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SUPPORTING REPORT
(VOLUME 4)
PART FOUR INLAND FISHERIES

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CHAPTER I GENERAL

In Indonesia, both fresh water and brackish water fisheries are categorized to inland fisheries. But, in this survey, inland fisheries means only fresh water fisheries, because the objective area is defined to the catchment area of Lake Tempe and the Cenranae River.

To clarify the present condition of inland fisheries and to estimate the potentiality of fish production, investigation and studies were carried out by means of data analysis and field survey.

Almost all statistic data were collected from the government fisheries offices concerned, such as Dinas Perikanan Daerah Propinsi Sulawesi Selatan, Dinas Perikanan Kabupaten Wajo, Soppeng, Sidrap, etc.

Two kinds of field survey were carried out. The one was limnological and ecological survey of fisheries water area itself, the other consists of fish marketing survey and personal interview with fisherman and others to know the activities of inland fisheries and its history.

CHAPTER II INTRODUCTION

In the objective area (Kab. Wajo, Soppeng and Sidrap), there are two kinds of fisheries activities. One is fishing in natural fresh water (lakes, swamps, rivers and reservoirs), the other is culturing by supplying fresh water (rice field, ponds and hatcheries).

According to the report of Dinas Perikanan in 1977, total fish production in the objective area is 14,000 tons (Table 4.1), and more than 99% of the production depends upon the fishing, especially the one from the lakes (92%, 12,877.1 tons). Secondary production comes from swamp fishing (7.6%, 1,072 tons). And the remaining amount (0.4%, 55.5 tons) consists of river fishing (0.1%, 19 tons), paddy field (0.2%, 23.7 tons) and culture ponds (0.1%, 12.8 tons).

From this data, it is easy to imagine that the lake fishing is playing an important role in the protein source for about one million people in the objective area.

There are three lakes, named Lake Tempe (13,000 ha), Sidenreng (3,000 ha) and Buaya (300 ha).

On the other hand, there are some circumstances not to believe the data of 1977 immediately, because it has been thought by many people that the fish production of Lake Tempe had decreased about 20,000 tons during past decades.

In 1967, the first report titled "Danau Tempe" concerning to Lake Tempe fishing was published, in which the author reported that its fish production peaked in 1948 (25,000 tons) and then, had been decreasing as little as to 5,000 tons in 1966 (Table 4.2). The main cause which he reported was high rate of sedimentation of sand and mud (10-20 cm/year) which flows into the lake from River Walanae and Bila, and this sedimentation induced decreasing the lake's water surface to 1,000 ha and shallowing its water depth to 30-50 cm in the end of dry season. As the secondary cause derived from primary cause, he mentioned overfishing and destruction of spawning place when the water depth goes down so low.

After this report, at least, nine kinds of field survey of Lake Tempe were carried out to grasp the condition of the lake and its fisheries, and at each time, the results were published, and proposed many kinds of recommendation and development plan. All the opinions or development plans are based on the same premises described in "Danau Tempe", that is, high rate of sedimentation and drastic decrease of fish production.

At present time, there are two kinds of data which are showing contradictions against these two premises. One is the final report of P.T. WASKITA KARYA in 1975, which shows 4 mm/year as the sedimentation rate of Lake Tempe. This value is quite different from that of the first report, "Danau Tempe".

The other is annual reports of Dinas Perikanan in each Kab. Wajo, Soppeng and Sidrap in 1977, which are showing 3 times greater amount (about 13,000 tons) of fish production than the average in last ten years (1966-1976), and 2 times greater than the average in last twenty years (1957-1976) (Table 4.2).

In addition total fish production of Lake Tempe in 1977 is only 3,000 tons less than the average during 1950-1956. If the data in 1977 is correct, it means no drastic decrease of fish production had happened during last 20 years.

On account of existence of these two contradictory points against the common premises, it is considered that these confusion should be made clear to recognize the real condition of present Lake Tempe fishing.

As described in the report of river group of the Team, the sedimentation rate of Lake Tempe is estimated about 1 cm/year.

The present condition of the lake fishing was studied and described hereinafter, especially intended to grasp the real amount of fish production from Lake Tempe.

CHAPTER III PRESENT CONDITIONS OF INLAND FISHERIES

3.1 SELECTION OF MAIN TARGET WATERS FOR THE DEVELOPMENT PLAN

As described in CHAPTER II, several kinds of fisheries waters exist in the objective area.

Table 4.3 shows the check list of these waters, based on the result of reconnaissance survey and annual report of Dinas Perikanan Kab. Wajo, Soppeng and Sidrap (1969-1977) summarized in Table 4.4-4.9.

From this check list, lakes and paddy fields were selected for the target waters of inland fisheries development plan.

3.2 LAKES

3.2.1 Fishing Ground

(1) Topographical and Hydrological Conditions of Three Lakes

Lake Sidenreng and Buaya are independently located upstream of Lake Tempe and connected to it by water channel. These lakes are located at the center of the basin, that is, the objective area (Fig. 4.1).

Two big rivers, Walanae and Bila, flow into Lake Tempe from its south and north.

These lakes have the following four kinds of topographical characteristics;

(i) River Menraleng flows into Lake Tempe during flood time of River Walanae, but flows out after its flood time.

(ii) Water level of Lake Tempe at its stable stage is about EL.6 m (water depth: 2.7 m). The inundation area between EL.6-7 m is so wide that the potentiality of fish production of the lake during flood time seems to be very high.

(iii) These lakes are combined into only one lake at the water level of EL.6 m.

(iv) Littoral zone of Lake Sidenreng is narrow and steep compared with that of Lake Tempe. Its water surface area will not shrink even under the water level of EL.6 m, because the channel between both lakes, River Wettee, is shallower than the bottom of Lake Sidenreng.

Fig. 4.2 shows the monthly average fluctuation of water level (EL. m), water surface area and water storage volume of Lake Tempe during 1968-1972, and 1975-1978 (when the water level is above EL.6 m, it shows the total of the three lakes). Following five hydrological tendencies were obtained from this figure.

(v) Total average of EL. water level, water surface area, and water storage volume during these years are about EL.5.9 m, 13,000 ha, 100 x 10^6 tons respectively, and during flood time, the figures often reach EL.7.8 m, 35,000 ha and 310 x 10^6 m^3 respectively.

(vi) The water depth of the lake may probably reach its minimum (30-50 cm) in every 5 years.

(vii) General tendency of the flood probability (about EL.6 m) is not changing, but the flood patterns are changing in each year.

(viii) Average flooded period in each year is about 5.3 months.

(ix) When the water level is above EL.6 m, the fluctuation of water storage volume is quicker than that of water level, and it becomes slower when the water level goes down below EL.6 m.

From these topographical and hydrological facts, it is concluded that Lake Tempe is wide and shallow compared with its volume, and flooded almost half of a year, in other words, it means Lake Tempe is being supplied much amount of water, solar energy, and oxygen compared with the condition at its stable stage. So, Lake Tempe has high potentiality of its primary production.

(2) Limnological and Ecological Condition of the Lakes

Field survey was carried out for the following items.

(a) Water depth

Water depth of Lake Tempe was measured on Feb. 1974 by preliminary survey team of CSSWRDP (6). By the Team, it was roughly checked for the confirmation of the former survey's result, and in addition, the water depth of Lake Sidenreng was also roughly measured, but the one of Lake Buaya was not done.

Measurement of Lake Tempe was carried out by using scaled wooden bar on Oct. 25-26, 1978. Fig. 4.3 shows its result. Generally, the bottom of Lake Tempe is flat but its central and western part are slightly deeper than

that of eastern part. Because in our survey the thickness of silt was not included to the measurement and it was found that much more silt deposit is spreading in the eastern part (15-50 cm) than in the western part. Based on the result, it might be reasonable to consider that the result of the preliminary survey is not so far from the real bottom condition of Lake Tempe.

Measurement of Lake Sidenreng was carried out on Dec. 5, 1978. Fig. 4.4 shows its result. Generally the bottom of this lake is flatter than that of Lake Tempe, and as mentioned before, its littoral zone is narrow and steep.

(b) Vegetation

Vegetation along the littoral zone of Lake Tempe and Buaya is rich and complicated as it is mentioned in the report of BIOTROP (7). Anything new was not proceeded beyond the report except the fact the vegetation of Lake Sidenreng is quite poor and simple, and only the area of its mouth is showing similar to that of Lake Tempe.

(c) Other items

Other items (water temperature, pH, turbidity, water color, silt depth, gas production, and distribution of submerged water grass) were checked in Lake Tempe and Sidenreng. Table 4.10 (1)-(2) shows the results on these items.

- Water temperature fluctuates daily between 29-31°C at any places and depth where submerged water grass is not growing thick. On the other hand, at the place where submerged water grass is growing thick, the water surface showed 33.5°C in the day time but its bottom water is kept at 28.5°C even the water depth is only 30 cm. The water grass absorbes the heat of solar energy, and blocks circulation of the water.

- pH is above 7 at any places in both lakes, but the bottom water of Sidenreng shows definitely higher pH than that of its surface even though the water depth is only 1.1 m.

- Turbidity seems to depend on the strength of wind and the streams from the rivers which are flowing into the lakes.

  In ordinary case, wind is not blowing early in the morning in Lake Tempe, and at this time the water is transparent except the area near to the mouth of the rivers. It may be only this time to check the water color of the lake. But just after wind starts blowing, almost all areas immediately increase turbidity by the

silt from the bottom. The stronger the wind, the higher the turbidity. We did not check the daily fluctuation of turbidity of Lake Sidenreng, but it showed always higher turbidity than that of Lake Tempe when it was observed.

- The siltation of Lake Tempe is not uniformed. Conspicuous siltation is occuring in the area near to the mouth of River Menraleng and east coast region. Especially the latter is heavily silted (15-50 cm). Siltation in the Lake Sidenreng is heavier than that of Lake Tempe. All its bottom is completely covered with silt up to the depth of 35 cm, even though its coast is sandy.

- Much amount of gas is being produced only at the bottom of heavily silted area. This gas has no smell and color, but it is flammable. This may be methane. It seems that reduction layer has been formed in those areas.

- Submerged water grass (Ceratophyllum demersum) is growing well in Lake Tempe and Buaya. Especially in Lake Tempe, several zones covered with the grass are being formed in north and east littoral region. Also it seems to be spreading from the area around the mouth of River Menraleng to the central part of the lake. But west half of the lake is not influenced so much by it. Any of the submerged water grass could be collected. In the upstream of River Wettee, Lake Sidenreng is located. No submerged water grass also could be seen.

From these limnological and ecological facts, it is concluded that Lake Tempe is a typical eutrophicated lake. Also, Lake Buaya might be the same type, because its vegetation is very similar to that of Lake Tempe, and in addition, fishermen are making Bunka Toddo which is particular fishing method in Lake Tempe (Table 4.13). On the other hand, limnological condition of Lake Sidenreng except its mouth is quite different from that of Lake Tempe, because its flora on the coastal zone is very simple and poor as mentioned above, and its bottom does not have any kind of submerged water grass.

(3) Fisheries Resources in the Lakes

At present about 20 kinds of fish are observed in the lakes. Table 4.11 shows these names and their component of fish catch in 1977. First seven species are primary fresh water fish, and others are secondary fresh water fish. First five species are most popular in quantity and frequency at markets, and it is reasonable to consider that about 95% of total fish catch in weight is occupied by these seven primary fresh water fish according to fish market survey by the Team.

According to the sampling data of fish production by Desa level 1977, average fish productivity (kgs/ha) of total lakes is about 850 kgs/ha, but there is a big gap of the values between Lake Tempe and Sidenreng, that is, 940 kgs/ha and 230 kgs/ha, respectively. This fact is again indicating that Lake Sidenreng has some kind of suppressing factor at least to the growth of fish and submerged water grass.

(d) Fishing ground from sociological point of view

It should be noticed that the wide areas of littoral zones of the lakes are owned by the regional governments and those areas are auctioned every 1-3 years to give the right of its exclusive use for fishing to the auction winner (Table 4.20). During Jan.-Jun., when the lakes are keeping high water level, those areas are free fishing zones, but during Jul.-Dec., when the water level is going down, they become exclusive fishing zones because during this time it is easy to catch fish and fish size is also bigger.

Fisherman must give 70-80% of their total fish catch to the owner when they catch fish from those areas.

