.70 | 0.06 | 0.06 | 1 - 15 |
| 14. Manganase (Mn) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.05 |
| 15. Arcen (As) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.05 |
| 16. Chromium (Cr) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.05 |
| 17. Mercurry (Hg) | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | - |
| 18. Dissolved Oxygen | mg/l | 4.75 | 4.90 | 5.15 | 5.70 | 5.10 | 5.35 | - |
| 19. Sulhide Acid | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | - |
| 20. Grease and Oil | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 |
| III.Bacteriology | | | | | | | | |
| 1. Caliform group | MNP/100ml | (+) | (+) | (+) | (+) | (+) | (+) | 10,000 |
| 2. Caliform fecal | MNP/100ml | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 2,000 |
| IV.Pesticide | | | | | | | | |
| 1. Organo phosphat | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.1 |
| 2. Carbemate | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.1 |
| 3. Chlor nimated | mg/l | n.d. | n.d. | n.d. | n.d. | n.d. | n.d. | 0 - 0.001 |

Note:<1Standard for water quality criteria for drinking water.

Table 3.5 SOIL CHARACTERISTIC AND CLASSIFICATION (1/2)

| No. | Great Soil Group | Topography (%) Phisiography | Parent Material (Origin) | Vegetation | Soil Depth (cm) | Drainage | Soil Colour | Acidity (pH) <1 |
|---|---|---|---|---|---|---|---|---|
| (1) | Regosol | 0 - 3 Coastal Plain (cp) | Sedimentary | Coconuts/ Bush | 30 - 90 | Excessive | Light Olive Gray, Olive Gray | Strongly acid |
| (2) | Marine Swamp Soils | 0 - 2 (cp) | Marine Sediment | Swamp Forest | 0 - 80 | Very poor | Black | Slightly alkalin |
| (3) | Peat Soils | 0 - 2 (cp) | Peat Swamp Forest | Swamp Forest | 0 - 80 | Very poor | Black, Olive Black | Extremely acid |
| (4) | Alluvial Soils | 0 - 3 Alluvial Plain (ap) | Sedimentary | Paddy | 60 - 90 | Moderately Poor | Olive Gray | Very strong acid, slightly acid |
| (5) | Gray Hydro-morphic Soils | 0 - 3 ap | Sedimentary | Paddy | 10 - 60 | Poor | Light Olive Gray | Very acid, slightly acid |
| (6) | Gley Humic Soils | 0 - 3 Lowlying Area | Sedimentary | Paddy | 60 - 90 | Poor | Brownish Black, Brownish Gray | Strongly acid |
| (7) | Red Yellow Podzolic Soils | 25 - 40 Undulating hill (h) | Acid Rocks, Rhyolite | Bush, coarse grass | 60 - 90 | Moderately well | Bright Yellowish Brown | Very strong-strongly acid |

Note :

<1: Acidity (pH(H2O))

| | |
|---|---|
| Extremely acid | = <3.5 |
| Very strongly aci | = 3.6 - 4.5 |
| Strongly acid | = 4.6 - 5.5 |
| Moderately acid | = 5.6 - 6.5 |
| Slightly acid | = 6.6 - 6.1 |
| Neutral | = 7.0 |
| Slightly alkalin | = 7.1 - 7.5 |

Table 3.5 SOIL CHARACTERISTIC AND CLASSIFICATION (2/2)

| No. | Great Soil Group | Fertility <1 | Texture <2 | Land Suitability <3 Wetland | Upland | Tree Crops | Forest | Soil Taxonomy (USDA, 1975) | Area (ha) |
|---|---|---|---|---|---|---|---|---|---|
| (1) | Regosol | K = 0.6 - 1.0<br>P = Low<br>N = Low | Moderately coarse (SL) | N | M | S (Co) | M | Tropopsamments | 1,790 |
| (2) | Marine Swamp Soils | K = 0.1 - 0.2<br>P = Low<br>N = Low<br>Na = High | Peat/swamp | N | N | N | M | Sulfaquents | 470 |
| (3) | Peat Soils | K = 0.6 - 1.0<br>P = Low<br>N = High | Peat | N | M | M | M | Tropofibrist, Tropohemists | 3,020 |
| (4) | Alluvial Soils | K = 0.1 - 0.2<br>P = Medium<br>N = Medium | Moderately fine (SL, SiCL, SCL) | S | S | S | S | Fluvaquents, Tropofluvents | 4,660 |
| (5) | Gray Hydro-morphic Soils | K = 0.1 - 0.2<br>P = High<br>N = Medium | Moderately fine (CL, SiCL, SCL)<br>Medium (L, SL) | S | M | M | M | Hydraquents | 950 |
| (6) | Gley Humic Soils | K = Medium<br>P = Medium<br>N = Medium | Fine (CL, C) | S | M | M (Rb/Cl) | M | Hydraquents | 2,480 |
| (7) | Red Yellow Podzolic Soils | Low-medium | Fine-Moderatcly (CL, SCL, SiCL) | N | N | S (Rb/Cl) | S | Tropodults, Tropudalfs | 2,960 |

Note : <1 : Fertility

| Rating | K = Available K (ml/100 g soil) *1 | P = Available P (ppm) *2 | N = Total N (% of soil by weight) *3 | Na = Exchangeable Na (ml/100 g soil) |
|---|---|---|---|---|
| 1. Very high | - | - | >1.0 | - |
| 2. High | >5 | 12 - 20 | 0.5 - 1.0 | >0.2 |
| 3. Medium | 0.5 - 0.25 | 8 - 13 | 0.2 - 0.5 | 0.1 - 0.2 |
| 4. Low | <25 | 5 - 7 | 0.1 - 0.2 | <0.12 |
| 5. Very low | - | | <1.0 | - |

*1 : G.W. Thomas, 1966, based on USA soils.
*2 : Olsens's method, Cooke, 1967.
*3 : Kjeldahl method, Metson, 1961.

<2: Soil Texture
SL = Sandy Loam
CL = Clay Loam
SiCL = Silty Clay Loam
SCL = Sandy Clay Loam
SiC = Silty Clay
L = Loam
C = Clay
SC = Sandy Clay
LS = Loamy Sand
S = Sand

<3 : Land Suitable Class
S = Suitalbe
M = Marginally Suitable
N = Not Suitable
(Co) = Coconuts
(Rb) = Rubber
(Cl) = Clove

Table 3.6 RESULTS OF THE AGRICULTURAL AND FARMER'S ECONOMIC SURVEY IN THE STUDY AREA (1/3)

| Particular | Unit | No. of Sample | Average | Max. Value | Min. Value | Standard Deviation | Co-efficient of Variance |
|---|---|---|---|---|---|---|---|
| 1 Age of head farmer | age | 193 | 40 | 65 | 18 | 8.9 | 0.22 |
| 2 Family size | nos | 192 | 7 | 16 | 2 | 2.38 | 0.37 |
| 3 Total farm size | ha | 193 | 0.84 | 6 | 0.11 | 0.66 | 0.78 |
| i)paddy field | ha | 193 | 0.58 | 2 | 0.11 | 0.36 | 0.62 |
| ii)upland | ha | 193 | 0.18 | 2 | 0 | 0.27 | 1.45 |
| iii)estate land | ha | 193 | 0.08 | 2 | 0 | 0.26 | 3.13 |
| 4 % of the farmers who own land | | | | | | | |
| i)upland | % | 102 | 53 | | | | |
| ii)estate land | % | 32 | 17 | | | | |
| 5 Land Tenure Status | | | | | | | |
| i)owner operator | % | 185 | 96 | | | | |
| ii)tenant | % | 8 | 4 | | | | |
| 6 Total Cultivated Land | ha | 193 | 0.61 | 4.5 | 0.11 | 0.78 | 1.08 |
| i)paddy field | ha | 193 | 0.49 | 2 | 0.11 | 0.3 | 0.62 |
| ii)upland field | ha | 193 | 0.03 | 1 | 0 | 0.11 | 3.87 |
| iii)estate land | ha | 193 | 0.09 | 4 | 0 | 0.38 | 4.18 |
| coconut | ha | 193 | 0.02 | 1 | 0 | 0.1 | 4.6 |
| rubber | ha | 193 | 0.01 | 1 | 0 | 0.09 | 7.04 |
| others | ha | 193 | 0.06 | 4 | 0 | 0.31 | 5.61 |
| 7 Cropping Intensity(1989/90) | | | | | | | |
| i)paddy field(wet season) | | 193 | 0.9 | 1 | 0.14 | 0.21 | 0.23 |
| ii)paddy field(dry season) | | 193 | 0.17 | 1 | 0 | 0.37 | 2.14 |
| iii)annual cropping intensity for paddy field | | 193 | 1.07 | 2 | 0.14 | 0.44 | 0.41 |
| iv)upland field | | 193 | 0.11 | 2 | 0 | 0.38 | 3.4 |
| 8 Rice variety | | | | | | | |
| wet season | | 193 | | | | | |
| i)HYV | % | 153 | 21 | | | | |
| ii)local variety | % | 40 | 79 | | | | |
| dry season | | 136 | | | | | |
| i)HYV | % | 26 | 45 | | | | |
| ii)local variety | % | 10 | 55 | | | | |
| 9 Yield of Paddy | | | | | | | |
| wet season paddy | ton/ha | 184 | 1.8 | 5.4 | 0.03 | 0.93 | 0.52 |
| dry season paddy | ton/ha | 29 | 1.08 | 5.4 | 0.06 | 1.1 | 1.02 |
| 10 Farm Input/ha | | | | | | | |
| i)average for all the farmers | | | | | | | |
| wet season | | | | | | | |
| seed | Kg/ha | 193 | 28 | 100 | 5 | 15.27 | 0.55 |
| urea | Kg/ha | 193 | 2.74 | 200 | 0 | 21.46 | 7.83 |
| TSP | Kg/ha | 193 | 1.91 | 200 | 0 | 16.42 | 8.59 |
| Kcl | Kg/ha | 193 | 0.7 | 100 | 0 | 7.4 | 10.5 |
| Agri.chemicals | l/ha | 193 | 0.78 | 4.46 | 0 | 0.93 | 1.19 |
| dry season | | | | | | | |
| seed | Kg/ha | 36 | 28 | 120 | 6 | 22.35 | 0.79 |
| urea | Kg/ha | 36 | 6.56 | 200 | 0 | 32.85 | 5.01 |
| TSP | Kg/ha | 36 | 6.31 | 200 | 0 | 32.87 | 5.21 |
| Kcl | Kg/ha | 36 | 3.31 | 100 | 0 | 16.56 | 5.01 |
| Agri. chemicals | l/ha | 36 | 0.69 | 2 | 0 | 0.65 | 0.94 |
| i)average for farmers who used inputs | | | | | | | |
| wet season | | | | | | | |
| seed | Kg/ha | 191 | 28 | 100 | 5 | 15.27 | 0.55 |
| urea | Kg/ha | 7 | 75.6 | 200 | 4 | 84.8 | 1.12 |
| TSP | Kg/ha | 5 | 73.8 | 200 | 3 | 71.46 | 0.97 |
| Kcl | Kg/ha | 4 | 34 | 100 | 0 | 38.83 | 1.14 |
| Agri. chemicals | l/ha | 104 | 1.45 | 4.5 | 0.5 | 0.8 | 0.55 |
| dry season | | | | | | | |
| seed | Kg/ha | 36 | 28 | 120 | 6 | 23.35 | 0.79 |
| urea | Kg/ha | 5 | 47.2 | 200 | 6 | 76.49 | 1.62 |
| TSP | Kg/ha | 4 | 56.8 | 200 | 5 | 828 | 1.46 |
| Kcl | Kg/ha | 3 | 39.7 | 100 | 3 | 43 | 1.08 |
| Agri. chemicals | l/ha | 22 | 1.12 | 2 | 0.5 | 0.44 | 0.4 |

Table 3.6 RESULTS OF THE AGRICULTURAL AND FARMER'S ECONOMIC SURVEY IN THE STUDY AREA (2/3)

| Particular | Unit | No. of Sample | Average | Max. Value | Min. Value | Standard Deviation | Co-efficient of Variance |
|---|---|---|---|---|---|---|---|
| 11 Percentage of farmers who used fertilizer/chemicals(wet season) | | | | | | | |
| i)urea | % | | 4 | | | | |
| ii)TSP | % | | 3 | | | | |
| iii)Kcl | % | | 2 | | | | |
| iv)Agri.chemicals | % | | 54 | | | | |
| 12 Method of Rice Cultivation | | | | | | | |
| i)Labor sources for operation | | | | | | | |
| land preparation | | | | | | | |
| farmers' themselves | | | | | | | |
| Gotong Royong | | | | | | | |
| transplanting | | 193 | | | | | |
| farmers' themselves | % | | 78 | | | | |
| Gotong Royong | % | | 22 | | | | |
| harvest | | 193 | | | | | |
| farmers' themselves | % | | 73 | | | | |
| Gotong Royong | % | | 27 | | | | |
| ii)Method | % | | | | | | |
| land preparation | | 193 | | | | | |
| man-power | % | | 100 | | | | |
| animal power | % | | 0 | | | | |
| mech-power | % | | 0 | | | | |
| harvest | | 193 | | | | | |
| ani-ani | % | | 100 | | | | |
| sickle | % | | 0 | | | | |
| 13 Source of seed | | 193 | | | | | |
| supply from product | % | | 100 | | | | |
| buying | % | | 0 | | | | |
| 14 Percentage of respondents who report damage for paddy | | | | | | | |
| wet season paddy | | | | | | | |
| rat | % | 169 | 98 | | | | |
| stem borer | % | 169 | 47 | | | | |
| hopper(wereng) | % | 169 | 72 | | | | |
| rice bag | % | 169 | 48 | | | | |
| other insects | % | 169 | 34 | | | | |
| floods | % | 169 | 0 | | | | |
| diseases | % | 169 | 0 | | | | |
| pig | % | 169 | 0 | | | | |
| water shortage | % | 169 | 7 | | | | |
| dry season paddy | | | | | | | |
| rat | % | 20 | 85 | | | | |
| stem borer | % | 20 | 10 | | | | |
| hopper(wereng) | % | 20 | 55 | | | | |
| rice bag | % | 20 | 15 | | | | |
| other insects | % | 20 | 0 | | | | |
| flood | % | 20 | 0 | | | | |
| diseases | % | 20 | 0 | | | | |
| pig | % | 19 | 0 | | | | |
| water shortage | % | 20 | 68 | | | | |
| 15 Inventory of Livestock | | | | | | | |
| buffalou/cow | nos | 193 | 0.01 | 2 | 0 | 0.14 | 13.86 |
| pig | nos | 193 | 1.7 | 10 | 0 | 1.29 | 0.78 |
| goats | nos | 193 | 0 | 0 | 0 | 0 | |
| 16 Price of Farm Input and Output | | | | | | | |
| paddy | Rp./Kg | 46 | 478 | 585 | 333 | 105 | 0.22 |
| urea | Rp./Kg | 7 | 180 | 200 | 120 | 27.9 | 0.16 |
| TSP | Rp./Kg | 5 | 192 | 300 | 120 | 59.88 | 0.31 |
| Kcl | Rp./Kg | 3 | 180 | 200 | 165 | 14.72 | 0.08 |
| Agri.chemicals | Rp./l | 104 | 14202 | 18000 | 5000 | 3447.77 | 0.24 |

Table 3.6 RESULTS OF THE AGRICULTURAL AND FARMER'S ECONOMIC SURVEY IN THE STUDY AREA (3/3)

| Particular | Unit | No. of Sample | Average | Max. Value | Min. Value | Standard Deviation | Co-efficient of Variance |
|---|---|---|---|---|---|---|---|
| 17 Marketing of Paddy | | | | | | | |
| i)% of farmers selling paddy | | | | | | | |
| wet season | % | 193 | 46 | | | | |
| dry season | % | 36 | 3 | | | | |
| ii)Selling to(wet season) | | 46 | | | | | |
| local market | % | | 43 | | | | |
| KUD | % | | 37 | | | | |
| Rice miller | % | | 20 | | | | |
| Agency | % | | 0 | | | | |
| iii)% of buying paddy | | | | | | | |
| wet season | % | 177 | 76 | | | | |
| 18 Total Cash Income per the Farmers | | 193 | 195537 | 3635000 | 0 | 378193 | 1.93 |
| livestock | Rp. | 193 | 43497 | 300000 | 0 | 44976 | 1.03 |
| crops | Rp. | 193 | 0 | 0 | 0 | 0 | |
| coconut | Rp. | 193 | 829 | 150000 | 0 | 10789 | 13.01 |
| rubber | Rp. | 193 | 1554 | 250000 | 0 | 18286 | 11.76 |
| upland crops | Rp. | 193 | 0 | 0 | 0 | 0 | |
| other estate crops | Rp. | 193 | 3601 | 1000000 | 0 | 12441 | 3.45 |
| rent from relatives | Rp. | 193 | 777 | 150000 | 0 | 10769 | 13.86 |
| rent from KUD | Rp. | 193 | 518 | 50000 | 0 | 5063 | 9.77 |
| rent from other source | Rp. | 193 | 0 | 0 | 0 | 0 | |
| remittance | Rp. | 193 | 0 | 0 | 0 | 0 | |
| labor for paddy cultivation | Rp. | 193 | 0 | 0 | 0 | 0 | |
| labor for estate | Rp. | 193 | 1813 | 350000 | 0 | 25128 | 13.86 |
| fish | Rp. | 193 | 0 | 0 | 0 | 0 | |
| other income | Rp. | 193 | 34078 | 1800000 | 0 | 189520 | 5.56 |
| rice | Rp. | 193 | 108870 | 3600000 | 0 | 324388 | 2.98 |

