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**WATERSHED MANAGEMENT
IN
KABUPATEN LUWU**

JULY 1983

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PROJECT LUWU
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INDONESIA**

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1. Introduction

Kabupaten Luwu is a regency in the province of South Sulawesi, Indonesia. It is located in the northeastern part of the province at the northern end of the Bay of Bone. The Kabupaten has an area of 25,144 km² and a population of about 500,000. A general map of the Kabupaten is shown in Figure 1.

Kabupaten Luwu is the site of a multi-sectoral development project aimed at improving the living standards of the rural population primarily through the improvement of the factors which affect agricultural income. The major effort in the project has gone into improving the main road and irrigation systems and improving farming technology and practices, farming inputs and the availability of markets. With irrigated agriculture—principally rice — as the main focus, the overriding emphasis has been, up to this time, on the development of the lowland areas amenable to such activity. However, in the development of plans for future activities in the Kabupaten, it has been recognized that other sectors and other areas need to be considered, both from the standpoint of how they will affect ongoing programs and how they may contribute to long term, sustainable economic growth and an improving quality of life in the region.

In this respect, the watersheds of the region — their condition and the way they are utilized — will be of vital importance to such long term viability. Accordingly a short-term study was undertaken to investigate the current status of watershed management in the Kabupaten. The purpose of the study is to describe the existing situation with respect to the watersheds of Kabupaten Luwu, to provide a conceptual framework for watershed planning and management and to develop suggested activities and programs leading toward the use of improved watershed management in the region. This report is the product of that study.

The data and information used in the study were collected from several sources including a review of reports of watershed management activities in Indonesia and elsewhere, reports prepared as a part of Project Luwu, discussions with members of the Project staff and with officials of government agencies at the Kabupaten and Provincial levels. Field trips were taken to observe existing conditions of the rivers and current watershed utilization. And, finally, discussions were held with several private firms whose plans and programs may influence watershed utilization in the future.

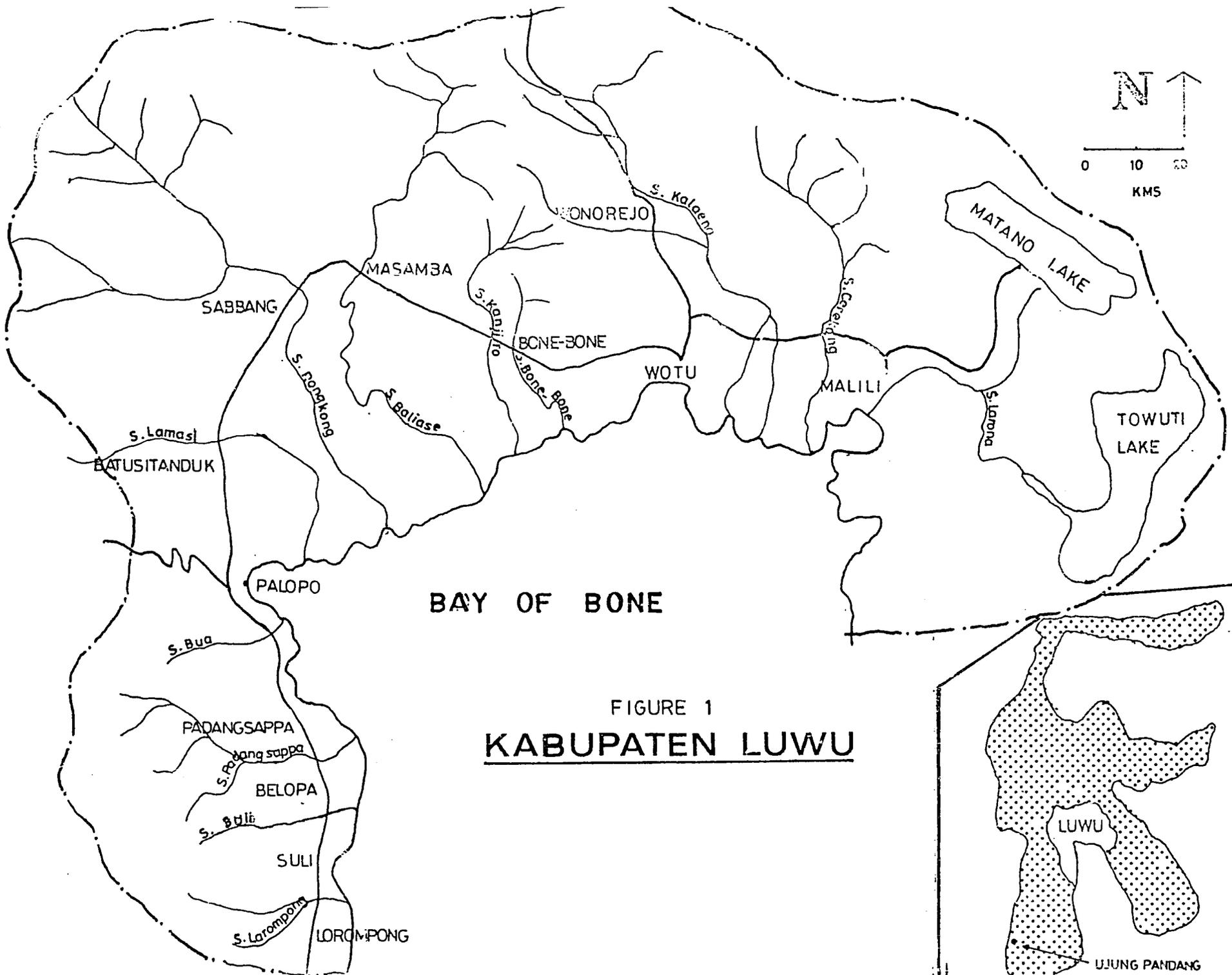


FIGURE 1
KABUPATEN LUWU

The following sections contain a discussion of general considerations in watershed management, existing physical conditions and the management practices, a discussion of conclusions as to needs and recommendations for implementing activities to meet the needs.

2. Watershed Management - General Concepts

2.1 A Rationale for Management

A watershed is a geographically defined area consisting of the entire drainage area of a river. Every river has its own watershed, or catchment area with relatively easily definable boundaries.

As the name implies, all the precipitation that falls within a given watershed ultimately finds its way into that particular river.¹ Anything that modifies the quantity, quality or distribution of surface water in the watershed will have an effect on the streamflow in the river.

A watershed is, in this sense, a natural ecological system within which interacting elements operate to give the watershed and the river their character. The topography, soil types, vegetation, elevation, rainfall and ground water all influence the nature of the watershed and the resulting streamflow. The natural system is dynamic. The runoff from rainfall erodes the soil and carries sediment into the river; plants and trees intercept the rainfall, take up moisture and bind the soil with their roots, retarding runoff. The watershed, even in its natural state, is constantly changing. Both floods and periods of low flow will occur with no help from man.

When, however, man decides that he needs to exploit the resources of the watershed, to use the land to grow crops, to harvest the timber and to use and harness the streamflow, these changes are exacerbated. Removal of the forest cover reduces the capacity of the soil to retain the rainfall and release it overtime into the streams and rivers. This causes increased flooding, both in frequency and magnitude. It also causes lower and more prolonged low flows during periods of little rainfall. And, heavy rainfall on slopes unprotected by vegetation will increase the amount of soil erosion and corresponding silt loads carried in the river and deposited as sediment downstream in waterworks, irrigation systems and channels and harbors. These alterations are detrimental to both upstream and downstream inhabitants. Loss of soil through erosion will reduce soil fertility and require increasing inputs of fertilizer to maintain crop yields. And, in critical cases, erosion

¹ This is somewhat over simplified because it ignores surface water - ground water interactions and losses due to evapotranspiration.

causes the abandonment of upland plots altogether, as decreasing productivity forces the farmer to seek out new land or other employment. The natural rate of soil formation is about 1 millimeter per year. It has been found in Java, for example, that soil erosion from cultivating crops on uplands with no conservation measures ranges from 3 to 5 millimeters per year on slopes up to 50% and 23 to 38 millimeters per year on steeper slopes. It has also been estimated that there are over one million hectares of land on Java that is so eroded that it is now useless even for subsistence farming.

Loss of soil in the upland also means increasing sediment loads downstreams, behind dams and weirs and in irrigation canals. Increased sediment means increased maintenance costs for irrigation systems and also for maintaining free flows through road bridges and culverts.

The changes in streamflows and resulting greater floods can cause structural damage to irrigation systems, roads and highways and communities along the banks of rivers. And, extended low flows will cause shortages in supply and force those usually dependent upon the river's flow to seek other water sources - at increased cost - or to curtail their productive activities.

Consequently, indiscriminate land use in the upper watershed can create severe economic and social hardship to inhabitants both in the uplands and in the lowlands. However, with an awareness that these problems exist, a knowledge of the behavior of the overall system and careful attention to the effects of proposed interventions on that system, man can exploit the resources for his long term economic and social advantage. This is the basic rationale for environmental management in general and watershed management in particular.

2.2 Components of a Management Program

A watershed management program should be planned and implemented within a framework providing adequate consideration to the needs of the people in the region, the basic natural system and its behavior and the technical, institutional and financial resources required to implement and maintain it.