3.2.2 Population

(1) Population in the Lake Fish Market

Lake fish market means the supplied area of lake fish. At present, it is covering in Kab. Wajo, Soppeng, Sidrap, Enrenkang and Maros. Negligibly small amount is reaching sea fish market area. On the contrary, sea fish is invading actively into this lake fish market, because it is estimated that about 850,000 people are living in this lake fish market (about 1 million in the objective area), and its fish demand is 25,500 t/year (30 kgs/capita-year). To this demand, only 13,000 tons of lake fish was supplied in 1977 (Fig. 4.7 and Table 4.18).

(2) Fisherman Population of the Lake Fishing

Table 4.12 shows the yearly change of fisherman population of lake fishing during 1965-1977. These values are quoted from the annual report of Dinas Perikanan Kab. Wajo, Soppeng, Sidrap. But it is very hard to agree with these values and fact that the number of full time fishermen in Wajo decreased 12,000 within ten years. In 1977, Indonesian government introduced a new estimation method for fisheries statistics. It is one kind of sampling method for the estimation of total fisheries activities of a Kecamatan level by grasping in detail all fishermen's activities in one Desa of the Kecamatan.

The number of fishermen in 1977 was estimated by this method. If we compare the values in 1977 with those before 1977, it is very clear that the number of full time fishermen of Wajo was overestimated in the former years. It is more reasonable to consider that the total number of fishermen in former years was not so far from its present number, because during our interview at the fisherman Desa, we never heard many full-time fishermen (12,000 persons) changed their job together with their family.

According to Table 4.12, the number of full-time fisherman is 4,367 and it is only 22% of the total number of fisherman. But it was estimated that they produced about 80% of total fish production of the lakes. (12)-(14)

3.2.3 Fishing Methods and Fishing Gears

(1) Fishing Methods

More than 20 kinds of fishing methods exist for the lake fishing. Those can be classified into the following two categories;

A type - the one which is used when the water depth of the lake goes down at least below 1.5 m, such as Bunka Toddo, Bubu Konde, Cappiang, Palawang, Julu, etc.

B type - the one which is not dependent strongly upon water depth, such as Lanra, Jala, Panambe, Bunre, etc.

Basic method of A type is to enclose the fishing ground or filter the fish way by units of bamboo fence which height is 1.5 m, and mesh is average 4 mm. This height is restricted up to 1.5 m by experience because the fence is just pushed and fixed to the soft bottom of the lake, so it is easy to fall down if this height is higher.

A type seems to be a seasonal catching method only when the lake's water depth goes down below 1.5 m. From this point, this method is particular to Lake Tempe because its water depth goes down to minimum 30-50 cm during its dry season, and its bottom is suitably flat and soft to fix the fence over the wide area. These methods are mostly being used at the auctioned fishing areas owned by the regional governments.

Basic methods of B type are various, and roughly speaking, there are following 4 kinds;

- First is netting (Gill net = Lanra, cast net = Jala, surrounding net = Bunre, and scoop net)

- Second is angling (Huck and line = Pancing, and long line = Panambe)

- Third is spearing (Spear = Tombak)

- The last is trapping (Trap = Buwu Urang)

(2) Fishing Gears

Table 4.13 shows the total inventory of typical fishing gears for the lake fishing and percentage of fish catch by each kind of fishing gear out of total fish catch (12,877.1 tons) in 1977. From this table, following facts can be imagined;

- A type fishing gear caught fish at least 13.07% of total fish production from the lakes in 1977, and B type was 80.45%.

- Lanra (gill net) is the most popular fishing gear for the lake fishing and produced more than 50% of total fish catch, but it does not mean Lanra is most effective fishing gear because frequency of its operation time is also more than 50% of total operation times. Maybe fishermen can handle it more easily and are not using much energy compared with the case of other fishing gears. In addition, it can be used at any time (day and night) and at anywhere (even the place where submerged water grass is growing thick).

- Bunre and A type fishing gears are showing higher efficiency, but Bunre can be used only at the place where submerged water grass is not growing, and other ones are restricted by the water depth and season.

At present, Lanra is the best fishing gear for the lake fishing, but at the same time, it is easily imagined that the way of using gill net, especially its mesh size, is strongly influencing the fishing resource of the lakes.

3.2.4 Potentiality of Fish Production by Fishing of the Lakes

As it is mentioned in CHAPTER II, potentiality of fish production of the lakes was formerly considered as much as 25,000 tons/year, and during decade of 1960 it decreased as little as to 5,000 tons/year. It was considered the high rate of sedimentation (10-20 cm/year) was the primary cause to have made the lake's bottom as shallow as to 30-50 cm in the end of dry season.

At present, there are two kinds of contradictory data against such reasoning. One of them is the value of sedimentation rate in Lake Tempe (4 mm/year) which was measured and finally reported by WASKITA KARYA in 1975. This value was reconfirmed and corrected as 1 cm/year by the Team.

The other is the data of total fish production from the lakes (12,877.1 tons) which is shown in the annual reports of each Kab. Wajo, Soppeng and Sidrap in 1977. This value is two times greater than the average of yearly fish catch in last twenty years (1957-1976). If this value is correct, there has not been drastic decrease of fish production in the Lake Tempe in last years, and all former published reports will lose their basic premises to discuss about the recovery plan of Lake Tempe fishing.

On the bases of such background, it is considered that the following items should be clarified to grasp the potentiality of fish production of Lake Tempe;

- To clarify the reason why the author of "Danau Tempe" could say there had been drastic decrease of fish production in Lake Tempe

- To clarify the reliabilities of the data Dinas Perikanan obtained by the newly introduced estimation method in 1977.

It was found that the data of fish production shown in the "Danau Tempe" is based on the annual report of Dinas Perikana, Kab. Wajo, Soppeng, and Sidrap. Collection of the data during 1955-1976 was carried out to see if there has been a drastic decrease of lake fish production or not. Some of them had been scattered already, but many of the original reports were collected and compared with the data shown in the "Danau Tempe". Table 2.2 shows the comparison between them. From this comparison it is concluded that values of the "Danau Tempe" before 1957 have some kind of confusion because of the following reasons.

- There is big gap in the production values between both reports before 1957, even though the exported amount of salted fish is showing same values. After 1957, both values of fish production are showing almost same fluctuation to each other.

- Concerning to the meaning of fish production values of the "Danau Tempe" before 1957 (10,000-25,000 tons/year), those values seen to be showing too high, because the experienced range of fish productivity of eutrophicated lakes is 250-1,500 kgs/ha which is including the amount of young fish. Even though 90% of the maximum fish productivity (1,350 kgs/ha) is assumed to be the maximum potentiality of fish production by fishing of Lake Tempe, it reaches only 17,500 tons/year.

For these reasons, the fish production before 1957 shown in the "Danau Tempe" might be not so reasonable values, especially the value in 1948 (25,000 tons) should be forgotten.

On the other hand, the fish production during 1957-1966 is not showing any tendencies of drastic decrease, even though it shows big fluctuation both of fish production and exported amount of salted fish. But when it is compared during the next decade (1967-1976) with its former decade (1957-1966), it can be said that the amount of fish production and exported amount of salted fish decreased so much;

- Average fish production

  during 1957-1966: 7,613 tons
  during 1967-1976: 4,242 tons

- Average exported amount of processed fish

  during 1957-1966: 1,474 tons
  during 1967-1976: 716 tons

It might be reasonable to consider that such a trend of fish production happened during the time, but it might be another thing to accept those amount of fish production as the real ones.

To know the real amount of such trend of fish production, we should know the following two items;

(1) <u>The Cause of the Fish Production Decrease during those 10 Years</u>

It is considered there might be two causes which induced the decrease of fish production;

- The influence of sedimentation to some particular location in Lake Tempe. For example, fishermen of Desa Tancung, which is one of the famous fisherman's villages located near the mouth of River Bila, complained that they cannot catch much fish any more without going far from the shore. Formerly during dry season they caught Tawes easily near the mouth of River Bila by using Julu (fish weir), but now they cannot catch them, because the bottom of Lake Tempe has become shallower caused by the sedimentation from River Bila. Now they must make much more effort to catch fish than before. This fact may be true, and one of the cause of production decrease for this village.

- The influence of overfishing. There is evidence of overfishing. According to the report of Dinas Perikanan Wajo in 1967, maximum weight of Tawes, Sepat, Gabus and I. Mas at markets were 2,500 grs, 70 grs, 3,000 grs and 7,500 grs respectively. But in the present time no such big size can be observed at markets except the case of Sepat Siam. At present their maximum weights are 500 grs, 70 grs, 600 grs and 1,400 grs respectively.

Fig. 4.5.(1) shows the body length component of Tawes caught by Bunka Toddo. The graph shows that the tail of normal distribution has been destroyed already by fishing. For this reason, it can be said this group is the maximum size in Lake Tempe. The maximum size is only 37.4 cm and average weight of 9 species (average size is 32 cm) is 478 grs.

Fig. 4.5.(2) shows the smaller group of Tawes caught in Lake Sidenreng by Bunka Toddo. This group is still forming the normal distribution. Its average weight is only 40 grs. Fishermen should use wider meshed bamboo fence.

Fig. 4.5.(3) shows the case of Sepat Siam caught at Sengkang. In case of Sepat Siam, present mesh size of bamboo fence might be normal, because they are being caught almost at their maximum size.

In addition, regional government is regulating the mesh size of Lanra (above 5 cm) but some percentage of this production came from Lanra using the smaller mesh size of 5 cm. When it is considered about the fact that more than 50% of fish production of these lakes is caught by Lanra (gill net) as described in 3.2.3.(2), it is easy to understand that fishermen are destroying their own fishing resources by using the smaller mesh gill net.

(2) The Reliability of the Fish Production Values Reported by Dinas Perikanan during Those Years

It is considered that the values of fish production reported by Dinas Perikanan before 1977 were underestimated and the one of 1977 shows the possible amount of present fish production from the lakes.

(a) The values of fish production reported by Dinas Perikanan before 1977;

It is found that the discussion on the history of inter-insular trade of processed lake fish will reveal the reliability of the values concerned.

Before discussion it must be kept in mind the following fact that the objective area was not safe during 1945-1965 even between Desas. Because the social condition did not allow people to go around freely in this area.

For example, fish price was so expensive even though at a little bit far place from fisherman village as shown in table below. At present, fish price is same between those Desas.

Price of Tawes by Market (1956-1961), 1977

(Unit: Rp/kg)

Year	Sengkang	Tancung	Belawa	Paria	Attapange	Wt. Soppeng	Batu 2
1956	1.84	1.85	5.22	-	-	4.22	2.83
1957	2.45	2.39	6.33	-	-	-	-
1958	-	-	-	-	-	-	-
1959 Wet	3.71	3.50	6.00	-	-	-	-
Dry	5.25	5.37	7.00	20.00	20.00		
1960	-	-	-	-	-	-	-
1961	7.39	5.65	7.00	9.39	-	-	-
1977	220.0	220.0	220.0	220.0	220.0	220.0	220.0

On the basis of such social background, the history of interinsular trade should be discussed.

Interinsular trade of salted fish from Lake Tempe was so famous (mainly Tawes and Sepat), and it was started before World War II. Main origin was Sengkang in Kab. Wajo. There were several cooperatives which were mainly engaged in the fish processing. The Sengkang cooperative was their center, collected salted fish from each fisherman Desa and shipped to Java. But during early years of 1960, most cooperative stopped their work. They could not collect or buy enough amount of fish for processing.

Table 4.14.(1) shows the comparison of price among salted fish for export, the one for local consumption, and wet fish (1956-1963). Under the condition of the conversion factor of 0.5 for processing from wet fish, the cost for making salted fish is estimated at almost same or higher than export price during all those years. But its trading could be still continued. From this fact, it can be easily imagined that fish supply of the lake was much more than demand in the area (before people there did not eat salted fish).

Table 4.14.(2) shows the comparison between total production of salted fish and total exported amount of salted fish in Wajo (1956-1963). Since 1960, local consumption of salted fish became not negligible amount.

Fig. 4.6 shows the price relation between wet fish and exported fish. It is apparent that, at present time, local price is so high that export price can never compete with it. Fishermen want to sell fish to local market even wet and dried fish, because they can sell higher price and get money immediately. Only when the local market can not consume the fish supply, export traders have a chance to buy salted fish.

Table 4.15 shows the estimated amount of local consumption in Wajo based on the annual report of Dinas Perikanan Kab. Wajo (1960-1976).

This data is not showing the increase of local consumption. If this is true, it can not be explained the reason why the fish price of local market has been increasing rapidly during these years and why it is higher than exported price.

From these discussions, it can be said that the values of fish production reported by Dinas Perikanan had been underestimated while the amount of local consumption was increasing during those years.