Table 3.7 YIELDS AND YIELD COMPONENTS

(Wet season, 1990/91)

| Plot No. | Planting density (hills/m2) | No. of panicles/m2 | No. of spike-lets/panicle | No. of spikelets/m2 | % of * ripened grains (%) | 1,000 grain -weight (g) | Yield (Kg/ha) | Name of variety |
|---|---|---|---|---|---|---|---|---|
| 1 | 18.9 | 105 | 111 | 11,634 | 57.6 | 23.6 | 1582 | Si Guda |
| 2 | 15.5 | 71 | 164 | 11,624 | 34.5 | 18.7 | 748 | Fache Cina |
| 3 | 14.1 | 65 | 207 | 13,420 | 56.6 | 22.1 | 1676 | Leuadulo |
| 4 | 19 | 105 | 136 | 14,265 | 35.1 | 25.9 | 1295 | Jabi |
| 5 | 18.4 | 87 | 143 | 12,431 | 45.6 | 20.8 | 1180 | Sinalela |
| 6 | 19.8 | 58 | 176 | 10,274 | 43 | 22 | 970 | Siadulo |
| 7 | 18.2 | 44 | 122 | 5,409 | 34.8 | 23.5 | 442 | Si Meja |
| 8 | 22.2 | 78 | 133 | 10,414 | 48 | 21.9 | 1094 | Jabi |
| 9 | 19.2 | 170 | 101 | 17,231 | 42.3 | 22.6 | 1645 | IR-46 |
| 10 | 18.2 | 78 | 125 | 9,737 | 32.5 | 17.9 | 568 | Si Rokok |
| 11 | 20.8 | 96 | 142 | 13,638 | 47.9 | 20.1 | 1314 | Su.Jambi |
| 12 | 20.8 | 130 | 70 | 9,163 | 43 | 23 | 906 | Si guda |
| 13 | 20.8 | 115 | 105 | 12,064 | 51 | 19.2 | 1182 | Si Boru Tua |
| 14 | 17.1 | 80 | 126 | 10,053 | 27.8 | 20.7 | 578 | Si Jabi |
| 15 | 23.2 | 103 | 166 | 17,174 | 52.1 | 15.3 | 1365 | Si Marobu |
| 16 | 16.6 | 108 | 161 | 17,397 | 70.7 | 16.4 | 2368 | Padi Rokok |
| 17 | 14.2 | 108 | 161 | 17,346 | 60.8 | 18.7 | 1968 | Padi Sia |
| 18 | 18.7 | 104 | 129 | 13,487 | 72.6 | 14.7 | 1440 | Si Rudu |
| 19 | 17 | 107 | 148 | 15,834 | 71.7 | 14.7 | 1660 | Si Rudu |
| 20 | 17 | 98 | 186 | 18,152 | 66.8 | 15 | 1814 | Si Rudu |
| 21 | 15.2 | 61 | 158 | 9,714 | 63.1 | 15.8 | 1440 | Jabi |
| 22 | 19.4 | 77 | 179 | 13,653 | 57.1 | 22.8 | 1774 | Jabi |
| 23 | 14.9 | 63 | 143 | 11,591 | 69.7 | 23.9 | 1933 | Jabi |
| 24 | 13.9 | 51 | 155 | 7,948 | 67.7 | 23.4 | 1261 | Jabi |
| 25 | 13.9 | 61 | 267 | 16,221 | 64.1 | 21.6 | 2240 | Jagai |
| Average | 17.88 | 89 | 149 | 12,795 | 52.6 | 20.17 | 1377.7 | |

* Separated with 1.08 specific gravity

Reference :

Correlation coefficient

| | | |
|---|---|---|
| Yield : Planting density | r = | -0.360 |
| Yield : No. of panicles/m2 | r = | 0.223 |
| Yield : No. of spikelets/panicle | r = | 0.502 |
| Yield : No. of spikelets/m2 | r = | 0.745 |
| Yield : % of ripened grains | r = | 0.793 |
| Yield : 1,000 grain-weight | r = | -0.168 |
| No. of panicles/m2:No.of spikelets/panicle | r= | -0.498 |

Table 3.8 INEFFECTIVE PANICLES OCCURED IN THE FARMER'S PLOTS

(Crop cutting survey)

| Farmer's Plot No. | No. of Panicles/m2 | Effective Panicles | Ineffective Panicles | |
|---|---|---|---|---|
| | | | Damaged by Disease and Pest (%) | Late-emerging Head (%) |
| 1 | 105 | 93.1 | 1.7 | 5.2 |
| 2 | 71 | 75.2 | 7 | 17.8 |
| 3 | 65 | 92.8 | 5.7 | 1.5 |
| 4 | 105 | 79.6 | 15.8 | 4.6 |
| 5 | 87 | 80 | 10.1 | 9.9 |
| 6 | 58 | 79.7 | 3.3 | 17 |
| 7 | 44 | 73.3 | 4.7 | 22 |
| 8 | 78 | 80.3 | 4.8 | 14.9 |
| 9 | 170 | 80.7 | 8 | 11.3 |
| 10 | 78 | 69.3 | 5.9 | 24.8 |
| 11 | 96 | 82.6 | 11.4 | 6 |
| 12 | 130 | 80.1 | 4.3 | 15.6 |
| 13 | 115 | 81.4 | 9.8 | 8.8 |
| 14 | 80 | 78.7 | 13.9 | 7.4 |
| 15 | 103 | 88.2 | 5.4 | 6.4 |
| 16 | 108 | 89.5 | 1.9 | 8.6 |
| 17 | 108 | 86.6 | 6.4 | 7 |
| 18 | 104 | 84.7 | 4.3 | 11 |
| 19 | 107 | 93.1 | 3 | 3.9 |
| 20 | 98 | 93 | 1.9 | 5.1 |
| 21 | 61 | 88.8 | 3.4 | 7.8 |
| 22 | 77 | 94.4 | 0.8 | 4.8 |
| 23 | 63 | 95.3 | 3 | 1.7 |
| 24 | 51 | 80.9 | 12.5 | 6.6 |
| 25 | 61 | 88.6 | 3.5 | 7.9 |
| Average | 88.9 | 84.4 | 6.1 | 9.504 |

Table 3.9 FARMER'S EXPECTATION FOR FUTURE AGRICULTURAL DEVELOPMENT

(%)

| Item | Grade of Expectation | | | |
|---|---|---|---|---|
| | A | B | C | D |
| Expansion of paddy land | 90 | 10 | 0 | 0 |
| Installation of irrigation facility | 91 | 9 | 0 | 0 |
| Installation of drainage facility | 79 | 21 | 0 | 0 |
| Development of road system | 91 | 0 | 9 | 0 |
| Flood prevention | 71 | 10 | 1 | 27 |
| Introduction of mechanization | 61 | 30 | 9 | 0 |
| Introduction of baffalou | 41 | 34 | 16 | 9 |
| Introduction of high yielding variety | 65 | 23 | 3 | 9 |
| Use of fertilizer | 46 | 31 | 14 | 9 |
| Use of agricultural chemicals | 59 | 23 | 18 | 0 |
| Introduction of threshing machine | 40 | 21 | 18 | 21 |
| Installation of rice mill | 51 | 30 | 9 | 10 |
| Reinforcement of credit services | 33 | 23 | 26 | 18 |
| Strengthening extension services | 72 | 19 | 0 | 9 |
| Weeding | 45 | 33 | 13 | 9 |

Grade of expectation

A: greatest
B: great
C: a little
D: no need

Table 3.10 GEOLOGY OF NIAS ISLAND

| | Name | Description |
|---|---|---|
| Qa | Alluvial | Blocks of limest, sand and clay.<br>Thickness is about 5 m - 30 m. |
| Qg | Gunung Sitoli Formation | Cora reef limestone, calcareous sandstone, silty limestone.<br>Thickness of this formation reaches 120 m. |
| Tmg | Gomo Formation | Clay stone, marl, sandstone, limestone and inserted tuffaceous marl, tuff, lignite and mollusc.<br>Maximum thickness of this formation is 150 m. |
| Tml | Lelematua Formation | Sandstone, clay stone, conglomerate, tuff, intercalated between sandstone and clay stone.<br>Inserted thin bed of coal, shale and clay stone.<br>Thickness of this formation is 3,000 m in east and 2,000 m in middle Nias. |
| Tmb | Conglomerate Formation | Intercalation of conglomerate, calcareous sand stone, sand stone an dinserted marl.<br>Thickness of this member is 20 - 200 m. |
| Tou | Ophiolite Complex | Blocks of sepentinite, peridonite, gabro, serpentinized hornblende gabro, basalt, shist, brecccia, conglomeratic breccia, conglomerate and greywacke, many clacite and quartz veins. Yellowish gray conglomerate, rounded component, grained 4 mm in size some 3 cm with matrix is sandstone. Component consists of ultramafic, mafic and quartz. |
| Tom | Melange Complex | Bodinages of conglomerate, matagraywacke, limestone, serpentinite peridonite, basalt, shale and shaly clay.<br>Component of conglomerate consists of chert, basalt, serpentinite, andesite, graywacke, calcite. |

Table 3.11 REALIZATION OF INSUS AND INMUM PROGRAM IN THE PROJECT AREA AND KEC.IDANO GAWO

| No. | Name of Village | INSUS A (ha) | INSUS B (ha) | INSUS C (ha) | INMUM (ha) | Total (ha) |
|---|---|---|---|---|---|---|
| 1 | Gazamanu | 0 | 0 | 0 | 0 | 0 |
| 2 | Hiliganoita | 0 | 5 | 0 | 0 | 5 |
| 3 | Sisarahili Bawolato | 0 | 5 | 1 | 0 | 6 |
| 4 | Dahana Bawolato | 0 | 19 | 0 | 2 | 21 |
| 5 | Hilihoru | 0 | 0 | 0 | 0 | 0 |
| 6 | Hilialawa | 0 | 0 | 0 | 0 | 0 |
| 7 | Hilifaosi | 0 | 2 | 0 | 2 | 4 |
| 8 | Tetegeonaai | 0 | 0 | 0 | 26 | 26 |
| 9 | Hililawae | 0 | 0 | 0 | 0 | 0 |
| 10 | Ahedano | 0 | 0 | 0 | 0 | 0 |
| 11 | Hilianaa Tafuo | 0 | 23 | 20 | 43 | 86 |
| 12 | Sitolu Banua | 0 | 0 | 0 | 0 | 0 |
| 13 | Hili Warokha | 0 | 4 | 0 | 0 | 4 |
| 14 | Siofa Ewali | 0 | 8 | 2 | 0 | 10 |
| 15 | Sohoya | 0 | 0 | 0 | 0 | 0 |
| 16 | Tagaule | 0 | 0 | 0 | 0 | 0 |
| 17 | Orahili | 0 | 0 | 0 | 14 | 14 |
| 18 | Mondrali | 0 | 0 | 0 | 14 | 14 |
| 19 | Boto Haenga | 0 | 0 | 0 | 0 | 0 |
| 20 | Hiliono Zega | 0 | 0 | 0 | 14 | 14 |
| 21 | Awoni Lauso | 0 | 27 | 17 | 10 | 54 |
| 22 | Bobozioli Loloanaa | 0 | 0 | 0 | 2 | 2 |
| 23 | Tetehosi | 0 | 0 | 0 | 4 | 4 |
| 24 | Maliwaa | 0 | 0 | 0 | 0 | |
| | Project Area | 0 | 93 | 40 | 131 | 264 |
| | | | | | | 0 |
| 25 | Saiwahili/Hiliadulo | 0 | | 4 | 0 | 4 |
| 26 | Oladano | 0 | | 6 | 0 | 6 |
| 27 | Hilimo'asio | 0 | | 15 | 0 | 15 |
| 28 | Sisobahili Ir.Hura | 0 | | 14 | 0 | 14 |
| 29 | Tuhewaebu | 0 | | 6 | 0 | 6 |
| 30 | Onodalinga | 0 | | 4 | 0 | 4 |
| 31 | Holi | 0 | | 14 | 0 | 14 |
| 32 | Sisobahili Ulu Gawo | 0 | | 15 | 0 | 15 |
| 33 | Siforo'asi Ulu Gawo | 0 | | 16 | 0 | 16 |
| 34 | Hilibadalu | 0 | | 14 | 0 | 14 |
| 35 | Hilimbowo | 0 | | 16 | 0 | 16 |
| 36 | Fatodano | 0 | | 12 | 0 | 12 |
| 37 | Fahandona | 0 | | 4 | 0 | 4 |
| 38 | Biouti | 0 | | 14 | 14 | 28 |
| 39 | Bozihona | 0 | | 15 | 4 | 19 |
| 40 | Laowo Hilimbaruzo | 0 | | 8 | 0 | 8 |
| 41 | Sifaoro'asi Ulu Hou | 0 | | 16 | 0 | 16 |
| 42 | Si'ofabanua | 0 | | 8 | 0 | 8 |
| | Kecamatan Idano Gawo | 0 | 93 | 241 | 0 149 0 | 483 |

Source: Kantor Statistik Propinsi Sumatera Utara (1990 Census Data)

Table 3.12 BASIC INFORMATION OF P3A (1/3)

| Item | Name of P3A | |
|---|---|---|
| | MADAWA | AFIA |
| 1. Kecamatan | Gido | Tuhemberua |
| 2. System | Ndra Humene | Afia |
| 3. Year of establishment | 1989 | 1980 (originally)<br>1990 (re-organized) |
| 4. Names of villages | Ononamele<br>Hilimboso<br>Bawedesolo<br>Dahana<br>Sifalete<br>Hilifanika<br>Fadoro<br>Hiligoro | Lasarasou<br>Gawu-gawu Bouse<br>Tetehosi<br>Afia<br>Hambawa<br>Loloanaa/Lelemoyo<br>Harevanekotane Dao |
| Number of participants | 30 households | 500 households<br>400 in irrigated<br>100 in rainfed area |
| 5. Total area irrigated (by desa) | 38 ha | 500 ha |
| 6. Irrigation fee (per ha/season) | proposed<br>20 kg/ha/season | proposed<br>12 kg/ha/harvest |
| Rate of collection | not available | first harvest so not yet collection |
| 7. Annual due | none | none |
| Rate of collection | not available | not available |
| 8. Membership fee | none | none |
| Rate of collection | not available | not available |
| 9. Inventory of P3A | | |
| i) List of participants | yes | yes |
| Annual modification of list | yes | yes |
| ii) Book of financial statement | not available | not available |
| iii) Book of regulations for this P3A | yes | just being formed |
| iv) Facilities | none | none |
| 10. Organization chart of this P3A | | |
| i) Have organization chart | yes | yes |
| ii) Positions | see diagram | see diagram |
| iii) No. of staff | 5 | 22 |
| iv) Salary/month if provided | none | planned division of collected padi<br>- 50 % for P3A staff & costs<br>- 45 % for Ketua Blok & assistants (18)<br>- 5 % for Kepala Desa |

Table 3.12 BASIC INFORMATION OF P3A (2/3)

| Item | Name of P3A | |
|---|---|---|
| | MADAWA | AFIA |
| 11. Name of : | | |
| i) Chairman | Fangumao Larosa | Tetena Zega |
| ii) Secretary | Sarosa Larosa | Mesiele Ziliwu |
| iii) Treasury | Atosuhi Larosa | Simoni Ziliwu |
| iv) Ulu-ulu | Bendaero Lauri | 9 Ketua Blok (see diagram) |
| v) Others : | | 9 assistants (see diagram) |
| Ili-ili | Tabos Lase | |
| Assistant | | Gasambewe Ziliwu |
| 12. Operation of irrigation system | | |
| i) Who decides starting time of irrigation | Ulu-ulu and Ili-ili | each Ketua Blok |
| ii) Who operates gates | Ulu-ulu | each Ketua Blok |
| - change gate operating periods | | each Ketua Blok |
| iii) Guidance/instruction for operation from PU staff | no | minimal |
| iv) Guidance/instruction for operation from Dinas Pertanian staff | PPL attends meetings | PPL attends meetings of P3A |
| 13. Maintenance of irrigation system | | |
| i) Maintenance of canals by Gotong Royong | yes | yes |
| ii) Action taken when irrigation canal and structures severely damaged | ask help from Dinas Pertanian | Call Dinas Pertanian |
| 14. Meeting system | | |
| i) How often are farmers meeting | once/3 months | 5 times in season |
| ii) How often are meetings with PU Staff | irregular | only when needed |
| 15. Financial conditions of this P3A | | |
| i) Income (year) slource and type | none | 1990 - none |
| ii) Expenses (year) source and amounts | not available | not available |
| 16. General agronomic information | | |
| i) Average farm size (ha or borongan) | 0.5 ha | 0.5 ha (max 2.0 ha, min 0.25 ha) |
| ii) Average unit yield : | | |
| - wet season | 2 t/ha | 2.5 - 3 t/ha |
| - dry season | 1.5 t/ha | 2.5 - 3 t/ha |

Table 3.12 BASIC INFORMATION OF P3A (3/3)

| Item | Name of P3A | |
|---|---|---|
| | MADAWA | AFIA |
| iii) Use of farm inputs : | | |
| a) Rice varieties | IR 42 (since 1982), trying IR 70 on 5 ha | IR 42 (used last 10 years) |
| b) Urea (kg/ha) | 150 | 50 |
| c) TSP (kg/ha) | 50 | 50 |
| d) KCL | rarely use | rarely use |
| e) Other chemicals : | | |
| Dharmabas (l/ha) | 1.5 | 2 |
| Bassa (l/ha) | 3 | - |
| Baycarb (l/ha) | 3 | 5 |
| Basudin (l/ha) | 0.5 | 2 |
| Diazinon (l/ha) | 1 | rarely used due to expense |
| Klerat (kg/ha) | 1 | 2 |
| Mipsin powder (kg/ha) | 1 | - |
| 17 Problems and expectations | - Irrigation water insufficient, system not fully cemented<br>- Water theft (minor)<br>- Blast and Hama Putih pests<br>- KUD fertilizer and pesticide too expensive, cheaper to buy in G. Sitoli from private trader<br>- P3A Training (twice since 1989) limited, would like more training<br>- Would like to have training in use of draft animalas - and assistance in obtaining animals | - Wereng pest - lack of pesticide sprayers<br>- Source of irrigation water is insufficient<br>- Water theft - but no actions taken against offenders<br>- Want an office but have no funds<br>- KUD not very active, not enough fertilizer or other inputs or too late, must buy inputs in G. Sitoli from traders and pay for transportation<br>- Want new seed varieties because of pests have :<br>- tried IR 46 but blast problems<br>- tried IR 46 but blast problems (want to try again)<br>- tried Segobang variety but low yield<br>- tried Sesadang variety but blast problem<br>- Lack of P3A training by Dinas Pertanian, none since 1990 re-organization of this P3A |

Table 3.13 BASIC INFORMATION OF KUD IN THE STUDY AREA (1/2)

| Item | Name of KUD | | | | |
|---|---|---|---|---|---|
| | Tolong Menolong | Masa Karya | Sadar* | Sehati Maju | Sinar Pagi AFIA** |
| 1. Location | Siefabanua | Tetehosi | Sindrondro | Bawolatu | |
| 2. Village | Siefabanua | Tetehosi | Sitolubanua | Dahana | L. Tetehosi |
| 3. Year of establishment | 1984 | 1981 | 1980 | 1987 | 1972 |
| 4. Number of villages participated | 11 | 10 | - | 5 | 10 |
| 5. Total number of participants | 672 | 179 | - | 205 | 240 |
| 6. Area covered (ha) | 241 | | - | 1800 | 2073 |
| 7. Annual due (Rp.) | 2000 | 1800 | - | - | - |
| 8. Total amount of annual due in 1989 (Rp. 1,000) | 4207 | 502 | - | 926000 | - |
| 9. Membership fee (Rp/year) | 6000 | 6000 | - | 12000 | - |
| 10. Inventory | | | | | |
| (i) List of participants | yes | yes | - | yes | yes |
| (ii) Book of financial statement | yes | yes | - | yes | yes |
| (iii) Book of regulation of KUD | yes | yes | - | yes | yes |
| (iv) Building | 1 | 1 | - | 1 | 1 |
| (v) Room | 2 | 1 | - | 2 | 3 |
| (vi) Desk | 8 | 4 | - | 3 | 3 |
| (vii) Chair | 10 | 5 | - | 5 | 13 |
| (viii) Blackboard | 1 | 1 | - | 1 | 1 |
| (ix) Locker | 2 | 1 | - | 1 | 1 |
| (x) Rice mill | no | 2 | - | no | 0 |
| (xi) Warehouse | 1 | 1 | - | no | 3 |
| (xii) Drying yard | no | 1 | - | no | 1 |
| 11. Meeting system | | | | | |
| (i) General meeting | once/year | once/year | - | one/year | once/year |
| (ii) Internal meeting within KUD | once/3 months | 3 times/year | - | 3 times/year | 2 times/year |
| (iii) Meeting with Cooperative Department | | 2 times/year | - | - | once/month |
| 12. Organization and staff | see Fig. 2.7.3 | see Fig. 2.7.4 | - | see Fig. 2.7.5 | - |

