Directorate General of
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International
Development

Small-Scale Irrigation Management Project (SSIMP)

FINAL REPORT
ENVIRONMENTAL ASSESSMENT
TIU KULIT DAM PROJECT

EXECUTIVE SUMMARY

October 1989

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EXECUTIVE SUMMARY

Introduction

The Tiu Kulit Dam Project will provide reliable irrigation to 1,700 hectares (ha) in Sumbawa District of NTB Province by constructing a dam on the intermittent Tiu Kulit River. Experts from Indonesia and the United States have reviewed the project plans and concluded that it will accomplish its primary objectives, but that significant environmental effects might result. This environmental assessment, prepared under the laws of Indonesia and the United States, explores the potential effects of the project on human and natural resources and recommends actions to mitigate adverse effects and enhance benefits.

Sponsoring Agencies

The project is 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.

Objective of the Environmental Assessment

The major objective of this environmental assessment is to inquire whether there are any probably major negative impacts of this project on the environment. This report also assesses possibly 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

Priority issues were identified as a result of an Environmental Scoping Session and these issues have been organized into four basic categories: water resources, land resources, biological resources, and socioeconomic and cultural resources. This is the scope of the report.

Description of the Proposed Project

Location

The Tiu Kulit Dam Project is located in Sub-district Plampang, near Maronge Village on the coastal plain of the Tiu Kulit River. The river drains a catchment area of 152 square kilometers (km2) on the eastern side of the western land mass of Sumbawa Island. The catchment area at the dam site is 54 km2. (See Figure ES-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 above. It also includes the entire land area and population of three villages in which the river basin is located.

Pre-Construction Period

The Tiu Kulit Dam Project has been investigated by a series of engineering studies during the 1980's. These include the Sumbawa Water Resources Development Planning Study (Fenco, 1982); various studies by PT Mettana (Mettana, 1984); a study by PT Cita Prisma (1985); another study by Peksi Consultants (1986); and a "Rapid Rural Irrigation Appraisal" in 1986, followed by a Household Survey in 1987. Final design reports and tender documents are scheduled for completion by PT Mettana in October 1989.

Construction Period

Major Structures. The project will contain two main types of structures: a dam and headworks complex at a gap in the hills some three kilometers (km) upstream of the main hamlet of Maronge Village, and a system of canals to convey the water to the service area and distribute it to the fields.

The dam will be a random fill structure with a height of 29 meters (m) above the river bed. It will impound a reservoir with a surface area of 110 ha and live storage capacity of 10 million cubic meters (MCM).

A lined headrace canal will convey water from the reservoir 1.8 km to the main/secondary canal system. The area will be served by three principal secondary canals, one of which will cross the Maronge River near the main hamlet of Simu Village to serve the left bank area. The canals will be unlined. A drainage system will be provided, primarily to remove excess rain water.

Work Force. The total construction force for the dam and irrigation system is expected to number approximately 850 workers, of which 700 will be laborers, 100 semi-skilled and skilled workers and 50 technical and management staff. Somewhat less than half of this total number will be required under the dam contract. The contractor may hire these laborers from the existing labor force in the district.

Schedule. The construction of the dam is expected to begin early in 1990 and continue for 30 months. The canal system will be constructed concurrently, if labor is available; if not, as soon as the work can be redistributed.

Operation Period

Irrigation: Method of Operation. Water will be provided to the service area on an as-needed basis, which is determined partly by rainfall. The reservoir will be filled during the early part of the rainy season, and will be full about February. By April the reservoir will begin its drawdown which will continue through the end of the dry season.

Equipment Use. Little special equipment will be required, other than that installed at the dam and in the canals to control flow. Some tools will be required for maintenance and will have to be carefully controlled if they are to be available when needed.

Resource Use. The only resources used by this project during operation will be water and hand labor. Virtually no mechanical energy resources will be required, since the system will be manually operated.

On-Farm Management. The functioning of local water users' associations (P3A) will be examined and, where necessary, strengthened. The relative roles of the locally elected malar (irrigation foreman) and the PU Operations and Maintenance (O & M) staff will be examined in terms of the effectiveness and reliability of the water distribution system.