(b) The values of fish production reported by Dinas Perikanan estimated by newly introduced estimation method in 1977 as described in 3.2.2

To check its reliability, the amount of fish supply and demand in the objective area was estimated by marketing survey and personal interview by the Team.

Fig. 4.7 shows the market area of lake fish by Desa level. Table 4.19.(1) - (3) shows the code of each market. Population in this area is estimated at 857,553 from the census data in 1977.

Table 4.16 shows the average market price by fish type based on the market survey. At present time, fish price is almost the same anywhere in the objective area. Table 4.17 shows the estimated amount of fish supply to the lake fish market in 1978. Estimated minimum supply amount of lake fish was about 11,000 tons. Table 4.18 shows the estimated average amount of fish consumption in the lake fish market in 1978. Estimated average fish consumption was about 22,000 tons, and the amount of lake fish consumed is about 15,000 tons.

From those studies mentioned above, it is reasonable to say that the estimated amount of fish production (12,877 tons or 1,000 kgs/ha/year) in 1977 by Dinas Perikanan might not be so far from present fish production of Lake Tempe. In other words, it means local consumption of lake fish had been increasing much more amount than that estimated by Dinas Perikanan during 1966-1976.

On the other hand, it might be true that some amount of fisheries resources of Lake Tempe has been decreasing, but this amount is not so big as 20,000 tons mentioned in the "Danau Tempe", but it was about 2,000-4,000 tons during last 20 years.

Fish production from the lakes in 1978 is newly reported by Dinas Perikanan in South Sulawesi, and it is about 14,600 tons. Average fish production of 1977 and 1978 is about

13,500 tons. If we take 17,500 tons as the maximum potentiality of fish production of the lakes by fishing, about 4,000 tons of fish can still be produced by protecting the fisheries resources.

3.2.5 Fisheries Organization

While the interinsular trading was active, fishermen cooperatives existed along the shore of Lake Tempe by Desa level. Members consisted of fish traders and fishermen. Its main work was to process fish for interinsular trade.

As of now, fisheries cooperatives stopped its work. Fishermen are not united. On the other hand, most productive areas (littoral zone) are owned by regional governments. These areas are auctioned by the governments, and the winners will hire fishermen to catch fish. Fishermen will get share 20-30% of total catch (Table 4.20). Fishermen want to attend the auction but they don't have any capital to win the auction individually.

The following table shows the living standard of fishermen. Their net income is smaller than that of farmers.

(Unit: Rp)

	Gross Income	Expense	Net Income
Fishermen*/1	370,725	223,139	147,586
Farmer	242,220	83,540	158,680

*/1: Fishermen in Wajo

3.3 PADDY FIELD

3.3.1 Paddy Field as the Fishing Ground

Paddy field fish culture is very popular in Indonesia, and, at present, its culturing technique seems to have been established.

Table 4.21 shows the development of paddy field culture in South Sulawesi and objective area during 1969-1977. According to this data, fish production from paddy field in South Sulawesi during 1969-1976 did not develop, and in the objective area, it has been diminishing. In 1977, drastic decrease of fish production and its surface area from paddy field can be observed. Because Indonesian government changed the estimation method of fish production for the purpose to get more accurate statistic data on fisheries activities. Based on the data in 1977, present conditions of paddy field culture in South Sulawesi and the objective area are following;

- Only 2.36% of total irrigation paddy field in South Sulawesi was used for fish culture in 1977, and 0.39% in the objective area.

- Irrigation paddy field area in the objective area occupies 22% out of total in South Sulawesi.

From these facts, it is concluded that paddy field culture is still not popular in South Sulawesi and especially in the objective area.

3.3.2 Potentiality of Fish Production by Paddy Field Fish Culture

At present, about 23,000 ha of year-round irrigated paddy fields exists in the objective area, and this will become 73,000 ha when the proposed irrigation areas of the same type are added by this development plan.

Potentiality of fish production from these paddy fields is simply estimated at about 11,000 tons (150 kg/ha) under the condition of taking no consideration of the influence of agricultural chemicals to fish in paddy field.

In 1977, 27 tons of carp was harvested from 180 ha of irrigated paddy field by 105 farm households in the objective areas. It was estimated that each farmer could add Rp. 18,000 of net income to their farm budget. About Rp. 770×10^6 of total net income will be added to this objective area by performing fish culture in 73,000 ha of year-round irrigated paddy field.

3.3.3 Hatchery

There are several public hatcheries in the objective area, and mainly carp fry are being produced. It seems that the basic hatchery technic itself is established but there are many matters to be improved to produce fry more efficiently. In 1977, about 2×10^6 pcs. of carp fry were produced but only its 10% was used for paddy field culture and the remains were stocked to the lakes. It seems to be needed to form more organized plan of hatchery operation to produce much more fry and to be used them for paddy field culture.

From the technical point of view, Citta Hatchery Center in Kab. Soppeng seems to have the best condition to produce fish fry most effectively, because much amount of free flowing underground water is available inside the job-site (0.5-1.0 ton/second).

CHAPTER IV DEVELOPMENT PLAN

4.1 DEVELOPMENT STRATEGY

Target yield for this plan is estimated in "Part III Socio Economy and Human Resources". It is 10,000 tons in the target year 2000.

According to the field survey and data analysis, following strategy for the inland fisheries development in the objective area is prepared.

(1) To protect the environmental conditions and to increase fish production in Lake Tempe, because almost all fish production has exclusively been raised from lake fishing by the fishermen around Lake Tempe.

(2) To develop new valuable fish production area in the irrigable paddy field, which is developed through the irrigation plan in the objective area.

(3) To prepare the indispensable supporting project for the success and continuation of technology transfer to the local people who are engaged in fisheries.

4.2 VIEWPOINTS OF THE DEVELOPMENT PLAN

Based on the present condition of lakes and paddy field and those potentiality of fish production, the following five development viewpoints are proposed;

(1) To provide fish protection area in Lake Tempe for the purpose of recovering its fisheries resources from the damage of overfishing and increasing its fishing resources up to the maximum potentiality of fish production of Lake Tempe.

(2) To perform paddy field fish culture for the purpose of effective use of the productive water area and fish supply against its future shortage.

(3) To perform lake fish culture for the purpose of the same reason of paddy field case.

(4) To provide a hatchery center to ensure the performance of viewpoint (2) and (3).

(5) To provide a supporting organization for the purpose of integrating and harmonizing the total development plan and make it advance practically (Table 4.22).

4.3 CONTENTS OF DEVELOPMENT PROJECTS

4.3.1 Lake Fishing Project

(1) To Provide Fish Protection Area

To protect fish resources effectively, protection area should not only be fenced but also given shaded place so as to make fish stay there and also protect from sunlight when the water level become very low and, in result, to increase the number of adult fish.

To increase the amount of fish recruitment so many as to produce additional 4,000 tons, the following conditions should be needed for the protection area:

(1) Total protection area is 300 ha.

(2) Fishing inside this total protection area should be strictly prohibited.

(3) At least 27 ha inside of this area should be covered with floating grass (real protection area), such as kankung (Ipomoea aquatica).

(4) This area should be located at the deepest place of Lake Tempe (around Laringgi water stuff gauge).

(2) To Support the Population of Tawes

To support the population of Tawes (puntius javanicus), new kind of species GENGOROBUNA (carassius auratus) should be tried to be stocked in Lake Tempe.

Grass carp should be also tried to be stocked for the purpose of cleaning the submerged water grass (Cerathophyllum).

(3) To Check the Effect of Those Projects

To check the effect of those projects, fish resource survey and culturing test should be carried out.

4.3.2 Hatchery Project

To support and supply enough amount of fish fry for the fish culture projects, a new hatchery center should be provided by improving the present Citta Hatchery Center owned by the regional government of Kab. Soppeng.

Free flowing underground water is coming out from the upper part of the job-site. It has never dried up even during heavy drought year in 1972 according to the chief of the Center. Its free-flowing amount might not be enough to operate a big scaled fish culture but may be sufficient to produce carp fry of 150 x 10^6 pcs.

To produce this amount, following size and number of ponds and facilities should be provided;

(i) Spawning pond : 10 m^2 x 10 ponds

(ii) Hatchery and nursery pond: 50 m^2 x 50 ponds

(iii) Adult pond : 30 m^2 x 48 ponds

(iv) Laboratory and office : 100 m^2

From the viewpoint of development plan policy (self-supply of fish for the demand), it is no need to produce more fry for paddy field culture than planned amount, but the studies on other kinds of fish culture should be carried out, preparing for the demand increase of fish with higher quality.

4.3.3 Paddy Field Fish Culture Project

To supply the deficient amount of fish demand, paddy field fish culture should produce about 2,700 tons of carp from 120 x 10^6 pcs. of fry which is supplied by the above-mentioned hatchery project.

To reach this target, 18,000 ha of irrigated paddy field should be used for paddy field fish culture. Temporarily this fish culture project should be carried out at the same time together with irrigation projects. Especially, in future, its performance should be focused to the place where is isolated from fish market, such as Sanrego area, Girilang areas, etc.

At present, paddy field fish culture is not well tried by the farmers in the objective area, because they do not have yet enough knowledge about it. Furthermore, in future, they should know the influence of agricultural chemicals for the fish in paddy field.

To perform this project practically, it will be needed well organized propagation and technical advice system.

4.3.4 Lake Fish Culture Project

To satisfy the target amount of development plan, more 3,000 tons of carp should be produced by lake fish culture using 12 x 10^6 fry supplied from hatchery center.

This project will be carried out by 917 units of 80 m^2 x 2 m (depth) pond which is made of net and fixed in some convenient place of the Lake.

3.6 tons of carps will be produced from 1 unit of this pond.

The different point of this lake culture from paddy field is as follows;

- Feed should be supplied every day,
- Productivity per ha is 22.5 kgs/m^2, that is 150 times greater than that of paddy field culture,
- Required period for one cycle of the culture is approximately 6 or 7 months, which are 2-3 months longer than that of paddy field culture,
- The size of product in one cycle will reach 700-1,000 g/pcs. compared with 150 g/pcs. in the case of paddy field culture,
- Culturing cost is strongly influenced and fluctuated by the culturing technique.

4.3.5 Supporting Organization Project

As described in each project, they need a supporting project for its performance and, in addition, they should be well organized. Through this organization and some technology for the innovation of inland fisheries, fishermen and farmers can bring the required income for the improvement of their living standard and succeed to maintain continuously the new valuable production area. For this purpose, supporting approach as is shown in Table 4.22 must be taken into consideration.

4.4 RECOMMENDATION

(1) To protect and increase the fisheries resources in the lakes, it is necessary to provide the fish protection area, and to enlighten fishermen.

(2) Hatchery should be used not only to produce carp fry for the culture projects but also to study further possibilities on the inland fisheries development, for example, to study on the influence of agricultural chemicals to fish, or to introduce fish of other species.

(3) To proceed paddy field fish culture and introduce lake fish culture, it is necessary to propagate the merit and transfer the technical knowledge to farmers and fishermen.

(4) To perform and reach the target of the inland fisheries development plan, the supporting organization should be established.

APPENDIX 1

Identification Approach to the Cause of Limnological Difference between Lake Tempe and Lake Sidenreng

As described in CHAPTER III, the most conspicuous limnological difference between Lake Tempe and Lake Sidenreng is the difference of their flora, that is, the former is rich in submerged water grass but the latter is very poor.

A.1.1 Probable Cause

Based on the survey result, the probable cause is considered to be one of the following eight environmental causes;

Cause 1. Non-existence of submerged water grass from the beginning in Lake Sidenreng.

Cause 2. Lack of solar energy for the grass because of higher turbidity in Lake Sidenreng than that in Lake Tempe.

Cause 3. Lack of growth nutrient for the grass in Lake Sidenreng.

Cause 4. Existence of growth inhibitant for the grass in Lake Sidenreng.

Cause 5. The case combined Cause 2 and Cause 3.

Cause 6. The case combined Cause 2 and Cause 4.

Cause 7. The case combined Cause 3 and Cause 4.

Cause 8. The case combined Cause 2, Cause 3 and Cause 4.

A.1.2 Method of Approach

(1) Basic Policy

To identify the cause by means of comparative growth test of submerged water grass and phytoplankton in both lakes.

(2) Test Items

(a) Water analysis

(b) Comparative growth test of submerged water grass (Ceratophyllum demersum) in both lakes, and

(c) Comparative growth test of phytoplankton (sampled in Lake Tempe) in both lakes.

(3) Assumption of the Test

(a) Water quality in each lake will not change itself by water depth, because the water depth of each lake is shallow.

(b) The growth condition of water surface layer in the area of Lake Tempe where Ceratophyllum is proliferating is the standard of the growth test.