2.2.1 Watershed Management Objectives

The basic objective of watershed management is to develop, for the upland areas, productive land use

combinations that maintain the stability of the soils, keep sediment loads at acceptable levels and regulate streamflows to prevent increasing downstream damages.

There may also be areas with environmental value such as unique or rare flora or fauna and landforms that society decides should be preserved for their ecological and social benefits rather than for economic exploitation.

2.2.2 Technical Elements

Planning for sound watershed management requires knowledge of the natural, social and economic systems involved. It requires inputs from many technical fields and needs to be carried out by a multidisciplinary team. The team should include members with good knowledge in soil conservation and water resource engineering, forestry, hydrology, agronomy, livestock, economics and legal and administrative institutions. The team should be able to draw upon a foundation of basic data that relates directly to the area for which the plan is being developed. The data should describe existing conditions within the watershed, including the topography, forests, soil types, hydrology and rainfall and present land use types, pattern and intensities. Economic data will also be needed when selecting and evaluating specific alternative development activities. These include market data, prices and production costs.

Although good data is an essential element in the development of a sound program it is often not readily available in an up-to-date and useful form, especially in remote areas.

Another facet of this problem may be a lack of specific knowledge about the behavior of a part of the particular system being planned. The technical expert may need to test his particular knowledge under field conditions to be able to predict with any certainty how that system will behave. This is particularly true when dealing with the effects of new cropping packages, for example, and conservation practices that have not been used in that area.

Inadequate data and knowledge in areas important to the watershed program will form the basis for data collection and research activity during the initial phases of planning. Such activities are costly and time consuming, however, and care should be taken to be sure that only essential work is done in this regard.

It frequently is necessary and desirable to initiate the planning activity without waiting for the results of

research and data collection. One approach is to develop an interim plan which can be implemented as a "holding action" to prevent serious or irreversibly-damaging changes to the resources of the watershed. Such interim plans can often be quite effective and can be accomplished by establishing and enforcing some rather general rules based upon the present knowledge of the area and the previous experience of the team members.

However it is accomplished, there needs to be a package, or packages, of technical options which can become a part of the watershed management program. Often called "technological packages" they may include specific combinations of land use, crops and/or engineering structures appropriate for application under specific conditions. Different packages may apply to areas depending upon slope, soil condition, existing land use and other parameters. They will also provide varying levels of cost, resource protection, production, and economic return. Among the more common technical elements are:

1. Forestry management with varying levels of protection;
2. Mixed practices such as tree crops combined with grass cover and animals;
3. Perennials with permanent ground cover;
4. Contour or strip planting; and
5. Construction of terraces, gully plugs and other structures.

2.2.3 Institutional Elements

Technical knowledge and data, though necessary for watershed management, are not sufficient. Institutional mandates and responsibilities must also be in place if the overall planning activity is expected to result in a workable program of long term benefit to the region and its people.

2.2.3.1. The planning function

As mentioned earlier there should be a planning team with the specific assigned responsibility to develop the plan. While the individual disciplines may be resident in several agencies - forestry, agriculture and water

resources, for example, - the responsibility and coordinative leadership should be vested in one which has the capability and authority to collect the various technical inputs and formulate the plan. When the team is multi-disciplinary and multi-agency there is a greater likelihood that all facets of the problem and all interests will be taken into account.

2.2.3.2 The implementing function

The responsibility for implementing may partly shift from the planning agency to the various agencies with direct legal and regulatory authority. The Forestry Department, Ministries of Agriculture and Finance, Water Resources and others may all have roles in the implementation. It will be most effective if there is, again, one lead agency. This lead agency may have no regulatory power. It may only provide a coordinating and monitoring function. It should have a direct link to the top government decision-makers and have enough status to gain the cooperation of all participating agencies. When the geographical area is sufficiently large a special unit may be established to carry out the coordination and monitoring.

A watershed management program must be developed for the entire watershed. This can cause difficulty, as frequently watershed and administrative boundaries do not coincide. The type of program to be implemented will determine how difficult this problem is to solve. The implementation of a technical advisory program may cause no problem, while a land use regulation may be impossible to implement. As nearly as possible a plan should cover, and be implemented in, an entire watershed, or group of watersheds.

2.2.3.3 The financing function

Adequate financial support for the planning, data collection and research, implementation and control is also an essential part of the program. Each organization and agency involved in the program needs to have a multi-year budget with annual increments that realistically reflect what can and must be done for each year of the program. Budgets will include the costs of data collection and research, consultation (if needed), staffing and all support costs needed to develop and implement the program. There should be a commitment on the part of the funding authority to provide funds for the entire period at the time the program is initiated. Any funding limitations should be taken into account during the planning to keep the program within the bounds of "fundability".

2.3 Watershed Management In Indonesia

Watershed management is not a new concept in Indonesia. Several large watershed management projects have been undertaken in the past decade. Major efforts, with international financial and technical assistance, were conducted in the Brantos, Solo, Jratunseluna and Citanduy River Basins and in the Yogyakarta Rural Development Project. These were all large, interdisciplinary and multi-agency projects. Several were initiated due to the severe degradation of the watersheds through indiscriminate clearing and cropping on steep lands. Serious over - population in the area forced farmers to cultivate land totally unsuited for annual crops.

It was found in those areas that, with rainfed cultivation and no conservation measures, soil was lost through erosion at the rate of 3 to 5 millimeters per year on slopes up to 50% (22.5°) and 23 to 38 millimeters per year on slopes greater than 50 per cent . With the natural soil formation rate of about 1 millimeter per year it is plain that such losses soon lead to disastrous conditions in the uplands. And, a part of the problem is transferred downstream with higher, more frequent flooding and increased sediment loads in irrigation systems, impoundments, channels and harbors.

It was also found in the Solo project that the cost to rehabilitate critically eroded land would run up to 1 million Rupiah per hectare. This cost estimate was further corroborated in the Cintanduy project. It appears that good planning and management before conditions reach a critical state is, by far, the preferred approach. While all these projects were on Java where conditions are quite different than in Luwu, they do illustrate the scope of the problem that can exist when nothing is done until conditions become critical.

In addition to these programs, a team of experts was recently formed to assess the present state of watershed management in Java. The team, formed under the auspices of USAID, prepared a report which provides a critique of current programs and offers suggestions designed to improve the efforts. While the study focuses only on Java, many of the findings and suggestions have relevance for watershed management in other parts of Indonesia as well.

3. Kabupaten Luwu - Existing Situation

3.1 General Physical Description

Kabupaten Luwu, with an area of 25,149 km² is located in the northeastern part of the province of South Sulawesi. It borders the northern end of the Bay of Bone and contains 16 administrative units called kecamatans. The boundaries of these units are shown in Figure 2. The region is characterized by low, flat coastal plains for most of its length, backed by hilly, steep and, in some places, mountainous terrain. Soil data is available only for parts of South Luwu and the North Luwu Plain. The main highway traversing the area is located approximately on the boundary between the coastal plain and the uplands. In most areas these hills rise abruptly from the coastal plain. Much of the upland area is mountainous with elevations commonly over 1500 meters and a few peaks over 3000 meters above sea level. Figure 3 shows the approximate area of hilly uplands in the Kabupaten. The elevations shown on that sketch are in meters above sea level.

3.2 Population

Kabupaten Luwu had, in 1980, a population of 503,743, and in 1982 a population of 532,241. Table 1 contains the 1982 population and population density for each of the sixteen kecamatans. As one might expect, population densities are highest in areas near the highway and lowest in those kecamatans most distant from the road - Bastem and Limbong.

TABLE 1

KABUPATEN LUWU - POPULATION AND DENSITY BY KECAMATAN
1982

<u>KECAMATAN</u>	<u>POPULATION</u>	<u>DENSITY PEOPLE/KM²</u>
Larompong	23,022	63.9
Suli	17,130	85.6
Bajo	37,129	62.7
Bastem	12,256	3.8
Bupon	49,237	65.6
Wara	60,405	317.9
Walenrang	70,974	38.8
Sabbang	30,909	12.8
Limbong	10,651	4.3

KECAMATAN	POPULATION	DENSITY PEOPLE/KM ²
Masamba	28,493	10.4
Malangke	18,708	23.4
Bone Bone	53,487	84.6
Wotu	31,912	18.0
Mangkutana	37,188	17.7
Malili	24,976	11.6
Nuha	29,112	10.0

Source: Department of Industry, Luwu.

3.3 Land Use

The most intensive land use in Kabupaten Luwu occurs in the coastal plain and in the river valleys that extend from the plain into the mountains. Much of that area is devoted to the growing of wet rice (sawah) and to fish ponds. The plain is extensively irrigated by small, village level irrigation systems in South Luwu, to the south of Palopo and by several large irrigation systems plus village systems in North Luwu.

Much of the steep and mountainous land behind the plain is still under forest cover. Clearing for agriculture is occurring on the near slopes of the hills, particularly around and to the south of Palopo.

Most of the plantings on the hills are in small plots and are used for cloves, with some coffee and cocoa. Some of this is on very steep land and there is little evidence that soil conservation measures of any kind are used on these slopes.

