Directorate General of
Water Resources Development
Ministry of Public Works
Republic of Indonesia

United States
Agency for
International
Development

Small Scale Irrigation Management Project (SSIMP)

FINAL REPORT
ENVIRONMENTAL ASSESSMENT
TIU KULIT DAM PROJECT

MAIN REPORT
including
MITIGATION PLAN and MONITORING PLAN

October 1989

PN-ABJ046

Small-Scale Irrigation Management Project (SSIMP)

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October 1989

Prepared by

HARZA ENGINEERING COMPANY

in association with

Development Alternatives, Inc.

Global Exchange, Inc.

Environmental Studies Center, University of Mataram

P.T. Wiratman and Associates

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Glossary and Acronyms

Agraria/Pertanahan	Directorate General of Land Affairs
AID	Agency for International Development
AMDAL-Analisa Mengenai Dampak Lingkungan	Environmental Impact Assessment
ANDAL-Analisa Dampak Lingkungan	Environmental Impact Study
BangDes-Pembangunan Desa	Directorate of Village Development, under the Department of Home Affairs
BAPPEDA Tk. II-Badan Perencanaan Pembangunan Daerah	District Level of the Regional Development Planning Board, under the Department of Home Affairs
Beras	Milled rice, uncooked
Bibit	Seed
BIMAS-Bimbingan Massal Swasembada Bahan Makanan	Mass Guidance for self-sufficiency in foodstuffs, a farm input-credit package program
BKLH-Biro Kependudukan dan Lingkungan Hidup	BPE-Bureau of Population and Environment
Buin Aik Panas	Hot water spring
BULOG-Badan Urusan Logistik	National food logistics body
Bupati	Head of a District, i.e., a Regency (Kabupaten)
Cabang	Branch office
Camat	Sub-District head
Cipta Karya	Part of GOI Department of Public Works
Cita Prisma	An engineering company (Bandung)
DA	Drainage (catchment) area
Dalam Negeri	Ministry of Home Affairs
Demplot	A demonstration plot by Agricultural Extension Services

Desa	A village
DGWRD	Directorate General of Water Resources Development
DOLOG/SUB-DOLOG-Depot Logistik	Provincial food logistics body
DPUP-Dinas Pekerjaan Umum Propinsi	Provincial Public Works Services
Dusun	A village administrative sub-area
EA	Environmental Assessment
EMP	Environmental Management Plan or Environmental Monitoring Plan
E & P-Exploitasi dan Pemeliharaan	O & M - Operation and Maintenance
Embung	Local term for a small dam/reservoir
Fenco	An engineering company (Canada)
FY	Fiscal Year (from 1 April to the following 31 March)
Gabah	Rice in husk after threshing
Gabah Kering	Dry gabah
Giliran	To go around, as in rotational supply of irrigation water
Gogo-rancah	Dry/upland rice
GOI	Government of Indonesia
Golongan	A class/division, as in a subdivision of irrigation area for rotating and spreading planting dates
Gotong Royong	Cooperative work effort by villagers; mutual self-help
Harza	An engineering company (US)
HHS	Household Survey
HYV	High Yielding Variety (rice)
Hutan Lindung	Protected forest status

IBRD	International Bank for Reconstruction and Development - World Bank
INMAS-Intensifikasi Massal	Massive Intensification, a farm input program
INPRES-Instruksi Presiden	Presidential Instruction, a general program for rural development
INSUS-Intensifikasi Khusus	Special Intensification, a farm input credit program for groups of farmers with improved infrastructure facilities
IR-36	Paddy seed variety
Juru Pengairan	Irrigation Sub-foreman for O & M in the Sub-district (Ranting Dinas)
Kabupaten	Regency
Kandang	A cattle corral
KanWil-Kantor Wilayah	Regional Office of a Ministry
Kecamatan	Administrative Sub-district within a kabupaten
Kejuron	Administrative area of the juru pengairan (mantri pengairan) from the branch office (ranting dinas) for O & M
Kelompok	A group, as in a quaternary irrigation unit
Kelompok Tani	A farmers' group
Kepala	Head of an organization
Kepala Desa	Head of a village
Kesehatan	Department of Public Health
Kerbau	Water buffalo
Ketua	Head, senior officer
Ketua P3A	Head of the Water Users' Association
kg/ha	Kilograms per hectare
Kios	Small shop
KK-Kepala Keluarga	Household head

Kontak Tani	Leader of a farmer group who is in contact with extension service; a key farmer
KSDA-Konservasi Sumber Daya Alam	Agency for the conservation of natural resources
KUD-Koperasi Unit Desa	A village cooperative
KUPPEDES-Kredit Umum Pedesaan	A village credit cooperative unit
KUT-Koperasi Usaha Tani	A Farmer Cooperative
Ladang	Dry fields, not used for wet rice production
Lebe	Well-respected community leader
LKMD-Lembaga Ketahanan Masyarakat Desa	Organization for Self-Reliance of the village community (Village community development committee)
LP3ES-Lembaga Penelitian Pendidikan dan Penerangan Ekonomi dan Sosial	Indonesian non-governmental organization with expertise in organizing water users' associations (Institute for Social and Economic Research, Education and Information)
LMD-Lembaga Masyarakat Desa	Village Development Council
Lurah	Head of kelurahan (large village)
m3/s	Cubic meters per second
mg/l	Milligrams per liter
Malar/Pekasih/Ulu-ulu	Irrigation foreman appointed by village
Mantri	Local official in charge of a specific service, kejuron or kemantren in his administrative service region
Mettana	An engineering company (Bandung)
MCM	Million cubic meters
NEPA	(US) National Environmental Policy Act
NTB-Nusa Tenggara Barat	A province
O & M	Operation and Maintenance

Orong	A group of contiguous rice fields relying on the same water source and some shared work tasks
Padi	Stalk rice, unthreshed rice which is harvested and can be tied into bundless with part of the stalk
Padi gabah	Unhusked rice (1 ton gabah = 630 kg dried rice)
Padi Gadu	Dry season rice
Padi Rendeng	Wet season rice
Palawija	Non-rice food crops, secondary crop, such as maize, cassava, soybeans
Pamong Desa	Village administrative officer
Panggung	A house usually made of wood with its floor elevated one or two meters above the ground
Panitia Irigasi	Irrigation Committee
Pantai Grazing Area	Beach grazing area
Peksi	An engineering company (Mataram)
PELITA V	Indonesia's Fifth Five-Year Development Plan
PEMDA-Pemerintah Daerah	Regional Government (District, Sub-District)
Pengairan	Irrigation; generally used in reference to the irrigation division of DGWRD-Directorate General Water Resources Development
Pengamat	Water distribution supervisor
Pengurus P3A	Executive board of the Water Users' Association
Perkebunan	Horticulture; estate (usually tree) crops services
P3A-Perkumpulan Petani Pemakai Air	Water Users' Association
P & K - Pendidikan dan Kebudayaan	Directorate of Education and Culture

Pertanian	Ministry of Agriculture
PKK-Program Kesejahteraan Keluarga	Women's Group for Family Prosperity Program
Petak	Individual bunded rice field
Pagar Hidup	A living fence; row of trees
PPL-Penyuluh Pertanian Lapangan	Field extension agent
PPM-Penyuluh Pertanian Madya	Field extension manager of PPL
PPS-Penyuluh Pertanian Specialis	Extension subject matter specialist
P3SA-Proyek Perencanaan Pengembangan Sumber Air	Water Resources Development Planning Project
PIL-Penyajian Informasi Lingkungan	Preliminary Environmental Information
PP 29-Peraturan Pemerintah 29	Indonesia's environmental law
PSL-Pusat Studi Lingkungan	Environmental Studies Center
PU-Pekerjaan Umum	Ministry of Public Works
Pusat	Center; usually central office
PU Seksi	Administrative area for irrigation management within the province
PU Wilayah	Administrative area for irrigation management within the province
PUSKESMAS-Pusat Kesehatan Masyarakat	Public Health Clinics; government-sponsored health program
Ranting/Ranting Cabang	"Twig"; smaller than sub-district, as in a village or irrigation system level
RH	Relative Humidity
RKL-Rencana Pengelolaan Lingkungan	Environmental Mitigation Plan
Rp	Rupiah

RPL-Rencana Pemantauan Lingkungan	Environmental Monitoring Plan
RRIA	Rapid Rural Irrigation Appraisal
RT-Rukun Tetangga	A village sub-unit of about 25 households, usually living together in one hamlet
RT-Rumah Tangga	A household
Sawah	Wet rice bunded field
Sederhana	Non-technical (simple) irrigation
SSIMP	Small-Scale Irrigation Management Project
TA	Technical Assistance
t/ha	ton per hectare
Tambak	Fish pond
Tani Maju	Progressive farmer
Tani Teladan	Expert, leading farmer
Tegalan	Dryland fields for growing upland crops
Tingkat I-Tk I	First level of government administration (usually Provincial)
Tingkat II-Tk II	Second level of government administration (usually Kabupaten and Kotamadya)
Ulu-ulu Desa	Water master within the staff of the Kantor Desa
Ulu-ulu P3A	Water master of P3A
US	United States
USAID	United States Agency for International Development
Wilayah	Subdivision of provincial DPUP
Wikel	Sub-area of the Wilud
Wilud-Wilayah Unit Desa	A village unit for agricultural extension

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PART 2

MAIN REPORT

Chapter I

INTRODUCTION

Background

This report has been prepared in conformance with the laws and regulations of the governments of the Republic of Indonesia and the United States of America, as administered by the appropriate agencies in terms of guidelines and decrees.

Indonesian Requirements

The basis for the Indonesian environmental assessment process is Government Regulation No. 29, 1986 (PP 29), as implemented through a series of decrees by the Ministry of Population and Environment. These decrees establish the process whereby a new project is the subject of a Preliminary Environmental Information (PIL) Report (Ministerial Decree No. 49/MENKLH, 1987) and, should the PIL commission so decide, a complete Environmental Impact Assessment (AMDAL) Report (Ministerial Decree No. 50/MENKLH, 1987). In addition to the AMDAL Report, Ministerial Decree No. 50/MENKLH establishes guidelines for the Environmental Management Plan (RKL) and the Environmental Monitoring Plan (RPL).

USAID Requirements

The US Government requirements on environmental planning were first set forth in the National Environmental Policy Act of 1969, extended to US-funded overseas projects by the Foreign Assistance Act Amendments of 1986. The details of the process are set forth in USAID Regulation No. 16. The USAID regulations establish a process similar to the Indonesian PIL process, whereby a project is determined to have potential for significant environmental impact, in which case an environmental assessment (EA) is required, or to lack such potential, in which case a declaration of "no significant impact" is made and no further environmental study is required.

Combined Process

Environmental specialists from the Ministry of Population and Environment, the Ministry of Public Works, USAID, and the engineering consultant firm, Harza Engineering Company, conferred in April 1988 to evaluate the need for an environmental study for each of the ten proposed surface water projects under the USAID-funded Small-Scale Irrigation Management Project (SSIMP). It was decided that most of the projects had potential for significant environmental impacts. It was further decided that a combined team of Indonesian and American consultants would prepare a single environmental report for each project, structured so as to satisfy both government's

requirements and prepared in both Indonesian and English. It was agreed that although the Indonesian ANDAL is best translated into English as "Environmental Impact Assessment," that the AMDAL was most similar in intent of meaning, to what is known in America as an "Environmental Assessment."

This report has been prepared by the SSIMP Technical Assistance Team and the University of Mataram Environmental Studies Center, with the support and assistance by the NTB Public Works Water Resources Division.

Environmental Policy

The governments of Indonesia and the United States have similar policies regarding environmental management. Their attitudes are effectively stated in the preamble to Indonesia's Government Regulation No. 29 as requiring "within the framework of implementing development with an environmental outlook therein resources rationally for sustainable development aimed at enhancing the living standard. Any activity as a rule has its impact on the environment, which shall be predicted at the initial stage of planning, in order ... to cope with any negative impacts and to enhance any positive impacts..." (translation by Canadian International Development Agency). The US National Environmental Policy Act (NEPA) contains similar language, mandating the inclusion of environmental planning in any action of the federal government that may exert significant environmental effects.

Objective of the Environmental Assessment

The major objective of this environmental assessment is to inquire whether there are any probable major negative impacts of this project on the environment. Conversely, this report also assesses possible negative impacts of the environment on the function and efficiency of the project. Once harmful effects are identified, a plan is provided to mitigate these major negative impacts.

Scope of Report

As a result of an Environmental Scoping Session held in Mataram in July 1986, and in subsequent visits to the site by environmental experts, a list of priority issues was developed. This list has been reorganized into four basic categories to reflect the requirements of PP 29. These are: water resources, land resources, biological resources, and socioeconomic and cultural resources. Information on climate and physiography is also presented, as required by PP 29. An account of the 1986 session is found in Appendix D to this report.

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The methodology for each of the four main areas of assessment followed standard research procedures common to the respective disciplines. In brief, they were:

- **Water Resources.** Streamflow estimates were developed from simulation studies that relied on records of staff gauge readings, discharge measurements and rainfall records. Water quality was based on standard laboratory analyses done at the Water Quality Laboratory of Mataram University. Water use estimates were based on household interviews.

- **Land Resources.** Land use definition relied on visual assessment of the study area in conjunction with available maps and aerial photographs. Details on soils were obtained from soil maps available from the National Board of Land Titles (Pertanahan). The agriculture analysis was based on a series of interviews with farmers and government officials in provincial, district, sub-district and village offices.

- **Biological Resources.** The primary methods of investigation of biological resources in the study area were to visually review local conditions, and to interview villagers and officials from relevant sectoral agencies (Departments of Agriculture, Livestock and Forestry).

- **Socioeconomic and Cultural Resources.** This assessment relied on primary and secondary data that included quantitative and qualitative characteristics of the study area population. These data included results of the various "Rapid Rural Irrigation Appraisals" (RRIA), the Household Survey (HHS), and a number of in-depth interviews with study area villagers and officials.

Sponsoring Agencies

This project is jointly sponsored by the Ministry of Public Works of the Government of Indonesia and the Agency for International Development of the Government of the United States.

Chapter II

DESCRIPTION OF THE PROPOSED PROJECT

Type of Project

The Tiu Kulit Dam Project is one of 10 surface water projects being studied under the Small-Scale Irrigation Management Project. It is a water storage project which will provide a reliable supply of irrigation water to farmers who are now unable to cultivate two or more crops per year.

Location of Project

The project is located within three villages: Maronge, Muer and Simu in the Plampang Sub-District of Sumbawa District, NTB Province, Indonesia. The Tiu Kulit river basin lies near the eastern edge of the west land mass of the island of Sumbawa, which is divided by Saleh Bay into two land masses connected by a narrow isthmus. The upstream end of the project area will be occupied by a reservoir on the Tiu Kulit River upstream of its confluence with the Pemasar River. The service area of 1,700 ha extends from Simu Village nearly to the bay and lies for the most part between the Maronge and Brang Kolong Rivers. (See Figure II-1, Project Location Map).

Limits of the Study Area

The study area for this environmental assessment consists of the entire river basin of the Tiu Kulit River, as defined in the previous section. Since this river basin is located within the administrative boundaries of three villages, the entire land area and population of these three villages is also considered to be within the study area. As all borrow areas are located within the river basin, there are no areas located outside the river basin that are directly affected by the project.

Project Life

For planning purposes, the life of the project is taken as 60 years, but there is no reason to believe that the structures, properly maintained, will not function for a much longer time.

Description of the Project

Pre-Construction Period

The Tiu Kulit Dam Project was investigated during the extension phase of the Sumbawa Water Resources Development Planning Study (Fenco, 1982). Prefeasibility designs and cost

estimates were prepared for a small dam and reservoir (embung) at a site located approximately 500 m downstream of the current site. Results of these studies are given in Technical Report 6 of the above-mentioned study.

In 1984, PT Mettana of Bandung was engaged by Provincial PU to perform design studies for the Tiu Kulit Project. An alternative upstream site was considered which permitted design of a slightly higher dam (23.5 m) having more than three times the storage volume (7.1 million cubic meters) of the downstream site. Mettana performed topographic mapping, geotechnical investigations, and technical studies resulting in a final design report and drawings (Mettana, 1984).

The following year, PT Cita Prisma of Bandung performed foundation drilling (four holes) and borrow area investigations to supplement the previous four drill holes and test pits done by Mettana at the dam site (Cita Prisma, 1985). In 1986, Peksi Consultants of Mataram performed surveys and designs for the Tiu Kulit irrigation system. Design documents for the main and secondary system and tertiary system were prepared (Peksi, 1986).

In late 1986, a "Rapid Rural Irrigation Appraisal" (RRIA) was conducted at the Tiu Kulit site by several USAID SSIMP social scientists and engineers (Duewel, 1986). A Household Survey (HHS) was then conducted in 1987 by this same USAID team, working with a survey team from NTB PU staff assigned to SSIMP. Information from these surveys has been incorporated into sections of this Environmental Assessment particularly in Chapter IV, "Existing Environmental Conditions," and in the proposed Mitigation Plan.

In March 1988, Provincial PU again contracted for the engineering services of PT Mettana, this time under project SSIMP. Mettana is currently performing a comprehensive review and revision of the Tiu Kulit Dam design and preparing tender documents in anticipation of awarding a construction contract for the dam in 1990. The studies are being performed under the direction of Provincial PU with advice and guidance from the SSIMP Technical Assistance (TA) Team led by Harza Engineering Company. Mettana is also preparing designs and tender documents for the Tiu Kulit Project main and secondary irrigation system, access road, and permanent buildings. The design reports and tender documents are scheduled for completion in October 1989.

Construction Period

Major Structures: Water Diversion. The principal structure of the project will be a dam on the Tiu Kulit River, 2.5 km upstream of its confluence with the Pemasar River. The dam will be a random fill structure with a height of 29.4 m above the river bed, giving a crest elevation of 61.4 m and a crest length of 160 m.

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The service spillway will be a concrete, free overflow structure located in a slight saddle of the hill that forms the left abutment. An emergency fuse plug spillway is planned adjacent to the service spillway. A saddle in the right abutment will be closed by the saddle dam approximately 250 m long with a maximum height of 25.4 m above the valley floor (see Figures II-2 and II-3, Project Layout and Major Project Features, respectively).

The reservoir formed by the Tiu Kulit Dam will have a surface area of approximately 110 ha at normal surface elevation of 57 m. The reservoir will have a total volume of 10.8 MCM with dead storage of 0.8 MCM, at the drawn-down elevation of 41.8 m. This provides live storage of 10.0 MCM.

Conveyance System. An outlet works structure will release irrigation water from the reservoir via a tunnel into a headrace canal which will convey it approximately 1.8 km to the main/secondary canal system. The headrace canal will be sized to carry a flow of approximately 2.0 m3/s. The canal will have a trapezoidal section with a bottom width of approximately 1.9 m and steep side slopes. The headrace canal will have a ston.. masonry lining.

Delivery System. Secondary canals will provide water to the subdivisions of the service area. Three principal secondary canals are planned: (1) Maronge secondary which crosses the Maronge River just downstream of Simu Village to serve the left bank area, (2) Brang Kolong secondary which traverses the southern limit of the right bank area, and (3) Maronge Srilahan secondary which delivers water to the area directly south of Maronge Village. The total length of main and secondary canals is approximately 23 km. The short length of main canal is sized nearly the same as the headrace canal. The secondary canals range from approximately 0.5 to 1.4 m bottom width with 1 : 1 side slopes. The canals are unlined.

A system of tertiary canals, from 0.5 to 1 m wide, will generally distribute water to quaternary canals, which in turn will provide it to the on-farm systems.

Drainage System. Excess water will be removed from the fields by a surface drainage system and returned to the Maronge River, the Brang Kolong River, or to the sea depending on location and topography. It is expected that the Brang Kolong, which will contribute no water to the project, will receive a total of about 1 m3/s from several drainage outfalls between Brang Kolong Village and the end of the service area, 3 km downstream.

Construction Support Facilities: Work Area. The dam contractor will require an area of about two hectares near the dam site for the field office, equipment storage, and materials stockpiling. The estimated 400 laborers on the contract will live in a tent village near the dam site, with more adequate housing for the

managerial staff and supervisory personnel. At the main camp, water and sanitation will be provided by the contractor. Water will be drawn from the river, when possible, and boiled for drinking.

The irrigation system contractors will establish base camps and offices near the canal alignments. Tents will be provided for most of the labor force; some may find lodging locally.

Access Roads. The existing road to the project dam site leaves the main road near Simu. This road, passable for most of its length for four-wheel drive vehicles, will be upgraded to an all-weather asphalt surface road capable of handling heavy trucks. For most of its 3 km length, this road parallels the Maronge secondary, and Tiu Kulit main and headrace canal. Other roads will be constructed for access to borrow areas which are located within 2 to 3 km of the dam site.

Borrow Areas. Materials for the main dam and saddle dam will be obtained from required excavation for the two spillways and outlet works structures, from alluvial deposits within the reservoir area, and from clay borrow sites near Simu. All of these borrow areas are within the Tiu Kulit river basin. The main dam and saddle dam are designed for a rockfill section with an impervious clay core separated by sand and gravel filter/drain and transition zones. The upstream and downstream cofferdams will be integrated into the dam section. The materials volumes involved are not large, as shown in Table II-1.

Table II-1

CONSTRUCTION MATERIAL REQUIREMENTS

Materials for Dams	Volume (m3)
Shell material:	
Rock from required excavation	130,000
Alluvium from river/reservoir area	100,000
Random fill from other borrow	40,000
Core material	160,000
Sand and Gravel	110,000
Rock for riprap	20,000
Total	560,000

Source: P.T. Mettana, Draft Bill of Quantities, March 1989.

Equipment Use. The contractor is expected to provide all equipment and implements used in construction of the project and to retain all usable items in his possession at the end of the project.

Control gate hardware and other fabricated parts will be obtained from sources within Indonesia, but probably not in Sumbawa. The contractor is expected to have a considerable machine shop and metal working facility on site.

Resource Use: Types of Resources. The actual construction of the dam and appurtenant structures will require approximately 560,000 cubic meters (m3) of rock, gravel, sand, and earth, as shown in Table II-1, the sources of which are described above. In addition, cement will be required for concrete and lumber and plywood for forming and for the construction of shops, sheds, and dwellings. The contractor will be able to obtain locally some unfinished wood for fenceposts and other uses that do not require sawn lumber but will be required to obtain these only from within the reservoir area.