(c) The comparative test of Ceratophyllum should be protected from the influence of waves of the lakes.

(4) Flow-chart of Identification Approach to the Cause

Table A.1.1.(1) - (2) show the flow-chart of identification approach to the probable cause.

APPENDIX 2

Calculation Formula for the Minimum Protection Surface Area

A.2.1 Location of Protection Area

Location of protection area is shown in Fig. A.2.1.

A.2.2 Figure of Protection Area (1 Unit)

Figure of protection area (1 unit) is shown in Fig. A.2.2.

A.2.3 Size of Protection Area

One unit of Protection Area consists of two kinds of area;

1) Outer protection area 100 ha

2) Inner protection area/1 25 ha

/1: Inner protection area is enclosed by 9 ha of BUNKA TODDO (floating grass belt), which is real protection area.

A.2.4 Calculation Formula for Setting Protection Surface Area

Most important part of this protection area is the area of BUNKA TODDO, because most of the lake fish hide under submerged water grass or floating grass (BUNKA TODDO), when the water depth of the lake reaches 0.5 m at the end of dry season.

This BUNKA TODDO area should protect enough numbers of adult fish which will reproduce fry to increase more 4,000 tons of fish production.

The following formula introduce the necessary surface area of the BUNKA TODDO;

$$N_r = V \times D \times P_{wtr} \times S_r \times 5 \times N_e \times R_s$$
$$= (S \times 0.5) \times D \times P_{wtA} \times S_r \times 5 \times N_e \times R_s \quad \text{----------} \quad (A)$$

Assumption

1) N_r: Necessary numbers of recruitment to increase more 4,000 tons of fish production; (40×10^6 pcs)/2

/2: Average weight increase of fish in Lake Tempe is estimated at 100 gr/pc/year.

2) V : Volume of water under the BUNKA TODDO at the end of dry season [water depth: 0.5 m]; (m^3)

3) D : Density of fish hiding under the BUNKA TODDO at the end of dry season; (3 kgs/m^3)

4) W_{tr}: Weight ratio of adult fish out of total fish weight under the BUNKA TODDO at the end of dry season; (0.2)

5) S_r : Sex ratio; (1.1)

6) 5 : Numbers of adult fish per kg

7) N_e : Numbers of eggs spawned by one female fish; (20,000 pcs/female)

8) R_s : Survival ratio of spawned eggs; (0.01)

9) S : Necessary surface area of the BUNKA TODDO; (m^2)

When the values of assumption are substituted to the formula (A);

$$40 \times 10^6 = S \times (0.5) \times (3) \times (0.2) \times (\frac{1}{2}) \times (5) \times (2 \times 10^4) \times (0.01)$$
$$= 150S$$

$$\therefore S \fallingdotseq 26{,}666.7 \text{ m}^2$$

$$\fallingdotseq 27.0 \text{ ha} = 9 \text{ ha} \times 3$$

It is considered that 27 ha of BUNKA TODDO is too wide, and hard to be made, and furthermore, water stream will be killed. Then, 27 ha was divided into 3 units (See Fig. A.2.2).

The size of outer protection area is just arranged for the purpose that its boundary keeps distance about 200-300 m away from the BUNKA TODDO not to make fishermen allow to catch fish directly from the BUNKA TODDO.

BIBLIOGRAPHY

(1) Annual Report of Dinas Perikanan in each Kab. Wajo, Soppeng and Sidrap, 1977

: Dinas Perikanan Kabupaten Daerah Tingkat II
Wajo, Soppeng and Sidrap

(2) Danau Tempe --- Pandangan Umum dan Masalah yang dihadapinya, 1967

: Inspeksi Dinas Perikanan Darat Propinsi
Sulawesi Selatan di Makassar.

(3) Suatu Analisa tentang Alat 2 dan Cara Penangakapan Ikan di Danau Sedenreng dan Danau Tempe, 1968

: Lembaga Penelitian Perikanan Darat - Bogor

(4) Outline Proposals for the Improvement of the Conditions of the Lake Tempe Region, South Sulawesi, 1970

: P.N. WASKITA KARYA

(5) Report on Irrigation Project in South Sulawesi, 1973

: O.E.C.F. Investigation Team of Indonesian Projects

(6) Preliminary Report on the Water Resource Development Plan in Central Part of South Sulawesi, 1974

: J.I.C.A.

(7) Laporan Pengukuran, Sediment Transport dan Kwalitas Air dari Wilayah Danau Tempe, Sul. Sel., 1974-1975

: D.P.M.A. in Bandung

(8) Biological Survey of "Lake Tempe" and vicinity, 1976

: BIOTROP in Bogor, Indonesia

(9) Fisheries: Interim Report Sulawesi Regional Development Study Vol. 3, 1977

: Univ. of British Columbia for Canada International Development Agency

(10) Fisheries: Annual Report/1977 Vol.I Results of the studies on the Regional Agricultural Developments in South Sulawesi Province, 1978

: RADP/ATA - 140 South Sulawesi

(11) A Summary Report on Fishery Resources Development for Project on RADP/ATA - 140 South Sulawesi, 1978

(12) Jumlah Trip & Produksi RTP Sample dan Estimasi Jumlah Trip & Produksi Desa Sample (Wajo), 1977

: Dinas Perikanan Kabupaten Daerah Tingkat II Wajo

(13) Jumlah Trip & Produksi RTP Sample dan Estimasi Jumlah Trip dan Produksi Desa Sample (Soppeng), 1977

: Dinas Perikanan Kabupaten Daerah Tingkat II Soppeng

(14) Jumlah Trip & Produksi RTP Sample dan Estimasi Jumlah Trip dan Produksi Desa Sample (Sidrap), 1977

: Dinas Perikanan Kabupaten Daerah Tingkat II Sidrap

Table 4.1 Activities of Inland Fisheries in the Objective Area (1977) /1

Fishing Ground	Production in Each Kabupaten							
	W a j o		Soppeng		S i d r a p		T o t a l /3	
	(ton)	(ha)	(ton)	(ha)	(ton)	(ha)	(ton)	(ha)
L a k e	8,587	(10,000)	3,054	(3,000)	1,236.1	(3,000)	12,877	(16,000)
Swamp	1,045	(9,800)	27	(235)	-	(178) /2	1,072	(10,213)
River	318	(1,273) /2	19	(640)	-	(1,337) /2	19	(3,250)
Reservoir	9	(28) /2	-	(-)	4.3	(248) /2	13.3	(276) /2
Pappy field	-	(-)	21.4	(116)	2.3	(12)	23.7	(128)
Pond	4.5	(6)	3.8	(6)	4.5	(12)	12.8	(24)
Total /3	9,636.5	(21,117)	3,125.2	(3,997)	1,242.9	(4,787)	14,004.5	(29,891)
B.B.I. /4	-		1,773.4 x 10^3 head		112 x 10^3 head		1,885.4 x 10^3 head	
K.P.I. /5	-		309.7 x 10^3 head		129 x 10^3 head		438.7 x 10^3 head	
Total	-		2,083.1 x 10^3 head		241 x 10^3 head		2,324.7 x 10^3 head	

/1: Annual report of Dinas Perikanan Kab. Wajo, Soppeng and Sidrap in 1977
/2: Annual report in 1976
/3: Including figures in 1976
/4: B.B.I. = Public hatchery pond
/5: K.P.I. = Private hatchery pond

Table 4.2 Comparison of the Figures of Lake Fish Production between the Annual Report of Dinas Perikanan and the Report "Danau Tempe" (1948-1978)

(Unit: ton)

Year	Figures of Dinas Perikanan					Figures of "Danau Tempe"	
	Wajo	Soppeng	Sidrap	Total	Exported/1	Total	Exported/1
1948	-	-	-	-	-	25,000	-
49	-	-	-	-	-	-	-
1950	-	-	-	-	-	16,960	1,325.6
51	-	-	-	-	-	9,720	861.8
52	-	-	-	-	-	16,900	1,362.0
53	-	-	-	-	-	19,840	1,286.9
54	-	-	-	-	-	10,464	1,464.8
55	5,866	982	1,000/2	7,848	3,484.9	23,640	3,484.9
56/3	3,992	507	1,000/2	5,499	1,672.4	16,854	1,672.4
57	1,966	324	1,000/2	3,290	443.9	3,921	443.9
58	3,537	399	1,000/2	4,936	1,546.9	4,828	1,546.9
59	?	1,009	1,000/2	?	2,375.8	5,006	2,375.8
1960	5,348	1,466	1,660	7,474	998.3	9,769	998.3
61	11,749	2,000/2	240	13,989	1,631.8	15,301	1,631.8
62	9,056	2,000/2	366	11,422	1,007.9	12,276	1,598.8
63	3,375	1,180	788	5,343	852.5	5,343	998.3
64	2,192	910	749	3,851	792.7	3,851	792.7
65	5,064	4,718	1,254	11,035	1,667.5	11,036	1,667.5
66/4	2,354	1,950	496	4,799	2,685.7	4,799	2,685.7
67	2,076	1,282	870	4,228	?		
68	2,676	2,287	1,070	6,033	717.6		
69	2,177	2,073	1,180	5,430	638.1		
1970	1,540	1,462	828	3,830	534.8		
71	1,413	1,289	767	3,469	513.0		
72	1,355	1,472	457	3,283	685.8		
73	1,674	1,163	610	3,447	772.9		
74	2,480	998	877	4,355	984.6		
75	2,893	910	838	4,641	877.4		
76/5	2,025	943	535	3,503	none		
1977	8,587	3,054	1,236	12,877	none		
1978	?	?	?	14,600	?		

/1: Exported amount of salted fish from Kab. Wajo (not only from the lake)

/2: Estimated from the figures of other years

/3: Before 1957, Kab. Wajo and Soppeng were included in Kab. Bone

/4: Figures of "Danau Tempe" end in 1966

/5: After 1977, Estimated by Desa sampling method, newly introduced by Indonesian government in 1977

Table 4.3 Check List on the Type of Fisheries Waters in the Objective Area

Check Items	Unit	Fisheries Water Area					
		Lakes	Swamps	Rivers	Reservoirs	Paddy field/2	Culture pond
1. Water surface area for inland fisheries	(ha)	16,000	7,980	3,250	280	118.3	20
2. Productivity/1	(kg/ha)	250 ('69-'76) 805 ('77)	116 ('69-'76) 140 ('77)	78 30	156	194	181
3. Stability of water area for fishing ground	(O,△,X)	O	X	X	△	△	X
4. Possibility of scaling up	(O,△,X) (ha)	O +5,000-6,000ha/3	△	X	X	O + 16500 ha	X
5. Practicability of fisheries development plan	(O,△,X)	O	△	△	X	O	X

/1: The figures before 1977 and those of 1977 are separated, because those are estimated by different methods.

/2: Included only irrigated paddy field

/3: Estimated surface area for lake fish culture

Table 4.4 Fish Production of Lakes (1969 - 1977)

Kab.	Items	1969	1970	1971	1972	1973	1974	1975	1976	1977	Total
Wajo	Production (t)	2,177	1,540	1,413	1,355	1,674	2,480	2,893	2,025	8,587	15,557/1
	Surface (ha)	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	80,000
	Kg/ha	217.7	154.0	141.3	135.5	167.4	248.0	289.3	202.5	858.7	194
Soppeng	Production (t)	2,073	1,462	1,289	1,472	1,163	998	910	943	3,054	10,310
	Surface (ha)	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	24,000
	Kg/ha	691	487	430	491	388	333	303	314	1,018	430
Sidrap	Production (t)	1,180	828	767	457	610	877	838	535	1,235	6,092
	Surface (ha)	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	24,000
	Kg/ha	393	276	256	152	203	292	279	178	412	254

/1: Not including the figures of 1977

Table 4.5 Fish Production of Swamps (1969 - 1977)

Kab.	Items	1969	1970	1971	1072	1973	1974	1975	1976	1977	Total
Wajo	Production (t)	962	438	648	786	1,196	-	1,149	790	1,065	7,034
	Surface (ha)	7,700	7,700	7,000	7,700	7,700	7,700	7,700	7,700	7,700	60,300
	Kgs/ha	124.9	56.9	84.1	102.1	155.3	-	149.3	102.6	138.3	116.6
Soppeng	Production (t)	50.0	87.3	29.8	7.7	19.1	32.8	33.0	83.4	27.0	370.1
	Surface (ha)	204	204	204	204.0	150.0	175.0	175.0	150.0	102.0	1,543.0
	Kgs/ha	245.1	427.9	146.1	37.7	127.3	218.7	188.6	556.0	264.7	239.9
Sidrap	Production (t)	0.6	22.3	10.0	5.9	9.3	27.8	15.4	17.4	-	108.7
	Surface (ha)	178	178	178	178	178	178	178	178	178	142.4/1
	Kgs/ha	3.4	125.3	56.2	33.1	52.2	156.2	86.5	97.7	-	76.3

/1: Not including the figures of 1977

Table 4.6 Fish Production of Rivers (1969 - 1977)

Kab.	Items	1969	1970	1971	1972	1973	1974	1975	1976	1977	Total
Wajo	Production (t)	355	170	170	173	204	-	270	319	-	1,661/1
	Surface (ha)	1,790	1,364	1,273	1,273	1,273	1,273	1,273	1,273	1,273	9,519
	Kgs/ha	198	125	133	136	160	-	212	250	-	174.5
Soppeng	Production (t)	4.1	8.6	0.5	1.9	4.6	6.8	3.1	12.3	19.2	61.1
	Surface (ha)	640	640	640	640	640	640	640	640	640	5,760
	Kgs/ha	6.4	13.4	0.8	3.0	7.2	10.6	4.8	19.2	30	10.6
Sidrap	Production (t)	45.8	70.5	86.8	38.9	75	70.4	35.3	32.3	-	387.5/2
	Surface (ha)	1,330	1,003	1,260	1,306	1,337	1,337	1,337	1,337	1,337	11,584
	Kgs/ha	34.4	70.3	68.9	29.8	56.1	52.6	26.4	24.1	-	33.4

/1: Not including the figures of 1975, 1977
/2: Not including the figures of 1977.