* not operated from 1988
** out of the study area (Kec. Tuhemberua)

Table 3.13 BASIC INFORMATION OF KUD IN THE STUDY AREA (2/2)

| Item | Name of KUD | | | | |
|---|---|---|---|---|---|
| | Tolong Menolong | Masa Karya | Sadar* | Sehati Maju | Sinar Pagi AFIA** |
| 13. Financial condition (Rp. 1,000) | | | | | |
| 1988 | | | | | |
| Income | 18657 | 5786 | - | 4329 | 3864 |
| Outgo | 7703 | 4879 | - | 1398 | 3673 |
| Balance | 10954 | 907 | - | 2931 | 191 |
| 1989 Income | 11911 | 7270 | - | - | 3015 |
| Outgo | 3957 | 4675 | - | - | 2647 |
| Balance | 7954 | 2595 | - | - | 368 |
| 1990 Income | - | - | - | - | 2527 |
| Outgo | - | - | - | - | 2560 |
| Balance | - | - | - | - | -33 |
| 14. Capital of KUD (Rp. 1,000) | | | | | |
| 1988 | | | | | |
| Basic saving | 4259 | 195 | - | 974 | - |
| Saving due | 10703 | 258 | - | 2922 | - |
| Other | 28150 | 0 | - | 8500 | - |
| Total | 43112 | 453 | - | 12396 | - |
| 1989 | | | | | |
| Basic saving | 4429 | 502 | - | - | 119 |
| Saving due | 6194 | 703 | - | - | 456 |
| Other | 24204 | 0 | - | - | 209 |
| Total | 34827 | 1205 | - | - | 784 |
| 15. Amount of credit from Bank or from the farmers (Kredit Usaha Tani) (Rp. 1,000) | | | | | |
| 1987 | 500 | 7882 | - | no | - |
| 1988 | - | - | - | no | - |
| 1989 | - | 500 | - | no | - |

* not operated from 1988
** out of the study area (Kec. Tuhemberua)

TABLE 3.14 NUMBER OF KELOMPOK PANI

| no. | Village | Name of farmers group | Name of Chairman | No. of Members | Establishment year |
|---|---|---|---|---|---|
| 1 | Tetehosi | Tohosi | Tasogo Zebua | 20 | 1984 |
| 2 | Ahedano | Baru | Amoni Zega | 30 | 1984 |
| 3 | Bobozioli | Sisobahili I | Marinus Warihi | 25 | 1985 |
| 4 | Bobozioli | Bisobahili II | Yusuf Duhu | 24 | 1986 |
| 5 | Maliwa'a | Tago'o | Taroni Zai | 25 | 1987 |
| 6 | Maliwa'a | Taflua | Tongoni Zai | 20 | 1987 |
| 7 | Tetehosi | Lolotehosi | Fatizaro H | 24 | 1983 |
| 8 | A.Lauso | Talabu** | F. Zebua | 26 | 1986 |
| 9 | A.Lauso | Busori** | Bungazani H | 16 | 1988 |
| 10 | A.Lauso | Saradodo** | Fongoli Zai | 21 | 1988 |
| 11 | A.Lauso | Sanandraigo** | Sokhinaogoa Hulu | 26 | 1988 |
| 12 | Mondrali | Faomasi** | Fatihili Zai | 20 | 1987 |
| 13 | Mondrali | Faedona** | Atuloo Ndruru | 21 | 1987 |
| 14 | Hilionozega | Setua** | Boroli Zebua | 25 | 1987 |
| 15 | Hilionozega | Kompak** | Dohosi TEl | 24 | 1987 |
| 16 | Siefa Banua | Melati** | Basudia Hal | 47 | 1986 |
| 17 | Siefa Banua | Talifuso** | Tahuara Ndruru | 45 | 1986 |
| 18 | Hili Tafuo | Subur** | Aliaro Zai | 40 | 1986 |
| 19 | Hili Tafuo | Maju** | Asambowo Zai | 35 | 1986 |
| 20 | Hili Tafuo | Sederhana** | Salatieli Waruwu | 50 | 1986 |
| 21 | Tetegeo Naai | Tolobafo** | Foboro Waruwu | 25 | 1987 |
| 22 | Tetegeo Naai | Saroha** | Sekhieli Waruwu | 21 | 1987 |
| 23 | Siefawail | Luahahele** | Faigizaro Hura | 25 | 1987 |
| 24 | Hililawae | Lawae | Natiaro Hura | 20 | 1987 |
| 25 | Siefawali | Balenohi | Taulombowo N | 25 | 1988 |
| 26 | Hiliwaroka | Solofo | TB. Wamenawi | 30 | 1989 |
| 27 | Hilifaosi | S.Baru | Gohisakhi T | 30 | 1989 |
| 28 | Hiliganoita | Desa Maju | Alui Lafao | 30 | 1989 |
| 29 | Sisarahili | Faomasi | A. Ano Lafao | 30 | 1989 |
| 30 | Dahana | Zumuzu | Ch. Lafao | 30 | 1989 |
| 31 | Sisarahili | Fahasaradodo | Tandraaro T | 25 | 1989 |
| 32 | Sisarahili | Fanalogda | Faorota Lafao | 27 | 1989 |
| 33 | Dahana | Sihiliowo | Ch. Lafao | 23 | 1989 |
| project area | | | | 830 | |
| 34 | Saiwahili | Riwu | Fuliaro Zai | 35 | 1982 |
| 35 | Maliwa's | Sagalui | Fatolasa Gea | 75 | 1982 |
| 36 | Ahedano | Niomasio | Sahaulu Hura | 35 | 1982 |
| 37 | L. Ana'a | Faeri | Anatona Duha | 34 | 1983 |
| 38 | L.Hilimbowo | S.Gunung** | Talizokho Hal | 25 | 1987 |
| 39 | L.Hilimbowo | S.Pagi** | Fauduaro Zai | 20 | 1987 |
| 40 | Oladano | Maju | Hasaeli Waruwu | 15 | 1986 |
| 41 | Hilimasio | Percobaan A | Elisati Hura | 18 | 1986 |
| 42 | Hilimasio | Percobaan B | A. Hura | 16 | 1987 |
| 43 | Hiliaawwa | S. Rezeki | Hz. Tel | 40 | 1989 |
| Kec. Idano Gawo | | | | 336 | |

** ; Active

Table 4.1 PROPOSED FARMING PRACTICES

| Items | Practices |
|---|---|
| (1) Variety | IR series(IR 46, IR 48, IR 54), High yielding variety |
| (2) Growth period | About 130 days |
| (3) Land preparation | Two ploughing, one harrowing, and one puddling by draft animal |
| (4)Planting | |
| - Area of nursery bed | 300 m2/ha(1.5m x 200m) |
| - Amount of seed | 30 Kg/ha of planting area, 100 gr/m2 nursery bed |
| - Nursery period | 25 days |
| - Planting density | 15 - 25 hills/m2, 3 seedlings/hill |
| (4) Fertilization | |
| - Urea | 225 Kg/ha |
| - TSP | 150 Kg/ha |
| - KCl | 100 Kg/ha |
| - Time of application | Basal application: before 2nd plowing |
| | 1st top dressing: 20 days after transplanting |
| | 2nd top dressing: 25 days before heading stage |
| (5) Weeding | Manual weeding |
| (6) Control of pests and diseases | |
| - Insecticide | Furadan 2G 30 Kg/ha, before 2 nd plowing, mix with soil |
| - Pesticide | Bla-s or Hinosann, 15 days after seeding |
| - Others | Warfarin, 30 days before heading stage |
| (7)Harvesting | Manual harvesting by sickle,30 days after heasing stage |

TABLE 4.2 LABOR BALANCE STUDY UNDER WITH PROJECT CONDITION IN THE PROJECT AREA

CASE-I:FULL MANPOWER

Unit:(1,000 man-day)

| Farming Practices | Unit Labor Requirement (man-day/ha) | Area (ha) | Jan. | | Feb. | | Mar. | | Apr. | | May. | | Jun. | | Jul. | | Aug. | | Sep. | | Oct. | | Nov. | | Dec. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late |
| 1. Nursery | 5 | 5,100 | | | | | | | 9 | 9 | 9 | | | | | | | | 9 | 9 | 9 | | | | | |
| 2. Land Prerparation | 75 | 5,100 | | | | | | | | 128 | 128 | 128 | | | | | | | | 128 | 128 | 128 | | | | |
| 3. Transplanting | 30 | 5,100 | | | | | | | | | 51 | 51 | 51 | | | | | | | | 51 | 51 | 51 | | | |
| 4. Weeding | 30 | 5,100 | 26 | | | | | | | | | 26 | 26 | 26 | 26 | 26 | 26 | | | | | 26 | 26 | 26 | 26 | 26 |
| 5. Field Maintenance | 10 | 5,100 | 9 | | | | | | | | | 9 | 9 | 9 | 9 | 9 | 9 | | | | | 9 | 9 | 9 | 9 | 9 |
| 6. Harvesting/Processing | 45 | 5,100 | | 77 | 77 | 77 | | | | | | | | | | | | 77 | 77 | 77 | | | | | | |
| Total Labor Requirement | 195 | | 35 | 77 | 77 | 77 | 0 | 0 | 9 | 137 | 188 | 214 | 86 | 35 | 35 | 35 | 35 | 77 | 86 | 214 | 188 | 214 | 86 | 35 | 35 | 35 |
| Available Labor Force<1 | | | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 |
| Labor Balance in the Project Area<2 | | | 118 | 76 | 76 | 76 | 153 | 153 | 144 | 16 | -35 | -61 | 67 | 118 | 118 | 118 | 118 | 76 | 67 | -61 | -35 | -61 | 67 | 118 | 118 | 118 |

CASE-II:UTILIZATION OF DRAFTANIMAL FOR LAND PREPARATION

Unit:(1,000 man-day)

| Farming Practices | Unit Labor Requirement (man-day/ha) | Area (ha) | Jan. | | Feb. | | Mar. | | Apr. | | May. | | Jun. | | Jul. | | Aug. | | Sep. | | Oct. | | Nov. | | Dec. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late | Early | Late |
| 1. Nursery | 5 | 5,100 | | | | | | | 9 | 9 | 9 | | | | | | | | 9 | 9 | 9 | | | | | |
| 2. Land Prerparation | 25 | 5,100 | | | | | | | | 43 | 43 | 43 | | | | | | | | 43 | 43 | 43 | | | | |
| 3. Transplanting | 30 | 5,100 | | | | | | | | | 51 | 51 | 51 | | | | | | | | 51 | 51 | 51 | | | |
| 4. Weeding | 30 | 5,100 | 26 | | | | | | | | | 26 | 26 | 26 | 26 | 26 | 26 | | | | | 26 | 26 | 26 | 26 | 26 |
| 5. Field Maintenance | 10 | 5,100 | 9 | | | | | | | | | 9 | 9 | 9 | 9 | 9 | 9 | | | | | 9 | 9 | 9 | 9 | 9 |
| 6. Harvesting/Processing | 45 | 5,100 | | 77 | 77 | 77 | | | | | | | | | | | | 77 | 77 | 77 | | | | | | |
| Total Labor Requirement | 145 | | 35 | 77 | 77 | 77 | 0 | 0 | 9 | 52 | 103 | 129 | 86 | 35 | 35 | 35 | 35 | 77 | 86 | 129 | 103 | 129 | 86 | 35 | 35 | 35 |
| Available Labor Force<1 | | | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 | 153 |
| Labor Balance in the Project Area<2 | | | 118 | 76 | 76 | 76 | 153 | 153 | 144 | 101 | 50 | 24 | 67 | 118 | 118 | 118 | 118 | 76 | 67 | 24 | 50 | 24 | 67 | 118 | 118 | 118 |

NOTE:

<1:(25,408:total population) x (0.92:ratio of farm house) x (0.625:ratio of available labor=more than 15 years old) x (0.7:ratio of available work day) = 10,227 man-day in the Project Area.
10,227 man-day x 15 days = 153,405 man-day/0.5 month

<2:Labor Balance=Available Labor Force - Total Labor Requirement

Table 4.3 ESTIMATION OF NO. OF DRAFT ANIMAL TO BE INTRODUCED

| Items | Proposed Irrigation Scheme | | | | Total |
|---|---|---|---|---|---|
| | Mezawa | Mola | How | Susuwa | |
| (1) Cropped Area per Season(ha) | 280 | 1,450 | 450 | 2,920 | 5,100 |
| (2) Draft animal requirement (pair of animal/ha) | 8 | 8 | 8 | 8 | 8 |
| (3) Required working area per day(ha)<1 | 6 | 32 | 10 | 65 | 113 |
| (4) Required No. of buffalo<2 | 120 | 640 | 200 | 1,300 | 2,260 |
| (5) Period of Distribution(year) | 3 | 3 | 4 | 5 | 5 |
| (6) Required No. of buffalo for purchase per year | 40 | 213 | 50 | 260 | 563 |

NOTE:
<1:(Cropped area/season)/45 days
<2:((3) x (2) x 2(for pair))/0.8, 0.8;rate of animal available for farm works.

TABLE 4.4 DEMAND PROJECTION OF PADDY IN THE NIAS ISLAND

| YEAR | POPU-LATON* | PER- CAPITA CONSUMPTION OF RICE (Kg/person/yr) | TOTAL PADDY CONSUMPTION (ton/year) | OTHER REQUIREMENT** (ton/year) | TOTAL PADDY REQUIREMENT (ton/year) | SUPPLY OF PADDY*** (ton/year) | DEMAND OF PADDY (ton/year) |
|---|---|---|---|---|---|---|---|
| 1989 | 558,700 | 135 | 116,000 | 15,800 | 131,800 | 94,500 | 37,300 |
| 1990 | 570,100 | 135 | 118,400 | 16,100 | 134,500 | 94,500 | 40,000 |
| 1995 | 624,700 | 135 | 129,700 | 17,700 | 147,400 | 94,500 | 52,900 |
| 2000 | 679,600 | 135 | 141,100 | 19,200 | 160,300 | 94,500 | 65,800 |
| 2005 | 735,700 | 135 | 152,800 | 20,800 | 173,600 | 94,500 | 79,100 |
| 2010 | 796,500 | 135 | 165,400 | 22,600 | 188,000 | 94,500 | 93,500 |
| 2015 | 858,100 | 135 | 178,200 | 24,300 | 202,500 | 94,500 | 108,000 |
| 2020 | 924,400 | 135 | 192,000 | 26,200 | 218,200 | 94,500 | 123,700 |

* : population growth rate 1989-1990 ;2.04 %
* : population growth rate 1990-1995 ;1.85 %
* : population growth rate 1995-2000 ;1.7%
* : population growth rate 2000-2005 ;1.6 %
* : population growth rate 2010-2015;1.5 %
* : population growth rate 2015-2020;1.5 %
** : including seed requirement,waste and feed requirement(about 12% of total demand of paddy)
*** : total production of paddy of the Nias island (80 % of average total production of lowland paddy and upland between 1985 and 1989)

Table 4.5 ECONOMIC PRICE OF RICE

| | Paddy |
|---|---|
| Projected 1995 world market price of rice(US$/ton)(1) | 243 |
| Quality adjustment(2) | 24 |
| International shipping and handling(US$/ton) | 29 |
| CIF price at Gunung Sitoli(US$/ton) | 248 |
| CIF price at Gunung Sitoli(Rp./Kg)(3) | 459 |
| Port charge, handling, operation(Rp./Kg) | 37 |
| Transport to wholesaler(Rp./Kg) | 13 |
| Trader margin(Rp./Kg) | 11 |
| Ex-mill or wholesale price(Rp./Kg) | 498 |
| Conversion ratio to paddy(4) | 324 |
| Milling cost(Rp./Kg) | 13 |
| Transport farm to mill(Rp./Kg) | 13 |
| Economic farm gate price(Rp./Kg) | 298 |

(1) Based on the IBRD price prospects for major primary commodities, 1988-2000. The IBRD figures estimated are given in 1985 constant prices, which have been adjusted by a factor of 1.4439 (MUV) to allow for price escalation between 1985 and 1990.
pricing basis: rice Thailand ,milled,5% broken,FOB Bangkok
(2) a 10 % discount for rice
(3) one US$=Rp.1850
(4) 65%

Table 4.6 ECONOMIC PRICE OF FERTILIZER

| | | |
|---|---|---|
| A) Urea | | |
| | Price of FOB Europe($/ton) | 248 |
| | Price differential of Urea ($/ton) | 16 |
| | FOB price of bagged urea ex-factory Lhokseumawe($/ton) | 264 |
| | Ex-factory Lhokseumawe(Rp./kg) | 488 |
| | Transport to Project area(Rp./kg) | 18 |
| | Handling costs(Rp./kg) | 17 |
| | Transport wholesaler to farm(Rp./kg) | 11 |
| | Economic farm gate price(Rp./kg) | 534 |
| B) TSP | | |
| | Price of US Gulf($/ton) | 240 |
| | Freight and insurance($/ton) | 63 |
| | CIF Indonesia($/ton) | 303 |
| | CIF Indonesia(Rp./kg) | 561 |
| | Transport to Project area(Rp./kg) | 18 |
| | Handling costs(Rp./kg) | 17 |
| | Transport wholesaler to farm(Rp./kg) | 11 |
| | Economic farm gate price(Rp./kg) | 607 |
| C) KCl | | |
| | Price of FOB Vancourver($/ton) | 132 |
| | Freight and Insurance($/ton) | 53 |
| | CIF Indonesia($/ton) | 185 |
| | CIF Price Belawan(Rp./kg) | 342 |
| | Transport to Project area(Rp./kg) | 18 |
| | Handling costs(Rp./kg) | 17 |
| | Transport wholesaler to farm(Rp./kg) | 11 |
| | Economic farm gate price(Rp./kg) | 388 |

Remarks: Exchange rate of one US$=Rp.1,850
Urea=export parity
TSP and KCl=import parity

Table 4.7 CROP BUDGET OF PADDY PER HA IN TERMS OF ECONOMIC VALUE WITH AND WITHOUT PROJECT CONDITIONS

WITH PROJECT CONDITION Unit:Rp.

| Items | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| Total Production Cost | | | | 726,980 |
| Seed | kg/ha | 30 | 350 | 10,500 |
| Urea | kg/ha | 225 | 534 | 120,150 |
| TSP | kg/ha | 150 | 607 | 91,050 |
| KCL | kg/ha | 100 | 388 | 38,800 |
| Agri.chemical | kg/ha | 3 | 5,660 | 16,980 |
| Labor | man-day/ha | 145 | 2,300 | 333,500 |
| Draft animal | pair-day/ha | 8 | 14,500 | 116,000 |