Further back into the mountains the population drops substantially and, where the land is used for crops, it is mostly a subsistence type of farming on a small scale. Primary forest still covers a large portion of the mountainous area. Table 2 contains a break down of the broad categories of land use in each of the kecamatan.

The primary pattern of land use, then, is generally agriculture in the plains and forests in the mountains with villages scattered throughout, but concentrating in areas near the road. One departure from this pattern is located in Kecamatan Nuha, on the shore of Lake Matano where P.T. Inco, a subsidiary of INCO Ltd of Canada operates an open pit nickel mine and smelter. This facility is virtually self contained with company towns for its employees. A good

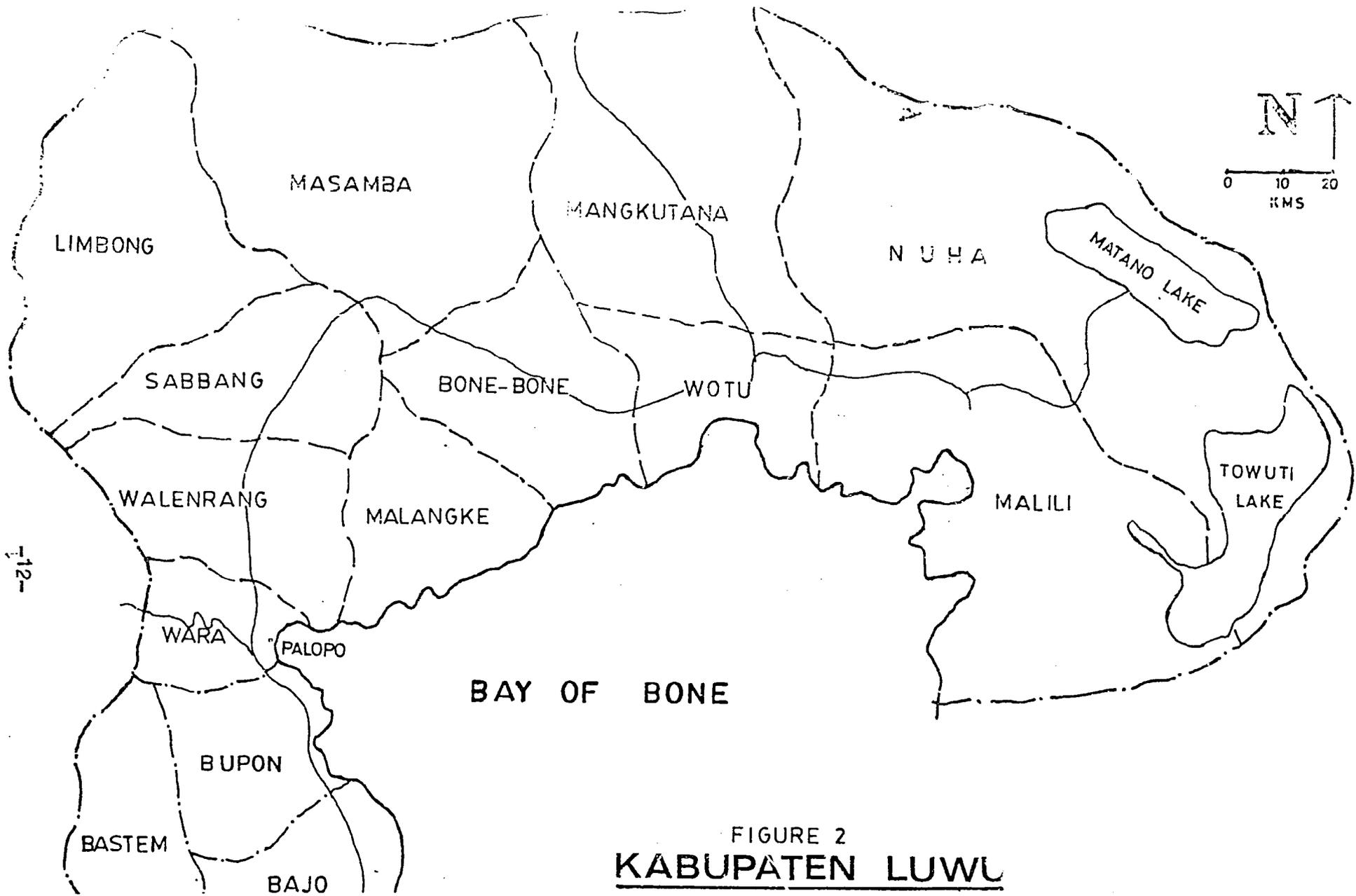
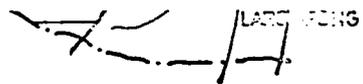
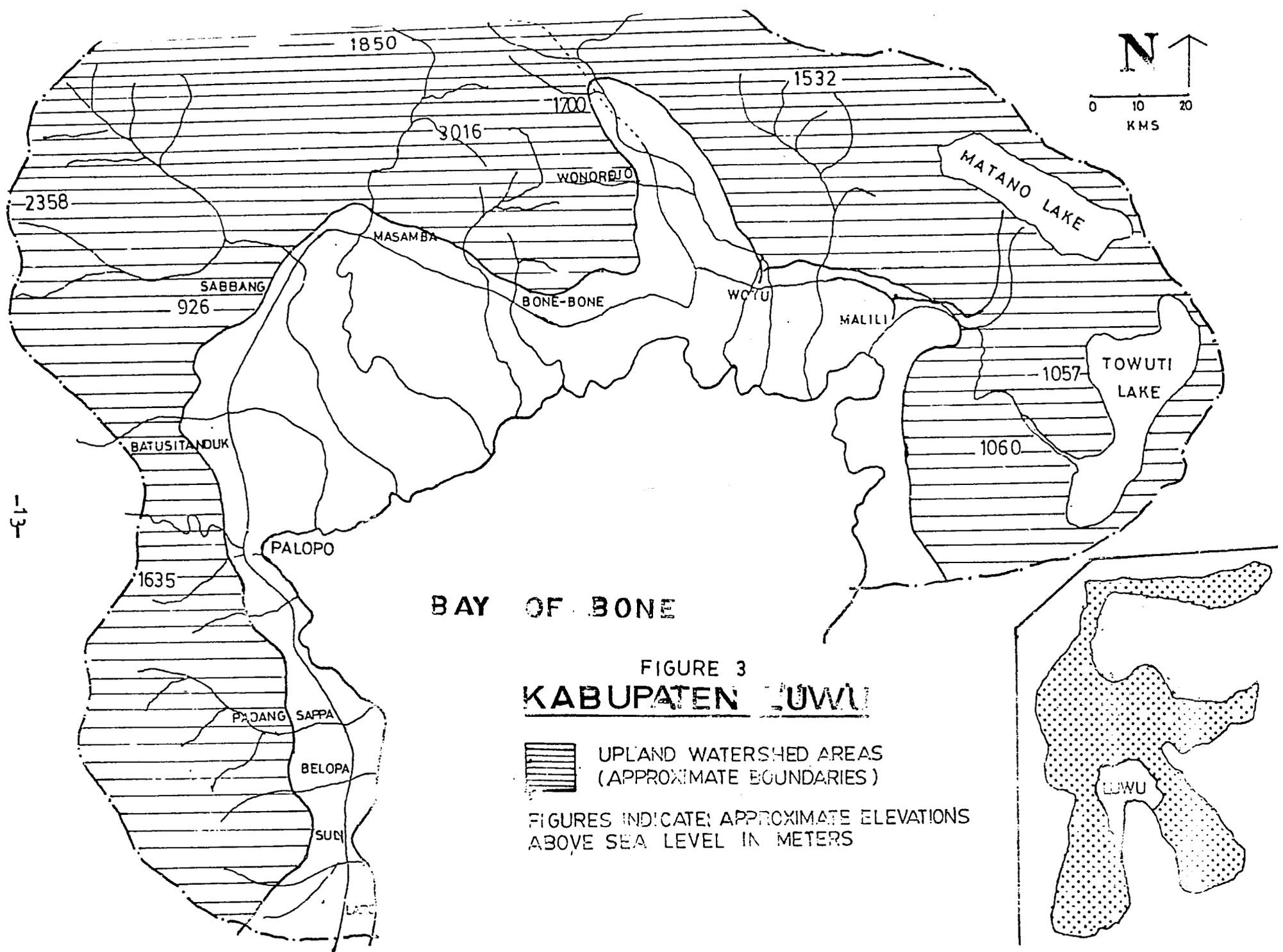


FIGURE 2
KABUPATEN LUWU





BAY OF BONE

FIGURE 3
KABUPATEN LUWU

 UPLAND WATERSHED AREAS
(APPROXIMATE BOUNDARIES)

FIGURES INDICATE APPROXIMATE ELEVATIONS
ABOVE SEA LEVEL IN METERS

TABLE 2

KABUPATEN LUWU - LAND USE DATA
1980

Kecamatans	Area (000 Ha)	Total Agricultural Land (Ha)	Irrigated Land (Ha)	Permanent Forest (Ha)	Pasture/ Grassland (Ha)	Urban/ Village (Ha)	Hectares Per capita *
Larompong	36.0	10,517	1,402	9,008	-	134	1.68
Suli	20.0	6,148	3,596	9,572	1,071	419	1.25
Bastem	324.9	12,875	1,050	275,176	38,875	1,716	25.92
Bupon	75.0	16,651	8,401	4,784	625	1,701	1.57
Wara	19.0	2,954	897	8,473	1,700	2,578	.32
Walenrang	183.2	17,317	11,224	135,356	1,350	2,800	2.64
Sabbang	241.4	3,862	2,995	105,634	98	193	8.35
Limbong	244.3	9,948	1,928	161,690	3,668	202	22.81
Massamba	274.0	11,084	4,754	178,040	52,615	1,038	10.87
Malangke	80.0	4,520	1,500	19,800	1,455	1,533	4.49
Bone Bone	63.2	5,837	3,988	28,650	-	2,437	1.22
Wotu	177.3	6,048	1,368	70,147	10	910	6.64
Mangkutana	210.4	10,249	3,448	126,700	223	2,619	5.88
Malili	215.5	2,305	450	176,977	380	1,843	14.26
Nuha	291.0	1,249	586	288,859	921	399	10.10
Total	2,514.4	132,408	53,437	1,639,862	103,617	22,819	4.99 (ave)

Source: Derived from Data from BAPPEDA, Kabupaten Luwu.