Table 4.7 Fish Production of Reservoirs (1969 - 1977)

Kab.	Items	1969	1970	1971	1972	1973	1974	1975	1976	1977	Total
Wajo	Production (t)	180.0	38.5	31.4	4.9	5.8	-	10.5	9.2	-	248.9/1
	Surface (ha)	152.0	174.0	-	35.0	40.0	-	39.0	28.0	-	468.0
	Kg/ha	844.4	221.3	-	140.0	145.0	-	269.2	328.6	-	529.9
Soppeng	Production (t)	-	-	-	-	-	-	-	-	-	
	Surface (ha)	-	-	-	-	-	-	-	-	-	
	Kg/ha	-	-	-	-	-	-	-	-	-	
Sidrap	Production (t)	1.5	8	27.9	20.9	18.7	6.1	5.4	4.3	-	92.8
	Surface (ha)	66.8	164	164	244	248	248	248	248	248	1,723.6/2
	Kg/ha	22.4	48.8	170.1	85.6	75.4	24.6	21.8	17.3	-	53.8

/1: Not including the figures of 1971
/2: Not including the figures of 1977

Table 4.8 Fish Production of Paddy Field (1969 - 1977)

Kab.	Items	1969	1970	1971	1972	1973	1974	1975	1976	1977	Total
Wajo	Production (t)	-	-	-	-	-	-	-	-	-	-
	Surface (ha)	-	-	-	-	-	-	-	-	-	-
	Kgs/ha	-	-	-	-	-	-	-	-	-	-
Soppeng	Production (t)	120	114.0	76.0	57.0	33.9	41.3	24.3	12.9	21.4	500.8
	Surface (ha)	353	380	380	380	370	370	370	370	116	3,089.0
	Kgs/ha	340	300	200	150	91.6	116.6	65.7	34.9	184.5	162.1
Sidrap	Production (t)	6.7	16.8	31.8	26.6	34.4	59.2	40.8	37.5	2.3	256.1
	Surface (ha)	42.5	68	89	104	93	97	147	157	12.0	809.5
	Kgs/ha	157.6	247.0	357.7	255.7	370	610	277	239	191.7	316.4

Table 4.9 Fish Production of Culture Pond (1969 - 1977)

Kab.	Items	1969	1970	1971	1972	1973	1974	1975	1976	1977	Total
Wajo	Production (t)	13	8.1	9.5	0.9	2.1	-	8.5	1.5	4.5	32.0/1
	Surface (ha)	150	14.0	-	5.0	-	-	30	3	-	202.0
	Kg/ha	86.7	578.6	-	180.0	-	-	283.3	500.0	-	158.4
Soppeng	Production (t)	13.2	4.4	3.8	2.5	2.0	3.2	4.1	18.7	3.8	37.0/2
	Surface (ha)	15.5	15.5	15.5	15.5	15.5	15.5	15.5	15.5	6.0	130.0
	Kg/ha	851.6	283.9	245.2	161.3	129.0	206.4	264.5	1,206.4	633.0	284.6
Sidrap	Production (t)	0.9	0.6	1.7	1.3	2.5	3.8	4.1	3.5	4.5	22.9
	Surface (ha)	14.8	8.1	12.7	25.6	25.6	25.6	25.6	25.6	11.5	175.1
	Kg/ha	60.8	74.1	133.8	50.8	97.6	148.4	160.1	136.7	391.3	130.8

/1: Not including the figures of 1971, 1973, 1974, 1977
/2: Not including the figures of 1976

Table 4.10 (1) Observation on the Limnological Condition in Lake Tempe (Oct.: 18-19, 1978)

Point	Water depth (m) /1	Temperature (C) /2	pH	Turbidity ++,+,-	Silt depth (cm)	Gas production ++,+,-	Submerged water grass ++,+,-
A	1.45	30-31	>7	+	15	++	+++
B	1.30	30-31	"	+	20	++	++
C	1.40	31	"	+	10	+	-
D	1.30	31	"	-	0	-	-
E	1.30	-	"	+	3	+	-
F	1.10	31	"	+	3	+	-
G	1.30	30-30.5	"	+	3	+	+
H	1.30	30	"	+	15	+	-
I	1.40	29.5	"	+	3	+	+
J	1.50	29.5	"	+	5	+	++
K	1.50	30	"	+	2	+	-
L	1.10	30	"	+	15	+	+
M	1.20	29-31	"	+	15	+	++
N	1.10	28.5-33.5	"	-	20	++	++++
O	1.05	31	"	+	15	+	+
P	0.85	28.5-33.5	"	++	0	-	++
Q	1.20	31	"	-	0	-	+
R	1.40	31	"	+	-	-	-
S	1.30	31	"	+	0	-	-

Table 4.10 (2) Observation on the Limnological Condition in Lake Sidenreng (Nov. 5, 1978)

Point	Water depth (m) /1	Temperature (C) /2	pH	Turbidity ++,+,-	Silt depth (cm)	Gas production ++,+,-	Submerged water grass ++,+,-
A	0.7	29	>7	+++	15	?	-
B	0.8	"	"	"	35	"	"
C	1.1	"	"	"	35	"	"
D	1.1	"	"	"	35	"	"
E	1.1	"	"	"	35	"	"
F	1.1	"	"	"	35	"	"
G	1.1	"	"	"	35	"	"
H	1.2	"	"	"	40	"	"
I	1.1	"	"	"	35	"	"
J	0.8	"	"	"	0	"	"
K	1.1	"	"	"	35	"	"
L	1.1	"	"	"	35	"	"
M	0.8	"	"	"	0	"	"

/1: Compare with Fig. 3.7.2 and 3.7.3.
/2: Measured on Dec. 9-10, 1978
/3: Table 3.8 (1) shows the temperature of bottom water and Table 3.8 (2) shows that of surface water.

Table 4.11 Names of the Lake Fish and the Species Component of Fish Catch in 1977

Local name		Scientific name	Fish catch (ton)	%
1.	Tawes	Puntius javanicus	6,748.6	52.4
2.	Sepat Siam	Trichogaster pectoralis	2,220.9	17.2
3.	Gabus	Channa striatus	1,283.3	10.0
4.	Ikan Mas	Cyprinus carpio	570.1	4.5
5.	Betok	Anabas testudianus		
6.	Tambakan	Helostoma temmincki	(1,283.3)/1	(10.0)/1
7.	Lele	Clarias spp		
8.	Bloso	Glossogobius guiris		
9.	Belanak	Mugil vaigensis		
10.	Petek		(513.3)/1	(3.9)/1
11.	Kakap			
12.	Bandeng			
13.	Sidat	Anguilla marmorata		
14.	Belut	Fluta alba		
15.	Rebon			
16.	Remis			
17.	Siput			
18.	Udang tawar	Plaemon spp	257.6	2.0
	Total		12,877.1	100.0

/1: Impression from market observation

Table 4.12 Yearly Change of Fisherman Population of the Lake Fishing /1

Year	Kab.	Full-timer	Part-timer	Laborer	Total
1965	Wajo	-	-	-	-
	Soppeng	-	-	-	-
	Sidrap	-	-	-	-
	Total	-	-	-	-
1966	Wajo	14,950	6,750	825 /2	22,525
	Soppeng	-	-	-	-
	Sidrap	-	-	-	-
	Total	-	-	-	-
1967	Wajo	-	-	-	-
	Soppeng	-	-	-	-
	Sidrap	-	-	-	-
	Total	-	-	-	-
1968	Wajo	-	-	-	-
	Soppeng	-	-	-	-
	Sidrap	-	-	-	-
	Total	-	-	-	-
1969	wajo	-	-	-	-
	Soppeng	-	-	-	-
	Sidrap	-	-	-	-
	Total	-	-	-	-
1970	Wajo	11,240	7,760	none	19,000
	Soppeng	3,240	12,050	none	15,290
	Sidrap	254	958	1,467	2,699
	Total	14,734	20,768	1,467	36,969
1971	Wajo	-	-	-	-
	Soppeng	3,240	12,050	none	15,290
	Sidrap	254	978	1,427	2,659
	Total	-	-	-	-
1972	Wajo	-	-	-	-
	Soppeng	3,445	12,767	none	16,212
	Sidrap	254	978	1,337	2,569
	Total	-	-	1,337	-
1973	Wajo	-	-	-	-
	Soppeng	1,430	12,895	none	14,325
	Sidrap	254	968	1,460	2,687
	Total	-	-	1,460	-
1974	Wajo	6,560	4,000	350 /2	10,910
	Soppeng	1,430	12,895	none	14,325
	Sidrap	239	968	1,460	2,667
	Total	8,229	17,863	1,460	27,902
1975	Wajo	6,560	5,078	none	11,638
	Soppeng	1,595	13,290	none	14,885
	Sidrap	249	968	1,610	2,827
	Total	8,404	19,336	1,610	29,360
1976	Wajo	3,015	-	none	-
	Soppeng	1,620	15,095	none	16,715
	Sidrap	249	978	1,610	2,837
	Total	4,884	-	1,610	-
1977	Wajo	2,842	1,681	none	4,523
	Soppeng	1,294	10,760	none	12,054
	Sidrap	231	1,150	1,575	2,956
	Total	4,367	13,591	1,575	19,533

/1: Including the fishermen of Lake Sidenreng and Buaya
/2: Amateur fishermen

Table 4.13 Inventory of Fishing Gear by Type[/1]

	Name of fishing gear	Type	Wajo	Soppeng	Sidrap	Total	F.C.G./2 / T.F.C. (%)	O.T.C./3 / T.O.T. (%)	F.E./4 (kg/operation)
1.	Lanra (gill net)	B	2,048	639	3,600	6,287	51.65	53.39	12.35
2.	Jala (cast net)	B	-	800	2,400	3,250	5.77	7.05	10.45
3.	Panambe (long line)	B	248	152	38	438	3.82	6.09	8.01
4.	Bunre (surrounding net)	B	-	161	45	206	5.45	1.41	49.38
5.	Bubu (bamboo fence)	A	416	3,375	2,800	6,591	9.81	10.90	11.49
6.	Dari (scoop net)	B	-	125	-	125	4.21	5.89	9.13
7.	Pancing (angling)	B	-	8,500	-	8,500	-	-	-
8.	Tombak (spear)	B	-	230	1,228	1,458	1.56	2.11	9.44
9.	Serok (scoop net)	B	301	-	-	301	2.40	3.40	10.77
10.	Julu (fish weir)	A	51	-	300	351	1.79	0.97	23.67
11.	Cappiang (bamboo fence)	A	5	-	-	5	0.25	0.01	48.83
12.	Sosok (scoop net)	B	-	285	-	285	3.36	3.34	12.86
13.	Seser (scoop net)	B	-	245	1,070	1,315	2.23	2.17	13.15
14.	Bunka Toddo (floating grass + bamboo fence)	A		-	-		0.97	0.06	220.46
15.	Timpo	B		-	-		0.25	0.43	7.32
16.	Other						6.48	2.78	14.44

/1: These are computed from the data of Desa Sampling in 1977 (12) (13) (14)

/2: Fish Catch per Gear/Total Fish Catch;

/3: Operation Times per Gear/Total Operation Times

/4: Fishing Effort = Total Fish Catch per Gear/Total Operation Times per Gear.