SMALL-SCALE IRRIGATION MANAGEMENT PROJECT

Figure II-1
Tiu Kulit Project
Location Map

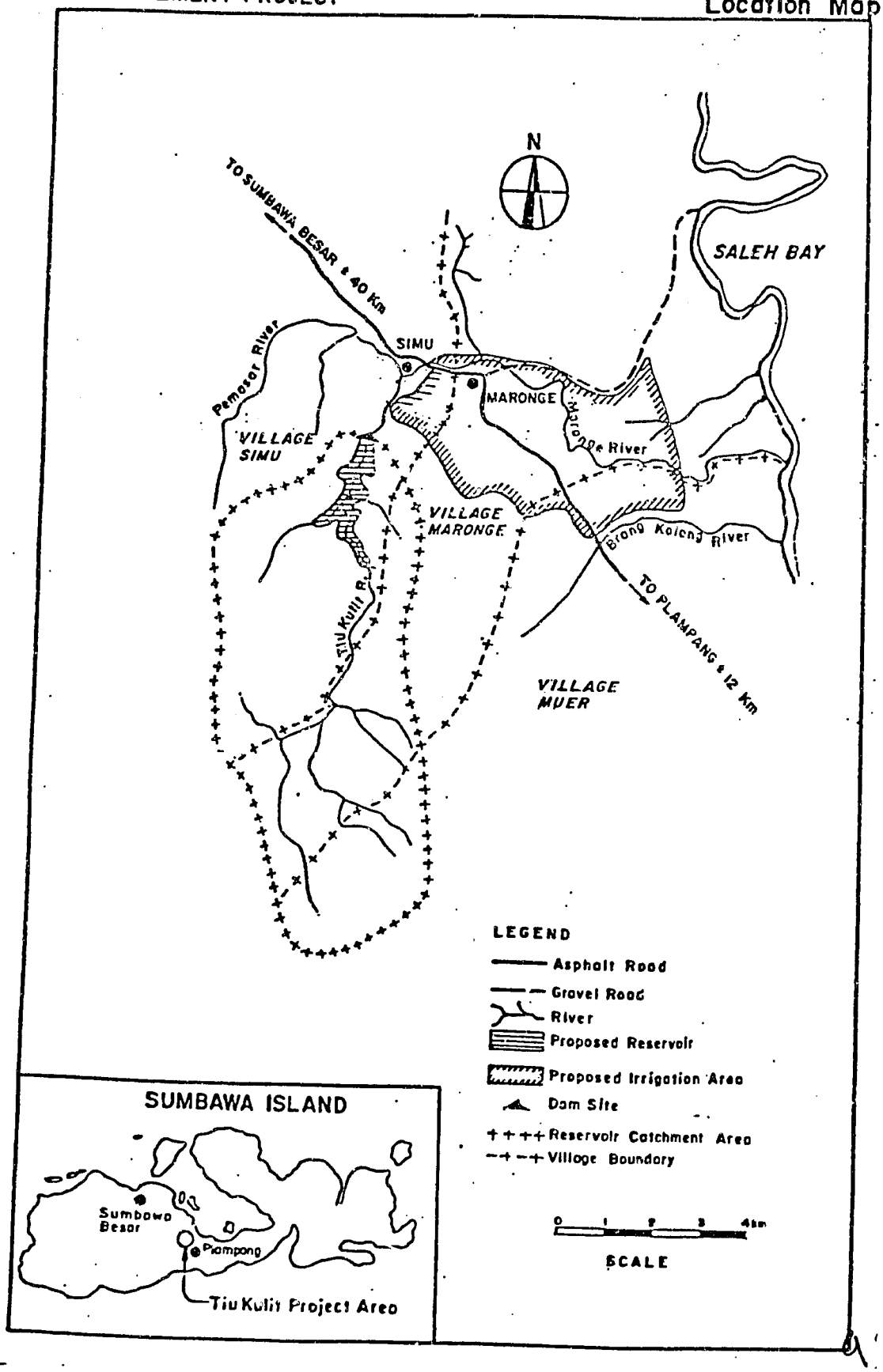
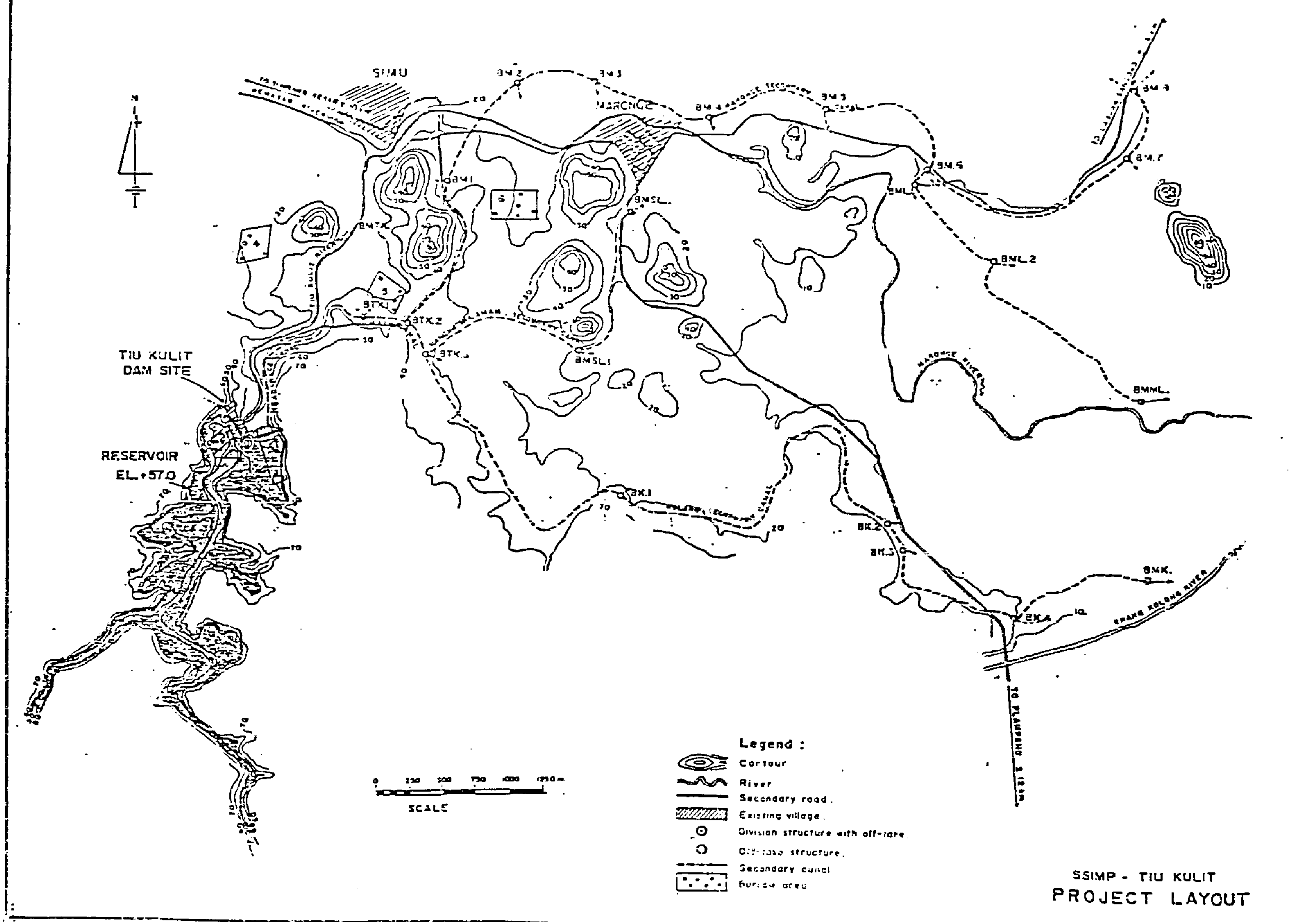
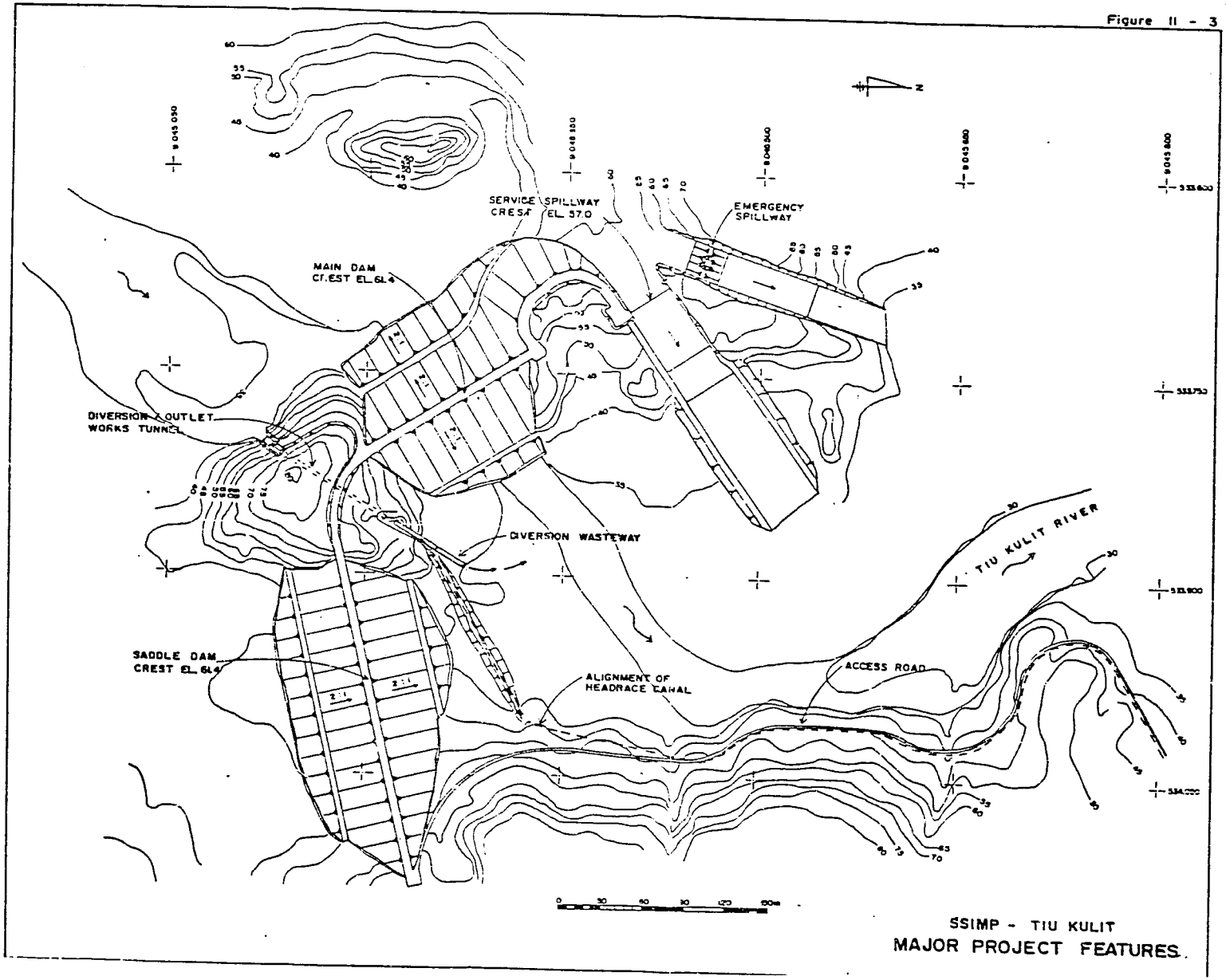


Figure II-2


SIMU
MARONGE
N
BM.1
BM.2
BM.3
BM.4
BM.5
BM.6
BM.7
BMTK
BMSL
BMSL.1
BTK.1
BTK.2
BTK.3
BML
BML.2
BMML
BK.1
BK.2
BK.3
BK.4
BMK
TIU KULIT DAM SITE
RESERVOIR EL.+57.0
MARONGE RIVER
Legend :
Contour
River
Secondary road.
Existing village.
Division structure with off-take.
Off-take structure.
Secondary canal
Furrow area
0 250 500 750 1000 1250 m.
SCALE
SSIMP - TIU KULIT
PROJECT LAYOUT



SSIMP - TIU KULIT
MAJOR PROJECT FEATURES.

Similarly, the work force will require fuelwood or kerosene for cooking, and some restrictions will be needed to prevent cutting of the woodland around the camp.

Waste Disposal. The usual practice in Indonesia, especially in remote areas, is to dispose of solid waste in any convenient depression or water course near the site of consumption. That practice, although environmentally unsound, probably will prevail at the Tiu Kulit site, with or without contract stipulations. It may be possible, however, to force the contractor to cover his trash heap with sand or gravel, which would keep down rats and render it less unsightly.

Human sanitary waste will be disposed of in pit latrines, which will be moved, and the pits filled in, at appropriate intervals.

Work Force. It is anticipated that construction of the dam and appurtenent structures, and irrigation system will require a total work force of approximately 850 people over a 30-month period. Of these, approximately 700 will be unskilled laborers, 100 will be semi-skilled (drivers, mechanics, carpenters), and 50 skilled and managerial. Contractors on Sumbawa customarily draw their work crews from a large pool of construction labor on Lombok and from their own full-time employees rather than from the immediate project area. The crews generally come without their families and live in tents near the construction site.

Construction Schedule. The construction of the dam is expected to start early in 1990 and require 30 months. Construction of the canal system will be performed concurrently with that of the dam, if the labor is available, and will require about 18 months. If the available labor force and contractors are not sufficient for simultaneous construction, the canal system construction may not be started until the dam is nearly complete.

Operation Period

Irrigation: Method of Operation. Operation of the reservoir outlet works, and main and secondary canal structures will be the responsibility of the PU O & M Section based in Sumbawa Besar. An irrigation inspector (juru pengairan), under the sub-district head (pengamat), will regulate canal discharges according to updated irrigation requirements for tertiary blocks in the system. The local heads of the water users' associations, or irrigation foreman (malar) will report their tertiary block water needs on a regular basis to the inspector. Each will direct the irrigation diversion rates and periods of application to the sub-tertiary blocks under his supervision. The total irrigation requirement for each area will determine the main and secondary canal diversion rates. Flow will be on a continuous basis in the main and secondary canals and will generally be adjusted every two weeks.

Equipment Use. Other than the control items installed at the time of construction, little special equipment will be required during operation. Tools will be required for maintenance of structures, including cleaning.

The PU irrigation inspector will be provided with a motorbike or bicycle to enable him to check on the irrigation system, to observe and record discharge at each control structure, and to coordinate with the malar on water management activities.

Resource Use. The irrigation system itself will use few natural resources, other than water, which is its "reason for being". Energy consumption will be minimal since the control gates will be hand operated. Operation of the irrigation system will not require chemical inputs, although some increase in chemical use is anticipated on the farms.

Labor Force. The operational labor force will come under the direction of the PU sub-district head who oversees approximately 5,000 irrigated hectares. Operational decisions will be by the irrigation inspector assisted by a staff of 10 to 15 persons for the Tiu Kulit Project.

On-Farm Water Management. The functioning of local water users' associations (Perkumpulan Petani Pemakai Air, known as P3A), will be examined and, where necessary, strengthened. The relative roles of the locally elected malar and the PU operations and maintenance staff will be reviewed in terms of the effectiveness and reliability of the water distribution system. PU will receive assistance in on-farm water management from the Indonesian non-governmental organization, (Lembaga Penelitian Pendidikan dan Penerangan Ekonomi dan Sosial, known as LP3ES).

Domestic Water Supply: Method of Operation. The simplest means to provide downstream domestic water during the dry season is to allow for a minimum downstream release from the reservoir. In most years a very small release would serve to keep the river bed alluvium "recharged" or flowing since the year-round presence of water will keep the water table from dropping below the river bed. Operation of downstream releases will be the responsibility of the PU O & M Section based in Sumbawa Besar. The irrigation inspector will monitor the condition of the water in the river bed and the inspector will authorize small releases of water as needed.

In addition, the project will also install filters, discharge control facilities, main delivery pipes and two village main distribution water reservoirs to the main hamlets of Simu and Maronge Villages. The PU O & M Section will be responsible for maintaining the automatic water offtake system and discharge control facility that supplies water to the villages main distribution water reservoirs.

Public Bathing and Livestock Watering: Method of Operation. Public bathing and laundry steps for the use of Simu and Maronge villagers will be built by the project. Once built, there will be some monitoring of the structures to see that they remain in good condition.

The project will construct livestock bathing and drinking sites to minimize damage to canal banks. PU will monitor the condition of these sites once the system is operating, to see that they remain in good condition.

Community education and eventually, community-led enforcement programs initiated through the joint efforts of Public Works, LP3ES, and the Departments of Agriculture and Livestock will be required if the canals are to be effectively protected from violation of the no-livestock regulations. In fact, the entire target population would benefit from a program to instill respect for the irrigation system. Maintenance of the livestock watering holes could be incorporated into an overall community livestock management program.

If begun before the system is installed, and continued vigorously, the education program could reduce the amount of plant matter and domestic trash thrown into canals and drains, illegal taps and other abuses of the system.

Waste Water Management. Waste water created by this project, consisting of irrigation return flows and rainfall runoff, will be returned to the nearest part of the river system through a system of surface drains.

Project Outputs. The project outputs will be a reliable supply of irrigation water, a much smaller, but equally reliable, supply of domestic water, and provision of sites along the canals for public bathing, laundry washing, and livestock watering.

Institutional Development and Training

The SSIMP consultant on the transfer of technical knowledge has prepared guidelines for a program of training of full-time Public Works SSIMP staff in the planning, construction and management of these irrigation systems. It is to be a four-year program, centrally administered in Jakarta, but focusing on the three provincial PU offices where these projects are located. Individuals would receive up to three months of intensive training.

The training program is in its formative stage, and the administrator has not yet been appointed. Scheduling, identification of training needs, course identification,

activities have not been undertaken. The training should have the following general objectives:

1. To upgrade the English capabilities of local personnel to enable them to communicate more effectively with expatriate specialists and to read technical literature not available in Indonesian.

2. To improve staff understanding of computer use, both for problem solving and for word processing, and provide hands-on training.

3. To develop skills in project management and supervision.

4. To improve staff knowledge of basic planning and design. These objective will be met through a variety of formal and informal means: short courses (local), long courses (overseas) workshops, symposia, guest lectures, and field courses.

SSIMP will also work to improve operations and maintenance of the Tiu Kulit system by training PU staff at the levels of wilayah, cabang, and ranting cabang. Special attention will be given to joint training of the local malar, alongside the PU staff responsible for working at the Tiu Kulit site. These local activities will occur under the coordination of LP3ES, who will be hired to organize the water users' associations.

Project Cost

Capital Costs

Construction of the Tiu Kulit Project will be performed under four separate contracts. The dam, appurtenant structures and headrace canal will form one contract, and the irrigation system works another. The two contracts will be bid under international competitive bidding, though stipulation will be made that the tertiary works be assigned to local subcontractors. Separate locally bid contracts will be let for construction of the access road and permanent buildings.

The dam construction contract is estimated at Rp 10,784 million (January 1989 price level). The irrigation system construction is estimated at Rp 3,552 million including main, secondary, and tertiary systems. Construction costs for the access road and permanent buildings are estimated as Rp 660 and Rp 351 million. Capital financing will also be required for engineering services and owner's overhead are during construction which includes construction supervision by PU staff. Guidance by an engineering consultant may be required, particularly for the preparation of design changes to match actual field conditions. The cost of engineering services and owner's overhead are estimated at 14 percent of construction

cost for the dam (Rp 1,510 million) and 12 percent for the irrigation system, access road and buildings (Rp 548 million).

A summary of the Tiu Kulit Project cost estimate is shown in Table II-2 below. The estimate is based on a draft Engineer's Cost Estimate prepared by P.T. Mettana in March 1989. A January 1989 price level has been adopted for the estimate with an exchange rate of Rp 1,730 per US dollar.

Foreign and Local Cost Components. Table II-2 presents the estimated breakdown into foreign and local currency requirements for the works. The breakdown for the dam follows from a detailed analysis of the foreign and local components of labor rates, construction material costs, and equipment rates used to develop unit prices. The foreign currency component includes the costs for heavy construction equipment and also major mechanical items not available locally.

The foreign versus local cost breakdown shown for the irrigation system is based on more general experience guidelines. The following distribution was assumed: 75% local to 25 foreign for the main system, 90% local to 10% foreign for the tertiary works, 70% local to 30% foreign for the roads and preparatory works.

The resulting foreign-local cost breakdown from Table II-2 for the irrigation works, access road and buildings is 25% foreign versus 75% local currency. For the dam, it is 61% foreign versus 39% local. The overall Tiu Kulit Project requirements are 50% foreign versus 50% local currency.

Operation and Maintenance Costs

Operation and maintenance costs for the project cover salaries and housing allowances for permanent and temporary staff of PU NTB O & M Section, office costs, tools, materials, motorcycles, bicycles, fuel and oil, and depreciation on equipment such as trucks, backhoes, and graders. Annual O & M costs for Tiu Kulit Project are estimated at Rp 30,000 per ha, which is in the higher range of annual costs for irrigation projects in NTB according to the PU O & M office. The estimated O & M cost for the project is Rp 51 million per year for 1,700 ha.

Table II-2

PROJECT COST ESTIMATE
(in million Rupiah)

	Item	Local Currency	Foreign Currency	Total Amount
1.	ACCESS ROAD/HEADRACE EXCAV.	304	270	574
2.	PERMANENT BUILDINGS	274	31	305
3.	IRRIGATION SYSTEM			
	Preparatory	140	60	200
	Main/secondary	1,087	362	1,449
	Inspection roads	522	224	746
	Domestic water (2 sites)	69	30	99
	Tertiary (1700 ha)	535	60	595
	TOTAL IRRIGATION SYSTEM	2,353	736	3,089
	TOTAL 1,2 AND 3	2,931	1,037	3,968
	Contingencies (15%)	440	155	595
	TOTAL DIRECT COSTS No. 1-3	3,371	1,192	4,563
	Engg/administration (12%)	329	219	548
	Contract tax (10%)	456	0	456
	Land acquisition	80	0	80
	TOTAL ESTIMATED COST No. 1-3	4,235	1,412	5,647
4.	DAM			
	Preparatory	617	457	1,074
	River diversion/shaft	317	580	897
	Saddle dam	722	1,991	2,713
	Emergency spillway	100	438	538
	Service spillway	654	775	1,429
	Main dam	666	1,835	2,501
	Outlet/headrace canal	150	502	652
	TOTAL DAM	3,226	6,578	9,804
	Contingencies (10%)	322	658	980
	TOTAL DIRECT COST	3,548	7,236	10,784
	Engg/administration (14%)	604	906	1,510
	Contract tax (10%)	1,078	0	1,078
	TOTAL ESTIMATED COST No. 4	5,230	8,142	13,372
	TOTAL PROJECT COST	9,465	9,554	19,019

Source: P.T. Mettana, Draft Engineer's Estimate, March 1989.

Chapter III

ALTERNATIVES TO THE PROPOSED PROJECT

No Action Alternative

If the project were not implemented, current land use and cropping patterns would remain relatively stable, since the intermittent nature of the Tiu Kulit River makes two-crop farming impossible in most of the service area.

Alternative Irrigation Technologies and Water Management

Water Sources

Two basic water sources are present in this region: surface water and ground water. Studies for this project indicate that the annual flow of the Tiu Kulit River, applied over three growing seasons through the use of a storage reservoir, is sufficient to meet project objectives. Average annual yield is estimated at 48 MCM; the total annual irrigation demand (based on a lower than average rainfall year) is taken as 24 MCM. (A quantitative analysis of streamflow at the Tiu Kulit site is presented in the next chapter - see Table IV-3).

Ground water supplies, on the other hand, are sufficient for most domestic demand during the wet season and for some households during the dry season, but could not possibly provide sufficient dry season irrigation water for more than a few hectares.

Water Management

A review and, if necessary, strengthening of the malar system of irrigation distribution control is part of this project. Other systems of water management, such as automated or metered systems would not be practical in rural Sumbawa society. The community organizations (water users' associations) also will be strengthened. This organizing will be accomplished by the Department of Public Works and the non-governmental organization, LP3ES.

Siting Alternatives

Project Structures

Dam. The Tiu Kulit Dam site has been selected as the most downstream site (closest to the service area) that will provide the storage required for the project.

At the site, several alternative configurations have been studied prior to the selection of the left bank saddle as the location for the emergency and service spillways (Mettana, 1988). The selected dam height was determined by optimization studies using a 28-year half-monthly reservoir operation simulation to derive crop areas and benefits relative to project costs for a range of dam heights.

Auxilliary Structures: Roads. Topographic considerations dictated the placement of the existing access road to the site. The alignment of the existing road, as shown in Figure II-2, avoids a major river crossing by turning from the major Sumbawa east-west highway just east of Simu Village, after the Maronge highway bridge. Access along the west side of the Tiu Kulit River would require a bridge over the Pemasar River. A road alignment along the Tiu Kulit right (east) bank was not possible, so the shortest route, just east of the two hills, was selected. The existing road is to be upgraded to the permanent project access road.

Construction Camp. Only a few areas, near the dam site are suitable for the construction contractor's workshops and vehicle storage. Actual selection of an area has not yet been made. Residential structures near the dam site will be required only for managerial personnel. Temporary facilities will be provided for the labor force.

Service Area. Selection of the service area has been based on water availability, existing cropping patterns, soils, topography, and the areas used as rainfed sawah.

Canals. Placement of irrigation canals is largely governed by the location of the service area relative to the water source (in the case of the main canal), the configuration of the service area (in the case of secondary and tertiary canals), existing irrigation systems, and local topography. These factors are interrelated and combine to restrict the alternatives available for the project layout.

In the final analysis, canal design, routing, and sizing decisions are made on the basis of economic criteria, within internationally established guidelines for the design of reliable irrigation systems, but with local constraints always taken into account in matters such as control structures and system maintenance.

Scheduling Alternatives

By their small size, projects of this type do not lend themselves to phased implementation, such as staging the development of the dam as water demand increases. Project justification studies indicate that complete development, to the maximum capacity of the water resource, can be absorbed quickly by the local community, providing the water users' associations are strengthened, as planned.

Chapter IV

EXISTING ENVIRONMENTAL CONDITIONS

Climate

The Tiu Kulit project area has a tropical wet climate characterized by annual catchment area rainfall of 1,430 to 2,860 mm (28-year average, 1,970 mm), nearly all of it falling within a four-month period. The rainy season lasts roughly from December through March, during which precipitation occurs on about 70 days. April is intermediate. The six-month dry season lasts from May roughly through October, with November again intermediate. Rainfall totals are less at lower elevations. Average monthly rainfall data for Plampang and Lape, the two stations with lengthy records nearest the project area, are summarized in Table IV-1.

Temperatures in the area range from warm to hot, with few extremes. The monthly average minimum ranges from 21.3 degrees C in July to 23.8 degrees in November and the monthly average maximum from 31.6 degrees in January to 34.5 degrees in November.

Ambient relative humidity (RH) ranges from a monthly average of 77 percent in October to 90 percent in January. Monthly average maximum RH ranges from 85 percent in October to 96 percent in January and February, and monthly average minimum RH from 59 percent in October to 79 percent in January.

Winds are generally moderate in the region, the prevailing direction being from the southeast. The minimum monthly average wind speed occurs in April, 2.6 km/hr, and the maximum in September, 9.4 km/hr; the annual average is 5.8 km/hr.

Air quality in the region is good, there being no significant sources of air pollution.

Table IV-1

AVERAGE MONTHLY RAINFALL IN THE TIU KULIT PROJECT AREA

Station	Elevation (m)	Year of Records (number)	Rain-fall	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Plampang	+ 25	1964-84 (21)	mm	323	359	259	92	48	37	8	2	8	31	79	235	1,481
			days	14	15	13	4	3	2	1	1	1	2	4	10	70
Lape	+ 25	1955-87 (33)	mm	300	303	244	97	51	22	10	1	7	28	124	280	1,467
			days	9	14	12	5	4	1	2	1	1	2	15	13	79

Source: Agriculture Department Office and P3SA - NTB

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Topography and Geology

Topography

The project area is divided between a steeply hilly catchment area upstream of the dam site and a relatively flat coastal plain. The coastal plain, especially near the dam site, is interupted by scattered steep hills that rise up to 50 m above the surrounding terrain.

The catchment area of the Tiu Kulit River has an area of 152 km2 and reaches an elevation of approximately 900 m above sea level. The hilly nature of the catchment area is shown by the relative amounts of terrain in various slope classes (Table IV-2).

The service area is largely flat (less than two percent slope) or gently undulating (two to eight percent slope).

Table IV-2

SLOPE CATEGORIES IN THE TIU KULIT CATCHMENT

Slope Type	Percent Slope	Total Catchment Area(ha)	Total Catchment Percent	Dam Catchment Area(ha)	Dam Catchment Percent
Flat	< 2	2,647	17.4	-	-
Undulating	2 - 8	761	5.0	-	-
Slightly Rolling	8 - 15	1,308	8.6	697	12.9
Rolling	15 - 25	61	0.4	50	0.9
Rolling-Hilly	25 - 40	4,974	32.7	1,355	25.1
Hilly-Mountainous	> 40	5,460	35.9	3,298	61.1
Totals		15,211	100.0	5,400	100.0

Source: Department of Agraria, 1986. Land Use Map, 1:25,000, using planimeter.

Geology

The Tiu Kulit River catchment consists of volcanic sediments overlying volcanic basement rock of Miocene age. The underlying rock consists of four types: tuffaceous sandstone, volcanic breccia, tuffs, and andesite.

The sandstone (the oldest) is locally exposed in the upper part of the catchment, revealing fresh to slightly weathered rock sloping 20 to 22 degrees. Volcanic breccia consists of essentially horizontal layers of andesitic and basaltic tuff and sandstone. Where exposed at the dam site, it is strongly weathered.

There is a layer of tuff at the dam site about 1.5 to 2.0 m thick, moderately sloping (11 degrees), and slightly to moderately weathered. The youngest rock, andesite, shows as scattered intrusions into the volcanic sediments, high in the dam abutment.

Faulting is not abundant near the dam site, but there is one fault running roughly east-west across the dam axis. The fault slope is approximately 45 degrees, with the lower edge in the upstream direction. The fault appears to be inactive. When the foundation is opened, the fault will be examined, and conservative allowances will be made in the embankment design.

The bed of the Tiu Kulit River consists of river-deposited sand, gravel, and boulders to a depth of 6.5 m (at the dam site). Below that is slightly weathered to fresh volcanic breccia.

Water Resources

Major Surface Water Bodies

The Tiu Kulit River is a generally north-flowing river that drains an area of low mountains on the western half of Sumbawa. The main stem of the Tiu Kulit flows northward from its origin on the slopes of Mt. Batulawang. After 14 km, during which it is joined by many small tributaries, it flows through the gap between two hills that constitutes the project dam site. After approximately 2.5 km, it meets its only major tributary, the Pemasar River, which flows from the west. The rivers join to form the east-flowing Maronge River which meanders approximately 14 km across the coastal plain before emptying into Saleh Bay.