WITHOUT PROJECT CONDITION/WET SEASON Unit:Rp.

| Items | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| Total Production Cost | | | | 341,982 |
| Seed | kg/ha | 35 | 350 | 12,250 |
| Urea | kg/ha | 3 | 534 | 1,602 |
| TSP | kg/ha | 2 | 607 | 1,214 |
| KCL | kg/ha | 1 | 388 | 388 |
| Agri.chemical | kg/ha | 0.8 | 5,660 | 4,528 |
| Labor | man-day/ha | 140 | 2,300 | 322,000 |

WITHOUT PROJECT CONDITION/DRY SEASON Unit:Rp.

| Items | Unit | Quantity | Unit Price | Amount |
|---|---|---|---|---|
| Total Production Cost | | | | 314,556 |
| Seed | kg/ha | 35 | 350 | 12,250 |
| Urea | kg/ha | 7 | 534 | 3,738 |
| TSP | kg/ha | 6 | 607 | 3,642 |
| KCL | kg/ha | 3 | 388 | 1,164 |
| Agri.chemical | kg/ha | 0.7 | 5,660 | 3,962 |
| Labor | man-day/ha | 126 | 2,300 | 289,800 |

## Table 4.8 FARM BUDGET ANALYSIS WITH AND WITHOUT PROJECT CONDITION

| Item | Unit | Without project(0.58 ha) | | | With project(farm size:0.58 ha) | | | With project(farm size:1.25ha)*** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Q'ty | Unit price Rp. | Amount Rp. | Q'ty | Unit price Rp. | Amount | Q'ty | Unit price Rp | Amount Rp. |
| Paddy(wet season) | | | | | | | | | | |
| Cropped area | ha | 0.58 | | | 0.58 | | | 1.25 | | |
| Unit yield | ton/ha | 1.30 | | | 5.00 | | | 5.00 | | |
| Unit price | Rp/kg | | 450 | | | 450 | | | 450 | |
| Gross return (1) | Rp. | | | 469,800 | | | 1,305,000 | | | 2,812,500 |
| Paddy(dry season) | | | | | | | | | | |
| Cropped area | ha | 0.10 | | | 0.58 | | | 1.25 | | |
| Unit yield | ton/ha | 1.10 | | | 5.00 | | | 5.00 | | |
| Unit price | Rp/kg | | 450 | | | 450 | | | 450 | |
| Gross return (2) | Rp. | | | 48,807 | | | 1,305,000 | | | 2,812,500 |
| Total gross return (3)=(1+2) | | | | 518,600 | | | 2,610,000 | | | 5,625,000 |
| Total production cost(4)=(12)+(21) | Rp. | | | 3,900 | | | 365,900 | | | 716,300 |
| Paddy(wet season) | | | | | | | | | | |
| seed(5) | Rp/kg | 2.47 | 450 | 643 | 17.40 | 450 | 7,830 | 37.50 | 450 | 16,875 |
| urea(6) | Rp/kg | 0.30 | 210 | 36 | 130.50 | 210 | 27,405 | 281.25 | 210 | 59,063 |
| TSP(7) | Rp/kg | 0.20 | 185 | 21 | 87.00 | 185 | 16,095 | 187.50 | 185 | 34,688 |
| KCl(8) | Rp/kg | 0.10 | 180 | 10 | 58.00 | 180 | 10,440 | 125.00 | 180 | 22,500 |
| agricultural chemicals(8) | Rp/kg or lit | 0.08 | 14,000 | 641 | 1.74 | 14,000 | 24,360 | 3.75 | 14,000 | 52,500 |
| hired labor(9)* | man-day | 0.00 | | | 27.19 | 2,300 | 62,531 | 27.19 | 2,300 | 62,531 |
| draft animal(10) | animal-day | 0.00 | | | 4.64 | 11,000 | 51,040 | 10.00 | 11,000 | 110,000 |
| harvesting cost(11) | Rp. | 0.00 | | | | | 0 | | | 0 |
| gross outgo(12)=(5)to(11) | Rp. | 0.00 | | 1,351 | | | 199,701 | | | 358,156 |
| Paddy(dry season) | | | | | | | | | | |
| seed(13) | Rp/kg | 2.76 | 450 | 1,242 | 17.40 | 450 | 7,830 | 37.50 | 450 | 16,875 |
| urea(14) | Rp/kg | 0.69 | 210 | 145 | 130.50 | 210 | 27,405 | 281.25 | 210 | 59,063 |
| TSP(15) | Rp/kg | 0.59 | 185 | 109 | 87.00 | 185 | 16,095 | 187.50 | 185 | 34,688 |
| KCl(16) | Rp/kg | 0.30 | 180 | 53 | 58.00 | 180 | 10,440 | 125.00 | 180 | 22,500 |
| agricultural chemicals(17) | Rp/kg or lit | 0.07 | 14,000 | 966 | 1.74 | 14,000 | 24,360 | 3.75 | 14,000 | 52,500 |
| hired labor(18)* | man-day | | | 0 | 12.62 | 2,300 | 29,015 | 27.19 | 2,300 | 62,531 |
| draft animal(19) | animal-day | | | 0 | 4.64 | 11,000 | 51,040 | 10.00 | 11,000 | 110,000 |
| harvesting cost(20) | Rp. | | | 0 | | | 0 | | | 0 |
| gross outgo(21)=(13)to(20) | Rp. | | | 2,516 | | | 166,185 | | | 358,156 |
| Land tax(22) | Rp/ha | 0.58 | 3,200 | 1,900 | 0.58 | 10,000 | 5,800 | 1.25 | 10,000 | 12,500 |
| Net income(23)=(3)-(4)-(22) | Rp. | | | 512,800 | | | 2,238,300 | | | 4,896,200 |
| Other income(24) | Rp. | | | 86,700 | | | 86,700 | | | 86,700 |
| Total income(25)=(23)+(24) | Rp. | | | 599,500 | | | 2,325,000 | | | 4,982,900 |
| Living expense(26)** | Rp. | | | 599,500 | | | 719,400 | | | 719,400 |
| Net surplus(27)=(25)-(26) | Rp. | | | 0 | | | 1,605,600 | | | 4,263,500 |

*: 15% of the labor requirement is assumed to be hired.

**: Assumed living expense with project condition will increase 120 % of the present one.

***: After the implementation of the project, considerable area of bush and upland crop will become paddy field. An average size of paddy field for the farmers in the project area will become paddy field. An average size of paddy field for the farmerts in the project area wil become twice (1.25 ha) assumed that all the newly reclaimed land is allocated to the farmers.

Table 4.9 PRINCIPAL FEATURES OF THE MEZAWA/HOW IRRIGATION PROJECT

| | | Description |
|---|---|---|
| 1 | Location | 130 km south from Gunung Sitoli, Nias Island, North Sumatra Province |
| 2 | Water Source | Mezawa river, Mola river, How river and Susuwa river |
| 3 | Command Area | |
| | 1) Gross irrigable area | 7,290 ha |
| | 2) Net irrigable area | 5,100 ha |
| 4 | Agricultural Development Plan | |
| | 1) Cropping pattern | Double cropping of paddy per year |
| | 2) Cropping intensity | 200% |
| 5 | Project Works | |
| | 1) Diversion weir | 4 nos. of fixed weir on Mezawa, Mola, How and Susuwa rivers |
| | 2) Main canal (Open canal with masonry lining) | 4 canals of 39.9 km in total |
| | 3) Secondary canal (Open canal with masonry lining) | 20 canals of 61.1 km in total |
| | 4) Drainage canal (Rehabilitation of existing rivers/streams) | 62.3 km in total |
| | 5) Farm road network | 130.5 km in total (New101 km, Rehabilitation 29.5 km) |
| | 6) On-farm facilities | 5,100 ha (2,640 ha newly developed) |
| | 7) Agricultural coordination center | 1 site (2,000 sq.m of land) |
| | 8) Procurement of O&M equipment | Operation vehicles, maintenance equipment & agr. machinery |
| 6 | Project Cost | |
| | 1) Direct cost (million Rp.) | 41,605 (4,410 US$/ha) |
| | 2) Other cost (million Rp.) | 25,002 |
| | 3) Total (million Rp.) | 66,627 |
| 7 | Economic Evaluation | |
| | Economic IRR | 10.20% |

TABLE 4.10 PROPOSED WATER USER'S ASSOCIATION

| Name of Federation | No. of P3A | Name of irrigation blocks | No. of irr. block | Area (ha) | Water sources |
|---|---|---|---|---|---|
| Mezawa/Mola P3A | 1 | MER-1to MER-6 | 6 | 220 | Mezawa/Mola rivers |
| | 2 | MEL-1 to MEL-3 | 3 | 50 | " |
| | 3 | MEL-4 to MEL-8 | 5 | 195 | " |
| | 4 | MEL-9 to MEL-12 | 4 | 105 | " |
| | 5 | MEL-21 to MEL-24 | 4 | 165 | " |
| | 6 | MEL-13 to MEL-15 | 3 | 135 | " |
| | 7 | MEL-16 to MEL-20 | 5 | 280 | " |
| | 8 | MOL-13 to MOL-15 | 3 | 140 | " |
| | 9 | MOL-9 to MOL-12 | 4 | 105 | " |
| | 10 | MOL-1&MOL-5 to 8 | 5 | 175 | " |
| | 11 | MOL-2 to MOL-4 | 3 | 160 | " |
| sub-total | 11 | | 45 | 1730 | |
| How P3A | 1 | HOW-1 to HOW-4 | 4 | 62 | How river |
| | 2 | HOW-5 to HOW-12 | 8 | 169 | " |
| | 3 | HOW-13 to HOW-23 | 11 | 219 | " |
| sub-total | 3 | | 15 | 450 | |
| Susuwa P3A | 1 | HOW2-8 to HOW2-12 | 5 | 229 | Susuwa river |
| | 2 | HOW2-4 to HOW2-7 | 4 | 160 | " |
| | 3 | HOW2-1 to HOW2-3 | 3 | 151 | " |
| | 4 | MOR-1 to MOR-4 | 4 | 189 | " |
| | 5 | MOR-5 to MOR-8 | 4 | 157 | " |
| | 6 | MOR-9 to MOR-12 | 4 | 223 | " |
| | 7 | MOR-13 to MOR-21 | 9 | 291 | " |
| | 8 | MOL2-1 to MOL2-4 | 4 | 240 | " |
| | 9 | MOL2-5 to MOL2-8 | 4 | 170 | " |
| | 10 | MOL2-9 to MOL2-12& MOL2-20 | 5 | 240 | " |
| | 11 | MOL2-13 to MOL2-16 | 4 | 140 | " |
| | 12 | MOL2-16 to MOL2-19 | 3 | 130 | " |
| | 13 | MOL2-21 to MOL2-22 | 2 | 110 | " |
| | 14 | MOL2-23 to MOL2-27 | 5 | 150 | " |
| | 15 | MOL2-28 to MOL2-30 | 3 | 140 | " |
| | 16 | MOL2-31 to MOL2-33 | 3 | 200 | " |
| sub-total | 16 | | 66 | 2920 | |
| Total | 30 | | 126 | 5100 | |

Table 4.11 FACILITY AND PERSONNELS NECESSARY FOR THE IRRIGATION AGRICULTURAL COORDINATION CENTER

| | items | area or number |
|---|---|---|
| A: FACILITIES | | |
| 1. Area of the Center | | |
| | seed farm area | 5.5 ha |
| | area for building | 0.5ha |
| 2. Building | | |
| | residence for staff | 32 m2 |
| | training room | 40m2 |
| | survey room | 32 m2 |
| | warehouse | 32 m2 |
| | seed treatment room | 18 m2 |
| | stotage room of seed | 64 m2 |
| | storage room of farm equip. | 120 m2 |
| | lavatory | 6 m2 |
| 3. Concrete yard | | |
| | for drying | 200 m2 |
| | for milling | 100 m2 |
| 4. Equipment | | |
| | tractor (35 ps, riding type) | 1 |
| | tractor( walking type) | 1 |
| | attachement of the above | 1 |
| | rotary harrow | 1 |
| | trailor | 1 |
| | automatic fed thresher | 1 |
| | drying facilities for paddy | 2 |
| | drying facility with thermometer | 1 |
| | moisture meter for paddy grain | 1 |
| | tester for budding | 5 |
| | balance | 3 |
| | copy machine | 1 |
| | typewriter | 1 |
| | videocamera | 1 |
| | video-set | 1 |
| | projector | 1 |
| B:PERSONNEL REQUIREMENT | | |
| | manager | 1 |
| | professional | 5 |
| | operator | 1 |
| | assistant-operator | 1 |
| | laborers | 5 |

Table 4.12 OUTLINE OF STANDARD CURRICULUM OF TRAINING FOR FARMERS (CHAIRMAN OF P3A)

| Training Item | Aims | Contents | Training Method |
|---|---|---|---|
| 1. Training orientation | | - registration<br>- levelling of expectation | lecture/workshop<br>- do - |
| 2. Overview of irrigation system management | to understand an overall system management | - irrigation facilities<br>- irrigation schedule (pre-, normal- and post-irrigation) | lecture<br>- do - |
| 3. Operation method of water management on facilities | to learn how to measure discharge<br>to learn how to operate water management of facilities | - measuring devices<br>- operation rule of water management facilities<br>- cropping pattern<br>- water distribution plan | lecture/field practice<br>- do -<br>- do -<br>- do - |
| 4. Maintenance of facilities | to maintain irrigation facilities | - maintenance system | lecture |
| 5. Monitoring system | to obtain knowledge of procedure of monitoring | - reporting system<br>- form of reports/communication | lecture<br>- do - |
| 6. Conflict of management | to solve conflict of water management | - sample exercise | lecture/exercise |
| 7. Organizational structure, function and responsibilities | to obtain knowledge about organizational structure and function<br>to make clear the responsibilities of P3A farmers and PU staff | - organizations of P3A and PU<br>- other organizations<br>- responsibility of farmers and PU staff | lecture/exercise<br>- do -<br>- do - |
| 8. Training evaluation | to evaluate training | - evaluation | lecture/exercise |

Table 4.13 OUTLINE OF STANDARD CURRICULUM OF TRAINING FOR FARMERS (ULU-ULU AND ILI-ILI)

| Training Item | Aims | Contents | Training Method |
|---|---|---|---|
| 1. Training orientation | | - registration<br>- raising of expectation | lecture/workshop<br>- do - |
| 2. Kind and function of facilities | to gain knowledge about function of irrigation facilities | - hydraulic features of structures | lecture/field practice |
| Operation method of water management facilities | to learn how to measure discharge and climate data | - measuring rainfall, evaporation, temperature, discharge, etc. | - do - |
| | to learn how to operate water management facilities | - operation rule of water management facilities | - do - |
| 3. Organizational structure, function and responsibilities | to obtain knowledge about organizational structure and function | - organization of the P3A<br>- organization of PU<br>- other organization | lecture<br>- do -<br>- do - |
| | to make clear the responsibilities of ditchtender at various level of management | - responsibilities of ditchtender | - do - |
| 4. Procedure for water management | to obtain knowledge about procedure for determination of the irrigation plan | - determination of annual irrigation plan | lecture |
| 5. Reporting system | to make clear reporting system | - reporting system for water management<br>- form of report/communication | lecture<br>- do - |
| 6. Maintenance of facilities | to understand the whole aspect of maintenance | - maintenance system | lecture |
| 7. Overall management | to understand the overall system of management | - system management | field visit/lecture |
| 8. Training evaluation | to evaluate effect of training | - evaluation | lecture/exercise |

Table 4.14 OUTLINE OF STANDARD CURRICULUM OF TRAINING FOR FIELD EXTENSION WORKERS (PPL)

| Training Item | Aims | Contents | Training Method |
|---|---|---|---|
| 1. Training orientation | | - registration | lecture/workshop |
| | | - raising of expectation | - do - |
| | | - training design orientation | - do - |
| 2. Organizational structure, function and responsibilities | to obtain knowledge about organizational structure and function | - organization of P3A | lecture |
| | | - organization of PU | - do - |
| | | - other organization | - do - |
| | to make clear the responsibility of P3A farmers and PU staff | - responsibility of farmers and PU staff | - do - |
| 3. Overview of irrigation system management | to understand an overall system management | - irrigation facilities | lecture |
| | | - irrigation schedule (pre-, normal-, and post-irrigation) | - do - |
| 4. Operation method of water management | to understand operation method of water management | - operation rule of water management facilities | lecture/field practice |
| | | - cropping pattern | - do - |
| | | - water distribution plan | - do - |
| 5. Procedure for water management | to understand about administrative procedure to determine the irrigation plan | - irrigation committee | lecture |
| | | - determination of annual irrigation plan | - do - |
| 6. Monitoring on practice of water management | to obtain knowledge about monitoring and evaluation on water management | - monitoring and evaluation on water management at main system | lecture/field practice |
| | | - monitoring and evaluation on water management at tertiary block level | - do - |
| | to obtain knowledge about monitoring and evaluation on economic benefit | - monitoring and evaluation system on economic benefit | lecture |
| | | - survey method and forms | lecture, exercise field visit/lecture |
| 7. Overall management facilities | to understand an overall system management | - system management | field visit/lecture |
| 8. Training evaluation | to evaluate training | - evaluation | lecture/exercise |