* 1980 Population data.

road, maintained by the company, extends from Malili to the facility, located at Soroako. P.T. Inco also maintains regular air service between Soroako and Ujung Pandang.

Transportation in the Kabupaten is provided for the most part by the main highway which traverses the region from Larompong to Malili and from Wotu north into Central Sulawesi. Another road goes west from Palopo through the mountains to Kabupaten Tanah Toraja.

Secondary roads to outlying areas away from the highway are very few and in very poor condition. In most cases 4 wheel vehicles cannot go but a few kilometers from the highway. The two more remote kecamatans, Limbong and Bastem, can only be reached on foot or horseback. Large portions of the watersheds of the major rivers are extremely remote and difficult to reach. Development in those critically important areas has been, and continues to be slow.

In terms of future land use a large oil palm estate is now being developed in kecamatans Wotu and Masamba. The first planting is now underway and production will begin in about 2 1/2 years. The estate is being developed as a nucleus estate in which a portion of the area being planted will be turned over to smallholders when it starts to produce. The small - holders would be trained in proper management techniques prior to that time. The company is now planning to construct one primary oil extraction mill to service the estate. The mill will be located near the highway on the Bungadidi River, about mid-way between Wotu and Bone Bone.

In another activity, exploration of copper-lead-zinc deposits has been underway in the mountains to the west of Batusitanduk in Kecamatan Walenrang. Should this prove feasible, a road would be constructed from the highway into the site and a separation and concentration mill would be constructed in the head waters of the Lamasi River.

Aside from those projects, no other specific future land use changes other than general increases caused by population growth can be identified at this time.

3.4 Water Resources

In Kabupaten Luwu there are many rivers and small streams emptying into the Bay of Bone. These rivers provide

all the water for irrigated agriculture in the coastal plain and also provide the majority of water needed by the people living along their banks and in nearby villages. Table 3 lists the major rivers with their lengths, catchment areas and slope. In North Luwu there are 22 rivers that originate in the mountains and flow to the Bay. Many of these have small, steep catchment areas and are less than 15 kilometers long. Ten of them have catchment areas of less than 100 square kilometers. Most of these smaller watersheds are quite near to the highway.

TABLE 3
MAJOR RIVERS OF KABUPATEN LUWU 1/

River	Length (Km)	Catchment Area (Km ²)	Slope %
1. Larompong	39	-	-
2. Suli	46	-	-
3. Paremang	105	883	-
4. Bajo	59	378	-
5. Batang	15	115	4.8
6. Lamasi	42	365	4.2
7. Makawa	15	198	7.7
8. Tabu	10	29	12.8
9. Ampak	9	29	9.9
10. Rongkong	52	1030	3.5
11. Baebunta	13	40	7.5
12. Radda	13	40	10.8
13. Masamba	17	105	7.2
14. Balease	38	855	4.3
15. Uraso	8	24	12.7
16. Lampuawa	14	29	8.8
17. Kanjiro	19	120	12.6
18. Bone Bone	10	46	10.2
19. Bungadidi	20	83	5.8
20. Bombalu	13	26	8.2
21. Senggeni	18	85	9.3
22. Tomoni	33	190	7.5
23. Kalaena	53	1070	2.0
24. Angkor	25	330	3.4
25. Cere'ang	41*	570	3.7
26. Larona	59	-	-

* Approximated with incompleated data.

1/ Source: Directorate General, Irrigation.

Most of the catchment areas of the larger rivers are located further inland from the road in the very steep, irregular mountainous terrain of Kecamatan Bastem, Walenrang, Sabbang, Limbong, Masamba, Mangkutana, Nuha and Malili. (See Figure 2). More than half of the watershed area in North Luwu is above 1000 meters in elevation.

In South Luwu most of the land under irrigation is supplied with water through village level systems. Here there are 4 large rivers and numerous small streams. The rivers rise in the mountainous areas on the western part of South Luwu, particularly in Kecamatan Bastem which is mostly mountainous, with peaks up to 3000 meters high.

Streamflow measurement are being taken in the larger rivers of Kabupaten Luwu by the Water Resources Division of the Ministry of Public Works. On the strength of that data it appears that many of the small rivers in North Luwu have periods of low flow less than that needed by the irrigation systems now in place, under construction, or planned.^{1/} This will particularly be the case in August and September, the months of normally lower rainfall. There are plans underway to divert flows from some of the larger rivers to make up the deficits for the irrigation schemes. Table 4 shows the plan for the North Luwu sub-project supplies. Additional development with major land clearing in the watersheds of these rivers will tend to prolong the low flow periods and may exacerbate the shortages.

Sediment loads are also measured monthly in the rivers of North Luwu. On the basis of measurements over the past eleven months all the rivers in North Luwu except the Masamba are carrying low silt loads.^{2/} This implies that upland erosion is, at this time, reasonably under control. Visual inspection of these rivers at bridge crossings tends to support this conclusion. However, it should be noted that high silt loads have been observed following heavy rains in the mountains. Monthly sampling and casual observation may not be frequent enough to provide a good representation of actual conditions. The Masamba River exhibits uniform high silt loads.

No silt measurements are available for the rivers of South Luwu. However, visual inspection at the bridge

^{1/} Ilaco, "Master Plan, Irrigation Development for the North Luwu Plain, Sulawesi Selatan", March 1977, pp. 88-92.

^{2/} Irrigasi, Proyek Luwu monthly records.

TABLE 4
 CONDITIONS OF STREAMFLOW FOR IRRIGATION - NORTH LUWU

River	Estimated Period Shortage	Alternate Supply
Lamasi	September	Batang
Makawa	September	Rongkong
Tabu/Ampak	September	Rongkong
Rongkong	Adequate flow	
Balaese	Adequate flow	
Kanjiro	Year Round	Balaese
Bone Bone	August/September	Balaese
Lauwo/Bungadidi	Many months	None
Senggeni	September (Minor)	
Tomoni	Adequate Flow	
Kalaena	September	Tomoni

Source: "Master Plan, Irrigation Development for the North Luwu Plan, Sulawesi Selatan" March 1977, Ilaco.

crossings indicates that silt loads are generally higher here than in North Luwu. This is consistent with the previous observation that there is more clearing and planting of crops on the near slopes here than to the north.

In terms of domestic water supply, nearly all residents of Kabupaten Luwu get their water directly from nearby streams or, if the distance to a stream is great, then from shallow wells. The rivers are heavily used for washing of clothes, bathing and waste disposal as well as consumption.

The main exception is in Palopo where filtered and treated water is provided through a piped system with some house connections as well as public taps. This system supplies about half the people of Palopo. The water is extracted from the Mangkaluku River, which is estimated to have an adequate flow to meet Palopo's needs until 1985. Another small, undeveloped river in the area has enough water to supplement the supply after that, but no development plans have yet been prepared.^{1/}

Precipitation in Kabupaten Luwu tends to be highest from March through June and lowest from August through October. Mean annual rainfall ranges from 1,736 millimeters

^{1/} Project Luwu, "The Economy of Kabupaten Luwu, South Sulawesi", December 1982 Page 131.

in Kecamatan Bajo to 3,611 millimeters in Kecamatan Masamba. The mean rainfall for the whole of the North Luwu Plain is about 2,900 millimeters per year. In the higher elevations away from the coast the mean annual amounts increase about 800 millimeters for each 500 meters increase in elevation due to the orographic effect of the hills. Table 5 shows mean monthly rainfall figures for selected stations in the Luwu plains.

3.5 Forest Resources

As mentioned earlier, a large part of Kabupaten Luwu is, at this time, under forest cover. The Forestry Office estimates that there are 1,325,314 hectares of forest, most of which is government owned and controlled.

Much of the forest contains a variety of species including hardwoods and softwoods, consisting of ebony, mangrove, rattan and mixed timber. There has been no overall survey of the forests and, therefore, no good inventory of the forest resources. The majority of the mixed timber resources are not of particularly high quality. The plant manager at the plywood factory in Bupon, for example, indicated that most of the high quality logs used by the plant come from outside the region. Meranti from Maluku and teak from Sulawesi Tenggara are used extensively for the facing veneer. There are over 30 species of local hardwoods used for the interior core material.