Domestic Water Supply: Method of Operation. The project will install a water supply system to the two downstream villages. Public Works O & M will be responsible for maintaining this system to distribute water to the village main distribution water reservoirs.

Public Bathing and Livestock Watering: Method of Operation. Public Works will install structures. Once built, there will be some monitoring of the structures to see that they remain in good condition. Community education and eventually, community-led enforcement programs will be required to effectively protect canals and other structures from damage.

Waste Treatment. The only significant waste created by the project will be water in the form of irrigation drainage. Those flows will contain some fertilizer and pesticide residues from the fields, plus human and animal waste from villages. The flows will be returned to the rivers without treatment.

Institutional Development

A training program for Public Works planning, operating, and management staff will be conducted over a four-year period, in order to improve language and computer skills, technical understanding in various fields, and to improve local operations and management ability.

Project Costs

Capital Costs. Tiu Kulit project construction will be carried out under four separate contracts: one contract for the dam, appurtenant works, and headrace canal, one for construction of the irrigation works, and one each for the access road and permanent buildings. The dam contract cost is estimated at Rp 10,784 million (January 1989 price level), of which Rp 7,236 million will be the foreign currency cost component. The sum of the irrigation system, access road, and permanent buildings construction packages is estimated at Rp 5,647 million, with Rp 1,412 million being the foreign currency component. Financing will also be required for engineering services and owner's overhead during construction which are estimated at Rp 1,510 million for the dam and Rp 548 million for the irrigation system.

Operation and Maintenance. Operating and maintenance costs for the dam, major structures and irrigation system are estimated based on other studies and experience in the region. The total project annual O & M costs are estimated at Rp 30,000 per ha, or Rp 51 million.

Alternatives to the Proposed Project

No Action Alternative

If this project is not implemented, the present uncertainties of agricultural production will continue, with the local people barely scraping by. Some emigration of younger farmers may take place, due to the attraction of better conditions elsewhere.

Alternative Technologies

Water Sources. The only alternative water source in the region, ground water, is not sufficient to meet irrigation needs.

Water Management. Effective management of existing surface water resources could not, of itself, improve the agricultural situation, since the river is too seasonal and its year-to-year fluctuation too great for reliable irrigation.

Siting Alternatives

The Tiu Kulit dam site is the most downstream site that will provide the required storage. Several alternative spillway and outlet works arrangements were examined in arriving at the selected plan. Placement of the access road and the canals was dictated by topography and the configuration of the service area.

Existing Environmental Conditions

Climate

The project is located in an area of tropical moist climate. The average annual catchment area rainfall is 1,970 millimeters (mm) while service area rainfall averages under 1,500 mm, most of it in a four-month period. Temperatures range from a monthly average minimum of 21.3 degrees Celsius (C) in July to a monthly average maximum of 34.5 degrees C in November.

Topography

The catchment area above the dam site is composed of steep valleys, while the coastal plain, containing the service area, is flat or gently undulating, punctuated by local hills up to 50 m in height.

Water Resources

The Tiu Kulit River system is the only natural surface water in the area, there being no lakes or ponds. The north-flowing Tiu Kulit is joined by the Pemasar River some 2.5 km downstream of the dam site to form the east-flowing Maronge River. The Tiu Kulit is a strongly seasonal river with peak monthly average flows of 4 to 11 cubic meters per second (m3/s) occurring usually in February and flows generally less than 1 m3/s from May through December. During several months of each year the river shows no surface flow.

Water quality analysis made in August 1988 (at a time when the river was reduced to subsurface flow), show the Tiu Kulit to be an unpolluted, slightly alkaline river, as would be expected from the relatively uninhabited nature of its upper catchment area.

Most households in the service area draw their domestic water from wells during much of the year, but when the wells go dry, as they frequently do during the dry season, the people must turn to pits excavated in the riverbed, where they are able to obtain some surface flow.

Land Resources

Land Use. The catchment area above the dam site, totaling approximately 5,400 ha, is very sparsely settled (barely 0.1 percent of the area being developed), leaving the rest in dense deciduous forest with some brush and savannah. The coastal plain, while containing all of the land in the catchment area suitable for rice cultivation, also contains considerable hilly land, largely uncultivated and covered with brushy woodland.