Table 4.14 (1) Market Price of Wet and Dry Fish, and Exported Price of Dry Fish in Wajo (1955-1963)

(Unit: Rp/kg)

Year	Market Price		Exported price of Dry Fish
	Wet	Dry	
1955	-	-	3.72
56	2.74	3.69-12.48	3.56
57	3.72	5.27-13.92	4.36
58	4.66	6.02-13.46	3.78
59	5.67	6.25-15.81	6.85
1960	9.63	8.35-20.90	7.63
61	8.30	6.64-20.50	9.20
62	26.64	30.32-100	29.33
63	107.00	75.70-175	61.15

Table 4.14 (2) Total Production, Exported Amount and Local Consumption of Processed Fish from Wajo (1956-1963)

(Unit: ton)

Year	Amount of Processed Fish				Exported Dried Fish	Local Consumption
	Dried	Smoked	Dried Shrimp	Total		
1956	1600.7	3.2	40.9	1653.8	1672.4	62.7
57	453.2	2.5	72.8	527.9	443.9	84.0
58	1602.1	4.8	160.5	1767.4	1546.9	220.5
59	2399.3	26.5	91.5	2411.1	2375.9	35.2
1960	1825.1	44.8	415.0	2284.9	998.3	1286.6
61	2278.5	42.1	404.6	2725.2	1631.8	1093.4
62	2366.8	52.2	121.3	2540.3	1007.9	1532.4
63	1059.8	53.3	246.9	1059.8	852.5	207.3

Table 4.15 Fish Production, Exported Amount, and Local Consumption in Wajo (1960 - 1976)

(Unit: ton)

Year	Fish production	Exported Amount/1	Local Consumption/2
1960	5,348	1,997	3,351
61	11,749	3,264	8,485
62	9,656	2,016	7,040
63	3,375	1,705	1,670
64	2,192	1,585	607
65	5,064	3,335	1,729
66	2,354	5,371	3,017
67	2,076	-	-
68	2,676	1,435	1,241
69	2,177	1,276	901
70	1,540	1,070	470
71	1,413	1,026	387
72	1,355	1,372	17
73	1,674	1,546	128
74	2,480	1,969	511
75	2,893	1,755	1,138
76	2,025	0	2,025

/1: Converted amount to wet weight (Convertion factor = 0.5)

/2: Local consumption = Fish production - Exported amount

Table 4.16 Average Market Price and Fishing Ground Price of Lake and Sea Fish (1978)

(unit: Rp./kg)

Fish kind		A.M.P.K/1 (Rp./Kg)	A.F.G.P.K/2 (Rp./Kg)
Wet and dried	Tawes	219.3	146.2
Wet and dried	Sepat	221.1	147.4
Wet	Gabus	360.8	240.5
Wet	Ikan Mas	273.0	182.0
Wet	Oseng	234.0/3	156.0
Wet	I. Bandeng	442.8/3	295.2
Wet and dried	Cakalang	432.2/3	288.1
Wet and dried	Layang	307.3/3	204.9

/1: A.M.P.K = Average market price by fish kind

/2: A.F.G.K = Average fishing ground price by fish kind

/3: Estimated directly by the sampling dasa without drawing the standard curve.

Table 4.17 Estimated Minimum Fish Supply to Markets in the Objective Area (November, 1978)/1

(Unit: ton/year)

Kab.	Lake fish		Sea fish		Yearly Total
	Wet	Dried	Wet	Dried	
Wajo	2,153.3	747.5	326.9	586.4	3,814.1
Soppeng	3,366.8	1,127.6	835.1	877.1	6,206.6
Sidrap	1,267.2	518.8	571.0	793.3	3,150.3
Bone	740.8	450.2	705.4	519.4	2,415.8
Enrekang	75.6	194.4	93.6	453.6	817.2
Maros	25.2	21.6	122.4	142.0	311.2
Total	7,628.9	3,060.1	2,654.4	3,371.8	16,715.2

/1: Estimated from market survey

/2: Kab.Enrekang and Maros are not included as the main market of lake fish in this report.

/3: Dried fish weight is converted to wet fish weight.

Table 4.18 Estimated Average Fish Consumption of Kabupatens in the Objective Area (November 1978)/1

	Lake fish (t/year)		Sea fish (t/year)		Yearly Total (t/year)	Population (person)	Fish consumption (kgs/capital/year)
	Wet	Dried	Wet	Dried			
Wajo	2,939.8	831.4	407.3	452.0	4,630.5	259,162	17.9
Soppeng	3,218.3	3,518.4	967.2	1,883.6	9,587.5	241,010	39.8
Sidrap	1,412.0	1,399.8	979.6	741.3	4,481.0	189,460	23.7
Bone	823.9	1,387.3	206.7	715.1	3,133.0	167,921	18.7
Total	8,403.9	7,076.9	2,560.8	3,792.0	21,832.7	857,553	25.46

/1: Estimated from personal interviewing survey

/2: Dried fish weight is converted to wet fish weight

/3: From the census in 1977, and only the number of people in the area under the influence of lake fish supply.

Table 4.19 (1) Code Names of Markets in Each Kabupaten (1978)

Code	Wajo	Code	Soppeng	Code	Sidrap	Code	Bone	Code	Enrekang
	Market name		Market name		Market name		Market name		Market name
Name	Kec. Name	name	Kec. name	name	Kec. name	name	Kec. name	name	Kec. name
W- 1	Central Tempe	So- 1	Wolonge Mario Riawa	Si-1	Wettee Panoalautang	B-1	Pompanua Atangale	E-1	Maroanging Maiwa
W- 2	Tempe Tempe	So- 2	Batubatu MarioRiawa	Si-2	Wanio Pancalautang	B-2	Timurung Atangale	E-2	Kabere Maiwa
W- 3	Impaimpa Tanasitolo	So- 3	Panincong	Si-3	Bilokka Pancalautang	B-3	Pappolo Atangale	E-3	Enrekang Enrekang
W- 4	Tancung Tanasitolo	So- 4	Leworang Lalabata	Si-4	Lise Pancalautang	B-4	Lebbae Atangale	Code	Maros
W- 5	Lajokka Tanasitolo	So- 5	Tajuncu Lalabata	Si-5	Massepe	B-5	Taretta Ulaweng	name	Market name Kab. name
W- 6	Baru Tanasitolo	So- 6	Central Lalabata	Si-6	Teteaji Maritengngae	B-6	Tobenteng Ulaweng	M-1	Camba Camba
W- 7	Belawa Belawa	So-7	Lalloe	Si-7	Amparita Tellu Limpoe	B-7	-	M-2	Kacincing Camba
W- 8	Ulugalung Sabbamparu	So-8	Pattojo Mario riawo	Si-8	Allakuang Maritengngae	B-8	-	M-3	Bengobengo Camba
W- 9	Salojampu Sabbamparu	So-9	Lajoa Mario riawo	Si-9	Central Maritengngae	B-9	Taccipi Ulaweng		
W-10	Patila Pammana	So-10	Pacenkang Mario riawo	Si-10	Empagae Empagae	B-10	Ulo Tellu siatinge		

Table 4.19 (2) Code Names of Markets in Each Kabupaten (1978)

Code	Wajo	Code	Soppeng	Code	Sidrap	Code	Bone	Code	Enrekang
	Market name		Market name		Market name		Market name		Market name
name	Kec. name	Name	Kec. name	name	Kec. name	name	Kec. name	name	Kec. name
W-11	Maroanging Pammana	So-11	Citta Lajoa	Si-11	Bendoro Empagae	B-11	Ranca Ranca	Pa-1	Labukkang Soreang
W-12	Kampiri Pammana	So-12	Cangadi Lajoa	Si-12	Gadiddi Empagae	B-12	Otting Ranca	Pa-2	Lakessi Ujung
W-13	Anabanua Maniangpajo	So-13	Cabenge Liliriaja	Si-13	Bajoe	B-13	-	Pi	Central Wt. Sawitto
W-14	Gilirang Maniangpajo	So-14	Salaonro Liliriaja	Si-14	Lawawoi Wt. Pulu	B-14	Pattiro Dua baccoe		
W-15	Paria Majualeng	So-15	Pallapaoe Liliriaja	Si-15	Manisa Wt. Pulu	B-15	Uloe Dua boccoe		
W-16	Attapange Majualeng	So-16	Lorengparae Liliriaja	Si-16	Rappang Pancarijang	B-16	Solo Ajangale		
W-17	Tosora	So-17	Takkalala Marioriawo	Si-17	Kelo Pancarijang	B-17	Welado Ajangale		
W-18	Sakkoli Sajoanging	So-18	Langkemme Marioriawo	Si-18	Baranti Baranti	B-18	Central Tanete riattang		
	Salobulo Sajoanging			Si-19	Lancirang Dua pitue	B-19	Koppe Lappa riaja		
	Akkotangeng Sajoanging			Si-20	Tanru Tedong Dua Pitue	B-20	Bengo Lappa riaja		

Table 4.19 (3) Code Names of Markets in Each Kabupaten (1978)

Code	Wajo	Code	Soppeng	Code	Sidrap	Code	Bone
	Market name		Market name		Market name		Market name
name	Kec. name	name	Kec. name	name	Kec. name	name	Kec. name
W-21	Bottotalla Sajoanging	-	-	Si-21	Bila Dua pitue	B-21	Tungke Lappariaja
W-22	Doping Sajoanging			Si-22	Otting Dua pitue	B-22	Leppangeng Lappariaja
W-23	Talang Sajoanging					B-23	Parigi Lappariaja
W-24	Kera Pitunpanua					B-24	Tanabatue Lappariaja
W-25	Kaluku Pitunpanua					B-25	Bancae Lappariaja
W-26	Siwa Pitunpanua					B-26	Turucinnae Lamuru
W-27	Peneki Takkalala					B-27	Lamuru Lamuru
W-28	Solo Takkalala					B-28	Bakunge Ponre

Table 4.20 Present Condition of Government or Private Owned Fishing Ground in the Lakes[/1]

	Unit	W a j o	S o p p e n g	S i d r a p
Total surface area	(ha)	10,000	3,000	3,400
Owned area by government	(ha)	about 2,000 (about 50)[/2]	1,687 (15)[/2]	about 1,000 (3)[/2]
Owned area by private	(ha)	about 100 (?)	457 (6)	? (?)
Name of government area		Ex-ornament	Palawang Pemerintah	Onkgo
Frequency of auction		Every 1 - 3 years	Every year	Every 2 years
Results of Auction in 1978	(Rp)	23×10^6	6×10^6	2×10^6
Effective period of the ownership		Every year July 4 - Dec. 31	Every year July 1 - Dec. 31	Every year July 1 - Dec. 31
Share for fishermen from total fish catch	(%)	20 - 30	20	25 - 33
T a x		Included in auctioned price	Included Price owner: 5% of total catch	Included

/1: Information from chief of each Dinas Perikanan Kab. Wajo, Soppeng and Sidrap

/2: The number of devided fishing ground.

Table 4.21 Fish Production of Paddy Field in South Sulawesi and Objective Area (1969 - 1977)

A r e a	Items	Unit	1969	1970	1971	1972	1973	1974	1975	1976	1977	Total
Total of Sulawesi	Production	(t)	1,813	2,114	2,082	1,665	1,725	1,920	1,986	2,045	1,056	16,406
	Surface[1]	(ha)	10,699	9,738	9,646	8,154	8,677 (653,450)	12,343 (112,713)	13,117 (125,178)	12,950 (150,731)	3,561 (-)	
	Productivity	(kg/ha)	169	217	204	204	199	156	151	158	297	186
Total of Objective area	Production	(t)	127	131	108	84	68	101	65	50	24	758
	Surface	(ha)	396	448	469	484	463	467	517	527	(33,000)[2]	3,899
	Productivity	(kg/ha)	321	292	230	174	147	216	126	95	188	194
Kab. Wajo	Production	(t)	-	-	-	-	-	-	-	-	-	-
	Surface	(ha)	-	-	-	-	-	-	-	-	-	-
	Productivity	(kg/ha)	-	-	-	-	-	-	-	-	-	-
Kab. Soppeng	Production	(t)	120	114	76	57	33.9	41.3	24.3	12.9	21.4	500.8
	Surface	(ha)	353	380	380	380	370	370	370	370	116	3,089.0
	Productivity	(kg/ha)	340	300	200	150	91.6	111.6	65.7	34.9	184.5	162.0
Kab. Sidrap	Production	(t)	6.7	16.8	31.8	26.6	34.4	59.2	40.8	37.5	2.3	256.1
	Surface	(ha)	42.5	68	89	104	93	97	147	157	12.0	809.5
	Productivity	(kg/ha)	157	247	357.3	255.7	610	610	277	239	191.7	316.4

Dinas Perikanan Daerah Propinsi Sulawesi Selatan 1977

/1: Numbers in parenthesis shows the development of irrigated area in South Sulawesi

/2: Total irrigation area in the inland fisheries objective area.