The Forestry Office indicated that there are three forest concessions now operated by private companies with licenses to harvest timber on about 660,000 hectares. Two of these concessions are active on about 173,000 hectares. These companies may have aerial survey inventory data for their concessions, but, if so, it is not publicly available. Nearly all the forests, with the exception of the coastal mangroves and river bank growths of rattan are in the upland areas. Much of the area shown as upland watersheds on Figure 3 is under forest cover.

In terms of monetary values, the Forestry Office provided the following data on 1982 timber prices:

- | | |
|----------------------|----------------------------|
| 1. Top quality ebony | -Rp 400,000/m ³ |
| 2. Kalappia Celibica | -Rp 120,000/m ³ |
| 3. #3 Mixed hardwood | -Rp 45,000/m ³ |
| 4. #4 Mixed hardwood | -Rp 35,000/m ³ |

TABLE 5
MEAN RAINFALL BY MONTH IN MILLIMETERS AT SELECTED STATIONS
IN KABUPATEN LUWU

	Bajo/Belopa	Palopo	Lamasi	Masamba	Bone Bone	Wotu/Tarengge	Mangkutana
January	128	204	175	331	164	172	350
February	150	222	223	321	225	204	303
March	217	288	265	386	222	246	435
April	227	318	362	428	306	371	442
May	188	323	316	397	391	294	445
June	178	250	271	361	257	219	311
July	140	188	196	233	242	237	258
August	96	153	160	229	262	194	233
September	81	135	164	192	173	113	94
October	62	158	168	155	119	116	201
November	137	232	211	226	150	195	230
December	132	248	231	352	172	172	293
Total	1,736	2,719	2,742	3,611	2,683	2,533	3,595

SOURCE: DHV Consulting Engineers, "100 Years of Rainfall Recording in South Sulawesi 1979-1980" March 1981.

However, without a survey and inventory, little can be said about the overall value of forest resources in Kabupaten Luwu except that they cover an extensive area and are of significant economic potential.

3.6 Government Agencies and Programs

3.6.1 Forest Management

The Ministry of Forestry, with provincial offices in Ujung Pandang and a local office and staff in Palopo, is directly responsible for managing the forest areas of the Kabupaten. Under present regulations all exploitation of forest resources is supposed to be done under license issued by the Forestry Office. There are several specific regulations which apply to the harvest of forest products. These regulations include a ban on harvesting in critical area and limits on the amount and size of logs harvested. At the present time harvesting mangroves is prohibited except when clearing for a fishpond. And, certain areas in Nuha and Malili are closed to the harvesting of rattan. Limits of log size specify that certain types of trees must reach a certain size before they are cut. For example, in the case of hardwood logs such as ebony and terminalia gigantea, only trees with a trunk diameter of 60 centimeter or more can legally be cut.

The implementation of these regulations and the control of the exploitation of forest resources are difficult because of the very large area of forest in the Kabupaten and the small forestry staff available to police activity. The large concessions are not too difficult to handle, because the restrictions can be built into the licenses. But, there is an extensive amount of "informal" harvesting of timber by individual both for firewood and for lumber. It appears to be common practice for farmers and others, during idle periods when no income is available, to go to the public forest to cut and sell wood. In many cases they have no good alternative source of income to turn to. This has led to some clearing of steep slopes and areas that should have been kept under forest cover.

The Office of Forestry also plays a major role in reforestation of disturbed areas, which is a national scale program to restore the Nation's watersheds through reforestation and implementation of soil conservation measures. The National Regreening Program (P3RPDAS) was set up to provide reforestation and soil conservation assistance in the Nation's watersheds. Until very recently this program has been under the Ministry of Agriculture, through

the Director General for Forestry. Now with the reorganization it is in the new Ministry of Forestry. While it is a national program it has only recently started to have an influence outside of Java. It is assumed here that the reforestation effort in Luwu is a part of this program. In this respect, however, the new Ministry is still in the formative stages. Within the Ministry there is a Directorate of Reforestation and Land Rehabilitation, a Directorate of Soil Conservation and a Directorate of Regreening and Shifting Cultivation Control all of which can have a strong influence on watershed management activities. Just how much remains to be seen. In Kabupaten Luwu the regreening effort is primarily aimed at reforestation on steep slopes. In 1980, 1981 and 1982 510 hectares were replanted with pine and lantoro in kecamatan Bastem. In 1982/83 440 hectares were reforested in Limbong. Such programs cost about Rp. 40,000 per hectare.

Forestry also has a plan to reforest about 4,500 hectares in the steepland adjacent to the North Luwu irrigation projects. These slopes, located near the transmigrant villages were seriously damaged by cutting and clearing before any controls were applied. Reforestation in that area is expected to cost about Rp. 500 million over a 5-year period.

The Forestry Office has prepared a management plan for the forest in all of Luwu. This plan divides the forest into five categories as follows:

- | | |
|---|---------------|
| 1. Absolutely protected for ecology, wildlife and preservation purposes | - 173,750 Ha. |
| 2. Protected for watershed management | - 611,875 Ha. |
| 3. Limited production forest | - 381,564 Ha. |
| 4. Regular production forest | - 36,875 Ha. |
| 5. Forest which can be converted to agriculture | - 121,250 Ha. |

The Forestry Office has prepared a map delineating the approximate boundaries of each category. These boundaries were drawn on the basis of best available data. With the lack of a forest inventory and the lack of data on soils, topography and elevation were the two more important parameters used in setting the boundaries.

The stated purpose of the plan is to protect the watersheds so that the water resources are available in the proper quality, quantity and distribution for the important downstream uses. The only areas in forest now that would be cleared for agriculture under that plan are:

- a. a small area in Bastem in the upper watershed of the Paremang River;
- b. a high, flat valley in upper Limbong in the watershed of the Betuwe River, which flows northwest out of Kabupaten Luwu;
- c. a high flat valley in upper Masamba which drains into Sulawesi Tengah; and
- d. an area of high valley in upper Mangkutana in the farthest reaches of the Kaleana watershed.

All the other existing forest would remain as permanent forest. Although it is not clear just what the ultimate fate of the "regular production" forest would be, forest areas in categories 1 and 2 would not be subject to exploitation at any level. Category 3 forest would be harvested at a rate not to exceed 30 cubic meters per hectare per year. (Apparently this is the estimated sustained yield capability).

Under the plan, all people living in the protected forest areas would be relocated, given a house, land and a 6 month supply of food. Relocation would cost up to Rp 3 million per family. There are an estimated 2060 families now residing in those areas.

This relocation program comprises a large part of the Luwu Forestry Office budget for the 5-year planning period, 1984-89, with relocation planned to be started in 1984-85 and continuing for 3 years at an estimated cost of over 6,000 million Rupiahs.

At the time of this report, the plan is still under consideration in Jakarta, and has not yet become the official forest management plan for Luwu.

3.6.2. Agriculture

The majority of effort in the Ministry of Agriculture in Luwu has been oriented toward the lowland farmer. The programs, concentrated mostly on managing and improving

production in the irrigated areas have little direct effect on the watershed areas. However, there are two potentially significant programs from the stand point of watershed management. The program carried out by the rural extension center (REC) does provide educational material on the subject of soil conservation. The effort is at the very early stages, but is expected to increase overtime as more and better training materials become available.

The second significant program is that activity in the Office of Estate Crops. Estate crops are coconut, clove oil palm, coffee, pepper, cocoa and others of a similar nature. Usually they are perennial crops and are most suitably grown in large operations rather than by small holder, because of the initial costs and the need for some form of processing and marketing management beyond that available to the small farmer. The oil palm estate mentioned earlier falls under this office's program.

Under this program small clove farmers are getting advice on soil conservation practices but there has been little follow-up to determine if the advice is used. Observation indicates that there has been little adoption of conservation techniques.

One interesting measure designed to improve soil conservation measures in upland agriculture was partially implemented in Luwu. In this case the Governor instructed the Office of Estate Crops and Bank Indonesia Rakyat to require that farmers seeking loans to plant estate crops be required to include a cover crop or other conservation measures in their plan, as a condition for the loans. The requirement was imposed but not followed-up. Once the loan is made it difficult to enforce such specific practices, and the lenders have not, in general, done so.

The Office of Estate Crops is more concerned with the development of larger operations. It is their belief that many parts of the Luwu upland areas are suitable for estate crops, particularly coffee and tea. They further feel that such crops can be established on large estates without serious soil erosion because the large companies who would undertake such projects would have the expertise and financial resources to use the proper methods. The office also indicated that they would include specific requirements for soil and water protection in operating plans.

3.6.3. Environmental protection

At the present time the Ministry of Environment program in Luwu is focused on protecting that portion of the forest designated as category one in the Forestry Plan. This area of 173,750 hectares is located in the northwestern part of Kecamatan Nuha. There are 6 staff members of this agency now in Luwu, all housed in Wotu. They indicated that they have no other duties at this time and that they lack manpower to expand their function.

