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

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Agency for
International
Development

Small-Scale Irrigation Management Project (SSIMP)

FINAL REPORT
SALOMEKKO IRRIGATION PROJECT
ENVIRONMENTAL ASSESSMENT

VOLUME I

MAIN REPORT

December 1990

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Prepared by

HARZA ENGINEERING COMPANY

in association with

Development Alternatives, Inc.

Environmental Studies Center
Hasanuddin University

Global Exchange, Inc.

PT. Wiratman & Ass.

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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 29/1986), 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 Assessment (ANDAL) Report (Ministerial Decree No. 50/MENKLH, 1987). In addition to the ANDAL 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, if a project has been determined to have a potential for significant environmental impact, then an environmental assessment (EA) is required, or if it lacks such potential, 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, 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 each 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 ANDAL is most similar in intent of meaning to what is known in the United States as an "Environmental Assessment".

This report for the Salomekko Irrigation Project has been prepared by the SSIMP Technical Assistance Team and the Hasanuddin University Environmental Studies Center, with the support and assistance of the South Sulawesi 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 as a deliberate and systematic effort to manage natural 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 the 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 irrigation project on the environment. 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 impacts.

Scope of Report

As a result of an Environmental Scoping Session held in Ujung Pandang in April 1988, and of 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 Indonesia's Government Regulation No. 29/1986. These are: water resources, land resources, biological resources, and socioeconomic resources. Information on climate and physiography is also presented, as required by

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that law (PP 29/1986). An account of the scoping session is found in Appendix C to this report.

Methodology

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 and automatic water level recorder readings, discharge measurements and rainfall records. Water quality was based on standard laboratory analyses done at the Laboratory of the Environmental Studies Centre of Hasanuddin 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, subdistrict, 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 Food Crops, Tree Crops, Livestock, Fisheries and Forestry). This was supplemented by appropriate published information for the area.

- **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's), the Household Survey (HHS), and a number of in-depth interviews with study area villagers, and officials from relevant sectoral agencies including the Departments of Village Development, Health, Statistics, Public Works, the Regional Development Planning Board, and both the District and Subdistrict administrative offices.

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 Salomekko Irrigation Project is one of the 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 regularly cultivate two crops per year. The scheme will have a net service area of 1,900 ha.

Location of the Project

The project area is located near the southeast coast of South Sulawesi, between the towns of Sinjai and Watampone (Figure II-1, Site Location Plan). It is about 100 km east of Ujung Pandang and can be reached by several good provincial roads. The project storage dam is located on the Salomekko River[1] about 4 km west of the main, paved north-south coastal road. The main part of the service area of 1,900 ha extends downstream from the dam approximately 5 km. Most of the service area lies on the west side of the main road, the main exception being 250 ha on the lower reaches of the adjacent Baruttung River.

Limits of the Study Area

The study area for this environmental assessment consists of the Salomekko River basin, extending from the headwaters above the dam site to the downstream service area; the Baruttung River basin, which lies just north of the Salomekko; as well as the coastal area located downstream. As this project is located within four villages in the subdistricts of Tonra and Salomekko, the study area includes the entire land area and population of these four villages. Material sources for construction are located near the dam site; there are no areas located outside the two river basins that are directly affected by the project.

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1 "Salomekko," in the Bugis language, means the twisting, or Winding River (i.e., "Salo" is Bugis for river, and "Mekko" means twisting or winding). For purposes of this report, it will be referred to as the "Salomekko River," since this is the way it is commonly described in English.

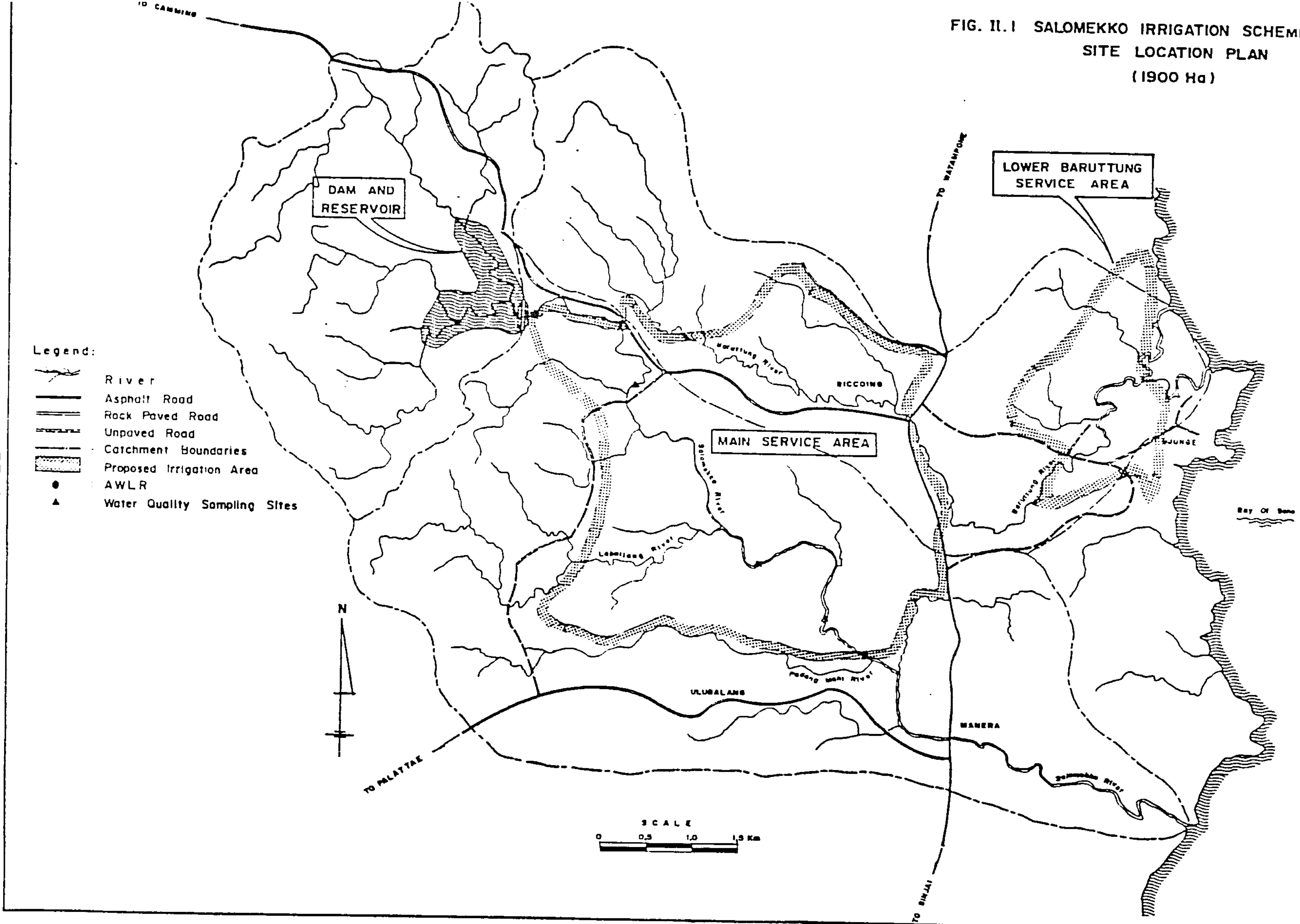

FIG. II.1 SALOMEKKO IRRIGATION SCHEME
SITE LOCATION PLAN
(1900 Ha)

Fig. II-1 SITE LOCATION PLAN

Project Life

The project economic evaluation is based on a fifty-year life span, but with effective maintenance and periodic replacement of mechanical equipment such as gates, an indefinite project lifetime is not unreasonable.

Description of the Project

Project Components

Irrigation Structures: Water Storage. The principal structure of the project will be a dam on the Salomekko approximately 8 river kilometers upstream of the main road crossing. The dam will be a rock and clay structure 28 m high (above the bed of the river) with a crest elevation of 80 m and a main crest length of 350 m. There are small saddle dams to the left and right, and an overflow spillway will be located in the left saddle dam (see Figure II-2 for major features of the dam site).

The reservoir thus formed will have a surface area of 92 ha at its normal maximum surface elevation of 76 m. It will have a total storage capacity of 7.8 million cubic meters (MCM), with dead storage, at the drawn-down elevation of 63.4 m, of 0.66 MCM and an active storage of 4.01 MCM.

Conveyance System. Water will be released through an outlet works into the system of primary and secondary canals for distribution. The canals will generally be unlined, trapezoidal sections varying in size from 5 m to 1.5 m wide at the water surface and a maximum depth of 1.5 m. The velocity of flow will be generally less than 0.5 m/s and flow volumes will range from 1.1 m^3/s to 0.1 m^3/s. The general layout of the irrigation system is shown on Figure II-3.

Delivery System. The water will be diverted from the secondary canals directly into the tertiary canals, from which the quaternary canals will deliver it to the fields. The tertiaries will be about 1 m wide and the quaternaries approximately 0.6 m. They will probably be unlined.

Drainage System. A system of drains will be provided. They will follow natural drainage patterns and serve primarily to remove excess rainwater during the wet season when the precipitation frequently exceeds crop needs. Water drained from fields will be discharged into tributary rivers and directly into the Salomekko or Baruttung.

Support Facilities: Roads and Bridges. An existing gravel surface district road which runs close to the dam site is adequate for project purposes, but some repairs and maintenance will be required. It passes within about 500 m of the dam site. Short new spurs will be required to the site, borrow areas, and the workers' camps.

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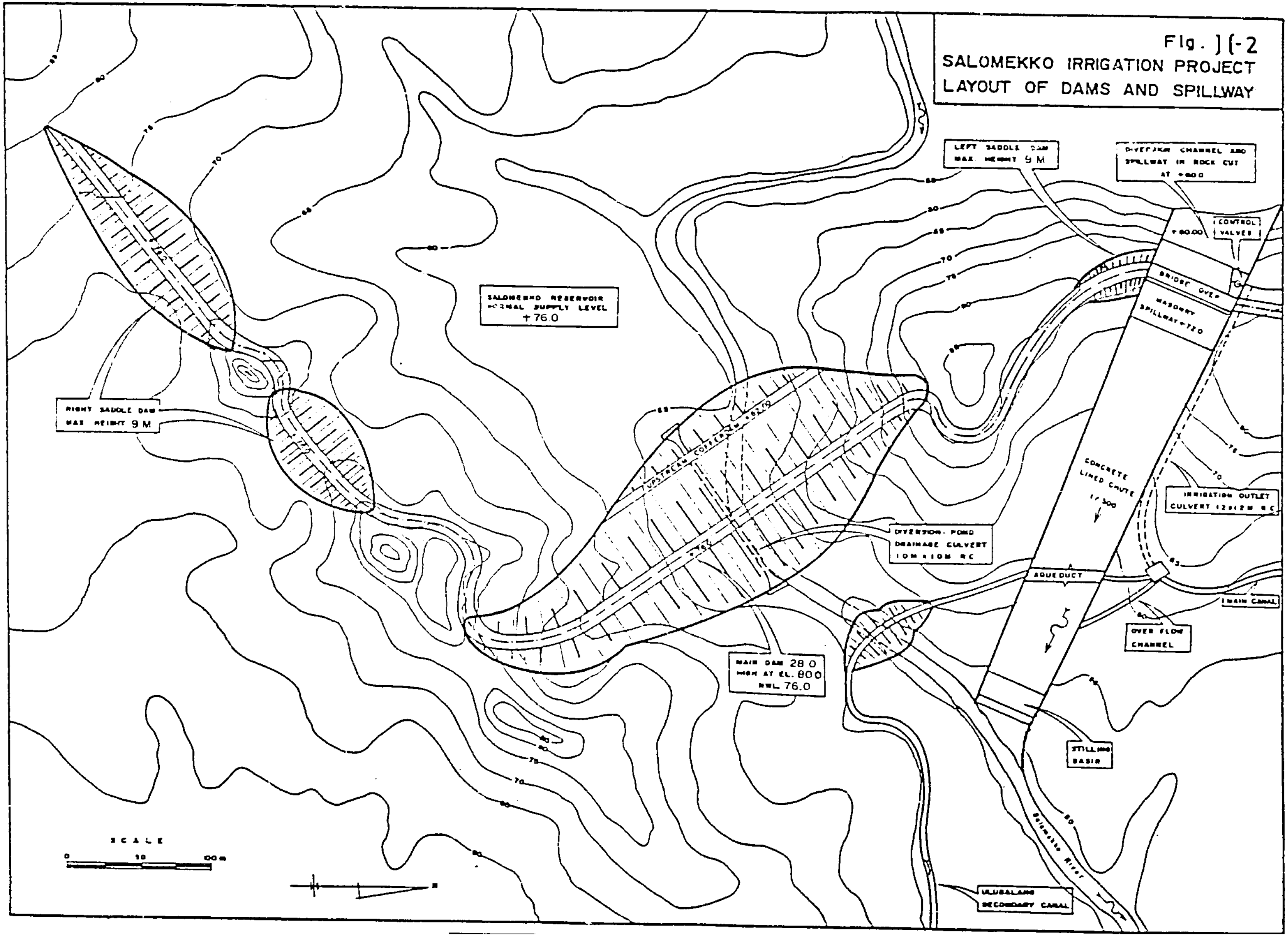

Fig. II-2
SALOMEKKO IRRIGATION PROJECT
LAYOUT OF DAMS AND SPILLWAY

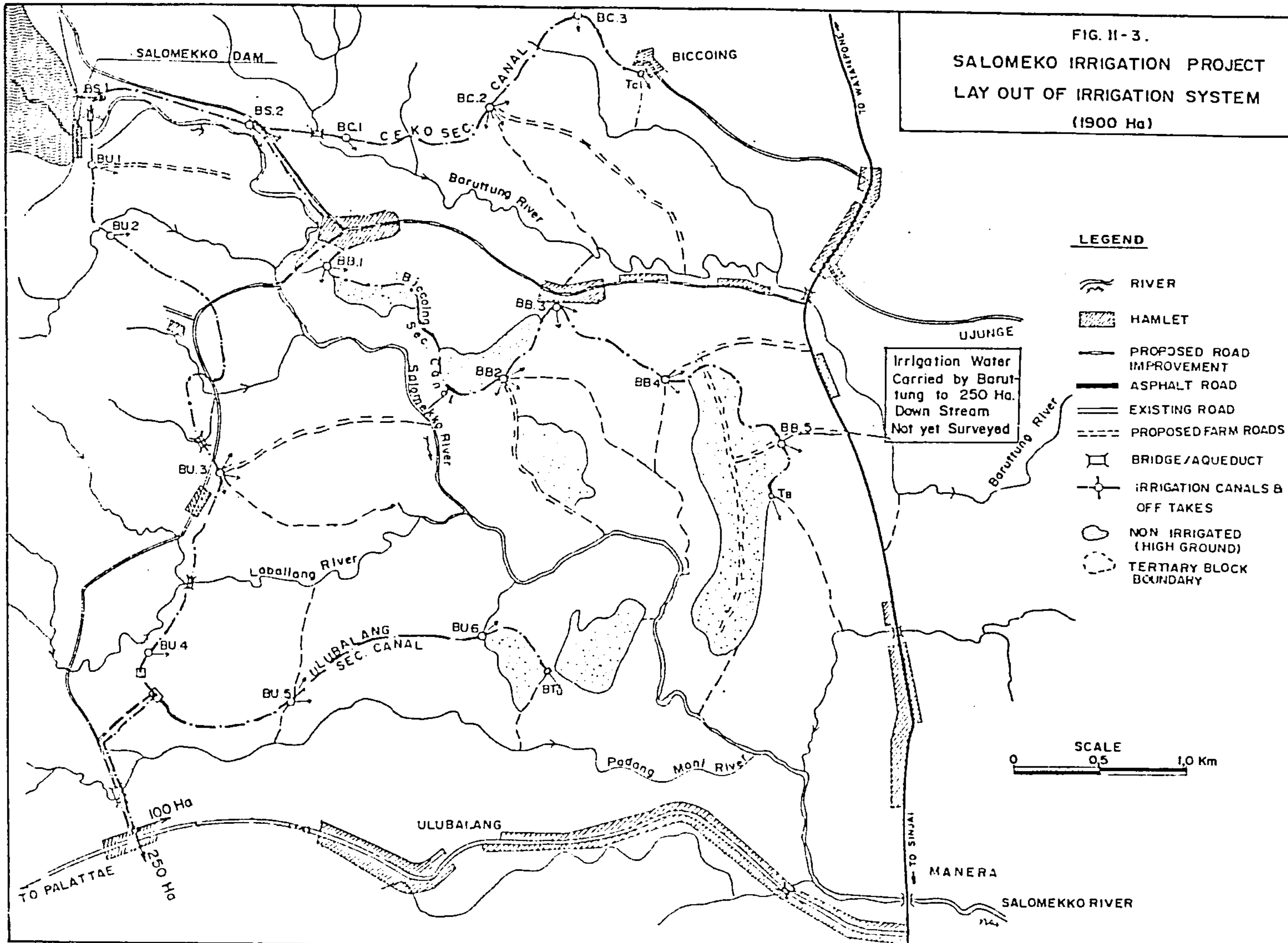

FIG. II-3.
SALOMEKO IRRIGATION PROJECT
LAY OUT OF IRRIGATION SYSTEM
(1900 Ha)
LEGEND
RIVER
HAMLET
PROPOSED ROAD IMPROVEMENT
ASPHALT ROAD
EXISTING ROAD
PROPOSED FARM ROADS
BRIDGE / AQUEDUCT
IRRIGATION CANALS & OFF TAKES
NON IRRIGATED (HIGH GROUND)
TERTIARY BLOCK BOUNDARY
SCALE
0
0.5
1.0 Km
Irrigation Water Carried by Baruttung to 250 Ha. Down Stream Not yet Surveyed
SALOMEKKO DAM
BS.1
BS.2
BU.1
BU.2
BU.3
BU.4
BU.5
BU.6
BC.1
BC.2
BC.3
CEKO SEC. CANAL
BICCOING
Tc1
TO WATAMPONE
Baruttung River
BB.1
BB.2
BB.3
BB.4
BB.5
Biccoing Sec. Can
Salomekko River
UJUNGE
Tb
Laballang River
ULUBALANG SEC. CANAL
BT1
Padang Mani River
100 Ha
250 Ha
TO PALATTAE
ULUBALANG
TO SINJAI
MANERA
SALOMEKKO RIVER

Fig. II - 3

Several new roads will be built as part of the scheme to give access for operation and maintenance of canals, and to improve access for farming operations.

Several new bridges and culverts will be included in the project to ensure good access to farmland when the canals are built.

Buildings. Project offices and housing for the project operating staff will be built in the area.

Pre-Construction Period

Initial survey and design of the Salomekko site commenced in 1983-84, when PU contracted CV Anugerah Jaya to develop a weir and irrigation system layout. Their report, completed in 1985, was part of the "Proyek Pembangunan Jaringan Irigasi Sedang, Kecil, dan Tersier, Sulawesi Selatan."

The Salomekko site was visited and the work then being conducted by CV Anugerah Jaya, was reviewed in November 1984, by a joint team from USAID and the Department of Public Works (Proyek Perencanaan Pengembangan Sumber-Sumber Air, known as "P3SA"). As a result of this assessment, the project was included in the list of sites accepted for inclusion for further study and possible construction in the Small-Scale Irrigation Management Project. In late 1986, a "Rapid Rural Irrigation Appraisal" (RRIA) was conducted by P3SA staff working with USAID social scientists and engineers. With its inclusion in SSIMP, staff from P3SA produced a "Site Profile" during 1986-1987. The resulting report, entitled "Site Profile (RRIA) Proyek Irigasi Salomekko," was completed in March 1987.

During July 1987, a pretest of the SSIMP-sponsored Household Survey (HHS) was conducted at the Salomekko site by several USAID SSIMP social scientists and engineers. During 1988 the Household Survey was conducted by this same team and a report prepared (Duewel, 1988).

In late 1987, mobilization of a Technical Assistance Team from Harza Engineering Company, Development Alternatives Inc, Global Exchange, and P.T. Wiratman and Associates began in South Sulawesi. This team was contracted by USAID to provide long-term advice to the provincial Public Works Department staff on the development of the SSIMP projects.

Two consultant services contracts were awarded by Public Works in 1988 to carry out the basic survey, investigation, and design work needed to assess the viability of the project. PT Indec and Associates were appointed to do the geological and geotechnical investigations. PT Airstan Ekawasta was contracted to do a land survey, hydrological analysis and preliminary project design. The tender procedure is now under way to select detailed design consultants for production of the final design.

During 1989-1990, the economist and social scientist of the Technical Assistance Team, working with P3SA staff assigned to SSIMP, continued to make site investigatory visits. The Salomekko site has also been visited several times during the same period by TA Team environmental scientists and engineers. Information from these surveys and site investigations has been incorporated into sections of this Environmental Assessment, particularly in Chapter IV, "Existing Environmental Conditions," and in the proposed Mitigation and Monitoring Plans.

Construction Period Conditions

Construction of the Salomekko Project will be accomplished by two separate contractors, under the general supervision of PU. The work will be divided approximately as follows:

Contract No.	Type of Contractor	Work Included
1	International	Dam, saddle dams, spillway, outlet works, permanent PU buildings, and dam access roads
2	International	Irrigation system, access roads, bridges, and culverts

Construction Schedule. The work is expected to be completed over a period of about two years.

Equipment Use. All equipment used in the construction of the project, such as excavators, dozers and haulage trucks, will be provided by the construction contractors and retained by them on completion of the construction. The dam contractor is expected to have a sizeable workshop on site.

Mechanical items, such as control gates and hoists, will be purchased from suppliers within Indonesia. Some of these items are manufactured in Ujung Pandang and some may have to be obtained in Java. Specialized controls for the dam outlet works may be obtained overseas.

Resource Use: Materials. Preliminary estimates for the construction of the dam and appurtenant structures indicate approximately 300,000 cubic meters (m^3) of rock, gravel, sand, and earth will be required, as shown in Table II-1.

In addition, cement will be required for concrete, lumber and plywood for forming and for constructing shops, sheds, and dwellings. Cement (about 300 tons), lumber and plywood will be purchased by contractors on the open market at the nearest possible source (probably Sinjai, Watampone or Ujung Pandang), depending on the economics of price and transportation.

Borrow Areas. Materials for the main and saddle dams will be obtained from required excavation for the spillway and outlet works structures, from alluvial deposits within the reservoir area, and from rock and clay borrow sites nearby. Most of the borrow areas are above the dam site. If necessary, some material may be taken from a small area immediately downstream of the dam site. Given the borrow area locations, it is expected there should be little risk of excessive amounts of sediments washing downstream. The probable quarrying sites are located near the dam site. If necessary, there are also two coastal rocky outcrops, of little or no agricultural potential that could be used.

The main dam is designed for a rockfill section with an impervious clay core separated by sand and gravel filter/drain and transition zones, An upstream cofferdam will be integrated into the dam section. The estimated volume of each of the main construction materials needed for the project is as follows:

Table II-1

Preliminary Estimates of Construction Material Requirements

Materials for Dam and Irrigation Works	Volume (m^3)
Clay Fill	130,000
Rock Fill	150,000
Rock for Masonry	16,000
Crushed Stone for Concrete	1,200
Total:	297,200

Source: Draft, Salomekko Project Justification Report, 1990.

Energy. A part of the energy required for construction will be electrical, provided by generators on site. Petroleum-based fuels, such as gasoline and diesel, will be used for powering vehicles and heavy equipment.

Transportation and Storage. The construction contractors will use motorcycles, trucks, and probably four-wheel drive vehicles on the site. Small stockpiles of materials will be maintained near the dam site and other major construction sites, in quantities sufficient for meeting the construction schedule. Materials excavated from the canals will be stockpiled alongside for subsequent use in embankments.

Waste Disposal. Waste generated by the construction process will be removed from the site, except human waste. Sanitary facilities at the camps will consist of pit latrines. These will be moved periodically and the abandoned pits will be filled in. Solid waste from the camp will be buried in the vicinity.

Work Force: **Characteristics.** The work force for the overall project is expected to comprise about 400 persons at its peak. About 250 will be laborers; 100 will be drivers, masons, carpenters. and other semi-skilled workers; and the rest skilled workers (such as mechanics, and equipment operators), foremen, and management.

Each contractor will hire his own crews. Due to the dispersed work areas, crews will probably be working concurrently on different structures and different sections of the dam, canals and roads.

The work force probably will include male and female members. Many laborers on construction projects in South Sulawesi are women, and they can be expected to play a part in hand excavation work and in carrying materials used for concrete and masonry structures in the canal network and at the dam. Most of the skilled and semi-skilled workers are expected to be men.

Source. Laborers and many of the semi-skilled workers are expected to be drawn from the immediate local area. Additional semi-skilled labor, skilled labor, and management personnel will probably move to the area from other areas in South Sulawesi and from construction company offices elsewhere in Indonesia.

Residential Area and Living Support. It is usual in Indonesia for work crews to live at home if recruited locally or to live in temporary shelters adjacent to the work area if they come from a significant distance. There is sufficient land for camps, already cleared and not too steeply sloping, owned by the government or private landholders, and within walking distance of the major structure sites. Several camps are likely to be established by the various contractors because of the dispersed locations of construction areas.

Since there will be many laborers hired from outside the area, who will be living in worker camps, the various contractors will be expected to hire some security guards to help maintain order. The security guards would be expected to work in close cooperation with local security agencies and village officials.

The contractor will either provide rice and fish to the workers as part of their pay or make arrangements with local entrepreneurs to bring those and other commodities to the camps for sale to the workers. Fuel wood will either be provided by the contractor, or some local entrepreneur will sell fuel wood to the laborers.

Some permanent buildings of brick, timber, and concrete will be constructed as part of the project. These will include offices, and houses for the PU management-level and permanent operating personnel.

Training Program. No training program is planned for the construction work force. The contractors are expected to have, on their staffs or among regular part-time employees, the required skilled and semi-skilled workers for their contracts.

Operation Period Conditions

Division of Responsibilities. Established GOI policy provides that PU assume responsibility for operation and maintenance of headworks structures, primary and secondary canals, tertiary offtakes, and the first 50 m of each tertiary canal. Water users' associations (WUA's) and their members are responsible for operation and maintenance of tertiary canals, quaternary boxes, and quaternary canals.

PU responsibilities for system operation are at the Cabang Dinas office, which normally covers about 25,000 ha of technically irrigated lands in one or more districts; at the Ranting Dinas office, which normally covers one or more systems totalling about 7,500 ha; and at the Sub-Ranting office, covering up to about 1,500 ha comprising all or part of a system. PU's contact at the WUA/farmer level is the gate keeper who covers several tertiary offtakes and passes information back and forth between farmers and the Sub-Ranting personnel.

The Cabang Dinas office for Salomekko will be in Watampone, about a one hour drive from the project site. The Ranting Dinas will probably be located in Pallatae. The Sub-Ranting offices, one for the dam and one or two for the irrigation system, will be at the project site.

Irrigation: **Method of Operation.** The project is designed to provide water from the Salomekko, stored in the project reservoir and conveyed by gravity through primary and secondary canals, to meet the crop water demands determined for each tertiary block. Water delivery at the tertiary offtakes is normally continuous over a period of time. To limit peak demands of the tertiary offtakes, delivery to blocks within each tertiary unit will probably be rotated on a schedule determined by the WUA. Diversions are typically adjusted every two weeks for projects in SulSel, but shorter time periods may be adopted for the Salomekko project to improve water use efficiency during drier months.

Diversion amounts and gate settings are typically determined at the Cabang Dinas level. Gate keepers report requests for water for each tertiary to the Sub-Ranting office, where they are consolidated and reported to the Ranting office. The Ranting consolidates Sub-Ranting requests, compares them with the estimated available storage water, and recommends a release rate which is approved or adjusted by the Cabang Dinas. Gate settings for each structure are then determined and passed down to the gate keepers.

Equipment Use. Other than control mechanisms permanently installed in the system, little special equipment will be required. Mattocks and shovels for cleaning canals will be maintained by PU.

For gauging and record keeping, equipment will be required by the local irrigation manager, a PU employee. He will also be provided with light transportation, probably a motorcycle, to enable him to check on parts of the system which are too far for walking.

Resource Use. The main project impact on resources will be the redistribution of water in the area, which is the purpose of the project. There will be little energy used in operation of the manually controlled system. Some fuel will be needed for operation of project vehicles. Small quantities of sand, gravel, stone, cement, and other building materials will be used on a continuing basis for routine maintenance.

Chemical inputs will gradually increase with intensification of agriculture, but Indonesian farmers generally apply fertilizer at rather low rates, about 300 kg/ha. Pesticide use also tends to be at rates below those recommended by pest control specialists; presumably factors such as cost, labor input, and the inability to measure precisely the amount dispersed enter into the situation.

Labor Force. The basic operation and maintenance of the tertiary and quaternary systems will be performed by the WUA's and their members, with advice and some logistic support from PU and the Agricultural Extension Services. Most area farmers have basic agricultural skills in rainfed paddy culture and palawija crops, but will require some training for effective intensification of cropping.

Operation and maintenance of the system will be performed by PU staff described above. Initially, the staff is expected to include three Sub-Ranting heads, one in charge of the dam and two in charge of different parts of the service area. In total, there should be a staff of 10 to 15 persons for the Salomekko Project. Cleaning of the primary and secondary canals is the responsibility of PU, and will probably be contracted out. Cleaning of tertiary and quaternary canals will be done by the farmers using the system.

Training Programs: Operating Work Force. Public Works will provide its local staff with orientation training for operation and maintenance of the system. This will also include training in the keeping of flow records and other types of records. Training will be conducted during the final months of project construction and during the turnover period.

Farmers. Extension training will be provided to farmers who are not accustomed to reservoirs and technical irrigation systems. The training is expected to consist of evening lectures in the villages or hamlets, supplemented with field advice by extension agents through the Contact Farmer system. PU will receive assistance in WUA organization and in on-farm water management from the Indonesian non-governmental organization, LP3ES (Lembaga Penelitian dan Penerangan Ekonomi dan Sosial).

Public Bathing and Livestock Watering. Public bathing and laundry steps for the use of local villagers will be built along secondary canals that go close to hamlets.

The project will also construct livestock bathing and drinking sites to minimize damage to banks on secondary canals. These structures will be standard in accordance with published PU specifications. PU will monitor the condition of these sites to see they remain in good condition.

Community education, and eventually, community-led enforcement programs initiated through the joint efforts of Public Works, LP3ES, Agricultural Extension Services, and the Departments of Food Crops 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 the overall community livestock management program.

If begun before the system is installed, and continued vigorously, the education program will 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 flow 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, and provision of sites along the canals for public bathing, laundry washing, and livestock watering pools.

CHAPTER III

ALTERNATIVES TO THE PROPOSED PROJECT

No-Action Alternative

If the project is not implemented, some advances in cropping intensity might be expected. This could occur by constructing some small irrigation schemes at the local level, either by simple rock and wire weirs on tributary streams or by limited use of privately-owned or village-owned pumps. However farmers have little experience with such schemes and there have never been any previous attempts in the area. It is likely that the Salomekko area would remain one of subsistence farmers, more or less locked into a low to medium living standard.

Any local irrigation developments could not be expected to keep pace with natural population growth. The area would continue to experience a steady outmigration of individual working age adults and whole households, moving out permanently, or living as circular migrants searching for work elsewhere.

Water Supply Alternatives

Ground Water Utilization

Ground Water in the Salomekko area provides most residents with serviceable domestic water, estimated at somewhat less than 200 cubic meters per day for the service area population of just under 4,000 persons. Even these requirements cannot be met fully during the dry season in most years. It is unlikely that shallow aquifers could meet even the wet season irrigation requirement of 6,400 m^3/ha needed for the 1,900 ha service area. Furthermore, the cost and reliability of ground water use are not as favorable as using the river water for irrigation.

Improved Water Management

A review, and, if necessary, strengthening of the local system of water distribution and control is part of this project. Community organizations (water users' associations) will be developed. This organizing will be accomplished by the Department of Public Works and the non-governmental organization, LP3ES.

Since there is no existing canal delivery system beyond that of simple ditches, and since pumping from the bigger rivers is impractical here for most of the area, there are no existing, formally organized water users' associations to manage irrigation. There is very little that farmers can now do to control water distribution and there is little pressure to form such organizations. Overall, if there is no project, there are severe constraints to improving management.