Agriculture: Production. At present, nearly all farmers in the region plant one crop of rice at the onset of the wet season, covering roughly 1,475 ha. On average, 90 percent of that planted area is harvested, or approximately 1,330 ha, yielding on average 2.0 to 2.3 tons of dried paddy per hectare (t/ha). Some farmers also plant mungbeans in the wet season in the drier portions of the project area amounting to 145 ha and yielding about 300 kilograms per hectare (kg/ha) in the harvested areas. Following the wet season many farmers attempt a palawija crop, usually mungbeans. The area planted is about 20 percent of the proposed service area, or 360 ha. Harvest of this crop, performed in August or September, is very uncertain, dependent entirely on soil moisture.

The main source of draft power for field preparation is the water buffalo, which are owned or managed by 80 percent of households and average nearly five animals per household.

Fertlizers are widely used, but at relatively low rates, well below those recommended by the agriculture specialists. Pesticides are used, but only insecticides, carbamates and some organophosphates being preferred. These, too, are applied at below recommended rates.

Crop Consumption. Rice is sold to middlemen who pick up and purchase at the farm, but only about 20 percent of the total crop is sold. More than 50 percent of the crop is consumed by the farm family; approximately 11 percent is used as wage payment; and some 10 percent is retained as seed. Mungbeans, on the other hand, are grown largely for the market, with 80 to 90 percent of the crop being sold.

Biological Resources

Habitat. The tropical deciduous forest of the upper Tiu Kulit catchment, which to date has been only sparingly cut, provides good habitat for a variety of wildlife. The service area, with more fragmented areas of woodland and heavier human use, contains habitat for species able to coexist with man. At the estuary a small swamp of mangrove exists, but it is not large enough to be ecologically important.

The aquatic habitat in the river, reduced to pools for much of the year, does not support a significant ecosystem.

Fauna. A 1986 report by the NTB Department of Forestry of a nearby catchment area gives an idea of the animal life to be expected in the wilder areas of the upper Tiu Kulit catchment. There probably are deer, wild pigs, macaque monkeys, and mongooses, all widely distributed in the Lesser Sundas, as well

The bird fauna is more diverse and is highlighted by the presence of Bonelli's Eagle (seen at the site by the Project Environmental Scientist), the nearest other population of which is in central Asia.

Flora. The upper catchment produces some trees with timber value (jati, kolaka, and ketapang) but these are not heavily exploited at present. At higher elevations (above 700 m) there is a more specialized flora of bamboo, figs and pandanus. Although the flora of Sumbawa has been well known for more than a hundred years, no special studies of noneconomic species have been done in the region of the Tiu Kulit catchment.

Socioeconomic Resources

Population. The three villages of Simu, Maronge and Muer contain approximately 9,000 people, not all of whom have land in the project service area. Population density is low, varying from 19 persons per km2 in Muer to 36 in Maronge. The population is young, with some 45 percent aged less than 15 years, 48 percent between 15 and 54 years of age, and the remaining seven percent more than 55 years old. Average household size is five persons. The rate of population increase cannot be determined accurately from available data.

Village records indicate that 56 percent of adults have at least completed primary school and are presumed literate, while another 34 percent have had some schooling and can read a little.

Public Health. Health statistics exist for those who have been treated at clinics and must be taken cautiously. They indicate that diseases of the respiratory system, digestive system, and skin are the most frequently treated. Malaria, although endemic, is not often treated. Waterborne intestinal diseases, such as gastroenteritis, typhoid, and cholera, appear to be widespread.

Potential Environmental Impacts

Background

There are three major phases to the Tiu Kulit Dam Project: preconstruction, construction, and post-construction. The preconstruction phase are now nearly complete and the project is about to enter the construction phase.