The adjacent catchment area to the south, that of the Brang Kolong River, has a shape similar to that of the Tiu Kulit. Its north-flowing section lies east of the Tiu Kulit, but like the latter the Brang Kolong makes a turn to the east before crossing the coastal plain.

Streamflow

Streamflow records at the dam site (DA = 54 km2) have been generated by Mettana (1988) for a 28-year period, 1958 to 1985. The records are based on 8 years of staff gauge readings and 3 years of discharge measurements at Maronge Village (DA = 83 km2), and rainfall records of more than 30 years at two

stations in the project vicinity (Plampang and Lape). Table IV-3 presents the estimated monthly streamflow data for the period; Figure IV-1 shows a plot of average, minimum, and maximum monthly flows.

The Mettana calculations indicate a strongly seasonal river with average monthly flows of 4 to 11 m3/s occurring in February, dropping to less than 1 m3/s by May in 23 of the 28 years of record. Zero flow is estimated to have occurred in June in 16 of the 28 years. The river has had a flow of less than 1 m3/s from July through November in all 28 years, including those of highest rainfall. Discharges of 0.03 m3/s or less dominate September and October throughout the period, and in many years the river apparently ceased to flow for those two months.

Average annual water yield of the Tiu Kulit River at the dam site was estimated by Mettana at 48.4 MCM, with extremes of 33.6 MCM in 1961 and 66.7 MCM in 1978.

Table IV-3

MONTHLY DISCHARGE AT DAM SITE
(in m3/s)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average (m3/s)	Total (MCM)
1956	1.59	9.43	8.19	0.81	0.83	0.00	0.24	0.09	0.03	0.01	0.20	1.28	1.88	57.9
1959	1.19	4.21	4.50	1.23	1.14	0.14	0.07	0.06	0.02	0.00	0.01	0.97	1.13	35.1
1960	1.68	8.65	7.46	1.08	1.06	0.09	0.06	0.06	0.02	0.02	0.37	0.17	1.80	55.3
1961	4.79	4.83	2.66	0.37	0.53	0.00	0.06	0.06	0.02	0.00	0.05	0.32	1.08	33.6
1962	3.77	7.35	2.50	1.02	0.29	0.09	0.11	0.06	0.02	0.01	0.00	0.88	1.36	41.8
1963	6.88	5.50	6.27	0.32	0.29	0.03	0.06	0.11	0.02	0.00	0.00	0.32	1.65	51.6
1964	0.25	4.60	6.13	2.31	0.48	0.04	0.06	0.06	0.03	0.04	0.43	0.40	1.24	38.4
1965	2.14	7.43	5.63	0.50	0.09	0.00	0.06	0.06	0.02	0.01	0.01	0.80	1.56	48.2
1966	3.62	8.63	7.66	0.38	0.11	0.02	0.06	0.09	0.03	0.00	0.09	0.63	1.76	54.3
1967	5.25	9.87	5.34	0.34	0.04	0.00	0.06	0.06	0.02	0.00	0.00	0.93	1.89	59.3
1968	2.93	8.58	3.43	1.29	3.42	0.33	0.65	0.06	0.02	0.02	0.00	1.81	1.88	58.0
1969	1.50	11.60	8.60	0.20	0.16	0.14	0.07	0.06	0.02	0.02	0.00	0.00	1.86	56.9
1970	3.02	4.44	4.38	0.45	0.35	0.00	0.06	0.06	0.02	0.00	0.20	0.72	1.19	37.1
1971	4.01	10.73	6.36	0.48	0.94	0.30	0.08	0.06	0.02	0.03	0.33	0.67	1.97	60.4
1972	2.42	8.26	6.60	0.02	0.17	0.09	0.06	0.06	0.02	0.00	0.00	0.61	1.42	43.9
1973	5.98	6.09	7.51	0.95	2.17	0.03	0.11	0.06	0.04	0.00	0.11	0.75	2.05	64.2
1974	1.96	10.20	6.04	0.59	0.11	0.00	0.06	0.06	0.04	0.02	0.32	0.90	1.74	53.3
1975	1.43	6.74	6.72	2.96	0.59	0.00	0.09	0.06	0.03	0.12	0.05	1.09	1.58	48.9
1976	3.16	6.84	6.61	0.04	0.04	0.00	0.06	0.06	0.02	0.00	0.01	0.23	1.42	44.0
1977	4.61	6.63	9.86	0.12	0.20	0.01	0.06	0.06	0.02	0.00	0.00	0.75	1.87	58.2
1978	4.35	9.71	6.98	0.46	0.56	1.26	0.13	0.70	0.02	0.00	0.08	0.64	2.16	66.7
1979	4.37	4.88	4.96	0.13	1.11	0.07	0.06	0.06	0.03	0.01	0.00	0.58	1.35	42.0
1980	5.89	6.06	2.60	0.08	0.04	0.95	0.06	0.06	0.02	0.00	0.00	0.86	1.24	38.3
1981	4.01	6.55	4.11	0.50	0.63	0.25	0.10	0.07	0.04	0.04	0.54	0.72	1.46	45.2
1982	3.97	5.94	4.95	0.64	0.04	0.00	0.06	0.06	0.02	0.00	0.00	0.38	1.34	41.4
1983	3.26	5.27	3.38	1.55	0.67	0.03	0.06	0.06	0.02	0.02	0.24	0.68	1.28	39.5
1984	2.42	7.68	5.52	0.37	0.46	0.00	0.06	0.06	0.05	0.01	0.04	0.48	1.43	43.9
1985	2.48	7.33	4.20	0.44	0.26	0.07	0.22	0.06	0.03	0.02	0.09	0.38	1.30	39.8
Average	3.37	7.21	5.76	0.70	0.68	0.09	0.10	0.09	0.03	0.01	0.11	0.67	1.57	48.43

Source: P.T. Mettana, "Ila Kulit Reservoir Simulation Studies - December 1988

ESTIMATED MONTHLY DISCHARGE AT DAM SITE

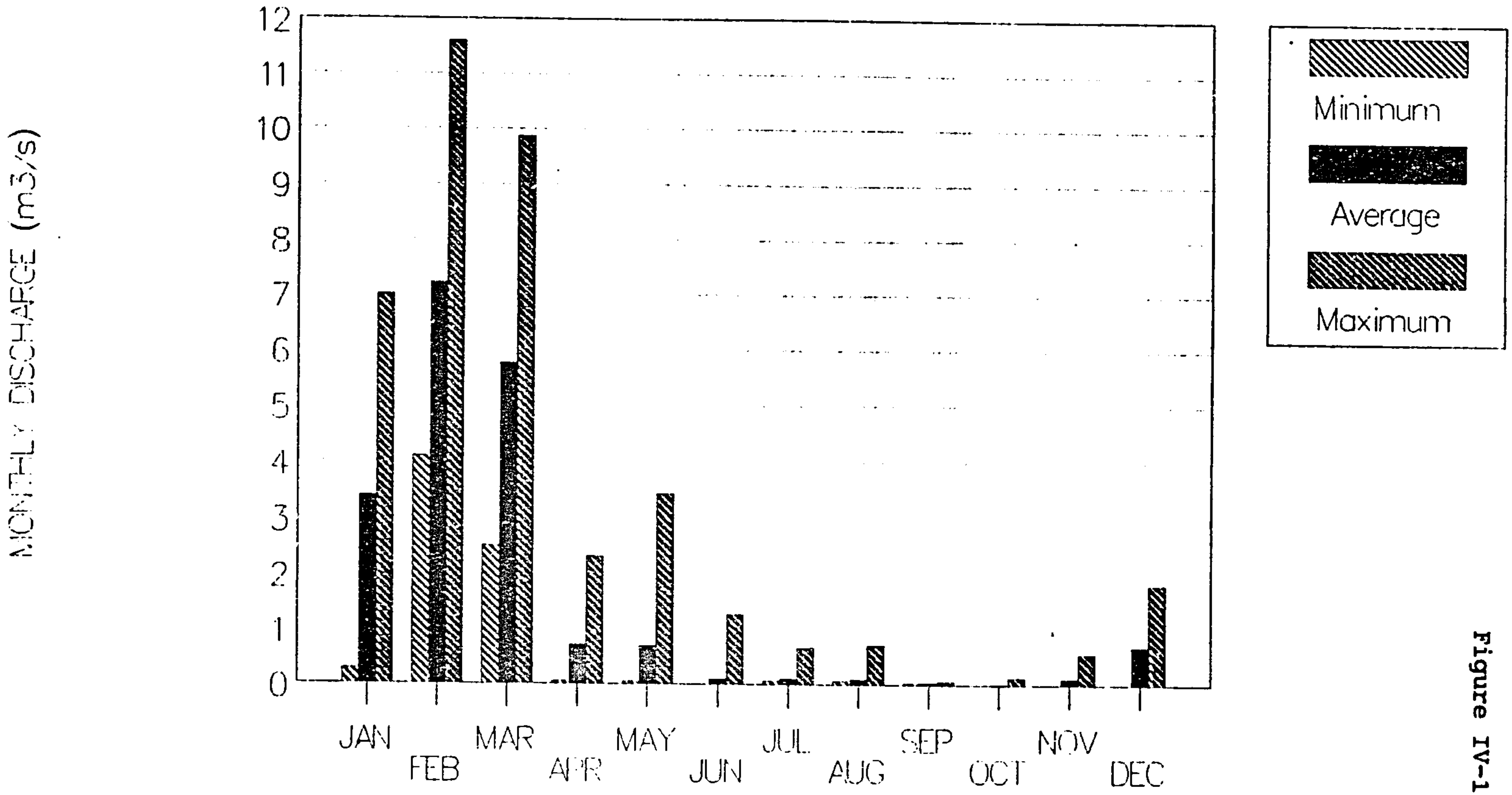

Figure IV-1

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Water Quality

Water samples were taken in August 1988 at eight locations in the project area (Figure IV-2) for analysis at the Water Quality Laboratory of Mataram University. The sample sites were as follows:

A1. At the dam site.

A2. On the Pemasar River, just upstream of its confluence with the Tiu Kulit River.

A3. Immediately downstream of the bridge at Simu, i.e., 750 m downstream of the confluence of the Pemasar and Tiu Kulit Rivers.

A4. Immediately downstream of Maronge Village.

A5. In the estuary of the major drain located north of the Maronge River.

A6. In the estuary of the main channel of the Maronge River.

A7. On the Brang Kolong, immediately downstream of the bridge at Brang Kolong Village.

A8. In the Maronge River estuary, approximately 5 km from the coast.

In addition to the laboratory analyses, certain measurements (pH, temperature) were made in the field. The results, shown in the Table IV-4, indicate a relatively clean, neutral to slightly alkaline, silt-free stream. The two samples from the estuary region showed high levels of suspended solids and sulfate ion, presumably due to tidal action and the presence of acid sulfate soils of the delta.

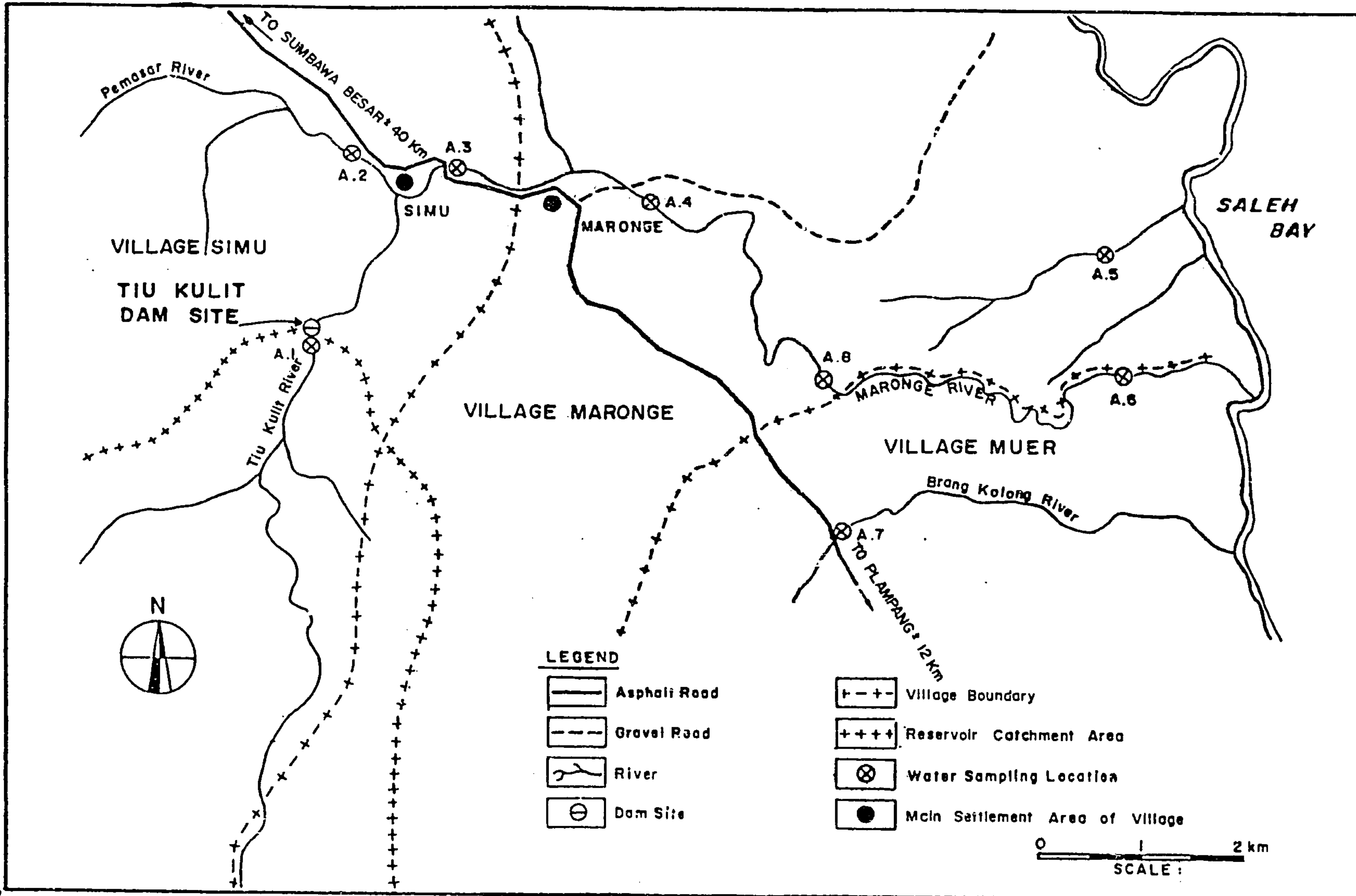


Figure IV - 2
Water Quality
Sampling sites

Table IV-4

WATER QUALITY IN THE TIU KULIT PROJECT AREA

Sample Location	pH	Total Suspended Solids (mg/l)	SO_4 (mg/l)	NO_3 (mg/l)	Cl (mg/l)	NH_4 (mg/l)	Alkalinity as $CaCO_3$ (mg/l)	Fecal Coliform Bacteria (MPN/l)	Chemical Oxygen Demand (mg/l O_2)
A1	6.8	242	15.84	0.45	0.83	0.0097	148.43	6	9.79
A2	6.4	330	23.86	5.79	0.71	0.0103	143.89	2	24.99
A3	6.9	277	17.90	0.60	0.93	0.0083	157.50	6.5	-
A4	6.9	428	38.68	0.35	1.28	0.0143	170.10	10.5	11.68
A5	7.3	43,982	2937.70	4.42	-	0.0175	163.04	10.5	79.27
A6	8.0	51,713	3394.87	5.49	-	0.0157	161.02	2	92.85
A7	7.5	559	292.78	0.81	1.50	0.0053	312.48	7.5	3.47
A8	7.5	575	35.39	0.10	2.33	0.0135	345.74	7.5	18.63

Source: Laboratory Tests and Field Measurements, 1988.

Ground Water

The ground water occurrence in this region is closely related to the distribution of the geological units. It occurs in joint fractures, foliation planes or weathered portions of the consolidated old volcanic rock units in the hilly or mountainous area of this region, and within the intergranular pore spaces of the unconsolidated alluvial sediments in the low topographic portions of this region. The ground water potential in the consolidated rock units is very poor because it occurs in the limited thickness of the upper zones of the jointed or weathered products of the bed rock formation. The unconsolidated alluvial sediments, on the other hand, have usually poor to fair ground water potential.

The unconsolidated alluvium deposited along the river valley of the Tiu Kulit and Maronge Rivers tend to be shallow. Bedrocks of old volcanic rocks are exposed along the river banks and numerous isolated old volcanic hills extend up through this plain. These river alluvial sediments have rather limited ground water potential, but are sufficient for most domestic water demand by dug wells, even during the dry season.

A relatively widespread alluvial plain occupies the eastern end of this region which will be within the proposed Tiu Kulit irrigation area. This plain is covered mainly by unconsolidated sediments of alluvio-marine origin overlying the basement of old volcanic rock. Infiltration of precipitation and runoff from the adjacent high lands supported by infiltration of surface irrigation water give this plain a relatively higher ground water potential.

Ground water in the unconsolidated alluvial deposits is generally unconfined. Its static water level is a few meters below the land surface.

Up to the present time, the use of ground water is still limited to households and to some extent for watering livestock, particularly within the villages of Simu and Maronge. The river alluvial deposits distributed along the river valley between the villages of Simu and Maronge consist of medium to coarse sand and are moderately to highly permeable. These deposits constitute a ground water body from which sufficient supplies of water for domestic demand can be recovered. The texture and thickness of these river deposits vary considerably, and their water-yielding capacity also differs from place to place.

There is a general lack of knowledge of ground water availability, particularly within the alluvial plain covering the area east of Maronge. Within this plain, rainfall is the ultimate source of water which sustains the water bearing formations underlying this plain. Other sources of replenishment are infiltration from the river or return seepages from water used to irrigate the available lands. Of these sources of recharge, direct penetration of rainfall is probably the most important. The rate and amount of infiltration generally depend on several variables, among which the rainfall and permeability of the soil are the most important.

If it is assumed that 10 percent of the annual precipitation within this plain infiltrates into the water table, and the average annual precipitation of this plain is 1,100 mm, then the annual groundwater recharge of one square kilometer would be:

0.1 x 1100 mm x 1000 m x 1000 m = 110,000 m3/year

For each square kilometer, if the ground water is developed, abstraction should not exceed this estimated recharge (110,000 m3/year or 3.49 l/s), unless it can be shown later, by test wells and pumping tests, that the ground water recharge is greater than this estimate.

The quantity of ground water estimated here would be suitable for domestic supply, but would not be sufficient to irrigate very much land.

Domestic Water Use. Most households in the project area rely on wells or, depending on location, the river, for domestic water. Drinking water is boiled before use, and will continue to be boiled, with or without the project. During the drier months, water availability becomes a problem and people utilize the subsurface flow of the Tiu Kulit River by digging shallow wells. The water thus collected is of fair quality, having been filtered, to some extent, through sand.

The water survey team made inquiries of households regarding the amount of water used. The results indicate a per capita use of approximately 21 liters per day (l/cap/da), a figure in fair agreement with the 25 l/cap/da initially assumed by Mettana (1988) for domestic piped water demand. The field team estimated a drinking and cooking water demand of 8 l/cap/da at Simu and Maronge, and 6 l/cap/da in the downstream area of Muer. Consumption in the dry season apparently is slightly higher than in the wet season in the downstream parts of the area. Other uses (bathing, laundry, and sanitation) require approximately 16 l/cap/da upstream and 11 l/cap/da downstream, irrespective of season. Some of these repeated activities take place in the same water of river pits, so water is not consumed.

These figures indicate that the total domestic water demand of Maronge area population, taken as 9,000 people in Simu, Maronge and Muer villages, is roughly 200,000 liters per day, or 2.3 l/s. This represents a river flow of only 0.0023 m3/s. Even that amount, however, is not always obtained easily during the drier months.

Land Resources

Land Use

The population of the Tiu Kulit catchment area is almost entirely settled on the coastal plain, resulting in a sharp division of land use between the upper catchment area (upstream of the dam site) and the lower catchment area. Land use in the catchment area is summarized in Table IV-5 and in Figure IV-3.

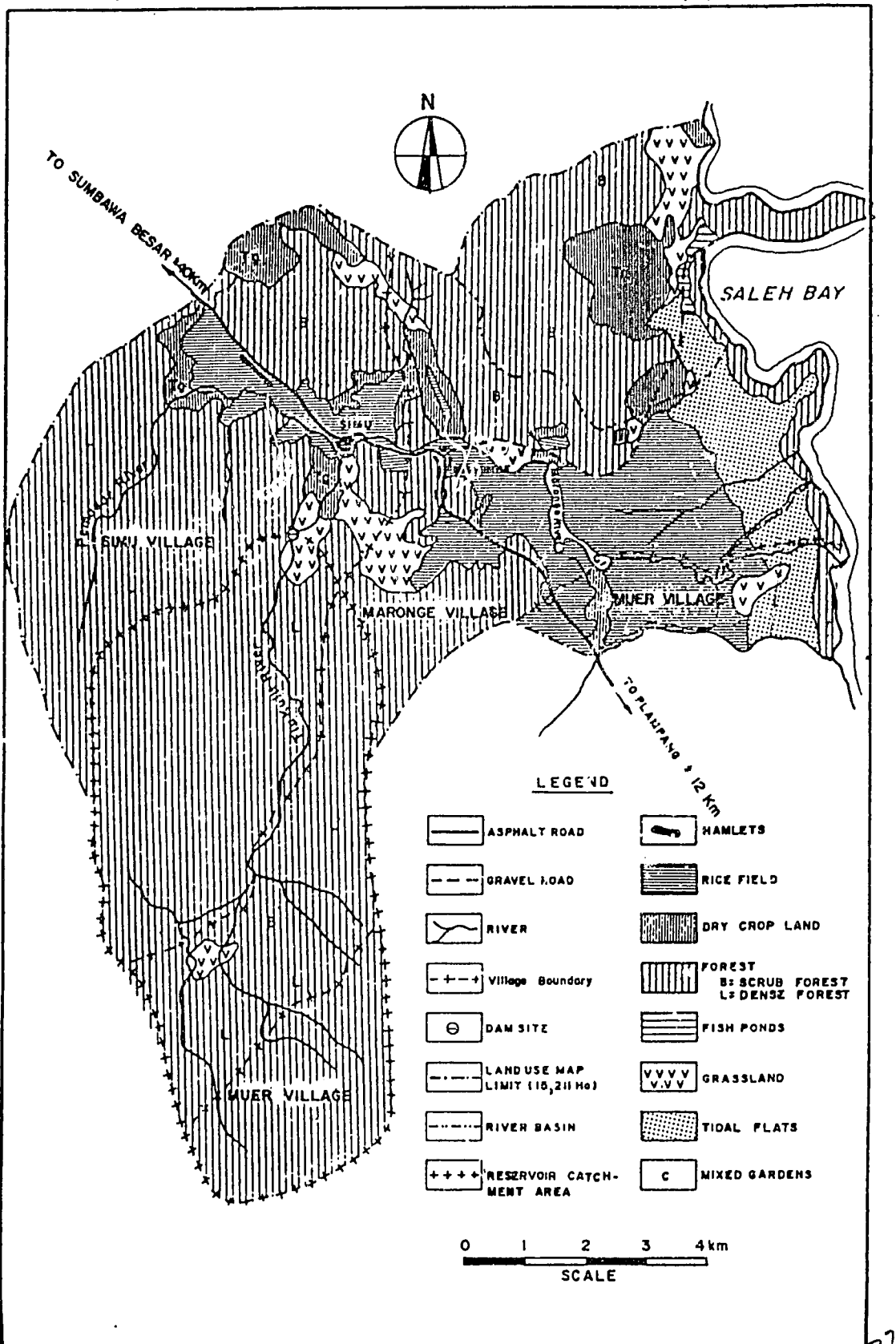
The upper catchment area, totaling approximately 5,400 ha, is some 85 percent clothed in dense tropical deciduous forest, with nearly all of the remainder in brush (5 percent), bamboo forest (6 percent), and teak forest (3 percent). The upper part of the Pemasar River catchment area shows similar land use but contains a greater percentage of deciduous forest. Both areas are roadless and, lacking villages, have only rudimentary trails.

By contrast, the coastal lowlands are intensively developed, with forest remaining only on the isolated hills. Although there remain many scattered clumps of vegetation, the dominant land use on relatively level areas of the coastal plain

is agriculture, while the hilly areas are left wooded. The forest nearer the coast is a dry shrubland and most of the areas within reasonable walking distance of villages are heavily cut for fuelwood and timber. Another major source of fuelwood is the "living fences", i.e., closely planted trees which fence off fields and living areas. The tree fences are cut back during the dry season each year, providing large quantities of fuelwood. The Environmental Studies Center estimates daily fuelwood consumption at 3 to 5 kg per family on average.

SMALL-SCALE IRRIGATION
MANAGEMENT PROJECT

Figure IV - 3
Land Use In
Tlu Kulit Area



The proposed gross service area of 1,790 ha is made up of 88 percent lowland, 9 percent upland, and 3 percent grassland and brush areas. In an average year, 90 percent of the proposed service area is cultivated in the wet season. Paddy and secondary crops constitute 91 percent and 9 percent respectively of the wet season planted areas. In the dry season, roughly 20 percent of the service area is planted in rainfed secondary crops (mungbean) with the remainder of land too dry to undertake cultivation. Settlements and home gardens in the area total approximately 200 ha, tree crops amount to 18 ha and there are additional areas of grassland and bush.

Table IV-5

LAND USE IN THE TIU KULIT CATCHMENT

Land Use Category	Total Catchment Area (ha)	Percent	Dam Catchment Area (ha)	Percent
Towns & Villages	64	0.4	-	-
Rainfed Agriculture	1,810	11.9	6	0.1
Irrigated Agriculture	519	3.4	-	-
Mixed Gardens	99	0.7	-	-
Savanna	51	0.3	45	0.8
Brush	2,979	19.5	330	6.2
Bamboo Forest	470	3.1	375	7.0
Teak Forest	161	1.1	145	2.7
Dense Forest	8,284	54.5	4,460	83.2
Mangrove	26	0.2	-	-
Estuary	388	2.5	-	-
Other	360	2.4	-	-
	15,211	100.0	5,361	100.0

Source: Department of Agraria, 1986. Land Use Maps, 1:25,000, using planimeter.

Soils

Soil mapping by the Directorate Pertanahan (formerly Agraria), NTB (1:25,000 scale), indicates that over the catchment area as a whole, approximately 27 percent is lowland, and consists of gray grumosols; some one percent, at the downstream end, contains a complex of grumosol-regosol-litosol. The remainder, slightly more than 72 percent, contains a complex of brown to reddish-brown Mediterranean litosol; this dominates the upper reaches of the catchment area.