Alternative Use of the Agricultural Land

If the project is not implemented, it may also be that land will be purchased by the Camming Sugar Cane Factory and converted to sugar cane production. The service area is already bounded on the north and to the southwest by sugar cane fields. The current agreement in the two subdistricts in which Salomekko is located, is that the factory will not purchase land in the Salomekko service area, since it is understood that USAID will sponsor irrigation development. If the project is not constructed, the agreement would probably be reconsidered. Converting land to sugar cane production in South Sulawesi is not accomplished in the same manner as in Java. In South Sulawesi, when land is converted to sugar cane production, the land is purchased outright. There is no smallholder production and the land is continuously cropped in sugar cane, with no intermittent paddy production as in Java. Usually most of the original farmers move away and labor camps are set up for company employees. Although there is much labor used in weeding and harvesting, this tends to be seasonal and few former landowners are reported to receive employment on the estate. Thus, if the project were not implemented, much of the resident population might move away in search of farm land elsewhere, or move to urban areas to seek employment.

Siting Alternatives

Structures

Since the Salomekko River is almost dry for extensive periods of the year, the original proposal to contruct only a weir was rejected on the basis of hydrology and crop-water demand studies. These studies indicated that a simple weir scheme would result in incremental gains in yields only during the wet season, and that only a very small area could be irrigated at other times, due to a lack of water.

Storage Dam. The selected dam and reservoir site was selected on the basis of hydrologic, topographical, and geotechnical considerations. The site has the following advantages:

1. Good height/storage characteristics.
2. Located on low-value range land.
3. Very few residents--fewer than five houses.
4. Close to the proposed service area.

5. Good rock foundation.

6. Good site for spillway.

7. Construction materials readily available.

8. Controls most of the catchment area above existing terraced paddy field areas.

Other locations for the dam were briefly considered, but they required more fill material for construction or did not control a large catchment. At the site, the selected dam height was determined by optimization studies to derive crop areas and benefits relative to project costs for a range of dam heights.

Canals. The project will include three secondary canals that branch off from a short primary main canal and an independent system on the lower Baruttung. One of these canals would run along the northern border of the service area, another along the western border, and the third roughly through the center. The area on the lower Baruttung would be served by water diverted from a small weir on the Baruttung with the river itself used to carry irrigation water down from the main canals above. Rivers and streams will be crossed with aqueducts. Livestock washing stations, bathing steps and foot bridges will be supplied as necessary.

Other canal routing alternatives have been evaluated and rejected on the basis of economics, reliability, and ability to serve an effective subcommand area.

Auxiliary Structures: Roads. The existing access road to the dam site, which runs within 500 m of the left abutment of the dam and connects the sugar cane factory in Camming with the main north/south coast road, has been selected as most appropriate. Other, new routes, would be excessively expensive to construct, and would probably not be any better in location than the existing, good quality road. Other roads will be located on the basis of the sources of fill, workers' camps, work areas, etc. Some new farm roads will be added to service inaccessible sectors of the service area.

Construction Camp. The locations of the workers' camps, office, and work areas have not yet been established. The sitings will take into account existing land use, movement distances, topography, and the ultimate uses planned for the structures.

Service Area

The selection of the area to be served by the project has been based on existing land use, topography and soils. The system will cover most of the existing rainfed paddy in the Salomekko and Baruttung basin areas. The plan for subcommand areas is based on the current layout of existing paddy fields in field complexes. The organization of field complexes is discussed in greater detail under socioeconomic resources, below.

Scheduling Alternatives

There is basically only one schedule worth considering for a small-scale irrigation project: to bring the entire system on line as soon as possible. The small size of this project precludes phased development. In selecting this project for development as one of the SSIMP project areas in South Sulawesi, USAID based its decision on social, economic, and technical factors. concluding that the selected project is among those with the greatest probability of yielding social and economic benefits.

The dam and conveyance system are expected to be constructed simultaneously, depending on labor availability. Simultaneous construction is preferred, because project benefits will be realized more quickly.

CHAPTER IV

EXISTING ENVIRONMENTAL CONDITIONS

Methodology

The methodology employed in this study relies upon a checklist developed from the initial Scoping Meeting held in April 1988 in Ujung Pandang. Assessment of the boundaries of the total catchment area is based on existing maps and some aerial photographs available from PU. The study area population is defined, based on the administrative boundaries of villages located at least partially within the project service area. These villages also happen to include the largely uninhabited and lightly used catchment area, and the inhabited downstream coastal area.

Socioeconomic information, and some of the information presented on domestic water use, agriculture, forest use, wildlife, fishing, etc., were collected through field interviews, surveys of the local population, and from government offices These interviews were conducted by Public Works staff assigned to SSIMP, by USAID staff from Jakarta, by staff of the Environmental Studies Center of Hasanuddin University (PSL UNHAS)and by the TA Team. Most of this information has already been made available in several reports, including results of a Household Survey (HHS), a "Rapid Rural Irrigation Appraisal" (RRIA), a "Site Profile", and a series of internal memos and reports.

Climate

The Salomekko project area has a tropical wet climate characterized by a short rainy season and a long dry season. Some rainfall occurs in every month, but during the dry season it is not sufficient to sustain most types of agriculture.

Heavy rainfall in the project area, as in other parts of the east coast of South Sulawesi, generally occurs during the months of April, May and June with the heaviest rainfall in May. This rainfall pattern is a consequence of the movement of the east monsoon, with prevailing winds from the direction of the Timor Sea during April to June. Superimposed on this, is the effect of the equatorial low pressure belt, or the Inter-Tropical Convergence Zone, which is associated with activities resulting in thunderstorms during April and May. During the months of September to March the west monsoon dominates, with winds blowing from the Java Sea. These winds are intercepted by the South Sulawesi mountain barrier such that the western side of the peninsula experiences heavy rainfall and little rain falls on the leeward side, in the Salomekko area. From about December through to March, when rains are heaviest on the west side of the peninsula, a spillover effect produces modest but erratic rainfall on the Salomekko side. This is referred to as the "transitional season" between dry and wet seasons.

There is little evidence of an orographic lifting effect on the east coast around Salomekko, probably because of the relatively low height of the barrier and its distance from the sea. Thus the rainfall pattern in the Salomekko catchment area would be expected to conform to general area trends.

Rainfall. Rainfall records are available for several stations in the area, some of them with very long records. None of the stations lie within the catchment area, but the Palattae and Sinjai/Biringere stations are located nearby. During the period of record (1975 to 1989), average annual rainfall at Palattae was 2231 mm (Table IV-1). The majority of this rain fell from April through July (usually more than 150 mm/mo), with the peak month usually May (more than 400 mm). The lowest year of record was in 1976 (with 1676 mm). The highest during the fifteen year period was in 1985 (with 2821 mm). September and October are usually the driest months, averaging less than 90 mm/mo.

Table IV-1

Monthly Rainfall (in mm) at Palattae Gauge, 1975-89

Month/ Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1975	166	140	101	309	436	357	277	222	157	196	57	83	2501
'76	57	51	88	247	342	381	228	14	0	104	73	91	1676
'77	79	41	139	197	456	385	64	126	0	0	151	262	1900
'78	66	127	170	139	369	318	258	306	78	131	108	254	2224
'79	110	121	135	120	269	414	273	87	121	2	24	77	1753
'80	57	176	156	445	510	398	67	115	0	3	2	133	2062
'81	115	51	351	121	532	144	303	36	305	219	163	79	2419
'82	145	117	111	426	436	182	141	56	0	0	50	130	1802
'83	128	180	233	67	380	673	327	108	3	110	84	168	2461
'84	263	85	129	341	528	540	269	61	197	8	91	119	2631
'85	156	154	223	185	657	144	672	93	80	154	138	165	2821
'86	276	69	182	268	276	502	306	13	26	87	136	117	2258
'87	171	67	130	409	508	128	87	7	0	45	144	285	1981
'88	249	219	248	98	329	386	287	271	223	95	177	94	2676
'89	142	122	163	71	294	334	437	281	72	44	-	-	-
Mean	145	115	171	230	421	352	266	120	84	80	100	147	2231

Note: Elevation is 200 m.
Source : Rainfall records, PU, Pusat Penyelidikan Masalah Air (PPMA) for Palattae, Subdistrict Kahu, District Bone.

Temperature, Evaporation and Relative Humidity. Air temperature in the area is fairly uniform, with a minimum monthly average of 26° C in June and a maximum monthly average of 27° C in November. Pan evaporation is approximately 1455 mm annually, with a maximum of 143 mm for October (4.6 mm/day) and a minimum of 100 mm for June (3.3 mm/day). Relative humidity also is high, with an annual average of 92 percent.

Air Quality. Air quality in the region is good, the main adverse influence being the burning of paddy straw after harvests. Noise pollution is limited to vehicles and is negligible.

Geology and Topography

Geology

Information on the geology of the Salomekko area is found on geological maps issued by the GOI Directorate General of Mines, in its Geological Survey of Indonesia (1974). These maps indicate that:

- The uplands and hilly areas of the Salomekko basin are underlain by bedrock that consists of basic volcanic lavas of basaltic and andesitic composition with associated volcanic breccias, tuffs, and some marine sediments. These rocks are included in the Camba Formation and the Kalamiseng Volcanics of Middle to Late Miocene age.

- The coastal plain consists of alluvial deposits in the form of loams, sands, and gravels. The soils are alluvial clays.

Topography

The project area is divided into a steeply hilly upper basin (highest point is 250 m above sea level), most of which lies upstream of the dam site; an intermediate zone of gently rolling land, where most of the population and the service area are located; and the coastal area below the main road. In the service area the alluvial flat and gently rolling lands are terraced for paddy fields. The service area extends from approximately 5 m in elevation at its lower end to 60 m in the upper reaches.

Water Resources

Major Surface Water Bodies

The Salomekko is one of several short rivers on the east coast of South Sulawesi which drain fairly small catchment areas between the eastern branch of the central mountainous spine and the Bay of Bone.

The Salomekko drains an area of 13.2 km^2 upstream of the Salomekko dam site (total catchment area for the Salomekko is 43 km^2). Its headwaters lie at an elevation of about 250 m above sea level, and the river is characterized by a radial plan with many streams converging near a single point. Most of the tributaries join together above the dam site, but there are several significant streams that flow into the Salomekko through the service area below that point, including the Laballang and Padang Mani.

The Baruttung River runs through the northern part of the main service area and through a further 250 ha along the river downstream of the main road. The river has a significant flow with a catchment area of almost 3 km^2 at the upper end of the service area and a total catchment area of 18 km^2.

Streamflow

The Salomekko is a perennial river, with an estimated annual discharge ranging from 11.3 to more than 28.1 million cubic meters (MCM) at the dam site. Direct measurements of streamflow for the Salomekko are available from an automatic water level recorder, installed in late 1986 by SSIMP, at a site 0.5 km below the dam site.

Flow data for the Salomekko have been taken continuously since January 1987, a relatively dry year in the region, but an average year in the Salomekko basin. These data have been correlated with area rainfall data in order to derive estimates of flow over a longer period (Table IV-2). During 1987 the highest daily average flow was 15.01 m^3/s, on 1 April, and the lowest flow was 0.02 m^3/s on 26 and 27 November.

River Water Quality

Water samples were taken in May 1988 at five locations along the Salomekko (Figure IV-1, Location of Water Quality Tests) for analysis by the Water Quality Laboratory at PSL UNHAS. The sample sites were as follows:

1. At an unnamed southern tributary flowing into the Salomekko at a site upstream of the proposed reservoir area.

2. The Salomekko, at the dam site.

3. The Salomekko, at the upper end of the service area.

4. The Salomekko, in the middle reach of the service area.

5. The Salomekko, at the lower end of the service area.

Table IV-2

Half-Monthly Mean Discharges for the Salomekko River at the Dam Site, 1975-89

	Synthesized Flows (MCM)											Measured Flows (MCM)			
Period	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89
Jan - 1	.040	.040	.145	.040	.330	.040	.264	.858	.449	1.241	.092	1.307	.061	.815	.418
- 2	.963	.040	.040	.040	.040	.040	.040	.040	.040	.673	.607	.766	.055	.760	.074
Feb - 1	.620	.040	.040	.040	.462	.224	.040	.224	.290	.251	.832	.040	.052	.654	.086
- 2	.040	.040	.040	.343	.040	.700	.040	.040	.686	.040	.040	.211	.044	.149	.058
Mar - 1	.185	.502	.040	.462	.040	.106	1.267	.040	.422	.370	1.109	.132	1.435	.185	.781
- 2	.040	.040	.515	.396	.700	.607	1.637	.251	1.162	.040	.356	.871	7.552	.384	.087
Apr - 1	1.333	.594	1.228	.554	.040	3.181	.356	2.574	.198	1.069	.515	.528	8.208	.628	.768
- 2	1.096	1.148	.040	.040	.462	.792	.040	1.175	.040	1.729	.528	1.452	1.104	2.440	.092
May - 1	1.927	2.600	.686	2.930	.647	2.138	2.732	.554	2.178	1.940	.937	.290	2.799	3.661	1.185
- 2	1.940	.211	3.406	.185	1.333	2.574	2.218	3.313	1.056	2.970	5.425	1.782	2.881	1.307	.192
Jun - 1	1.624	1.531	2.508	2.178	2.851	1.861	.040	1.016	6.085	4.369	.594	3.115	1.394	2.097	1.158
- 2	1.360	1.716	.779	.343	.766	1.571	.977	.040	.449	.686	.040	1.505	.219	2.164	2.079
Jul - 1	.040	1.333	.040	.396	1.980	.040	2.891	.937	.066	.647	1.241	2.376	1.007	2.393	1.905
- 2	2.416	.185	.040	1.465	.053	.040	.040	.040	2.574	1.333	5.306	.040	.335	1.157	1.562
Aug - 1	1.082	.040	.106	.185	.145	.554	.040	.040	.040	.092	.066	.040	.108	2.735	0.791
- 2	.370	.040	.264	1.082	.040	.040	.040	.040	.132	.040	.040	.040	.111	1.229	0.5
Sep - 1	.845	.040	.040	.066	.832	.040	1.835	.040	.040	1.280	.040	.040	.064	4.135	0.220
- 2	.040	.040	.040	.040	.040	.040	.554	.040	.040	.040	.079	.040	.052	.460	0.272
Oct - 1	.515	.040	.040	.040	.040	.040	1.637	.040	.040	.040	.040	.040	.052	.121	0.130
- 2	.647	.647	.040	.528	.040	.040	.040	.040	.304	.040	.792	.040	.060	.123	0.124
Nov - 1	.040	.040	.040	.040	.040	.040	.700	.040	.040	.040	.040	.436	.230	.080	0.052
- 2	.040	.290	1.175	1.148	.040	.040	.079	.040	.132	.356	.911	.053	.044	.137	0.039
Dec - 1	.040	.040	.964	1.360	.040	.541	.040	.040	.079	.172	.330	.396	.118	.065	0.052
- 2	.040	.066	.937	1.518	.040	.040	.040	.845	.766	.119	.475	.040	.102	.066	0.041
Annual Total	17.28	11.30	13.19	15.42	11.04	15.33	17.59	12.31	17.31	19.58	20.[illegible]	15.58	28.09	27.95	12.67

Mean = 17.00 MCM/YR

Source: Jawed, K. 1990. "Review of Hydrologic Analyses, South Sulawesi Projects." Harza/SSIMP, Ujung Pandang.

The samples were analyzed for a broad range of parameters to permit characterization of standard physical and chemical properties, including major ion composition, nutrients and dissolved and suspended matter. The results are displayed in Table IV-3.

Table IV-3

Chemical and Bacterial Characteristics of the Salomekko River

Constituent	Units	Sample Sites				
		S-1	S-2	S-3	S-4	S-5
Suspended solids	mg/L	220	196	210	250	245
pH		7.2	7.0	7.0	7.1	7.1
Calcium	mg/L	8.3	8.8	8.0	8.1	8.5
Magnesium	mg/L	3.8	3.0	3.2	3.5	4.0
Hydrogen Sulfide	mg/L	0.020	0.025	0.025	0.023	0.016
Conductivity*	mmhos/cm	6.10	6.80	7.00	6.30	6.80
Nitrate N	m /L	6.9	5.0	5.2	5.6	6.0
Ammonia N	mg/L	0.010	0.014	0.006	0.008	0.010
Dissolved Oxygen	mg/L	5.8	6.3	6.4	6.9	5.9
Coliform Bacteria Colonies per 100 ml		280	270	283	294	286

Note : Samples taken in May 1988.
* There appears to be an anomaly in the conductivity figures.
Source: PSL, UNHAS, Environmental Baseline Report, 1988.

The Salomekko varies little between sample locations for the parameters measured. The water was of neutral pH and high in dissolved oxygen. Levels of suspended solids were moderately low, as were dissolved solids such as calcium, magnesium and sulfate, when compared to other rivers in Indonesia. Nitrate nitrogen was moderately high, and coliform bacteria was present at moderately low cell counts, which would be indicative of some agricultural and animal waste runoff from the land.

The water is suitable for irrigation and most domestic needs, although it should be boiled prior to use as drinking water.

Ground Water

There is a general lack of quantitative knowledge of ground water availability in the area. Rainfall is the ultimate source of water which sustains the water bearing formations underlying this area. Another source of replenishment is infiltration from the rivers. Of these two sources, direct penetration of rainfall is probably the most important. The rate and amount of infiltration generally depend on several variables, among which rainfall and the permeability of the soil are the most important.

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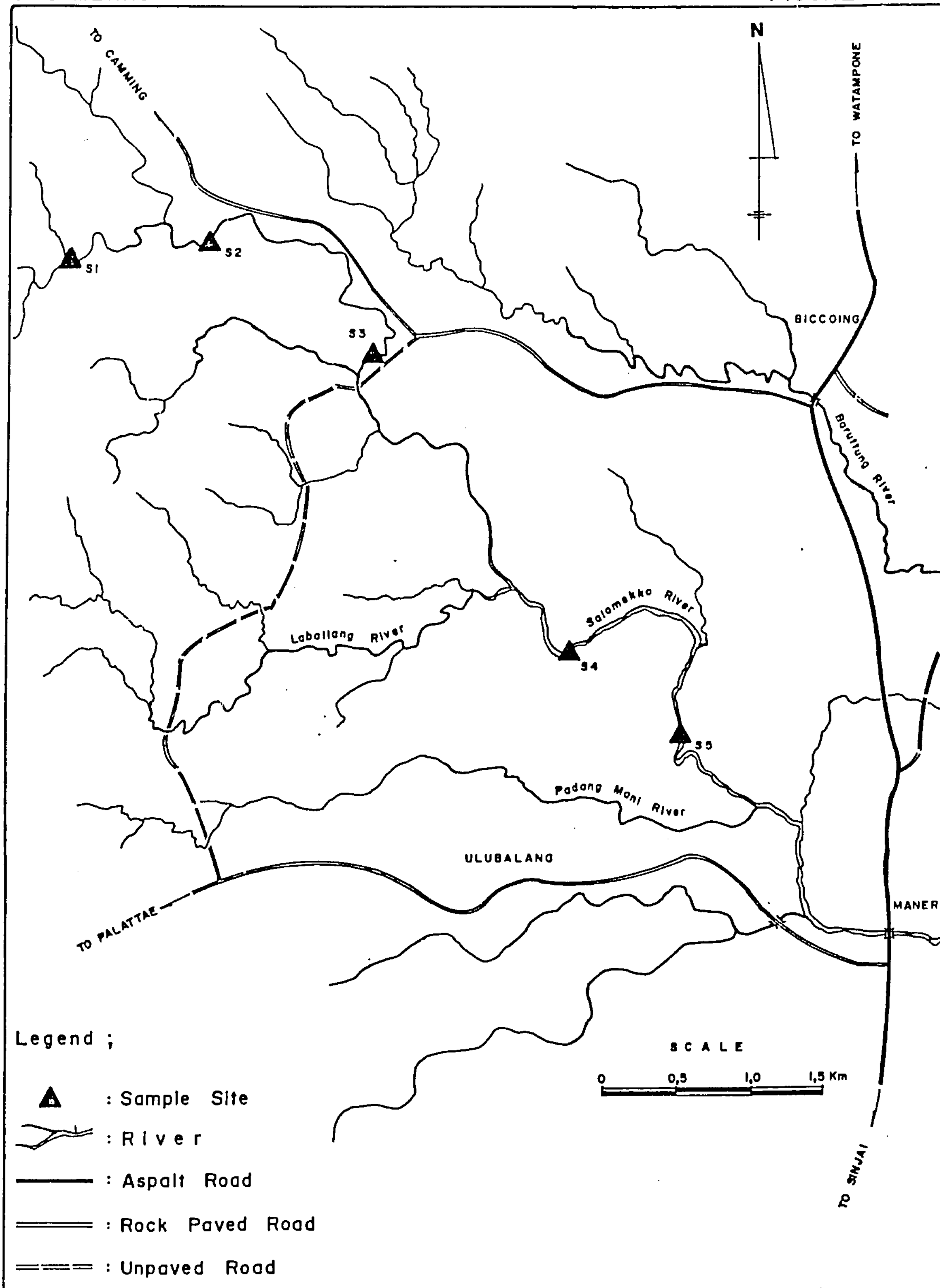
FIGURE IV - I



WATER QUALITY SAMPLING LOCATIONS
IN THE SALOMEKKO RIVER BASIN

26

Domestic Water: Wells and Springs. Ground water is the most important source of domestic water for most households in the project area. Most of this water comes from shallow, hand dug or drilled wells. Hand dug wells were observed to be 4 to 10 m in depth and lined with concrete or stone masonary walls. Water levels in the wells fluctuate according to the season, and occasionally some wells go dry in the dry season. In the coastal areas of Ujunge Village, wells deeper than 5 m are saline, some year-round and some seasonally. A number of drilled wells have been installed in the area during the past two years, averaging 8 and 14 households per well in the subdistricts of Tonra and Salomekko, respectively. These wells were installed by the Department of Health more than two years ago, and more recently (1989-90) by UNICEF. An undetermined number of pumps are broken and some wells do not yield water during the dry season. SSIMP study teams counted both hand dug and drilled wells along the roads heading west into the service area from the main road. There were approximately 6 houses per well along the Biccoing/ Camming road and 9 houses per well along the Ulu Balang road.

The Department of Public Works, working with the Department of Mining and Energy, has recently been drilling deep (more than 80 m exploratory wells in the area. The objective is to find a source of pumpable water for the town of Sinjai and the subdistrict administrative centers for Tonra (located several kilometers north of the service area) and Salomekko (located in the project village of Manera).

There are a number of springs in all the villages in the service area except Ujunge Village. Many of these springs have only a seasonal flow. The springs are used to a limited extent to irrigate crops either year round, or to enable farmers to put in early seedbeds before the rainy season is really started. They also serve as a source of domestic water. The springs appear to be a source of water to some of the Salomekko River tributaries, and reportedly for the Baruttung River as well.

Fresh Water Demands

Agricultural Demand. The water resources of the Salomekko and Baruttung Rivers are almost totally undeveloped. Little or no river water is used for irrigation in the Salomekko service area at present.

Domestic Demand. Virtually all the households in the project area rely on shallow wells for their domestic water. Households in close proximity to a river or spring, use this water as a supplement if well water is not sufficient. In very dry years the rivers may be reduced to subterranean flow and water may be available only from holes dug in the river beds, and from the deepest wells. Some shallow wells in the estuary area become saline in dry months, and members of households normally using them must travel farther inland for fresh water, or go by small boats to collect water from a fresh water spring located along the coast but outside the service area.

Livestock Demand. During the dry and transitional seasons (September - March), the rivers are extensively used for watering livestock. Even when there is little to no surface flow in the rivers there are reportedly enough pools present for this purpose. The Baruttung and tributaries to the Salomekko are the principal streams used for this purpose. As there are almost no houses located immediately next to the banks of the Salomekko, it is not used much for livestock watering if other sources exist. An exception is the last hamlet before the dam site in Biccoing Village, which regularly uses both the Salomekko and Baruttung Rivers.

Aquaculture Demand. Given the limited, seasonal nature of current aquaculture development and lack of any sophisticated salinity control in the project area, there is virtually no "demand" for fresh water for brackish fish ponds at this time. Possible future demands could not be met by pumping or channeling fresh water from the river without requiring major construction efforts.

Land Resources

Catchment Land Use

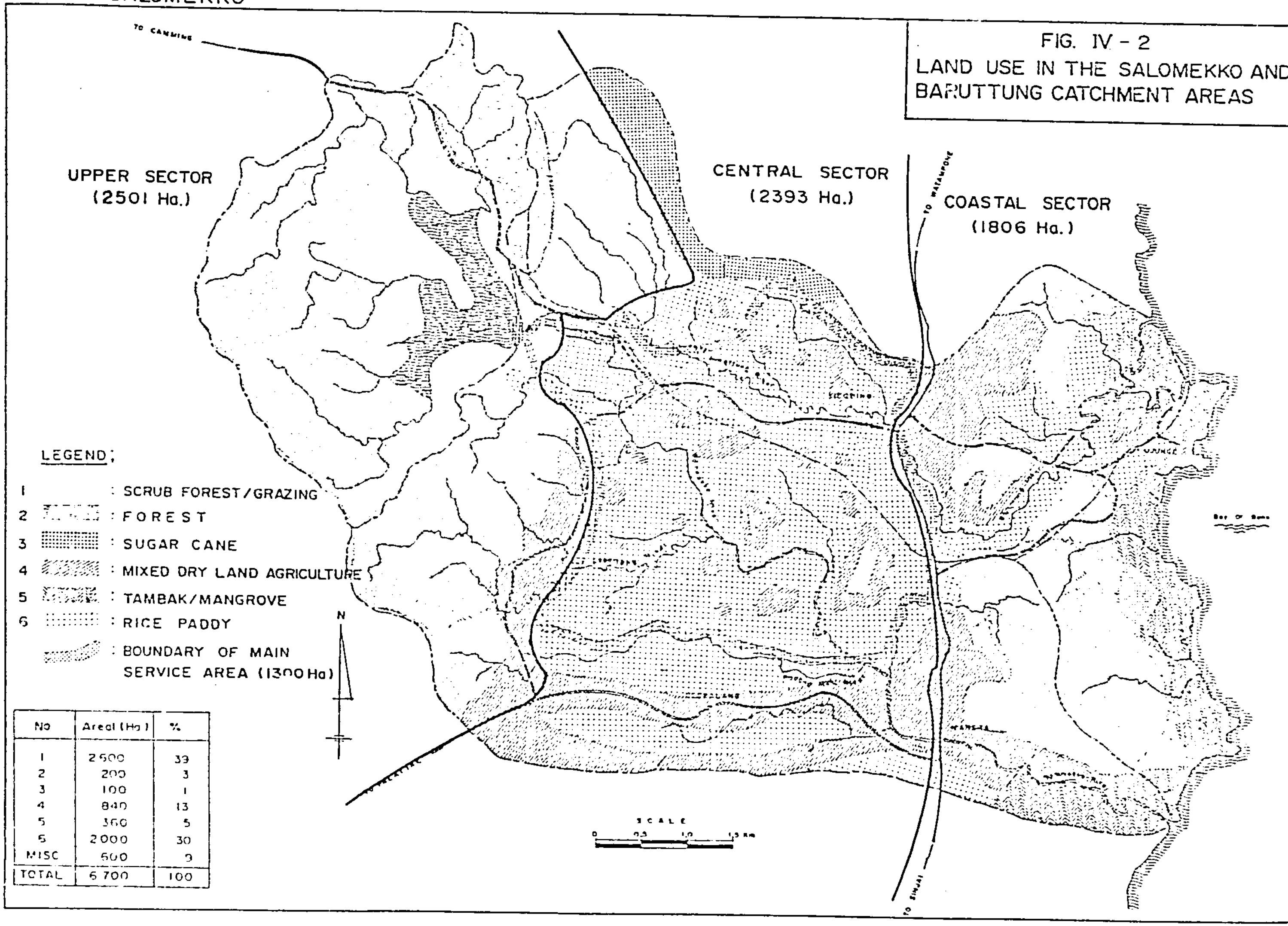
For purposes of this study, the land use areas have been delimited to the following sectors:

- The upper hilly sector consisting of the catchment areas of the upper Salomekko and some of its tributaries together with the upper Baruttung (2501 ha)
- The rolling and flat central sector that includes hamlets, roads, unirrigable land, and most of the 1900 ha gross service area (2393 ha)
- The downstream coastal sector that includes hamlets, roads, paddy fields, mixed agricultural land, fish ponds, and tidal flats (1806 ha)

In total, 6700 ha has been assessed for its current land use (see Figure IV-2 and Table IV-4).

The population of the Salomekko catchment is largely concentrated in the central and coastal sectors. No one is allowed to live in the steeper hills of the upper watershed. Very little of the original forest remains in the upper catchment and the lower part of the catchment was converted long ago to various types of agricultural ecosystems.

Some areas, such as the upper catchment area of the Baruttung River, some Salomekko tributaries, and a small area of land between the mouths of the Baruttung and Salomekko Rivers have also been included for general information purposes, but are not affected by the project.



No	Areal (Ha)	%
1	2500	39
2	200	3
3	100	1
4	840	13
5	360	5
6	2000	30
MISC	600	9
TOTAL	6700	100

Fig. IV - 2

Upper Hilly Sector. The upper catchments, totaling 2501 ha, are covered with pasture and secondary growth forest. Access to the upper Salomekko catchment is not difficult as there is a good quality road directly through the area, recently improved by the Camming sugar cane factory to connect the factory with the coastal road. Most of the hills have long ago been cleared of the original forest, except on a few slopes at the north end of the catchment. In the rest of the area there are predominantly grass lands with some woodland left along the water courses and on the crests and slopes of some hills.

Land in the upper catchment area that is already covered with grasses is used as pasture, and is regularly burned by owners of livestock to allow cattle better access to new growth. This occasional burning acts to maintain the area as grassland and prevents regrowth of scrub forest. Within the past several years, local government has stipulated there is to be no further cutting of existing forest in the upper catchment area (located mostly in Biccoing Village), and reportedly, there are a few sporadic attempts at reforestation and planting tree crops.

Table IV-4

Current Land Use in the Salomekko Study Area

Land Use Category	Upper Hilly Sector		Central Sector		Coastal Sector		Total Area	
	ha	%	ha	%	ha	%	ha	%
1. Scrub Forest/ Grazing	1977	79	20	1	603	33	2600	39
2. Forest	200	8	0	0	0	0	200	3
3. Sugar Cane	0	0	100	4	0	0	100	1
4. Mixed Dry Land Agriculture	124	5	373	16	343	19	840	13
5. Tambak/Mangrove	0	0	0	0	360	20	360	5
6. Paddy Fields	0	0	1650	69	350	19	2000	30
7. Miscellaneous	200	8	250	10	150	9	600	9
Total	2501	100	2393	100	1806	100	6700	100

Source: Technical Assistance Team estimates, 1990.

Reservoir Area. About 92 ha of the catchment area will be within the reservoir area. The higher parts of this are pasture with a few secondary growth trees along the course of the Salomekko. The lower reservoir area contains a small farm with fewer than five houses, along with their accompanying gardens, tree crops and steeply terraced paddy fields. There are also established mixed gardens and tree crops (mostly young cashew trees) at the dam site and adjacent to it (proposed site of the worker camp) in the area between the dam site and the Camming Road through Biccoing Village.

Central Sector. Most of the agricultural fields of the Salomekko study area are concentrated on the flat and rolling land of the central plain, resulting in a relatively sharp division of land use between this and the upper catchment areas. Most of the proposed irrigation area lies in this central sector.

There are small hillocks within the irrigation area that have been planted in tree crops and mixed gardens, and some small open areas are used as pastures. Most of the population resides in hamlets built in narrow strips along roadsides, but a few households live on the hillocks.

Service Area. The 2,000 ha Salomekko gross service area currently consists only of rainfed bunded lowland (sawah) only (Table IV-5).

In terms of agricultural land use, the lowland area is planted fully in the wet season and partially in the dry season due to restricted water supplies.