Table 4.15 OUTLINE OF STANDARD CURRICULUM OF TRAINING FOR PU-O&M STAFF

| Goal of Training | Training Item | Aims | Contents | Training Method |
|---|---|---|---|---|
| 1. Training orientation | | | - registration | lecture/discussion workshop |
| | | | - raising of expectations | - do - |
| 2. To acquire knowledge of the irrigation plan | on-farm irrigation requirement | to understand approx. amount, constituent factors, seasonal variation of water requirement for paddy and diversified crops | - evapotranspiration | lecture |
| | | | - percolation | - do - |
| | | | - effective rainfall | - do - |
| | | | - irrigation efficiency | - do - |
| | | | - rotational irrigation and simultaneous irrigation | lecture/discussion |
| | irrigation requirements for tertiary block, and major diversion structure | to understand irrigation method such as rotational and simultaneous irrigation | - farming practice and irrigation method | - do - |
| | | to understand diversion requirement | - seasonal diversion requirements | - do - |
| | hydrology | to understand regional hydrological characteristics | - general climate | lecture |
| | | | - rainfall/available water sources | - do - |
| | | to understand available water sources of the river | - water balance in the river system | - do - |
| | | to understand water balance in the river system | - data bank system | - do - |
| 3. To acquire knowledge of facilities | kind and function of irrigation facilities | to gain knowledge about the kind and function of irrigation facilities | - design criteria for canal | lecture |
| | | | - hydraulic features of structures | lecture/ field practice |
| | | to gain knowledge about water management facilities | - movable structures such as gate and check structures | - do - |
| | operation method of water management facilities | to learn how to measure discharge | - measuring device | lecture/ field practice |
| | | to learn how to operate water management facilities | - operation rule of water management facilities | - do - |
| 4. To acquire knowledge of organization and responsibilities | organizational sturcture, function and responsibilities | to obtain knowledge about organization structure and function | - organizations of the P3A | lecture |
| | | | - organization of PU | - do - |
| | | to make clear the responsibilities of O&M staff at various level of management | - other organization | - do - |
| | | | - responsibilities of each level staff | - do - |
| 5. To learn procedures for water management and reporting system | procedure for water management | to obtain knowledge about administrative procedure to determine the irrigation plan | - irrigation committees at various levels if available | lecture |
| | | | - determination of annual irrigation plan | - do - |
| | reporting system | to make clear reporting system | - reporting system for water management | - do - |
| | | | - form of reports/ communication | - do - |
| 6. To acquire knowledge about monitoring and evaluation | monitoring on practice of water management | to obtain knowledge about monitoring and evaluation on water management | - monitoring and evaluation on water management at main system | lecture/ field practice |
| | | | - monitoring and evaluation on water management at tertiary block level | - do - |
| | | to obtain knowledge about monitoring and evaluation on economic benefit | - monitoring and evaluation system on economic benefits of project | lecture |
| | | | - survey method and forms | lecture, exercise |
| 7. To acquire knowledge on maintenance of irrigation facilities | maintenance of irrigation facilities | to understand the whole aspect related to maintenance of facilities | - maintenance system | lecture |
| | | | - maintenance method | - do - |
| | | | - responsibility of organization | - do - |
| | | | - budget | - do - |
| 8. To acquire knowledge on the overall management of the irrigation system | overall management | to understand an overall system management | - system management | field visit/ lecture |
| 9. To evaluate effect of training | training evaluation | to evaluate effect of training | - evaluation | lecture/exercise |

Table 5.1 SUMMARY OF PROJECT COST

| | Cost Item | F/C (1,000 US$) | L/C (Rp.million) | Total (Rp.million) |
|---|---|---|---|---|
| **I** | **Detailed Design** | **946** | **2,217** | **3,968** |
| **II** | **Land Acquisition** | **0** | **2,670** | **2,670** |
| **III** | **Construciton Cost** | | | |
| 1 | Direct Construction Cost | | | |
| | 1) General Items | 852 | 2,201 | 3,777 |
| | 2) Intake Weir | 557 | 1,921 | 2,951 |
| | 3) Irrigation Canals | 5,854 | 14,666 | 25,496 |
| | 4) Drainage Canals | 449 | 1,592 | 2,423 |
| | 5) Farm Roads | 450 | 786 | 1,619 |
| | 6) On-farm Development | 1,212 | 3,050 | 5,292 |
| | 7) IACC | 6 | 37 | 48 |
| | Sub Total | 9,380 | 24,253 | 41,606 |
| 2 | Contingencies | | | |
| | 1) Physical Contingency (15%) | 1,407 | 3,638 | 6,241 |
| | Sub Total | 1,407 | 3,638 | 6,241 |
| 3 | Total for Item 1&2 | 10,787 | 27,891 | 47,847 |
| 4 | Tax on Civil Works, VAT (10%) | 1,079 | 2,789 | 4,785 |
| | **Total for Item III** | **11,866** | **30,680** | **52,632** |
| **IV** | **O&M Equipment** | **897** | **41** | **1,700** |
| **V** | **Engineering Services** | **938** | **2,425** | **4,161** |
| **VI** | **Administration Cost** | **281** | **728** | **1,248** |
| **VII** | **Training Program** | **0** | **250** | **250** |
| | **GRAND TOTAL** | **14,928** | **39,010** | **66,628** |

Table 7.1 BUILD-UP PERIOD

| Irrigation System | Land Criteria (%) | | | Build-up Period * (years) |
|---|---|---|---|---|
| | Irrigated Paddy Field | Rainfed Paddy Field | Reclaimed Land | |
| 1. Mezawa | 0 | 82 | 18 | 4.5 |
| 2. Mola | 0 | 80 | 20 | 4.6 |
| 3. How | 0 | 40 | 60 | 5.8 |
| 4. Susuwa | 0 | 31 | 69 | 6.1 |

* : Irrigated Paddy Field (%) x 3yrs. + Rainfed Paddy Field (%) x 4 yrs. + Reclaimed Land (%) x 7 yrs.

Table 7.2 IRRIGATION BENEFIT

| Irrigation Scheme | Cropping Season | With Project Condition | | | | | | Without Project Condition | | | | | | Irrigation Benefit(7) (Rp.million) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Project Area (ha) | Cultivated Area (ha) | Unit Yield (ton/ha) | Gross Income(1) (Rp.million) | Production Cost(2) (Rp.million) | Primary Profit(3) (Rp.million) | Existing Paddy Field (ha) | Cultivated Area (ha) | Unit Yield (ton/ha) | Gross Income(4) (Rp.million) | Production Cost(5) (Rp.million) | Primary Profit(6) (Rp.million) | |
| 1. Mezawa | Wet | 280 | 280 | 5.0 | 417 | 204 | 213 | 230 | 230 | 1.8 | 123 | 79 | 44 | 169 |
| | Dry | - | 280 | 5.0 | 417 | 204 | 213 | - | 39 | 1.1 | 13 | 12 | 1 | 212 |
| | Annual | - | 560 | - | 834 | 408 | 426 | - | 269 | - | 136 | 91 | 45 | 381 |
| 2. Mola | Wet | 1,450 | 1,450 | 5.0 | 2,161 | 1,054 | 1,107 | 1,160 | 1,160 | 1.8 | 622 | 397 | 225 | 882 |
| | Dry | - | 1,450 | 5.0 | 2,161 | 1,054 | 1,107 | - | 197 | 1.1 | 65 | 62 | 3 | 1,104 |
| | Annual | - | 2,900 | - | 4,322 | 2,108 | 2,214 | - | 1,357 | - | 687 | 459 | 228 | 1,986 |
| 3. How | Wet | 450 | 450 | 5.0 | 671 | 327 | 344 | 180 | 180 | 1.8 | 97 | 62 | 35 | 309 |
| | Dry | - | 450 | 5.0 | 671 | 327 | 344 | - | 31 | 1.1 | 10 | 10 | 0 | 344 |
| | Annual | - | 900 | - | 1,342 | 654 | 688 | - | 211 | - | 107 | 72 | 35 | 653 |
| 4. Susuwa | Wet | 2,920 | 2,920 | 5.0 | 4,351 | 2,123 | 2,228 | 890 | 890 | 1.8 | 477 | 304 | 173 | 2,055 |
| | Dry | - | 2,920 | 5.0 | 4,351 | 2,123 | 2,228 | - | 151 | 1.1 | 49 | 47 | 2 | 2,226 |
| | Annual | - | 5,840 | - | 8,702 | 4,246 | 4,456 | - | 1,041 | - | 526 | 351 | 175 | 4,281 |
| Total | | 5,100 | 10,200 | - | 15,200 | 7,416 | 7,784 | 2,460 | 2,878 | - | 1,456 | 973 | 483 | 7,301 |

Note:
(1):Annual Cultivated Area x Unit Yield x Rp.298,000/ton
(2):Annual Cultivated Area x Rp.726,980/ton
(3):(1) - (2)
(4):Annual Cultivated Area x Unit Yield x Rp.298,000/ton
(5):Wet Season Cultivated Area x Rp.341,982/ton, Dry Season Cultivated Area x Rp.314,556/ton
(6):(1) - (2)
(7):(3) - (6)

Table 7.3 ECONOMIC COST OF THE PROJECT

| | Cost Item | F/C (1,000 US$) | L/C (Rp.million) | Total (Rp.million) |
|---|---|---|---|---|
| **I** | **Detailed Design** | **946** | **1,884** | **3,634** |
| **II** | **Land Acquisition** | **0** | **2,270** | **2,270** |
| **III** | **Construciton Cost** | | | |
| 1 | Direct Construction Cost | | | |
| | 1) Mezawa river system | 391 | 1,074 | 1,797 |
| | 2) Mola river system | 2,105 | 5,070 | 8,964 |
| | 3) How river system | 733 | 1,580 | 2,936 |
| | 4) Susuwa river system | 6,146 | 12,858 | 24,228 |
| | 5) IACC | 6 | 31 | 42 |
| | Sub Total | 9,380 | 20,613 | 37,968 |
| 2 | Contingencies | | | |
| | 1) Physical Contingency (15%) | 1,407 | 3,092 | 5,695 |
| | **Total for Item III** | **10,787** | **23,705** | **43,663** |
| **IV** | **O&M Equipment** | **897** | **35** | **1,694** |
| **V** | **Engineering Services** | **938** | **2,061** | **3,797** |
| **VI** | **Administration Cost** | **281** | **618** | **1,139** |
| **VII** | **Training Program** | **0** | **213** | **213** |
| | **GRAND TOTAL** | **13,849** | **30,787** | **56,410** |

Table 7.4 ECONOMIC CASH FLOW OF MEZAWA/HOW IRRIGATION PROJECT

(Unit : MILLION RP.)

| Year in Order | Year | Costs | | | Gross Benefit (B) |
|---|---|---|---|---|---|
| | | Const-ruction | OMR | Total (C) | |
| 1 | 1992 | 3,635 | 0 | 3,635 | 0 |
| 2 | 1993 | 13,194 | 0 | 13,194 | 0 |
| 3 | 1994 | 13,194 | 0 | 13,194 | 0 |
| 4 | 1995 | 15,833 | 100 | 15,933 | 1,031 |
| 5 | 1996 | 10,555 | 121 | 10,677 | 2,437 |
| 6 | 1997 | 0 | 306 | 306 | 5,943 |
| 7 | 1998 | 0 | 528 | 528 | 6,626 |
| 8 | 1999 | 0 | 528 | 528 | 6,995 |
| 9 | 2000 | 0 | 528 | 528 | 7,166 |
| 10 | 2001 | 0 | 528 | 528 | 7,258 |
| 11 | 2002 | 0 | 528 | 528 | 7,301 |
| 12 | 2003 | 0 | 528 | 528 | 7,301 |
| 13 | 2004 | 0 | 528 | 528 | 7,301 |
| 14 | 2005 | 0 | 528 | 528 | 7,301 |
| 15 | 2006 | 0 | 528 | 528 | 7,301 |
| 16 | 2007 | 0 | 528 | 528 | 7,301 |
| 17 | 2008 | 0 | 528 | 528 | 7,301 |
| 18 | 2009 | 0 | 528 | 528 | 7,301 |
| 19 | 2010 | 0 | 528 | 528 | 7,301 |
| 20 | 2011 | 0 | 528 | 528 | 7,301 |
| 21 | 2012 | 0 | 528 | 528 | 7,301 |
| 22 | 2013 | 0 | 528 | 528 | 7,301 |
| 23 | 2014 | 0 | 626 | 626 | 7,301 |
| 24 | 2015 | 0 | 1,126 | 1,126 | 7,301 |
| 25 | 2016 | 0 | 1,028 | 1,028 | 7,301 |
| 26 | 2017 | 0 | 528 | 528 | 7,301 |
| 27 | 2018 | 0 | 528 | 528 | 7,301 |
| 28 | 2019 | 0 | 528 | 528 | 7,301 |
| 29 | 2020 | 0 | 528 | 528 | 7,301 |
| 30 | 2021 | 0 | 528 | 528 | 7,301 |
| 31 | 2022 | 0 | 528 | 528 | 7,301 |
| 32 | 2023 | 0 | 528 | 528 | 7,301 |
| 33 | 2024 | 0 | 528 | 528 | 7,301 |
| 34 | 2025 | 0 | 528 | 528 | 7,301 |
| 35 | 2026 | 0 | 678 | 678 | 7,301 |
| 36 | 2027 | 0 | 528 | 528 | 7,301 |
| 37 | 2028 | 0 | 528 | 528 | 7,301 |
| 38 | 2029 | 0 | 528 | 528 | 7,301 |
| 39 | 2030 | 0 | 528 | 528 | 7,301 |
| 40 | 2031 | 0 | 528 | 528 | 7,301 |
| 41 | 2032 | 0 | 528 | 528 | 7,301 |
| 42 | 2033 | 0 | 528 | 528 | 7,301 |
| 43 | 2034 | 0 | 626 | 626 | 7,301 |
| 44 | 2035 | 0 | 1,126 | 1,126 | 7,301 |
| 45 | 2036 | 0 | 1,028 | 1,028 | 7,301 |
| 46 | 2037 | 0 | 528 | 528 | 7,301 |
| 47 | 2038 | 0 | 528 | 528 | 7,301 |
| 48 | 2039 | 0 | 528 | 528 | 7,301 |
| 49 | 2040 | 0 | 528 | 528 | 7,301 |
| 50 | 2041 | 0 | 528 | 528 | 7,301 |

## Table 7.5 FINANCIAL CASH FLOW STATEMENT OF THE MEZAWA/HOW DEVELOPMENT PROJECT

(Unit : Rp. Million )

| Year | Year in Order | Cash Outflow | | | | | | Cash Inflow | | | | | Balance (B)-(A) | Accumulated Loan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Project Cost | O &M Cost | Peplacement Cost | Loan Interest | Loan Repayment | Total Outflow(A) | Foreign Loan | Government Budget | Government Subsidy | Water Charge | Total Inflow(B) | | |
| 1992 | 1 | 3,968 | 0 | 0 | 79 | 0 | 4,047 | 3,174 | 794 | 79 | 0 | 4,047 | 0 | 3,174 |
| 1993 | 2 | 15,665 | 0 | 0 | 393 | 0 | 16,058 | 12,532 | 3,133 | 393 | 0 | 16,058 | 0 | 15,706 |
| 1994 | 3 | 15,665 | 0 | 0 | 706 | 0 | 16,371 | 12,532 | 3,133 | 706 | 0 | 16,371 | 0 | 28,238 |
| 1995 | 4 | 18,798 | 126 | 0 | 1,082 | 0 | 20,006 | 15,037 | 3,761 | 1,208 | 0 | 20,006 | 0 | 43,275 |
| 1996 | 5 | 12,532 | 153 | 0 | 1,333 | 0 | 14,018 | 10,025 | 2,507 | 1,486 | 0 | 14,018 | 0 | 53,300 |
| 1997 | 6 | 0 | 386 | 0 | 1,333 | 0 | 1,719 | 0 | 0 | 1,719 | 0 | 1,719 | 0 | 53,300 |
| 1998 | 7 | 0 | 666 | 0 | 1,333 | 0 | 1,999 | 0 | 0 | 1,999 | 0 | 1,999 | 0 | 53,300 |
| 1999 | 8 | 0 | 666 | 0 | 1,333 | 0 | 1,999 | 0 | 0 | 1,999 | 0 | 1,999 | 0 | 53,300 |
| 2000 | 9 | 0 | 666 | 0 | 1,333 | 0 | 1,999 | 0 | 0 | 1,999 | 0 | 1,999 | 0 | 53,300 |
| 2001 | 10 | 0 | 666 | 0 | 1,333 | 0 | 1,999 | 0 | 0 | 1,999 | 0 | 1,999 | 0 | 53,300 |
| 2002 | 11 | 0 | 666 | 0 | 1,266 | 2,665 | 4,597 | 0 | 0 | 4,597 | 0 | 4,597 | 0 | 50,635 |
| 2003 | 12 | 0 | 666 | 0 | 1,199 | 2,665 | 4,530 | 0 | 0 | 4,530 | 0 | 4,530 | 0 | 47,970 |
| 2004 | 13 | 0 | 666 | 0 | 1,133 | 2,665 | 4,464 | 0 | 0 | 4,464 | 0 | 4,464 | 0 | 45,305 |
| 2005 | 14 | 0 | 666 | 0 | 1,066 | 2,665 | 4,397 | 0 | 0 | 4,397 | 0 | 4,397 | 0 | 42,640 |
| 2006 | 15 | 0 | 666 | 0 | 999 | 2,665 | 4,330 | 0 | 0 | 4,330 | 0 | 4,330 | 0 | 39,975 |
| 2007 | 16 | 0 | 666 | 0 | 933 | 2,665 | 4,264 | 0 | 0 | 4,264 | 0 | 4,264 | 0 | 37,310 |
| 2008 | 17 | 0 | 666 | 0 | 866 | 2,665 | 4,197 | 0 | 0 | 4,197 | 0 | 4,197 | 0 | 34,645 |
| 2009 | 18 | 0 | 666 | 0 | 800 | 2,665 | 4,131 | 0 | 0 | 4,131 | 0 | 4,131 | 0 | 31,980 |
| 2010 | 19 | 0 | 666 | 0 | 733 | 2,665 | 4,064 | 0 | 0 | 4,064 | 0 | 4,064 | 0 | 29,315 |
| 2011 | 20 | 0 | 666 | 0 | 666 | 2,665 | 3,997 | 0 | 0 | 3,997 | 0 | 3,997 | 0 | 26,650 |
| 2012 | 21 | 0 | 666 | 0 | 600 | 2,665 | 3,931 | 0 | 0 | 3,931 | 0 | 3,931 | 0 | 23,985 |
| 2013 | 22 | 0 | 666 | 0 | 533 | 2,665 | 3,864 | 0 | 0 | 3,864 | 0 | 3,864 | 0 | 21,320 |
| 2014 | 23 | 0 | 666 | 98 | 466 | 2,665 | 3,895 | 0 | 0 | 3,895 | 0 | 3,895 | 0 | 18,655 |
| 2015 | 24 | 0 | 666 | 598 | 400 | 2,665 | 4,329 | 0 | 0 | 4,329 | 0 | 4,329 | 0 | 15,990 |
| 2016 | 25 | 0 | 666 | 500 | 333 | 2,665 | 4,164 | 0 | 0 | 4,164 | 0 | 4,164 | 0 | 13,325 |
| 2017 | 26 | 0 | 666 | 0 | 267 | 2,665 | 3,598 | 0 | 0 | 3,598 | 0 | 3,598 | 0 | 10,660 |
| 2018 | 27 | 0 | 666 | 0 | 200 | 2,665 | 3,531 | 0 | 0 | 3,531 | 0 | 3,531 | 0 | 7,995 |
| 2019 | 28 | 0 | 666 | 0 | 133 | 2,665 | 3,464 | 0 | 0 | 3,464 | 0 | 3,464 | 0 | 5,330 |
| 2020 | 29 | 0 | 666 | 0 | 67 | 2,665 | 3,398 | 0 | 0 | 3,398 | 0 | 3,398 | 0 | 2,665 |
| 2021 | 30 | 0 | 666 | 0 | 0 | 2,665 | 3,331 | 0 | 0 | 3,331 | 0 | 3,331 | 0 | 0 |
| Total | | 66,628 | 24,790 | 2,007 | 22,914 | 53,300 | 169,639 | 53,300 | 13,328 | 103,011 | 0 | 169,639 | 0 | |

Remarks:

Foreign Loan: Annual interest of 2.5% for repayment period of 30 years including 10-year grace period.