In texture, these soils vary from fine (clays, clay loams, and sandy loams) to coarse (sands), with 97 percent consisting of medium-textured soils. They are well drained and under

existing conditions of rainfall and topography less than three percent ever get flooded.

Soils of the project area are generally not deep. Approximately 10 percent are less than 10 cm deep; 6 percent are 10 to 30 cm; 56 percent are 30 to 60 cm deep; 27 percent are 60 to 90 cm deep; and less than one percent more than 90 cm deep. Many fields used for cropping have less than 30 cm of soil. These soils tend to be low in organic matter and in available nitrogen, but higher in phosphorus and potassium. They tend to be moderately to slightly acid with pH usually between 5.4 and 7.2.

Erosion and Landslides

Erosion is not a serious problem in the project area, largely because the vegetative cover is quite dense. An area of about 510 ha in Simu Village is considered lightly eroded, but no areas of moderate or heavy erosion are found in any of the three villages.

Agriculture

Cropping Patterns. Rice is the most extensively cultivated crop in the project area, being planted in the wet season with the onset of rains. This onset period can vary considerably, ranging from November to January; harvest follows in the range of March to May of the following calendar year. Approximately 1,475 ha of paddy per wet season are planted, with an average of 90 percent of that area harvested. Additional area in the wet season is planted in mungbean, at an annual average of 145 ha.

Following the wet season, a limited area is planted in mungbean, amounting to 20 percent of the project area, or 360 ha. Harvest of this secondary crop occurs during July through early August; the extent of the harvest area is quite variable, depending on the sufficiency of moisture in the dry season.

Cropping intensity under the present regime is estimated at 111 percent.

Farm Practices. Current farming in the project area can be described as low-input and risk-minimizing. Without secure supplies of water, farmers are understandably reluctant to make expenditures for the water-complementary inputs recommended in rice intensification packages. Rice cultivation is practiced in a labor- rather than capital-intensive manner. While labor-intensive, cultivation practices in the project area are somewhat less so than in some densely populated areas of Lombok or Java.

Paddy. In the project area, rice is grown under rainfed or simple irrigation conditions. Rice is started in seed beds of roughly 4 to 5 percent of the area to be planted. Seeding in

the nursery is at rates of 40 to 80 kilograms per hectare. The most prevalent seed variety is IR36, reported by two-thirds of the farm survey respondents. Farmers may use the same seed stock for two or three seasons before purchasing new stock. Fertilizer and agrochemical applications in the nursery development stage are not common. After 20 to 30 days, the plants are pulled, bundled, and taken to the field for transplanting. Family, exchange, and hired labor are used in transplanting.

Land preparation precedes transplanting and involves plowing, harrowing, and puddling. The main source of draft power is the water buffalo. Water buffalo outnumber cattle in the area by fifteen to one. Tractor mechanization is not a factor in the area.

Fertilizers and pesticides, while used, are applied at rates low relative to Department of Agriculture recommendations. The type of fertilizer used is mainly urea, with some farmers reporting triple-super-phosphate (TSP) applications. When used, TSP is incorporated into the soil at land preparation, and urea is applied as a topsoil dressing two to three times during plant development, usually broadcast by hand. The only agrochemical type reportedly used in the project area survey was insecticide; no fungicide, herbicide, or rodenticide use was reported. Insecticide application is made by use of knapsack sprayers, but application rates are again low relative to recommended rates.

During the plant growth, weeding is done by hand. Practicing precise row transplanting would facilitate the use of a mechanical weeder or hoe and thus increase labor efficiency in weeding.

Harvest and post-harvest activities also are carried out by hand, employing family, exchange, and hired labor. In harvesting, the plant is cut with a sickle and moved to the threshing area. Separation of the grain from the stalk is accomplished by beating the bunched panicles against a rack or barrel. The separated grain is winnowed and then dried by sun before bagging for sale or storage.

Secondary Crops (Palawija). Mungbean is the main secondary food crop currently grown in the project area, with an average of 145 ha planted in the wet season in upland areas (tegalan) and 360 ha planted in lowland areas in the dry season. Cultivation practices are primitive. Seed is broadcast at a rate of 20 to 25 kg/ha with little or no land preparation preceding the activity. Varieties used are predominantly local. Rice straw may be scattered over the seed or on occasion harrowing may be practiced after broadcasting. Fertilization of the crop is not practiced. Weeding and crop maintenance activities are very limited, but insecticide application is commonly practiced.

Harvest of the plant is accomplished by pulling up by hand or cutting by sickle. The seed of the plant is either beaten or trampled out of the pods, separated, cleaned, and dried. While relatively less labor-intensive than paddy cultivation, mungbean production in the area still employs hired labor.

Crop Yields and Production Levels

Present crop yields and production levels for the project area are derived from data provided by the Sub-district Plampang Department of Agriculture, the project farm Household Survey, and numerous discussions with government officials and university specialists. Five-year time series data on yields were collected from Sub-district Plampang Department of Agriculture and the farm Household Survey, in an attempt to present an accurate picture. In the data from the agricultural office, the five-year average yield for the villages of the study area was 2.3 tons dried paddy per hectare. In the case of the farm Household Survey (targeted within the proposed project service area), the five-year average dry paddy yield 2.0 t/ha. For the purpose of this analysis, we have employed 2.2 t/ha as the standard for production in the proposed project area under the existing conditions. The estimated yield for mungbean is 300 kg/ha.

Livestock

The number of livestock in the three villages is summarized in Table IV-6. Livestock are used for draft power, investment, and consumption purposes. Buffalo provide the main source of draft power, and when analysis is conducted to evaluate draft requirements and sufficiency, it is found that the herd is more than adequate to supply land preparation needs under the current situation.

Independent data from the Sub-district Plampang Department of Livestock office and the farm Household Survey reveal that the majority of farmers own livestock, at a rate of about five per household. The survey revealed a fairly even distribution across the sampled farm households; the number of households that either own or manage large livestock is on the order of 80 percent.

A review of the data on land use and herd size in the Tiu Kulit project area (Tables IV-5 and IV-6) by the NTB Livestock Department indicates that the existing available fodder is sufficient to support the numbers of livestock in the area. Existing available fodder is estimated at 156,700 tons which equates to a carrying capacity of 10,730 animal units (AU). The current livestock population is 10,042 AU, so there is approximately a 7 percent surplus of fodder.

Livestock management practices in the area are generally a mix of extensive, semi-extensive, and semi-intensive practices. During the dry season, many farmers allow livestock to graze freely in grasslands and fallow fields. During cropping periods, livestock management becomes more labor-intensive with supervised grazing and tethering of animals, and cut-and-carry of grasses and leguminous tree leaves for feeding. Crop residues of bunded and upland plots, together with grasses from bunds, banks, roadsides, etc., and leaves from trees like Lamtoro and Sesbania, when used in conjunction with forest grassland, give cattle, water buffalo, goats and sheep adequate nutrition.

Table IV-6

LIVESTOCK POPULATIONS IN THE PROJECT AREA

Administrative Unit	Farm House -holds	Buffalo Qty.	Buffalo Avg /HH	Cattle Qty.	Cattle Avg /HH	Horses Qty	Horses Avg /HH	Goats Qty	Goats Avg /HH	Sheep Qty	Sheep Avg /HH
Sub-district Plampang	3,650	13,907	3.8	998	0.3	3,310	0.9	1,342	0.4	46	0.0
Maronge Village	611	3,158	5.2	317	0.5	627	1.0	294	0.5	0	0.0
Huer Village	592	2,931	5.0	72	0.1	726	1.2	234	0.4	25	0.0
Simu Village	418	1,923	4.6	96	0.2	367	0.9	181	0.4	0	0.0
Total Average for Study Area Villages	1,621	8,012	4.9	485	0.3	1,720	1.0	709	0.4	25	0.0

Source: Department of Livestock, Sub-District Plampang, 1987.

Prices and Marketing of Agricultural Production

The most important agricultural output in the area is paddy. More than half of this production is consumed by the farm household. The remainder of the crop is used as wage payment (11 percent), seed stock (10 percent) or marketed (20 percent). Paddy is sold to middlemen, who pick up and purchase at the farm; a limited amount of paddy is sold at local markets.

The average farmgate price at harvest reported during the farm survey was Rp 155 per kg husked paddy. The purchase (floor) prices reported for husked rice at DOLOG (the provincial rice and commodity procurement agency) for year 1987-1988 were Rp 202.7 and Rp 197.7 for KUD (Koperasi Unit Desa) and non-KUD sources, respectively. The price differential between the

farmgate and the purchase center (sub-DOLOG) in Sumbawa Besar is roughly 30 percent. The price of rice is stabilized by the government through DOLOG purchases and sales. The 1987-1988 floor price for milled rice was Rp 307 per kg and the ceiling price, (for Class IV rice, i.e., current production) was Rp 430 per kg. When market prices for rice drop below the floor price, BULOG (the national food procurement agency) purchases rice on the market; when rice prices rise above the ceiling price, BULOG engages in market operations to sell rice stocks. Currently, the sub-DOLOG Sumbawa has warehouse facilities for 20,000 metric tons of rice. Supplies of rice acquired by sub-DOLOG Sumbawa have averaged 5,400 metric tons for the past five years. The stock position as of June 1988 was only 2,600 metric tons--a utilization rate of only 13 percent of capacity.

Mungbean production in the area is largely for the market, with 80 to 90 percent of production sold at an average farmgate price of Rp 650 per kg. There are reported to be five to ten independent middlemen purchasing paddy, and roughly double that number buying mungbeans from farmers. These numbers indicate a fairly competitive purchasing market and imply that prices received by farmers should be fairly efficient (without distortions due to monopolistic or oligopolistic buying situations). The center from which the buyers operate is Sumbawa Besar, 40 kilometers from the project site. Upgrading of the main road connecting Sub-District Plampang with Sub-District Sumbawa Besar is underway under an IBRD road improvement project and should contribute towards improved marketing of produce and better prices received by farmers. While floor prices have been set by DOLOG for palawija crops, in fact they have been set low relative to actual market prices, and the DOLOG has not been active in price stabilization for these crops. The implication here is that farmers are subject to more price uncertainty with palawija crops than with paddy.

Sumbawa District, along with NTB Province, is an excess producer of paddy and the surplus is annually distributed by DOLOG to food deficit areas in Indonesia. Surplus palawija production in Sumbawa is said to flow to Surabaya, Java. In the cases of both paddy and palawija, there are currently developed marketing channels.

Real wholesale rice prices have grown at an average rate of 3 percent the past five years, but most of the increase occurred at the beginning of the period and there has been a stagnation of the price level in the most recent years. Real mungbean prices have grown at rate of 6 percent over the same five-year period.

The farmers' cooperative (KUD) in the project area has not been much of a factor in marketing farm output. The KUD is said to be in a state of recovery and rebuilding from earlier setbacks.

Biological Resources

Habitat

Terrestrial. Natural habitat in the Tiu Kulit catchment consists of two basic types: tropical deciduous forest, on the upper slopes, and shrub savannah, in the lower and drier areas.

The long dry season has resulted in natural woodland composed of trees that shed their leaves or go into dormancy for much of the year. Many of the trees, such as Zizyphus, are thorny. In the upper catchment, including the reservoir inundation zone, trees of fair size remain, but many of the larger specimens have been cut for timber. The plant community structure is largely one of a two-layered, discontinuous canopy, with frequent small clearings. Tamarind (Tamarindus) is dominant, with Barringtonia and Corypha also abundant. The dominant trees having timber value are jati (Tectona grandis), kolaka (Parina corymbosum), bungur (Lagerstromia speciosa), ketapang (Terminalia catappa), and laban (Vitex pubescens). The shrub layer contains numerous species, most of which have not been studied in detail in this area. In the clearings and where soils are unsuitable for trees, grass of the genera Imperata, Paspallum, Pennisetum, and Chloris dominate. Milkweed (Asclepias sp) is a common colonist of clearings.

At the higher elevations (above 700 m) the understory is thick, with bamboo, figs (Ficus spp), and pandanus (Freycinetia), and the ground cover and shrub layer less dense.

As wildlife habitat, the plant community appears to be fairly good, providing sufficient variety of cover, fruits and other plant material, and moisture for substantial animal diversity in the more secluded parts of the catchment area.

On the less sloping sections of the coastal plain, where agriculture and villages are the dominant land uses, what habitat exists is provided by orchards, scattered fruit trees, paddy fields, and a few groves of bamboo or other woody vegetation around cemeteries and shrines. Faunal use of these areas is predictably limited.

In the estuary there are small areas of mangrove (Rhizophora, Avicennia, and Bruguera), but these are not extensive.

Aquatic. The absence of perennial surface water in the area means that aquatic habitat consists of scattered pools in the river, many of which dry up or become anoxic during the dry season. These support algae, some insects--dragonflies, diving beetles, and water striders were seen by the field team.

Fauna

Detailed studies of the plant and animal life of the project area have not been done, but a 1986 report by the Forestry Department of NTB on the Dodo-Jaranpusang Forest (in the region, but not within the basin) gives an indication of the forms of wildlife that may be expected in the wilder areas. They report deer (Cervus timorensis), wild pig (Sus vittatus), and a macaque monkey (Macaca iris). Among the reported carnivores is a species of fox (Acanthyon brachyurum) and a mongoose (Viverricula malaccensis). There also are some marsupials, including a porcupine (Hystrix brachiola) and several species of rodents. Bats are an important and diverse part of the fauna.

Birds, being more mobile, are better represented in the fauna of the Lesser Sundas than mammals. White and Bruce (1986) list 121 species of landbirds for Sumbawa, many of which can be expected in the Tiu Kulit catchment. Noteworthy among these is the green junglefowl (Gallus varius), one of several species ancestral to the domestic chicken. Raptors are abundant and some, such as the owls and the Brahminy Kite (Haliastur indus) are significant predators on pest rodents in agricultural areas. A scientifically noteworthy species, observed at the dam site by the Project Environmental Scientist, is Bonelli's eagle (Hieraaetus fasciatus). A small isolated population of this species inhabits the less disturbed areas of Sumbawa, isolated by some 10,000 kilometers from the nearest other members of its species, in southern China.

The paddy fields are host to a small variety of water birds, especially the Javan pond heron (Ardeola speciosa) which may concentrate in great numbers during insect outbreaks. The tiny munias (Lonchura spp.) and the Java sparrow (Padda oryzivora) are pests on rice at times of harvest.

Socioeconomic and Cultural Resources

Population Profile

Density. The project area comprises parts of three villages (Simu, Maronge, and Muer), with a total 1987 population of 8,965. The lowest population density is found in the largely coastal village at Muer, which contains 34 percent of the total population (3,069), at 19 persons per km2. Maronge, in the heavily agricultural middle reach of the coastal plain, contains 42 percent of the total (3,757), at 36 persons per km2. The inland village of Simu contains 24 percent (2,139), at 20 persons per km2.

Age Structure. The population of the area is a young one, with 44.5 percent (3,989) less than 15 years old, 48.8 percent (4,375) between 15 and 54 (considered the working population),

and the remaining 6.7 percent (601) 55 years and older. The working-age population is 95 percent as large as the dependent population. These figures do not tell the whole story, however, as children begin productive work very early, at ages 5 or 6, and by their early teens are performing independent tasks that free adults for more arduous field labor. Similarly, many continue in the active work force well past the age of 55 years, and even when no longer capable of the more strenuous field labor, the aged contribute to domestic work.

Sex Ratio. The overall sex ratio for the three desas is 107 (males to females x 100). This is considered quite normal, as are the ratios for Simu (106) and for Maronge (102). The ratio for Muer (116) is high in 1987 (the sex ratio for Muer in 1986 was more normal, at 99).

Household Size. Households in the three project villages usually consist of a nuclear family, as is true throughout most of Indonesia. Household size averages five persons.

Education and Literacy. In the past, many children either never attended school or dropped out before completing primary school. There is not such a problem today. Of the 1,616 primary school age children (7 to 12 years old), 98 percent are attending the 10 primary schools and one kindergarten in the three villages (579 children, or approximately 6 percent are below school age). Today, attendance of girls in primary schools is equal to boys, as is true for most of Indonesia. Children who continue their education do so at the intermediate level school, located in the nearby sub-district town of Plampang, but must go to the district high school in farther away Sumbawa Besar (no attendance data available beyond primary school).

Approximately 56 percent of the population (children and adults) has completed at least primary school and may be presumed to be literate, while another 34 percent who either attended school and dropped out or are still in primary school, have some reading ability. Those who have completed junior high school and still live in these villages number only 207 (2.3 percent); of these, 110 went on to complete high school (1.3 percent). Only three individuals living here hold bachelors' degrees and one of these holds a masters' degree. Since most high school and university graduates find it difficult to find appropriate work in these villages, it is probable that graduates from high school or university have sought work in urban areas. Thus the information that few persons have higher educational attainment should not be taken to indicate the lack of higher educational attainment overall among the people coming from these villages.

Religion. The prevailing religion of the region is Islam, embraced by 99 percent of the population. The remainder are Hindus and Christians.

Income. Income levels in the project area are low, compared to provincial and national averages. An average farm in the project area, with 2.64 ha of cropland, returns a gross income of just over Rp 900,000, assuming 1.47 ha sawah (lowland), 1.10 ha of upland cropping, and 0.07 ha of orchard or home garden. Farm expenses of approximately Rp 260,000 leave a net income of Rp 640,000. This level cannot be taken as a median income level, for the majority of farms are smaller. In general, there is a direct relationship between farm size and disposable income. The most common farm size is 1.5 ha and smaller farms are on the order of 0.75 ha; these farmers have average net farm incomes of Rp 305,000 and Rp 155,000 respectively.

When household consumption is considered, per capita maintenance of Rp 9,000 per month, or Rp 540,000 per year for a family of five. Families unable to attain that figure from farm income live at a low living standard and seek supplementary sources, such as farm wage labor, fishing, wood gathering, livestock husbandry, and home industries.

Kinship and Marriage. Bilateral extended family ties are strong in the rural areas, with family members providing reciprocal labor and even economic assistance to each other in time of need and for ceremonial occasions such as weddings and funerals. Marriage partners are sought within the immediate village or in the region, usually within the same religious and ethnic group. Usually agricultural land is inherited by sons, with daughters receiving their inheritance in the form of household goods and some cash at the time they marry. Generally, houses are inherited by the youngest child as this person tends to remain living in the parental house after siblings have married and moved out.

Health and Disease

Clinical records at the Sub-district Plampang offices indicate that the most common health problems of the local population for which they seek medical attention are those of the respiratory system, digestive system, and skin. Local awareness of disease causes and cures is low, so the clinical data must be taken as only a general indication of local conditions. Overt conditions, such as diseases of the eyes or skin, and those that severely weaken an individual abruptly, are more apt to cause an individual to seek treatment than some others that may be more life threatening. Reported diseases in 1987, in order of frequency, were: skin diseases, 316 cases; arthritis, 304; influenza, 261; anemia, 222; gastroenteritis, 219; eye infections, 118; malaria, 85; vitamin deficiency, 46; tuberculosis, 24; and ear infections, 18. These data bear little relationship to the actual incidence of the diseases. Malaria, for example, is endemic in the area, not limited to one

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reported cases. It is debilitating but rarely the primary cause of death. It does, however, render a person more likely to succumb to flu or gastroenteritis.

There are three health clinics in the project area, two in Maronge and one in Muer. They are served by a collective staff of one doctor (who also serves other clinics in the region), six nurses, and one midwife. There is an administrative staff totaling ten.

Attitudes Toward the Project

People in the project area are greatly in favor of the project, representing as it does a major improvement in water availability for agriculture. They do not oppose the taking of part of their land for project structures.

Cultural Resources

Interviews were conducted by the PSL field team with local government officials, village leaders and farmers in and around the project area. The interviews revealed that there are no special cultural or religious shrines in the area, except for a hot spring ("buin aik panas") located south of the catchment. Elder farmers mentioned the spring was believed to be haunted and therefore shunned.

There is a cultural mystique to working the fields that seems to originate in respect for the soil and for rains as the source of life.

Regional Infrastructure

Roads. The project area is traversed by a two-lane asphalt road, the main east-west highway of Sumbawa. That road currently is being improved as part of a project funded by the World Bank. There are also 18 km of graded earth roads and about 30 km of feeder roads, passable in dry weather only, in the project area.

There are several rice mills and warehouses in the project area. The public market in Maronge serves the area, as a supplement to scattered small shops in all three villages.

There is no piped water or sanitation system in the area; human waste flows or is thrown into the drains and rivers.

Settlement Pattern and Administrative System

Settlement Pattern. The settlement pattern and administrative system are interlinked. Within the village (desa) are a number of sub-areas (dusun), each with several hundred people. The dusun are composed of hamlets with one or more administrative units (rukun tetangga, referred to as "RT") of 25 to 50

households (rumah tangga, or, referring to the household head, kepala keluarga, "KK"). Simu Village has four dusun and Maronge and Muer Villages each have three.

In the smaller, more isolated hamlets, most dwellings are made of local materials: timber, bamboo and palm thatch, in an architectural style known as panggung. House floors are usually wood, elevated one to two meters above the ground. Greater prosperity, usually along the main road, is reflected in concrete or brick houses, corrugated or tile roofs and glass windows.

Administrative System. Village heads (kepala desa) are appointed by the sub-district government. Village administrative officers (pamong desa), including secretary and office staff, are responsible for handling administration, development, welfare, finances, and miscellaneous administrative and record-keeping duties. The kepala desa is advised by the LKMD (Lembaga Ketahanan Masyarakat Desa), a kind of planning council at village level. Members of this council are local key persons and representatives of semi-governmental organizations like the rural women's group (Program Kesejahteraan Keluarga, or "PKK"), key or contact farmers (kontak tani), the malar, or water users' association leaders (P3A), and village unit cooperatives (KUD). Proposals are made by the village advisory body, known as the "LMD" (Lembaga Masyarakat Desa), who finally make recommendations to the kepala desa. In practice, the quality of the village administration strongly depends on the capabilities of the village leaders.

Farmer Organizations

In addition to the village and hamlet organizations, the farmer has an opportunity to receive support and assistance from three farm-oriented systems.

Kelompok Tani. Farmers groups have been organized under the existing extension system in accordance with the Training and Visit system model. There are 16 groups under the field extension agent (Penyuluhan Pertanian Lapangan, or "PPL") that covers the villages of Maronge and Simu and another 16 groups in a neighbouring area that includes the village of Muer. These farmer groups are headed by a contact farmer who is assisted by five leading farmers (tani teladan), who are each supposed to guide another twenty farmers in their surrounding areas.

Koperasi Unit Desa (KUD). While a farmers cooperative KUD in Maronge has been established for some time, it has been largely non-functional in recent years. Credibility has been a problem due to earlier setbacks. The scope for growth and increased activity with the arrival of irrigation is substantial. Farmers could benefit from combined processing, storage and marketing of crop outputs, and from bulk input purchases, transport and storage.

Pooling of resources would also enhance access to credit through both government (e.g., KUT and KUPPEDES credit program). But without improved management, training and active farmer participation, KUD realization of these benefits is not likely. The general record of farm cooperatives in developing countries has not been favorable.

The Malar System. The current simple irrigation schemes are organized around malars, who are agriculture and water distribution managers from the villages in charge of distinct agricultural subcommand areas. They are active in seeing that fences and simple irrigation facilities are maintained, and supervise distribution of water supplies during wet season periods when river water is available for diversion into canals. Each system is headed by a chief malar, assisted by other malars responsible for subsections of the service areas. The position is held for varying durations of time with supervision provided by village officials. The malar sometimes receives compensation on the order of 0.5 to 1.0 percent of farmer yields.

Chapter V

POTENTIAL ENVIRONMENTAL IMPACTS

There are three major phases to the Tiu Kulit Dam Project: preconstruction, construction, and post-construction, otherwise known as the operation and maintenance period. Within the preconstruction phase are several subcomponents, including this Environmental Assessment, the 'feasibility' study that results in the Project Justification Report, and completion of the final design and tender documents. The subcomponents of the preconstruction phase are now nearly complete as the Environmental Assessment, the Project Justification Report and the final design and tender documents have been submitted for review by the Department of Public Works and USAID.

As noted in Chapter I of this Environmental Assessment, the focus of this study is the result of an early Scoping Session, held in Mataram in July 1986 (Appendix D to this report). The information contained in this report is also based on subsequent field visits to the site by environmental experts who prepared this report.

Virtually all of the potential environmental impacts that have been identified, refer to post-construction, or operational impacts. However, the Tiu Kulit Dam Project preconstruction phase had some minor physical impacts where test bores were made and where a water level measuring recorder was installed. The work accomplished during the feasibility assessment by contractors also resulted in wood and cement survey markers being installed. Work during the preconstruction phase produced generally positive social impacts among the local population, and raised public interest in the likelihood of receiving irrigation. The only negative social impact of the preconstruction work has been where some farmers had to give up some agriculturally productive land to be used as the site of the dam and reservoir, for some borrow areas, and for primary and secondary canal routes. This project remains incontroversial in the area since it does not entail any resettlement. In general, the preconstruction phase was viewed enthusiastically by the local population.

Potential environmental impacts during the construction phase will mostly be temporary ones. The local population will positively benefit from increased employment opportunities and from increased demand for locally procured goods and services while construction crews build the system. The local population will probably be somewhat inconvenienced by increased noise and dust, and there will be some limited disruption of agricultural production along canal routes, as they are built.

The following details the potential environmental impacts that are likely to be more long term, occurring mostly in the post-construction phase of the project.

Water Resources

Streamflow Characteristics

The major objective of this project is the geographic and temporal redistribution of water, storing approximately 10 MCM early in each wet season for distribution to cropland during the latter part of the wet season and into the dry season. The filling of the reservoir will take approximately 20 percent of the 48 MCM estimated by Mettana (1988) as the average annual discharge of the Tiu Kulit River. Depending on the vagaries of rainfall, the reservoir will begin to fill in late November and continue filling until mid-February, allowing for the irrigation discharge of approximately 1.0 m3/s during that period.

Reservoir operation studies show that the full-reservoir condition usually will continue from February through March, and often into April or May. (See Table V-1, Reservoir Simulation for a Typical Year.) Excess inflows during the period, above the required irrigation releases, will be spilled creating streamflow downstream of the dam. The pattern of streamflow during this period of spilling will resemble pre-project conditions, though flood peaks will be substantially reduced. Irrigation releases for the sawah will peak in April at 1.6 m3/s. The reservoir will begin its drawdown in April and reach its minimum level in November.

Minimum operating level for the reservoir is El. 41.8, which corresponds to a dead storage allowance of 0.8 MCM. In very few years will the reservoir actually draw down to below El. 42. This would permit, if necessary, a minimum release from the reservoir during the dry season so that the river channel downstream of the dam does not dry up completely and create hardship for the local people. A minimum release on the order of 10 liters per second (26,000 m3/mo) would be sufficient to meet the household needs of the local people, and would not perceptibly affect the irrigation operations.