Table IV-5

Land Use in the Gross Service Area of the Proposed Project

Land Category	hectares	% of area
lowland	2,000	100
upland	--	--
grasslands/brush	--	--
Total:	2,000	100

Note: 95 % of the 2,000 ha gross service area will be irrigated (i.e., 1,900 ha), while 5 % consists of bunds and other non-irrigable land.
Source: Project field surveys '88-90; aerial photos.

Coastal Sector. The eastern edge of the main irrigation area runs north-south, being virtually co-terminous with the coastal highway. A separate part of the service area (250 ha) is included in this sector and lies to the east of the highway on the lower reaches of the Baruttung River. The coastal area, running to the coast of the Bay of Bone, is a picturesque area of hillocks, steep terraces, many small hamlets, fish ponds, and a narrow sandy beach with many colorful small boats. This area provides the resident population with the opportunity for paddy cultivation, gardens, fish pond production, sea fishing, and direct access to seasonal boat trade expeditions to other parts of Sulawesi and elsewhere.

The estuary area and tidal flats are fairly narrow. Most of the mangrove has been cleared in the past 2 to 4 years to develop brackish water fish ponds. With this rapid pace of clearing, locals estimate that as of mid-1990 there is about 25 to 50 ha of fish ponds being prepared in Ujunge Village, located near the mouth of the Baruttung River, and about 300 ha of fish ponds in Manera Village, near the mouth of the Salomekko River, and southwards from there.

Land Suitability

A land and soil survey was conducted by Hasanuddin University (1988) for the Salomekko area as part of the pre-design work contracted with PT Airstan Ekawasta. Their survey area (4875 ha) was broad and somewhat different than the final delineation of the proposed service area since at that time, little work had been done to determine water availability and land suitability. The main part of the service area was, however, covered in their report. The resulting land classification is fully described in the Project Justification Report in terms of suitability for paddy, palawija and perennial crops. The land is classified as highly suitable (S1), moderately suitable (S2), and marginally suitable (S3). The unsuitable land is divided into two categories of temporarily unsuitable (N1) and permanently unsuitable (N2). All of the existing rainfed paddy land is assessed as being in categories S1, S2 or S3 for both paddy and palawija crops.

Erosion

Upper, Hilly Sector. In general, soil erosion is not a major problem in the Salomekko River watershed. Project field teams found little evidence of erosion and the low level of suspended solids in the river suggests that there was not much erosion at the time water samples were taken (May 1988). Nevertheless, the relatively high erodability of the soil types found in the upper basin, coupled with the hilly nature of the terrain, indicate that erosion and sedimentation would be problems if grazing, rock extraction, forest clearing, or hillside farming were to increase greatly.

Although locals have been forbidden to cut any more trees, they are still permitted to extract rocks for construction. At present this is small-scale, but it could, if continued, presumably destabilize some slopes.

The trend is toward tree planting, but the recently opened road passing through the upper watershed and connecting this area with the Camming Sugar Cane Factory to the west, could lead to increased pressure on the land, as could disruption of lower grazing areas due to an intensification of cropping with the introduction of irrigation.

Central Sector. Parts of the central area, particularly along the river banks, show signs of severe erosion in a few places. Although the more steeply terraced paddy fields have potentially high erodability, farmers maintain these areas well, particularly the drainage ditches.

Agricultural Production Practices

The typical farm consists of lowland within the service area, and upland, home gardens and orchards outside the immediate lowland service area. According to SSIMP surveys, an average farm is approximately 2.0 ha in size: 1.6 ha lowland (sawah), 0.3 ha upland, and 0.1 ha as home garden and/or orchard. Individual fields average only 0.3 ha, and farmers typically own 4 to 5 separate bunded fields, often located across several field complexes.

Most of the irrigation area is divided according to natural, topographical features, into hundreds of complexes called "lompo", ranging from 1 to 30 ha in size, and averaging 7 to 10 ha. Complexes tend to be larger on flatter terrain, and smaller in hillier/steeper areas. Complexes have anywhere from 1 to 60 farmer members, with an average of 15 members.

Cropping Patterns and Intensity. The overall intensity of cropping in the project area is about 135 percent (Table IV-6). The agricultural calendar commences with wet season paddy, when almost all farmers plant paddy seedbeds and prepare fields in March/April, transplant seedlings a month later and harvest in July/August, depending on the timing of rains. Fields are left fallow after the harvest and are used primarily for pasture during this dry period that may last into mid-November. As the third season, or transitional season of intermittent rains begins, farmers plant palawija crops, consisting primarily of mungbeans, but also some groundnuts and maize. On average, probably 30 to 40 percent of the service area can be planted in the transitional season. The ability of the soils to retain water, and drainage efficiency appear to be key determinants in where to plant palawija crops. Generally the lower-lying, flatter areas are better than the higher (drier) terrain, unless rains become too heavy and local flooding occurs, which may damage or even destroy crops.

Upper Basin Cropping. Most of the area upstream of the dam site is pasture or woodland, but some farmers have prepared 5 to 10 ha of terraces and are raising paddy, maize, groundnuts, and vegetable crops. There are also several hectares planted in tree crops, mostly cashew.

Farm Practices. Current farming practices in the project area are reportedly relatively advanced for a rainfed area. Farmers employ recommended inputs in paddy cultivation, but their yield returns from use of fertilizer and agrochemicals are extremely limited by the unavailability of dependable water supplies.

Paddy. In the irrigation area, paddy is grown under rainfed conditions. Paddy is started in seedbeds of roughly 4 to 5 percent of the area to be planted. Seeding in the nursery ranges from rates of 50 to 60 kg/ha to be cultivated. The most prevalent seed variety found in the area is PB42. Seeds of PB48, PB36 and others are used, but to much lesser extents. Farmers often use seed of the same stock source for many seasons before acquiring new seed. Fertilizer and agrochemical applications in the nursery development stage are not common. After approximately 30 days, the seedlings are pulled, bundled and taken to the field for transplanting. The use of family, exchange, and hired labor are reported for transplanting work.

Table IV-6

Current Cropping Patterns and Intensity within Gross Service Area

Crop Pattern	Average Area by Season Wet : (ha):	Dry 1: (ha) :	Dry 2: (ha) :	Percent of Gross Service Area
Paddy/Palawija	760	760	--	38 %
Paddy/	1,180	--	--	59 %
Average Area				
Cultivated:	1,940	760	0	
Uncultivated:	60	1,240	2,000	
Gross Service Areas:	2,000	2,000	2,000	
Current Cropping Intensity:				135 %

Source: Subdistrict Agriculture Offices, 1988; Household Survey, 1988; Field Surveys 1987-90.

Land preparation precedes transplanting and involves plowing, harrowing and puddling. Draft animals in the study area include both water buffalo and cattle. Use of two-wheel tractors for land preparation has recently been introduced into the area (see Table IV-7).

Fertilizer and agrochemicals, according to results of the Household Survey, are applied at relatively high rates for a rainfed area. The type of fertilizers used include urea, ammonium sulphate (ZA), triple super-phosphate (TSP), and potassium chloride (KCL). When used, TSP is normally incorporated into the soil at land preparation or soon after transplanting, and the other fertilizers are mixed and applied two or three times (usually broadcast by hand) during plant development. Agrochemical types reportedly used include pesticides and herbicides applied using knapsack sprayers. Additional weeding during the plant growth stages is done by hand.

Harvest and post-harvest activities are carried out by hand, again employing family, exchange and some hired labor. The paddy plant is cut with a sickle and moved to the threshing area.

Table IV-7

Estimated Number of Tractors Owned and Rented Within Project Villages

Village	Numbers of Tractors Owned	Rented*
Biccoing	6	0
Ujunge	1	0
Ulu Balang	2	3
Manera	3	4

* Tractors are privately rented from tractor owners living in Subdistrict Tonra.
Note: Cost of a new hand tractor is about Rp 3 million.
Source: Village Headmen, 1990.

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 sun-dried before bagging for sale or storage.

Table IV-8

Typical Farm Input Use Under Without-Project Patterns

Farm Input	Unit	Paddy	Mungbean
Seed	kg/ha	55	12
Fertilizer			
Urea, ZA	kg/ha	200	--
TSP	kg/ha	100	--
KCL	kg/ha	100	--
Agrochemical	lt/ha	1.5	2
Rat Poison	kg/ha	--	--
Labor	work days	52	37
Draft	team days	11	2

Source: HHS Farm Survey, 1987, and discussions with local agricultural officials, 1988.

Table IV-8 presents typical seed, fertilizer, agrochemical, and labor inputs per hectare for crop production in the project area. While material input applications for paddy production are high for rainfed conditions, labor inputs are relatively low for both paddy and mungbean cultivation.

Secondary Food Crops (Palawija). Secondary food crops, including mungbean, groundnut and maize, are cultivated under rainfed conditions over the transitional season period of late October through February. They are found in the lower-lying areas and in soils which have a better capacity to retain moisture.

Mungbean is the dominant secondary food crop currently grown in the project area with groundnut and maize occupying only minor fringe areas. Cultivation practices are primitive. In the case of mungbean, seeding (by both dibbling and broadcasting) occurs at a rate of about 12 kg per ha with little or no land preparation preceding the activity. Some minimal plowing (harrowing) may follow to turn the seeds into the soil. Alternatively, paddy straw may be scattered over the broadcast seed. Fertilization of the crop is not practiced. Weeding and crop maintenance activities are very limited, but due to plant susceptibility to insects, pesticide is commonly applied at rates of up to 2 liters per ha.

Harvest of the crop is accomplished by plucking the maturing pods of the plant over a 1 to 2 week period. The plant seed is either beaten or trampled out of the pods, and then separated, cleaned and dried. Considerably less labor intensive than paddy cultivation, mungbean production is undertaken almost exclusively with household labor. Table IV-8 above presents typical input use per ha for mungbean production in the project area.

Crop Yields and Production Levels

Crop yields and production levels for the project area under present conditions are derived from results of the project Household Survey, data provided by the project area Subdistrict Agricultural Offices, and discussions held with government officials and non-government specialists. The project Household Survey time series for harvests over a five-year period indicated paddy yields averaging 2.2 t/ha in the area (Table IV-9). Wet season unhusked paddy (gabah) yields average from 2 to 3 t/ha in different field complexes, although some farmers reportedly achieve 4 t/ha levels when conditions are optimal. Higher class soils, often identified with lower-lying field complexes, attain 3 t/ha averages; by contrast, less fertile, usually higher-lying portions of field complexes, average 1.5 to 2.5 t/ha. Increased fertilizer usage and better agronomic practices in recent years, stimulated by active extension activities initiated by the local agricultural extension agents, have raised overall yields and narrowed yield differentials between different soil classes. However, farmers are reaching the limits they can expect to improve yields if they lack technical irrigation.

While accurate data on palawija yield levels is lacking, informants report comparatively low to moderate yields, with little, if any, fertilizer usage. Yields of rainfed mungbean are estimated at 0.4 t/ha. In general, locations with better water retention achieve higher yields than locations with more porous, higher-lying soils, particularly during seasons when rainfall is moderate. During seasons when rainfall is intermittently heavy, however, farmers with plots in mini-depressions often are forced to replant, and may undergo severe yield reductions.

Prices and Marketing of Agricultural Production

Paddy. The most important agricultural output in the area is paddy. According to the SSIMP Household Survey results, a greater portion of production is consumed on the farm than marketed. Crop use is allocated among consumption (60 percent), marketing (25 percent), harvest wage payments (5 percent), seed stock, and other uses (10 percent). Paddy is sold to middlemen, who pick up and purchase at the farm; a limited amount of paddy is sold at local markets.

Secondary Food Crops (Palawija). Secondary food crop production is almost exclusively for market in the case of mungbean and groundnut, less so for the small amounts of maize grown in the area. The bulk of the secondary food crop production, mungbean, flows to market at rates of 80 to 90 percent of production and is sold at an average farmgate price of Rp 640 per kg. As in the case of paddy, buyers are reported to arrive at harvest periods.

Many of the buyers are said to come from Sinjai, a regional market center 20 km south of the project area. While floor prices have been set for some secondary food crops by BULOG, in fact they have been set low relative to actual market prices, and

BULOG has not been active in price stabilization for these crops. The implication here is that farmers are subject to more price uncertainty with secondary food crops than with paddy.

Table IV-9

Average Crop Area, Production, and Yields in Project Service Area--Existing Situation

Season and Crop	Planted Area (ha)	Harvested Area (ha)	Harvested Quantity (tons)	Yield (tons/ha)
I. Wet Season				
Lowland rainfed paddy	1,940	1,882	4,140	2.2
II. Dry Season				
Lowland rainfed mungbean	760	684	274	0.4

Source: Subdistrict Agriculture Offices, 1988; Household Survey, 1988; Field Surveys, 1987-90.

Livestock Production

There are approximately 1700 water buffalo and 1000 Bali cattle owned and grazed within the four villages (Table IV-11).[1] They are kept almost exclusively for draft power in field preparation. The majority of cultivators own draft animals, with an overall average of 2 to 3 head per household. However, results of the Household Survey conducted in early 1988 indicated that about 20 percent of the interviewed farmers neither owned nor managed draft livestock. Farmers who reported owning or managing livestock had 2 to 5 head, so that of those who owned/managed draft livestock, there were closer to 5 head per household. Horses are relatively unimportant as draft animals and are principally used for transport (there are about 300 in the villages).

Pastures and Fodder. The villages have fundamental rules for managing large livestock. Increasingly, house compounds are being fenced with closely planted fast-growing leguminous trees (pagar hidup). This keeps livestock from damaging house gardens

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[1] Estimates of the number of large livestock in project villages varies by source, but the figures given here appear to be reasonable.

and enables farmers to securely quarter their most valuable stock. These draft animals are let out to graze alongside roads and paths under close supervision. Field complexes remain largely unfenced, although some farmers, with fields adjacent to roads, construct temporary fences to control animal foraging alongside roads. Draft animals unfit to work or not needed for work are sometimes sent up to the large communal pasture in the upper catchment area, where they are only lightly supervised.

Salomekko farmers share field preparation work. Efforts are made to ensure that all farmers within a field complex complete land preparation and planting at about the some time. This serves to keep cropping patterns uniform within complexes and gets all livestock removed from a complex to avoid damaging newly planted crops and embankments. Once fields are planted, livestock are either free-range grazed in the several lower communal pastures or in the large upper catchment communal pasture, or quartered near house compounds.

All livestock principally forage on available grasses, and few if any, receive much hand cut fodder (either grasses or leguminous tree leaves). All livestock principally derive water from existing rivers rather than from wells.

The recent halting of cattle and water buffalo theft from communal pastures has been accomplished by installing locked gates at the entrances to all village roads, preventing the entry of nocturnal trucks and other unauthorized vehicles. Roadblocks are also maintained by village voluntary guards. However the improved road connecting the coastal highway with the Camming sugar cane factory is still a potential problem, providing an open route through the upper communal pasture.

Table IV-10

Large Livestock In the Salomekko Service Area

Adm. Unit: Subdistrict/Village	Farm Households*	Buffalo Qty	Buffalo Avg.	Cattle Qty	Cattle Avg.	Horses Qty	Horses Avg.
Subdistrict Tonra	2558	3116	1.2	3387	1.3	1008	0.4
Biccoing Village	193	449	2.3	255	1.3	45	0.2
Ujunge Village	180	427	2.4	200	1.1	37	0.2
Subdistrict Salomekko	2903	2340	0.8	2612	0.9	675	0.2
Manera Village	492	212	0.4	365	0.7	42	0.1
Ulu Balang Village	381	576	1.5	145	0.4	126	0.3
Village Total	1246	1664	-	965	-	250	-
Village Average	-	-	1.3	-	0.8	-	0.2

* These are the households reported to be principally engaged in farming in 1987.
Source: Subdistrict Offices, Tonra and Salomekko, Dept. of Livestock.

Biological Resources

Terrestrial Vegetation and Habitat

Cleared areas in the watershed tend to be covered quickly by a grass known as alang-alang (Imperata cylindrica), a dense clumping form that discourages succession into woodland communities. Reportedly there have been sporadic attempts to plant another grass that is more nutritious for cattle, known locally as "rumput gajah" (elephant grass).

Forest vegetation in the watershed is completely second growth, with trees from 6 to 20 cm in diameter and 4 to 12 m in height. The canopy is approximately 80 percent closed in such forest, restricting the shrub layer. The more common tree species found, with their Indonesian and scientific (Latin) names, are listed in Table IV-11. Almost all of the large trees with any commercial potential have been harvested, although some of the remaining trees are considered valuable for fuelwood and local housing construction.

Unlike some other SSIMP sites in NTB Province, the Salomekko area does not rely very heavily on the planting of leguminous trees (Lantar Loboh) along the bunds of paddy fields. Second growth trees are found along the bottom of gullies and river beds.

As habitat for animals, this woodland is poor to fair the blocks of woodland are too small to be attractive to larger mammals, and the levels of succession and diversity are low. Among the tree species found, only two, teak (jati) and bitti, are commercially important and neither is found in quantity.

Table IV-11

Tree Species Observed In the Salomekko Watershed

Name in Indonesian (English)	Scientific Name	Family
Jati (teak)	Tectona grandis	Verbenaceae
Bitti	Vitex copassus	Verbenaceae
Jampu-jampu	Cryptoneria sp.	Cryptonerionaceas
Lempu-lempu	Pterospermum sp.	Sterculiaceae
Jambu biji	Eugenia sp.	Myrtaceae
Kaspuk (kapok)	Ceiba pentandra	Bombacaceae
Jambu mente (cashew)	Anacardium occidentale	Anacardiaceae
Bojo	Pterospermum celebicum	Sterculiaceae
Kalukku	Gironniera subaequalis	Ulminaceae
Jampu salo	Eugenia sp.	Myrtaceae
Araja	Tristania sp.	Myrtaceae
Cendrana	Pterocarpus indicus	Papilionaceae
Bilalang	Albizzia procera	Mimosaceae
Bittahang	Neonauclea sp.	Rubiaceae
Kenrang (fig)	Ficus sp.	Moraceae
Cempa, asam	Phyllanthus emblica	Euphorbiaceae
Kayu padang	Alaeocarpus sp.	Alaeocarpaceae
Kayu langi	Pongamia pinnata	Papilionaceae
Pangi	Pangium edule	Flacourtiaceae
Sugimanai	Anthocephalus cadamba	Rubiaceae
Settung	Sondaricum koetjape	Meliaceae
Terro	Arthocarpus teysmanni	Moraceae
Ampiri	Aleurites molucccana	Euphorbiaceae

Source: Baseline Study of the Salomekko Irrigation Project, PSL UNHAS, 1988.

In the estuary and coastal zone, there are very limited areas of mangroves (Rhizophora, Avicennia, and Bruguiera), but most of this has been cut and converted to fish ponds.

Wildlife

The fauna of the Salomekko watershed has not been studied in detail, but that of South Sulawesi is fairly well known. Field visits by the PSL UNHAS team contracted to study the site, and by project environmental scientists in June and April 1988, in October 1989, and in later visits in 1990, respectively, indicated that the bird life in some woodland areas of the basin is quite rich; no wild mammals, other than bats, were seen in the area.

White and Bruce (1986) list more than 100 species of birds that might be expected in the region. In the upper watershed, where there is little or no standing surface water, the predominant groups are doves, cuckoos, bee-eaters, and songbirds. Raptors (hawks and eagles) also are present and undoubtedly range in and out of the watershed.

In the service area, where there is livestock and agriculture, the most abundant bird species are those that coexist well with man, such as the Java pond heron (Ardeola speciosa), doves (especially the Chinese dove, Streptopelia chinensis) and munias (Lonchura spp).

Game Species. Game mammals (of which there are few on Sulawesi) appear to be scarce throughout the watershed, probably due to habitat destruction and overhunting. The deer, Rusa, or Cervus timorensis and the pig Sus barbatus are the only significant wild species in South Sulawesi and both were reported by farmers to be scarce in this watershed. Bats, which coexist well with man, are abundant.

Pest Species. There are usually no serious bird crop pests in the area, but in neighboring paddy growing areas the munias and the Java sparrow (Padda oryzivora) sometimes reach pest proportions.

Similarly, there are sometimes outbreaks of rats, as is true across all of South Sulawesi wherever there are paddy fields. Whitten, et al. (1987) list 46 species of rats, mice, and shrews found in Sulawesi. Reportedly the worst species in the area, in terms of their ability to damage crops, is the rice field rat (Rattus argentiventer).

Endangered Species. Of the 16 animal species listed by the International Union for the Conservation of Nature and Natural Resources (IUCN) as at risk of extinction, only three are likely to occur in this part of South Sulawesi (Whitten et al, 1987). One of the these, the Sulawesi Tarsier (Tarsius spectrum) might persist in the patchy forest of the project area, but is usually an inhabitant of primary forest. Two birds, the Chinese Egret (Egretta eulophotes) and the Milky Stork (Ibis cinereus) (both rated by the IUCN as "vulnerable") have been recorded in South Sulawesi (White and Bruce, 1986). The Chinese Egret is associated with coastal wetlands and the Milky Stork with mangrove. Their occurrence in the project service area, especially after irrigation is introduced, cannot be ruled out. There are many coastal areas of irrigated paddy fields where either species could occur, but neither has been found, despite occasional ornithological expeditions in those areas. A Milky Stork has been found in the mangrove forest near Maros, on the west coast of South Sulawesi (Escott and Holmes, 1980).

Freshwater Biology and Fisheries

The aquatic fauna of the Salomekko, Baruttung, and other rivers were not included in this enviromental study, since the initial reconnaissance (April 1988) indicated that during periods of low flow the Salomekko River virtually disappeared and those pools that remained were too small to support any large fish. During a later reconnaissance when there was some river flow, a few tiny fish (less than 6 cm long) were seen. The aquatic community of the rivers does not seem to be sufficiently large or complex to constitute a significant part of the local environment.

A fisherman interviewed near the bridge of the coast highway over the Salomekko River in October 1989, stated that seasonally, there are abundant fish in the lower Salomekko and that freshwater prawns (Macrobrachium sp.) are present. The latter, being migratory, could be expected farther up in the upper parts of the basin during periods of substantial flow. Talks with authorities in the area indicate that the freshwater fishery is not significant to local diet or income, and not specific to the geographic area.

The eels, Monopterus albus and Anquilla sp., are also likely residents of the Salomekko and Baruttung rivers. They move out to the marine environment to reproduce. Other marine brackish water species may be seasonally present in the lower reaches of the rivers. These include sea perch (Lates calcarifer), and milkfish (Chanos chanos), among others.

Other Aquatic Fauna. Various lizards, including the monitor lizard, are common to stream banks in Sulawesi, and have been sighted at other project sites not far from Salomekko. Estuarine crocodiles (Crocodylus porosus) may once have been common, but are no longer found here. Sulawesi has four species of brownish-grey freshwater snakes, and it is possible that one or more of these species are present in the watershed.

Benthic Fauna. Similar to the Awo River, farther up the coastline, the Baruttung and Salomekko are presumably host to a variety of micro- and macrobenthic organisms such as amphipods, small molluscs and various aquatic insects (stoneflies, caddisflies, dragonflies, midges, etc.). Attached algae of various species are also likely to be present. However, given the much lower stream flow in these rivers, and the fact that in dry years there may only be pools of water for several months, the benthic fauna population is probably much smaller than at the Awo site.

Aquaculture. Near the mouth of the Salomekko there are small aquaculture ponds totaling approximately 300 ha, and there is a smaller area of fish ponds at the mouth of the Baruttung River. The ponds are quite new but constructed and managed in a manner considered traditional in South Sulawesi. Most of the fish pond farmers reportedly have little direct experience and have received minimal assistance from the Department of Fisheries.

About 25 ha are owned and being developed by people from Ujung Pandang, who are presumably giving some technical assistance in their construction. So far, yields are reportedly very low.

The farmers use the pesticide Thiodan, a persistant hydrocarbon, to eradicate pests in the ponds before stocking. Shrimp and fish fry are usually stocked at the beginning of the rainy season in April and raised up through August. The farmers nearest the river report that they have lost significant portions of their stock due to flooding of ponds by river water during the wet season.

Salinities fluctuate widely in these ponds according to the season. The farmers are not able to directly utilize the freshwater that comes from the rivers since they do not operate pumps, and because the estuary river water is already somewhat saline, particularly in the dry season. Salinities are moderated in the ponds by rainfall and the natural mixing of river water and seawater in the nearshore waters. Water exchange in the ponds is regulated simply by opening a gate to take advantage of high and low tides. The Department of Fisheries in Watampone reports that there are plans to investigate the feasibility of supplying freshwater to the ponds in the area, presumably by regulating or diverting some of the rivers' flows.

Estuaries and Coastal Mangrove

Coastal mangrove exists in a few small, narrow pockets of the coastline, but most of it has been cut to make fish ponds. The two river estuaries (Salomekko and Baruttung) are fairly short and narrow, the estuary of the Salomekko extending less than 1.0 km up the river course, while the estuary of the Baruttung extends an estimated 3.0 km up its winding course. Water in the river bed of the Baruttung is saline at the first village bridge crossing in Ujunge Village, while the water in the Salomekko is fresh as it crosses the coastal highway.

The downstream river channels of both these rivers are only lightly used by very small, local boats. During the dry season there is virtually no boat traffic on the rivers.

Socioeconomic Resources

Population Profile

Beneficiaries. The 1987-88 total population of the four villages was 7,751, living in 1,531 households, with an average household size of five persons (some sources, such as the Household Survey, put average household size around 7 persons). Of these, an estimated 56 percent were living within the village sub-areas (dusun) that will be irrigated. The majority of beneficiary households hold land in either Manera Village (sub-area Manera/Timpalaja), in Ulu-Balang Village (sub-area Balangnge), in Biccoing Village (sub-area Biccoing) or in Ujunge village (sub-area Bacu).

Irrigation improvements will principally benefit the owner - cultivator and sharecropper households who cultivate land in the service area. According to results of the SSIMP-conducted Household Survey (Duewel, 1988), the average area of cultivated paddy fields per household is 1.55 ha. About 1230 households, or between 6150 to 8610 people would directly benefit from the project if every household (averaging 5 to 7 persons) had this same amount of land. These estimates are significantly more than the current size of the resident population of the administrative sub-areas to receive irrigation (Table IV-12).[1]

Table IV-12

Service Area Population

Village	Sub-Area (Dusun)	Population
Biccoing	Biccoing	647
Manera	Manera (Timpalaja)	1653
Ulu-Balang	Balangnge	1365
Ujunge	Bacu	650
Total:		4315

Source: Village statistics.

Population Growth and Densities. Within the subdistricts of Tonra and Salomekko, the average annual rate of population growth was about 14 percent during the period 1977 to 1982, so that the population doubled in only five years. This high growth rate virtually stopped during the period 1982 to 1987, and in the case of Subdistrict Salomekko, the total population even decreased slightly.

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[1]Usually farmers live as near as possible to their major landholdings so that their residence and land are located in the same village sub-area. In the Salomekko area, residence and land locations appear to be fairly mixed up. As is true of virtually all the SSIMP sites, landholding is not consolidated, and due to inheritance (and some purchases) of small parcels of land, most farmers have fields scatterd across village sub-areas (dusun). Thus the population living in village sub-areas receiving irrigation is not necessarily the same as the population of direct beneficiaries, although it is likely that the majority of residents of a particular sub-area will own and/or sharecrop nearby land.

Within the study area villages during this same period, the population increased much more slowly (perhaps only 1.4 percent annually). Ujunge Village grew at only 0.3 percent annually; Manera and Ulu-Balang Villages increased annually at rates of 0.6 to 1.1 percent; Biccoing Village grew at annual rates of 3.5 to 4.0 percent. Thus there was only a moderate to low rate of growth in the project area, except in the case of Biccoing Village.

These fairly low rates of growth for 3 of the 4 villages indicates tnat the forces that encouraged high growth elsewhere through this period hardly affected the project area. While some people may have in-migrated to the area, many continued to out-migrate. All land with at least some agricultural potential is privately owned and virtually all of it is cultivated. There is no "new" land left to develop.

Densities. Density in the study area is about 89 persons/km^2, ranging from 66 in Biccoing, 69 in Ujunge, to 86 for Ulu Balang and 132 in Manera. Most of this population resides alongside the main coastal highway or alongside the main village roads, clustered in hamlets, closest to the best agricultural land.

Age Structure, Work Force, and Sex Ratio. The population of the project area is principally within the 15 to 54 year age group (58 percent), considered the working age cohort (Table IV-14). Only 38 percent of the population is aged less than 15 years, and another 4 percent are aged 55 years and older. Strict application of these figures would suggest the working age cohort was 28 percent larger than the dependent cohort, but the boundaries of the divisions are not sharp. Much farm labor is performed by children, even as young as ages 7 or 8, freeing older family members for more arduous tasks. Healthy adults often continue to do field labor well past the age of 55, and even those unable to work in the fields perform useful work around the home.

Sex Ratios. The project area has a relatively low sex ratio of 84, when a "normal" sex ratio according to international data could be expected ranging from 98 to 103. Sex ratios in the age groups 30 to 44 years are particularly low, indicating (probably) that some adult males have left the area to seek work elsewhere. Some of these men might return if the area were irrigated.

Table IV-13

Population by Five-Year Age Groups and Sex in the Salomekko Study Area

Age Group	Males	Females	Sex Ratio	Total Population Number	Total Population Percent
0- 4	427	441	97	868	11
5- 9	525	606	87	1131	15
10-14	446	528	84	974	13
15-19	350	436	80	786	10
20-24	309	356	87	665	9
25-29	289	354	82	643	8
30-34	242	320	76	562	7
35-39	229	309	74	538	7
40-44	188	269	70	455	6
45-49	184	228	81	412	5
50-54	188	207	91	395	5
55+	153	169	91	322	4
Totals	3,530	4,221	84	7,751	100

Source : Village records, as found in the "Daftar Isian Potensi Desa & Kelurahan, 1987-88".

Kinship and Marriage

Bilateral extended family ties are strong in the Salomekko area, with family members providing reciprocal labor and economic assistance to each other in time of need and for ceremonial occasions such as weddings and funerals. Marriage partners are generally sought within the area and from within the same religious-ethnic group.

This area was ruled by Bugis political, social, and economic elites of royal descent, and has historically been part of the hinterland of the realm of Bone, whose center, located in Watampone, is today about an hour's drive away. These ties of kinship and marital alliances continue to be important and widely recognized.

Ethnicity and Religion

The majority of the study area population are ethnic Bugis, who are Muslim. A few of the local citizens are sufficiently wealthy to have made the pilgrimage (haj) to Mecca. Reportedly there are eight residents who are Protestant Christians.

Islam dominates the lifestyle of the area. As in other parts of Indonesia, farmers share a common, general consensus about agricultural practices. The majority of the population still continue to hold various pre- and post-harvest ceremonies and ritual meals related to the rains and paddy production, held at special sites. These ceremonies are probably pre-Islamic in origin.

Archeology and Cultural History

The project area has historically been part of the rural hinterland of the old Bugis cultural center, located in Watampone, to the north. The area has probably always had a relatively low population density and has never supported an urban setting or been the site of any major temples, mosques, large burial areas, or any large buildings. There are no known sites of ceramic remains, or foundations of older buildings in the area. Although the area has probably been inhabited for centuries, there are no known surviving neolithic or any other sites of any archeological interest that can be observed from surface remains. Unlike the caves around Maros on the west coast, there are no caves of any size that might once have been inhabited.

The project villages have several Muslim graveyards located on hillocks. The grave markers are of conventional construction and none are remarkable for their presumed age or ornamentation, unlike other graveyards located nearer Watampone or Soppeng, to the northwest. Thus, there are no known sites of much historical or archeological interest in the area, and virtually all structures in the area have been built since about 1965-70.

Education and Literacy

In the past, many children either never attended school or dropped out before completing primary school. Today, virtually all children of primary school age reportedly attend the 10 primary schools and 1 kindergarten within these four villages. After primary school, attendance drops off, but many children continue their education at the two intermediate level and one senior level secondary school located within the four villages.

The majority of the population aged 7 to 35 years may be considered at least minimally literate. Some adults have participated in government-sponsored adult literacy programs (Paket 'A'), and are now literate.