They expect their main office in Jakarta will carry out a survey of the protected area to prepare a multi-use development plan for wildlife protection and, perhaps a national park.

As an additional duty, they have received a Ministerial decree that all rivers should have a forested conservation reserve 100 meters wide on each side of every river, presumably for their entire length. At this time they are unable to carry out this instruction or to undertake any environmental assessments or analyses. This office is governed by General Law Number 4, dated 1982 which provides a general statement about the need for environmental management and the responsibility of all citizens to protect and manage the environment and natural resources. That law says what should be done, but does not set in place the mechanisms to do the job. The agency may be of more importance to watersheds and environmental management in the future as more specific authorities and responsibilities are assigned in decrees and regulations.

3.6.4. Water Resources

The Office of Hydrology, Directorate of Water Resources, Ministry of Public Works, is primarily a data collection agency. The agency collects, analyzes and publishes data for most of the large rivers in Kabupaten Luwu. For the most part, up to now, it has measured streamflows and sediment loads. They do have some data on chemical water quality dating back to 1977-78 which could be used in the future to determine the changes taking place in the rivers. This agency has no resource management authority or responsibility. However, it could play an important part in future planning by providing the capability to monitor the region's water resources and identify critical changes requiring corrective action. They would also be an important part of any regional development planning that might include upstream impoundments.

3.6.5 BAPPEDA - The Regional Planning Office

There is a regional planning office in each province (Bappeda TK I). In addition regional planning offices are now authorized at the Kabupaten level (Bappeda Tk II). In January 1982 Bappeda TK II Luwu was formed to assist the Bupati with the formation and evaluation of development policy in Kabupaten Luwu.

The implementation legislation outlines the general functions of Bappeda, which include:

Coordinating the planning of all government offices;

Coordinating and conducting al research for planning;

Following the preparation of plan implementation;

Monitoring development progress.

Consequently, Bappeda is to conduct planning studies to assist the Bupati and the Governor in deciding on development policy to be carried out by the various government agencies. There are several divisions within Bappeda TK II including a Data and Reporting Division, an Economic Division, a Socio-Cultural Affairs Division and an Infrastructure Division. The last one include land use, natural resources and environment under its areas of responsibility. Much of the activity in these areas is still in the formative, early stages.

4.0 Conclusions

4.1 Present Watershed Conditions

At the present time most of the watersheds in Kabupaten Luwu are in reasonably good condition. There are areas around the population centers where indiscriminate clearing has occurred, and is still occurring on steep slopes. Some corrective actions are needed on some slopes in South Luwu, around Palopo and near the highway in North Luwu, but, as opposed to conditions on Java, where massive effort and expenditure are needed for reclamation work, the main effort in Luwu can focus on protection and prevention of serious damage through good management. The main protection for most of the watersheds now is the lack of easy access and lack of population pressures. There is still good agricultural land available in the plains awaiting development, and, therefore, should be no great need for people to move into the hills and mountains at this time. Any major inflow of people through further transmigration projects could quickly change this and should be evaluated carefully.

The rivers reflect the good watershed conditions, especially in North Luwu where the Masamba is the only river that shows consistently high silt loads.

Any attempt to rank the watershed of Luwu in order of importance leads to the conclusion that all the rivers of Kabupaten Luwu are important to the people living along them and using the water for food production and domestic consumption.

In North Luwu the watersheds of the Lamasi, Rongkong, Balease and Kalaena are the largest and supply the largest portion of the irrigation needs in the North Luwu Plain irrigation projects. But all the rivers supply some and even those with small catchment areas should be managed to maintain this flow for downstream users. In fact, the smaller watersheds are the more susceptible to damage because they are closest to the population centers and, with their small size, a small absolute amount of clearing on the hills constitutes a relatively large intrusion on that natural system.

4.2 Present Planning and Management

There is a strong awareness on the part of government officials at all levels of the importance of the watersheds and the need for protecting them. The strong push for good

management comes down quite directly from the National level and this is probably due to what has already happened to the watershed in other parts of Indonesia, particularly Java.

At this time, efforts to properly manage the resources of the watersheds in Luwu are fragmented. Each agency has its own set of activities and priorities. Many of the institutional pieces necessary for developing a good watershed management program are here, but the overall perspective and framework needed to coordinate and manage the pieces and develop a systematic planning effort responsive to the needs of the Kabupaten is not yet in place. The Bappeda TK II Luwu office is the logical candidate agency to take on this role. Its stated objectives and responsibilities are consistent with watershed management planning needs but its staff and funding would need to be reinforced.

Of the government programs in place now, the Forestry activities are the most influential in the use of the watersheds. They have licensing procedures and rules and regulations regarding forest practices. But they have difficulty in controlling just what goes on in the forest areas. Unauthorized cutting and clearing are common. With the vast areas of forest, much of it with difficult access, policing is a difficult matter.

The forest management plan prepared by the Office of the Forestry and now under review in Jakarta is an ambitious plan. If approved and implemented it will essentially prevent development in most of the Kabupaten's watersheds and keep all the high land under forest cover. From an environmental and ecological point of view it appears to be a superior plan. It would guarantee that the rivers and streams would be maintained in their present condition. And, coupled with the reforestation efforts now underway and planned, it could lead to improved water resources overtime.

In the long run, however, the Forestry plan may be too restrictive. More productive use can be made of many of the upland areas without damaging the water resources or the soils of the area. New agricultural packages, tree crops, for example, in combination with permanent cover, useful as forage, could mean more productive use of the hilly areas in the long run if done properly. Not enough attention or serious consideration has been given to such alternatives. That attention will not be forthcoming in any systematic manner until a coordinated planning framework is in place and functioning.

In areas of privately held land, much of it is in small agricultural plots. Most small farmers do not have the technical knowledge or the financial resources to do a proper soil conservation job. Agriculture, through its Rural Extension Centers and the Estate Crops extension workers, can play a very important role in teaching these farmers the reasons for and methods of soil conservation. The REC program has started this on a limited scale, but now is only touching the surface. They need more training materials - films and slide shows, etc. - to get the message across.

The use of large-scale estate development in specific areas is promising. Large organizations, developing large areas will have more and better technical knowledge and resources with which to assure proper initial preparation of the land and proper conservation and cultivation practices. The use of the nucleus estate concept, where a portion of the land is turned over to the smallholders when it starts producing, also has a potential place in upland development. The crops raised in these enterprises are usually perennials which can be grown with permanent cover to prevent serious erosion.

The Office of Estate Crops has indicated that several large companies would be ready to develop estates in the higher lands of Bastem and Limbong if and when an access road is provided. These higher elevations are well suited to coffee and tea and other crops requiring similar climatic conditions and having reasonably good export markets. These potential productive activities should not be overlooked in the watershed planning approach, although the Bastem road was given a low priority in the Luwu Road Program Study.

4.3 Planning Data

Data on soil capability, land use, and forest inventories is lacking for much of the Kabupaten. A good program of aerial photography, coupled with ground surveys and soil survey would substantially improve the data base upon which good plans can be established.

4.4 Technical Information

Most of the Agricultural research for Luwu has, up to now, concentrated on food crop production in the irrigated lands. There is a need for a systematic evaluation of technical agricultural options suitable for use on the steep and mountainous lands of Luwu. Information is needed on the various crop combinations suitable for the existing soils

and the different agro-climatic zones at the various elevations ^{1/}. There also is a need for improved guidelines in terms of limits to cultivation on various slopes. Some general rules are available now which can guide the early developments, but more must be done to determine what the safe limits are, and what practices should be followed to prevent serious erosion on steep lands. For example, now present policy attempts to discourage annual crops on slopes over 5°. With terracing or grass contour strips up to 7°; perennials up to 15°; and some commercial estates up to 40° with good slope length and soil texture. In most of the watershed programs in Java an absolute slope limit of 22° (50%) is used for all crops, with forest cover on everything steeper. Previous experience and observations in other regions indicate that there are technical agricultural packages which will allow good use of steeper land without seriously endangering the soil or water resources. This needs further study specific to Luwu conditions.

Another area where little is known is in the hydrologic behavior of the watershed system when the vegetation is modified. It is obvious that clearing slopes without proper precautions causes massive erosion and enhances floods and drought conditions. But the net effect on the water resources of changing from a forest ecosystem to an oil palm plantation or a grass fruit tree combination for example, is not clear. In a watershed where the river flows are already marginal for downstream users this will be an important thing to know before going ahead with development in the upper watershed.

4.5 Laws and Regulations

The existing laws and statutory authorizations appear to be reasonably adequate for watershed management on public lands. They reflect the awareness of the importance of the watersheds mentioned earlier. One area where there are weaknesses now is in environmental control. The general law specifying the need for environmental concern and setting up a case for the environmental assessment of potentially damaging projects is now in place. However, under the present law this responsibility is placed at the local (Kabupaten) level where technical resources are extremely limited.

^{1/} Over half of the land of Luwu, outside of the coastal plain is over 1000 meters in elevation. This can create very different climates and very different practical cropping patterns than the coastal plains and lowlands.

Within the present legal framework there are no means for requiring and enforcing good conservation management on private land. This must be done through extension education and personal persuasion.