Any reservoir minimum release will be augmented from other sources which will contribute to river flows during most or all of the year:

1. runoff from tributaries which enter the Tiu Kulit River downstream of the dam
2. subterranean flow in the shallow aquifers, which occurs under present conditions
3. seepage from the reservoir
4. spill from the reservoir
5. irrigation return flows.

A general indication of the change in streamflow pattern from the pre-project to the post-project condition is illustrated in Figure V-1. The figure shows monthly streamflows for a typical year with near-average flows. The post-project condition shown includes estimates for seepage and spill from the reservoir.

Ground Water

The increase in surface water on a year-round basis and normal seepage from the reservoir is expected to augment ground water, and generally improve the capacity of shallow wells in the immediate area.

Seepage from the reservoir will enter the shallow alluvial aquifers of the river valley and make its way downstream resulting in an increase in streamflow over present conditions. During the dry season, when the ground water table of the alluvial aquifers are lower than the stream level, some recharge will occur through seepage of river water to the surrounding lower water table. The amount thus supplied to the water table depends on the topography and the extent of the river valley, as well as on the thickness and storage capacity of the permeable layers throughout the valley.

The river alluvium, as indicated by the exploratory drilling carried out at the dam site, ranges from 3.5 to 6.5 m in depth. These alluvial beds are very pervious (K = 0.01 m/s) and the saturated water table thus ranges between 1.5 to 5.5 m below the actual river bed. The storage capacity of this pervious layer is considered to be between 10 and 20 percent. Extrapolating from these assumptions, each hectare of river bed would contain the following volume of stored water:

$$0.15 \times 3.5 \times 100\ m \times 100\ m = 5{,}250\ m3/ha$$

This additional recharge from streamflow will constitute a substantial supply of ground water during the dry season.

In addition to this direct recharge from the stream, water infiltrating from the open earth canals, as well as deep percolation from the irrigated lands will replenish the local ground water table, particularly during the dry season. During the wet season, ground water under the irrigated lands is mostly recharged by precipitation.

The infiltration capacity of a soil at any time is the maximum rate at which water will enter the soil. Once all of the soil pore spaces have been saturated with water, further downward movement of soil water to reach the water table is controlled by the permeability of the subsoil and duration of time that irrigation takes place.

Table V-1

RESERVOIR SIMULATION FOR A TYPICAL YEAR

Spillway Crest Elev. : + 57.0 m -- Year : 2000
Max. Storage Capacity : 10,804,300 m3
Min. Operation Capacity : 763,628 m3 for 1st - 30th years
Min. Operation Capacity : 1,536,865 m3 for 30th - 60th years

Half Month	Starting Storage 10^3 m3	Water Surf. Elevation m	Inflow to Res. 10^3 m3	Losses Evap. 10^3 m3	Losses Seepage 10^3 m3	Diver. Reqt m3/ha	Irrig. Area ha	Total Release 10^3 m3	Spill 10^3 m3	Ending Storage 10^3 m3
Dec 2	4932.57	50.59	518.40	55.79	2.37	0.59	1700	995.25	0.00	4396.96
Jan 1	4396.96	49.86	2958.34	51.22	2.26	1.13	1700	1920.02	0.00	5381.80
Jan 2	5381.80	51.18	2773.44	55.21	2.31	1.11	1700	1881.53	0.00	6216.18
Feb 1	6216.18	52.21	8987.33	53.87	2.29	0.32	1700	540.81	3802.24	10804.30
Feb 2	10804.30	57.00	8987.33	71.04	2.92	0.15	1700	249.81	8664.56	10804.30
Mar 1	10804.30	57.00	10547.71	81.18	3.34	0.81	1700	1381.85	9081.35	10804.30
Mar 2	10804.30	57.00	9898.48	76.11	3.13	1.30	1700	2209.81	7599.43	10804.30
Apr 1	10804.30	57.00	648.00	76.11	3.13	1.24	1700	2108.46	0.00	9264.60
Apr 2	9264.60	55.53	648.00	70.21	2.92	0.47	1700	806.37	0.00	9033.10
May 1	9033.10	55.30	124.42	73.70	3.08	0.36	1700	611.02	0.00	8469.71
May 2	8469.71	54.73	116.64	66.63	2.76	0.36	1080	370.92	0.00	8145.00
Jun 1	8146.00	54.39	0.00	65.38	2.65	0.34	1080	641.05	0.00	7436.81
Jun 2	7436.81	53.62	0.00	62.61	2.63	0.59	1080	727.83	0.00	6643.71
Jul 1	6643.71	52.72	82.94	63.42	2.34	0.67	1080	1067.49	0.00	5593.06
Jul 2	5593.06	51.45	77.76	55.79	2.32	0.99	1080	969.98	0.00	4642.71
Aug 1	4642.71	50.20	82.34	53.22	2.04	0.90	1080	659.90	0.00	4010.21
Aug 2	4010.21	49.28	77.76	45.49	2.05	0.61	1080	0.00	0.00	4040.44
Sep 1	4040.44	49.33	25.92	45.69	2.04	0.00	1080	0.00	0.00	4018.62
Sep 2	4018.62	49.29	25.92	45.55	2.04	0.27	1040	280.35	0.00	3716.60
Oct 1	3716.60	49.63	13.82	46.43	2.11	0.40	1040	414.06	0.00	3267.83
Oct 2	3267.83	48.09	12.96	40.37	1.87	1.18	1040	1223.84	0.00	2014.71
Nov 1	2014.71	45.60	12.96	30.86	1.53	1.16	1040	1207.66	0.00	787.62
Nov 2	787.62	41.96	12.96	15.70	1.02	0.00	1040	0.00	0.00	783.87
Dec 1	783.87	41.94	1105.92	16.71	1.08	0.00	1040	0.00	0.00	1872.00
Total:	140014.30	--	47729.95	1319.28	57.05	--	3860	20267.62	29147.58	142953.73
Average:	5093.93	51.42	1989.75	54.93	2.38	0.61	1287	844.48	1214.48	5956.41

Source: P.T. Multatuna, Final Report Design Note, April 1989

PROJECT IMPACT ON STREAMFLOW REGIME

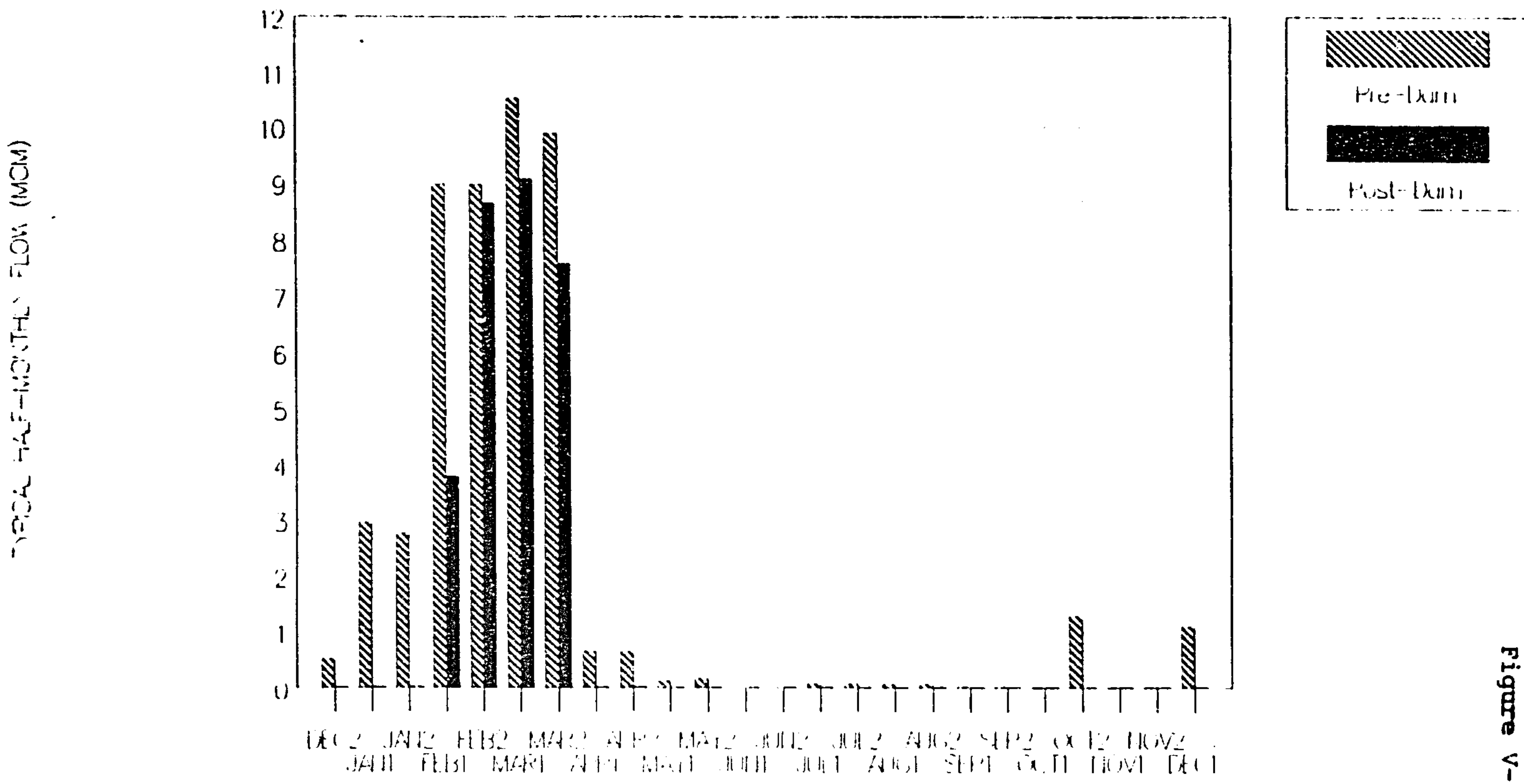

Figure V-1

Results of infiltration tests conducted at Plampang (Fenco, 1982) show the infiltration rate of the soil is about 2 mm/da. The rate of recharge to the ground water table will be less, due to evaporation and transpiration losses. If it is assumed that 20 percent of the infiltration reaches the water table and the total time duration for irrigation of cultivated lands during the dry season is 60 days, then the total amount of irrigation water that replenishes the ground water for each hectare during the dry season is:

0.2 x 0.002 m/da x 60 da x 100 m x 100 m = 240 m3/ha

Assuming one-third of the service area (567 ha) is irrigated during the dry season, the amount of irrigation water percolating into the water table is 136,000 m3, which represents about 8 percent of the irrigation water applied to the third season mungbean crop. To this must be added seepage from the irrigation canals.

As to the upstream portions of the dam site, it is likely that there will be a small impact to the ground water condition of this area, except that the water level of the existing ground water surrounding the reservoir will become much shallower. The possible recharge to groundwater in the downstream direction of the dam site is also small. This is due to the fact that most of the rock formations underlying the reservoir are dipping southwards, that is, against the downstream direction. In addition, the foundation treatment for the dam, including curtain grouting, will reduce the seepage capability of the underlying rock formation surrounding the reservoir.

Water Quality

Upstream. The quality of the water in the reservoir will be essentially the same as that of the river under present conditions, less virtually all of the sediment load. There are no significant pollution sources in the upper watershed that would contaminate the reservoir.

For the first year or so, the nutrient level in the reservoir will be influenced by the decay of any vegetation left standing at the time of first filling. The density and height of the forest in the reservoir, however, are such that even if no clearing is done at all, the effect on water quality would be negligible. The reasons for this are as follows:

1. The reservoir, being relatively deep and narrow, will have a high proportion of water volume to vegetative biomass.

2. Even under conditions of first filling, there will be a high rate of flushing, as water is removed from the reservoir for irrigation.

3. The drawdown of the reservoir prior to the onset of rains will flush out nearly all of the nutrients released into the water by the decay of vegetation.

Some pockets of anoxic water must be expected in the shallow embayments of the reservoir where vegetation was most dense at the time of inundation. On the whole, allowing for mixing, the water quality in the reservoir will be suitable for irrigation and domestic use from the first filling.

Service Area. Water entering the irrigation system will be good quality, as it is at the dam site under pre-project conditions. How long that quality will be maintained will depend on whether waste discharges into the canals are curtailed and on what non-irrigation use is made of the water. The canal water, at its worst, will be of better quality than the surface water available to people of this area under present conditions. In general, the main stem of the Tiu Kulit River probably will contain the best water during the middle part of the wet season, when the dam is spilling, but the canal system probably will be better during the rest of the year. The reach of the river from the dam to the main Simu hamlet (about 2.5 km), will not receive significant return flows, and should maintain good quality year-round.

Downstream. Water quality in the river all the way downstream is likely to be degraded somewhat, especially during the dry season, when irrigation return flows, bearing some fertilizers, pesticides and considerable human and animal waste, will be the main source of flows. The assimilative capacity of the river will be low, so the use of water in the main stem of the river for any purpose other than livestock watering would pose a risk to human health.

Land Resources

Land Use and Capability

Most of the land to be irrigated under this project already is dedicated to agriculture, but much of it produces only wet season crops. Little land is expected to be brought into irrigated agriculture.

The main and secondary canals for the project, totaling 23 km in length and about 10 m in total width (including the service road), will consume approximately 23 ha of land, most of it now in agriculture or along the field fringes. Parts will lie in the alignments of existing small canals. The tertiary system also will take strips of land from the edges of fields.

Project structures themselves--the dam, spillway, work areas, borrow and spoil areas--will take land that currently is covered with brushy forest. Most of the materials sources are

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within the inundation zone of the reservoir or from the required excavation for structures. The clay borrow areas are an exception, and could affect a total of up to 31 ha of land at several locations downstream of the dam site. The contractor will be required to restore all borrow areas to a smooth and natural appearance with adequate drainage.

The project drainage system will require some land now in agriculture. The total length of drainage canals in the irrigation area will be about 33 km, so the total area required will be approximately 5 ha. The distribution of land taking for drains will be very broad.

There is no evidence of the need for deep drains to lower the water table in any part of the existing service area presently under active cultivation. There is expected to be instances where the alignment of the new canals will traverse or cross existing natural drains, thus necessitating construction of a drainage channel immediately adjacent (above) the newly built secondary or tertiary canal. In almost all such instances, material from the excavated drainage channel will be used in a balanced cut and fill operation to construct the secondary or tertiary canal.

Soil Chemistry and Waterlogging

No significant changes in soil chemistry are expected to occur with the project. Increased soil moisture is the general objective of the project, of course, to be accomplished in a controlled manner. Waterlogging and the attendant salinity problems are not common in Indonesian irrigation projects, partly due to the requirements of rice soils, partly to high ambient relative humidity, and partly to the use of effective drainage systems. Any build-up of salts that might occur in the surface soils during prolonged dry periods will be thoroughly flushed out by the heavy annual rains.

Erosion, Sedimentation and Soil Movements

Erosion and sedimentation rates in the catchment area are of interest because of the potential impact on the operation and overall life of the project due to sediment accumulation. A high rate of sedimentation could reduce the active storage volume of the reservoir to such an extent that the project benefits would not be achieved over time. Also, the design and operating procedures for the outlet works might need to be modified to accommodate sediment deposition.

A qualitative review of the Tiu Kulit catchment area indicates that erosion and sedimentation should not be a serious problem. The catchment has a dense deciduous, bamboo and teak

studies reported that there were no areas of moderate or heavy erosion in the project area; only some 510 ha in Simu Village were classified as lightly eroded.

Extensive forest clearing in the future is not likely to be a problem since the timber resource itself in the catchment is not extensive and the steepness of slopes makes extraction difficult. In addition, the Tiu Kulit dam and reservoir will effectively cut off existing access into the catchment area, so any future timber cutting will be more easily controlled.

An estimated soil erosion rate of 0.5 mm/yr over the catchment area has been adopted for design of the Tiu Kulit Project. To accommodate sediment inflows and deposition over the life of the project, a dead storage volume of 0.76 MCM has been allowed in the reservoir. In addition, a dual-level outlet works intake structure has been adopted. As sediment deposition begins to encroach on the entrance to the lower level intake sometime around year 30, the outlet works intake will be raised. The higher level intake will permit full reservoir operation through the 60-year project life.

In the Tiu Kulit irrigation system, erosion of the earthen works is a problem whose solution lies in effective design of canals to maintain low water velocities and to avoid unlined sharp bends where erosion can be expected. Project roads are being design with effective drainage and foundations so as to avoid erosion. The permanent access road will be constructed to Bina Marga Class 3 standards, with construction supervision by PU inspectors. Cut slopes will be flat enough to ensure no local slope failure; earth cut slopes will be sodded.

A serious source of canal bank erosion is the use of the channels for washing and bathing livestock. Additional availability of water in the dry season is likely to lead to an increase in this activity, to the detriment of the canals. This is discussed further under "Water Use," below.

Biological Resources

Habitat

Terrestrial. The only significant habitat change resulting directly from the project will be the conversion of some 100 ha of hillside seasonal forest (plus some 10 ha of river bed) into a reservoir and dam site. Some qualitative changes will occur in the vegetation along the edge of the reservoir over a number of years, (probably 20 or 30), due to the presence of higher groundwater near the reservoir. This will favor trees that are less tolerant of drought conditions, and may result in a narrow belt of evergreen vegetation along the reservoir margin.

The drawdown zone of the reservoir, however, will support no vegetation whatsoever, there being no plants in the region able to withstand long periods (several months) of total immersion, followed by water withdrawal and drying out. Submerged aquatic plants growing under those conditions are dessicated on drawdown and denied light on filling. Deep reservoirs all over the world show the same characteristics: when drawn down, the banks are bare gravel with some deposits of silt or mud where streams enter. When clearing is not performed, the bare skeletons of forest trees remain for many years, but eventually they are destroyed by insects and bacteria.

Aquatic. As aquatic habitat, the reservoir will possess minimal value. Worldwide experience with deep reservoirs subject to severe drawdown is that such water bodies never get a chance to develop the complex food chains and species diversity that characterize stable, shallow lakes. The nearest example of the latter is Lake Taliwang, which, for all its weed problems, is a high productive ecosystem. The opposite will be true of the Tiu Kulit reservoir, whose aquatic productivity will be inhibited by the following factors:

1. Low nutrient inflow. This will be offset initially by decaying vegetation, but after about a year the reservoir ecosystem will have to rely on what nutrient is carried in by the Tiu Kulit River.

2. Great depth. Most of the reservoir's water will lie below the region of effective light penetration (known as the "euphotic zone") in which photosynthesis is able to take place.

3. High flushing. Any aquatic organisms that are not attached to the bottom are likely to be carried into the canal system with the irrigation water. Those organisms that are not flushed away will find themselves in the small pool of the maximum drawdown, where water temperature will be high and dissolved oxygen low.

Therefore, the concern expressed at the 1986 Scoping Session, that the Tiu Kulit reservoir might become a weed-clogged replica of Lake Taliwang, is groundless. The reservoir is unlikely to support a significant amount of aquatic vegetation, floating or rooted.

Species of Special Interest

Rare or Endangered Species. No species of plants or animals in the project area have been identified as of special conservation or scientific importance, so no significant effect is to be expected in this respect. Bonelli's eagle, which may nest near the dam site, will find abundant nesting habitat upstream.

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on Sumbawa, but in Eurasia it is a bird of open forest. Such habitat is typical of the Tiu Kulit catchment.

Commercially Important Species. The forests of the Tiu Kulit catchment contain a few tree species of considerable timber value and many more with fuelwood value. Some of each will be lost to reservoir inundation, unless salvaged. The additional access to the upper basin provided by the dam access road would be expected to augment illegal woodcutting in the catchment, but the lack of roads upstream of the dam, and the loss of the riverbed as a dry season route (additionally blocked by the dam itself) will balance any improved access provided by the project road.

On the other hand, improved living standards and more intensive on-farm labor may increase the market for fuelwood to the point where some farmers in the fringe areas, not served by irrigation, would become full-time woodcutters, placing greater pressure on the catchment area. The total fuelwood consumption of the project area will rise only slowly, however, and most of this demand will continue to be met from the hills around the service area.

The situation with game animals is similar to that of fuelwood: the increase in living standards and improved access to the area may lead to additional hunting, legal and illegal. There is little reason to believe, however, that this increase will be much more rapid than the gradual increase in pressure on the wild fauna that is going on at present.

Pest Species: Crop Pests. Any intensification of cropping is likely to result in higher and more persistent populations of crop pests. These may be categorized by animal group:

1. Insects. Pests on both field and stored crops. Back-to-back rice cropping is likely to allow insects to maintain their populations from one crop to another, necessitating higher insecticide use.

2. Birds. No bird species have been identified as special pests of rice in the Tiu Kulit region, but munias and Java sparrows cause considerable damage in other areas where rice is multiple cropped. Repetitive cropping of rice, followed by soybeans, allows these grain-eating birds to attain higher populations than they can sustain when forced to seek alternate dry season foods.

3. Mammals. Rodents are the main pests of rice in the area, taking grain both in the field and in storage. The species involved are different, but the problem parallels that of birds. Additionally, increased living standards of the farm population leads to laxity in the disposal of waste. The result can be a severe increase in the population of black rat (Rattus rattus).

Disease Vectors. The principal disease vector that benefits from year-round irrigation is the mosquito, which tends to breed in stagnant drains and field edges. With the increase in mosquitoes, one usually sees an increase in mosquito-borne diseases, in this area malaria and dengue.

Fisheries. The increased availability of surface water makes aquaculture possible in a region, but the intensive agricultural water demand will leave little for that purpose. At present, there are no *tambak* in the project area.

The reservoir, as noted above, is not expected to support a significant fishery. The river itself, which has no fishery at present, is not likely to develop sufficient dry season flow to support exploitable fish populations.

Socioeconomic and Cultural Resources

The primary objective of this project is an increase in the living standard among local farmers through the provision of water for multiple-crop agriculture. The economic benefits of improved agricultural production will be unequally distributed among members of the population, some of whom will receive direct benefits and others of whom will receive secondary benefits or even adverse effects. For the purpose of considering these secondary effects, which are generally considered "environmental" due to their not being the main objectives of the project, the local population may be considered in several categories (USAID, 1980):

1. Target Population. These are the group to whom the projects benefits are directed, in this case, farmers who will receive additional irrigation water.

2. At-risk Population. This group is outside the area of direct project benefits, due to location, occupation, economic status, or whatever reason, but vulnerable to some adverse secondary effect, such as loss of resource, deprivation of an amenity, or even some minor inconvenience.

3. Migrant Population. This category includes both immigrants to the area, attracted by labor opportunities or potential markets for goods, and emigrants, whether officially resettled or driven out of the area by other factors.

4. Host Population. This broad group includes most members of the other three, being defined as all persons "living within the area of project influence."

By the above definitions, the groups of greatest interest in a consideration of secondary project effects are the target population, which, in addition to receiving the primary benefits of the project, is likely to experience other effects, and the

at-risk population, which, while not in line for primary benefits, may experience positive and/or negative secondary effects.

In general, the secondary effects of an irrigation project fall into several categories:

1. Secondary benefits arising from the primary benefits of increased crop production and disposable income.

2. Opportunities to enhance the use of a resource through secondary applications of project facilities, e.g., reservoir, canals, roads, drainage canals.

3. Potential adverse effects of project construction or normal operation, e.g., demand by the construction work force for scarce local resources, resource contamination, or conflicting demand for the water.

4. Failure of the project to live up to expectations, due to over-optimism of planners, inadequacies of maintenance, or misuse by the local population.

Of the above, the fourth is the most distasteful for project planners, because it arises from a fundamental weakness in the plannning system: the tendency of technical people to foresee a project operating in a trouble-free, idealized situation, as opposed to a worst-case condition involving misuse, neglect, and unplanned modifications of the system. To adopt the latter approach would be unnecessarily pessimistic, and irrigation planners increasingly stress combining structural improvements with upgraded management, user education, and periodic review of the project, in an attempt to achieve a more foolproof system. In actuality, however, despite continuing efforts toward more effective operation, rural irrigation systems in many parts of Indonesia, as elsewhere, continue to be plagued by abuses at many levels of the system: control gates left open instead of releasing water on schedule, damage to canal banks by livestock, lack of maintenance, and a variety of other factors.

This section on socioeconomic effects deals with both the effects of the project on living conditions and the potential effects of local society on the project. Both sets of effects, especially the latter, form feedback loops: if the practices of the local population compromise the effective operation of the irrigation system, that in turn may have effects on the health or economic status of local people.

Settlement Pattern and Movements

One positive factor in the siting of the Tiu Kulit reservoir is that there are no permanent dwellings in the proposed inundation area or at the dam site. It will not be

necessary to relocate any people for the purposes of project construction.

The presence of irrigation, on land now farmed on a rainfed basis, may lead farmers from other areas, especially those nearby, to attempt to buy into the Tiu Kulit area. This would elevate land values and lease rates but mainly only for lands in the project service area. It is unlikely that owners of the improved lands would sell, since the increase in production would be greater than what they could make on a one-time sale of land.

Sharecropping farmers probably will find that part of the gain that they acquire through irrigation will be shared with the landowners. Nevertheless, the tenant will see substantial benefit.

Increased agricultural activity in the area is likely to attract and hold some agricultural laborers who now visit the area only at harvest. However, such laborers would need to sharecrop or find other employment if they are to take up residence in the area as harvest work will provide full-time work for only two months per year. Increased agricultural production and cash flow may also lead some entrepreneurs to relocate permanently in the area. Initially, these are likely to be vendors who sell food, clothing and other items at the weekly market in Maronge, but others may follow.

Services, Infrastructure and Social Organization

Improved living standards and more economic opportunity in the target population probably will result in some of the younger farmers remaining in the area rather than out-migrating. Other farmers will move into the area because of irrigation development. Traders and middlemen will establish more shops and services as trade increases. Demand, in general, will increase for services and infrastructure (schools, health clinics, roads, transport, markets and extension services), and with this increased demand, and diversified population, the local social structure will become more complex.

Farming Systems

Cropping Patterns. The rice-oriented Indonesian farmer, when provided with a secure water supply for a second season of cropping, usually responds by adding additional rice, which he sells. Economic studies in Indonesia have shown that rice does not provide the highest rate of return for the farmer's input of labor and direct costs; higher income can be gained from onions, melons, tobacco, groundnuts, pineapples, lettuce, and other vegetable crops. The usual pattern when an irrigation system is added or upgraded is for farmers to grow a second crop of paddy

higher income. There is every reason to believe that farmers in the Tiu Kulit area will follow that pattern.

Environmentally as well as economically the diversification of cropping is a benefit, for it reduces the likelihood of an outbreak of plant disease or an insect pest that can devastate an area.

The intensification and diversification predicted by the agricultural economist is expected to lead to increased sophistication on the part of the farmer. The more aggressive and successful farmers may turn to more mechanization of tasks now powered by animal or human means. This may gradually reduce the value of the buffalo as a source of traction.