Public Health

Incidence of Diseases and Disorders. Public health statistics are available from the subdistrict offices and reflect general conditions in the area, but are not specific to any village. Moreover, the data represent only cases treated at subdistrict health centers and do not necessarily reflect the incidence of diseases that go untreated. These subdistrict records show that skin infections account for 11.6 percent of treated cases, influenza 9.0 percent, diarrhea (including cholera) 7.0 percent, trauma from accidents 5.0 percent, gastroenteritis 4.7 percent, eye infections 4.6 percent, vitamin deficiency 4.0 percent, rheumatic fever 2.1 percent, tuberculosis 2.0 percent, and "others" 44.9 percent. Probably the number of treated cases for some diseases is actually higher, since some patients avoid the local clinics and are treated in Sinjai, Watampone, Ujung Pandang, and elsewhere.

The major childhood diseases -- poliomyelitis, measles, and whooping cough are absent from the list either because of the efficacy of early childhood inoculation efforts, or simply because these diseases are treated (and reported) through separate public health programs. The large residual category of 44.9 percent may contain these childhood diseases, as well as a great variety of parasitic and infectious conditions.

Malaria is also absent from the list. Kesavalu (1989) reports that blood examination of infants and children (1 to 9 years old) in District Bone showed only 0.1 to 0.3 percent infection rates over the past six years. Informal comments by both Indonesian and expatriate medical personnel indicate malaria has been a problem in only certain areas of South Sulawesi, and places such as District Bone, while not malaria-free, have had no major problems for many years. This seems to be as much due to natural conditions rather than due to any particular malaria (mosquito) control programs. In fact, most mosquito control programs all along the east coast and central parts of South Sulawesi have been sporadic at best, since malaria is not perceived as a major health problem.

Dengue fever, another mosquito-borne disease, is reported by travelers to be common on the east coast of South Sulawesi. The fact that it frequently strikes infants and young children, and because it can easily be confused with other fevers in the absence of blood tests, makes it difficult to estimate the relative seriousness of the problem.

Cases of gastrointestinal diseases such as gasteritis, diarrhea, and even cholera, continue to be a largely seasonal problem. Their incidence tends to rise during the dry season, and particularly in hamlets most downstream when the quality of water deteriorates.

Drinking Water Supply. The study area population relies most heavily on wells, as mentioned in previous sections of this chapter. None of the households are totally dependent on river water for their domestic water supplies. The only households in which procuring fresh water year-round is a problem, are those located directly along the coast in Ujunge Village, where salinity and pollution are seasonal problems. These households reportedly use small boats to collect water from a few nearby ever-flowing springs or go inland and bring water from wells located closer to the coastal highway where salinity is not a problem.

Housing and Sanitation. As the population of the area is predominantly Bugis, housing conforms to Bugis housing standards, where people live in clean, airy wooden houses built about two meters up, on wooden supports, in an architectural style known as "panggung". The area beneath the house is often less sanitary, being used as work and storage space and sometimes for tethering livestock. Frequently there are polluted pools of water and waste materials located below the house, caused by livestock, and from food and water being dropped through the floor from the kitchen.

Among the population there are wide differences in the size and quality of housing construction, ranging from two-room dwellings to large houses with four or five bedrooms. Minimum standard houses consist of thatched roofs and woven bamboo walls. The better houses have metal sheeting roofs, louvered glass windows, and the outside wooden walls are painted or covered with aluminium siding.

Basic sanitation facilities--toilets, or a combination well, bathhouse and toilet--are not uniformly valued, even when a family can afford to build them. More progressive households have built toilet and bathhouses near wells (unfortunately, often the source of polluted water), but these structures are not yet the general rule and minimum effort goes into maintaining them.

Overall, the majority of the population is adequately, if not comfortably housed. A small proportion of the population still have sub-standard housing. Some sub-standard housing exists because families have recently moved from somewhere else in the project villages and have yet to build a better house, so that they are essentially living in poor quality quarters at the building site of their new house. Other houses are of poor quality where the family has lived there for sometime, and is probably a true indicator of their poverty.

Nutrition. No data is available on the nutritional status of the population. There is no visual evidence of any particularly severe malnutrition in the area. This would only be expected to occur, or be a problem in drought years with widespread crop failure. Being close to the sea, there is probably adequate availability of fresh and dried fish to provide sufficient animal protein in the diet.

Health Care Facilities and Services. Each of the four study area villages has participated in standard health care training programs offered by the Department of Health. Each village, and most of the village sub-areas have some sort of health clinic that is open either weekly or on a rotating basis (Posyandu or Pos Kesehatan), staffed by a travelling clinic team (PUSKESMAS Keliling). In addition to an active family planning program, there is an attempt to provide health services to mothers and infants, and to provide immunization to infants and young children to the age of five years (known by the acronym "BALITA"). There is also at least one in-resident, trained health care worker as well as several midwives per village.

The main health clinic for Subdistrict Salomekko is located right in Manera Village, where a doctor is in residence along with several nurses and other health care workers. Another main health clinic is located in the nearby administrative center for subdistrict Tonra. The nearest hospital is located in Sinjai, about a 20 minute drive from the project area.

Economic Aspects

Occupations. Paddy production is the primary economic base of the study area, with 3 out of every 4 (reported) economically active workers employed as paddy farmers. Another 5.2 percent of the work force engage in farming other than paddy production. Fishing and aquaculture are the primary occupations of 5.2 percent of the workforce, although these occupations are reportedly important as secondary activities. The remaining work force is employed in service sector occupations: 3.1 percent in crafts, 1.9 percent in commerce, 7.7 percent in public service, and 2.8 in all other occupations.

Agricultural Labor. Results of the project Household Survey highlighted some minor internal manpower shortages in paddy cultivation at times of peak labor activity: land preparation, transplanting, and harvest. At these times, farmers hire on outside laborers for wages or production shares. During other activity periods, most tasks are conducted with household or exchange labor. Wage labor is compensated on the order of Rp 2,000 to 2,500 per person per day. Harvest shares are paid out to paid laborers at a rate of 1/7 to 1/6 of the total they bring in.

While use of hired labor in the area is noted, farmers do not report being constrained in production by labor shortages. Approaches to increase efficiency in labor such as extensive use of tractors, herbicides and contract labor are not common.

Income. Income levels in the project area are low, compared to provincial and national averages. Results from the SSIMP Household Survey indicated an average farm size of 2 ha. Estimates of net farm income from an average-sized farm was about Rp 720,000, which, for an average farm family would just cover living expenses (fuel, clothing, medical needs, off-farm purchases, household improvements, etc.). Under such circumstances, the annual net family savings or reserve for the average farm would be minimal, if any.

Cultivation Costs and Exchange Labor Institutions. Both paddy and palawija cultivation involve comparatively low outlays of cash, confined primarily to the purchase of seeds and fertilizers, and secondarily to provision of food to outside laborers who assist in cultivation tasks. Approximately 20 percent of farmers obtain fertilizer through informal local credit arrangements, involving barter exchange of newly harvested paddy (gabah) at harvest time at 20 percent interest. Intensification of cropping patterns and labor and fertilizer use do not appear to involve major cash increments or credit needs, and should be accompanied by substantial gains in net returns.

The comparatively low cash costs of cultivation in the Salomekko service area, which range from approximately 15 percent to 25 percent of gross returns for paddy and palawija crops, arise in part from the virtual absence of wage (cash) labor in agricultural cultivation. In paddy cultivation, preharvest outside labor is recruited primarily through traditional modes of interhousehold labor exchange, thereby eliminating up-front labor cash costs. Harvesting is the one cultivation task involving major (non-food) compensation. In the case of paddy, this usually consists of 1/7 to 1/6 piece rate shares.

A second factor lowering production costs concerns the fairly high levels of household participation in paddy cultivation tasks. In theory, most pre-harvest paddy cultivation tasks, aside from plucking paddy seedlings, are considered male preserves. In practice, female household members often assist in plucking and bundling seedlings for transplanting, and they perform a major share of the harvesting work, sometimes on the plots of others. Overall, about 72 percent of paddy cultivation labor inputs is performed by men and 28 percent by women.

In secondary food crop cultivation, a labor pattern similar to paddy cultivation prevails with respect to female labor inputs. Pre-harvest tasks (primarily land preparation, planting and weeding) are primarily done by male household members (83 percent of the work), with some assistance, as in planting, by female household members (15 percent). Almost no outside labor is used. Harvesting, in contrast, is carried out primarily by female household members (61 percent), and secondarily by male household members (only 8 percent). Overall, about 60 percent of the inputs in palawija mungbean cultivation, are provided by male labor and 40 percent by female labor.

This flexibility in labor roles helps to ensure more optimum use of household labor. Since future net increases in agricultural yields should accrue primarily to cultivators, incentives for farmers to take the necessary steps to make such yield increments possible are high.

Land Ownership and Taxation

Land Acquisition. All of the land cultivated in the service area has been under individual ownership since the colonial era. There are now four main ways to acquire land in the Salomekko service area. These are through inheritance, sharecropping (including renting or leasing), pawning (gadai), and by purchase. There is no open, or unclaimed land in the service area that is suitable for cultivation.

The majority of farmers claim rights to land through inheritance from parents, or by land their wives inherited. Results of the HHS indicated as many as 83 percent of farmers inherited at least some of their paddy fields.

Land inheritance follows Islamic custom where sons receive two parts and daughters receive one part. Land is "registered" in the name of the person who receives it, so that men and women bring their own land into marriage. Generally, newlywed couples live with the wife's parents until they build their own house. Newlywed men may work their wive's parents' land if they have not yet inherited land. Houses are often inherited by the youngest child, as this person tends to remain living in the parental house after older siblings have married and moved out.

Some absentee owners sharecrop out their land and have moved to the district capital town of Watampone, to Sinjai, or elsewhere (including, reportedly, Ujung Pandang, other parts of Sulawesi, Java, Sumatra, Sumbawa, etc.), and have become public servants or traders.[1]

Sharecropping is fairly extensive, but specific details vary by source. About 36 percent of farmers sharecrop additional land (according to the HHS), and another 28 percent acquire temporary cultivation rights through pawning arrangements. Sharecropping or pawning land is most extensive in Ulu-Balang Village. Village data indicate more than half the Ulu-Balang farmers only sharecrop or pawn land but do not own land in the village (although they may own land in a neighboring village). (See Table IV-14).

Land Registration. Each village maintains its own records on land ownership for purposes of making clear who owns the land, and to collect land taxes. Farmers in the Salomekko service area lay legal claim to their cultivated land through three systems of land regisration: land registration books with maps of field complexes, simple lists of land owners, and individual land title certificates. All land not claimed as privately owned remains government land (tanah negara), including land used for communal purposes such as pasture land.

A very few farmers in the study area reportedly have had their land surveyed by the most modern of the land registrationmethods. With this system of land registration, farmers pay fees to the government to have their land surveyed in order to acquire modern legal title. These farmers have certificate title (Sertifikat) to their land. It is uncommon for any farmer to have certificate title to his land at Salomekko. Lack of certificated title can lead to problems in using the land as collateral for credit.

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1. Most of the absentee owner-patrons are former residents who fled during the Islamic rebellion in the 1960s. During the period 1955 to 1970, hardly any of the existing bunded lowland was cultivated and there were mass movements of households to more secure areas. Roads became almost non-existent and impassable. One result of this regional turbulence was that many craftsmen and small businessmen left and never moved back to the area.

Acquisition of agricultural land continues mostly on the basis of inheritance, sharecropping and some cash purchases. Registration of land appears clear cut and no major problems seem to exist regarding land rights or tenure in the service area.

Land Values. Land values have changed considerably over the past 40 years. During the period 1950 to 1965, the average bartered value of 0.3 to 0.5 ha of bunded lowland was reportedly equivalent to a horse or water buffalo (cash value of an adult water buffalo today is about Rp 400,000; its cash value 1950-65 is unknown).

During the 1970s and 1980s, particularly following the introduction of high yield rice varieties, the value of bunded lowland has increased to an average, now, of about Rp 1.3 million per hectare. By 1988 (according to the HHS), the value of more productive and accessible land was averaging Rp 2 million/ha. Prime land in the service area in 1989 was supposedly about Rp 3.5 million/ha and it is predicted that it will go higher than Rp 5 million/ha, as SSIMP goes ahead and constructs the irrigation system. Prices are unlikely to reach the reportedly prime rate of Rp 20 million/ha in South Sulawesi Province, because the area does not have the best soil types, and, even with irrigation there is likely to be some water shortage.

Table IV-14

Farm Operators in the Study Area, According to their Land Tenure Status

Village	Owner Operators*	Sharecrop Only	Total Farmers
Number of Farmers:**			
Biccoing	281	121	402
Ujunge	189	25	214
Manera	351	152	503
Ulu-Balang	667	802	1469
Totals:	1488	1100	2588
Percent Distribution:			
Biccoing	70	30	100
Ujunge	88	12	100
Manera	70	30	100
Ulu-Balang	45	55	100
Overall Percent Distribution:	58	42	100

* Owner operators may also sharecrop, rent, lease or pawn land.
** There are 45 landless farm laborers living in Manera, who are excluded from this table.
Source : Village statistics.

Land Classification and Taxation. Land is still classified according to old systems established by the Dutch, with some more recent refinements. As the land has never had a complete cadastral survey based on aerial photographs, tax assessments are estimated, based on the amount of land and its classification, as reported owned by a farmer.

In the village, agricultural land in the area is divided into a few basic categories according to its general productivity. These categories are basically: rainfed paddy (sawah tadah hujan) and dry/upland fields (tanah kering), whose primary use is either as mixed gardens (ladang), tree crops (kebun), or cattle grazing (padang). Public pasture land is not taxable, but the other categories of land are, at least in theory, taxable. The value standards vary by province and even by district, to reflect differences in productivity, although the general categories remain the same across the country.

Land taxes (formerly the IPEDA tax; now the PBB tax) are collected within each administrative sub-area (dusun) of the villages. Comparison of the reported number of hectares of rainfed paddy fields from village records, with the number of hectares as estimated by the Taxation Department in Watampone, indicates reasonable congruence. According to this comparision, about 98 percent of the rainfed paddy land is taxed at any rate in Biccoing, about 64 percent is taxed in Manera, about 74 percent is taxed in Ulu-Balang, and only 38 percent is taxed in Ujunge.

Completion of technical irrigation will probably be accompanied by a drive to complete a cadastral survey of the service area and an upgrading of land titles to the modern system of land tenure. Tax rates should probably increase then. Technical irrigation should raise income sufficiently to allow for future water users' fees to help pay for some of the necessary costs associated with operation and maintenance of the system.

Farm Support Organizations

Farmer Groups. Farmer groups (kelompok tani) have been formally organized by the Department of Agriculture's extension workers (Penyuluhan Pertanian Lapangan, or 'PPL'). In Biccoing Village, for instance, there are 8 farmer groups of about 30 farmers each. Each farmer group covers several field complexes, but is not affiliated with any particular hamlet. Participation depends on the level of interest or motivation of individual farmers and individual extension workers.

Each farmer group has a contact farmer (kontak tani), and usually a few lead farmers (tani maju), but in general, there are relatively few activities or technical information that is passed on from extension workers to farmers that requires much formal organization. Without irrigation there are severe limits to improving yields through assistance from extension workers, and the farmer organizations remain weak. The main cooperative efforts remain with farmers cultivating land within a single field complex where there are some joint field preparation activities, shared labor exchange for harvests, and joint post-harvest livestock grazing.

Meetings (tudang sipulung) are still held in hamlets for the entire village, to determine when to begin the planting season and what local seed varieties to use. Traditional leaders (pallontara) who are senior, respected members of the community, rely on Bugis almanacs and ecological signs to stipulate the schedule of seedbed preparation and transplanting, and subsequent tasks including when to organize necessary rituals. These traditional meetings are usually followed by more formal meetings in the village and subdistrict offices. The necessary community level agricultural decisions are coordinated with recommendations from the Agricultural Extension Service and other offices in the subdistrict. Thus the local administrative environment, backed by custom, supports the organization of agricultural practices.

Irrigation Organizations. As there are no weirs and no pump-fed irrigation systems in the service area, farmers are not formally organized into irrigation associations at Salomekko. However as noted above, farmers are informally organized and typically meet prior to the wet season (but after the tudang sipulung), to decide on the specific timing of field plowing and seedbed preparation. Prior to the beginning of planting, traditional ceremonies (called mappananrang) are held which promote cooperation in agricultural work and there are other ceremonies throughout the agricultural cycle. These rituals are quite likely pre-islamic in origin. They help to legitimize and sanction partial group control over agricultural cultivation.

Administrative Divisions and Village Government

The Salomekko service area lies at the intersection of four villages: Biccoing, Ujunge, Ulu Balang, and Manera. They are administratively parts of two subdistricts: Tonra (Biccoing and Ujunge villages), and Salomekko (Ulu Balang and Manera villages); both subdistricts are within District Bone. For purposes of irrigation management, the entire service area is located in the same district (Bone). All major management decisions can therefore be handled by the same district Irrigation Committee, and operate under a single administrative structure.

Virtually the entire population is now settled in consolidated hamlets. The majority of the population resides alongside the main north-south highway, or alongside village roads. This enables the government to provide better coverage and access to services, particularly schools, health care centers and roads.

The villages are divided into administrative sub-areas (dusun), each village having 2 to 6 such sub-areas. Each sub-area has agricultural land as well as one or more hamlets (kampung). The hamlets, in turn, are divided into small village administrative units of 15 to 50 neighboring households, known as

"RT" (rukun tetangga). Each household is represented by its head at any meetings held within the "RT" or at village-wide functions. Community public works projects (gotong royong) are organized using this basic work unit, the "RT".

Village heads (kepala desa) are appointed by the subdistrict government, with the consent of village residents. 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 village head 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" as it is known), farmer groups (kelompok tani), and the village advisory body (Lembaga Masyarakat Desa, known as the "LMD"), who finally make recommendations to the village head. In practice, the quality of the village administration strongly depends on the capabilities of the village leaders.

Regional Infrastructure

Roads and Transport. Public transport services along the main north-south coastal highway that run through the project area, are excellent. Inland into the service area there are a few hamlets with relatively poor access and where four-wheel drive vehicles can enter only in the dry season. However, given the relatively small service area and the fact that most of the population lives along all-weather roads, virtually no households are seriously cut off from outside access. Overall, there are 7 cars, 3 small buses, 12 large buses, about 66 motorcycles, 25 bicycles, around 19 small boats and about 300 horses locally owned and used for transport in the project area.

Communications. There are short-wave radios in the subdistrict offices and some of the police/military posts along the main highway. The area has good radio and television reception and households rely on combinations of batteries, local, privately owned generators, and some "town" electricity supplies to run their televisions. Reportedly there are at least 128 radios and 78 televisions in the project area.

Bank and Credit Facilities. The nearest branch of Bank Rakyat Indonesia (BRI) is located about 20 km north of the service area. The major sources of agriculture credit to farmers in recent years have been four: BIMAS, KUT, KUPEDES and private, non-institutional sources.

Public Markets. The main market facility in the area is located in the administrative center of Manera Village. There are a number of small shops scattered throughout the hamlets. The next closest main market town is in Sinjai, about 20 km to the south of the project area.

Extension. In the project vicinity, there are two working districts (WKPP) covering the village areas in the projected irrigation service area, and with the districts, an equal number of extension agents (PPL). The agricultural extension center (BPP) for the area is in Subdistrict Tonra, along the main road traversing the irrigation site but outside the project service area.

Credit. The BIMAS program provided credit for purchase of a standard package of farm inputs according to government guidelines, plus provision of a living allowance. The last operational year of this program in the study area was 1983. Areas covered in the project villages over the last three years of this credit program averaged about 100 hectares at rates of Rp. 25,000 per hectare served. Recovery rates over the same period for the proect villages averaged 41 percent (Table IV-15).

KUT (Kredit Usaha Tani) is designed so that farmers obtain credit in the form of inputs rather than cash, and on an individual basis rather than according to pre-determined levels as was the case under the earlier BIMAS program. The KUT credit is only available through cooperatives (KUDs) which have been approved as reliable by BRI. Interest payments on loans are one percent per month for members and 1.5 percent for non-members. One of the two local KUD covering the project villages had a limited KUT credit which extended inputs to about 100 farmers in the 1986 and 1987 crop years.

KUPEDES (Kredit Umum Pedesaan, general rural credit program) is a cash credit program administered by BRI. It can be utilized by farmers if a reliable KUD (and KUT credit) is not available. Money has been extended from the BRI to creditors in the project villages, but almost exclusively for trade and commerce. Officials state that agriculture is an historically bad loan performer, especially if the agriculture is rainfall dependent. The BRI center covering the project villages is not proximate to the service area, located in the Subdistrict of Mare about 10 km north of the project site.

Private Credit: with the limited success and amount of institutional credit available to the agricultural sector, the most prevalent credit arrangements are amongst farmers themselves, or less frequently, with middlemen. Loans are made in the form of inputs (seed or fertilizer) with repayment to be made from the crop harvest, usually in-kind. The rates on these small loans are estimated to be 25 to 50 percent over a season. A typical loan would be in the input form of fertilizer to be paid back at harvest in an equal weight of paddy.

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Table IV-15

Last Years of BIMAS Credit in Project Area

Village/ Year	Area (ha)	# of Borrowers	Amount/ Hectare Coverage	Amount/ Borrower	Percent Recovery Rate
Ujunge					
1983	61	80	17,698	13,495	73
1982	12	14	39,100	33,514	100
Biccoing					
1982	287	250	24,141	27,714	20
1981	74	93	22,244	17,700	91
Recovery Rate for the Villages for 3-Yr Period:					41

Source: Bank Rakyat Indonesia, Unit Desa Kadia/Mare, 1988.

Regional Development

There are currently no known, well developed plans for any integrated approach to development of the Salomekko area, nor any particular development projects, aside from this SSIMP project, focusing on these four SSIMP-project villages.

Attitudes Toward the Project

Farmers in the project service area, aware of the limitations placed upon agriculture by the vagaries of rainfall in the long dry season, are highly supportive of the project. As a result of initial assessments, indications are that the Salomekko site will be socially suitable for technical irrigation. This site meets the general USAID requirements that farms be principally smallholder, owner-operated and that knowledge and interest of farmers are sufficiently high so that provision of irrigation will result in maximum benefits.

CHAPTER V

POTENTIAL ENVIRONMENTAL IMPACTS

Methodology Used to Identify Project Effects

Identification of the potential impacts of a particular project are usually based on several types of information sources, any of which may prove appropriate or inappropriate upon close examination. These sources of information are:

1. The published literature on similar projects, world-wide.

2. Local knowledge of problems that have been experienced on similar projects.

3. Concerns expressed by local officials in reports or at formal meetings.

4. Extrapolation of baseline environmental conditions by analysis of the interaction of resources with the project.

All of these sources have been used to some extent to determine the likely environmental problems of the Salomekko project.[1]

On 14 April 1988, a meeting was held in Ujung Pandang, with 31 participants, representing a number of government agencies, USAID, and technical consultants. The objective of the meeting was to bring to light concerns over general and specific effects of both the Awo and Salomekko Projects. An account of the meeting is presented in Appendix C to this report.

Participants discussed both positive and negative interactions of the project with its environment. The same general categories of effects were used in the meeting as in this report: water, land, biological, and socioeconomic resources. The general areas of concern were largely those already identified by specialists at USAID and by the Technical Assistance Team. These may be summarized as follows:

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[1]The theory and methodology currently available to analyse a complex series of interactions involving changing technology and human activities with the environment is incomplete and still evolving. Prediction of impacts in this context, with so many largely unquantifiable variables is an inexact science and does not, as yet, lend itself to very much analysis using numerical modeling.

- Availability of river water for downstream users.

- Interactions of the project with the clearing of the watershed: effects of clearing on the project and effects of the project on clearing.

- Possibility of adverse health effects among downstream water users.

Pre-construction Phase

Work during the pre-construction phase such as site surveys, public meetings, and test bores have produced generally positive social impacts among the local population and raised public interest in the likelihood of receiving irrigation.

One of the negative impacts during pre-construction has been that the local population has become impatient with delays, since they were first told they were to receive irrigation in about 1983. Another negative impact will be the necessary resettlement of a few households out of the reservoir and dam site area, as well as the loss of their land to production.

On the technical side, the greatest negative impact during pre-construction will be acquisition of some agriculturally productive land to be used primarily for supply and drainage canals, borrow areas, sites for offices and housing of irrigation construction staff, and the inundation of about 92 ha in the reservoir area. Since the land area to be taken is small and the local population is enthusiastic about the project, albeit disappointed in delays, the impact should be small. It is important, however, that negotiations for compensation to the villagers for their land be conducted in an expediant and fair manner. Otherwise significant, further delays in the project could result, and ill-will amongst the population could escalate.

Construction Phase

Potential environmental impacts during the construction phase will be mostly temporary ones. The local population will benefit positively from increased employment opportunities and a greater demand for locally procured goods and services while construction crews build the system. Prior to construction of the dam and canals the main road into the project site will be repaired with the resultant improvement in transportation services in the area.

While construction is underway, the local population will be inconvenienced somewhat by increased traffic, noise, and dust, and there will be disruption of agricultural production along some of the canal routes as they are built. The disruption caused by the contractor, however, should be kept to a minimum. Clearing in the reservoir and borrow areas should be limited to just those areas. Fences should be used if necessary, to clearly delineate boundaries to everyone, and contractors should attempt to minimize disruption of the daily activities of villagers. Dust during the dry season can be controlled by watering roads, and should be a responsibility of the contractor. The labor and logistics camps will be placed where they will create minimum impact on the environment and villagers. Pit toilets will be provided and relocated occasionally. Trash should be burned and all hazardous materials such as used motor oil should be stored and later removed from the site. The contractor should be prepared to supply his laborers with housing, food, drinking water and firewood when these items are scarce locally; otherwise competition for resources with the indigenous population will result, and create price inflation. It is especially important that the laborers not be allowed to take wood from the watershed, as this area must be preserved for soil and water conservation.

Post-Construction Phase: The Operation Period

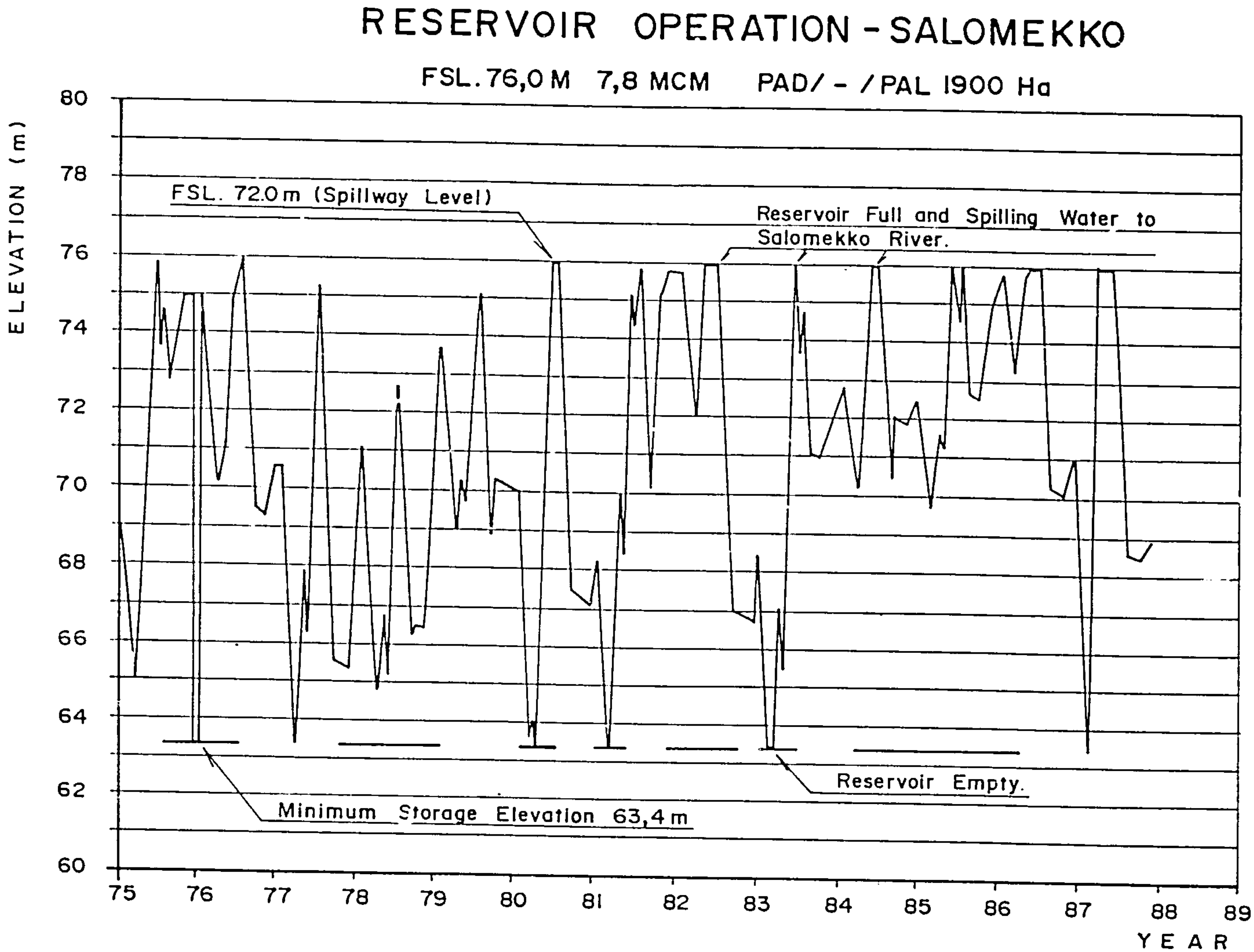
Given that the SSIMP surface water projects are only small to medium-scale, and socially and environmentally non-controversial, the investigation of potential impacts has been relatively straightforward. Virtually all the potential environmental impacts that have been identified pertain to the post-construction phase, also known as the operation period. These potential impacts are presented here, following the same sequences as earlier chapters: water, land, biological, and socioeconomic resources. They are summarized in Table V-1, "Summary of Potential Environmental Impacts," found at the end of this chapter.

Water Resources

Water Quantity

Streamflow Characteristics. The primary objective of the project is to store 7.8 MCM during periods of high river flow and to distribute it to cropland during the wet season and into the dry season. The operation of the reservoir will control the release of a large part of the 17 MCM estimated as the average annual discharge of the Salomekko River.

The reservoir will be operated so as to maximize the amount of water stored. Whenever the reservoir contains less than 7.8 MCM the complete flow of the river will be used to fill it again, after which the excess will pass over the spillway. The reservoir simulation shown in Figure V-I, indicates the reservoir will reach its target storage of 7.8 MCM almost every year. Consequently, water should be expected to spill into the Salomekko from the dam during many wet seasons but not during the rest of the year.



SSIMP
SALOMEKKO

Fig. V - I
SIMULATION OF SALOMEKKO
RESERVOIR OPERATION

The operation of the system has been simulated using flows based on correlation with fifteen years of rainfall data together with assessments of runoff, evaporation, seepage, cropping patterns, and agricultural practices. However, hydrology is not an exact science and the simulation has a degree of uncertainty. Provided that this is kept in mind, the simulation may be used as a reasonable guide to the flows which can be expected downstream of the dam under various rainfall conditions.

Tributaries, rainfall, and irrigation return flows will be the main sources of water for the Salomekko downstream from the dam outside of the wet season. Smaller contributors may be dam seepage, dam overflow and springs. Flow from the Padang Mani, Laballang and other smaller tributaries may account for half the Salomekko's nonproject downstream flow during the dry season if catchment area is used as a means of comparison. Rainfall runoff from the service area and irrigation return flows will normally contribute a much smaller portion (less than ten percent) of river flow. Of course much depends on the efficiency with which water is applied to the fields. Under total efficiency, irrigation applications and rainfall would exactly meet crop needs and there would be little or no return flow. Under actual operating conditions, however, some excess application always occurs and this results in drainage water. It is impossible to calculate exactly the percentage loss of flow to the Salomekko due to the dam, but it can be estimated to be less than 30 percent at the river mouth, on an average annual basis. This estimate is based on the area of the dam catchment area (13.2 km^2) as compared to the total Salomekko basin area (42 km^2).