Table 8.1 IDENTIFICATION OF MATRIX FOR ENVIRONMENTAL IMPACTS

| Environmental Matrix/Impacts | PRE-CONSTRUCTION | | | | CONSTRUCTION STAGE | | | | | | | | OPERATION AND MAINTENANCE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Survey Area | Area marking | Land release | Removal of people | Mobilisation of materials and heavy equipment | Mobilization of man power | Opening and cleaning land | Construction of access road | Construction of weir | Excavation and transportation of materials | Construction of drainage ditches | Construction and operation of base camp | Operation of weir | Agricultural extensification | Agricultural intensification | Water management |
| I. PHYSICAL | | | | | | | | | | | | | | | | |
| Temperature | | | | | | | ○ | | | | | | | | | |
| Humidity | | | | | | | ○ | | | | | | | | | |
| Rainfall | | | | | | | ○ | | | | | | | | | |
| Climate type | | | | | | | ○ | | | | | | | | | |
| Air polution | | | | | | | ○ | | | | | | | | | |
| Noise | | | | | | | ○ | | | | | | | | | |
| II.PHYSIOGRAPHY | | | | | | | | | | | | | | | | |
| Geology | | | | | | | ○ | | | | | | | | | |
| III.HYDROLOGY | | | | | | | | | | | | | | | | |
| River sedimentation | | | | | ○ | | ○ | ○ | ○ | ○ | ○ | | | | | |
| River discharge | | | | | | | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | |
| IV.WATER QUALITY | | | | | | | | | | | | | | | | |
| River(Physical) | | | | | | ○ | ○ | ○ | ○ | | ○ | ○ | ○ | ○ | ○ | ○ |
| River(Chemical) | | | | | | ○ | ○ | ○ | | | ○ | ○ | ○ | ○ | ○ | |
| Well(Physical) | | | | | | ○ | | | | | | ○ | ○ | | | |
| Well(Chemical) | | | | | | ○ | | | | | | ○ | ○ | | | |
| V.SOIL AND LAND USE | | | | | | | | | | | | | | | | |
| Land use condition | | | ○ | | | | ○ | ○ | | | ○ | | | ○ | | |
| Soil Physics | | | | | | | | | | | ○ | | | ○ | ○ | |
| Soil Chemist | | | | | | | | | | | ○ | | | ○ | ○ | |
| Erosion | | | | | ○ | | ○ | | ○ | ○ | | | | | | |
| Sedimentation | | | | | | | ○ | | ○ | ○ | | | ○ | ○ | | |
| VI.BIOLOGY | | | | | | | | | | | | | | | | |
| Food crops | | | | | | | ○ | | | | ○ | | | ○ | ○ | |
| Estate crops | | | | | | | ○ | | | | ○ | | | ○ | ○ | |
| Natural vegetation | | | | | | | ○ | ○ | ○ | | ○ | | | ○ | ○ | |
| Basic vegetation | ○ | ○ | | | | | ○ | ○ | | | ○ | | | ○ | ○ | |
| Fauna | | | | | | | ○ | | | | | | | ○ | | |
| Mammalia | | | | | | ○ | ○ | | ○ | | | | | ○ | | |
| Reptilia | | | | | | | | | | | | | | | | |
| Amphibia | | | | | | | | | | | | | | | | |
| Insects | | | | | | | | | | | | | | ○ | | |
| Plankton | | | | | | ○ | ○ | | | | ○ | ○ | ○ | ○ | ○ | |
| VII.AQUATIC BIOTA | | | | | | | | | | | | | | | | |
| Benios | | | | | | ○ | ○ | | | | ○ | ○ | ○ | ○ | ○ | |
| Fish | | | | | | ○ | ○ | | | | ○ | ○ | ○ | ○ | ○ | |
| VIII.SOCIAL-ECONOMY | | | | | | | | | | | | | | | | |
| Income level | ○ | | | | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | |
| Labor absorption | ○ | | | | | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | |
| Perception of local people | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ | | ○ | ○ | ○ |
| Transportation | | | | | ○ | ○ | | ○ | | ○ | | ○ | | | | |
| Social problems/conflicts | | | ○ | ○ | | ○ | ○ | ○ | | | ○ | ○ | ○ | ○ | ○ | ○ |
| Housing | | | | | | | | | | | | | | ○ | ○ | |
| IX.ORGANIZATION | | | | | | | | | | | | | | | | |
| Socio-cultural organization | | | | | | ○ | | | | | ○ | | | ○ | ○ | |
| Formal/non-formal institution | | | ○ | ○ | | ○ | ○ | ○ | | | ○ | ○ | ○ | ○ | ○ | ○ |

Note:○=Impacts predicted through the proposed project activities for Mezawa/How Irrigation Development.

TABLE 8.2 SPECIES OF BASIC VEGETATION IN THE STUDY AREA

| No. | Species | Tetehosi | | Sitolu banua | | Hilihoru | | Important Value | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | R.I. (%) | R.F. (%) | R.I. (%) | R.F. (%) | R.I. (%) | R.F. (%) | 1 (%) | 2 (%) | 3 (%) |
| 1. | Cleome rutiduspermae | 15.39 | 5.67 | 8.77 | 3.45 | 8.43 | 2.94 | 21.06 | 12.22 | 11.37 |
| 2. | Digitaria sp. | 4.28 | 3.77 | - | - | - | - | 8.05 | - | - |
| 3. | Cyclosorus aridus | 18.74 | 3.77 | 5.26 | 3.45 | 7.63 | 2.94 | 22.51 | 8.71 | 10.57 |
| 4. | Digitaria sanginalis | 3.21 | 3.77 | - | - | - | - | 6.98 | - | - |
| 5. | Cyperus kylingga | 1.07 | 1.88 | 0.19 | 3.45 | 2.41 | 2.94 | 2.95 | 3.64 | 5.35 |
| 6. | Paslatum conjugatum | 10.98 | 5.67 | 19.29 | 10.34 | 8.03 | 8.82 | 16.65 | 29.63 | 16.85 |
| 7. | Clocasia esculentum | 2.54 | 3.77 | 1.17 | 3.45 | 5.62 | 2.94 | 6.31 | 4.62 | 8.56 |
| 8. | Ipomea batatas | 7.09 | 3.77 | 2.34 | 3.45 | 7.22 | 2.99 | 10.86 | 5.79 | 10.21 |
| 9. | Cyperusiria | 1.61 | 5.07 | - | - | 5.88 | 4.42 | 6.68 | - | 10.30 |
| 10. | Hiptis romboida | 1.07 | 3.77 | 1.75 | 3.45 | 0.08 | 2.94 | 4.84 | 5.20 | 3.02 |
| 11. | Cyperus sp. | 0.81 | 1.88 | 2.92 | 6.90 | 2.94 | 2.81 | 2.69 | 9.82 | 5.75 |
| 12. | Centoteca lappacea | 2.27 | 1.88 | - | - | - | - | 4.15 | - | - |
| 13. | Borneria alata | 4.68 | 3.77 | - | - | - | - | 8.45 | - | - |
| 14. | Ageratum conyzoides | 2.68 | 3.77 | 13.45 | 10.34 | 6.02 | 5.88 | 6.45 | 23.79 | 11.90 |
| 15. | Saccharum sp. | 0.27 | 1.88 | 1.75 | 3.45 | - | - | 2.15 | 5.20 | - |
| 16. | Eleuisine indica | 0.53 | 1.88 | 1.17 | 3.45 | 0.08 | 2.94 | 2.41 | 4.62 | 3.02 |
| 17. | Echinocloa colonum | 2.41 | 3.77 | - | - | - | - | 6.18 | - | - |
| 18. | Echinocloa crusgalli | 0.27 | 1.88 | - | - | 3.61 | 2.94 | 2.15 | - | 6.55 |
| 19. | Cynodom dactilon | 2.54 | 3.77 | - | - | 1.61 | 2.94 | 6.31 | - | 4.55 |
| 20. | Sida rombifolia | 2.01 | 3.77 | 1.75 | 3.45 | - | - | 5.78 | 5.20 | - |
| 21. | Cyperus esculentus | 1.74 | 5.61 | - | - | - | - | 7.35 | - | - |
| 22. | Biden pilosa | 0.53 | 1.88 | - | - | - | - | 2.41 | - | - |
| 23. | Commelia benghaleuis | 0.81 | 1.88 | - | - | - | - | 2.69 | - | - |
| 24. | Digitaria ascendens | 1.34 | 3.77 | - | - | 4.82 | 2.94 | 5.11 | - | 7.76 |
| 25. | Fimbristis milliaca | 0.81 | 3.77 | - | - | - | - | 4.58 | - | - |
| 26. | Leersia hexandra | 0.53 | 1.68 | - | - | 4.82 | 2.94 | 2.21 | - | 7.76 |
| 27. | Micania michoranta | 1.34 | 3.77 | 2.34 | 3.45 | 4.82 | 2.94 | 5.11 | 5.79 | 7.76 |
| 28. | Commelia diffusa | 0.94 | 1.88 | - | - | - | - | 2.82 | - | - |
| 29. | Imperata cylindrica | 2.54 | 3.77 | 2.92 | 3.45 | 2.81 | 5.88 | 6.31 | 6.37 | 8.69 |
| 30. | Leptochloa chinensis | 4.95 | 1.88 | - | - | 2.00 | 2.94 | 6.83 | - | 4.94 |
| 31. | Manihot utilisima | - | - | 3.51 | 6.90 | - | - | - | 10.41 | - |
| 32. | Stachytarphaeta jamais | - | - | 1.17 | 3.45 | 0.04 | 2.94 | - | 4.62 | 2.98 |
| 33. | Euphorbia lienta | - | - | 5.26 | 6.90 | - | - | - | 12.16 | - |
| 34. | Borreria latifolia | - | - | 5.34 | 3.45 | 3.61 | 5.88 | - | 8.79 | 9.49 |
| 35. | Eupatorium odoratum | - | - | 1.75 | 3.45 | - | - | - | 5.20 | - |
| 36. | Mimosa invisa | - | - | 5.84 | 6.90 | - | - | - | 12.74 | - |
| 37. | Melastoma sp. | - | - | 1.17 | 3.45 | - | - | - | 4.62 | - |
| 38. | Fimbristis milliata | - | - | - | - | 2.81 | 2.94 | - | - | 5.75 |
| 39. | Commelia diffusa | - | - | - | - | 3.61 | 2.94 | - | - | 6.55 |
| 40. | Panicum repens | - | - | - | - | 4.01 | 5.88 | - | - | 9.89 |
| 41. | Paspalum dilatum | - | - | - | - | 1.61 | 2.94 | - | - | 4.55 |
| 42. | Pennisetum polystachyor | - | - | - | - | 2.41 | 2.94 | - | - | 5.35 |

Note:
1=Tetehosi village
2=Sitolumbanua village
3=Hilihoru village
R.I.=Relative Intensity
R.F.=Relative Frequency

# TABLE 8.3 SUMMARY OF BIOLOGICAL RESOURCES IN THE PROJECT ACTIVITY SITES

## BASIC VEGETATION AT PROPOSED WEIR SITE OF MEZAWA RIVER

| Species | RI (%) | RF (%) | IV (%) |
|---|---|---|---|
| 1. Dacryodes rostrata | 41.75 | 11.54 | 53.29 |
| 2. Coffea liforalia | 5.83 | 7.69 | 13.52 |
| 3. Coffea robusta | 2.91 | 7.69 | 10.60 |
| 4. Intsia palembanica | 7.77 | 11.54 | 19.31 |
| 5. Litsea resinosa | 5.83 | 11.54 | 17.37 |
| 6. Hiptis SP | 2.91 | 3.85 | 6.76 |
| 7. Stambosi javanica | 12.62 | 11.54 | 24.16 |
| 8. Eupatorium odoratum | 2.91 | 7.69 | 10.60 |
| 9. Erytrina orientalis | 0.74 | 11.54 | 12.28 |
| 10. Hevea brasiliensia | 1.94 | 3.85 | 5.79 |
| 11. Macarangadenticulate | 4.85 | 7.69 | 12.54 |
| 12. Melastonia melabatricum | 1.94 | 3.85 | 5.79 |

## BASIC VEGETATION OF POLE GROUP

| Species | RI (%) | RF (%) | IV (%) |
|---|---|---|---|
| 1. Coffea robusta | 8.82 | 11.11 | 19.93 |
| 2. Erytrina orientalis | 5.88 | 5.56 | 11.44 |
| 3. Calopyllum granditorum | 8.82 | 11.11 | 19.93 |
| 4. Intsia resinosa | 26.47 | 16.67 | 43.14 |
| 5. Hevea brasiliensis | 8.82 | 11.11 | 19.93 |
| 6. Macaranga denticulata | 5.88 | 11.11 | 16.99 |
| 7. Mussa paradisca | 20.59 | 11.11 | 31.70 |
| 8. Litsea velutira | 2.94 | 5.56 | 8.50 |
| 9. Calopyllum soulatri | 5.88 | 5.56 | 11.44 |
| 10. Artocarpres integra | 2.94 | 5.56 | 8.50 |
| 11. Polvosma sp. | 2.94 | 5.56 | 8.50 |

## BASIC VEGETATION OF PILLAR GROUP

| Species | RI (%) | RF (%) | IV (%) |
|---|---|---|---|
| 1. Hevea brasiliensis | 13.96 | 10.71 | 24.67 |
| 2. Erytrina oryentalis | 15.38 | 10.71 | 26.09 |
| 3. Calopyllum granditorum | 7.69 | 10.71 | 18.40 |
| 4. Nipa fructicans | 5.77 | 7.14 | 12.91 |
| 5. Fragrea ellephca | 7.68 | 7.14 | 14.83 |
| 6. Litsea resinosa | 5.77 | 7.14 | 12.91 |
| 7. Cannarium littorala | 11.54 | 7.14 | 18.68 |
| 8. Mangipen sp. | 5.77 | 10.71 | 16.48 |
| 9. Litsea velutire | 5.77 | 3.57 | 9.34 |
| 10. Endrian alsa sp. | 7.69 | 7.14 | 14.83 |
| 11. Adianandra desvanta | 3.46 | 3.57 | 7.03 |
| 12. Mallotus phillipensis | 3.46 | 7.14 | 10.60 |
| 13. Xanthopylum sp. | 1.82 | 3.57 | 5.39 |
| 14. Xanthopylum sp. | 3.46 | 3.57 | 7.03 |

## BASIC VEGETATION OF TREE GROUP

| Species | RI (%) | RF (%) | IV (%) |
|---|---|---|---|
| 1. Ormosia macrodisca | 15.00 | 14.09 | 29.09 |
| 2. Erytrina oryentalis | 15.00 | 14.29 | 29.29 |
| 3. Hevea brasiliensis | 20.00 | 21.43 | 41.43 |
| 4. Ormosa sp. | 15.00 | 14.29 | 29.29 |
| 5. Cocostrucifera | 10.00 | 7.14 | 17.14 |
| 6. Platea latifolia | 5.00 | 7.14 | 12.14 |
| 7. Mallotus phillipensis | 5.00 | 7.14 | 12.14 |
| 8. Durio sp. | 5.00 | 7.14 | 12.14 |
| 9. Xanthophyllum sp. | 5.00 | 7.14 | 12.14 |

Note:
RI = relative intensity
RF = relative frequency
IV = important value

## SEEDLING GROUP OF HOW FOREST

| Species | RI (%) | RF (%) | IV (%) |
|---|---|---|---|
| 1. Platea latifalia | 8.16 | 6.89 | 15.05 |
| 2. Pygeum parviflora | 2.04 | 3.45 | 5.49 |
| 3. Calamus javansis Bl. | 12.14 | 10.30 | 22.44 |
| 4. Shorea parfifolia | 2.04 | 3.45 | 5.49 |
| 5. Bana oyo puya | 6.12 | 3.45 | 9.57 |
| 6. Eugenia sp. | 2.04 | 3.45 | 5.49 |
| 7. Hopeasangal sp. | 4.08 | 3.45 | 7.53 |
| 8. Xamthophyllum sp. | 10.20 | 6.81 | 17.01 |
| 9. Calophylum soulatri | 2.04 | 3.45 | 5.49 |
| 10. Mangipera sp. | 2.04 | 3.45 | 5.49 |
| 11. Litsea resinosa | 4.08 | 3.45 | 7.53 |
| 12. Premna tomentosa | 8.16 | 10.34 | 18.50 |
| 13. Closiduou sp. | 6.12 | 6.89 | 13.01 |
| 14. Macaranga denticulata | 2.64 | 3.45 | 6.09 |
| 15. Endinandra sp. | 4.08 | 3.45 | 7.53 |
| 16. Endinandra sp./silanga | 8.16 | 6.89 | 15.05 |
| 17. Aporasa sp. | 6.12 | 3.45 | 9.57 |
| 18. Dillenia sp. | 8.10 | 13.79 | 21.89 |
| 19. Xanthophyllum sp. | 2.64 | 3.45 | 6.09 |

## POLE GROUP OF HOW FOREST

| Species | RI (%) | RF (%) | IV (%) |
|---|---|---|---|
| 1. Premna tomentosa | 11.11 | 5.56 | 16.67 |
| 2. Parkia sp. | 3.70 | 5.56 | 9.26 |
| 3. Carcenia celebica | 7.41 | 11.11 | 18.52 |
| 4. Calamus javansis Bl | 22.22 | 11.11 | 33.33 |
| 5. Macarangadesticalata | 7.41 | 5.56 | 12.97 |
| 6. Linociera sp. | 14.81 | 16.67 | 31.48 |
| 7. Linociera/efuse | 3.70 | 5.58 | 9.28 |
| 8. Dillenia sp. | 7.41 | 11.11 | 18.52 |
| 9. Mangipera sp. | 3.70 | 5.56 | 9.26 |
| 10. Shoneapartifolia | 7.41 | 11.11 | 18.52 |
| 11. Durio sp. | 3.70 | 5.56 | 9.26 |
| 12. Acinyia excisa | 7.41 | 5.56 | 12.97 |

## PILLAR GROUP OF HOW FOREST

| Species | RI (%) | RF (%) | IV (%) |
|---|---|---|---|
| 1. Callimus javansis Bl. | 12.50 | 17.69 | 30.19 |
| 2. Cuercus terbanate | 6.25 | 7.69 | 13.94 |
| 3. Barcinia celebia | 12.50 | 15.38 | 27.88 |
| 4. Batcinia celebia | 6.25 | 7.69 | 13.94 |
| 5. Adianamndra desvanta | 12.50 | 7.69 | 20.19 |
| 6. Timonius compresi | 6.25 | 7.69 | 13.94 |
| 7. Mavaltus phillipensi | 18.75 | 15.38 | 34.13 |
| 8. Ormosia macrodisca | 6.25 | 7.64 | 13.89 |
| 9. Hopes sangae | 12.50 | 15.38 | 27.88 |
| 10. Xanthophyllum sp. | 6.25 | 7.69 | 13.94 |