Land Use. The major foreseeable change in the use of farmland is a decrease in availability of fallow fields for dry season livestock grazing. This will be partly offset by an increase in field-edge and ditchbank vegetation. Also, livestock management practices will shift from the present generally extensive practices to more intensive means, such as tethering of animals and cut-and-carrying of grasses. This shift has been noted by the Livestock Department on other Sumbawa irrigation projects including Kalimantong I project.

The conflicting demands on family labor due to intensification of cropping may make the tending of buffalo, currently a task for the older children, too time consuming. The balance may swing in the direction of culling the herd, especially as the investment value of the buffalo is replaced by a higher cash reserve. This whole process is likely to require several decades.

Agricultural Chemicals. Increased cropping intensity and diversification almost invariably lead to greater use of fertilizers and pesticides. Moreover, faced with unfamiliar insect pests on his vegetable crops, the farmer, acting on the advice of a more sophisticated cooperative or extension agent, may find himself using chemicals with which he is unfamiliar. This often leads to errors in mixing or handling that can have serious results. In Pakistan, following a malaria pandemic in 1973, the Malaria Directorate switched from DDT wettable powder to Malathion liquid. The former is so safe for humans that spray operators had become careless in handling the chemical. Malathion concentrate is a potent cholinesterase inhibitor that is readily absorbed through the human skin. Failure to indoctrinate the mosquito control crews led to several fatalities among spray operators and the hospitalization of many others. Subsequent training of the operators and alerting of hospital staffs corrected the situation and Malathion was used safely. Local agricultural agents should be alerted to the dangers of transporting, storing, formulating, and applying certain chemicals.

The other adverse impact of chemical use, frequently seen when agriculture is intensified, is the contamination of surface water by chemicals in agricultural runoff. Aquatic ecosystems (including fisheries) can be seriously damaged through food chain effects. In the Tiu Kulit area at present, there are no significant freshwater ecosystems and the chemicals reaching the estuary are likely to be diluted to the point where their effect will be negligible. Moreover, the pesticides in current use are relatively nonpersistent.

Regional Economics

Target Population. Farmers in the Tiu Kulit service area, experiencing increased disposable income, will spend much of it locally, on food, clothing, and home improvements. Some of the disposable cash will be spent on agricultural improvements, such as mechanized implements.

Greater affluence in a population generally results in non-economic improvements: better nutrition, increased awareness of health risks, with more demand for health services and pharmaceuticals, and more attention to education.

At-Risk Population. Farmers and others who do not receive the direct benefits of the project will, nevertheless, obtain some secondary benefits. Their labor probably will bring more income if they hire out--many farmers in this category do not have sufficient land for complete subsistence--and the natural products with which they augment their income, such as thatch, woven mats, and fuelwood, will see increased demand as the target farmers find themselves with less time for off-farm activities.

Public Health

Vector-borne Diseases. With the increase in mosquitoes will come an increase in the risk of malaria, dengue and other vector-borne diseases. The risk tends to be lower when water is used conservatively, which it is when scarce, and higher when water is allowed to stand in drains or fields.

Other Water-related Diseases. The risk of increase in water-related diseases will depend in large measure on the reaction of a population accustomed to dry season water, limited to pools in the river bed, to a greater availability of purer water in the canal system. It seems likely that intestinal and parasitic diseases, poliomyelitis, and typhoid will decrease as people utilize the purer water source, assuming, of course, that they continue to boil drinking water.

Resource Use

Water: Quantity. The lack of water in the Tiu Kulit River is now a considerable source of hardship for the people of the area. Conditions with the project should be no worse, and probably even improved throughout the year. There will also be increased availability of water in the canals and drainage system. Water uses now accomplished in the river, such as personal bathing, laundry, and the all important watering of livestock, will shift to the main and secondary canals. This shift, especially the watering of buffalo, will severely degrade the canal banks unless preventive steps are taken. Use of planned personal washing points in the canals and turnout washing points for buffalo must be enforced.

Farther downstream on the Maronge and on the Brang Kolong downstream of Brang Kolong village, the project will increase dry season flows through the discharge of irrigation return flows. This water, although of poor quality, may augment the meager pools that are now used for dry season bathing, laundry, and livestsock watering.

Quality. The water available to most of the population in the canal system will be of superior quality to that obtained from river pools during the dry season, but probably inferior to the well water used during the wet season.

Other Resources. The improved levels of disposable income and standard of living in the project area may lead to home expansions or improvements that would place a demand on timber and other local forest resources. The number of such improvements is not likely to be great enough to severely stress local forest resources, however.

Effects of Project Alternatives

No Action Alternative

The pressure of a gradually increasing population, dependent on a land resource with limited irrigation and an unreliable water supply, would lead to greater poverty and lower living standards. These would induce the younger members of the communities to emigrate in search of wage labor or better farming conditions. Some might turn to exploitation of different resources, such as the forest or the wild fauna.

In time, a village-level irrigation scheme might be implemented, but it is doubtful that local funding could provide the water storage reservoir on the scale required for effective utilization of the catchment's surface water resources.

Alternative Technologies

There being no viable technical solutions to the need for more water, speculation on the environmental effects of other systems would be meaningless.

Design Alternatives

Siting. There being no downstream dam sites in the basin that offer the possibilities of the selected one, no environmental effects will be postulated for such alternatives. The siting of the access road is fairly well fixed, but the environmental effects of the alternate routes would not be greatly different from those of the current plan.

Selection of the service area on other than topographic, soils, and geographic bases really is not possible if the project is to function. The environmental effects of alternative command area selections would be about the same as those of the proposed area.

Reservoir Elevation. Conceivably, the reservoir elevation could have been lower, which would have had the effect of shaving project benefits. Raising the reservoir above its proposed level is not technically nor economically advantageous due to the height of the left abutment which would require extensive embankments. Other than inundating more forest land, the larger reservoir would not exert significant environmental effects.

Scheduling Alternatives

The effects of scheduling the project so as to stretch it out over a longer period would resemble those of the no action alternative, i.e., continued poverty for the part of the target population not receiving water and, possibly, shifts of people within the area to take advantage of irrigation water.

Chapter VI

EVALUATION OF SIGNIFICANT IMPACTS

This chapter summarizes the probable major positive and negative effects of this irrigation project on the environment. It also points out possible negative effects of the environment on the functioning and efficiency of the project. Virtually all of the likely significant effects will occur during post-construction, that is, during the operation and maintenance phase.

A primary effect of this project will be to increase incomes and raise the standard of living. This is considered to be a positive, long-term impact. The project is also expected to augment ground water. Other significant impacts that are likely to be negative and long-term require that mitigating measures be put into effect. Thus, a Mitigation Plan has been prepared to deal with these potential negative effects of the project on the environment, and of the environment on the project.

Water Resources

Streamflow. The major objective of this project will be to store and redistribute water geographically and temporally to provide irrigation water during the latter part of the wet season and into the dry season. The effect of this will be to significantly alter the streamflow regime. In order to mitigate any adverse impacts of this effect, the reservoir will make minimum downstream releases as needed to augment river flows during critical periods. A village water supply system will be built to provide the two downstream villages with better domestic water supplies than they now have during the dry season.

Ground Water. The increase in surface water on a year-round basis and normal seepage from the reservoir are expected to augment ground water. This will generally improve the capacity of shallow wells in the immediate area, and further improve downstream domestic water supplies.

Water Quality. The quality of the water in the reservoir will be essentially the same as that of the river under present conditions, less virtually all of the sediment load. Water entering the service area will of be good quality, as it is at the dam site under pre-project conditions. How long that quality will be maintained will depend on whether waste discharges into the canals are curtailed, and on what non-irrigation use is made of the water. The canal water, at its worst, will be of better quality than the surface water

downstream river is likely to be degraded somewhat, especially during the dry season.

In order to help minimize waste discharges into the canals, and minimize non-irrigation use of the water, the project will provide community education assistance (Public Works staff, assisted by LP3ES) to villagers as the water users' associations are organized.

Land Resources

Land Use. The major impact of this project on land use will be to bring the land under irrigated agriculture during seasons of the year when it has in the past been mostly fallow. Approximately 23 ha of land will be converted to main and secondary canals and the tertiary system will take strips of land from the edges of fields. Project structures will take land that is currently covered with brushy forest. Borrow areas could affect a total of 31 ha of land at several locations downstream of the dam site. Another 5 ha will be used for drainage canals.

These are considered to be unavoidable adverse impacts of the project on the environment.

Erosion. A serious potential source of future canal bank erosion will be the use of channels for washing and bathing livestock.

In order to mitigate this potentially negative impact, the Department of Public Works, assisted by LP3ES, will seek to educate villagers in the proper use of canals and livestock watering sites.

Biological Resources

Habitat: Terrestrial. The only significant habitat change resulting directly from the project will be the conversion of some 100 ha of hillside seasonal forest (plus some 10 ha of river bed) into a reservoir and dam site.

This is considered an unavoidable adverse impact of the project on the environment.

Pest Species: Crop Pests. Any intensification of cropping is likely to result in higher and more persistent populations of crop pests including insects, birds and mammals.

Mitigation of the damage caused by crop pests will require that the Department of Agriculture provide appropriate monitoring of the situation and adequate extension services to farmers.

Disease Vectors. Increases in irrigation water are likely to increase the mosquito population, as their breeding grounds will be increased. There are likely to be increases in both malaria and dengue fever.

Mitigation of possible increases in mosquitoes and consequent mosquito-borne diseases will require that the Department of Health provide appropriate monitoring of the situation and provide public health education and health care services to the local population.

Socioeconomic and Cultural Resources

The primary socioeconomic impacts of this project will be to increase income and improve the living standard among local farmers, as direct beneficiaries (the target population). Spillover effects are likely to raise incomes and improve living standards to secondary beneficiaries as well (i.e., the at-risk population, and the migrant population).

Farming Systems: Land Use. The major foreseeable change in the use of farmland will be to decrease the availability of fallow lowland fields for dry season livestock grazing. This will be partly offset by an increase in field-edge and ditchbank vegetation. Also, livestock management practices will shift from the present generally extensive practices to more intensive means.

As this change in land use principally affects livestock, the Department of Livestock should come up with a plan so that the livestock population in the area has sufficient grazing area or cut fodder. They should probably develop this plan by coordinating their proposal with the Departments of Agriculture and Forestry.

Agricultural Chemicals. Fertilizer and pesticide use is likely to increase. Some farmers may use these chemicals incorrectly and harm themselves; others may incorrectly use chemicals and contaminate surface water.

An appropriate mitigation plan would be to encourage the Extension Services to provide adequate information on the proper uses of agricultural chemicals to local farmers.

Chapter VII

CONCLUSIONS

The Tiu Kulit Dam Project is a reservoir storage scheme to supply irrigation water to 1,700 ha. Approximately 1,600 ha of the proposed service area is already planted in rice and secondary crops for one or two seasons. The project will boost the service area's cropping intensity, currently 111 percent, to 220 percent.

The Tiu Kulit Dam will create a reservoir, storing approximately 10 MCM of water early in each wet season for distribution to cropland during the latter part of the wet season and into the dry season. Irrigation water will be released from the reservoir to the canal system, the sawah, the drains, and then back into the river. The effect of this will be to significantly alter the streamflow regime, particularly during the early wet season. In order to mitigate any adverse impacts of this effect, the reservoir will make minimum downstream releases as needed to augment river flows during critical periods.

Other potential environmental impacts of the project include additional recharge of the groundwater aquifers, generally improved water availability and access to water, some agricultural land being used for project facilities, inundation of 110 ha of forest and riverbed, decreased dry season grazing areas for livestock, increased crop pests and mosquitoes, and improved economic conditions for the local population. As discussed in the previous chapter, and in the following Mitigation Plan section, these impacts are not serious and in most cases can be mitigated.

Alternatives to the proposed project are limited. If no action is taken, it is doubtful that village-level irrigation schemes could ever provide sufficient water storage on the scale required for effective utilization of the catchment's surface water resources. There are no other viable technical solutions to the need for more water in this area. There are no downstream dam sites in the basin that are really suitable, and the service area is defined and limited by topography, soils and geography. Lowering the reservoir elevation would reduce project benefits, and raising the elevation would not be technically or economically advantageous. Delaying the schedule would only continue poverty in the area.

Based on these studies, the conclusion of this Environmental Assessment is that the Tiu Kulit Dam Project is environmentally feasible, and that potentially negative environmental impacts have been adequatley addressed in the Mitigation Plan.

PART 3

MITIGATION PLAN

TIU KULIT DAM PROJECT

MITIGATION PLAN

The objective of an environmental study is to develop the information necessary for assessing project effects and then to develop a plan to minimize the adverse effects and enhance benefits. Environmental impacts can be considered as falling in two general categories:

1. Unavoidable Adverse Impacts. These are effects, such as the loss of habitat to reservoir inundation, that are inevitable with project implementation and do not lend themselves to remedial actions without compromising the project.

2. Manageable Effects. These are direct or indirect effects, adverse or beneficial, that lend themselves to some sort of actions to improve the situation. Such actions may lessen the severity of adverse impacts or enhance secondary benefits of the project.

Types of Actions

The approach to managing an environmental effect varies with the type and degree of effect, its time and place of occurrence, and the stage of project development at which it is recognized. Ideally, the process of environmental impact assessment is a continuous one that permits midcourse corrections in project planning. More often, an environmental assessment is a one time affair, conducted during a prefeasibility or feasibility study, at a time in project development when only superficial changes in project design are possible. In this project, however, sufficient latitude exists to permit planners to address all of the major environmental concerns.

Mitigation actions may be divided into those directed at changing some aspect of the project, such as design, construction method, or operation, and those directed at changing the environment so as to avoid or lessen a project effect or to increase a benefit. Within these two groups of actions, a further distinction may be made between those that must be implemented during project construction, in order to be effective, and those that take place during project operation.

Impacts to be Mitigated

The most serious potential environmental problems associated with this project involve conflicting demands on the limited water resource, especially during the dry season. The

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problems are not new to area residents; under present conditions they find it difficult to find water of good quality for domestic purposes.

Proposed Mitigation Plan

Overall responsibility for coordinating the proposed Mitigation Plan will be shared by the NTB Provincial Public Works, Water Resources Division, and the Regional Development Planning Board (BAPPEDA). It is recommended that other government agencies be involved in the Mitigation Plan of the project. These agencies include the Extension Services of the Departments of Food Crops and of Livestock, the Departments of Forestry and Health, the National Board of Lands (Badan Pertanahan Nasional, formerly Agraria), the Agrarian Taxation Office (IPEDA/PBB), that part of Public Works responsible for village water supply (Cipta Karya), and regional government (PEMDA) at and below the district level, including the Bupati and Camat, and their delegated staff.

Water Resources

Downstream Water Use: Domestic Water. This project offers the opportunity to substantially improve domestic water quality and availability in the service area without removing a significant amount of water from the irrigation supply. The simplest alternative is to allow for a minimum downstream release from the reservoir during periods when the river would dry up. In most years a very small release would serve to keep the river bed alluvium "recharged" or flowing since the year-round presence of water will keep the water table from dropping below the river bed. A minimum release of 10 l/s (0.01 m3/s) would be sufficient, and would not adversely affect the project irrigation operations.

The second alternative, that of providing piped water from the reservoir to the villages of Simu and Maronge, would be preferable from the viewpoint of improved domestic water supplies for the local people. In their 1988 report, Mettana noted that upgrading domestic water supplies is a priority objective of the Indonesian government. Considering the relatively small amount of money required for a piped system (about Rp 140 million), Mettana's proposal has considerable merit.

Mettana calculated the volume of water required to provide Simu and Maronge with a year-round supply at 25 L/cap/da on the basis of population growth of 2.5 percent per year from a base population of 5,258 people in the two villages. The resulting populations (14,100 people after 30 years of project life and 29,600 after 60 years), could not possibly be supported by the area's resources. A more realistic sustainable population for the area would be 12,000, a doubling of the present density.

Also, the proposed 25 l/cap represents an absolute minimum daily water supply. A more reasonable figure of 60 l/cap/da, which meets Health Department guidelines for rural piped water systems should instead be adopted. This results in an annual domestic water demand of 0.26 MCM (0.008 m3/s) at full development, which represents just two percent of the operating volume of the reservoir.

In order to accomplish construction of the domestic water system for the villages of Simu and Maronge, two problems must be addressed: (1) overcoming bureaucratic inertia that resists the multiple-use approach to water development; and, (2) funding the design and installation of the water distribution system. Neither of these problems is environmental in nature; both require management initiative by those responsible for moving the project forward.

Mettana has included provision for domestic water releases from the reservoir in their design of the Tiu Kulit Project outlet works. They have also prepared a preliminary design and cost estimate for a PVC-pipeline system from the dam to water tanks in Simu and Maronge Villages. Mettana included the cost of the domestic water system as a line item in their project cost estimate. It remains now for PU NTB to coordinate with Cipta Karya and the Department of Health to review the proposed design and arrange for its timely construction. The following ideas are presented for consideration:

1. The system should be sized for peak, rather than average, demand. The domestic water for a day's use is drawn at two times during the day, creating two sharp peaks in demand.

2. The locations of village water points should be carefully selected so that a maximum number of people, especially those in the at-risk population, can obtain water without excessive walking. Selection of these sites must be done in consultation with the water users, after public meetings in the targeted hamlets where men, women and children hear about the project from Public Works and LP3ES staff.

3. The design of village water points themselves must be carefully considered. To avoid waste, a self-closing outlet is strongly recommended, but it must be one that can be operated by children, since they do much of the water fetching in rural areas. The platform surrounding the outlet must be well drained, to avoid standing water that would provide mosquito breeding sites. It is strongly recommended that some of the construction work be done by the end users to ensure their active participation and understanding of how the water system is to operate and be maintained.

4. An educational program should be provided to adults and children alike, stressing the need for water conservation and sanitation. Although the water in the reservoir will be of good quality, villagers should be urged to continue boiling their drinking water, since the conditions of carrying it are often not sanitary. Periodic water quality testing will be included in the environmental monitoring program.

Public Bathing and Livestock Watering. The project will build public bathing and laundry steps for the use of Simu and Maronge villagers. Water for livestock bathing and drinking is a critical necessity in rural Indonesia, and the shortage of water in the dry season causes considerable difficulty for the owners of buffalo and cattle in the Tiu Kulit area. The drying of the river bed in dry season makes the situation difficult for those who depend on river pools for livestock watering; those farmers must be expected to turn to the abundant water in the project canals. If damage to canal banks is to be avoided, some form of livestock bathing pools must be installed as part of the canal system. The pools must be designed so that cattle can enter and exit easily and so that water carried out on the bodies of the animals drains back into the pools.

Community education and community-led enforcement programs through the joint efforts of Public Works, LP3ES, and the Departments of Agriculture and Livestock will be required if the canals are to be effectively protected from violation of the no-livestock regulations. In fact, the entire target population would benefit from a program to instill respect for the irrigation system. Maintenance of the livestock watering holes could be incorporated into an overall community livestock management program.

If begun before the system is installed, and continued vigorously, the education program could reduce the amount of plant matter and domestic trash thrown into canals and drains, illegal taps and other abuses of the system.

Land Resources

Reservoir Vegetation Clearing. Concern often is shown for the potential water quality effects of vegetation inundated by a reservoir, especially as the released nutrients might promote the excessive growth of aquatic plants. As noted in the previous chapter, the nutrient problem probably will not occur in the Tiu Kulit reservoir, so there is no need for an expensive reservoir clearing program for water quality reasons.

From the viewpoint of forest resources, however, a good argument can be made for partial clearing. The fuelwood contained in the area alone might justify some clearing. This could best be determined by the simple expedient of Public Works putting the clearing out for bids. Alternatively, the local

population could be allowed to gather what they could and carry out domestic fuelwood while the dam was being constructed. Some restrictions would have to be imposed on the contractor and the general public, however, and strictly enforced:

1. No cutting would be permitted above the high water contour.

2. No roads would be permitted above the high water contour, nor in adjacent valleys. Such roads would encourage later incursions into the watershed.

3. All cut vegetation not removed from the reservoir area must be piled and burned. Failure to do so would result in an accumulation of plant matter at the outlet works entrance.

It is the opinion of the Project Environmental Scientist that commercial fuelwood suppliers, faced with the above restrictions and the costs of transporting fuelwood and timber to the nearest urban markets, will be unwilling to pay for the opportunity to exploit this small forest resource. In the event that the project is required to bear <u>any</u> of the clearing costs (including that of surveillance), the reservoir area should be left uncleared.

<u>Livestock Management</u>. The problem of shortage of grazing produced by more intensive cropping was raised at the 1986 Scoping Session and again at the 1988 meeeting. Estimates by the Department of Livestock indicate there is sufficient plant biomass to sustain the existing livestock. The economics of irrigated pasture should be examined, although at a glance it seems unlikely to compete with crop production. The Department of Livestock should establish an optimum herd size and study ways of obtaining a reduction, if it is justified.

Grazing fees could be implemented and enforced, in order to convince farmers that the keeping of livestock is not without costs, even if that cost is measured in terms of resource consumption. Such fees, which would appear not to have been previously instituted in the region, should be low.

Care must be taken to avoid excessive erosion in the catchment area above the dam both in clearing and in livestock grazing areas. Controlling erosion on pasture land is largely a matter of avoiding overgrazing. Here again, a modest grazing fee would help regulate grazing intensity.

Community education and development of a community-enforced grazing land and livestock watering policy should be the responsibility of the Departments of Agriculture (Food Crops) and Livestock, and assisted by Public Works and the non-governmental organization, LP3ES.

Biological Resources

Catchment Management. Despite remarks by the PU spokesman (at the 1986 Scoping Session) that the management of the catchment area is not a responsibility of the irrigation managers, there are cogent reasons for those managing the project to be interested in the upper catchment. Foremost among these is that extensive forest clearing would result in a sharp increase in erosion and in siltation of the reservoir.

The NTB Forestry Department and the Bupati of Sumbawa District should be alerted to the need for protecting the Tiu Kulit catchment area, so that serious deforestation can be detected and corrective measures taken.

Aquaculture Ponds. Several individuals at the 1986 Scoping Session expressed interest in having fresh water available for aquaculture ponds in the estuary area and concern over contamination of the river by chemicals in the irrigation drainage flow. The spokesman for PU pointed out (correctly) that pesticide levels in drainage water would be negligible. He also stated that the possible use of irrigation water for aquaculture would be studied. A brief review of the question indicates that the critical period for fresh water inflows to the ponds comes during the dry season, when the stored Tiu Kulit project water is being fully utilized for irrigation. A more thorough study might be carried out by the Department of Fisheries, but the actual water allocation to agriculture or aquaculture, assuming the water resource to be finite and the storage capacity of the Tiu Kulit reservoir to have been optimized, will require difficult social, economic and development priorities decisions.

Socioeconomic and Cultural Resources

Services and Infrastructure. Improved living standards, more economic opportunity and a larger population will increase demand for services and infrastructure (schools, health clinics, roads, transport and markets). Some medium- and long-term planning activities are needed if services and infrastructure are to keep pace with irrigation components of the project.

BAPPEDA, Tk II should work together with the Departments of Education, Health and District Public Works to develop local medium- and long-term plans. The Bupati of Sumbawa District and area government (PEMDA) would play an important role in in acsertaining the need and timing for any increases in services and infrastructure, and coordinating various development plans in the Tiu Kulit area.

Farming Systems. Improvements in irrigation of the Tiu Kulit service area will lead to increased demand for agricultural extension services. The Department of Agriculture (Food Crops) will work together with Public Works, PEMDA, LP3ES and local

farmers to shift to cropping patterns that maximize returns with the secure agricultural water supply. The Department of Agriculture should incorporate the need for increased agricultural extension services into its new five-year plan (PELITA V). This whole process is likely to require several decades. During this time it is likely there will also be increased demand for agricultural cooperatives and extension of credit for technical inputs.

Land Classification, Land Values, and Land Ownership. With the advent of agricultural intensification upon completion of irrigation construction, it is expected that the irrigated service area land will be reclassified to a higher value. Land values will probably increase even before the irrigation system is completed. It is expected that some farmers will seek to acquire certificate title to their land. It may be that the government will organize a special land survey so that the whole service area will be converted to the modern land title system.

Land Taxes and Water Users' Fees. The government should expect to receive an increase from land taxes once the value of the irrigated area has been increased. If water users' fees are eventually initiated, the government can expect to receive an increase in operation and maintenance funds from this source.

Organizing Water Users' Associations and an Irrigation Committee. Conversion of the service area to operation under one irrigation system will require a higher level of organization than currently exists among local water users' associations. Local farmers will also have to work more closely with local government to operate and maintain the system. The Department of Public Works has contracted the non-governmental organization, LP3ES to assist in this process.

Public Health. Changes in surface water distribution and the attendant possibility of increases in mosquitoes will require a program of malaria and dengue prevention on the part of health authorities, if increases in the incidence of the disease are to be avoided. Any such program should be tied in with a program of public education and local mosquito control. When informed about malaria and dengue and given the impetus for action, many rural people respond positively. The additional cash flow in the service area should enhance the ability of people to purchase the inexpensive chemicals needed for mosquito control.

In addition to increased risk of mosquito-borne diseases, the risk of an increase in other water-related diseases will depend on how the population uses water from the canal system. The Department of Health, through its regular PUSKESMAS clinics and its various infant-child health programs should educate mothers, in particular, about the importance of boiling water and innoculating children against preventable water-borne diseases.

Post-Construction Report

A report should be prepared after construction of the Project is completed. The report should be a detailed description of the monitoring and mitigation measures recommended, and a designation of the responsible agencies for each task. The report should be distributed to the agencies involved, and should be reviewed after a year or two of operating experience, and revised as may be necessary.

Mitigation Plan Components: Timing and Costs

Public Works will construct the "water resources" mitigating factors, provide any possible clearing of vegetation from the reservoir site, and develop water users' associations. Other government agencies, as mentioned above, will be principally responsible for their own extension programs and ongoing activities. In most cases the commencement of programs and extension services by other sectoral agencies (see Figure MI-1) should occur by the time the irrigation system construction is completed (construction will begin about December, 1990), and is expected to take about 18 months to complete (May 1992). By this time there should be a livestock management plan, a catchment area management plan, and a public health plan in place.

It is expected that any increases in services and infrastructure (e.g., schools, non-project roads, health clinics) will be gradual, and probably occur after 1992. It is expected that changes in land classification, land values, land ownership, land taxes and possibly an initiation of water users' fees will occur after farmers have had several harvests to adapt to intensification.

The organizing of water users' associations and irrigation committees will probably commence in the first quarter of 1990 when the non-governmental organization, LP3ES, begins working with PU staff, local government, and the existing water users' associations.