Surveys of well distribution in the service area indicate that there is usually sufficient water available from that source for domestic needs, even during the dry season. There are only about two small hamlets located where the road is especially close to a river, where the villagers also take water from the river for household uses. This alternative may cease to exist, either because the river has been blocked or diverted as in the case of the upper reaches of the Salomekko, or because the river is no longer fit for human use due to fertilizer and pesticide contamination from irrigation runoff.

The rivers are also important for watering livestock. In some areas the diversion or pollution of the rivers may not make this possible. However in the case of the Salomekko River, alternative water sites exist for most hamlets in the Baruttung and tributaries of the Salomekko River. In addition, the irrigation canals can also serve as watering sites where the proper livestock watering structures have been constructed.

The Salomekko and Baruttung are both too small to be important for transportation. There are no forest products being floated down these rivers and boat traffic near their mouths is minimal and limited to use by local villagers using very small boats.

Runoff and Drainage. The application of irrigation water, even under carefully controlled conditions, will result in increased flow in drains and then in the tributary streams into which they discharge. There also is likely to be a somewhat greater domestic waste-water flow into the same drains, due to wider distribution of water in the canal system. Farmers will have to carefully maintain drains in steeper areas to avoid erosion of terraced slopes.

Ground Water. As the ground water situation in the project area is not well understood it is difficult to assess the impact of the project on it. The increase in surface water on a year-round basis is expected to recharge ground water somewhat, with the result that some wells that go dry under present dry season conditions will provide water later into the dry season. The potential effect of the project on springs is unknown, however the impact should be small since most springs originate above the service area. Raising the water table to the surface, thus causing waterlogging and soil salinity problems, should not be a concern since the rolling topography is naturally free draining.

Water Quality

Reservoir. 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, most of which will settle out. There are no significant pollution sources in the upper watershed that would contaminate the reservoir but the basin should be cleared before filling to reduce the risk of anoxic conditions due to rotting vegetation.

Irrigation System. Water entering the irrigation system will be of 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 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 dry season conditions. In general, the main stem of the Salomekko River probably will contain the best water during the middle part of the wet season, in years when the dam spills, but the canal system probably will be better during the rest of the year.

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 and pesticides and considerable human 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.

Ground Water. Some contamination of ground water may occur in areas of exceptionally high fertilizer use, but the effect would be largely one of taste rather than a danger to health. It is unlikely that, even with maximum project development, this will be a problem.

Contamination by pesticides is a greater likelihood, not from normal crop applications but from careless storage or formulation, or accidental spills. Repeated mixing of pesticides at one spot often results in substantial soil contamination, especially when equipment is washed in the same area after use. This type of contamination is unlikely to be detected unless a sudden discharge of concentrated chemical results in enough contamination of ground water to cause illness or fatalities. Such incidents probably are not as infrequent as they appear to be from the lack of reported cases.

Land Resources

Land Use and Capability

The land to be irrigated under this project already is converted to bunded, terraced fields, but nearly all of it produces only wet season crops. Little or no new land is expected to be brought into agriculture.

The main and secondary supply canals for the project will total about 30 km in length and will be between 10 to 20 m wide (including the service road), and will occupy approximately 40 ha of land, much of it now in agriculture or along the field fringes. The tertiary system will also take strips of land from the edges of fields. The project drainage system will require some land now in agriculture but will attempt to utilize existing drainage routes whenever possible. The exact amount required has not been calculated but certainly the distribution of land taking will be very broad. The value of land lost to canals will be offset by the increased production brought about by the irrigation scheme.

Project structures--the dam, spillway, work areas, borrow and spoil areas--will occupy land that currently is covered with pasture and brush. Most of the materials sources are within the inundation zone of the reservoir. The most striking change will be the conversion of approximately 92 ha of brushy woodland and river bed into a reservoir. There are a very few families and some crop fields in the inundation zone.

A reservoir can be a valuable addition to the recreational, and even tourism facilities of an area and this is likely to be especially true of Salomekko since there are few such facilities in this part of South Sulawesi, and the land is picturesque, particularly from high points in the catchment, alongside the Camming Road.[1] The reservoir will attract visitors for swimming, boating, fishing and picnicking. With this in mind, provision should be made to cater for the visitors, both to enhance the recreational value of the asset and to protect the structures from damage. To achieve this, the following measures are strongly recommended:

(a) Clear the reservoir area of all vegetation (except grasses) before filling. Rotting vegetation can cause anoxic conditions and provide an excess of nutrients in the reservoir. This should be avoided if possible. Also, trees and stumps not cleared beforehand will be exposed during the regular annual drawdown. This will be both unsightly and dangerous to lake users and will hinder access. The cost of clearance is relatively small and should be included in the dam contract.

(b) Provide access to the water edge. If carefully chosen, the access routes can enhance the recreational value of the resource and keep the general public away from the important structures and gates. The detailed design consultant for the dam should make recommendations on this issue.

Camming Sugar Estate. The sugar estate, with a factory some 40 km to the north of the project area, owns a substantial amount of land near the Salomekko basin. The estate is steadily acquiring more land and there is some concern that it may buy into the service area either before or after completion of the scheme. There are two reasons which make this unlikely. First, there is an agreement between the estate and BAPPEDA (see Appendix G), that the estate will not buy land in the Salomekko service area. Second, sugar cane growing is less profitable for the small farmer than paddy and palawija in a two crop season, so farmers would not willingly raise cane to sell to the factory.

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, due partly to the requirements of paddy soils, partly to high ambient relative humidity, and partly to the use of effective drainage systems.

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[1] This entire area is almost totally undeveloped for foreign tourism. The downstream village of Ujunge might also be developed as a picnic area and recreation/rest area (e.g., seeing fishing villages, boat rides and visits to nearby offshore islands) as part of the general plan to heighten foreign interest in visiting the eastern parts of South Sulawesi.

Erosion

Erosion in the catchment area may be accelerated if more land is cleared for livestock grazing, firewood collecting or putting in tree crops. Overgrazing of pasture lands or incorrect management of crop irrigation will have a similar effect. Also, extracting rocks (for housing construction) from hillsides, as is now practiced, may have unfortunate long term effects on slope stability.

Erosion of earthworks 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. This will be important in the development of tertiary and quaternary layouts, and in the design of drains on the more steeply terraced areas. Project roads are being designed with effective drainage and foundations so as to avoid erosion.

A serious source of canal bank erosion is the use of the channels for laundry, personal bathing and watering 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.

Agricultural Practices

Cropping Patterns. A cropping pattern with paddy in the wet season, no crop in the subsequent dry season, and palawija in the transition season season is being recommended. This is the current farming practice and makes the best use of stored water. Experience in Indonesia has shown that the higher returns obtained by vegetables, groundnuts, tobacco and melons gradually cause farmers to switch willingly to those crops during the second or third growing season, once a main paddy crop is secured. As the road network improves over the next few decades, farmers in the Salomekko area will find better access to urban markets and the middlemen will be more willing to purchase fragile produce such as tomatoes.

The increased cash flow available to area farmers may be expected to lead to increased mechanization of field preparation. There will be more pressure toward mechanization if the keeping of draft animals becomes more difficult as pasture land is reduced.

Agricultural Chemicals. The amount of fertilizers and pesticides applied is expected to increase gradually, as a result of increased pest populations, better extension advice, and more sophisticated farmers, able to see demonstrably improved returns with chemical use. The types of fertilizers are not expected to change much over the next few decades, but pesticide selection and formulation will change as new compounds become available.

The introduction of toxic compounds in an area not accustomed to them poses risks of improper storage, handling, mixing, and disposal of chemicals. This is especially true when more toxic compounds or different formulations are introduced. Liquid organophosphate compounds, for example, are rapidly absorbed through human skin and a few drops of the concentrate can prove fatal. Operators often grow careless when mixing wettable powders, due to the lack of contact risk, but similar carelessness in handling the liquid concentrates can prove fatal. The switch from DDT to Malathion in Pakistan during the 1973 malaria epidemic was not accompanied by adequate training programs and several operators died from contact poisoning.

Pesticides in rural areas often are not sufficiently protected from accidental ruptures of bags or wetting by rains or floods. Such failures result in environmental contamination that usually goes unnoticed, except in the rare instance of mass illness.

The possibility of ecological effects of pesticides use, other than from a major spill or other accident, seems remote, since the chemicals used at present are nonpersistent and there is a trend toward more specific, short-lived compounds. Intensive use of chlorinated hydrocarbons (DDT, toxaptene, chlordane, lindane, etc.) could result in severe impacts on the fish ponds downstream of the service area, especially on ponds producing shrimp, but their use in agriculture is very limited so such effects are extremely unlikely.

Grazing and Fodder. More intensive cropping of lands that now serves partly to support the large herd, will leave livestock owners looking for more grazing land or cut grasses for fodder. Some owners, faced with higher demand for household labor in the fields (including that of children who do much of the livestock tending) may elect to sell off some of their animals. There will also be increased pressure to clear more land in the watershed or overgraze the land. These practices should be discouraged since they contribute to erosion. Farmers are already replacing draft animals with hand tractors, and this trend may be accelerated.

Alternatively, it is possible to continue to promote the livestock industry while developing the project area for irrigated crop land. Results of a study by Fenco (1982)[1] on livestock development for Sumbawa may also be applied to South Sulawesi, where conditions are even more favorable. The study noted that the natural carrying capacity of unimproved pasture land is approximately 0.25 to 0.5 AU (animal units) per ha. Enhanced pasture productivity, with investment of considerable time, management ability and money, can achieve a carrying capacity of up to 2.0 AU per ha.

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1 Sumbawa Water Resources Development Planning Study, Technical Report, Volume 9, Agriculture / Livestock, Fenco Consultants, Ltd. (Lavalin International Inc.), 1982, for Ministry of Public Works, Directorate General of Water Resources Development.

Continuously cropped land generates crop residue of four to ten tons of useable dry fodder for livestock per ha per year. This fodder can consist of paddy straw, soybean and mungbean hays, and maize tops. Further, along with the increased crop residues available for feed from an irrigated crop area, improved fodder grasses and trees can be grown along bunds and canals, also contributing to the quality and variety of feed generated for livestock. Altogether, an irrigated, continuously cropped area through fodder and feed generation can achieve the same level of carrying capacity at 2.0 AU as an area of improved pasture, with the additional benefit of increased crop production and an improved quality of water supply.

Thus the proposed cropping pattern of 100 % paddy, 100 % palawija and a single fallow season, rather than reducing opportunities for livestock, could actually increase productivity if good advice and extension services are provided.

Biological Resources

Terrestrial Vegetation and Habitat

The most significant habitat change resulting directly from the project will be the conversion of some 92 hectares of steeply terraced paddy fields, hillside pasture, and riverine forest (plus some 10 hectares of river bed) into a reservoir. 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 ground water 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. If grazing continues at its present intensity, however, the seedlings of such trees are not likely to survive.

Most of the drawdown zone of the reservoir, however, will support no vegetation whatsoever, there being no terrestrial 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.

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.

Commercially Important Species. The forests of the Salomekko watershed already have been exploited for the few tree species of timber value and the many more with fuelwood value. Some of each will be lost to reservoir inundation, unless salvaged.

The situation with game animals is similar to that of fuelwood: there appears to be little habitat for larger game species within the Salomekko basin. There is little reason to believe that pressure on game animals will increase more rapidly than at present.

Pests

Any intensification of cropping is likely to result in higher and more persistent populations of crop pests in the service area and, secondarily, downstream. These may be categorized by insect or animal group.

Insects. Back-to-back paddy cropping would allow insects to maintain their populations from one crop season to another, necessitating higher insecticide use. The proposed paddy/no crop/palawija cropping pattern will be less of a problem, since different pests affect the two types of crops.

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

Mammals. Rodents are the main pests of paddy in the area, taking grain both in the field and in storage. The species involved are different, but the problem parallels that of birds.

The Rice Field Rat (Rattus argentiventer) is the most serious rat pest of paddy in Sulawesi. It feeds on paddy plants at all stages of developent and on the grain heads, causing considerable damage to fields where it is abundant. These rodents have an extremely high reproductive potential, rendering them capable of rapid population explosions under favorable ecological conditions such as those presented by multiple cropping of paddy. The situation may become particularly bad when there is great variation in planting times within one field complex. In this situation the rats forage quite well, moving from field to field, continuously eating ripening grain.

The Polynesian (or Little) Rat (R. exulans), and the House (or Black) Rat (R. rattus), also are agricultural pests in South Sulawesi. Although they are more prone to taking stored grain and other foodstuffs, these two species enter paddy fields when other food is scarce and may do considerable damage. They live in or near villages and farmsteads, causing damage to many different types of foodstuffs. The Rice Field Rat, on the other hand, lives in burrow systems in the paddy field dikes, which may be damaged, to the extent of being washed out, by water passing through the burrows. Rice Field Rats can be more easily killed by communal hunts for them over the whole field complex.

Disease Vectors. The principal disease vector that benefits from year-round irrigation is the mosquito, which tends to breed in near-stagnant drains and field edges. Although the incidence of malaria in the Salomekko area is low, some increase in the vectors of malaria may occur with more widespread surface water availablility. With the increase in mosquitoes, one usually sees an increase in mosquito-borne diseases, in this area, malaria and dengue fever.

Aquatic Habitat

Reservoir. As an aquatic habitat, the reservoir will probably possess relatively low productivity. Worldwide experience with deep reservoirs subject to severe drawdown is that such waters do not get a chance to develop the complex food chains and species diversity that characterize stable, shallow lakes. The nearest example of the latter in South Sulawesi is Lake Tempe, which is a highly productive ecosystem. The opposite will be true of the Salomekko 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 nutrients are carried in by the Salomekko 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 tiny pool of the maximum drawdown, where water temperature will be high and dissolved oxygen low.

It may be possible to maintain a small freshwater fishery or aquaculture operation in the reservoir. As mentioned previously the primary productivity of the reservoir will be low and annual environmental fluctuations high. This will limit fish species to only the more hardy varieties. Fish farming may be practical if the fish are held in cages and given supplemental feed.

Canals. The proliferation of aquatic plants in irrigation systems is a widespread problem in Indonesia and elsewhere. The increased use of fertilizers and the presence of water in drains year-round allows plants to survive the dry season, when they would otherwise dry out and die back. The problem is less severe in the larger canals, where water velocities are rather high and nutrient levels low, than in the drains, where flows are sluggish and all sorts of waste nourishes plant life. Pest plants are of several sorts: floating, emergent, and submerged. All three should be expected in project waterways and all block the effective flow of water. Continual maintenance is necessary to eliminate such effects. Some water weeds, such as Hydrilla verticilata and water hyacinth (Eichornia crassipes) can be used as feed for cattle, pigs, ducks, and chickens. The grass carp (Ctenopharyngodom idella) will feed on various types of aquatic weeds and have been used for weed control.

The increase in canal area will almost certainly produce more potential mosquito breeding sites. Mosquitoes can be controlled to some extent by introducing mosquito fish (Aplocheilus panchax) into the drainage canals.

Fisheries. The reservoir, as noted above, is not expected to support a significant fishery. The rivers, which do not have a large fishery at present, are not likely to develop enough dry season flow to support exploitable fish populations.

Concern was expressed in the Scoping Meeting that the project might adversely affect downstream water users, including the aquaculture ponds at the river's mouth. These effects would derive principally from the use by fish pond operators of river water for flooding and salinity control. Ponds could be affected in one or both of two ways: shortage of fresh water due to reduced flows in the river; and, poor quality of available water due to contamination by agricultural chemicals.

Pond farmers are dependent on rainfall and river outflow for fresh water to dilute the seawater in their ponds. However since the farmers do not have pumps or freshwater supply canals they have very little control over the pond salinities. The result is usually too much fresh water in the wet season and not enough in the dry season. The Salomekko River also periodically floods the pond area during the wet season and the farmers loose a portion of their stock. A decrease of freshwater flow to the ponds during the rainy season will actually help fish farmers by increasing salinities and decreasing flooding. Lower river flows in the dry season are not relevant since the fish farmers do not currently farm during that time.

River water quality should also not affect the fish ponds. Fertilizers and pesticides will be amply diluted by wet season river flows. Besides, the fish farmer is currently using a pesticide (Thiodon) for pest eradication which is far more toxic and persistent than what is used in the paddy fields.

Socioeconomic Resources

The primary objective of this project is an increase in the living standard among local farming households 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 purposes of considering these secondary effects, which are generally considered to be environmental due to their not being the main objective of the project, the local population may be considered in several categories (USAID, 1980):

1. **Target Population.** These are members of the group to whom the project's benefits are directed, in this case, farmers and their families who will receive 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 any 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 and 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 construction or maintenance, or misuse by the local population.

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

The presence of irrigation in this area, now farmed for the most part on a rainfed basis only, may lead farmers from other areas, especially those nearby, to attempt to buy into the Salomekko area. This would elevate land values and sharecropping rates for farmers already in the area, but probably 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.

Tenant farmers probably will find that part of the gain acquired through irrigation will be shared with the landowners. Nevertheless, the tenants will see substantial benefit.

Increased agricultural activity in the area is likely to attract and hold some laborers who now visit the area only at harvest time. Such laborers would have to find year-round employment to take up residence in the area. Increased agricultural production and cash flow may also lead some entrepreneurs to relocate permanently in the area.

Achaeology and Cultural History. The project villages have graveyards located on the hillocks throughout the service area and also near the dam site. These graveyards are usually well marked or self-evident, but there are some isolated sites which are less clearly indicated. Careful mapping and planning is required to avoid disturbance to these sites.

Public Health

Vector-borne Diseases. The extension of time when there is standing water in fields and drains will create favorable mosquito breeding sites, particularly if the water scarcely moves through the system. More mosquitoes may result in an increased prevalence of mosquito vector diseases, such as malaria (transmitted by Anopheles and Culex species), and dengue fever (Aedes) and filiarisis (Culex and Mansonia). The disease organism depends on its survival to be transmitted from an infected to uninfected human, by a mosquito, normally within 24 hours.

Control of a vector-borne disease may employ these methods:

- Prophyllaxis (chloroquine, primoquin, or other suppressant) to prevent the disease organism from becoming established in an individual bitten by an infected mosquito.

- Clinical treatment of affected individuals showing the disease, primarily to protect the health of the individual, but partly to prevent the spread of the disease.

- Control of the vector population by:

  - Spraying to kill adult mosquitoes (in domiciles or along roads and in ditches.

  - Poisoning of breeding waters with larvicides, to reduce survival of larva.

  - Introduction of small fish (guppies and mosquito fish) to mosquito breeding pools.

  - Reduction of breeding/rearing areas, i.e., standing surface water.

  - Isolation of uninfected individuals, largely through screening of windows in domiciles.

None of these methods by itself can eliminate a mosquito-borne disease completely, but in combination they may be very effective. Usually, however, altering one part or the epidemiological balance is reflected in changes in other parts, unless extra effort is expended on one of the above control methods. Among the factors that may lead to an increase in the prevalence of the disease are:

- Acquired resistance in the mosquito population to the chemical used for control.

- Acquired resistance in the malarial parasite (plasmodium) to the drug used for prophyllaxis or clinical treatment.

- Changes in the vector population due to the presence of more breeding sites (caused by an increase in standing surface water) or due to improved survival of mosquitoes at existing sites (caused by reductions in predatory fish, for example).

- Introduction of infected persons from other areas, making more malaria organisms available to the mosquito population.

Among these factors, all but the second have been observed at irrigation projects somewhere (not necessarily in Indonesia) and could occur in the Salomekko area. Resistance in the plasmodium to chloroquin is found in some parts of Southeast Asia where prophyllactic campaigns have been vigorous. In general, the improvement in living standard that results from a successful irrigation project is reflected in greated awareness of health problems and more use of available health services. The increased risk of mosquito-borne diseases need not manifest itself in higher incidence of disease if other aspects of regional development move forward along with irrigation.

Concern has been expressed that schistosomiasis (S. japonicum), which now occurs on Sulawesi only in a small area around Lake Lindu and in the Napu Valley, might spread to newly developed irrigation systems, through the migration of farm workers. We have been advised by Dr. John Cross and Dr. M. J. Bangs, both of whom have studied S. japonicum in the Lore Lindu region, that the likelihood of such a spread of the disease is infinitesimal, for the following reasons:

1. Schistosomiasis cannot be transmitted from person to person; it requires an alternate host, in this case the widespread Asian snail Oncomelania hupensis, to complete its life cycle.

2. Despite diligent searching, medical epidemiologists have not found either Oncomelania or schistosomiasis on Sulawesi outside of the Lore Lindu region, except in people known to have visited that area.

3. Schistosomiasis apparently has existed in the Lore Lindu area for at least a century, perhaps much longer, according to specialists who have described the host snail as a distinct subspecies of Oncomelania hupenses. Irrigated agriculture was introduced to the Lindu region about 1910, yet the disease has not broken out to other parts of the island.

4. A possible reason for the failure of the disease to reach other parts of Sulawesi may lie in the ecology of the snail host. In most parts of its range Oncomelania hupensis is found from sea level to about 500 meters of elevation. The Sulawesi race of the species is found only at the higher elevations and evidently prefers cooler temperatures.

We conclude, therefore, that the possibility of schistosomiasis becoming established as a result of the Salomekko. Project is so infinitesimal as to be beneath consideration and requiring neither further study nor monitoring.

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 being limited to pools in the river bed, finding a greater availability of purer water in the canal system. It seems likely that enteric diseases, some skin infections, poliomyelitis, and typhoid will decrease as people utilize the purer water source, assuming, of course, that they continue to boil drinking water.

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Farming Systems

Cropping Patterns. The paddy-oriented Indonesian farmer, when provided with a secure water supply for a second season of cropping, usually responds by adding additional paddy, which he sells. Economic studies in Indonesia have shown, however, that paddy does not always 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 where there are markets (usually urban). The usual pattern when an irrigation system is added or upgraded is for farmers to grow a second crop of paddy initially if enough water is available, but after a few years to shift to crops producing higher income such as palawija. The crop pattern recommended for Salomekko is with transition season palawija and wet season paddy, because this makes best use of stored water and wet season rainfall. There is not sufficient water to support any dry season crops on 1900 ha.

Environmentally, as well as economically, this 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 and lead to excessive applications of toxic chemicals.

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 water buffalo and Bali cattle 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 transition season livestock grazing. This will be partly offset by an increase in field-edge and ditchbank vegetation. The conflicting demands on family labor due to intensification of cropping may make the tending of water buffalo and cattle, 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 buffalo and cattle are 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 new crops, the farmer, acting on the advice of a more sophisticated 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. Local agricultural agents should be alerted to the dangers of transporting, storing, formulating, and applying certain chemicals, so that information will reach the farmers.

Services, Infrastructure and Social Organization

Demand, in general, will increase for services and infrastructure (schools, health clinics, roads, transport, markets and extension services). With this increased demand and diversified population the local social structure will become more complex.

Improved living standards in the target population probably will result in some of the younger farmers remaining in the area who might have grown dissatisfied with the poor farming conditions that now exist. If so, and if, as is usual, they settle near the family homestead (or inherit it), improved social cohesion and community stability will result. This effect, although difficult to express in quantitative terms, could be considered a secondary benefit of the project.

Land Ownership and Tax Collection

Although inheritance of land is expected to remain an important means to land acquisition in the service area, it is anticipated that there will be increasing amounts of sharecropping and rental agreements with intensification.

Initially, there may be cash sales of land. While most land owners in the area will not wish to sell their land, some farmers may face increasing pressure by people from outside the area to sell their land. In order to protect some simple farmers who may not fully appreciate the implications of selling their land--especially when land titles are not under the modern form--it would be advisable if district government declared the Salomekko service area "closed" to outsiders purchasing into the area.

As the value of land in the service area increases, then taxes can be expected to increase. Most agricultural land in the area is still registered and classified under the traditional system, and the area has not yet had a modern cadastral survey based on air photographs. Introduction of technical irrigation should result in increased demand for a more modern system of land tenure in the area, and an upgrading of land taxes commensurate with the true value or the land.

The lack of modern legal title to the land could lead to problems for farmers who wish to take loans to improve their plots using the land as collateral the farmer may feel a particular need for new loans in the period following the construction of the new irrigation scheme (for fertilizer, seed, and hired labor) if they are to realize the benefits of increased production quickly.

Regional Economics

Target Population. Farmers in the Salomekko service area, experiencing increased disposable income, will spend much of it in the local area, on food, clothing, home improvements and their childrens' education. Some of the disposable cash will be spent on agricultural improvements not currently available locally, such as mechanized implements, particularly hand tractors and pesticides sprayers.

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 higher level of educational attainment.

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--some farmers in this category do not have sufficient land for complete subsistence--and the natural products they make or collect, 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.

Regional Development

The Project area lacks an integrated long-term development plan. One potential impact of the SSIMP project could be the development of such a plan. This plan would not be the same as the Management Plan or the Monitoring Plan included in this Environmental Assessment, but such an integrated plan could build on the recommendations found in this report.

Resource Use

Water: Quantity. The lack of water in the Salomekko River is now a source of inconvenience and occasional hardship for the people of the area. Except in the short reach of the river between the dam and the service area which is largely uninhabited, conditions with the project should be no worse, and probably even improved, during much of 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 washing, and the all-important watering of livestock, will shift to the main and secondary canals. This shift, especially the watering of buffalo and cattle, 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 and cattle must be enforced.

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.

Ground Water. The broad application of water to the ground surface, coupled with seepage from the canals, is expected to improve dry season ground water levels, permitting longer use of some wells that currently go dry during the drier months.

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. Given current restrictions on cutting existing timber, it is likely most of the timber would be purchased and brought in from elsewhere.

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 area to emigrate in search of wage labor or better farming conditions.

Alternative Irrigation Technologies

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

Alternative Use of the Land

If the project does not go ahead, it may be that the land will be purchased by the Camming Sugar Cane Estate. If the irrigation project proceeds, it is unlikely that the land will used for sugar cane production.

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. A site farther upstream would require a longer canal and would fail to capture flow from several river tributaries. The siting of the access road may change in coming months, 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 service area selections would be about the same as those of the proposed area.

Reservoir Elevation. The reservoir elevation could have been higher, which would have had the effect of reducing the project rate of return. The proposed dam height was selected on the basis of water availability, there being an optimized elevation beyond which the probability of storing more water is not great enough to justify the more expensive dam. Other than inundating more pasture and brush land, the larger reservoir would not exert

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significant environmental effects. A lower dam height has the added advantage of spilling water more regularly to refresh the lower reaches of the Salomekko.

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.

Cropping Alternatives

The recommended cropping pattern (paddy/no crop/palawija) results from a study of the various alternative combinations of dam height/stored volume, cropping pattern and size of service area. A three crop season (paddy/palawija/palawija) is possible but this would reduce the service area (and the number of beneficiaries) by up to 50 percent. Also the continuous effort required for non-stop cropping is probably too different from the existing agricultural practices. Double crop paddy would reduce the size of the service area by even more. Split season cropping (e.g. 50% palawija/50% paddy) would involve the smallest decrease in service area but the operation of canals and distribution of work would be prone to abuse by the most influential farmers because of the vastly different net water requirements between paddy and palawija in the dry season.

The selected pattern maximizes economic returns while spreading the benefits of irrigation over a large number of farmers who would be farming the familiar pattern of paddy in the wet season, preceded by palawija in the intermittent season.

TABLE V-I
SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS
SALOMEKKO IRRIGATION PROJECT

ENVIRONMENT COMPONENT	DESCRIPTION OF IMPACT	SOURCES OF IMPACT: PRIMARY	SOURCES OF IMPACT: ASSOCIATED	IMPACT LOCATION: CATCH-MENT AREA	IMPACT LOCATION: IRRI-GATION AREA	IMPACT LOCATION: DOWN-STREAM AREA	TIMING OF IMPACT: PRE-CONST.	TIMING OF IMPACT: CONST.	TIMING OF IMPACT: OPER.	EXTENT OF IMPACT: UPON*	EXTENT OF IMPACT: DURATION	EXTENT OF IMPACT: INTENSITY	REMARKS
WATER AND ATMOSPHERIC RESOURCES Water Quantity	Reduced availability in river below dam	Water diverted from river to canal			x			x	x	One hamlet	Long-term	Minor	Water available in wells/canals
	Creation of a reservoir	The Project		x				x	x	Beneficiary farmers	Long-term	Major	Storing and redistributing water are the means to meet project goals
	Flood control	Greater control of water			x	x			x	Downstream fish pond owners/some farmers	Long-term	Moderate to major	Salinity and possible flooding of ponds can be controlled; flooding of low areas reduced
Water Quality	Increased chemical concentration	Agricultural chemicals	Irrigation		x	-			x	Irrigation area and downstream area	Long-term	Minor to severe	Proper use reduces risk of adverse impacts
	Provide good water for domestic and livestock use from canals	Some canals will be close to hamlets			x				x	People near canals	Long-term	Minor to moderate	Water supply from wells already adequate; canal water will be a supplementary source
	Increased nutrient and coliform levels	Livestock and human waste	Sanitation and livestock mgmt.		x	x			x	Surface and ground water	Long-term	Moderate to severe	Possible risk to domestic water supplies
Air Quality	Increased fugitive dust	Construction activity		x	x			x		Construction area	Short-term	Moderate	Mitigation involves contractor dust control (road watering)
	Increased smoke	Burning surplus straw and other crop residues			x	x			x	Project area	Long-term	Moderate	Straw burned when intensive cropping leaves no time for natural decomposition
LAND RESOURCES Erosion	Increased sedimentation of reservoir	Deforestation; over-grazing; grass burning	Quarrying in catchment	x	x				x	The reservoir and entire project	Long-term	Minor to moderate	Area already has catchment management plan that needs enforcing
	Canal bank and field erosion	Lack of water control on steeper slopes	Poor control over livestock		x			x	x	Service area	Long-term	Minor to severe	Steeper sloped field compounds will require good maintenance; good livestock control necessary
Agriculture	Increased production	Multiple cropping and dependable water supply			x				x	Service area	Long-term	Moderate to major	A main purpose of the project
	Less grazing land	Multiple cropping		x	x				x	Entire area	Long-term	Minor to moderate	Loss in area due to second season cropping but service area fodder quality will be improved due to extra residues
	Loss of farm land	Construction of system		x	x			x	x	Irrigation area	Long-term	Minor	Unavoidable. Small percentage of total area
BIOLOGICAL RESOURCES Terrestrial Vegetation and Habitat	Convert 70 ha to a reservoir, 40 ha to canal	The Project		x	x			x	x	A few landowners	Long-term	Minor	Unavoidable. Small percentage of total area
	Increased pest population	Multiple cropping			x	x			x	Irrigation and downstream areas	Long-term	Minor to moderate	Control measures needed
Aquatic Habitat	Proliferation of aquatic weeds in canals and drains	Increased nutrients	Inadequate maintenance		x	x			x	Service area	Long-term	Minor to moderate	Depends on maintenance
	Increased numbers of mosquitoes	Increased breeding area with irrigation			x	x			x	Resident population	Long-term	Minor to moderate	Malaria and dengue fever may increase
SOCIOECONOMIC RESOURCES Land Ownership	Purchase land for dam site, reservoir, canals	Must acquire land for Project	Equitable compensation necessary	x	x		x	x	x	Many landowners	Long-term	Minor	Small amounts of land needed from many landowners
Land Ownership/Resettlement	Move a few houses from dam site/reservoir area	Must acquire land for Project	Equitable compensation necessary	x			x	x	x	A few households	Long-term	Minor	Households can be resettled nearby in same village
Settlement Pattern and Movements	Increased population and immigration	Economic opportunity		x	x	x		x	x	Resident population and migrants	Long-term	Major	Unavoidable
Regional Economics and Development	Improvement and diversification of economy	The Project	Subsequent planned/spontaneous development	x	x	x		x	x	Resident population and migrants	Long-term	Major	A multi-sectoral long-term development plan is needed
Land Ownership and Tax Collection	More leasing and share-cropping; demand for cadastral survey and modern land registration; increased land taxes	Intensification of farming	Improved value of land		x				x	Beneficiary farmers	Long-term	Moderate	Unavoidable. Need to "close" service area to land speculation and purchase by outsiders
Services, Infrastructure, and Social Organization	Increased demand for svcs. and infrastructure	Improved economy	Increased population		x	x			x	Resident population	Long-term	Moderate	Unavoidable
Public health	Increase disease vectors	More mosquitoes with irrigation	Lack of vector prevention	x	x	x			x	Resident population	Long-term	Minor to moderate	Education and control required

CHAPTER VI

EVALUATION OF ENVIRONMENTAL IMPACTS

Methodology to Identify the Most Significant Impacts

This chapter summarizes the probable major positive and negative effects of this 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 effects will occur during the operational phase of the project.