## TREE GROUP OF HOW FOREST

| Species | RI (%) | RF (%) | IV (%) |
|---|---|---|---|
| 1. Litsea resinosa | 9.09 | 11.11 | 20.20 |
| 2. Altingia excisa | 4.55 | 5.56 | 10.11 |
| 3. Durio sp. | 4.55 | 5.56 | 10.11 |
| 4. Sterculia sp. | 9.09 | 5.56 | 14.65 |
| 5. Timonius compresa | 4.55 | 5.56 | 10.11 |
| 6. Platea latifolia | 13.64 | 11.11 | 24.75 |
| 7. Cuercus terbinate | 13.69 | 16.67 | 30.36 |
| 8. Movaltus phillipensis | 4.55 | 5.56 | 10.11 |
| 9. Movaltus phillipensis | 4.09 | 5.56 | 9.65 |
| 10. Garcinia celebica | 9.09 | 5.56 | 14.65 |
| 11. Cartoxicon sp. | 9.09 | 5.56 | 14.65 |
| 12. Xanthophyllum sp. | 4.55 | 5.56 | 10.11 |
| 13. Ormosia macrodisca | 4.55 | 5.56 | 10.11 |

## SPECIES OF AVES

| Species | Location 1 | 2 | 3 | 4 | Status |
|---|---|---|---|---|---|
| 1. Domicella-domicella | + | + | + | + | P |
| 2. Lonchura maja | + | + | + | - | UR |
| 3. Aviceda kuphotes | + | + | + | + | UP |
| 4. Eqretta sp. | + | + | + | + | P |
| 5. Pelargopsis capensis | + | + | + | + | UP |
| 6. Ruka-ruak | + | + | + | - | UP |
| 7. Passer montanus | + | + | + | - | UP |
| 8. Callocalia vestica | + | + | + | - | UP |
| 9. Cairrive sculata | + | + | + | - | UP |
| 10. Otus sp. | + | + | + | + | UP |
| 11. Arborophila fubitris | + | + | + | - | UP |
| 12. Antracnceros sormotatus | + | + | + | + | P |
| 13. Treros sp. | + | + | + | + | UP |
| 14. Psittacula alecandripeinca | + | + | + | + | P |
| 15. Picusrienceus reasensis | + | - | + | + | P |
| 16. Copucus soularis | + | - | - | + | P |
| 17. Elaus hipolencus | + | + | + | + | P |
| 18. Loriculus galgulus | + | + | - | + | P |
| 19. Ixobryelus sinensis | + | + | - | + | P |
| 20. Ludynamis caloptreris | + | + | + | + | UP |
| 21. Egnitta sp. | + | + | + | + | P |
| 22. Empirit loncuranticulate | - | + | - | + | UP |
| 23. Graculla religiosarobusta | + | + | + | + | P |
| 24. Rhinocopus sp. | + | + | + | + | UP |
| 25. Numenius phaeopus | + | + | + | - | P |

## SPECIES OF MAMALIA, REPTIL AND AMPHIBIA

| Species | Location 1 | 2 | 3 | 4 | Status |
|---|---|---|---|---|---|
| 1. Munticus munjak | - | + | + | + | P |
| 2. SUS scrofa | + | + | + | + | UR |
| 3. Timias concolor | + | + | + | + | UP |
| 4. Macco fascicularis | + | + | + | + | P |
| 5. Tricastoma vander bilti | + | + | + | - | UP |
| 6. Mustel hamluri | + | + | + | - | UP |
| 7. Zoocys carinatus | + | + | + | + | UP |
| 8. Tenggiling | + | + | + | + | UP |
| 9. Pythonretivulatus | + | + | + | + | UP |
| 10. Rhino lopus sp. | + | + | + | + | UP |
| 11. Callus ecunes sp. | + | + | + | - | UP |
| 12. Rattus | + | + | + | + | P |
| 13. Crocodylus novabguinavo | - | - | + | - | UP |
| 14. Bufo asper | + | + | + | + | P |

Note:
Location 1 = Tetehosi village
Location 2 = Siofabanua village
Location 3 = Hili horu village
Location 4 = How forest

## SPECIES OF FITOPLANKTON

| Species | Location 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Tabellaria | 4 | 3 | 3 | 4 |
| 2. Mycrocytis | 5 | 3 | 4 | 6 |
| 3. Thorea | 3 | 5 | - | 3 |
| 4. Trfbonema | 5 | - | 3 | 6 |
| 5. Nostoc | 4 | 10 | 2 | 3 |
| 6. Eruciqenia | 1 | - | - | 2 |
| 7. Zygnema | 7 | 6 | - | 6 |
| 8. Surirella | 2 | 2 | - | 4 |
| 9. Protococcus | 4 | 3 | 3 | 8 |
| 10. Synedra | 2 | 5 | - | 4 |
| 11. Clamidomonas | 2 | 6 | - | - |
| 12. Monostroma | - | 4 | - | - |
| 13. Hormindium | - | 2 | 7 | - |
| 14. Oocytis | - | 4 | - | 2 |
| 15. Triponema | - | 6 | - | - |
| 16. Aphaxizonenon | - | - | 4 | 8 |
| 17. Mengatia | - | - | 3 | 2 |
| 18. Dedogonium | - | - | 3 | 2 |
| 19. Anketrodermis | - | - | 5 | 6 |
| Index of varieties | 0.99 | 1.07 | 0.97 | 1.13 |
| Species of abundance | 11 | 13 | 10 | 15 |
| Individual abundance | 39 | 59 | 37 | 66 |

## SPECIES OF ZOOPLANKTON

| Species | Location 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Rotifera | 3 | - | 6 | - |
| 2. Stentor | 2 | 7 | 4 | - |
| 3. Loxedes | 4 | - | 3 | 2 |
| 4. Euricerus | 3 | - | - | 3 |
| 5. Macrptrix | 2 | - | - | - |
| 6. Melicerta | 2 | - | 4 | 1 |
| 7. Chilo monas | 4 | - | 3 | 1 |
| 8. Dhirella | 2 | 4 | 3 | 3 |
| 9. Amphileptus | 4 | - | 2 | 4 |
| 10. Halteria | 2 | 3 | - | 2 |
| 11. Chilidomonas | - | 3 | - | - |
| 12. Frontoria | - | 2 | 2 | 3 |
| 13. Synchaeta | - | 1 | 1 | 2 |
| 14. Polyphemus | - | 2 | 4 | - |
| 15. Conchohilus | - | - | 3 | - |
| 16. Floculario | - | - | 5 | - |
| Index of varieties | 0.98 | 0.77 | 1.04 | 0.92 |
| Species of abundance | 10 | 7 | 12 | 9 |
| Individual abundance | 28 | 24 | 40 | 21 |

## SPECIES OF BENTHOS

| Species | Location 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Tuberfedm | 2 | - | - | - |
| 2. Oligochaeta | 3 | 1 | 2 | - |
| 3. Chenonomus | 1 | - | - | 1 |
| 4. Balanus | - | - | 2 | 1 |
| 5. Copepoda | 2 | - | 1 | 3 |
| 6. Patella sp. | - | - | 1 | 2 |

Note:
Location 1 = Mezawa river
Location 2 = Mola river
Location 3 = How river
Location 4 = Susuwa river

TABLE 8.4 FLORA SPECIES IN THE STUDY AREA

| NO. | Species | Tetehosi | | Sitolubauna | | Dahana Bawolato | | Hilihoru | | Important Value(%) | | | | Classification |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | RI(%) | RF(%) | RI(%) | RF(%) | RI(%) | RF(%) | RI(%) | RF(%) | Tetehosi | Sitolubanua | Dahana | Hilihoru | |
| 1 | Cocos nucifers | 28.50 | 10.61 | 21.97 | 7.78 | 36.48 | 10.53 | 27.64 | 9.68 | 39.11 | 29.75 | 47.01 | 37.32 | PC |
| 2 | Arenga catechu | 7.39 | 8.33 | 7.38 | 5.39 | 14.66 | 7.02 | 7.45 | 8.60 | 15.72 | 12.77 | 21.68 | 16.05 | PC |
| 3 | Carica papaya | 1.32 | 3.03 | 0.35 | 0.60 | 1.95 | 3.52 | 2.80 | 5.38 | 4.35 | 0.95 | 5.47 | 8.18 | PC |
| 4 | Mehgipera indica | 2.11 | 6.30 | 1.58 | 3.59 | 2.28 | 3.52 | 2.48 | 3.23 | 8.41 | 5.17 | 5.80 | 5.71 | PC |
| 5 | Artocarpus integra | 1.32 | 3.78 | 4.92 | 7.19 | - | - | - | - | 5.10 | 12.11 | - | - | PC |
| 6 | Mgssa paradisiace | 16.36 | 6.82 | 8.26 | 5.99 | 20.52 | 7.89 | 13.04 | 7.53 | 23.18 | 14.25 | 28.41 | 20.57 | PC |
| 7 | Lansium domesticum | 0.53 | 1.52 | 0.53 | 1.20 | 0.97 | 2.64 | 1.24 | 3.23 | 2.05 | 1.73 | 3.61 | 4.47 | PC |
| 8 | Acctoria schloaria | 0.26 | 0.76 | - | - | - | - | - | - | 1.02 | - | - | - | PC |
| 9 | Anona muricata | 3.96 | 6.82 | 2.11 | 1.80 | 0.98 | 2.63 | 1.86 | 5.38 | 10.78 | 3.91 | 3.61 | 7.24 | PC |
| 10 | Averhona muricata | 1.06 | 3.03 | 1.41 | 1.80 | 1.64 | 3.51 | 1.55 | 3.23 | 4.09 | 3.21 | 5.15 | 4.78 | PC |
| 11 | Hibiscus rosasinesis | 0.79 | 1.52 | 0.53 | 1.20 | - | - | - | - | 2.31 | 1.73 | - | - | FP |
| 12 | Coffea robusta | 1.85 | 3.79 | 2.46 | 2.40 | - | - | - | - | 5.64 | 4.86 | - | - | PC |
| 13 | Havea brasiliensis | 4.22 | 2.27 | 2.81 | 5.39 | - | - | - | - | 6.49 | 8.20 | - | - | PC |
| 14 | Ceiba petandra | 0.79 | 1.52 | 1.76 | 4.19 | 1.30 | 2.63 | 1.86 | 4.30 | 2.31 | 5.95 | 3.93 | 6.16 | PC |
| 15 | Eugenia aquatica | 2.11 | 3.79 | 0.35 | 1.20 | 2.28 | 2.63 | 1.55 | 4.30 | 5.90 | 1.55 | 4.91 | 5.85 | PC |
| 16 | Psidium gufara | 0.79 | 2.27 | 0.53 | 1.20 | - | - | 2.17 | 4.30 | 3.06 | 1.73 | - | 6.47 | PC |
| 17 | Sacharum officinarum | 4.22 | 2.78 | 4.34 | 2.40 | 16.29 | 6.14 | 7.78 | 3.23 | 7.00 | 6.74 | 22.43 | 11.01 | PC |
| 18 | Bambusa sp. | B | 1.52 | B | 1.80 | B | 2.63 | B | 5.38 | - | - | - | - | PC |
| 19 | Curcuma domestica | 5.54 | 2.27 | 4.39 | 2.40 | 8.14 | 3.51 | 9.63 | 6.45 | 7.81 | 6.79 | 11.65 | 16.08 | CD |
| 20 | Erytrina orientalis | 1.06 | 3.03 | 2.64 | 3.60 | 3.91 | 6.14 | 1.55 | 3.23 | 4.09 | 6.24 | 10.05 | 4.78 | SF |
| 21 | Citrus sinensis | 0.79 | 1.52 | 1.58 | 3.60 | - | - | - | - | 2.31 | 5.18 | - | - | PC |
| 22 | Citrus aurantifolia | 1.32 | 3.79 | 0.70 | 1.80 | 1.31 | 3.50 | - | - | 5.11 | 2.50 | 4.81 | - | PC |
| 23 | Nephelium lappaceum | 1.85 | 4.55 | 1.23 | 1.80 | - | - | - | - | 6.40 | 3.03 | - | - | PC |
| 24 | Hydropogon citratus | 2.38 | 1.52 | 2.64 | 1.80 | - | - | - | - | 3.90 | 4.44 | - | - | CD |
| 25 | Sinningia speciosa | 1.32 | 1.52 | - | - | 1.63 | 3.51 | - | - | 2.84 | - | 5.14 | - | FP |
| 26 | Durio zibetinus | 1.58 | 3.79 | 0.53 | 1.20 | 1.96 | 4.39 | 0.93 | 3.23 | 5.37 | 1.73 | 6.35 | 4.16 | PC |
| 27 | Ricinus communis | 0.53 | 0.76 | - | - | - | - | - | - | 1.29 | - | - | - | SF |
| 28 | Ceunamomum zeylanida | 0.26 | 0.76 | 0.53 | 1.80 | - | - | - | - | 1.02 | 2.33 | - | - | SF |
| 29 | Persea fx americana | 0.79 | 2.27 | 1.93 | 2.40 | - | - | - | - | 3.06 | 4.33 | - | - | PC |
| 30 | Solanum melongena | 4.49 | 4.55 | 2.64 | 2.40 | - | - | 4.04 | 5.38 | 9.04 | 5.04 | - | 9.42 | CD |
| 31 | Culeenus sativus | 0.53 | 6.76 | 0.35 | 0.60 | - | - | - | - | 7.29 | 0.95 | - | - | CD |
| 32 | Spondias pinnata | - | - | 0.88 | 2.40 | - | - | - | - | - | 3.28 | - | - | PC |
| 33 | Musaenda sp. | - | - | 0.18 | 0.60 | - | - | - | - | - | 0.78 | - | - | SF |
| 34 | Eugenia malaccusis | - | - | 0.35 | 1.20 | - | - | - | - | - | 1.55 | - | - | PC |
| 35 | Eugenia aromatica | - | - | 0.53 | 1.20 | - | - | - | - | - | 1.73 | - | - | PC |
| 36 | Caladium bicolor vent | - | - | 0.87 | 1.20 | - | - | - | - | - | 2.07 | - | - | FP |
| 37 | Manihot utilisima | - | - | 11.07 | 5.39 | B | 3.51 | 8.65 | 4.30 | - | 16.46 | - | 12.95 | CD |
| 38 | Jatrova carlos | - | - | 1.23 | 2.40 | - | - | B | 5.00 | - | 3.63 | - | - | SF |
| 39 | Ipomea batatas | - | - | B | 1.20 | B | 4.39 | - | - | - | - | - | - | SF |
| 40 | Alpinia galanga | - | - | 3.34 | 4.19 | 6.18 | 4.38 | - | - | - | 7.53 | 10.56 | - | CD |
| 41 | Hibiscue tiliances | - | - | 0.35 | 1.20 | - | - | - | - | - | 1.55 | - | - | SF |
| 42 | Acacia sp. | - | - | 0.18 | 0.60 | - | - | - | - | - | 0.78 | - | - | SF |
| 43 | Rimbang | - | - | - | - | 0.33 | 0.87 | - | - | - | - | 1.20 | - | CD |
| 44 | Mangipera | - | - | - | - | 0.65 | 1.75 | 0.62 | 2.15 | - | - | 2.40 | 2.77 | PC |
| 45 | Tepeti | - | - | - | - | 0.97 | 2.63 | - | - | - | - | 3.60 | - | FP |
| 46 | Clocasium esculentum | - | - | - | - | 4.23 | 4.38 | 3.11 | 2.15 | - | - | 8.61 | 5.26 | CD |
| 47 | Mussa sp. | - | - | - | - | 0.65 | 1.75 | - | - | - | - | 2.40 | - | FP |

Note:RI=relative intensity, RF=relative frequency, PC=Productive Crops, CD=Crops for domestic consumption, SF=Shade Flora, FP=Flowering plant

TABLE 8.5 RESULTS OF PARTICIPATION SURVEY

| Items | | No. of farmer | Percentage(%) |
|---|---|---|---|
| I.KNOWLEDGE ABOUT THE PROPOSED PROJECT | | | |
| 1.1 | Never heard of | 0 | 0.0 |
| 1.2 | Have heard of but do not know the purpose | 5 | 8.3 |
| 1.3 | Have heard of and know the purpose | 55 | 91.7 |
| II.UNDERSTANDING OF PROJECT TARGET | | | |
| 2.1 | Only government policy | 0 | 0.0 |
| 2.2 | Increase of farm income | 59 | 98.3 |
| 2.3 | Nothing | 1 | 1.7 |
| III.PARTICIPATION OF LOCAL PEOPLE | | | |
| 3.1 | Land Release | | |
| 1) | Will provide without any compensation | 0 | 0.0 |
| 2) | Will provide with adequate compensation payment | 58 | 96.7 |
| 3) | Can not decide | 2 | 3.3 |
| 3.2 | Cooperation for the Project | | |
| 1) | Will cooperate during construction | 60 | 100.0 |
| 2) | Will not cooperate with Project | 0 | 0.0 |
| 3.3 | Performance of double cropping of paddy cultivation | | |
| 1) | Will perform | 57 | 95.0 |
| 2) | Will not perform | 0 | 0.0 |
| 3) | Can not decide | 3 | 5.0 |
| 3.4 | Performance of maintenance of irrigation systems | | |
| 1) | Will perform | 56 | 93.3 |
| 2) | Not our responsibility | 1 | 1.7 |
| 3) | Can not decide | 3 | 5.0 |
| 3.5 | Participation with P3A | | |
| 1) | Will participate in | 57 | 95.0 |
| 2) | Will not participate in | 1 | 1.7 |
| 3) | Can not decide | 2 | 3.3 |
| IV.OTHER ON FARM ACTIVITIES UNDER IRRIGATION | | | |
| 4.1 | Inland fishery at farm pond | 49 | 81.7 |
| 4.2 | Sell the land | 0 | 0.0 |
| 4.3 | Working at other farmer's field | 11 | 18.3 |
| V.ATTITUDE TO NEW COMMER | | | |
| 5.1 | Good | 60 | 100.0 |
| 5.2 | Not good | 0 | 0.0 |
| 5.3 | Hostility | 0 | 0.0 |
| VI.EXPECTATION OF INCREASE OF INCOME LEVEL | | | |
| 6.1 | Yes | 60 | 100.0 |
| 6.2 | No | 0 | 0.0 |
| VII.PERFORMANCE OF PROPOSED FARMING PRACTICE | | | |
| 7.1 | Yes | 53 | 88.3 |
| 7.2 | No | 0 | 0.0 |
| 7.3 | Can not decide | 7 | 11.7 |

TABLE 8.6 EVALUATION CRITERIA FOR PROJECT IMPACTS

| Importance of impact | Class | Evaluation Criteria | Necessity of countermeasure (Negative impacts) | Evaluation of Benefit (Positive impacts) |
|---|---|---|---|---|
| Not so important | (a) | Spread of impact is very limited compared with the scale of the project area, tolerance capacity of the environment against the impact is very high and impact proceeds within a very short time. | basically no/ proposal of regulation for project performances, if any | intangible benefit |
| Important enough | (b) | Spread of impact is limited compared with the scale of the project area, tolerance capacity of the environment against the impact is comparatively low. | preparation of regulation for project performances /discussion with local people | intangible benefit |
| Important | (c) | Spread of impact is substantially wide, tolerance capacity of the environmental against impact is decreasing. Direct impact is substantially in a long time. | further study for countermeasure | tangible benefit |
| More important | (d) | Spread of impact is wide, tolerance capacity against impact is low and the impact is proceeding in a long time. | costs for countermeasure should be estimated for evaluation | tangible benefit |
| Most important | (e) | Spread of impact is very wide, tolerance capacity against impact is very low and the impact is proceeding in a very long time. | development plan should be re-formulated | tangible benefit |

Note;classification of the project impacts is made based on the field survey and collection of data and information.