In July 1986 and May 1988, meetings were held in Lombok and Sumbawa, respectively, for the purpose of bringing to light the concerns and interest of local administrators and agency specialists over this project. Many of the statements made at the meetings showed that people were worried about potential impacts that are improbable or impossible, or that they have

hopes for the project that lie outside of its capabilities. The technical team has addressed all of these expressed concerns, however, even those based on misconceptions. In addition, the checklist of potential impacts of small-scale irrigation projects presented in USAID's 1980 publication "Environmental Design Considerations for Rural Development Projects" was consulted, along with other publications on the environmental effects of irrigation projects.

As might be expected, most of the perceptible side effects of this project will be related to changes in water use and availability that will occur in the post-construction phase of the project. These effects were sometimes alluded to by agency representatives at the 1986 and 1988 meetings.

Water Resources

Streamflow. Storage of 20 percent of the river's annual discharge, and redistribution of the water through the canal system and back to the river (some of it) will have the general effect of prolonging the period of low flow in the river immediately downstream of the dam. Since that is a period when all of the intermittent tributaries to the Tiu Kulit will be beginning to flow, there will be water entering the river below the dam. At the start of the dry season, however, the impoundment of flow will have the effect of drying up the river earlier in the year, except for reservoir seepage and minimum downstream releases when required.

Ground Water. The addition of water to fields and normal seepage from the reservoir to the river channel probably will have the effect of raising the water table somewhat, during the dry season. This would allow the continued use of wells that now go dry during the later months of the dry season.

Water Quality: Reservoir. The water quality in the reservoir will be essentially like that of the river at present, less most of the sediment load. Concerns that the reservoir may become weed-covered "like Lake Taliwang" are unfounded. The physical conditions of the reservoir will be totally unlike those of the shallow Lake Taliwang, while land use in the upper catchment also is completely different.

Irrigation System. Water entering the irrigation system at the headworks will be of good quality, coming from an uncontaminated river. The amount of degradation received in the canals will depend on the extent of nonagricultural use it receives (laundry, bathing, livestock watering, waste disposal). With reasonable precautions (see "Mitigation Plan") it should provide better quality water for general use during the dry season than exist at present in comparable months.

Downstream. There is likely to be some decline in water quality in the main stem of the river, due to decreased flows and the contribution of drains. This will be particularly felt during the drier months, when a greater proportion of the flow will come from irrigation return flows. Most of the chemical contribution of agriculture to these flows is fertilizer, but one should expect them to carry human and animal wastes that do not reach the river under existing conditions. The potential effect of the decline of river water quality will be largely mitigated by the availability of better water in the canals.

Land Resources

Land Use. The most striking land use change resulting from this project will be the creation of a reservoir in an area now consisting of brushy woodland and river bed.

Other land use changes will be less evident, but more important. Main and secondary canals will consume approximately 20 ha of land, much of it now in agriculture production. Tertiary and quaternary canals, as well as drains, will take land from field edges.

Equally important, the shift in cropping pattern toward intensified rice cultivation will mean that some fields now used for grazing of cattle and water buffalo will be unavailable for that use. With the high population of large animals to be fed, livestock management practices will become more intensive.

Soil Chemistry and Waterlogging. Concern was expressed at the 1986 meeting that the reservoir would cause waterlogging and salinization of soils, by raising the water table. The steep-sided reservoir, however, is not likely to saturate soils in its vicinity, and at any rate the lands surrounding it are not agricultural. Seepage of water from elevated canals is a greater threat, where the canals are adjacent to fields, but the relatively high humidity in the project area will serve to reduce this risk. Nevertheless, the irrigation managers should be alert to excessive seepage through canal banks, which costs water, as well as damaging soil.

Erosion. Catchment area degradation and subsequent silting of the reservoir also were concerns of meeting participants. At present, the sediment load of the river is low, but extensive deforestation of the upper catchment could alter the picture.

Biological Resources

Terrestrial. The loss of 100 ha of terrestrial habitat to inundation is not a serious one, since the habitat there is not exceptional.

Aquatic. The reservoir is expected to exhibit the characteristics of other deep narrow reservoir subject to severe annual drawdown. With a relatively small euphotic (productive) zone relative to its total volume and with relatively low nutrient values in the inflowing water, the reservoir will not be ecologically productive. Rooted aquatic plants that become established at high water will be desiccated as the water recedes; those established at low water will be drowned in darkness on filling.