4.6 Projections

If no changes are made to current watershed management practices and current trends in land use continue, there will be increasing small-scale but damaging clearing on the steep hills, especially in areas near transportation routes. The small watersheds of North Luwu will be susceptible to severe modification. Most of the clearing will be done without proper conservation methods such as terracing, contour strips or permanent cover, and erosion will continue. The rivers will carry increasing silt loads over time and the river flows will change.

The high forest land now in government ownership will be reasonably well protected, especially if the plan for conservation proposed by Forestry is implemented, for the next few years. However, with increasing population in the Kabupaten and increasing economic activity, there will be growing pressures to harvest more timber from the steep lands and to clear and plant to provide a living for people as small farmers. This pressure will be very difficult to resist. Where Forestry now has problems enforcing limits on cutting, the problems will be compounded as development pressures increase.

As the Luwu development continues, roads will be improved, making the now remote Kecamatan of Bastem, Limbong and others in the upper watersheds more accessible. The problems of protecting the high steep lands will increase.

Generally, while conditions in the watershed of Kabupaten Luwu are now comparatively good, without a reasonably well-balanced management program that reflects the present and future needs of the people for a healthy economy and a healthy environment, watershed conditions will deteriorate.

4.7 Options for Watershed Management

There are many different ways in which the watersheds of Kabupaten Luwu can be managed. These are perhaps better classified as "degrees", or intensity of management.

On one extreme there is always a "do-nothing" alternative. In this option nature and man take their chosen courses with respect to what is done with the resources of the watershed without intervention-free from regulation or control. In the short run this is the easiest and least expensive option to implement-and it often is the one chosen because it offers the maximum short term exploitation.

On the other extreme there is a total preservation alternative. In this option any and all activities which might alter the environmental conditions of the watershed would be prohibited. The costs of implementing this option are relatively low also, because no studies or surveys are needed and no judgements as to how resources should be used will be needed. It may be difficult to enforce, however. From a short term economic point of view this alternative has little appeal as there would be no resource exploitation. In some cases this is chosen as the preferable option in limited or unique areas with special attributes that society wishes to preserve or to preserve an area until better data is available for good management decisions.

Within these two extreme there is a continuum of options which provide different levels of exploitation and preservation. Just what constitutes an optimum point between them is a matter for public policy to decide. The conscious selection and implementation of a management option that seeks to provide this optimum is more difficult to develop. It requires good data and a reasonable knowledge base. It requires the balancing of conflicting views and objectives. And it requires the greatest amount of resources to get the planning done and implemented. But in the long term, done properly and implemented, the balanced plan will serve the people well, helping them to meet their economic needs and maintain a good natural resources base and environment for sustained development. Naturally, this is the option recommended for watershed management in Kabupaten Luwu.

5.0 Recommendations

The recommendations for managing the watersheds of Kabupaten Luwu are in two general categories. One deals with the establishment of the institutional framework for planning and management while the other category deals with specific items which should be underway now, or very soon, under existing authorizations and within existing agencies.

5.1 The Institutional Framework for Watershed Management

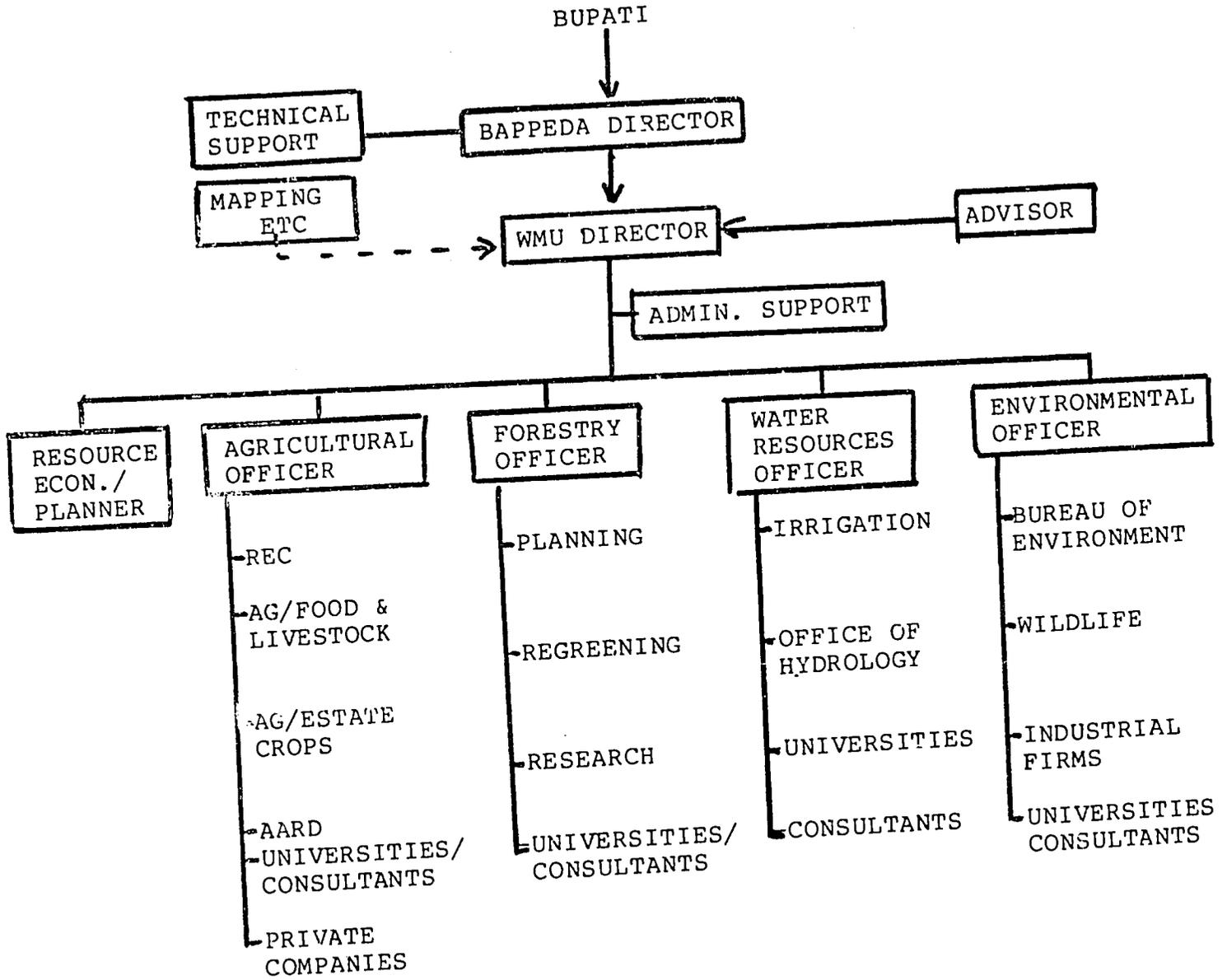
A watershed planning and management "unit" (WMU) should be set up at the kabupaten level. The WMU would be responsible for developing and coordinating the implementation of a plan for the protection and long term development of the watershed areas in Kabupaten Luwu, in balance with the overall development program and objectives of the Kabupaten.

This WMU should be established independent of operating agencies with line responsibilities in any related areas, but it must have close communication and cooperative working relationships with those agencies.

The Regional Planning Office in the Kabupaten - Bappeda TK II - is recommended as the "home" of this unit.

The primary function of the WMU will be to coordinate the activities of all the agencies now working in parts of watershed management and to provide a central forum in which the parts can be brought together into an overall integrated plan. The WMU must be staffed with a capable, interdisciplinary team and be able to work closely with the operating agencies. Ideally, the WMU would be staffed with specialists from the line agencies, primarily Ministry of Agriculture, Ministry of Forestry, Office of Environment and Water Resources as well as the planning staff of Bappeda. If this is not possible then these specialists should form a technical advisory and liaison committee to work with the unit as well as their parent agency on a periodic basis. At this time it is assumed that the technical staff will be seconded from the line agencies. The WMU director must be independent of all line agencies. He should be a permanent senior staff member of Bappeda. Ideally he would work directly with a counterpart expatriate advisor through the initial development of the plan. This Advisor should be available for at least a 3 year period. The WMU must have a budget and operating funds of its own and should be able to make proposals for funding various activities through specific agencies so that programs of data collection and

FIGURE 4
 WATERSHED MANAGEMENT UNIT
 PROPOSED ADMINISTRATIVE STRUCTURE



research can be carried out where needed to develop the watershed management plan. Figure 4 depicts the proposed administrative structure of the WMU.

5.2 The Long Term Plan

The WMU would develop the overall watershed management plan within a 5-year period. The planning period is governed to a large extent by the time needed to acquire data and research outputs. Following completion, approval and adoption of the plan the level of staffing and activity within the WMU may be reduced. The individual members of the planning team from the operating agencies should then concentrate on the implementation of those parts of the plan relevant to their own agencies. However, it is essential that the WMU continue to exist as a permanent base for watershed management within Bappeda. It would be responsible for coordinating the parts of implementation, act as a catalyst as necessary when and if progress in implementation slows down, monitor and report on the status of the implementation program in all the agencies and, over time, adjust plan elements if conditions change within the Kabupaten.