The methodology employed to identify the most likely significant impacts is as described in Chapter V. The evaluation of these impacts is likewise based on the following considerations:

- o Experience, in retrospect, with similar projects, worldwide;
- o Local knowledge of problems with similar projects in Indonesia;
- o Detailed knowledge of local conditions and the design of the project, as it fits, or meets those local conditions;
- o A best-guess assessment of how the most significant components of the environment and the project are likely to interact, given several scenarios.

If serious negative impacts had been identified during this evaluation, then a more thorough environmental impact study would have been recommended for this project and more detailed site-specific studies conducted.

Pre-construction

The irrigation and drainage canals will take approximately 40 ha of predominantly agricultural land, or 0.02 percent of the total service area. This will be for primary and secondary canals and roads for which some type of compensation will have to be given to the owners. As for other land affected--such as for the tertiary and quaternary systems and drainage--the villagers are expected to donate needed land at their own expense. Negotiations for the land must be conducted in a fair and expedient manner, otherwise the project could be delayed and ill-feeling will be generated among the project area population.

During this period, the service area should be closed to outsiders who may wish to purchase land in anticipation of its future increase value. Farmers who own farm land within the area should make sure their titles to land are clearcut.

Construction

There will be some disruption of agricultural activities along the canal routes as construction proceeds. The local population will also have to temporarily cope with some dust, noise and congestion. The contractor must provide his laborers with those commodities that are scarce locally, such as housing, water, and firewood. The local population may realize some economic benefits from the sale of service and commodities.

Water Resources

Downstream Flow. A major environmental aspect of the project is that the dam will store almost all water from the catchment area with spilling to the Salomekko River below it only during the wet season. For part of the year flows into the river will be limited to rainfall runoff, irrigation drainage and flow from tributaries. These sources, however, are significant, and only the first 4 km below the dam should go nearly dry during the dry part of the year. One hamlet of approximately 40 households in Biccoing Village (the hamlet, Kampung Dilau Panreng) indicated some use of this section of the river for livestock watering and to a lesser extent domestic water. This hamlet also has wells, most of which operate in all but extreme dry years, as well as access to the Baruttung River. The irrigation scheme includes a secondary supply canal which will pass through much the same area as the dry portion of the Salomekko River. Water of higher quality than the river will be available from this canal for bathing and livestock except during the driest months when there will be no canal flow. Most of the houses within the service area depend on the Baruttung and lower tributaries of the Salomekko River, which will not be significantly affected by the project.

The fish pond farmers near the mouth of the Salomekko River depend on rain water to dilute the seawater in their ponds. However during the wet season there tends to be too much fresh water so that pond salinities are low, and some areas even flood. The project should be beneficial to production by decreasing the loss of stock due to flooding. Lower freshwater flows during the dry season will not affect current fish farming since the ponds are not stocked during this time.

It is impossible, given the limited scope of this study, to assess the effects of altered freshwater flows into the coastal waters. The influence of these flows on the environment and biota of the coastal regions is complex and not completely understood. It is recognized however, that river outflows have a large impact on the nutrient and sediment deposition in the estuary. Changes in these factors can in turn influence river and coastal ecology, fisheries and navigation.

Water Quality. Return irrigation flows will undoubtedly contain higher levels of nutrients from fertilizer runoff. Water quality in the Salomekko and Baruttung may be somewhat poorer than at present, especially during the dry season. However, the extent of degradation is not normally expected to be great enough to cause problems for downstream users. For those who have access to a supply canal, the water will be of better quality than the rivers, except during the driest months when there will be no canal flow. At these times, well water must be used.

Land Resources

Land Acquisition and Resettlement. The creation of a 92 ha reservoir has the potential for positive impacts over the long term. The reservoir itself can be viewed as a water resource not only for irrigation but for recreation, fisheries and domestic water supply. Necessarily, some paddy fields, tree crops, gardens, pasture and woodland will be lost. In addition, a few houses will have to be moved to make way for the reservoir, dam site, and construction work area. In addition, perhaps another 40 ha of agricultural land will be taken for canals and roads.

Livestock Grazing and Fodder. With the introduction of a more intensive cropping system less land will be available for cattle and buffalo grazing. The result may be overcrowding of the present land or increased pressure on upland pastures, unless farmers convert to more intensive fodder collecting techniques and cattle management. Unless they do, cattle will continue to contribute to erosion. Farmers are already purchasing tractors, and this trend may be hastened if they have difficulties grazing their animals. The canals will be used for bathing and watering livestock with a resultant erosion of the banks unless the proper structures are constructed.

Agriculture. Some agricultural land will be lost to the construction of the supply and drainage canal system, for which the farmers will expect compensation for land lost to the major canals and structures. The project is expected to have significant impacts on the farming system, including higher agricultural yields of paddy and palawija crops, increased mechanization, and more frequent applications of agricultural chemicals.

Biological Resources

Pests. There is the risk that crop pests, aquatic weeds, and mosquitoes will all increase due to more abundant water and crops. Monitoring and control programs can offset these risks.

Fisheries. The reservoir's surface area and volume will fluctuate considerably from wet season to dry season and from year to year in response to rainfall and irrigation demand. In some years the reservoir will drop to 14 percent of its maximum operating volume and 40 percent of its maximum operating area. This is likely to limit, or essentially wipe out any fishery development in the reservoir, unless the.e is regular restocking.

Socioeconomic Resources

Increased agricultural production will lead to increased income and improved living standards. This directly affects the target population, and provides secondary benefits to the at-risk and migrant populations.

Settlement Patterns and Movements. The demand for additional labor can be expected to lead to an increase in the population. Some people who temporarily enter the area will decide to permanently settle there. Increased agricultural activity is likely to hold some farmers who might otherwise be expected to move away.

Archaeology and Cultural History. Several graveyards are located in the area of the canal network in the irrigation service area and near the dam site. Because of the widespread nature of the construction activity there is a risk of disturbance to these sites.

Public Health: Vector-Borne Diseases. The project will probably bring with it an increased risk of mosquito-borne diseases, particularly malaria and dengue fever.

Services, Infrastructure and Social Organization. Improved living standards and more economic opportunity in the area will probably lead to increased trade and demand for services. There should also be an increased demand for more infrastructure (schools, health clinics, roads, transport, and markets).

Land Ownership. The project will result in increased land values. With it will come the demand for a complete cadastral survey and modern land registration. Also, the possession of modern legal titles may make loans for farmers easier to negotiate. The land should be closed to outsiders purchasing land in the area.

Farm Support Organizations. Farmers will be organized into water users' associations. Agricultural extension services will be stepped up, and it is expected there will be increased activities of farmer cooperatives.

Resource Use. Increased prosperity will lead to new house construction and housing repairs, with consequent increased demand for sawn lumber obtained from commercial outlets with sources outside the basin, or from the upstream forests. Domestic fuel use will increase, and at least at first, the demand for fuel wood will increase.

Regional Economics and Development. The project will make a direct, positive impact on the target population, but will also create new opportunities for other types of development. There should be a multi-sectoral development plan for the area.

CHAPTER VII

CONCLUSIONS

The Salomekko Project is a dam scheme to supply irrigation water to 1,900 ha. Almost all of the proposed service area is already planted in paddy and palawija crops for one or two seasons.

The Salomekko dam will create a reservoir occupying 92 ha at its maximum storage capacity. Irrigation water will be released from the reservoir to the canal system, then be distributed to the irrigated fields, and the excess will flow back into the river. The effect of this diversion will be to alter the Salomekko River streamflow regime with the result that the upper portions of the river just below the dam will receive little or no water for most of the year. People who depend on this section of the river for water should have sufficient alternative sources, including wells, irrigation supply canals, springs, and other rivers for most of the year. There are enough contributions from below-dam tributaries and irrigation return flows so that downstream users should not be adversely affected.

Other significant impacts of the project include some resettlement and compensation, decreased dry season grazing areas for livestock, some loss of agriculture land for supply and drainage canals, increased risk of crop pests and mosquitoes, and improved economic conditions for the local population. As discussed in the previous chapter, and in the following Management Plan, the negative impacts are not serious and in most cases can be mitigated.

Based on these studies, the conclusion of this Environmental Assessment is that the Salomekko Irrigation Project has no major detrimental impacts which call into question the viability of this project. The project will result in spatial and temporal changes in water distribution which will have limited environmental effects on the local population. The project is therefore environmentally feasible, and the mitigation of any potentially negative impacts has been adequately addressed in the Management Plan.

APPENDIX A

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APPENDIX C

RECORD OF SSIMP ENVIRONMENTAL SCOPING SESSION

HELD IN UJUNG PANDANG, 14 APRIL 1988

Note: This record was prepared by USAID/Harza shortly after the April 1988 scoping session. Some rearrangements of responses to questions have been done, in order to bring similar topics together. In addition, Harza editors in Ujung Pandang have added a few comments on some of the statements made by the meeting participants.

Introduction

Environmental procedures of the Agency for International Development specify that a meeting of knowledgeable individuals is to be held early in the environmental analysis process, in order to draw upon insights not available to the project environmental staff. Such a meeting, attended by representatives of government agencies, citizen groups and others with local knowledge, may render the environmental staff vital assistance in developing an appropriate study plan. Moreover, the advance familiarity with the project gained at the Scoping Session facilities prompt review of the environmental report when the meeting participants receive it.

The Environmental Scoping Session for the Awo and Salomekko Projects was held at the BAPPEDA offices in Ujung Pandang, South Sulawesi, on 14 April 1988.

The meeting was called to order by Drs. K. Salemo at 08:15 and adjourned at 15:00. An agenda was distributed. Attendance was taken (Appendix D), but a stenographic record was not made. Several participants took notes, however, and this record results from a pooling of notes by Messrs. Ames and Gunawan. The meeting was conducted largely in Indonesian.

Record of the Meeting

After a welcoming statement by BAPPEDA representative Drs. K. Salemo, participants were provided a general description of the projects by Ir. H.A. Yantahin, PU/Ujung Pandang. He indicated the location of each project, the area served and the major project features.

Gk

Dr. Peter Ames, Harza Engineering Company, then summarized the objective of the Scoping Session: to elicit from the participants their concern about the potential environmental impacts of these projects. His remarks were translated into Indonesian by John Deuwel (USAID/Jakarta).

Mr. M. Amron (PU/Jakarta) outlined the environmental requirements and procedures of the Government of Indonesia (the AMDAL process), after which Mr. Gunawan Widjaya (USAID/Jakarta) described the roles of various organizations in the preparation of the environmental analysis for these projects.

Ms. Isna Marifa (USAID/Jakarta) explained the four-step process required by USAID and Mr. Ron Greenberg (USAID/Jakarta) explained the role of environmental analysis and review in the project development process.

Mr. Suwarno (PU/Ujung Pandang) described the local agricultural problems that the Awo and Salomekko Projects are expected to solve. He provided further design details about the projects features and some general information about their surroundings.

The next speaker was Mr. D. Noertemtomo (Dit. BPP/Jakarta) who placed the two projects under discussion in the framework of the five SSIMP projects planned for South Sulawesi. With the help of Mr. Amron and others, he laid out on the whiteboard a matrix of impact types versus location, to be used as a record of the scoping discussion (Table C-1 and C-2 of this Appendix).

Discussion of potential environmental effects was divided among four resource categories: water, land, biological, and human resources. For each, Dr. Ames presented a brief summary of the relationship of that resource to typical irrigation development projects. The discussion that followed each summary provided entries for the matrix. If a resource was considered likely to interact with the project being considered, a check was put in one or more columns, depending on whether the effect was expected to be positive or negative, and located upstream (above the dam or weir), in the middle basin (the project service area), or downstream (below the service area). Each check was supplemented with initials to indicate whether the effect was induced by the project upon its environment (PE) or by the environment upon the project (EP).

In general, Dr. Ames noted, the environmental impact assessment is concerned with the effects of the project upon its environment, rather than the reverse. But potential effects of environmental changes upon the projects should be identified, for two reasons: (1) certain conditions of the environment (e.g., changes in sediment load brought about by land clearing) must be taken into consideration by project planners; and, (2) compensatory changes in the project may induce secondary effects on other parts of the environment.

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Summary of Areas of Concern

Awo Project

Water Resources. The consensus of the participants was that service area flooding and dry season water availability will be improved by the project (the latter being the primary project benefit), but there is a potential for negative effects on water used in some parts of the service area. Tendencies toward waterlogging and operational losses are expected to be improved in the service area. On the negative side, there is a potential for degradation of water quality in the service area and downstream, due to fertilizers and pesticides in the irrigation return flows.

Land Resources. The project is expected to exert a beneficial effect on the productivity of soils in the service area and downstream; this is the primary objective of the project. Similarly, the effects of sedimentation on middle and downstream areas are expected to be improved. Concern was shown, however, for the impact of land clearing in the upper basin on the project, although Mr. Schoeller noted that the project weir design will permit flushing accumulated sediment from the pool and the canal headworks will take largely sediment-free water.

Biological Resources. The general view was that too little is known of the ecology of the basin to begin predicting areas of impact. It is clear, however, that forest clearing in the upper basin is a major ecological problem that could be affected, positively or negatively, by the project. The potential for outbreaks of crop pests (both insects and vertebrates) exists with the intensification of cropping in the service area. The presence of biota of special interest and the potential for project effects should be investigated. The use of project return flows in fish ponds was considered to have both adverse implications (pesticides) and benefits (fertilizers).

Socioeconomic Resources. Discussion of these topics was led by John Duewel. Within the service area, the project is expected to exert a beneficial effect on settlement patterns, but the potential was recognized for upstream settlements to have adverse effects on the project. In general, the project will be beneficial for social organization, standards of living, and farming systems; these are natural secondary objectives of agricultural improvement. The existing community participation system is expected to benefit the project. The question of project-induced changes in land ownership patterns deserves attention; there appears to be potential for both beneficial and adverse effects. Attention also should be paid to the distribution of water-related diseases, as it may be altered by changes in the availability and quality of water.

Salomekko Project

Water Resources. The project is intended to provide increased water to its service area but this carries the potential for deprivation of water for middle basin users. Mr.Schoeller noted, however, that the release of sufficient water for downstream users would be required of the project and that dry season flows may be improved. Some control of flooding is expected as the project stores high flows. If, in fact, flows are reduced in certain river reaches, this could lower the capacity of the river to assimilate human and animal wastes, thus degrading water qualities. The increase in use of fertilizers and pesticides in the project service area could result in degradation of water quality downstream of the return flows.

Land Resources. The project is expected to have a beneficial effect on soil productivity in the service area (part of the project objectives). A potential also exists for misuse of water resulting in waterlogging of soils, but standard farm management practices are expected to accompany the project, to minimize this possibility.

Overgrazing and continued land clearing in the watershed have increased the extent of erosion and continuation of this situation is expected to result in further increases in sediment load. Concern was shown among participants, but the project planners noted that the dam and reservoir are sized to allow for sedimentation. The project was considered to have potential for both positive on negative effects and land clearing.

Biological Resources. Creation of the reservoir will result in inundating some forest and some pasture land. Concern was expressed that the breakdown of flooded plant matter could cause aquatic weed problems downstream and in the reservoir. Dr. Ames expressed the opinion that the amount and type of vegetation in the area of inundation are such that water quality would not be seriously affected by failure to clear the reservoir area. He noted, however, that there might be salvageable fuelwood resources in the area.

Concern was expressed that intensification of cropping may produce increases in insect and vertebrate pests, as has happened elsewhere.

Socioeconomic Resources. There is a potential for increases in the prevalence of water-related diseases due to increases in standing surface water and to degradation of water quality through reduced stream flows.

Participants expressed the view that the project is likely to exert a positive influence on settlement patterns, farming systems, and living standards; this would be the natural outcome of improved agricultural production.

It was noted that a small burial ground is located on top of one of the hills near the dam alignment. Protection of the graves from accidental destruction by project equipment may require special attention.

Summary of Expressed Concerns

Awo Project

The primary concerns about environmental impacts of this project centered around the availability of the water for downstream residents not direct beneficiaries of the project, the interaction of project development with land clearing activities that are rapidly denuding the upper basin, and the potential for adverse health effects downstream. The ecological characteristics of the region are too poorly known to permit identification of potential effects at this time, but general areas of concern were noted: habitat loss, species of special interest, and increases in pest populations.

Salomekko Project

The relatively small flow of the Salomekko River produced concern for availability of water for downstream users and the quality of that water. Secondary effects on public health also are possible. Land use changes in the basin, although of less concern than in the Awo Project, are also an area of interest, especially regarding the direct effects of reservoir inundation.

Table C-1

Matrix of Potential Environmental Impacts, Awo Project

	Positive Impact			Negative Impact		
	Upstr.	Mid	Dwnstr	Upstr	Mid	Dwnstr
<u>Water Resources</u>						
Flooding		PE			PE	
Water Use		PE			PE	
Drainage		PE				
O & M Losses		PE	PE			
Water Quality					PE	PE
<u>Land Resources</u>						
Soil/Land Capability		PE	PE			
Salinity						
Waterlogging			PE			
Erosion				EP	EP	
Sedimentation, reservoir					EP	
Sedimentation, service area		PE	PE		EP	
Construction		PE	PE		PE	
<u>Biological Resources</u>						
Forest	PE			PE/EP		
Pasture						
Fisheries			PE			
Aquatic Biota		?	?		?	?
Plant/Animal Pests					PE	
<u>Socioeconomic Resources</u>						
Water-related Diseases						PE
Pesticide Problems					PE	PE
Settlement Patterns	PE/EP	PE		PE/EP		
Social Organization	EP	EP				
Land Ownership		PE/EP			PE/EP	
Farming System		PE				
Community participation		EP				
Archaeological/Historical						

PE = Project effects on environment
EP = Environmental effects on project

Table C-2

Matrix of Potential Environmental Impacts, Salomekko Project

	Positive Impact			Negative Impact		
	Upstr	Mid	Dwnstr	Upstr	Mid	Dwnstr
<u>Water Resources</u>						
Flooding		PE		PE		
Water Use	PE	PE			PE	EP
Drainage		?			?	
O & M Losses		PE	PE			
Water Quality					PE	PE
<u>Land Resources</u>						
Soil/Land Capability		PE				
Salinity						
Waterlogging					PE	EP
Erosion				EP	EP	
Sedimentation, reservoir					EP	
Sedimentation, service area		PE	PE		EP	
Construction		PE	PE		PE	
<u>Biological Resources</u>						
Forest				PE		
Pasture				PE		
Fisheries		PE	PE			
Aquatic Biota						
Plant/Animal Pests					PE	
<u>Socioeconomic Resources</u>						
Water-related Diseases					PE	PE
Pesticide Problems						PE
Settlement Patterns		PE		PE		
Social Organization		EP				
Land Ownership		PE/EP			PE/EP	
Farming System		PE				
Community participation		EP				
Archaeological/Historical				PE		

PE = Project effects on environment
EP = Environmental effects on project

APPENDIX D

LIST OF SSIMP ENVIRONMENTAL SCOPING SESSION PARTICIPANTS

Ujung Pandang, 14 April 1988

Name	Profession/Position	Organization
Sulsel Province		
Ainuddin Samad	KaKanwil	PU Sulsel
H. Abd. Yantahin	Kasubdin Air	PU Sulsel
M. Said Fattah	KaSie Penyuluhan	PU Sulsel
Suwarno HP	Pelaksana SSIMP	PU/SSIMP
Abd. Wahab	Ka. Tata Usaha	PU/SSIMP
M. Rum Ashar	Staf Sie Pengairan	BAPPEDA
Shahibu Muhsin	Staf	Biro BKLH Office of Governor
Syahrir M.	Kasie Sumber Daya	BAPPEDA
Sofyan Muhammad	Ka.Sub.Dinas	Health Services
Abd. Rasyd D.	Kasub. Dinas	Food Crop Services
Herak Saung	T.G.A	Food Crop Services
K.Salemo	Kabid. Pispra/IV	BAPPEDA
Natalia D.	Staf	Forestry Services
Muslimin Mustafa	Director	Environmental Center (PSL), Hasanuddin University.
Marthen L. Lande	Staf	ditto
Totok Prawitosari	Staf	ditto
Jacob Ampang	Kabid Program	Agricultural Services
Abd. Rahim Azis	Seksi Data	ditto
Jakarta		
Supriyono	Staff SubDit	PU/Irrigation I
Noertamtomo D.	Staf	PU Bina Program/ Pengairan
Isna Marifa	Program Specialist-Environment	USAID
Gunawan Widjaya	ARD/WRAP	USAID
John Duewel	PSC	Bina Program/SSIMP
Ron Greenberg	Mission Environmental Office	USAID
M. Amron	Lintas Sektoral	PU Bina Program/ Pengairan

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Harza

Peter L. Ames	Environmental Specialist	Harza/Chicago
Herb E. Schoeller	Team Leader	Harza/ Sulsel

District

Abdul Rahimsah	Chief	PU Pengairan, Wilayah II
Mardjo	Chief	PU Pengairan, Ranting Wajo
Mahmud Masri	Kabid Fespra	BAPPEDA, Wajo
Bustamin Betta	Kabid	BAPPEDA, Wajo

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APPENDIX E

LIST OF PERSONS CONTACTED

* Dr. Robert G. Morrison, Environmental Management Development in Indonesia (EMDI), Canadian International Development Agency (CIDA), Jakarta.
* Dr. George Green, Environmental Management Development in Indonesia, Canadian International Development Agency, Jakarta.
* Mr. Nabiel Makerim, Deputy Assistant Minister, Ministry of Population and Environment, Jakarta.
* Mr. Gempur Adiyan, Staff Deputy Assistant Minister, Ministry of Population and Environment, Jakarta.
* Mr. Henri Reichart, World Wildlife Fund, Jakarta.
* Ir. Mardjono Notodihardjo, Department of Public Works, Jakarta.

APPENDIX F

GLOSSARY AND ACRONYMS

AMDAL-Analisa Mengenai Dampak Lingkungan	Environmental Impact Assessment
ANDAL-Analisa Dampak Lingkungan	Environmental Impact Study
AU	Animal Unit Used in Livestock Number Calculations
BAPPEDA-Badan Perencana-an Pembangunan Daerah	Regional Development Planning Board, under the Department of Home Affairs
BIMAS-Bimbingan Massal Swasembada Bahan Makanan	Mass Guidance for self-sufficiency in foodstuffs, a farm input-credit package program
BRI	Bank Rakyat Indonesia
BPP-Balai Penyuluhan Pertanian	Agricultural Extension Services
BULOG-Badan Urusan Logistik	National Food Logistics Body
Bupati	Head of a District (Kabupaten)
Camat	Sub-District Head
DOLOG/SUB DOLOG-Depot Logistik	Provincial Food Logistics Body
Dusun	A Village Administrative Sub-Area
EA	Environmental Assessment
GOI	Government of Indonesia
HHS	Household Survey
IPEDA-Iuran Pembangunan Daerah	Former Name for National Land Tax
Kabupaten	District

Kecamatan	Administrative Sub-district
Kepala Desa	Head of a village
KUD-Koperasi Unit Desa	A village cooperative
KUPPEDES-Kredit Umum Pedesaan	A village credit cooperative unit
KUT-Koperasi Usaha Tani	A Farmer Cooperative
LP3ES-Lembaga Penelitian Pendidikan dan Penerangan Ekonomi dan Sosial	Indonesian non-governmental organization with expertise in organizing water users' associations
MENKLH-Menteri Kependudukan dan Lingkungan	Ministry of Population and Environment
O & M	Operation and Maintenance
PBB-Pajak Bumi dan Bangunan	National Land Tax
PSL-UNHAS	Environmental Studies Centre UNHAS
Palawija	Non-Rice Food Crops, Secondary Crop, Such as Maize, Cassava, Soybeans, Mungbeans
PELITA IV	Indonesia's Fourth Five-Year Development Plan (1984-89)
PEMDA-Pemerintah Daerah	Regional Government (District, Sub-District)
P3A-Perkumpulan Petani Pemakai Air	Water Users' Association
P3SA (PPPSA)-Perencanaan Pengembangan Sumber Air	Planning Section of the Water Resources Directorate of Public Works
PU-Pekerjaan Umum	Public Works Department
RKL-Rencana Kelestarian Lingkungan	Environmental Management Plan
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 as a hamlet
Sawah	Wet paddy bunded field
SSIMP	Small-Scale Irrigation Management Project
Tingkat I-TK I	First level of government administration (usually Provincial)
Tingkat II-TK II	Second level of government administration (usually district or city level)
USAID	United States Agency for International Development
UNHAS	University of Hasanuddin, Ujung Pandang
WUA	Water User Associations (P3A)

Appendix G

BUPATI KEPALA DAERAH TINGKAT II
BONE

Watampone, 12 Desember 1990.

Nomor : 521.52/2826/Pengairan
Lampiran : -
Perihal : Pertanaman Tebu.

Kepada Yth.:

Kepala Kantor Wilayah Departemen Pekerjaan Umum Propinsi Sulawesi Selatan

di -

Ujung Pandang.

Dengan hormat,

Sebagaimana telah dibahas dalam Rapat Koordinasi antara Pemerintah Daerah, Pabrik Gula Camming, Bappeda Tingkat II, Cabang Dinas Pengairan, Direktorat Agraria, Camat Libureng, Camat Kahu, Camat Tonra, dan beberapa Kepala Desa seperti Desa Biccoing Kecamatan Tonra, Desa Ulubalang Kecamatan Salomekko Desa Palakka dan Sanrego Kecamatan Kahu Desa Swadaya dan Desa Bune Kecamatan Libureng, yang dilaksanakan pada tanggal 11 Mei 1989, tentang lokasi perluasan pertanaman tebu pada rencana areal lokasi pembangunan jaringan irigasi Salomekko dan Ponre-Ponre, dimana pihak Pabrik Gula Camming telah menjelaskan bahwa lokasi perluasan tanaman tebu dilakukan hanya pada Daerah yang ketinggian dan luasnya hanya ± 200 Ha, di Desa Bune praktis tidak akan mengurangi luas areal rencana Proyek pembangunan irigasi Ponre-Ponre bantuan USAID, demikian pula pada Desa Biccoing, Ulubalang, Manera, Gareccing untuk Irigasi Salomekko.

Terlaksananya pembatasan pengembangan/ perluasan tanaman tebu dalam rapat tersebut disepakati, disebabkan adanya pertimbangan bahwa masyarakat pemilik lahan memang sangat mendambakan lahan / sawahnya yang sudah sekian terlantar tidak dimanfaatkan secara optimal karena ketiadaan air.

Untuk itu dengan ini kami dari pihak Pemerintah Daerah berkesimpulan bahwa perluasan areal pertanaman tebu pada lokasi rencana areal irigasi Ponre - Ponre dan Salomekko pada prinsipnya tidak akan ada lagi dan akan menjadi perhatian kami selanjutnya.

Demikianlah penyampaian kami dengan harapan rencana pembangunan jaringan irigasi tersebut dapat terlaksana dengan aman, tertib dan lancar.

Atas perhatian kami ucap banyak terima kasih.-

BUPATI KEPALA DAERAH

ANDI SJAMSOEL ALAM.-

TEMBUSAN : Kepada Yth.

1. Pemimpin Proyek SSIMP — di Ujung Pandang,
2. Kepala Kantor Pembantu Sub Dinas Pengairan Wilayah II — di Watampone,
3. Kepala Cabang Dinas Pengairan Bone — di Watampone,
4. Pertinggal.-

Small-Scale Irrigation Management Project (SSIMP)

FINAL REPORT
SALOMEKKO IRRIGATION PROJECT
ENVIRONMENTAL ASSESSMENT

VOLUME II

EXECUTIVE SUMMARY
ENVIRONMENTAL MANAGEMENT
AND MONITORING PLANS

December 1990

Prepared by

HARZA ENGINEERING COMPANY

in association with

Development Alternatives, Inc.

Environmental Studies Center
Hasanuddin University

Global Exchange, Inc.

PT. Wiratman & Ass.

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VOLUME II

PART I

EXECUTIVE SUMMARY

Introduction

The Salomekko Project includes a storage dam and irrigation canal system to supply reliable irrigation water to 1,900 hectares (ha) of land in Bone District (Kabupaten) of South Sulawesi Province. The Salomekko dam will create a reservoir occupying 92 ha at its maximum storage capacity. Irrigation water will be released from the reservoir to the canal system, then will be distributed to the irrigated fields, and any excess water will drain back into the rivers.

Experts from Indonesia and the United States have reviewed the project plans and concluded that it will accomplish its primary objectives, but that some 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.

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. When harmful effects are identified, a plan is provided to mitigate and manage them.

Scope of the Report

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

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.

Description of the Proposed Project

Location

The project area is located near the southeast coast of South Sulawesi Province, between the towns of Sinjai and Watampone (see Figure ES-1, Project Location Map). It is about 100 km east of Ujung Pandang and can be reached by several good provincial roads. The project dam is located on the Salomekko River, about 4 km from the main, paved north-south coastal road. Most of the 1900 ha service area lies on the west side of the main road, the main exception being 250 ha on the lower reaches of the adjacent Baruttung River.

Limits of the Study Area

The study area for this environmental assessment consists of the catchment areas of the Salomekko and Baruttung river basins, extending from the headwaters above the dam site through the downstream service area to the coastal area located below. As this project is located within four villages in the subdistricts of Tonra and Salomekko, the study area includes the entire land area and population of these four villages. All borrow areas are located near the dam site; there are no areas located outside the river basin that are directly affected by the project.

Project Life

The project economic evaluation is based on a sixty-year life span, but with effective maintenance and periodic replacement of mechanical equipment such as gates, an indefinite project lifetime is not unreasonable.

Project Components

Irrigation Structures: Water Storage. The priciple structure of the project will be a dam on the Salomekko River approximately 8 river kilometers upstream of the main road crossing. The dam will be an earthfill structure 28.0 m high (above the bed of the river) with a crest elevation of 80.0 m and a main crest length of 350 m. There are small saddle dams to the left and right, and an overflow spillway will be located in the area of the left saddle dam.

The reservoir thus formed will have a surface area of 92 ha at its normal maximum water surface elevation of 76.0 m. It will have a live storage capacity of 7.8 million cubic meters (MCM), with dead storage, below the drawn-down elevation of 63.4 m, of 0.66 MCM.

Conveyance System. Water will be released through an outlet into the system of primary and secondary canals for distribution by gravity to the service area. The canals will generally be unlined, trapezoidal sections varying in size from 5 m wide to 1.5 m wide, with a maximum depth of 1.5 m.