Species of Special Interest: Commercial. Some of the commercial valuable timber trees in the upper catchment and many fuelwood species may be subject to increased cutting if the improved cash flow created by the project stimulates entrepreneurs to provide these products.

Pests. An increase in cropping intensity may be expected to favor populations of insect and vertebrate pests. Farmers and rice middlemen will require better pest management or more intensive pesticide use if outbreaks are to be avoided.

Mosquitoes, pests of a sort, are likely to increase with more standing surface water in drains and fields, and with them the incidence of malaria, filariasis and dengue.

Socioeconomic Resources

Economic Side Effects. The primary objective of this project is an improved standard of living for the portion of the population that receives irrigation water. The increase in disposable income may be expected to increase the demand for goods and services from those in the region that do not have access to irrigation. Certain tasks that the target population now perform for themselves will be more difficult for them as they devote more time to agriculture, leaving less time for house repairs, manufacture of furniture for their homes, and other activities required to maintain their living standard. With more cash available, they will hire labor or purchase goods from others. This will have the effect of spreading project benefits through the community.

The fear, expressed at the 1986 meetings, that increased land values will make it more difficult for farmers to purchase or lease land ignores the fact that these farmers will experience income increases that should keep pace with land values. Sharecroppers and renters of irrigated land will see increased land costs as the owners raise rates but the sharecroppers and renters should experience an increase in net income as well.

Farming Systems: Cropping Patterns. Initially, irrigation is expected to be used by most farmers for an additional crop of rice, but in time the greater economic return of other crops is expected to lead many to grow vegetables, tobacco, groundnuts,

and melons. The diversification of cropping will have the advantage of reducing the likelihood of pest outbreaks that often occur in multicrop monoculture.

Increased intensity of cropping of both rice and palawija (secondary food) crops is likely to result in greater use of fertilizers and pesticides, especially the carbamate and organophosphate insecticides. These chemicals are unlikely to cause toxicity problems in areas receiving agricultural runoff, but care should be used in storage, handling and formulating such chemicals.

Public Health. The increase in mosquito populations that may be expected to result from increased surface water will increase the risk of malaria, dengue, filariasis, and other mosquito-borne infections. This will require additional attention on the part of health authorities.

Resource Use: Water. The project will reduce the already low dry season flows in the reach of the Tiu Kulit River between the dam and the upstream drainage discharge points. Downstream, the water quality will be unsuitable for domestic consumption. Water in the canal system, however, will be broadly available and of fair quality, depending on the use made of it in the main and secondary canals. Overall, water will be more available to the service area during the dry season than at present.

The service area population may be expected to take advantage of the canals for bathing, laundry, and livestock watering, using the washing/bathing steps and water buffalo pools provided for these purposes. If people are allowed to bathe water buffalo and cattle away from the sites being provided in the canals, considerable destruction of canal banks and water quality degradation will result.

Evaluation of Significant Impacts

A primary impact 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.

Conclusions

The conclusion of this Environmental Assessment is that the Tiu Kulit Dam Project is environmentally feasible. It is also concluded that potentially negative environmental impacts have been adequately addressed in the Mitigation Plan.

Mitigation Plan

As might be expected in an area chronically short of water for half of every year, most project impacts amenable to mitigation are concerned with conflicting demands for limited surface water.

Water Resources

Domestic Use. At present, people of Maronge and Simu Villages depend on hand-dug wells and river flows for domestic water sources. The reservoir operating plan for Tiu Kulit project allows for the release of a minimum amount of water to the downstream river channel to supplement reservoir seepage, tributary flows and irrigation return flows as needed. A minimum release of 10 liters per second (l/s) would be sufficient to serve the needs of the local people without adversely affecting the performance of the project. This supplemental release would likely be required only during the period of reservoir filling.

Another alternative for domestic water is a piped water supply system as recommended by P.T. Mettana, in their 1988 report. This option is worthy of consideration since it would improve the quality of the water available to the people and the quantity of water required would be little more than 0.2 MCM, or about two percent of the live storage of the reservoir.