5.3 Near Term Recommendations

As an adjunct to the main planning process the WMU should immediately begin the task of coordinating, monitoring, and enhancing watershed management that is now underway or should be underway to prevent further deterioration of watershed conditions. Each relevant agency program should be reviewed in detail, and evaluated with respect to its relationship to other activities and the overall needs in watershed management, and assistance given to expedite those activities which are needed. The following items should be given attention in the near term.

5.3.1 Forestry-related activity

The Forestry office should implement the initial phase of its forest management plan. The area designated for park and wildlife in Northwest Nuha should be officially set aside as a preserve. However, the plan to relocate families now living in the areas designated as protected forest should be delayed until the WMU has a more balanced plan for managing the watersheds 1/. The forest management plan,

1/ The relocation program in general in South Sulawesi has been extremely slow. In their 1982 Annual Report Forestry indicated that of about 10,700 upland farmers slated for relocation only about 360 have been moved up to now.

as proposed, should be considered a holding action for the near term, subject to modification on the basis of additional data and analyses.

The Forestry Office should strengthen its enforcement capability by adding additional forest police to control illegal informal harvesting of timber and clearing of steep slopes. Where such harvesting provides the only essential income to people, such as farmers between cropping seasons, the Forestry Office should consider setting up a program, such as a "Conservation Corp" to provide short term employment in forest management labor as a substitute source of income to these people.

The Forestry Office should also undertake a forest survey to provide a good data base in forest resources. The survey should be started now and should be completed within 3 years. If this time phasing proves impractical then areas for survey should be selected on a priority basis, in coordination with WMU needs.

Stream bank protection should be enforced and reforestation of improperly cleared slopes should be continued. The plan for reforesting 4,500 hectares in North Luwu should be implemented now.

The Forestry Office should cooperate with the Ministry of Agriculture in identifying and evaluation alternative tree and crop combinations which may be suitable for steep slopes and high elevations.

And, finally, the Forestry Office should assign a professional forester, familiar with Kabupaten Luwu and the Forestry Office's Plans and Program to the WMU as a permanent staff member.

5.3.2 Agriculture-related activity

The extension and training activity in soil conservation initiated by the Rural Extension Center in Luwu and by the Office of Estate Crops should be increased and given more support. They should be able to provide a more comprehensive program of soil conservation to the small farmer in the upland areas. This will require additional visual aids, such as slides and movies, and field demonstration in the use of simple effective measures.

Upland crop research programs should get under way immediately. The Ministry of Agriculture, through the Agricultural Research Institute and academic institutions,

should develop alternative upland agricultural packages, or farming systems, suitable to Luwu conditions and based on the various agro-climatic conditions found at various elevations in the mountains of Luwu. It is anticipated that a major portion of this research can be done by review of existing literature and other on-going research projects, to determine the state of the art. There may be some relatively minor field investigations. No large scale field trials and research are anticipated at this time.

In keeping with this research activity, the Office of Estate Crops should seek proposals for future private investment into large estates where the land may be suitable. They have indicated that several large companies are eager to invest in plantations in Bastem and Limbong, for example for coffee and tea. Concrete proposals should be forthcoming for these enterprises, including details of methods and devices to be used for soil protection.

Where problems of serious erosion now exist Agriculture should take action to provide assistance to the small farmers in implementing soil conservation and reclamations measures. Where the cost of needed remedies exceed the individual farmers' financial capacity there should be financial assistance available. Serious considerations should be given to providing direct subsidies for this purpose. This is reasonable because some of the benefit of reclamation will accrue to the downstream user and, also because lowland farmers have been receiving subsidies as a general practice (e.g. the irrigation systems) while upland farmers have received none.

The Ministry of Agriculture should also assign a professional agriculturalist as a permanent members of the WMU.

5.3.3 Environmental Management activity

The activity of the Office of Environment should be expanded at the Kabupaten level. A staff member knowledgeable in environmental assessment procedures should be assigned to Bappeda permanently. This officers should be able to draw upon the Provincial level office of Environment to provide technical assistance as necessary.

All new proposed major developments in the watersheds, or on the river systems, should be subjected to an environmental assessment. This assessment can be multi-stage. An initial screening should be done by the

local staff. In most cases this will indicate that there will be no serious, long lasting effects, in which case the assessment ceases. Should the indications be that serious effects may occur then a more detailed assessment should be done with assistance from the provincial level, or with experts in relevant fields.

As a starting point there should be an initial screening of the proposed palm oil mill on the Bungadidi River. Palm oil mills are generally heavy water users and notorious polluters. If the waste sludge is returned to the river without adequate treatment downstream users will be faced with serious problems.

As a second task the environmental officer should review the plans and earlier studies related to the potential copper mine and associated developments in the upper Lamasi because the Lamasi River is an extremely important water source for irrigation.

5.3.4 Data for planning

In additions to the forest inventory mentioned earlier there is also a need to develop good data on soil capability, land use and watershed conditions and river conditions.

A program of aerial survey and land use mapping should be undertaken immediately. It will take time and it will be costly, but it is essential to both the agricultural sector and the forestry sector as well as the overall planning effort. It will also be of use to many agencies outside the WMU as well. This survey should be managed through Bappeda.

A soil capability survey should be carried out very soon under the direction and support of the Ministry of Agriculture. Some data now exists for South Luwu. If that data is reliable and sufficient then the major survey effort should focus on the watersheds of North Luwu.

5.3.5 Water Resources Activity

The Office of Hydrology should expand its river monitoring program in Kabupaten Luwu. The frequency of sediment and streamflow measurements should be increased to get a firmer understanding of watershed conditions now and as the management plan is implemented in the future. Ideally, the sediment program should be set up to sample a river immediately following a distinct change in streamflow. At this time, however, this is not practical. At the least,

the frequency of sampling should be increased to twice a month, and the four larger rivers in South Luwu should be added to the sampling program.

5.4 Program Costs

5.4.1 Watershed management unit budget

The estimated costs for supporting the WMU over the initial 5-year period were developed on the basis of several assumptions.

- a. The program would support all the staff salaries on its own budget. That is, even if professionals are seconded from line agencies their salaries are accounted for in the WMU budget.
- b. While the WMU may be housed with Bappeda or in some existing government office space, it is assumed that the space is rented at reasonable market rates.
- c. Extraordinary activities to be carried out by the line agencies will fall under their own existing budgets and are not included in the WMU budget. However, these costs may be substantial, especially for data collection.
- d. It is assumed for budget purposes that the full complement of staff would work for the full five year period with the exceptions of the expatriate advisor who would be employed for the first three years only.
- e. It is also assumed that there will be a need for short term consultants to work on specific problem areas. This research input would be the greatest in the early years of the planning and is expected to taper off by the fourth year. Consequently the budget includes 15 man-months for each of the first three years and 6 man-months in year 4 and year 5.

Table 6 contains the total basic budget estimate for the WMU for the 5-year period. On the basis of this estimate and the expected high costs of data collection it is clear that the cost of this planning activity exceeds the Bappeda local capability for funding and also exceeds the Provincial capability. It appears that outside assistance is needed to support this endeavor, especially in the first three years. A well thought out and fully funded foreign

TABLE 6

WATERSHED MANAGEMENT UNIT
5-YEAR BUDGET

RECURRING COSTS

<u>Staff</u>	<u>Annual Cost</u> (000 Rp)
Director - 1 at Rp. 120,000/month	1,440
Professionals - 5 at Rp. 100,000/month	6,000
Technical - 2 at Rp. 80,000/month	1,920
Skilled - 2 at Rp. 75,000/month	1,800
Short-term Specialists	
15 man-months/year at Rp. 120,000	1,800
(6 man-months/year in 4th and 5th year)	
Total Staff Costs	12,960
Travel - Per Diem	8,500
Vehicle Operation/Maintenance	18,000
Office Rent	2,500
Office Supplies	10,000
Other Annual Costs	<u>39,000</u>
TOTAL ANNUAL COSTS	51,960

INITIAL COSTS

Furniture/Equipment	20,000
Vehicles	<u>60,000</u>
Total	80,000
EXPATRIATE ADVISOR	U.S.\$252,000

technical and financial assistance project could put watershed management in Kabupaten Luwu on a solid basis.

5.4.2 Associated Agency Costs

Any major costs that will be incurred over normal operating budgets during the planning period will, for the most part, be related to data acquisition. Just how these activities can be funded is not clear at this time. It is important that data acquisition get underway early in the planning period. Without good data on current land use, forest conditions and resources and soil capability planning cannot proceed much beyond the conceptual stage.

Economies can be achieved in the data collection by selecting carefully the areas to be surveyed according to their importance in the management program. For example, there is no need at this time to expand the data base in the coastal plains for this planning activity. Furthermore, any areas that will definitely be set aside regardless of the findings - such as preserves for parks and wildlife, need not be surveyed for the initial planning. They may need to have good data later on for providing a management plan, but this should not be attributed to the costs of developing the watershed management plan.

One of the initial areas for decision by the WMU planning team will be the selection of high priority areas where data collection should be initiated early in the program. The present 6,000 million Rupiah now budgeted by Forestry for relocation of families from the protected forests would be better reprogrammed for acquisition of current data on land use and resource conditions in the Kabupaten's forest area as a part of the planning activity.