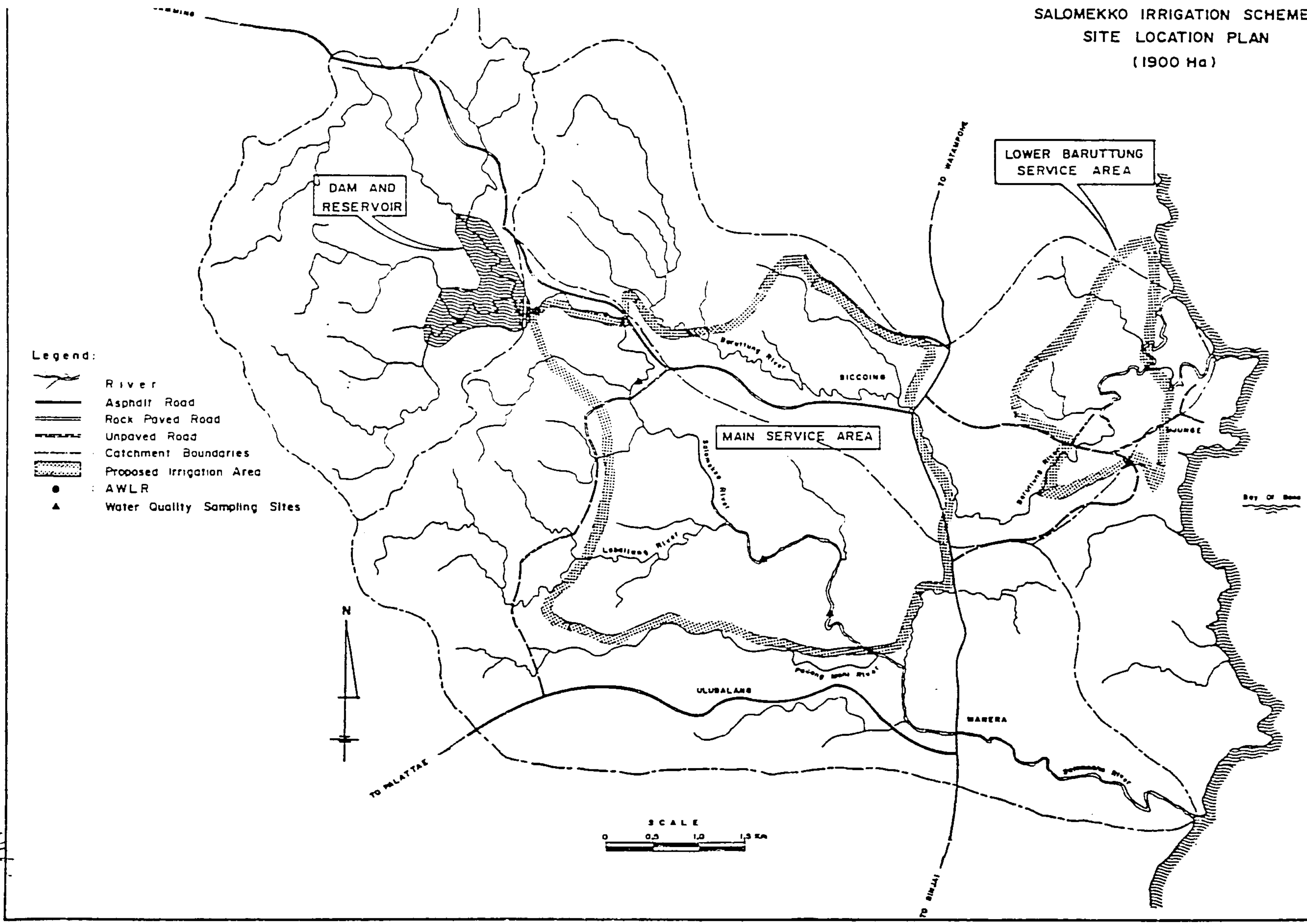

Fig. ES-1
SITE LOCATION PLAN

Delivery System. The water will be diverted from the secondary canals directly into tertiary canals, from which quaternary canals will deliver it to the fields. The tertiaries will be about 1 m wide and the quaternaries approximately 0.6 m. They will probably be unlined.

Drainage System. A system of drains will be provided. They will follow natural drainage patterns and serve primarily to remove excess rainwater during the wet season when the precipitation frequently exceeds crop needs. Water drained from fields will be discharged into tributary rivers and directly into the Salomekko.

Support Facilities: **Roads and Bridges.** An existing road near the dam site is adequate for project access purposes but some repairs and maintenance will be necessary. It passes within about 500 m of the dam site. Short new spurs will be required to the site, borrow areas, and the workers' camps. Roads for access to the outlet works and main canals will be required, but routing is not yet complete. These roads will provide access for the construction contractors and some will provide permanently improved access to the project area in support of increased agricultural production. Several new bridges and culverts will be included in the project to ensure good access to farmland when the canals are built.

Buildings. Project offices and housing for the project operating staff will be built in the area.

Construction Period Conditions. Construction of the Salomekko Project will be accomplished by two separate contractors under the general supervision of PU. The work is expected to be completed over a period of about two years.

Equipment Use. All equipment used in the construction of the project, will be provided by the construction contractors and retained by them on completion of the construction. Mechanical items, such as gates and hoists, will be purchased from suppliers within Indonesia.

Resource Use: Materials. The primary materials required by this project are rock, clay, cement, stone, sand, and some lumber and plywood for forms and miscellaneous construction. Rock will be quarried from within the reservoir area. Clay will be transported from borrow areas near the dam. Excavation and fill materials will be obtained from, and used in localized areas along, the canal alignments. Sand, gravel, and stone will be obtained in borrow areas in and along the Salomekko River. Cement, lumber and plywood will be purchased by contractors on the open market at the nearest possible source (probably Sinjai, Watampone or Ujung Pandang), depending on the economics of price and transportation.

Energy. A part of the energy required for construction will be electrical, provided by generators on site. Petroleum-based fuels (gasoline and diesel) will be used for powering vehicles and heavy equipment.

Transportation and Storage. Small stockpiles of materials will be maintained near the dam site and other major construction sites, in quantities sufficient for meeting the construction schedule. Materials excavated from the canal will be stockpiled nearby for subsequent use on roads or where fill is needed.

Waste Disposal. All waste generated by the construction process will be removed from the site, except human waste. Sanitary facilities at the workers' camp will consist of pit latrines. These will be moved periodically and the abandoned pits filled in. Solid waste from the camp will be buried in the vicinity.

Work Force: Characteristics. The work force for the overall project is expected to comprise about 400 persons at its peak. About 250 will be laborers; 100 will be drivers, masons, carpenters and other semi-skilled workers; and the rest skilled workers (such as mechanics, and equipment operators), foremen, and management. Each contractor will hire his own crews. Due to the dispersed work areas, crews will probably be working concurrently on different structures and different sections of canal or road. The work force will include male and female members.

Source. Laborers and many of the semi-skilled workers are expected to be drawn from the immediate local area. Additional semi-skilled labor, skilled labor, and management personnel will probably move to the area from other areas in South Sulawesi and from construction company offices elsewhere in Indonesia.

Residential Area and Living Support. It is usual in Indonesia for work crews to live at home if recruited locally or to live in temporary shelters adjacent to the work area if they come from a significant distance. Several camps are likely to be established by the various contractors because of the dispersed locations of construction areas. The contractor will either provide rice and fish to the workers as part of their pay or make arrangements with local entrepreneurs to bring those and other commodities to the camps for sale to the workers. Fuel wood will either be provided by the contractor, or some local entrepreneur will sell fuel wood to the laborers. Some permanent buildings of brick, timber, and concrete will be constructed. These will include offices, workshops, and residences for the PU management-level and permanent operating personnel.

Training Program. No training program is planned for the construction work force.

Operation Period Conditions

Division of Responsibilities. Established GOI policy provides that PU assume responsibility for operation and maintenance of dams and headworks structures, primary and secondary canals, tertiary offtakes, and the first 50 m of each tertiary canal. Water users' associations (WUA's) and their members are responsible for operation and maintenance of tertiary canals, quaternary boxes, and quaternary canals.

Method of Operation. The project is designed to provide water from the Salomekko River, through primary and secondary canals, to meet the crop water demands determined for each tertiary block. Water delivery at the tertiary offtakes is normally continuous over a period of time. To limit peak demands of the tertiary offtakes, delivery to blocks within each tertiary unit will probably be rotated on a schedule determined by the WUA. Diversions are typically adjusted every two weeks for projects in SulSel, but shorter time periods may be adopted for the Salomekko project to improve water use efficiency during drier months.

Resource Use. The main project impact on resources will be the redistribution of water in the area, which is the purpose of the project. There will be little energy used in operation of the manually controlled system. Some fuel will be needed for operation of project vehicles. Small quantities of sand, gravel, stone, cement, and other building materials will be used on a continuing basis for routine maintenance.

Labor Force. The basic operation of the tertiary and quaternary systems will be performed by the WUA's and their members, with advice and some logistic support from the Agriculture Department. Most area farmers have basic agricultural skills in rainfed paddy culture and palawija crops, but will require some training for effective intensification of cropping.

Operation and maintenance of the primary and secondary system will be performed by the PU staff described above.

Training Programs: Operating Work Force. Public Works will provide its local staff with orientation training for operation and maintenance of the system. This will also include training in the keeping of flow records. Training will probably be conducted during the final months of project construction and during the turnover period.

Farmers. Extension training will be provided to farmers who are not accustomed to irrigation systems. The training is expected to consist of evening lectures in the villages or hamlets, supplemented with field advice by extension agents through the Contact Farmer system. PU will receive assistance in WUA organization and in on-farm water management training from the Indonesian non-governmental organization, LP3ES (Lembaga Penelitian dan Penerangan Ekonomi dan Sosial).

Public Bathing and Livestock Watering. Public bathing and laundry steps for the use of local villagers will be built.

The project will construct livestock bathing and drinking sites to minimize damage to canal banks.

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

Alternatives to the Proposed Project

No-Action Alternative

If the project is not implemented, some advances in cropping intensity might be expected through simple irrigation schemes at the local level, either by weirs on tributary streams or by limited use of privately-owned or village-owned pumps even though there have never been such attempts in the area. However, it is likely that the Salomekko area would remain one of subsistence farmers, more or less locked in a low-medium living standard.

Water Supply Alternatives

Ground Water Utilization. Ground water in the Salomekko area provides most residents with serviceable domestic water, except during the dry season in some years. It is unlikely that shallow aquifers could meet the dry or even wet season irrigation requirements for the service area. Furthermore, the cost and reliability of ground water use are not as favorable as using the abundant river water for irrigation.

Improved Water Management. Water conservation and improved on-farm management are parts of the extension package for the Salomekko project, but good management cannot provide rain water when the natural supply is unreliable.

Alternative Use of the Agricultural Land

If the project is not implemented, it may also be that land will be purchased by the Camming Sugar Cane Factory and converted to sugar cane production.

Siting Alternatives

Structures: Storage Dam. The dam and reservoir site was selected on the basis of hydrologic, topographic, and geotechnical considerations and comparative cost estimates. The present site has the following advantages: 1) good height/storage characteristics, 2) located on low value range land, 3) very few residents (no hamlets), 4) close to the service area, 5) good rock

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foundation, 6) good site for spillway, and 7) construction materials readily available, and 8) control of a reasonable catchment area.

Canals. The project will include three secondary canals that branch off from a short primary canal. One of these canals would run along the northern border of the service area, another along the western border, and the third roughly through the center. The area on the lower Baruttung would be served by water diverted from a small weir on the Baruttung with the river itself used to bring irrigation water down from the main canals above. Rivers and streams will be crossed by aqueducts. Livestock washing stations, bathing steps and foot bridges will be supplied as necessary.

Other canal routing alternatives have been evaluated and rejected on the basis of economics, reliability and ability to serve an effective subcommand area.

Auxiliary Structures: Roads. The existing road near the dam site, which runs within 500 m of the left abutment and connects the sugar cane factory in Camming with the north/south coast road, has been selected as most appropriate project access. Other, new routes would be excessively expensive to construct, and would probably not be any better in location than the existing, good quality road. Other roads will be located on the basis of the sources of fill, workers' camps, work areas, etc. Some new farm roads will be added to service inaccessible sectors of the service area.

Construction Camp. The locations of the workers' camps, office, and work areas have not yet been established. The sitings will take into account existing land use, movement distances, topography, and the ultimate uses planned for the structures.

Service Area. The selection of area to be served by the project has been based on existing land use, topography, and soils and will cover most of the existing rain fed paddy fields in the Salomekko and Baruttung basin areas.

Scheduling Alternatives

There is basically only one schedule worth considering for a small-scale irrigation project: to bring the entire system on line as soon as possible. The small size of this project precludes phased development.

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Existing Environmental Conditions

Climate

The project is located in an area of tropical wet climate characterized by a short rainy season and long dry season, with an annual rainfall averaging 2231 mm.

Most rain falls from April through July, with the peak month usually May, and the lowest months usually September and October. The lowest year of record was in 1976 (with 1676 mm). The highest during the 15-year record period was in 1985 (with 2,821 mm).

Air temperature in the area is fairly uniform, with a mean usually between 26 to 27°C. Relative humidity is high, averaging 92 percent.

Geology and Topography

The uplands and hilly areas of the Salomekko basin are underlain by bedrock that consists of basic volcanic lavas of basaltic and andesitic composition with associated volcanic breccias, tuffs, and some marine sediments. The coastal plain consists of alluvial deposits in the form of loams, sands, and gravels; and the soils are alluvial clays.

The project area is divided into a steep hilly upper basin (highest point is 250 m above sea level), most of which lies upstream of the dam site; an intermediate zone of gently rolling land, where most of the population and the service area are located; and the coastal area below the main road. In the service area the flatter and gently rolling lands are terraced for paddy fields. The service area extends from approximately 5 m in elevation at its lower end to 55 m in the upper reaches.

Water Resources

The Salomekko River is a short river which drains a fairly small catchment area of 13.2 km^2 upstream of the dam site. Its headwaters are about 250 m above sea level, and the river is characterized by a radial plan with many streams converging near a single point above the dam site. There are several more significant streams that flow into the Salomekko River through the service area below that point.

The Salomekko is a perennial river, with estimated annual discharges over 15 years ranging from 11.3 million to more than 28.1 million cubic meters at the dam site.

Water quality in the Salomekko is fairly good, with low to moderate concentrations of solids, major ions and nutrients. Most parameters are within recommended water quality limits. Moderate to high levels of bacterial contamination are common, restricting its direct use for drinking water.

Ground water is an important source of domestic water for most households. Most of this water comes from shallow hand dug or drilled wells. Water levels in the wells fluctuate according to the season, and occasionally some wells go dry. There are a number of springs in all the villages in the service area except Ujunge. The springs are used to irrigate crops year round, as well as a source of domestic water.

Water Demands : Agricultural Demand. The water resources of the river are almost totally undeveloped. Little or no river water is used for irrigation in the Salomekko service area at present.

Domestic Demand. Virtually 100 percent of the households in the project area rely on shallow wells for their domestic water.

Livestock Demand. During dry periods when surface water is not readily available in the higher grazing areas, livestock are brought down near the rivers. Even when there is little to no surface flow in the rivers there are reportedly enough pools present for this purpose. The Baruttung and tributaries of the Salomekko River are the principal rivers used for this purpose.

Aquaculture Demand. Given the limited, seasonal nature of current aquaculture development in the project area, there is virtually no demand for fresh water for brackish fish ponds at this time. Future demands might be met by pumping or channeling fresh water from the river with major construction efforts.

Land Resources

Land Use. The population of the Salomekko catchment is largely concentrated on the central rolling lands and in the coastal area. No one is allowed to live in the steeper hills of the upper watershed. Very little of the original forest remains in the upper catchment and the lower part of the catchment was converted long ago to various types of agricultural ecosystems. Within the past several years, local government has stipulated there is to be no further cutting of existing forest in the upper catchment area (located mostly in Biccoing Village), and reportedly, there are a few sporadic attempts at reforestation.

Erosion. In general, soil erosion is not a major problem in the Salomekko River watershed. However, the relatively high erodability of the soil types found in the upper basin, coupled with the hilly nature of the terrain, indicate that erosion and sedimentation would be problems if grazing, forest clearing, or hillside farming were to increase greatly. At present, the trend is toward tree planting, but a recently opened road passing through the upper watershed and connecting this area with Camming, to the west, could lead to increased pressure on the land.

Localized, sometimes severe, erosion has occurred in some downstream locations near the proposed service area.

Livestock. There are approximately 1700 water buffalo and 1000 Bali cattle owned and grazed within the four villages. They are kept almost exclusively for draft power in field preparation. Horses are relatively unimportant as draft animals and are principally used for transport (about 300 in the villages). The villages have fundamental rules for managing large livestock as livestock are potentially destructive of crops, house gardens, and even common lands. Increasingly, house compounds are being fenced with closely planted leguminous trees (pagar hidup), in part to better control livestock movement and manage forage areas. All livestock principally forage on available grasses on common land or in fallow fields, and few if any, receive much hand cut fodder (either grasses or leguminous tree leaves). All livestock principally derive water from existing streams rather than from wells. Recently farmers have started selling livestock in order to purchase tractors.

Biological Resources

Terrestrial Vegetation and Habitat. Cleared areas in the watershed tend to be covered quickly by alang-alang grass (*Imperata cylindrica*), a dense clumping form that discourages succession into woodland communities. Forest vegetation in the watershed is completely second growth. As a habitat for animals, this woodland is poor to fair. The blocks of woodland are too small to be attractive to many of the larger mammals, and the levels of succession and diversity are low.

Wildlife. The bird life in some woodland areas of the basin is quite rich; but no wild mammals, other than bats, are usually seen.

Pest Species. There are no serious bird or mammal crop pests in the area, but in neighboring paddy growing areas the munias and the Java sparrow (*Padda oryzivora*) sometimes reach pest proportions. Rats are occasionally a problem.

Endangered Species. None of the 16 endangered animal species listed by the International Union for the Conservation of Nature and Natural Resources (IUCN) as present in Sulawesi are known to reside in the area.

Freshwater Biology and Fisheries. The relatively small rivers are essentially dry at some times during the year, and the aquatic community does not seem to be sufficiently large or complex to constitute a significant part of the local ecology. Talks with authorities in the area indicate that the freshwater fishery is not significant in terms of local diet, income, or geographic area.

Socioeconomic Resources

Population Profile. Parts of the Salomekko service area lie within four villages: Biccoing, Ujunge, Ulu Balang, and Manera. They are administratively parts of two subdistricts: Tonra

(Biccoing and Ujunge Villages), and Salomekko (Ulu Balang and Manera Villages); both subdistricts are in District Bone.

The 1987-88 total population of the four villages was 7,751, living in 1,531 households, with an average household size of five persons. Of these, an estimated 56 percent were living within the village sub-areas (dusun) that will be irrigated. The population of the project area is principally within the 15 to 54 year age group (58 percent), considered the working age cohort. Only 38 percent of the population is aged less than 15 years, another 4 percent are aged less than 15 years and another 4 percent are aged 55 years and older.

Ethnicity and Religion. The majority of the study area population is ethnic Bugis, who are Muslim. A few of the local citizen are sufficiently wealthy to have made the pilgrimage (haj) to Mecca. Reportedly there are eight residents who are Protestant Christians.

Archeology and Cultural History. The are no known sites of significant historical or archeological interest in the area, and virtually all structures have been built since about 1965-70.

Education and Literacy. Within the four villages there are one kindergarten, 10 primary schools, and two intermediate level and one senior level secondary schools. The majority of the population aged 7 to 35 years may be considered at least minimally literate.

Public Health. Public health statistics for the general region show that malaria and dengue fever are not seen as major problems in the area. Gastric and intestinal diseases (gasteritis, diarrhea, and cholera) are a problem, with the incidence rate higher during the dry season when the quality of domestic water decreases.

Economic Aspects

Occupations. Paddy production is the primary economic base of the study area, with 3 out of every 4 (reported) economically active workers employed as paddy farmers. Another 5.2 percent of the work force engage in farming other than paddy production. Fishing and aquaculture farming are the primary occupations of 5.2 percent of the workforce, although these occupations are reportedly important as secondary activities. The remaining work force are employed in service sector occupations: 3.1 percent in crafts, 1.9 percent in commerce, 7.7 percent in public service, nd 2.8 in all other occupations.

Farmers do not report labor shortages in the area but hiring of labour at times of peak labour activity is noted. Income levels in the project area are low compared to provincial and national averages, with an estimated annual income of Rp 720,000 for the average size of farm (2.0 ha).

Cultivation costs are low, primarily because of interhousehold labor exchange and there is a virtual absence of wage labor.

Land Ownership and Taxation

Land Acquisition. All of the land cultivated in the service area has been under individual ownership since the colonial era. There is no open, or unclaimed land in the area that is suitable for cultivation.

The majority of farmers claim rights to land through inheritance from parents, or by land their wives inherited. Results of the HHS indicated as many as 83 percent of farmers inherited at least some of their paddy fields.

Some absentee owners sharecrop out their land.[1]

Land Values. Land values have changed considerably over the past few years and are averaging Rp 2 million/ha for productive and accessible land. This may double following the construction of the SSIMP scheme.

Land Classification and Taxation. Land is still classified according to the old systems established by the Dutch with some more recent refinements. Land taxes (formerly the IPEDA tax; now the PBB tax) are collected within each administrative sub-areaa (dusun) of the villages.

Completion of technical irrigation will probably be accompanied by a drive to complete a cadastral survey of the service area and an upgrading of land titles to the modern system of land tenure. Tax rates should probably increase then. Technical irrigation should raise income sufficiently to allow for future water users' fees to pay for the necessary costs associated with operation and maintenance of the system.

Farm Support Organizations. As there are no weirs and no pump-fed irrigation systems in the service area, farmers are not formally organized into irrigation associations. However traditional ceremonies (mappananrang) are held in the villages prior to the beginning of the paddy planting, which promote cooperation in agricultural work. Many farmers participate in loosely structured farmer groups (kelompok tani), in contact with the government-sponsored agricultural extension service. Many small field

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1. Most of the absentee owner-patrons are former residents who fled during the Islamic rebellion in the 1960s. During the period 1955 to 1970, hardly any of the existing bunded lowland was cultivated and there were mass movements of households to more secure areas. Roads become almost non-existent and impassable. One result of this regional turbulence was that many craftsmen and small businessmen left and never moved back to the area.

complexes are loosely organized to coordinate land preparation, planting, harvesting, etc.

Administrative Divisions and Village Government

The Salomekko service area lies at the intersection of four villages: Biccoing, Ujunge, Ulu Balang, and Manera. They are administratively parts of two subdistricts: Tonra (Biccoing and Ujunge villages), and Salomekko (Ulu Balang and Manera villages); both subdistricts are within District Bone. For purposes of irrigation management, the entire service area is located in the same district (Bone). All major management decisions can therefore be handled by the same district Irrigation Committee, and operate under a single administrative structure.

Regional Infrastructure

Public transport services along the main coastal highway are excellent and since most of the population lives along all weather roads, they have good access to the outside. There are shortwave radios in the subdistrict offices and the area has good radio and television reception. The nearest bank is 20 km away but the major sources of credit to farmer in recent years have been BIMAS, KUT, KUPEDES and private, non-institutional sources.

The main local market facility is in Manera Village and the nearest market town is Sinjai, 20 km away.

Attitudes Towards the Project. Farmers are highly supportive of the project and the Salomekko site meets the general USAID requirements that farms should be smallholder, owner operated. Indications are that the site will be socially suitable for technical irrigation.

Potential Environmental Impacts

Background

Assessment of the impacts of irrigation projects such as this are usually based upon information from a number of sources, including published liturature, expert opinion, local knowledge of conditions, and baseline biophysical and socioeconomic monitoring. As part of the Environmental Assessment process for the Salomekko project, an environmental scoping session was held in Ujung Pandang in April 1988 to permit comment by local and regional agencies on the plans for the project. This meeting identified a number of potential issues which are discussed in this report. The major environmental issues identified for the Salomekko project were:

- o Availability of river water for downstream users

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- Interactions of the project with the clearing of the watershed: effects of clearing on the project and effects of the project on clearing
- Possibility of adverse health effects among downstream water user

Pre-construction Phase

The greatest impact during the pre-construction phase will be the acquisition of some agriculturally productive land to be used primarily for supply and drainage canals. Since the land area to be taken is relatively small and the local population is enthusiastic about the project, the impact should be small. The reservoir will inundate an additional 92 ha of primarily brush forest and grass land. It will be necessary to resettle a very few families (fewer than five) from this area. It is important that negotiations for compensation to the villagers for their land be conducted in an expedient and fair manner.

Construction Phase

Potential environmental impacts during the construction phase will be mostly temporary ones. While construction is underway, the local population will be inconvenienced somewhat by increased traffic, noise, and dust; and there will be disruption of agricultural production along some of the canal routes as they are built. The labor and logistics camps will be placed where they will create minimum impact on the environment and villagers.

Post-construction Phase: The Operation Period

Water Quantity: Surface Flows. The primary objective of the project is to store approximately 7.8 MCM during high river flow periods and to distribute it to cropland during the latter part of the wet season and into the dry season. A simulation of reservoir filling indicates that it regularly reaches its target storage of 7.8 MCM. Consequently, water should be expected to spill into the Salomekko from the dam during the wet season in almost evey year. However, during the dry season no water will pass the dam site and tributaries, rainfall, and irrigation return flows will be the main sources of water for the lower Salomekko River. Smaller contributors may be dam seepage, and springs.

Surveys of well distribution in the service area indicate that there is usually sufficient water available from that source for domestic needs, even during the dry season. Only in a couple of hamlets where the road is especially close to a river do the villagers also take water from the river for household uses. This alternative may cease to exist, either because the river has been blocked or diverted as in the case of the upper reaches of the Salomekko River; or because the river is no longer fit for human use due to fertilizer and pesticide contamination from irrigation runoff.

The rivers are also important for watering livestock in the dry season. In some areas the diversion or pollution of the rivers may not make this possible. However in the case of the Salomekko River, alternative water sites exist for most hamlets in the Barutung and Salomekko tributaries. In addition, the irrigation canals can also serve as watering sites when they are flowing where the proper structures have been constructed.

Ground Water. The increase in surface water on a year-round basis is expected to recharge ground water somewhat, with the result that some wells that go dry under present dry season conditions will provide water later into the dry season. Raising the water table to the surface, thus causing waterlogging and soil salinity problems, should not be a concern since the rolling service area is generally well drained.

Water Quality: Reservoir. 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, most of which will settle out. There are no significant pollution sources in the upper watershed that would contaminate the reservoir. It is recommended that the reservoir inundation area be cleared prior to filling so as to avoid any potential of anoxic conditions, to make it accessable for recreation and fisheries, and to make a more esthetic environment.

Ground Water. Some contamination of ground water may occur in areas of exceptionally high fertilizer use, but the effect would be largely one of taste. It is unlikely that, even with maximum project development, this will be a problem. Contamination by pesticides is a greater likelihood, not from normal crop applications but from careless storage or formulation, or accidental spills.

River 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 and pesticides and considerable human 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.

Irrigation System. Water entering the irrigation system will be of 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 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 dry season conditions.

Land Resources

Land Use and Capability. Most of the land to be irrigated under this project already is dedicated to agriculture, but nearly all of it produces only wet season crops. Little new land is expected to be brought into agriculture. Approximately 92 ha of brushy woodland and river bed will be converted into a reservoir. The main and secondary canals and new roads will consume approximately 40 ha of land, much of it now in agriculture or along the field fringes. The tertiary system will also take strips of land from the edges of fields.

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, due partly to the requirements of rice soils, partly to high ambient, relative humidity and partly to the use of effective drainage systems.

Erosion. Erosion in the catchment area may be accelerated if more land is cleared for livestock grazing, firewood or tree crops. Overgrazing of pasture lands or incorrect management of crop irrigation will have a similar effect.

A serious source of canal bank erosion is the use of the channels for laundry, personal bathing and watering 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.

Agricultural Practices: Cropping Patterns. A cropping pattern with paddy in the wet season, palawija (mostly mungbeans, soybeans, and maize) in the transition season and no crop in the dry season is being recommended. This is the current farming practice and makes the best use of stored water.

Agricultural Chemicals. The amount of fertilizers and pesticides applied is expected to increase gradually, as a result of increased pest populations, better extension advice, and more sophisticated farmers, able to see demonstrable improved returns with chemical use. The introduction of toxic compounds in an area not accustomed to their use poses risks of improper storage, handling, mixing, and disposal of chemicals. The possibility of ecological effects of pesticide use (other than from a major spill or other accident) seems remote, since the chemicals used at present are nonpersistent and there is a trend toward more specific, short-lived compounds. Intensive use of chlorinated hydrocarbons (DDT, toxaptene, chlordane, lindane, etc.) could result in severe impacts on the fish ponds downstream of the service area, especially on ponds producing shrimp, but their use is very limited so such effects are extremely unlikely.

Grazing and Fodder. More intensive cropping of lands that now serve partly to support the large herd will leave livestock owners looking for more grazing land. Some owners, faced with higher demand for household labor in the fields (including that of children who do much of the livestock tending) may elect to sell some of their animals. There will also be increased pressure to clear more land in the watershed or overgraze the land. Farmers are already replacing draft animals with hand tractors, and this trend may be accelerated.

Biological Resources

Terrestrial Vegetation and Habitat. The most significant habitat change resulting directly from the project will be the conversion of some 92 ha of hillside pasture, riverine forest (plus some 10 hectares of river bed), and steep terraced paddy fields into a reservoir. 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.

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.

Commercially Important Species. The forests of the Salomekko watershed already have been exploited for the few tree species of timber value and the many more with fuelwood value. Some of each will be lost to reservoir inundation, unless salvaged. At present the area has few or no game animals.

Pests. Any intensification of cropping is likely to result in higher and more persistent populations of crop pests. Back-to-back paddy cropping is likely to allow insects to maintain their populations from one crop to another, necessitating higher insecticide use. No bird species have been identified as special pests of paddy in the Salomekko region. Rodents are the main pests of paddy in the area, taking grain both in the field and in storage.

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. Although the reported incidence of malaria is fairly low in the Salomekko area, some increase in the vectors of malaria may occur with more widespread surface water availablility. With the increase in mosquitoes, one usually sees an increase in mosquito-borne diseases, in this area, malaria and dengue fever.

Aquatic Habitat. It may be possible to maintain a small freshwater fishery or aquaculture operation in the reservoir. The primary productivity of the reservoir will be low and annual environmental fluctuations high. This will limit fish species to nently settle there. Increased agricultural activity is likely to hold some farmers who might otherwise be expected to move away.

Archeology and Cultural History. Several graveyards are located in the area of the canal network in the service area and near the dam site. Because of the widespread nature of the construction activity there is a risk of disturbance to these sites.

Public Health: Vector-Borne Diseases. The project will probably bring with it an increased risk of mosquito-borne diseases, particularly malaria and dengue fever.

Services, Infrastructure and Social Organization. Improved living standards and more economic opportunity in the area will probably lead to increased trade and demand for services. There should also be an increased demand for more infrastructure (schools, health clinics, roads, transport, and markets).

Land Ownership. The project will result in increased land values. With it will come the demand for a complete cadastral survey and modern land registration. Also, the possession of modern legal titles may make loans for farmers easier to negotiate. The land should be cloased to outsiders purchasing land in the area.

Farm Support Organizations. Farmers will be organized into water users' associations. Agricultural extension services will be stepped up, and it is expected there will be increased activities of farmer cooperatives.

Resource Use. Increased prosperity will lead to new house construction and housing repairs, with consequent increased demand for sawn lumber obtained from commerical outlets with sources outside the basin, or from the upstream forests. Domestic fuel use will increase, and at least at first, the demand for fuel wood will increase.

Regional Economics and Development. The project will make a direct, positive impact on the target population, but will also create new opportunities for other types of development. There should be a multi-sectoral development plan for the area.

Conclusions

The Salomekko Project is a dam scheme to supply irrigation water to 1,900 ha. Almost all of the proposed service area is already planted in paddy and secondary crops for one or two seasons. The Salomekko dam will create a reservoir occupying 92 ha at its maximum storage capacity, irrigation water will be released from the reservoir to the canal system, be distributed to the irrigated fields, and the excess will flow back into the river. The effect of this diversion will be to alter the Salomekko River streamflow regime with the result that the upper portions of the river just below the dam will receive little or no water for much of the year. People who depend on this section of the river for water should have sufficient alternative sources, including wells, irrigation supply canals, springs, and other rivers. There are enough contributions from below-dam tributaries and irrigation return flows so that downstream users should not be adversely affected.

Other significant impacts of the project include decreased dry season grazing areas for livestock, some loss of agriculture land for supply and drainage canals, increased risk of crops pests and mosquitoes, and improved economic conditions for the local populations. As discussed above, the negative impacts are not serious and in most cases can be mitigated. See Table ES-1 for summary of potential impacts.

Based on these studies, the conclusion of this Environmental Assessment is that the Salomekko irrigation Project has no major detrimental impacts which call into question the viability of this project. The project will result in spatial and temporal changes in water distribution which will have limited environmental effects on the local population. The project is therefore environmentally feasible, and the mitigation of any potentially negative impacts has been adequately addressed in the Environmental Management Plan.