Table MI-1 summarizes the estimates costs of the mitigating activities. Those costs borne by the Department of Public Works have been factored into the costs of construction of the project. In the cases of costs for other government agencies, most of the recommended mitigating activities should incur no special costs and should come under regular operating costs. The exception to this is the case of catchment management, where it is anticipated that Rp 5 million be spent every year. Also, if the National Board of Lands decides to commence a land titling program, there will be special costs, only part of which will be borne by the farmers themselves.

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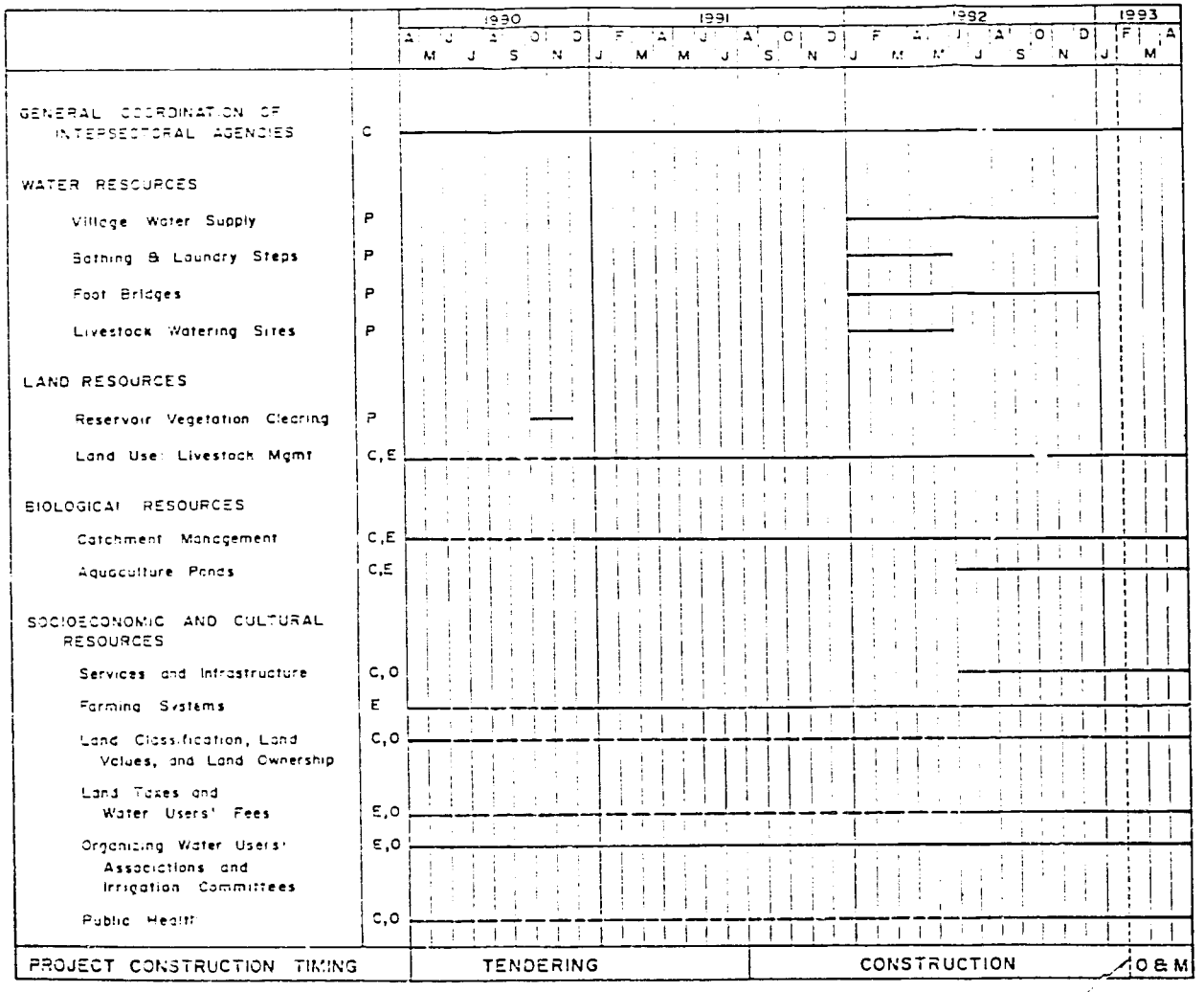
Figure MI - 1



C = Coordination and Planning
P = Physical Construction
E = Extension Services
O = Ongoing Program

SSIMP - TIU KULIT
MITIGATION PLAN COMPONENTS
AND ESTIMATED TIMING

Table MI-1

MITIGATION PLAN COMPONENTS AND ESTIMATED COSTS

Item	Participating Entities	Estimated Cost (Rp)
General Coordination of Sectoral Agencies	BAPPEDA, Tk II, and district government	No Special Cost
Water Resources:		
Domestic Water Supply: provide piped water to Simu and Maronge Villages	Public Works, NTB Province	140,000,000 (1)
Bathing and Laundry Steps in Canals (Rp 50,000/unit x 3)	Public Works, NTB Province	150,000
Foot Bridges over Canals (Rp 1,391,215/unit x 4)	Public Works, NTB Province	5,564,860
Livestock Watering Sites in Canals (Rp 2,307,336/unit x 3)	Public Works, NTB Province, and Extension Services of Agriculture (Food Crops) and Livestock	6,922,008
Land Resources:		
Reservoir Vegetation Clearing (Optional)	Public Works, NTB Province, Sub-contractor and Local Population	No Cost (2)
Land Use: Livestock Management for Establishing pastures/ fodder sources, and number of cattle	Departments of Livestock and Forestry, assisted by Public Works and LP3ES	No Special Cost (3)
Biological Resources:		
Catchment Management	Bupati and Camat, Public Works, NTB Province, Department of Forestry, and assisted by LP3ES	5,000,000 Every Year (4)
Aquaculture Ponds	Department of Fisheries and Public Works, NTB Province	No Special Cost (5)

Table MI-1 (cont)

Item	Participating Entities	Estimated Cost (Rp)
Socioeconomic and Cultural Resources:		
Services and Infrastructure	BAPPEDA Tk II, and district government	No Immediate Costs (6)
Farming Systems	Department of Agriculture (Food Crops), with Public Works assisting	Regular Operating Costs (7)
Land Classification, Land Values, and Land Ownership	National Board of Lands (Badan Pertanahan Nasional) and Agrarian Taxation Office (IPEDA/PBB), with district government	Special Costs (8)
Land Taxes and Water Users' Fees	Agrarian Taxation Office, National Board of Lands, district government, and Public Works	No Special Costs (9)
Organizing Water Users' Associations and the Irrigation Committee	Public Works, NTB Province, Agricultural Extension Services, and assisted by LP3ES	No Special Costs (10)
Public Health	Department of Health	Regular Operating Costs (11)

Notes:

(1) Public Works plans to install pipes down to the main hamlets of Simu and Maronge Villages, and build two village reservoirs for domestic water supplies.

(2) Any sub-contractor given permission to clear the reservoir area would keep monies earned from selling the cut wood. There would be no costs to PU NTB.

(3) Establishing a land use and grazing policy would be part of the community development activities that would occur while the water user's associations are being organized. Inputs from the Departments of Livestock and Forestry would consist of their field staff attending village meetings.

(4) This assumes a cost of Rp 1 M for satellite imagery photographs; one month salary of Rp 2 M for a watershed management specialist to interpret the photographs, make a visual inspection of the sites, and prepare a report. Rp 2 M are reserved for miscellaneous expenses.

(5) There are currently no downstream operating aquaculture ponds. The Department of Fisheries has only recently discussed developing aquaculture. Any future assessments would become part of their on-going programs.

(6) Regional government would be expected to increase the numbers of schools, health clinics and other services as the population increases. No immediate or special costs are envisaged.

(7) Development of new irrigation is usually accompanied by an intensification of agricultural extension services. It is expected that increased staffing by the Department of Agriculture will occur.

(8) Survey of the land and the necessary administrative costs of providing certificated title to land would partially be borne by the farmers and partially by the respective agencies involved in this task.

(9) Increased revenues from land tax collection would result, but the system for collecting land taxes is already in place. Collection of water users' fees would presumably be shared by the water users' associations and existing tax collecting systems.

(10) Costs for the LP3ES contract with Public Works is covered by GOI/USAID project costs.

(11) The Department of Health should monitor developments in this area and adjust their programs and services accordingly.

PART 4

MONITORING PLAN

TIU KULIT DAM PROJECT

MONITORING PLAN

General Considerations

Environmental monitoring is one of the most difficult components of project development to accomplish. Although continued data gathering is a logical follow-on to the environmental program during planning, design, and construction, and may be mandated by law (as it is Indonesia), operating agencies seldom are receptive to the idea of further studies. The reasons for this reluctance are not difficult to identify:

1. Whereas project design and construction often is funded from exterior sources, the local government bears the burden of operating costs. The local agency rarely is able or willing to allocate funds to what its managers see as an unproductive program.

2. The operating agency usually has its expertise concentrated in the area of its primary responsibility (e.g., agriculture) and lacks expertise in some of the areas required for environmental monitoring.

3. Administrators tend to dislike "open-ended" programs that do not relate directly to the primary mission of their agency.

4. Environmental monitoring programs tend to impinge on the spheres of responsibility of several agencies (e.g., forestry, fisheries, public health), and so tend to inflame inter-agency jurisdictional disputes.

Some of the above factors may be absent in NTB Province and Sumbawa District, but one must anticipate that some parts of the proposed monitoring program will encounter resistance on the part of responsible agencies. The program proposed is a minimal one, however, that will provide data useful for integrated resource management in the project area.

Proposed Monitoring Plan

Water Quality

Program Objective. The monitoring of water quality will determine the suitability of water in the Tiu Kulit system for the various uses to which it is directed. This will be especially important for avoiding adverse health effects that might arise from the domestic use of canal water.

Location. Six to ten sample sites should suffice for this program. The following locations are recommended:

1. At the headworks of the main canal.
2. At the intake of the domestic water pipe (if one is installed).
3. The Pemasar River immediately upstream of its confluence with the Tiu Kulit.
4. At one water point in Maronge Village (assuming a domestic water system is installed).
5. In the main canal, 2 to 3 km downstream of Maronge.
6. In a major drain that receives mostly agricultural runoff.
7. In a major drain that has considerable human contact (i.e, used for livestock watering or bathing).
8. In the Maronge River just upstream of the tidal zone.
9. In the Brang Kolong, midway between Brang Kolong Village and the mouth of the river.

Methods and Equipment. A competent water quality laboratory, such as that of the University of Mataram, will be needed for analyses. Field meters should be used to measure electrical conductivity, pH, and dissolved oxygen. A hand thermometer will suffice for temperature readings. It would be advisable to establish a staff gauge at each site, in order to obtain flow measurements.

Standardized data sheets must be used for recording all field data, including conditions at each site, flow, and personnel, as well as the analytical data for the sample. Parameters to be analyzed should include total suspended solids, sulfate, nitrate nitrogen, ammonia, phosphate phosphorus, salinity (expressed as chloride ion), alkalinity (expressed as calcium carbonate), and fecal coliform bacteria. We do not advise analyzing for pesticide residues, unless there is known use in the area of a chemical that leaves significant residue in runoff, or there is some clinical manifestation of pesticide poisoning.

An attempt always should be made to determine flow at each site, even if it is only a general estimate. If a staff gauge is present at the site, its reading should be recorded at the time of sampling.

Schedule. Water quality should be tested during the wet season and the dry season of every third year. The sampling should be coordinated with other environmental monitoring (e.g., land use), in order to establish linkages in the system.

Implementing Agency. It is recommended that the Department of Public Works assume primary responsibility for water quality testing, although it may wish to contract out the required testing of water samples.

Land Use

Program Objective. The principal reason for monitoring land use changes in the project area is to detect changes that are caused by the project, especially those that might affect project operation, such as through increased erosion, water quality of runoff, or farming practices.

Location. Land use should be monitored periodically throughout the Tiu Kulit River catchment, including all tributaries.

Methods and Equipment. Aerial photography and satellite imagery are the usual tools for land use study. To avoid the cost of periodically photographing the catchment, the surveillance should use satellite imagery. Satellite imagery is provided by the United States Landsat Data Center to any foreign government making a formal request for imagery of its own territory. An image of the entire catchment would cost about 500 US dollars. If this should prove unavailable, four test quadrangles of about 25 ha should be established and visited periodically on foot. In any case, some ground checking is needed. No special equipment, other than hand-held cameras will be needed for the field reconnaissance. The field team should note signs of land clearing, new trails or roads, and erosion.

Schedule. This survey of land use changes should be conducted annually, with field checking of sample areas at least every third time. Reports should be submitted to all interested agencies, including Forestry and Agriculture.

Personnel. A trained watershed management specialist or remote sensing specialist will be required for this program. It is difficult to retain the same individual for many years on a program requiring only a few weeks of work every three years, but as interest in land use increases in the Forestry and Agriculture Departments, trained specialists may become more readily available.

Implementing Agency. It is recommended that the Planning Section (P3SA, NTB) of Public Works in NTB Province be principally responsible for overall coordination of watershed protection, but that it work closely with the Department of Forestry, and local government (PEMDA).

Biological Resources

Objectives. Monitoring of biological resources will be performed on an as-needed basis, i.e., when a problem of an ecological nature, such as an outbreak of insect, rodent, or bird pests occurs or there is reason to believe that project activities are affecting biological resources. The objective of such a study program would be to evaluate the problem, identify causes, and develop solutions.

Location. Biological resources in any part of the catchment could interact with the irrigation project, but those of the upper catchment are of greater interest from a conservation viewpoint. Pest problems may be expected anywhere in the agricultural production system, from planting to storage and marketing.

Methods and Equipment. Each sort of ecological monitoring problem will require its own methods and equipment. When a problem arises that requires surveillance, the program must be tailored to that problem.

Schedule. Care should be taken that monitoring of a biological resource is not terminated too soon to evaluate the effectiveness of solutions applied to the particular problem.

Personnel. Some ecological problems that may arise will require highly specialized knowledge. Assistance for such problems should be sought elsewhere in Indonesia, or outside the country if no expertise can be found in Indonesia.

Implementing Agencies. It is recommended that the Department of Agriculture and the Department of Health share primary responsibility for monitoring the biological resources as needed. The Department of Forestry is the logical agency to monitor the condition of an endangered species found in the area.

Socioeconomic and Cultural Resources

Integration of Local and Regional Planning. Any program of environmental monitoring of sociocultural conditions would serve only to supplement the analysis of project effectiveness which will accompany this development on a long-term basis. It is assumed that the Agriculture Department, the sub-district, and local bodies will monitor agricultural production and support systems so as to ensure project effectiveness and correct any shortcomings that may arise. The project staff also should be aware of peripheral problems arising from water use, land use changes, or economic changes. The effects of upgrading the agricultural system will be so profound, in terms of income and lifestyle of the target population, that adjustments may have to be made in another sector of the local economy. The sub-district and the provincial government must be alert to increased demand for health services, education, and transportation system changes, and the need for electricity at the local level, in order to integrate the irrigation project into regional development. Presumably BAPPEDA will act as the lead agency in this regard.

No special studies are envisioned to monitor the socioeconomic conditions, beyond those already in place among local agencies, but it is hoped that the accumulated data will be examined periodically to evaluate cause-effect relationships

among the complex network of social and economic elements. The Department of Statistics in the District can be expected to provide both BAPPEDA, Tk II, and the sectoral agencies with relevant data, although the sectoral agencies can be expected to collect some of the necessary information through their regular monitoring mechanisms.

A P P E N D I C E S

APPENDIX A

LIST OF PREPARERS

No.	N a m e	Specialization
1.	Ir. Abdullah M.T.	Agricultural Ecologist Certificate B EIA
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Note: Preparers 1 through 7 are faculty and staff at University of Mataram; 8 through 12 are members of the Technical Assistance Team under SSIMP.

APPENDIX B

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APPENDIX C

RECORD OF SSIMP ENVIRONMENTAL SCOPING SESSIONS HELD IN MATARAM IN JULY 1986

Note: This record was prepared by USAID/Jakarta shortly after the July 1986 scoping session. Some rearrangement of responses to questions has been done, in order to bring similar topics together. In addition, the editor, who is also the Project Environmental Scientist, has added his own comments on some of the statements made by the meeting participants.

Introduction

In general, the purpose of an environmental scoping session is to sensitize the project participants to environmental concerns and to identify potential environmental problems that should be studied in greater depth. The results of the scoping sessions and the follow-up studies are then used throughout the project cycle for planning and management purposes, particularly with regard to efforts to ensure project sustainability. From 21 through 25 July 1986, USAID/Jakarta held its first joint USAID/GOI environmental scoping session. The session was for two SSIMP sites, Kalimantong II and Tiu Kulit, in NTB Province. Because neither USAID nor the Indonesian agencies involved had any prior experience with environmental scoping sessions, a major goal of the session was to make the scoping process familiar to all the planning agencies involved.

The NTB session was attended by representatives from several Indonesian agencies, including the provincial PU, BAPPEDA Tk. I NTB, Agricultural services, Education & Culture, Agraria (now called Pertanahan), Forestry, Fisheries, Transmigration, Rural Development ("Bangdes"), PSL-UNRAM, BKSA, Health, and Husbandry. At the national level, there were representatives from PU.

The official session began on Thursday, 24 July, with Mr. Hamid, from Ketua BAPPEDA, giving the opening ceremonies. Next, Mr. Newman, from USAID, talked about current SSIMP program activities and gave a brief introduction on environmental problems in irrigated agriculture. Following Mr. Newman was Mr. Suhartono, from PU/Pusat, who explained the new GOI policy regulations (AMDAL), a policy change that requires project analysis of environmental, as well as technical, economic, and management issues. Next, Mr. Philley, from USAID/W, explained the rationale, goals, and procedures for the environmental scoping session. Finally, Mr. Karta briefly described the key features of the projects, such as the total area to be irrigated, the size of the affected population, etc.

After a short break, Mr. Fauzi from BAPPEDA Tk. I, read the agenda, and Mr. Rustam, from PU/Pusat, led the discussion of topics.

I. Land Resources

A. Soils and Land Capability
B. Salinity/Alkalinity and Waterlogging
C. Soil Erosion in Catchments
D. Sedimentation in Irrigation Reservoirs
E. Construction and Land Clearing

Questions/Statements and Answers

1. Education & Culture: What will be the impact of flooding? Will it decrease salinity?

   Response: The impact of a reservoir is on the shallow water table. Through the capillarity of the soil, the salt will reach the root zone area and cause salinity problems. (Mr. Rustam, PU/Pusat).

2. PSL-UNRAM: Erosion may be a problem, especially at the embung (reservoir). We need to mitigate it. Have we planned the actions?

   Response: Erosion in Tiu Kulit is estimated at 0.5 mm/yr. In 25 years, it will be 600,000 m3. In the reservoir design, there is 600,000 m3 of dead storage to trap this sediment. Monitoring the system will be important in the future. (Mr. Karta, P.U./NTB).

3. Agraria: Land acquisition: public interest sometimes becomes a problem for us (Agraria).

   - We hope to have enough time, 6 to 12 months, for land acquisition before construction starts.
   - Land compensation is not always money; sometimes it is other lands or other houses.
   - Site permit and other permit problems should be handled far in advance.

   Response: There will be no land acquisition for the Tiu Kulit reservoir, just for the (support) systems. (Mr. Karta).

4. Transmigration: There will be a resettlement program in 1986/87 for 1,000 families in the Tiu Kulit area. Can they get benefits from this project? The site is in Labangka, in Sub-district Plampang.

Response: The location of the resettlement (Labangka) is about 20 to 25 km away from the project site, so they will not get any benefit, except for increased employment opportunities as farm laborers.

5. Health: Sumbawa is proposed for livestock development. What kind of structures are suitable for this proposal so that cattle will not damage the structures?

Response: Not answered.

6. Agriculture: Soil conditions: At the beginning of the project, evaporation is high, so the water requirement is around 2.2 l/sec/ha, up to 4 l/sec/ha. Has PU planned the tertiary system? If the soil is porous, it (the tertiary system) will need lining. The goal is for the farmers to start benefiting as soon as possible.

Response: Not answered.

7. In PELITA IV there is 3,375 ha of critical land; 2,700 ha will be conserved in Sub-district Plampang. Tiu Kulit is located in the Moyo catchment.

Efforts to mitigate erosion:

- Use multicrop system.

- For conservation, build debris-dams and farmers dams.

Response: Information only (NAN). (What does this mean? Presumably that no response is required - Ed.)

8. Forestry: In the upstream area of the reservoir there are three kinds of forest:

- Forest preserve.

- Unanimous (?) forest, part for preserve, part for production.

- Limited production forest.

9. PSL-UNRAM: We need special techniques for land clearing in order to preserve water quality.

Response: Only selective clearing will be done, due to funding limitations.

II. Water Resources

A. Streamflow Characteristics

B. Drainage

C. Water Losses and System O & M

D. Water Quality

Questions/Statements and Answers:

1. Fisheries: Regarding water quality, it is hoped that the Tiu Kulit reservoir will not be like Lake Taliwang, where long ago the flooded area was thousands of hectares, but now only 800 ha.

   (Editorial note: The statement that Lake Taliwang once covered "thousands of hectares" is incorrect. The drainage basin of the lake is only about 8,000 ha, and the lake level was controlled by an natural sill until the installation of the present control weir. The water surface probably never has greatly exceeded 900 ha. (See the 1981 FENCO report.)

   - For development of fishponds along the seashore of 1,200 ha, we need fresh water to neutralize the salinity of water that comes from the drains.

   - Regarding pesticide impact, since the distance from the seashore is large enough, the impact is small. Moreover, because the supply of fresh water is not needed often and the amount of seawater is large, the fisheries will not be affected.

   Response: See following statement and comments following.

2. Agriculture: The concern that pesticides and fertilizers will contaminate water used for fishponds is small; the use of fertilizer is only 300 kg/ha, or 30 gm/m2. Furthermore, because farmers dry the rice fields for three days after applying fertilizer, the fertilizer has already been absorbed into the soil by the time it is irrigated.

   Response: None. (Editorial comment: If this were true, the presence of fertilizer in agricultural runoff would be rare, but such is not the case. Lake Taliwang is a striking example of the effects of nutrients derived from irrigation return flows.)

Concerning pesticides, the Department of Agriculture uses an integrated system where pesticide is used as a last resort only. (The question of pesticides is a valid one. The amount used ofter exceeds the "correct amount". Moreover, pesticides often enter the ecosystem by means other than spraying, eg. spills, washing of equipment, etc.)

3. PU/Pusat: Regarding salinity, we need a monitoring program to detect whether or not there is a problem.

   Response: None.

4. PSL-UNRAM: We need a system to treat drainage water, especially during the dry season, when salinity is high, because the flow is too low. Furthermore, crops planted during the dry season use less water, causing the salt concentration to rise.

   Response: None.

Comments by project staff: Although there were no specific responses to the remarks above, some explanations were offered.

1. Mr. Karta: The functions of the reservoir are:

   - To ensure the water supply during the first growing season.

   - To irrigate only, not to be involved in upstream water management. (Editorial comment: This statement suggests a belief that the reservoir operates in isolation from the basin that provides its water.)

   - If there is enough water during the dry season, it can be used to grow second crops and to provide domestic water.

2. Mr. Menninger: There will be enough water to grow secondary crops and for domestic water, because to grow two crops of paddy there need only be 5 million m3 when 70 ha is flooded. Previously, when 100 ha was to be flooded, we needed 6.6 million m3.

   We need to protect Simu village, located on the Tiu Kulit River, from flooding during the rainy season, considering that the dam is 23 m high. (Editorial comment: This concern over flooding at Simu is misplaced, unless he is speaking of a failure of the dam. Simu is located just downstream of the junction of the Tiu Kulit and Maronge Rivers. The dam and its reservoir, upstream of the village, will alleviate the flooding problem somewhat, storing some flood water and reducing the flood peak. There is no practical way to

protect the village from a dam failure other than a warning system.)

3. Mr. Karta: Regarding the O&M system, there is none yet, but the operation will be the same as the regular irrigation system, combined with gogo-rancah. No maintenance problem has been foreseen so far, but the reservoir will require further study.

III. Biological Resources

A. Critical Habitat for Threatened or Endangered Species

B. Fisheries

C. Biomass in the Impoundment

D. Water Weeds and Pests

Questions/Statements and Answers:

1. Agriculture:

- If the system is for dry-paddy (gogo-rancah), it does not need irrigation.

- Water Weeds: During the dry season there is no water, so it is not necessary to worry about water weeds.

- Pests: With the increase in cropping intensity, there will of course be an increase in pests.

Response (PSL-UNRAM): We disagree. Gulma (water weeds) and grazing land still need to be considered.

2. Education & Culture: Agriculture and farming systems in Sumbawa are closely related. For instance, buffalo are used for working in the fields and for transportation. Therefore, we should take into account the following:

- We need to gather data on farming and environmental patterns.

- We need new grazing land to substitute for land lost to irrigation, in order to protect the watershed from cattle.

- Animals that live in the reservoirs/dams/canals, such as crabs, can damage the structures.

Response: None.

3. KSDA (Konservasi Sumberdaya Alam):

- Deer and pythons should be protected from the villagers.
- The project development will invite other types of birds to the project. Please protect the birds.
- Specifically protected trees: Sawo kecik and gaharu.

Response (PSL-UNRAM): There is no problem with deer or python in the project area.

4. BKLH:

- With project development, grazing land will be lost.
- When land clearing, do not burn the trees; it can disturb the area around it.
- Deer need to be protected, especially during the implementation stage.

Response: See response to 3, above.

5. PU/Pusat: We need to take into account the migration of people into the watershed area.

Response: None.

6. PSL-UNRAM: Responses to 1, 3, and 4, above.

7. Agriculture: We need to identify critical lands and give guidance to farmers on how to use such lands, including grazing land.

IV. Environmental and Public Health

A. Water-borne Diseases

B. Agro-chemicals

C. Livestock Diseases

Questions/Statements and Answers:

1. Health:

- The prevalence of malaria will increase and must be considered.
- Endemic (Enteric? Ed.) diseases also will increase.

- There is no schistosomiasis in the project area.

Response: None.

V. Socioeconomic Factors

A. Settlement

B. Social Organization

C. Farming Systems

D. Community Participation

Questions/Statements and Answers:

1. PU/Pusat:

- Regarding cropping patterns, we need to give the farmers guidance in changing the system from dry/ rainfed paddy to an irrigated system.

- Land-farming (?) for dry-land area.

- Is land ownership spread equally?

Response: None

2. Fisheries:

- We need a constant water supply to grow fish in the rice fields (three months).

- Fishponds need a freshwater supply for 1,200 hectares.

Response: None.