Table 8.7IMPACT EVALUATION OF THE PROJECT ACTIVITIES

| Environmental Matrix/Impacts | PRE-CONSTRUCTION | | | | CONSTRUCTION STAGE | | | | | | | | OPERATION AND MAINTENANCE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Survey Area | Area marking | Land release | Removal of people | Mobilisation of materials and heavy equipment | Mobilization of man power | Opening and cleaning land | Construction of access road | Construction of weir | Excavation and transportation of materials | Construction of drainage ditches | Construction and operation of base camp | Operation of weir | Agricultural extensification | Agricultural intensification | Water management |
| I. PHYSICO-CHEMICAL | | | | | | | | | | | | | | | | |
| Climate/noise | | | | | (-)a | | (-)a | | | | | | | | | |
| Physiography/geology | | | | | | | | | | | | | | | | |
| Hydrology | | | | | | | (-)a | | (-)a | | (-)a | | (-)a | (-)a | (-)a | |
| Water quality(river) | | | | | | (-)a | (-)a | (-)a | (-)a | (-)a | (-)a | (-)a | (-)a | (-)a | (-)a | (-)a |
| Water quality(well) | | | | | | (-)a | (-)a | | | | | (-)a | | | | |
| Soil and land use | | | (+)a | | (-)a | | (-)a | (-)a | (-)a | (-)a | (-)a | | | (+)b | (+)b | |
| II. BIOLOGY | | | | | | | | | | | | | | | | |
| Flora | (-)a | (-)a | | | | | (-)a | (-)a | (-)a | | (-)a | | | (-)a | (-)a | |
| Fauna | | | | | | (-)a | (-)a | | | | | | | (-)a | (-)a | |
| Aquatic biota | | | | | | (-)a | (-)a | | | | (-)a | (-)a | | (-)a | (-)a | |
| III. SOCIO-ECONOMY | | | | | | | | | | | | | | | | |
| Income level | (+)b | | (+)b | | | (+)c | (+)c | (+)c | (+)b | (+)b | (+)b | (+)b | | (+)d | (+)d | |
| Labor absorption | (+)b | | | | | (+)c | (+)b | (+)d | (+)b | (+)b | (+)b | (+)b | | (+)d | (+)d | |
| Perception of local people | (+)b | (+)c | (+)d | (+)b | (+)c | (+)c | (+)d | (+)c | (+)b | (+)b | (+)c | (+)c | | (+)d | (+)d | (+)c |
| Transportation | | | | | (-)a | (+)c | | (+)c | | (-)a | | (+)c | | | | |
| Social problems/conflicts | | | (-)b | (-)b | | (-)a | (+)b | (-)a | | | (-)a | (-)a | | (-)a | (-)a | (-)a |
| Housing | | | | | | | | | | | | | | (+)b | (+)b | |
| Socio-cultural organization | | | | | | (+)b | | | | | | (+)b | | (+)b | (+)b | |
| Formal/non-formal institution | | | (+)c | (+)b | | (+)b | (+)b | | | | (+)b | (+)b | | (+)b | (+)b | (+)b |

Note:
a:not so important
b=important enough
c=important
d=more important
e=most important
- =negative impact
+ =positive impact

TABLE 8.8 PROPOSED SOLUTION FOR NEGATIVE IMPACT OF THE MEZAWA/HOW IRRIGATION PROJECT

| Predicted Negative Impacts by the Project | Environmental Category | Objective Aspects | Implementation Stage of the Project | Reason of occure | Evaluation Class | Proposed Solution (Implementation of project activity) | Environment management and monitoring |
|---|---|---|---|---|---|---|---|
| 1. Social conflicts | Socio-cultural/ economy | Local people | Pre-construction | Land release | (-b) | Land cadastral survey, Clarification of boundary | guidance of project target for local people land holding size survey |
| | | | | Removal of people | (-b) | Adequate compensation | resettlement plan |
| | | | Construction | Mobilization of labor | (-a) | Settlement of project worker in the particular location | proper management of project worker |
| 2. Disappearence of biological resources | Biology | Fauna/ Flora | Pre-construction | Site survey | (-a) | Prohibition of fauna/flora catching | supervision of construction works |
| | | | Construction | Opening & Clearing land | (-a) | Confirmation of existence of conservancy resources | site observation |
| | | | | Construction of related facilities | (-a) | Regulation of construction performances | supervision of construction works |
| 3. Increase of noise level | Physical Impacts | Noise | Construction | Mobilization of materials and heavy equipments | (-a) | Regulation of motor speed | supervision of construction works |
| | | | | Construction of weir/canal/access roads | (-a) | Regulation of operation hour/time | supervision of construction works |
| | | | | Opening & clearing land | (-a) | Regulation of performances | supervision of construction works |
| 4. Deteriolation of water quality | Physico-chemical impacts | River water | Construction | Mobilization of heavy equipments | (-a) | Decision of proper site for installation of heavy equipments | check of water turbidity |
| | | | | Opening & clearing land | (-a) | Regulation of land clearing works | check of water quality |
| | | | | Construction of weir | (-a) | Decision of adequate weir site | check of river turbidity/flow |
| | | | | Construction of irrigation facilities | (-a) | Regulation of drainage water quality | check of water quality |
| | | | O & M stage | Utilization of Farm inputs | (-a) | Proper farming practices, Regulation of agro-chemical application | check of water quality |
| | | Well water | Construction | Operation of base camp | (-a) | Regulation of drainage water quality/proper drainage | check of water quality |
| | | | | Mobilization of man power | (-a) | Regulation of drainage water quality/proper drainage | check of water quality |
| | | | O & M stage | Utilization of fertilizer and agro-chemicals | (-a) | Proper farming practices, Regulation of agro-chemical application, Protection of well water from chemicals | check of water quality and health |
| 5. Land slide/erosion | Physical impact | Slope stability | Construction | Mobilization of heavy equipments | (-a) | Regulation of load weight/ motor speed | check of river water turbidity |
| | | Soil erosion | Construction | Opening and clearing land | (-a) | Proper land use plan regulation of land clearing works Re-forestation/re-vegetation | check of river water turbidity |
| | | | | Construction of irrigation facilities | (-a) | Regulation of excavation works, proper work schedule based on the weather condition | check of river water turbidity |
| 6. Sedimentation | Physical impact | River water | Construction | Construction of weir | (-a) | Proper site decision of weir | check of sedimentation |
| | | | | Opening and clearing land | (-a) | Soil conservation/re-vegetation along river | check of sedimentation |
| 7. Change in river flow | Physical impact | River flow | Construction | Construction of weir | (-a) | Inform construction schedule for water user in down stream area | Observation of river flow |
| | Socio-cultural/ economy | Farmer | O & M stage | Increase of Cropping Intensity | (-a) | Adequate water management system planned irrigation water utilization | Observation of river flow |
| 8. Unstable water supply | Socio-cultural/ economy | people in downstream | Construction | Construction of weir | (-a) | Minimization of fluctuation of river discharge by proper design of weir | Observation of river flow |

Table 9.1 PROJECT COST OF MEZAWA/HOW IRRIGATION PROJECT

| | Cost Item | Mezawa | | | Mola | | | How | | | Susuwa | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | F/C (1,000US$) | L/C (Rp.mill.) | Total (Rp.mill.) | F/C (1,000US$) | L/C (Rp.mill.) | Total (Rp.mill.) | F/C (1,000US$) | L/C (Rp.mill.) | Total (Rp.mill.) | F/C (1,000US$) | L/C (Rp.mill.) | Total (Rp.mill.) | F/C (1,000 US$) | L/C (Rp.million) | Total (Rp.million) |
| **I** | **Detailed Design** | **27** | **88** | **139** | **147** | **418** | **690** | **89** | **200** | **365** | **682** | **1,511** | **2,773** | **946** | **2,217** | **3,968** |
| **II** | **Land Acquisition** | **0** | **120** | **120** | **0** | **790** | **790** | **0** | **260** | **260** | **0** | **1,500** | **1,500** | **0** | **2,670** | **2,670** |
| **III** | **Construciton Cost** | | | | | | | | | | | | | | | |
| 1 | Direct Construction Cost | | | | | | | | | | | | | | | |
| | 1) General Items | 36 | 115 | 181 | 191 | 542 | 896 | 67 | 169 | 292 | 559 | 1,375 | 2,409 | 852 | 2,201 | 3,778 |
| | 2) Intake Weir | 74 | 262 | 399 | 170 | 561 | 875 | 108 | 372 | 572 | 205 | 726 | 1,105 | 557 | 1,921 | 2,950 |
| | 3) Irrigation Canals | 155 | 460 | 747 | 1,256 | 3,531 | 5,854 | 376 | 963 | 1,659 | 4,067 | 9,712 | 17,237 | 5,854 | 14,666 | 25,497 |
| | 4) Drainage Canals | 40 | 188 | 262 | 111 | 434 | 639 | 43 | 49 | 128 | 255 | 921 | 1,393 | 449 | 1,592 | 2,422 |
| | 5) Farm Roads | 34 | 87 | 149 | 103 | 110 | 301 | 26 | 28 | 75 | 288 | 561 | 1,093 | 450 | 786 | 1,619 |
| | 6) On-farm Development | 52 | 151 | 248 | 274 | 787 | 1,294 | 114 | 279 | 490 | 772 | 1,833 | 3,260 | 1,212 | 3,050 | 5,292 |
| | 7) IACC | | | | | | | | | | | | | 6 | 37 | 48 |
| | Sub Total | 391 | 1,264 | 1,986 | 2,105 | 5,965 | 9,858 | 733 | 1,859 | 3,215 | 6,146 | 15,128 | 26,497 | 9,380 | 24,252 | 41,605 |
| 2 | Contingencies | | | | | | | | | | | | | | | |
| | 1) Physical Contingency (15%) | 59 | 190 | 298 | 316 | 895 | 1,479 | 110 | 279 | 482 | 922 | 2,269 | 3,975 | 1,407 | 3,638 | 6,241 |
| | 2) Price Contingency | | | | | | | | | | | | | | | |
| | Sub Total | 59 | 190 | 298 | 316 | 895 | 1,479 | 110 | 279 | 482 | 922 | 2,269 | 3,975 | 1,407 | 3,638 | 6,241 |
| 3 | Total for Item 1&2 | 449 | 1,453 | 2,284 | 2,420 | 6,860 | 11,337 | 843 | 2,138 | 3,698 | 7,067 | 17,397 | 30,472 | 10,787 | 27,890 | 47,846 |
| 4 | Tax on Civil Works, VAT (10%) | 45 | 145 | 228 | 242 | 686 | 1,134 | 84 | 214 | 370 | 707 | 1,740 | 3,047 | 1,079 | 2,789 | 4,785 |
| | **Total for Item III** | **494** | **1,598** | **2,512** | **2,662** | **7,546** | **12,471** | **927** | **2,352** | **4,067** | **7,774** | **19,137** | **33,519** | **11,866** | **30,679** | **52,631** |
| **IV** | **O&M Equipment** | **49** | **2** | **93** | **255** | **12** | **484** | **79** | **4** | **150** | **514** | **23** | **974** | **897** | **41** | **1,700** |
| **V** | **Engineering Services** | **39** | **126** | **199** | **210** | **596** | **986** | **73** | **186** | **322** | **615** | **1,513** | **2,650** | **938** | **2,425** | **4,161** |
| **VI** | **Administration Cost** | **12** | **38** | **60** | **63** | **179** | **296** | **22** | **56** | **96** | **184** | **454** | **795** | **281** | **728** | **1,248** |
| **VII** | **Training Program** | **0** | **14** | **14** | **0** | **71** | **71** | **0** | **22** | **22** | **0** | **143** | **143** | **0** | **250** | **250** |
| | **GRAND TOTAL** | **621** | **1,987** | **3,137** | **3,338** | **9,612** | **15,787** | **1,191** | **3,079** | **5,283** | **9,769** | **24,281** | **42,354** | **14,928** | **39,010** | **66,628** |

Table 9.2 PRINCIPAL FEATURES OF THE ALTERNATIVE DEVELOPMENT PROJECT

| | Description | Mezawa System | Mola System | How System |
|---|---|---|---|---|
| 1 | Net irrigable area | 280 ha | 1,450 ha | 450 ha |
| 2 | Water Source | Mezawa river | Mola river | How river |
| 3 | Project Works | | | |
| | 1) Diversion weir | Fixed weir (with Intake & Sand settling basin, Intake) discharge Q=0.41m3/s) | Fixed weir (with Intake & Sand settling basin, Intake) discharge Q=2.16m3/s) | Fixed weir (with Intake & Sand settling basin, Intake) discharge Q=0.67m3/s) |
| | 2) Main & secondary canals (Open canal with masonry lining) | 5.3 km in total | 32.2 km in total | 8.5 km in total |
| | 3) Drainage canal (Rehabilitation of existing rivers/streams) | 4 km in total | 39.8 km in total | 5 km in total |
| | 4) Farm road network | 6.8 km in total (Rehabilitation 5 km, New 1.8km) | 42 km in total (Rehabilitation 10 km New 32 km) | 11 km in total (Rehabilitation 8.5 km, New 2.5 km) |
| | 5) On-farm facilities | 280 ha (50 ha newly developed) | 1,450 ha (300 ha newly developed) | 450 ha (270 ha newly developed) |

Table 9.3 PROJECT COST FOR ALTERNATIVE DEVELOPMENT PROJECT

| | Cost Item | Mezawa | | | Mola | | | How | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | F/C (1,000US$) | L/C (Rp.mill.) | Total (Rp.mill.) | F/C (1,000US$) | L/C (Rp.mill.) | Total (Rp.mill.) | F/C (1,000US$) | L/C (Rp.mill.) | Total (Rp.mill.) | F/C (1,000 US$) | L/C (Rp.million) | Total (Rp.million) |
| **I** | **Detailed Design** | **29** | **93** | **147** | **106** | **321** | **517** | **89** | **200** | **365** | **224** | **614** | **1,029** |
| **II** | **Land Acquisition** | **0** | **140** | **140** | **0** | **550** | **550** | **0** | **260** | **260** | **0** | **950** | **950** |
| **III** | **Construciton Cost** | | | | | | | | | | | | |
| 1 | Direct Construction Cost | | | | | | | | | | | | |
| | 1) General Items | 38 | 121 | 191 | 138 | 417 | 672 | 67 | 169 | 293 | 243 | 707 | 1,156 |
| | 2) Intake Weir | 74 | 262 | 399 | 170 | 561 | 875 | 108 | 372 | 572 | 351 | 1,196 | 1,846 |
| | 3) Irrigation Canals | 174 | 523 | 845 | 531 | 1,687 | 2,670 | 376 | 963 | 1,659 | 1,081 | 3,173 | 5,174 |
| | 4) Drainage Canals | 40 | 188 | 262 | 256 | 972 | 1,446 | 43 | 49 | 129 | 339 | 1,210 | 1,837 |
| | 5) Farm Roads | 36 | 89 | 156 | 145 | 156 | 424 | 26 | 28 | 76 | 207 | 273 | 656 |
| | 6) On-farm Development | 52 | 151 | 248 | 277 | 791 | 1,303 | 114 | 279 | 490 | 443 | 1,221 | 2,041 |
| | 7) IACC | | | | | | | | | | 6 | 37 | 48 |
| | Sub Total | 414 | 1,336 | 2,102 | 1,517 | 4,584 | 7,390 | 733 | 1,859 | 3,215 | 2,671 | 7,816 | 12,758 |
| 2 | Contingencies | | | | | | | | | | | | |
| | 1) Physical Contingency (15%) | 62 | 200 | 315 | 228 | 688 | 1,109 | 110 | 279 | 482 | 401 | 1,172 | 1,914 |
| | Sub Total | 62 | 200 | 315 | 228 | 688 | 1,109 | 110 | 279 | 482 | 401 | 1,172 | 1,914 |
| 3 | Total for Item 1&2 | 476 | 1,536 | 2,417 | 1,744 | 5,271 | 8,499 | 843 | 2,138 | 3,697 | 3,072 | 8,989 | 14,671 |
| 4 | Tax on Civil Works, VAT (10%) | 48 | 154 | 242 | 174 | 527 | 850 | 84 | 214 | 370 | 307 | 899 | 1,467 |
| | **Total for Item III** | **524** | **1,689** | **2,658** | **1,919** | **5,799** | **9,349** | **927** | **2,352** | **4,067** | **3,379** | **9,888** | **16,138** |
| **IV** | **O&M Equipment** | **85** | **4** | **161** | **440** | **20** | **834** | **79** | **4** | **150** | **604** | **28** | **1,145** |
| **V** | **Engineering Services** | **41** | **134** | **210** | **152** | **458** | **739** | **73** | **186** | **322** | **267** | **782** | **1,276** |
| **VI** | **Administration Cost** | **12** | **40** | **63** | **46** | **138** | **222** | **22** | **56** | **96** | **80** | **234** | **383** |
| **VII** | **Training Program** | **0** | **13** | **13** | **0** | **72** | **72** | **0** | **22** | **22** | **0** | **107** | **107** |
| | **GRAND TOTAL** | **692** | **2,114** | **3,393** | **2,662** | **7,357** | **12,283** | **1,191** | **3,079** | **5,283** | **4,554** | **12,603** | **21,028** |

Table 9.4 ECONOMIC COST OF THE ALTERNATIVE DEVELOPMENT PROJECT

| | Cost Item | F/C (1,000 US$) | L/C (Rp.million) | Total (Rp.million) |
|---|---|---|---|---|
| **I** | **Detailed Design** | **224** | **522** | **936** |
| **II** | **Land Acquisition** | **0** | **808** | **808** |
| **III** | **Construciton Cost** | | | |
| 1 | Direct Construction Cost | | | |
| | 1) Mezawa river system | 414 | 1,136 | 1,902 |
| | 2) Mola river system | 1,517 | 3,896 | 6,703 |
| | 3) How river system | 733 | 1,580 | 2,936 |
| | 4) IACC | 6 | 31 | 42 |
| | Sub Total | 2,670 | 6,643 | 11,583 |
| 2 | Contingencies | | | |
| | 1) Physical Contingency (15%) | 401 | 996 | 1,737 |
| | **Total for Item III** | **3,071** | **7,640** | **13,320** |
| **IV** | **O&M Equipment** | **604** | **24** | **1,141** |
| **V** | **Engineering Services** | **267** | **664** | **1,158** |
| **VI** | **Administration Cost** | **80** | **199** | **347** |
| **VII** | **Training Program** | **0** | **91** | **91** |
| | **GRAND TOTAL** | **4,246** | **9,947** | **17,802** |