TABLE ES–1
SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS
SALOMEKKO IRRIGATION PROJECT

ENVIRONMENT COMPONENT	DESCRIPTION OF IMPACT	SOURCES OF IMPACT		IMPACT LOCATION			TIMING OF IMPACT			EXTENT OF IMPACT			REMARKS
		PRIMARY	ASSOCIATED	CATCHMENT AREA	IRRIGATION AREA	DOWNSTREAM AREA	PRE-CONST	CONST	OPER.	UPON?	DURATION	INTENSITY	
WATER AND ATMOSPHERIC RESOURCES													
Water Quantity	Reduced availability in river below dam	Water diverted from river to canal			x			x	x	One hamlet	Long-term	Minor	Water available in wells/canals
	Creation of a reservoir	The Project		x				x	x	Beneficiary farmers	Long-term	Major	Storing and redistributing water are the means to meet project goals
	Flood control	Greater control of water			x	x			x	Downstream fish pond owners/some farmers	Long-term	Moderate to major	Salinity and possible flooding of ponds can be controlled; flooding of low areas reduced
Water Quality	Increased chemical concentration	Agricultural chemicals	Irrigation		x	x			x	Irrigation area and downstream area	Long-term	Minor to severe	Proper use reduces risk of adverse impacts
	Provide good water for domestic and livestock use from canals	Some canals will be close to hamlets			x				x	People near canals	Long-term	Minor to moderate	Water supply from wells already adequate; canal water will be a supplementary source
	Increased nutrient and coliform levels	Livestock and human waste	Sanitation and livestock mgmt.		x	x			x	Surface and ground water	Long-term	Moderate to severe	Possible risk to domestic water supplies
Air Quality	Increased fugitive dust	Construction activity		x	x			x		Construction area	Short-term	Moderate	Mitigation involves contractor dust control (road watering)
	Increased smoke	Burning surplus straw and other crop residues			x	x			x	Project area	Long-term	Moderate	Straw burned when intensive cropping leaves no time for natural decomposition
LAND RESOURCES													
Erosion	Increased sedimentation of reservoir	Deforestation; overgrazing; grass burning	Quarrying in catchment	x	x				x	The reservoir and entire project	Long-term	Minor to moderate	Area already has catchment management plan that needs enforcing
	Canal bank and field erosion	Lack of water control on steeper slopes	Poor control over livestock		x			x	x	Service area	Long-term	Minor to severe	Steeper sloped land [illegible] require good maintenance; and livestock control necessary
Agriculture	Increased production	Multiple cropping and dependable water supply			x				x	Service area	Long-term	Moderate to major	A main purpose of the project
	Less grazing land	Multiple cropping		x	x				x	Entire area	Long-term	Minor to moderate	Loss in area due to second season cropping but service area fodder quality will be improved due to extra residues
	Loss of farm land	Construction of system		x	x			x	x	Irrigation area	Long-term	Minor	Unavoidable. Small percentage of total area
BIOLOGICAL RESOURCES													
Terrestrial Vegetation and Habitat	Convert 75 ha to a reservoir, 40 ha to canal	The Project		x	x			x	x	A few landowners	Long-term	Minor	Unavoidable. Small percentage of total area
	Increased pest population	Multiple cropping			x	x			x	Irrigation and downstream areas	Long-term	Minor to moderate	Control measures needed
Aquatic Habitat	Proliferation of aquatic weeds in canals and drains	Increased nutrients	Inadequate maintenance		x	x			x	Service area	Long-term	Minor to moderate	Depends on maintenance
	Increased numbers of mosquitoes	Increased breeding area with irrigation			x	x			x	Resident population	Long-term	Minor to moderate	Malaria and dengue fever may increase
SOCIOECONOMIC RESOURCES													
Land Ownership	Purchase land for dam site, reservoir, canals	Must acquire land for Project	Equitable compensation necessary	x	x		x	x	x	Many landowners	Long-term	Minor	Small amounts of land needed from many landowners
Land Ownership/ Resettlement	Move a few houses from dam site/reservoir area	Must acquire land for Project	Equitable compensation necessary	x			x	x	x	A few households	Long-term	Minor	Households can be resettled nearby in same village
Settlement Pattern and Movements	Increased population and immigration	Economic opportunity		x	x	x		x	x	Resident population and migrants	Long-term	Major	Unavoidable
Regional Economics and Development	Improvement and diversification of economy	The Project	Unless joint planned simultaneous development	x	x	x		x	x	Resident population and migr..	Long-term	Major	A multi-sectoral long-term development plan is needed
Land Ownership and Tax Collection	More leasing and share cropping; demand for cadastral survey and modern land registration; increased land taxes	Intensification of farming	Improved value of land		x				x	Beneficiary farmers	Long-term	Moderate	Unavoidable. Need to "close" service area to land speculation and purchase by outsiders
Services, Infrastructure, and Social Organization	Increased demand for svcs. and infrastructure	Improved economy	Increased population		x	x			x	Resident population	Long-term	Moderate	Unavoidable
Public health	Increase disease vectors	More mosquitoes with irrigation	Lack of vector prevention	x	x	x			x	Resident population	Long-term	Minor to moderate	Education and control required

only the more hardy varieties. Fish farming may be practical if the fish are held in cages and given supplemental feed.

Canals. The proliferation of aquatic plants in irrigation systems is a widespread problem in Indonesia and elsewhere. The increased use of fertilizers and the presence of water in drains year-round allows plants to survive the dry season, when they would otherwise dry out and die back. Pest plants are of several sorts: floating, emergent, and submerged. All three should be expected in project waterways and all block the effective flow of water. Continual maintenance is necessary to eliminate such effects. Mosquitoes will breed in the stagnant water created by the weeds.

Fisheries. The reservoir, as noted above, is not expected to support a large fishery. The rivers, which do not have a significant fishery at present, are not likely to develop enough dry season flow to support exploitable fish populations.

The existing downstream fish pond farmers are dependent on rainfall and river outflow for freshwater to dilute the seawater in their ponds. However since the farmers do not have pumps or freshwater supply canals they have very little control over the pond salinities. The result is usually too much fresh water in the wet season and not enough in the dry season. The Salomekko river also periodically floods the pond area during the wet season and the farmers lose a portion of their stock. A decrease of fresh water flow to the ponds during the rainy season will actually help fish farmers by increasing salinities and decreasing flooding. Lower river flows in the dry season are not relevant since the fish farmer does not currently farm during that time. River water quality should also not affect the fish ponds. Fertilizers and pesticides will be amply diluted by wet season river flows. Besides, the fish farmer is currently using a pesticide (Thiodon) for pest eradication which is far more toxic and persistent than what used in the paddy fields.

Socioeconomic Resources

Target Population. The farmers with access to the irrigation water are expected to experience substantial gains in net income and in standard of living, which will be reflected in better nutrition, increased purchases of consumer goods, greater demand for education, and increased communication with area outside the project area.

At-risk Population. This group, by definition limited to people that do not receive direct benefits from the project in the form of irrigation water but are living in the study area villages, includes upland farmers and livestock owners on non-irrigable land, downstream paddy farmers not receiving irrigation, fish pond farmers, fishermen, merchants, craftsmen and mechanics, laborers, and other members of the community who do not grow paddy. The increased prosperity of the target population will

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benefit this group economically by increasing demands for goods and services.

Settlement Pattern and Movements. The presence of irrigation in this area, now farmed on a rainfed basis only, may lead farmers from other areas, especially those nearby, to attempt to buy into the Salomekko area. This would elevate land values and share-cropping rates for farmers already in the area, but probably 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.

Public Health. With the increase in mosquitoes will come an increase in the risk of malaria, dengue fever and other vector-borne diseases. The extension of the period of standing water in fields and drains will create favorable conditions for mosquitos, vectors of malaria, denque and filariasis.

Social Organization. Improved living standards in the target population probably will result in some of the younger farmers remaining in the area who might have grown dissatisfied with the poor farming conditions that now exist. If so, and if, as is usual, they settle near the family homestead (or inherit it), improved social cohesion and community stability will result. This effect, although difficult to express in quantitative terms, could be considered a secondary benefit of the project.

Farming Systems. The intensification and diversification in agricultural crops 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 water buffalo and Bali cattle as a source of traction. The major foreseeable change in the use of farmland is a decrease in availability of fallow fields for transitional season livestock grazing. This will be partly offset by an increase in field-edge and ditchbank vegetation. Some new fodder sources may have to be sought unless the livestock herd is reduced somewhat.

Services and Infrastructure. Demand, in general, will increase for services and infrastructure (schools, health clinics, roads, transport, markets and extension services). With this increased demand and diversified population the local social structure will become more complex.

Land Ownership and Tax Collection. Although inheritance of land is expected to remain an important means to land acquisition in the service area, it is anticipated that there will be increasing amounts of sharecropping and rental agreements with intensification. There may also be increasing cash sales of land.

As the value of land in the service area increases, then taxes can be expected to increase. Most agricultural land in the area is still registered and classified under the traditional system, and the area has not yet had a modern cadastral survey based on air photographs. Introduction of technical irrigation should result in increased demand for a more modern system of land tenure in the area, and an upgrading of land taxes commensurate with the true value of the land.

Regional Economics. The target population will experience increased disposable income, much of which will be spent in the local area. In addition, the at-risk population will obtain some secondary benefits with more work opportunities and more demand for the natural products such as thatch, woven mats and fuel wood, with which they augment their income.

Regional Development. The project area lacks an integrated long-term development plan. One potential impact of the SSIMP project could be the development of such a plan. This plan would not be the same as the Management Plan or the Monitoring Plan included in this Environmental Assessment, but such an integrated plan could build on the recommendations found in this report.

Resource Use. Water. Except in the short reach of Salomekko river just below the dam which is largely uninhabited, the lack of water in the river will be no more than at present and, during the transitional season, may be improved due to water in the canals. Steps should be taken to ensure that planned washing and bathing places are provided in the canals for people and livestock. The quality of this water will be better than that obtained from river pools during the dry season. Ground water levels should improve due to seepage and generally wetter conditions, leading to longer use of some wells during dry periods.

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 regional forest resources. The number of such improvements is not likely to be great enough to stress the available resources, however.

Effects of Project Alternatives

No Action Alternative. The effects of not implementing the project would be to continue the present low income and living standards. Introduction of irrigation into neighboring watersheds would lead to emigration of the younger and more mobile farmers.

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

Alternative Use of the Land

If the project does not go ahead, it may be that the land will be pruchased by the Camming Sugar Cane Estate. If the

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irrigation project proceeds, it is unlikely that the land will be used for sugar cane production.

Design Alternatives. 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. A site farther upstream would require a longer canal and might fail to capture enough river tributaries.

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.

Cropping Alternatives. Other cropping patterns are possible but these would generally result in a reduction in number of beneficiaries and overall project profitability.

Evaluation of Environmental Impacts

Pre-construction

The irrigation and drainage canals will take approximately 40 ha of predominantly agricultural land; some compensation will have to be given to the owners. As for other land affected--such as for the tertiary and quaternary systems and drainage--the villagers are expected to donate needed land at their own expense.

During this period, the service area should be closed to outsiders who may wish to purchase land in anticipation of its future increased value. Farmers who own or farm land within the area should make sure their titles or claim to land are clearcut.

Construction

There will be some disruption of agricultural activities along the canal routes as construction proceeds. The local population will also have to temporarily cope with some dust, noise and conjection.

Water Resources

Downstream Flow. The dam will store almost all water from the catchment area with spilling to the Salomekko River below it only during the wet season. For part of the year, flows into the river will be limited to rainfall runoff, irrigation drainage and flow from tributaries. The irrigation scheme includes a secondary supply canal which will pass through much the same area as the dry portion of the Salomekko River.

Water Quality. Return irrigation flows will undoubtedly contain higher levels of nutrients from fertilizer runoff. Water quality in the Salomekko and Baruttung may be somewhat poorer than at present, especially during the dry season. However, the extent of degradation is not normally expected to be great enough to cause problems for downstream users. For those who have access to a supply canal, the water will be of better quality than the rivers, except during the driest months when there will be no canal flow. At these times, well water must be used.

Land Resources

Land Acquisition and Resettlement. The creation of a 92 ha reservoir has the potential for positive impacts over the long term. The reservoir itself can be viewed as a water resource not only for irrigation but for recreation, fisheries and domestic water supply. A few houses will have to be moved to make way for the reservoir, dam site, and construction work area. In addition, perhaps another 40 ha of agricultural land will be taken for canals and roads.

Livestock Grazing and Fodder. Less land will be available for cattle and buffalo grazing. The result may be overcrowding of the present land or increased pressure on upland pastures, unless farmers convert to more intensive fodder collecting techniques and cattle management.

Agriculture. The project is expected to have significant impacts on the farming system, including higher agricultural yields of paddy and palawija crops, increased mechanization, and more frequent applications of agricultural chemicals.

Biological Resources

Pests. There is the risk that crop pests, aquatic weeds, and mosquitoes will all increase due to more abundant water and crops. Monitoring and control programs can offset these risks.

Fisheries. The reservoir's surface area and volume will fluctuate considerably from wet season to dry season and from year to year in response to rainfall and irrigation demand. Any fishery development in the reservoir will be wiped out, unless there is regular restocking.

Socioeconomic Resources

Increased agricultural production will lead to increased income and improved living standards. This directly affects the target population, and provides secondary benefits to the at-risk and migrant populations.

Settlement Patterns and Movements. The demand for additional labor can be expected to lead to an increase in the population. Some people who temporarily enter the area will decide to perma-

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PART II

SALOMEKKO IRRIGATION PROJECT

ENVIRONMENTAL MANAGEMENT PLAN

Environmental management, as applied to development projects, is a process of identifying and evaluating future interactions between a project and its surroundings, and then taking actions that minimize adverse effects and enhance beneficial ones. Environmental impacts can be considered as falling in two general categories:

1. Unavoidable Adverse Impacts. These are adverse side effects that are so closely tied to project effectiveness that not much can be done to ameliorate them. Often the unavoidable adverse impact is the residual of a more serious impact that has been lessened through an effective mitigation program.

2. Manageable Effects. These are direct or indirect project effects, adverse or beneficial, that lend themselves to improvement through careful action. Sometimes a potentially adverse situation can be turned into a project benefit through wise use of financial or other resources.

Type 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 mid-course corrections in project planning. More often, an environmental assessment is a one time affair, conducted during a pre-feasibility 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 Managed

The most serious potential environmental problems associated with this project involve conflicting demands on the limited water resource, especially during the intermittent rainy season, as well as the dry season. The problems are not new to area residents; under present conditions they find it difficult to find water of good quality for domestic purposes and there are inadequate supplies, of course, for irrigation.

Proposed Management Plan

Responsibility. As soon as the construction is completed, the mitigation and monitoring program will be the responsibility of PRIS and BAPPEDA in each district (BAPPEDA Tk. II). It will be supervised by the Environmental Department of the Ministry of Public Works under Indonesia's Environmental (AMDAL) law. Oversight is provided by the Ministry of Population and Environment. It is recommended that other government agencies be involved in implementing the Mitigation Plan of the project. These agencies include the Extension Services of the Departments of Food Crops and 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, the two Camat, and their delegated staffs.

The areas of project effects that are most appropriate for mitigative measures include those that were stressed by participants at the scoping session including downstream flow effects and land clearing in the basin.

Preconstruction Phase

The project should acquire the necessary land before construction commences. This will entail the resettlement and compensation of a few households, as well as compensation to those who own land at the dam site, borrow areas, and along major canal routes, office sites, etc.

District government should safeguard the service area against outsider land speculation by limiting land sales to only those who currently own or farm land within the service area.

Construction Phase

Adverse environmental impacts during construction should be temporary. Increased noise, traffic and dust are unavoidable, although in the case of dust, its effect can be lessened by watering the roads when necessary. The contractor should be prepared to supply his laborers with all those necessities that are not readily available from the local villages. In any case, firewood must not be taken from outside those areas that need to be cleared for construction. The contractor must keep the labor camp in a sanitary condition, otherwise pests, disease and hazardous wastes could result. Efforts should be made to minimize the potentially disrupture effect of the presence of mostly outside laborers in the village over a period of months.

Post-Construction Report

A report should be prepared after completion of Project construction. The report should be a detailed description of the future monitoring and mitigation measures required, estimated further costs, the status of what has already been implemented and a designation of the responsible agencies for each task. The report, written in the Indonesian language, should be distributed to the implementing agencies with enough lead time to enable them to submit their annual budgets. The plan should be reviewed after a year or two of operating experience, and revised as necessary.

Water Resources

Downstream Flow. The dam will divert almost all water from the catchment area to irrigation so that the Salomekko will depend on rainfall, tributary flow and irrigation drainage for its flows. At certain times of the year a portion of the river directly below the dam will go dry. The impact on users of the Salomekko River should be slight because:

1. Almost all the inhabitants in the service area who use river water, take it from the Baruttung and tributaries of the Salomekko River.

2. There has been a well drilling program in the area during the last two years. Wells are now the predominant source of domestic water.

3. The hamlet closest downstream to the dam, which uses the Salomekko for some of its water needs, will have access to an irrigation supply canal.

It is therefore concluded that no mitigative measures are needed for downstream water users at this time.

However, since the question of a minimum flow in the river downstream of the dam may arise again, the question may be put to the district (kabupaten) irrigation committee. These discussions should take place over the next two years as an integral part of the preparation of project operation and maintenance procedures. The USAID/Jakarta environmental officer will take an active role in the discussions. Once the project moves into the operation phase, the irrigation committee, assisted by the local water users' association representatives, will evaluate and monitor the adequacy of the minimum river flow.

If at a later time population growth outstrips well capacity, or the Baruttung River is diverted for irrigation, other options are available to supply more water to the villages including:

1. drilling more wells

2. a piped water system from the dam

3. water trucked from the reservoir to central holding tanks in the hamlets.

There is no significant freshwater fishery on the Salomekko River that will be harmed by decreased annual freshwater flows. The brackish water pond fisheries may even benefit from reduced freshwater flows and flood control into the estuary during the wet season.

Livestock Watering and Canal Bank Protection. Even with some flow in the river, many livestock owners are likely to take their buffalo and cattle to the canals for bathing and wallowing. Some will place their animals in drains, since buffalo show a definite preference for mud over clear water. In the interests of protecting the canal banks from damage by livestock, a two-pronged program is needed. This would include:

1. A vigorous program of education of adults and youth in the farm population to instill respect for the canal system and the realization that damaging the canals is contrary to the interests of farmers and the community. This must be backed up by enforcement, with penalties (perhaps in the form of fines and labor) for violators.

2. Alternative stock watering places should be provided in the form of basins receiving a small flow of water from the canal. The pools, built to established PU specifications, must be adequate in number, location, and volume to meet the demand for livestock watering.

Bathing and laundry steps leading down the banks into the canals, and footbridges over the canals will also help prevent canal bank destruction as well as provide access to fresh water.

Water Quality. No mitigation program appears needed to maintain water quality at or above present levels, but periodic sampling should be performed (see Monitoring Plan) to ensure that degradation to unacceptable levels does not occur.

For those occasions when a portion of the river does go dry, the Monitoring Program may show that it is necessary to release an occasional flow of water from the dam to flush accumulations of drainage water when it is heavily contaminated with fertilizers, pesticides or animal waste products. The agricultural extension unit and the water users' associations should collaborate on a program of farmer training in the proper handling and use of pesticides.

Land Resources

Land Acquisition. About 92 ha of land will be acquired for the reservoir and maybe another 40 ha for primary/secondary supply canals. While the overall benefits to the service area will more than outweigh the loss, the individually farmers affected should be given fair compensation for their land. This will avoid construction delays and generate a positive attitude towards the project.

Livestock Management. The project will increase pressure on present pasture lands and watershed areas. These areas should be protected from destruction due to overgrazing or deforestation in order to preserve catchment hydrological characteristics and to prevent erosion. Additional fodder will be required for the area's livestock population during the period of the intermitten season crop (palawija). Rather than relying on local enterprise to find and develop new grazing lands, PU should work with the Livestock Department to determine grazing needs, potential sources, and, if needed, possible methods of achieving herd reduction.

There is a local law (Peraturan Daerah, known as a "Perda") restricting grazing in the upland areas. This law should be more strenuously enforced. There is also a program to build and contain livestock in fenced-in areas which should be further encouraged. Grazing fees could be implemented, 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 appear not to have been previously instituted in the region, should be kept low.

Community education and development of an enforced grazing land and livestock watering policy should be the responsibility of Agricultural Extension Service and the Department of Livestock, and be assisted by nongovernmental organizations. Mechanization of field tilling with hand tractors, now practiced to some extent in the project area, should be encouraged through agricultural extension services and perhaps easy credit for machine purchases. This can promote a lessening of dependence on pasture animals.

Agriculture Management. Although the use of pesticides and chemicals is not projected to significantly harm the general environment, even with increased usage, it would be wise to regularly test for them as part of the recommended water quality monitoring program (see Monitoring Plan). Some of the chemicals can have acute or persistent health effects on the farmers using them. The Department of Agriculture should regulate what chemicals are used and provide training in safe handling and disposal practices.

Biological Resources

The longer growing season and higher cropping intensities resulting from this irrigation project will encourage increases in pest populations unless adequate control measures are instituted. The Department of Agriculture should work closely with the farmers to improve pest management procedures.

Pest Management. A program of integrated pest management has been successfully implemented elsewhere to control insect populations. Use of biological control and biocides together is the best means of avoiding developed resistance in pest populations. Crop rotation and the use of resistant plant hybrids are also effective measures.

Rats are natural inhabitants of paddy fields and villages. Their numbers can be held in check by a persistent poisoning and trapping program, as well as better storage of grain. Land management, that restricts the types of food available to the rats at any one time, is also effective.

Aquatic plants that grow in canals and drainage ditches can be controlled in various ways. Weeds can be physically removed, and in some cases be fed to farm animals or used as mulch. Some species of fish feed on certain aquatic weeds, and therefore might be raised in the canals. The proper use of herbicides can also help control weed proliferation.

Mosquitoes will breed in the canals and drainage ditches if there is stagnant water. If the canals are kept free of weeds and debris then the flow of water will make it difficult for mosquitoes to reproduce. Insecticides used judiciously for serious outbreaks can also be helpful. In some locations mosquito fish can be introduced into the canal as a control measure.

Socioeconomic Resources

Services and Infrastructure. Improved living standards, more economic opportunities 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.

The government development planning board (BAPPEDA) should work together with the Departments of Education, Health, and

District Public Works to develop local medium- and long-term plans. The Bupati of Bone District and district government (PEMDA) would play an important role in ascertaining the need and timing for any increase in services and infrastructure, and coordinating various development plans in the Salomekko project area.

Farming System. Introduction of irrigation to the Salomekko service area will lead to increased demand for agriculture extension services. The Department of Agriculture (Food Crops) should work together with Public Works, district government, LP3ES and local farmers to encourage a 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 be increased demand for 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 modern certificate title to their land. It may be that the government will organize a special cadastral survey so that the whole service area will be converted to the modern land title system.

Even before this process commences, the district government should declare the service area "off-limits" to outsider land speculation, and restrict land transactions to only those farmers (and their descendents) who currently own land within the service area.

Land Taxes and Water Users' Fees. The government should expect to receive increased income 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 Irrigation Committees. 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 a non-governmental organization, LP3ES, to assist in this process.

Burial Sites. All sites should be identified and a map showing each site should be prepared. The layout of the irrigation canals and drains and the location of all dam structures should be made such as to avoid these sites.

Any sites close to construction activities should be fenced and signposted to avoid accidental disturbance.

Health Problems. The PU staff should alert local health officials to the possibility of increased risk of malaria and dengue fever in the project villages. Since there is no comprehensive malaria or dengue control program present in the region, little action is likely to be taken beyond perhaps establishing the existing incidence of malaria and dengue fever, against which project induced changes could be measured.

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 can educate mothers, in particular, about the importance of boiling water and inoculating children against preventable water-borne diseases.

Recreational Use. The dam and reservoir will be an attraction for visitors from a wide area, particularly because of its proximity to the main north/south highway. To enhance this, the reservoir basin should be cleared of all vegetation (except grass) before filling proceeds, and furthermore, the dam design consultant should consider the provision of access roads and picnic areas for recreational use. The downstream coastal shore in Ujunge Village might also be simultaneously developed for recreation as well.

Management Plan Components: Timing and Costs

Public Works will construct the water resources mitigating structures as part of the system's development. Other government agencies, as mentioned above, will be principally responsible for their own extension programs and ongoing activities. In most cases programs and extension services (see Figure MA-1) should commence about the time the irrigation system is constructed. It is expected that construction of the dam and irrigation system will take about 24 months to complete. By the end of that 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 increase in services and infrastructure will be gradual. 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. Some land will undoubtedly be sold to "outsiders", but district government should take steps to see this process is not abused.

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

Table MA-1 summarizes the estimated 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 activites should incur no special costs and should come under regular operating costs.

Table MA-1

MANAGEMENT PLAN COMPONENTS AND ESTIMATED COSTS

Item	Participating Entities	Estimated Cost (Rp)
General Coordination of Sectoral Agencies	BAPPEDA, and District Government	No Special Cost
Water Resources:		
Bathing and Laundry Steps in Canals (Rp 1,000,000/unit x 13)	Public Works, SulSel Province	13,000,000 (1)
Foot Bridges over Canals (Rp 1,500,000/unit x 16)	Public Works, SulSel Province	24,000,000 (2)
Livestock Watering Sites in Canals (Rp 3,000,000/unit x 16)	Public Works, SulSel Province, and Extension Services of the Departments of Agriculture (Food Crops) and Livestock	48,000,000 (3)
Land Resources:		
Land Use: Livestock Management	Public Works, SulSel Province, with Departments of Livestock and Forestry	No Special Cost (4)
Biological Resources:		
Watershed Management	District Government, the Bupati and two Camat, and the Department of Forestry	No Special Cost (5)
Socioeconomic Resources:		
Land Acquisition and Resettlement	Public Works, SulSel Province, Village Development, District Government, and Other Agencies	370,000,000 (6)

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Table MA-1
(Continued)

Item	Participating Entities	Estimated Cost (Rp)
Public Health	Department of Health	Regular Operating Costs (7)
Services and Infrastructure	BAPPEDA Tk II, District Government	No Immediate Costs (8)
Land Ownership, Land Registration, and Land Values	National Board of Lands (Badan Pertanahan Nasional) and Agrarian Taxation Office (IPEDA/PBB), with district government	Special Costs (9)
Land Taxes and Water Users' Fees	Agrarian Taxation Office, National Board of Lands, District Government and Public Works	No Special Costs (10)
Burial Sites	Village Government, District Government and PU SulSel	No Special Cost (11)
Farming Systems	Department of Agriculture	Regular Operating Costs (12)
Organizing Water Users' Associations, and the Irrigation Committee	Public Works, Agricultural Extension Services, and assisted by LP3ES	No Special Costs (13)
Recreational Use	Public Works, SulSel Province	11,000,000 (Reservoir Clearing) (14)

Notes to Table MA-1:

(1) Estimated costs are preliminary, pending final design of the irrigation system. Cost will be included in the irrigation system contract.

(2) As in (1) above.

(3) As in (1) above.

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

(5) This assumes that the general policy decisions already made would be continued.

(6) Cost estimates for land acquisition and resettlement will be finalized in the Final Design Phase.

(7) The Department of Health should monitor developments in this area and adjust their programs and services accordingly. Adequacy of funding in annual Health Department budget (DIP) to be confirmed by BAPPEDA, Tk. II.

(8) Regional government would be expected to increase the number of schools, health clinics and other services as the population increases. No immediate or special costs are envisaged. BAPPEDA, Tk. II, and district government to determine scheduling and funding.

(9) 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. District government to close off the service area to possible outsider land speculation. Land sales to be restricted to transactions among those who already own or farm land in the area.

(10) 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.

(11) Location maps should be prepared by the detailed design consultant using survey information from local people. Any fencing and signposting recommended would be part of the preliminary costs of the contractor.

(12) 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. Funding increase will be required in the annual budget (DIP) of Department of Agriculture, and should be confirmed by BAPPEDA, Tk. II.

(13) Costs for the LP3ES contract with Public Works is covered by GOI/USAID SSIMP project costs. At this time there is no plan to bring LP3ES into the Project since PU and USAID have not yet committed funding under SSIMP to construct this project. If funds are committed to construct it, then LP3ES will be brought in to do the organizing.

(14) The detailed design consultant should consider the provision for recreational facilities, but work would be implemented by Provincial or District level Government. Further studies are needed to develop this area for recreational use.

PART III

SALOMEKKO IRRIGATION PROJECT

ENVIRONMENTAL 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 carried out during planning, design, and construction, and may be mandated by law (as it is in 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 external sources, the local agencies bear 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 interagency jurisdictional disputes.

Some of the above factors may be absent in South Sulawesi Province and Bone 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 Program

Water Resources

Program Objective. The Salomekko Irrigation Project will influence both river flows and water quality. It is anticipated that flow on the Salomekko will be limited below the dam to rainfall runoff, tributary contributions and irrigation return flows with the result that portions of it will have no appreciable water during the dry season. In addition, fertilizer and pesticide runoff will increase as the cropping pattern is intensified.

It is therefore strongly recommended that the Salomekko and Baruttung rivers be monitored to determine the suitability of water 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 and river water.

Location. Water from at least five sample sites, selected from the following eleven sites on the supply canals, and on rivers that receive irrigation return flows should be considered for testing under this program. The following are suggested locations:

1. From the headworks of the main canal.

2-4. From at least one site on each of the three secondary canals where human usage is significant.

5. From a point on the Laballang River just upstream of where it enters the Salomekko River.

6. From a point on the Padang Mani River just upstream of where it enters the Salomekko River.

7. From the point where the Salomekko River crosses the Sinjai-Bone Highway.

8. From any other site on the Salomekko River where human usage or pollution appears to be significant.

9. From the Baruttung River where the secondary canal crosses it.

10. From the Baruttung River where it crosses the Sinjai-Bone Highway.

11. From any other site on the Baruttung River where human usage or pollution appears to be significant.

If unacceptable water quality is encountered at one of the sampled sites, additional sampling may be necessary to isolate the source of pollution.

Methods and Equipment. A competent water quality laboratory will be needed for analyses. Field meters properly calibrated 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, nitrogen, phosphate phosphorus, salinity (expressed as chloride ion), alkalinity (expressed as calcium carbonate), and fecal coliform bacteria. Although pesticides are not currently foreseen as a problem, some testing for pesticide residues is recommended, due to the significant increase in usage that is anticipated as a result of the project.

An attempt should always 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 twice a year, once during the wet season and again during the dry season. 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 Resources

Program Objective. The principal reason for monitoring land use changes in the project area is to detect changes that are caused by the project, or those that might affect project operation. Changes might include increased erosion due to deforestation and overgrazing, water quality decline in the return flows, or farming practices.

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

Methods and Equipment. Aerial photography and satellite imagery are the usual tools for land use study. This will probably prove infeasible for such a small area as Salomekko. In any case, four test quadrangles of about 25 ha should be established in strategic areas and visited periodically on foot. 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. Reports should be submitted to all interested agencies, including Forestry and Agriculture.

Implementing Agency. It is recommended that the Planning Section (P3SA) of Public Works in SulSel Province be principally responsible for overall monitoring 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.

Socioeconomic Resources

Integration of Local and Regional Planning. Any program of environmental monitoring of socioeconomic 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 subdistrict administrative offices, 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 subdistrict 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 socioeconomic conditions, beyond those already in place among local agencies, but it is hoped that 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.

TABLE MO-1

MONITORING PLAN COMPONENTS
AND ESTIMATED COSTS

Item	Participating Entities	Estimated Cost (Rp)
General Coordination of Sectorial Agencies	Public Works, SulSel Province, and BAPPEDA Tingkat II	No Special Cost
Water Resources		
Water Sampling and Analysis Rp. 4,000,000 (for approximately 5 of 11 sample sites x 3 samples/site) x 2 times/yr	Public Works	8,000,000 (1)
Land Resources		
Land Use Reconnaisance	Public Works (P3SA)	Essentially No cost (2)
Biological Resources		
Monitoring Pests, Diseases and Other Problems	Public Works, Health, Agriculture, Forestry, and Other Sectoral Agencies	No Immediate or Special Cost
Socioeconomic Resources		
Monitoring Social Change, Needs, Conditions, Including Domestic Water Use	BAPPEDA TK II, Statistics, Health, Education, and Other Sectoral Agencies	No Special Costs

Notes to Table MO-1:

(1) These estimates are provisional. Quotes on costs from different laboratories vary widely.

(2) This could be done annually by taking photographs of the catchment, from the highest point in the catchment, easily accessible from the Camming Road.