3. PSL-UNRAM: (Important) activities during project construction:

a. Before construction:

- Land acquisition. We need to confirm with Agraria that the land belongs to the government.

b. During construction:

- Labor/workers: availability and absorption

- Communication.

c. After construction:

- Resettlement, due to: labor; development of the project area; good roads.
- To stimulate the farmers' sense of belonging:
- Make a demonstration plot for water management at the tertiary level.
- Prohibit land speculation during land acquisition.
- Minimize the impact on the farmers' way of life.

Response (Agraria): There will be no problem with land acquisition, because it will be used in the public interest and there are land laws and records that show peoples' rights to the land.

4. Bangdes: We need to develop the settlement area.

Response: None.

5. Agraria:

- There are no problems for the development project.
- The camat prohibits the shifting cultivation system.
- We need to carefully examine land status, due to the tanah; after 2-5 years of cultivation, it is left fallow.

Response: None.

VI. Cultural Property

A. Archaeological, Historical, or Religious Sites

B. Esthetic or Natural Values

Questions/Statements and Answers:

1. Education & Cultural: So far, there is no problem at these sites, except for a cemetary that must be protected from negative impact.

Response: None.

2. PSL-UNRAM: There is one small lake in the upstream area of the Tiu Kulit project that is used by a horse-healer for a ceremony. Horseracing is a common sport in Sumbawa, and to make a horse the winner, people use a horse-healer.

Response: None.

VII. Conclusions: Tiu Kulit. (Refer to the ESS check-list)

1. Land Resources

A. We may need further detailed soil analysis.

B. Do not need analysis, only monitoring.

C. Do not need analysis, only monitoring, management, and mitigation.

D. Need only monitoring.

E. We need analysis to determine where to get borrow material for construction. We need to be selective in cutting for land clearing.

2. Water Resources

A. We need an environmental assessment.

B. We need an environmental assessment, including flood control.

C. We need an environmental assessment, an O&M manual for the reservoir, and a plan for the use of water over time.

D. We need an environmental assessment and an analysis of the impact of drainage water on the seashore and mangrove.

3. Biological Resources

A. No conclusion.

B. We need an analysis with inventory.

C. No conclusion.

D. We need an analysis with inventory, as well as a monitoring plan and mitigation of water weeds.

4. Environmental and Public Health

   A. No conclusion.

   B. Need analysis.

   C. No conclusion.

5. Socioeconomic Factors

   A. No conclusion.

   B. No conclusion.

   C. Integrated with site profiles.

   D. Integrated with Co-Management system.

6. Cultural Property

   A. Do not need analysis, only inventory.

   B. Monitoring is necessary during construction, whether there is cultural property or not.

VIII Conclusions: Kalimantong II

1. Land Resources

   A. No conclusion.

   B. No conclusion.

   C. Need analysis.

   D. No conclusion.

   E. For construction period, need analysis; for land clearing, no problem.

2. Water Resources

   A. We need an analysis of forest status, because part of the watershed forest is designated limited production forest.

   B. We need an environmental assessment, including flood control.

   C. We need an environmental assessment.

   D. No conclusion.

3. Biological Resources

   A. No conclusion.

   B. No conclusion.

   C. We need an environmental assessment.

   D. No conclusion.

4. Environmental and Public Health

   A. We need an environmental assessment.

   B. No conclusion.

   C. No analysis needed; only monitoring. Wait for information about animal diseases from Animal Husbandry Service.

APPENDIX D

RECORD OF SSIMP ENVIRONMENTAL BRIEFING HELD IN SUMBAWA BESAR ON 26 MAY 1988

Background

In April-May 1988, the Project Environmental Scientist visited NTB to assess needs and propose methods and schedules for conducting the environmental studies for two SSIMP projects: Kalimantong II Weir and Tiu Kulit Dam. A draft outline was prepared for the Environmental Assessment Reports. Discussions were held with the University of Mataram Environmental Studies Center (PSL), which agreed to participate in the environmental baseline studies.

In early May, the Project Environmental Scientist, the head of PSL, and a USAID Program Specialist traveled to Sumbawa to visit the two project areas. They were unable to arrange a meeting with representatives of the locally concerned agencies, as hoped, so the meeting was delayed until 26 May 1988. A record of the meeting is presented below.

Introduction

The purpose of the environmental briefing in Sumbawa Besar was first to inform the local agencies of the plans and progress on the Kalimantong II and Tiu Kulit projects, and then to identify any environmentally sensitive topics which should be addressed during the course of the SSIMP studies. The scoping session for these projects was held in Mataram in July 1986, with limited participation by the local Sumbawa agencies.

A copy of the environmental briefing agenda is given in Appendix E; the list of participants is shown in Appendix F. After the introduction and overview of the projects, the discussion followed the checklist topics as shown on the agenda. Questions or comments on each topic were made by the local agency representatives followed by response from the P.U. NTB Project Managers, head of PSL, and SSIMP NTB Team Leader. The discussion first covered the Tiu Kulit Project and then the Kalimantong II Project. A summary of the discussion follows.

Discussion on Tiu Kulit Project

I and II. Land and Water Resources

- From Tax Office (IPEDA Dinas Luar):

  Will the Tiu Kulit Dam Project supply an area of 3000 hectares?

  Response from Project:

  The Tiu Kulit Dam Project capability is just calculated for a maximum 1600 hectares.

- From Agricultural Department Office:

  The existing local weirs on Tiu Kulit River irrigate an area of 815 hectares with a planting intensity of 200 percent. Will the planting intensity be raised to 300 percent?

  Response from Project:

  The Tiu Kulit dam is planned to supply irrigation water for an area of 1520 hectares with a plant intensity of 200 percent.

- From Local Development Office:

  How will the balance of available water be used in the dry season?

  Response from Project:

  The available water during dry season is expected to be used for palawija cultivation.

III. Biological Resource

- From Fisheries Office:

  Fresh water supply is needed for a fish pond in tidal area. Fresh water should be used not only for irrigation but also other forms of food production such as fish culture. Will the project supply water to existing fish pond?

  Response from Project:

  The Tiu Kulit Dam Project is designed to sustain paddy in the first planting season and, if possible, to support palawija in the second planting season. Calculation of water requirements for the fish pond has

not yet been undertaken, but the possibility will be studied.

IV. Environmental and Public Health

From the Head of PU, West Sumbawa:

Excessively detailed environmental assessments are not necessary for these projects.

V. Socioeconomic Factors

- From the Head of Plampang Sub-district:

The people in Plampang look forward to receiving the benefits of the embung as soon as possible. We must developed the awareness of the people about the embung construction. Are all land acquisition costs paid in the water storage area?

Response from Project:

There will be no land acquisition costs for government land, nor the tertiary canal system.

- From District Government Office:

No free land can be used for the project area, especially for water storage, without land acquisition.

Why did not the project get money for land acquisition while for the Kalimantong II project and Mamak water storage project there are land acquisition (allocations)?

VI. Cultural Property

No discussion.

Discussion on Kalimantong II Project

I and II. Land and Water Resources

- From Head of PU, West Sumbawa:

  There has been some information concerning the Kalimantong II project supplying water to the Taliwang Lake, which when raised could supply water to land in Seteluk District for use by a sugar cane plantation. If the lake is raised, what would be the impact to the existing road?

  Response from Project:

  The plan to raise the level of Taliwang Lake is still in the feasibility study.

III. Biological Resources

- No discussion.

IV. Environmental and Public Health

- From Forestry Office:

  The project location (and catchment area) lies in Preserve Forest, limited Production Forest, and Social Forest. The weir site is located in Social Forest area but is not expected to have negative impact on forest productivity.

  The catchment area should be protected against wood cutting to save water resources. The Forestry Office has some programs to reduce erosion in the upstream areas, i.e., the Reforestation Program

V. Socioeconomic Factors

- From Local Planning and Development Board (BAPPEDA):

  Will local labor be used in project construction, and if so, we hope the project will propose some training.

  Response from Project:

  The project will principally use the local labor force.

  Response from Head of PU, West Sumbawa:

  It would be better to use local labor.

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From Lands Office (Agraria):

We have some problems with land acquisition because private land and ownership data are not available. A schedule for land acquisition should be made.

VI. Cultural Property

- No discussion.

Summary by Ir. Kartabrata:

Some project matters should be studied in detail, examples:

Conflicting interests for water and land resources.
Land acquisition.
Erosion and Sedimentation.
Labor, qualifications, and resources.
Socioeconomic issues.
Resettlement.
Diversified water use; example: electric power generation.

LIST OF SCOPING SESSION PARTICIPANTS
TIU KULIT AND KALIMANTONG II WEIR

Sumbawa, May 26, 1988

Name	Profession/position	Organization
Provincial		
01. Kartabrata	Irrigation	PU. NTB
02. Wahju Djoko M.	Irrigation	PU. NTB
03. Sudanta	Embung Project	PU. NTB
04. Djoko Prakoso	Kalimantong Project	PU. NTB
05. Abdullah MT.	Head of Environmental Center (PSL)	Mataram University
Harza NTB		
06. Jeffery Frey	NTB Team Leader	Harza
07. Robin B. Erickson	Agro Econ. Consult.	Harza
Regency		
08. M. Kabil	--	Village Development
09. L. Mudahan	--	Village Development
10. Alimuddin Nur	Head District	Plampang
11. Agil Husein	--	Food Crop Services
12. Sustomo	Acting Head of Agrarian	Agrarian
13. Soedirman	--	Forestry Services
14. Gufranuddin H.	--	Plantation Services
15. M. Noer Tala	--	Health Services
16. Arman A. Hamid	--	Fishery Services
17. Edy Mokhtar	--	Sumbawa Office
18. P.M. Loilewen	--	BAPPEDA
19. Mahfud Johari	--	BAPPEDA
20. Usman	--	BAPPEDA
21. Idris	--	BAPPEDA
22. Agus Sutisna	Irrigation	West Sumbawa, PU
23. Slamet Sumardjo	--	West Sumbawa, PU
24. M. Soewadji	Head of PU	Sumbawa Besar
25. Djalaludin R.	Head of PU	East Sumbawa
26. Lunar	--	--

APPENDIX E

AGENDA OF SSIMP ENVIRONMENTAL BRIEFING

Sumbawa, 26 May 1988

I. Opening

II. Introduction

1. Small-Scale Irrigation Management Project

- DGWRD/USAID
- Provincial PU/Technical Assistance Consultant/Local Consultants

2. Environmental Regulations, Scoping Sessions, and Purpose of Meeting

3. ANDAL and PIL

III. Overview of Kalimantong II and Tiu Kulit Projects

IV. Discussion

1. Explanation of Checklist.

2. Land Resources

- Soils and Land Capability
- Salinity/Alkalinity and Waterlogging
- Soil Erosion in Catchments
- Sedimentation in Reservoirs and Downstream Irrigation Works
- Construction and Land Clearing

3. Water Resources

- Streamflow Characteristics and Water Availability
- Water Retention and Drainage Potential
- Water Losses through Operations and Maintenance
- Water Quality

4. Biological Resources

- Critical Habitat for Rare and/or Endangered Species
- Livestock and Pasture Land
- Fisheries
- Biomass, Water Weeda and Pests

5. Environmental and Public Health

- Water-related Disease and Insect Vectors
- Agrochemicals

6. Socioeconomic Factors

- Settlement
- Social Organization
- Farming Systems
- Community Participation

7. Cultural Property

- Archeological, Historic or Religious Sites
- Aesthetic or Natural Values

IV. Conclusion and Recommendations

APPENDIX F

LIST OF SSIMP ENVIRONMENTAL BRIEFING PARTICIPANTS

Sumbawa, 26 May 1988

Name	Profession/position	Organization
NTB Province		
1. Kartabrata	Irrigation	PU NTB
2. Wahju Djoko M.	Irrigation	PU NTB
3. Sudanta	Embung Project	PU NTB
4. Djoko Prakoso	Kalimantong Project	PU NTB
5. Abdullah MT.	Head of Environmental Center (PSL)	Mataram University
Harza, NTB		
6. Jeffery Frey	NTB TA Team Leader	Harza
7. Robin B. Erickson	Agricultural Economist	Harza
Regency		
8. M. Rabil	--	Village Development
9. L. Mudahan	--	Village Development
10. Alimuddin Nur	Head District	Plampang
11. Agil Husein	--	Food Crop Services
12. Sustomo	Acting Head of Agraria	Agraria
13. Soedirman	--	Forestry Services
14. Gufranuddin H.	--	Plantation Services
15. M. Noer Tala	--	Health Services
16. Arman A. Hamid	--	Fishery Services
17. Edy Mokhtar	--	Sumbawa Office
18. P.M. Loilewen	--	BAPPEDA
19. Mahfud Johari	--	BAPPEDA
20. Usman	--	BAPPEDA
21. Idris	--	BAPPEDA
22. Agus Sutisna	Irrigation	West Sumbawa, PU
23. Slamet Sumardjo	--	West Sumbawa, PU
24. M. Soewadji	Head of PU	Sumbawa Besar
25. Djalaludin R.	Head of PU	East Sumbawa
26. Lunar	--	--

APPENDIX G

LIST OF PERSONS CONSULTED

No.	N a m e	Status
1.	Drs. Alimuddin Nur	Head of Plampang Sub-district
2.	M. Ali Syam	Head of Simu Village
3.	Ismail M.	Head of Maronge Village
4.	Dr. I Wayan Rata Yasa	Doctor at Plampang Medical Center
5.	M. Yasin LB	Informal Leader - Maronge Village
6.	Husein	Informal Leader - Simu Village
7.	Burhanuddin	Maronge Village official
8.	Karim	Simu Village official
9.	H. Muhammad	Farmer, Simu Village
10.	Jamal Hemat	Farmer, Simu Village
11.	Ibrahim Aga	Farmer, Simu Village
12.	Bedjo	Farmer, Maronge Village
13.	A. Rachman	Farmer, Maronge Village
14.	M. Said Djalik	Farmer, Maronge Village
15.	Sabaruddin Sambe	Farmer, Maronge Village
16.	Jeraming	Farmer, Maronge Village
17.	H. Ahmad Djalik	Farmer, Maronge Village
18.	Masnang	Farmer, Maronge Village
19.	H. Muhammad Poro	Farmer, Maronge Village
20.	Muslim / Taslim	Farmer, Muer Village
21.	M. Zen	Farmer, Muer Village
22.	Arsyad	Farmer, Muer Village
23.	H. Mustaram	Farmer, Muer Village
24.	Dr. Robert G. Morrison	Environmental Management Development in Indonesia (EMDI), Canadian International Development Agency (CIDA), Jakarta
25.	Dr. George Green	Environmental Management Development in Indonesia, Canadian International Development Agency, Jakarta
26.	Mr. Nabiel Makerim	Deputy Assistant Minister, Ministry of Population and Environment, Jakarta
27.	Mr. Gempur Adiyan	Staff Deputy Assistant Minister, Ministry of Population and Environment, Jakarta
28.	Mr. Hensri Reichart	World Wildlife Fund, Jakarta
29.	Dr. Peter Neame	Environmental Consultant, Ujung Pandang
30.	Ir. Mardjono Notodihardjo	Department of Public Works, Jakarta

APPENDIX H

RECORD OF REVIEW MEETING ON DRAFT ENVIRONMENTAL ASSESSMENT REPORTS

Introduction:

The meeting was held on 17 March 1989 in response to a request by Harza Engineering Company to have all interested parties review the draft Environmental Impact Assessment reports for the Tiu Kulit and Kalimantong II projects.

The location of the meeting was the conference room of BAPPEDA TK I, Mataram. Participants included representatives of the following:

1. BAPPEDA TK I
2. Public Works - Jakarta and Provincial NTB
3. Agriculture
4. Forestry
5. Livestock
6. Fisheries
7. Bangdes
8. PSL-UNRAM
9. Small Industry
10. USAID
11. Consultants: P.T. GeoSurvey (Kalimantong II Project)
12. Consultants: P.T. Mettana (Tiu Kulit Project)
13. Harza Engineering Co., Technical Assistance (TA) Team

The session was opened by Drs. H. L. Parka Mahardan, Head of BAPPEDA Tk I. The second speaker was Ir. Koesdaryono, Ministry of Public Works, Jakarta, who explained that each new project was required to have an Environmental Impact Assessment study (AMDAL). This study should be prepared in conformance with the laws and regulations of the participating governments of the Republic of Indonesia and the United States of America.

The third speaker was the SSIMP NTB TA Team Leader, Mr. Jeff Frey, who gave a general briefing of the major components of each individual project. Following this, Drs. Abdullah MT of the PSL-UNRAM, gave a detailed description of the methodology and results of the impact study for each project. He also invited comments or questions from the participating body in order to ensure that they understood the study or had their queries addressed.

The following notes are a record of the questions (Q) or statements (S), together with the responses (R), plus the name of the speaker whenever that individual could be identified:

Q - Drs. Fauzi Gani, from BAPPEDA, stated he understood this was a study based upon the laws and regulations of the

governments of the Republic of Indonesia and the United States, but what about the report status - was it a PIL or ANDAL?

R - Drs. Abdullah MT, PSL-UNRAM, responded that this draft report was an ANDAL althougn it still had to be revised to conform with this format.

S - A PU Jakarta staff member from Project Evaluation, indicated, that the Tiu Kulit project costs were too high compared with similar projects, although the EIRR was favorable.

R - Tiu Kulit is a new project, not on-going. The initial construction cost is high because of the dam. The large irrigation area will support the project costs.

Q - What was being planned to prevent livestock from destroying the canal embankments? What about grazing land that was now to become agricultural land? What plans were being made to mitigate the effects of construction, i.e., cut areas, borrow pits, embankments, etc.

S - A PU Jakarta staff member stated that the prices and costs of production were in the socioeconomic section of the draft report.

Q - Were there any beneficial or negative factors regarding aquatic plants in the proposed projects?

Q - The construction program was to attract about 400 laborers from other regions. How about the negative impact of these incoming laborers in terms of crime? What has been planned to overcome this negative aspect?

R - No specific response to the above.

S - Public Health stated that construction of the dam and reservoir would increase the population of mosquitoes.

Q - Are there any plans to overcome this potential problem?

Q - Interrelated with the village water supply, if the water level in the reservoir falls sharply, how can water be delivered to the household users?

R - The above problems are primarily the responsibility of the Department of Health and it is their duty (with the help of BAPPEDA) to provide possible solutions.

S - A Provincial PU staff member stated that the water quality (based on the sampling done in this study) was considered adequate for the purposes intended, but this did not include the standards necessary for fisheries.

Q - How about the quality of return flows (drainage) from the service area?

R - no specific response

S - Construction workers need water for their daily use.

Q - What water were they expected to use?

Q - Check with the Forestry Department on the relationship between slope and degree of erosion.

R - Since much of the catchment of the proposed reservoir is forested, there is not expected to be erosion problems.

Q - How far was the seepage (from the canals, etc.) expected to influence public (domestic) water supplies?

Q - Did the Tiu Kulit project expect to increase farm mechanization?

R - There is expected to be selective increases in farm mechanization due to the higher cropping intensities requiring faster tillage methods between cropping seasons. There may also be mechanical tillage equipment used in the heavier clay soils (gromosols) during the dry season.

Q - What would be the impact caused by the maximum discharge (flood)?

Q - Was there a pilot project being proposed?

R - Parameter data for water quality for irrigation and/or water supply requires future monitoring and is being planned to be done each two to three years.

S - Changes in discharge volumes could cause changes in aquatic plant infestations so that this aspect needs to be investigated.

S - A Jakarta PU technical staff member stated that with the present yield of rice at 2 t/ha being increased to 5 t/ha under improved irrigated conditions, then this is already considered to be a high level of technology.

Q - A PU Jakarta staff member asked the following:

- Requested clarification of ANDAL?

- How about operations and maintenance?

- How about operations and management during wet or dry season and the impact downstream?

- What is the future use of livestock (draft or consumption)?

- What about water supply (domestic)?
- Has there been any investigation into the possibility of a landslide into the reservoir from the adjacent steep slopes?

R - All these questions were answered previously.

Q - Should ANDAL be processed in Jakarta or NTB Provincial level?

Q - What about the safety in storing the ten million cubic meters of water in the 100 ha reservoir behind the dam?

Q - Clarification is required to explain how and where the borrow areas are to produce the immense quantity of embankment material required to build the dams?

Q - What about the cost/benefit ratio computations for the economic analysis?

Q - The USAID staff member asked about the RKL (Environmental Management Plan) and the RPL (Environmental Monitoring Plan) in relation to the discussion about high project development costs? What about the real costs?

S - A BAPPEDA staff member stated that land use data was given in sufficient detail, but there was no data on ownership status so that this could be a problem in implementation.

S - Bpk. Wijaya, from the Department of Small Industry, made the following statements:

- PIL or ANDAL should be reported to the AMDAL commission. Erosion and landslide problems in the Tiu Kulit report should be supported by analyses and investigations.

- On the subject of public health - give information concerning nutrition and sanitation.

- The report should have included oceanography and the study based on a matrix evaluation.

- Bpk. Nasri, from PU Jakarta, stated that the questions concerning Tiu Kulit and Kalimantong II projects were almost identical.

- Drs. Fauzi Gani, from Provincial BAPPEDA, stated that this report was not yet a final ANDAL. When the revisions have been finalized, it should be discussed by the NTB Provincial Environmental Commission (Komisi Daerah) and then reviewed and approved by the PU Central Environmental Commission in Jakarta. There should be a systematic analysis of the various components of the environmental impact study such as biology, physics, socioeconomics and public health. The NTB Provincial Environmental Commission (Komisi Daerah) is responsible for this study because the projects are located within this one province.

S - A PU, Jakarta staff member stated that since these projects were both located within NTB province, the first step in approval would be at this level. When a revision is accomplished, final approval would be done at the PU Jakarta head office.

S - A USAID staff member stated that in 1986, the ANDAL was already prepared, but since the Jakarta office was very busy it was handed down to the provincial level again for final approval. This report is still in the draft stage and after revision it will be changed into a final report using USAID format.

S - Bpk. Danu, PU, Jakarta, stated this report format does not fit the ANDAL model since it does not use the matrix method. The report is still in the draft stage and the matter of fitting the proper format is not paramount now, but in the final revision the appropriate governmental regulations should apply.

Borrow Areas. Materials (rock, gravel, sand and clay) for the weir, cofferdams and left bank canal protection dike will be obtained from borrow in the immediate vicinity of the weir site. There is a restriction that borrow for the dike can not be excavated within fifty meters upstream thereof as a protection against underseepage. The contractor may exercise his option to obtain theses materials from other locations subject to the contract provisions and the Supervising Engineers' approval.

Materials for access road embankments are expected to be obtained within the designated right-of-way from excavated sections that are within the nominal haul distances as specified in the contract. Canal embankment materials are expected to be obtained from drains that are excavated immediately above the main canals to intercept run-off from the higher adjacent lands.

In some isolated cases, there will be borrow sites designated where the calculated embankment material is in short supply from the normal sources as described above. In the event that borrow sites are designated, the contractor will be required to restore such sites by providing drainage and reducing the cut slopes so as to make the site useful for other non-agricultural pursuits.

NOTULEN RAPAT PEMBAHASAN

LAPORAN ANDAL PROYEK TIU KULIT DAN KALIMANTONG
DI MATARAM TGL. 17 MARET 1989

1. Bahwa pada hari Jum'at tanggal 7 Maret 1989, telah diadakan pembahasan laporan ANDAL proyek irigasi beserta waduk Tiu Kulit dan Proyek Irigasi Kalimantong, Nusa Tenggara Barat di Mataram, yang dipimpin oleh Ketua Bappeda Dati I NTB yang dihadiri oleh :

   I. Dari Jakarta.
      - Staf Ahli Menteri PU Bidang Pengairan.
      - Kepala Biro perencanaan Dep. PU beserta Ir. Dana A. Kartakesuma.
      - Kasubdit K2S, Dit. Bina Program Pengairan.
      - Kasubdit Evaluasi Proyek Dit. Bina Program Pengairan beserta Ir. Ngajiono.
      - Wakil Direktorat Irigasi I Ir. Achmad dan Ibnu Sudarman.

   II. Dari Daerah.
      - Ketua Bappeda Dati I NTB beserta Staff.
      - Kakanwil Dep. PU NTB beserta Staff.
      - Kasubdin Pengairan beserta Pemimpin Proyek-proyeknya.
      - Wakil-wakil dari Dinas dan Instansi terkait Dati I NTB

   III. Pihak USAID

   IV. Konsultan Harza dan Konsultan Lokal

2. Pada pembukaan diskusi telah memberi pengarahan Ketua Bappeda Dati I NTB dan Staff Ahli Menteri PU Bidang Pengairan

3. Setelah presentasi laporan-laporan oleh Konsultan PSL Universitas Mataram, para peserta rapat dari Pusat dan Propinsi telah menyampaikan tanggapan yang umumnya sangat berguna sebagai input bagi perbaikan laporan-laporan Andal tersebut.

4. Berdasarkan pengarahan-pengarahan dan diskusi yang berlangsung dapat diambil beberapa kesimpulan :

   4.1. Judul laporan-laporan perlu disesuaikan dengan ketentuan-ketentuan yang ada.

   4.2. Amdal Proyek Tiu Kulit adalah Andal (E.I.A), perlu dilengkapi dengan metoda dan evaluasi dampak penting, jadi perlu dilengkapi sistematika atau kerangka laporan yang berlaku.

   4.3. Amdal Proyek Kalimantong adalah Andal yang perlu dilengkapi dengan metoda flowchart dan evaluasi dampak penting.

4.4. Uraian komponen proyek agar diuraikan lebih rinci lagi, termasuk pada tahap operasi dan pemeliharaan mengenai pengaturan alokasi air.

4.5. Uraian Rona Awal dan dengan dampak agar didukung oleh data kwantitatif yang dikumpulkan dilapangan (sekunder dan primer).

4.6. K.P.L dan R.K.L akan disusun lebih rinci setelah laporan Andal ini telah sesuai dengan ketentuan yang ada.

5. Dengan demikian dari studi Andal ini, yang laporan Akhir akan diperbaiki sesuai dengan hal tersebut di atas dan memperhatikan tanggapan rinci dalam rapat, dapat disimpulkan bahwa dampak lingkungan proyek-proyek ini masih dalam batas-batas yang dapat ditanggulangi (kecuali yang memang telah direncanakan seperti penggenangan daerah waduk) yang tentu saja memerlukan dana dan biaya yang harus diperhitungkan dalam perencanaan dan perhitungan ekonomi proyek-proyek tersebut:

Mataram, 17 Maret 1989

Staff Ahli Menteri PU
Bidang Pengembangan Pengairan

(Ir. Koesdaryono)

Ketua Bappeda
Dati I NTB

PEMERINTAH PROPINSI DAERAH TINGKAT I NUSA TENGGARA BARAT
BAPPEDA

(Drs. H. Lalu Parka Mahardan)

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