This is the only recommended mitigation action that will affect the design of the dam/reservoir system (albeit only slightly). Selection of water points and determination of peak demand will be required for sizing the conveyance and delivery system. Outlets at water points must be carefully selected so as to avoid waste without preventing the outlets from being used by children and the elderly. Delivery of water to a population not accustomed to receiving piped water requires a program of education in order to ensure continuation of domestic water conservation now in practice and to avoid abuse of the system.

Public Bathing and Livestock Watering. The project will build public bathing and laundry steps into the banks of the main canals.

In order to avoid damage to canals by livestock, especially water buffalo, alternative bathing pools must be provided. The Department of Public Works has established workable designs for

such pools and has constructed them in other irrigation systems. The total capacity of such pools for the Tiu Kulit project should be sufficient to meet the current high demand for livestock watering, allowing for other sources such as drains and rivers. An education and community-sanctioned enforcement program will be required if the people (many of them children) watering livestock are to refrain from using the canals for that purpose.

Land Resources

Reservoir Vegetation Clearing. Considering the nature of the reservoir and its operating regime, there is no water quality basis for a reservoir clearing program. Therefore, the trees in the reservoir inundation zone should be left standing unless they have sufficient value for timber or fuelwood to induce entrepreneurs to remove them at no cost to the project.

Livestock Management. Available grazing lands will be reduced as increased cropping makes sawah lands unavailable for livestock. Experience in Sumbawa on similar projects has shown that livestock management practices will shift from extensive to semi-intensive methods, such as tethering of animals and cut-and-carrying of grasses. If additional lands are required, the government should endeavor to develop them in areas where they will not affect other land uses adversely.

Biological Resources

Catchment Management. Protection of the forest of the Tiu Kulit catchment area is the responsibility of the Forestry Department, but the effectiveness of such protection, over the life of the project, will affect runoff and siltation rates. Therefore, it behooves Public Works to work with the Department of Forestry to devise methods for minimizing illegal clearing and timber cutting in the catchment.

Aquaculture Ponds. Despite interest shown at the 1986 and 1988 meetings in water for coastal fish pond (tambak) facilities, there is no allocation for such use in the present project, nor are there areas of significant coastal fish ponds in the Tiu Kulit River estuary. There would be the possibility of making additional downstream releases from the reservoir to supply fish ponds with fresh water, however, these releases would generally be at the expense of cutting back on irrigated areas since the water resources of the catchment are planned to be fully utilized for agriculture.

Socioeconomic Resources

Services and Infrastructure. Improved living stantards, 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.

Public Health. Although an irrigation project cannot be held accountable for diseases that are endemic in the area, Public Works should make local health authorities aware of possible increase in water-related diseases and should incorporate health messages into farmer education programs.

Monitoring Program

A minimal environmental monitoring program is recommended for this project, concentrating in two areas where long-term changes in the environment may affect project success: land use and water quality. The effects of the project on biological resources and on social conditions certainly should be watched for by the appropriate agencies.

Water Quality

Water samples should be taken at six to ten sites, mostly in the service area, twice during every third year. They should be analyzed for the standard parameters that indicate nutrient load, salinity, alkalinity, acidity, and human contamination. There is little utility in analyzing for pesticides unless there is reason to suspect residue contamination.

Land Use

The recommended program of land use monitoring consists of the study of inexpensive infrared or false color satellite imagery of the entire catchment, including all tributary catchments, every year. Imagery should be selected that shows most clearly the differences between forested and cleared areas. The services of a trained remote sensing specialist and a couple of technicians will be required for about a month.

If Public Works has any difficulty in hiring a trained remote sensing specialist to analyze satellite imagery, then a ground verification team should evaluate the entire catchment, preferably by helicopter, every year or two. This team should include representatives from BAPPEDA and the Department of Forestry, in addition to Public Works, or the assessment could be contracted to the local university's environmentalists for execution.

Integration of Local and Regional Planning

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.

Presumably BAPPEDA will act as the lead agency in monitoring the future need for any increases in social services and basic infrastructure.

Report Finding

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

SMALL-SCALE IRRIGATION
MANAGEMENT PROJECT

Figure E3-1
Tiu Kulit Project
Location Map