Table 4.22 Matrix of Strategy of Development Plan and It's View Point

View point \ Strategy		To protect the environment condition of Temp and increase fish production	To develop the irrigated paddy field for fish production area	To prepare the indispensable supporting project
Lake fishing	Fish protection area	○		○
	To stock with new sp.	○		○
Hatchery pond		○	○	○
Paddy field fish culture			○	○
Lake fish culture		○		○
To provide fisheries supporting organization		○	○	○

Table 4.23 Activities of I.F.D.C to Each Plan and Target Area ∠1

Plan \ Target Area		Lake Tempe	Lake Sidenreng	Paddy Field
Lake Fishing	Protection Area	○		
	Introduction of new sp.	○	○	
Hatchery pond		○	○	○
Paddy field fish culture				○
Lake fish culture		○	○	

∠1 : I.F.D.C. = Inland Fisheries Development Center

I.F.D.C. —
- Transfer of Fisheries Technology
- Pilot Plan
- Research and Experiment

Table A.I. (1) Flow Chart of Identification Approach to the Probable Cause

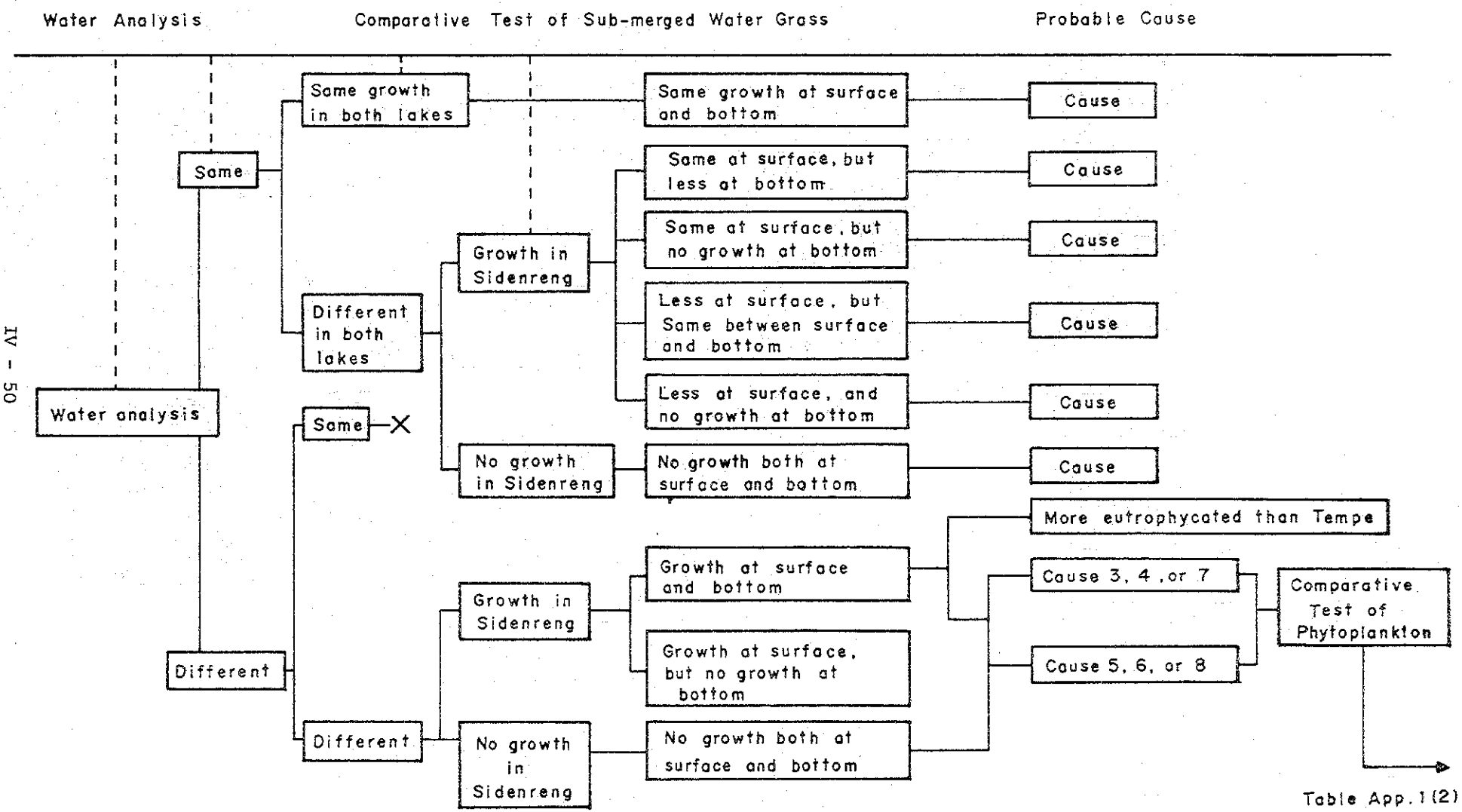


Table A.1 (2) Flow Chart of Identification Approach to the Probable Cause

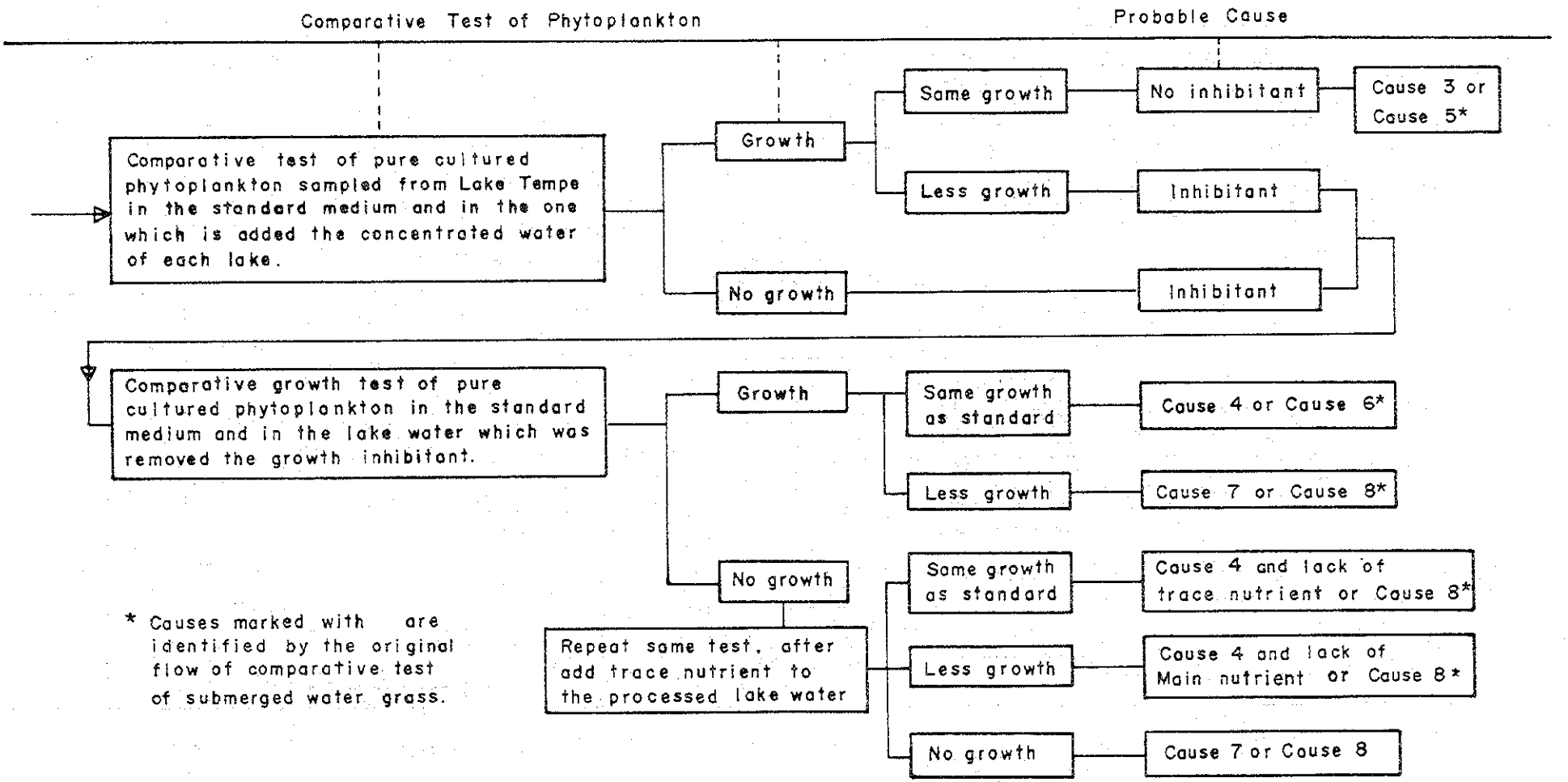


Fig. 4.1 Contour Map of Lake Tempe

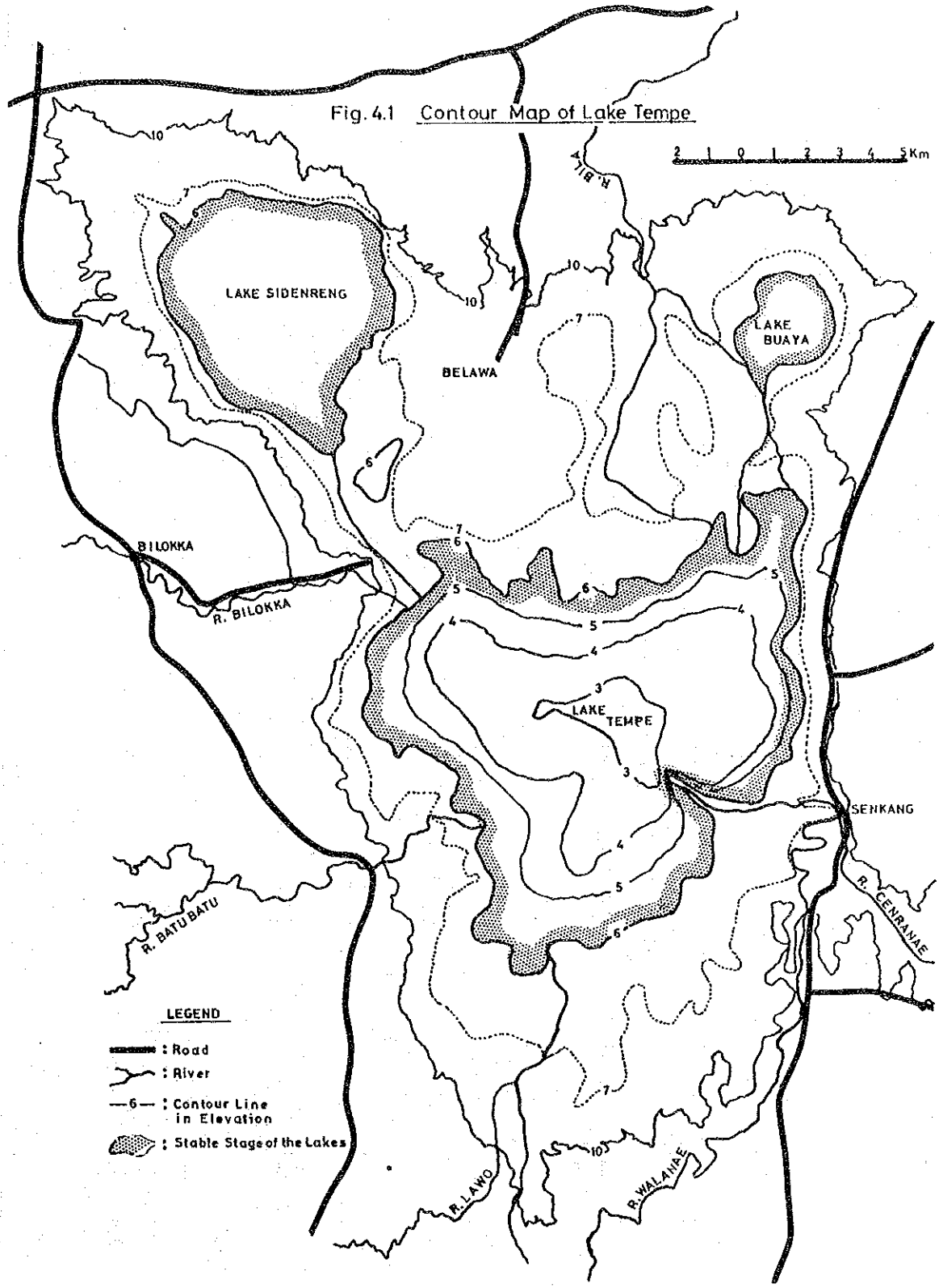


Fig. 4.2 Hydrological Average Fluctuations of Lake Tempe

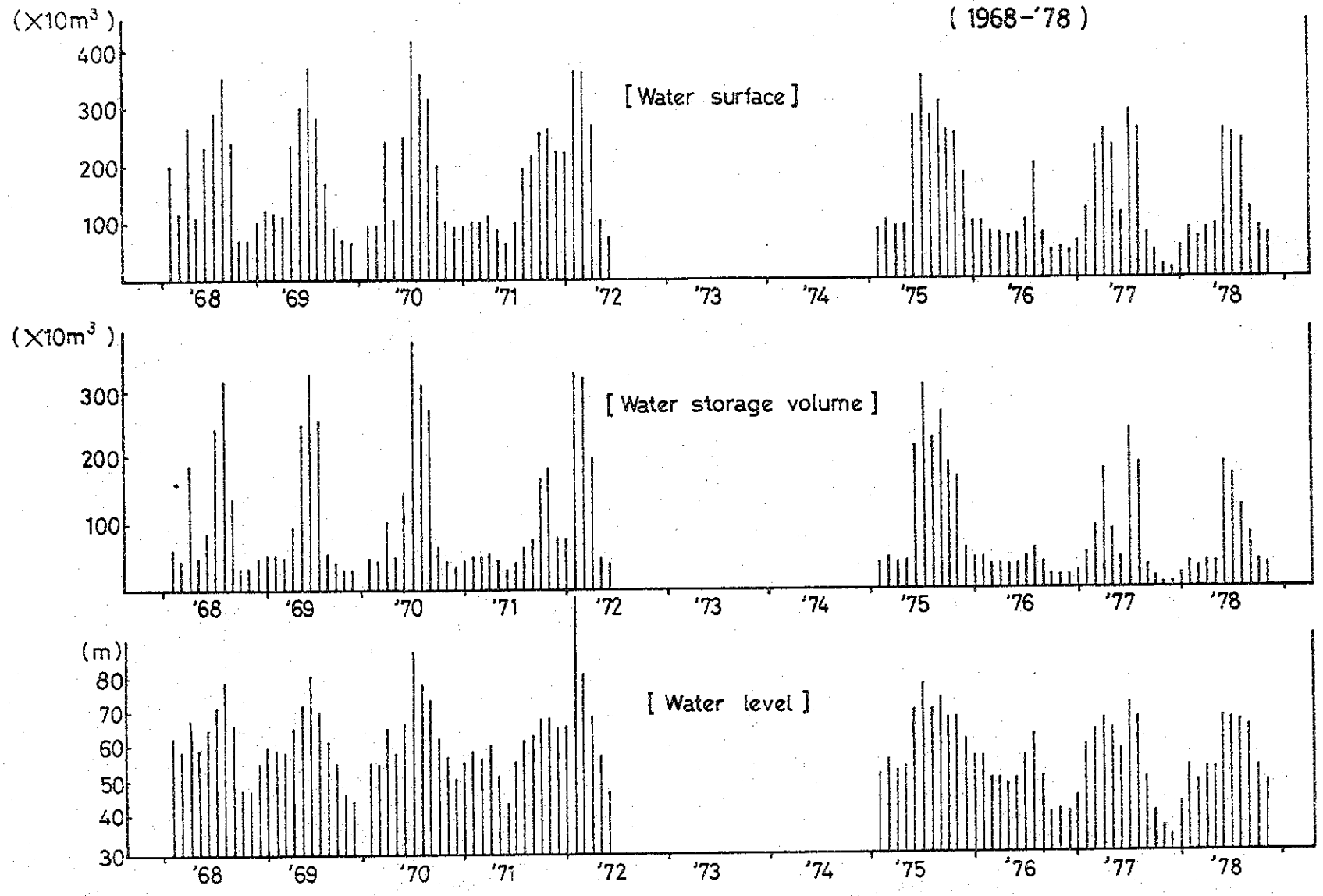
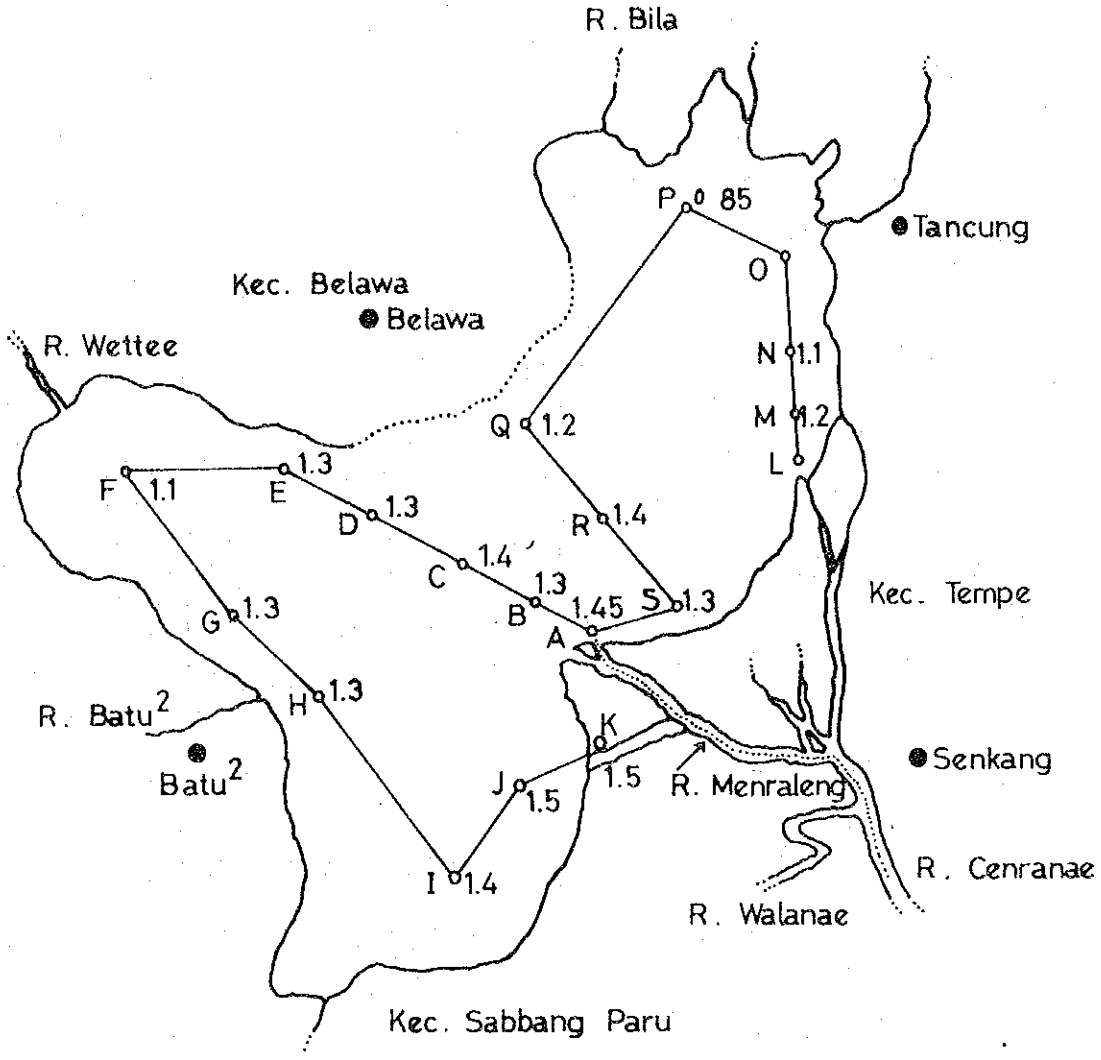


Fig. 4.3 Water Depth of L. Tempe



REMARK

∠1 : Each position of the obsevation points is roughly estimated by the sailing time

∠2 : Numbers in the map show the water depth at each point

∠3 : Point A-K were surveyed on Oct. 18 '78
Point L-S were surveyed on Oct. 19 '78

Fig. 4.4 Water Denpth of Lake Sidenreng

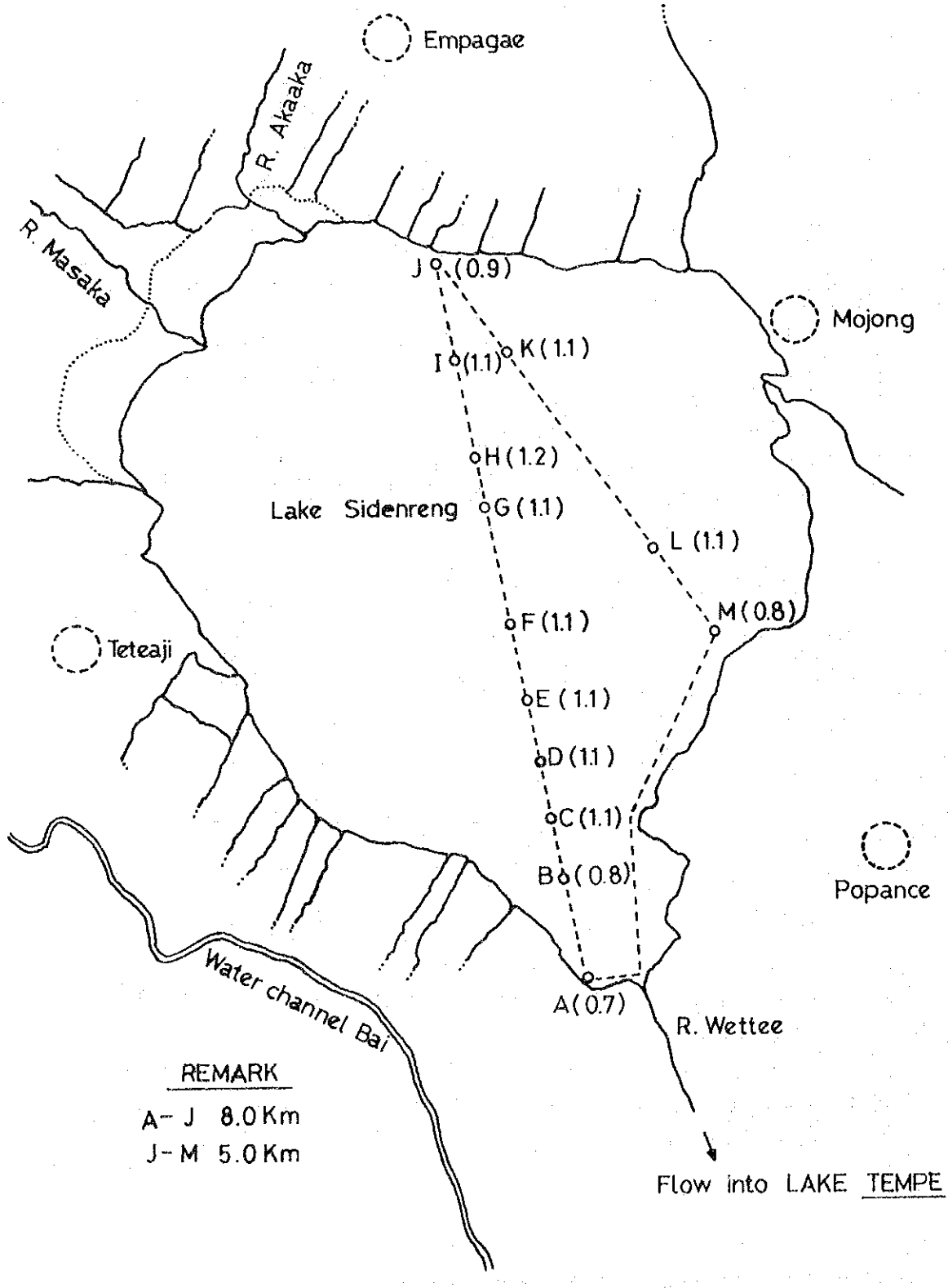


Fig. 4.5-(1) Body Length Component of Tawes from Belawa area in Lake Tempe

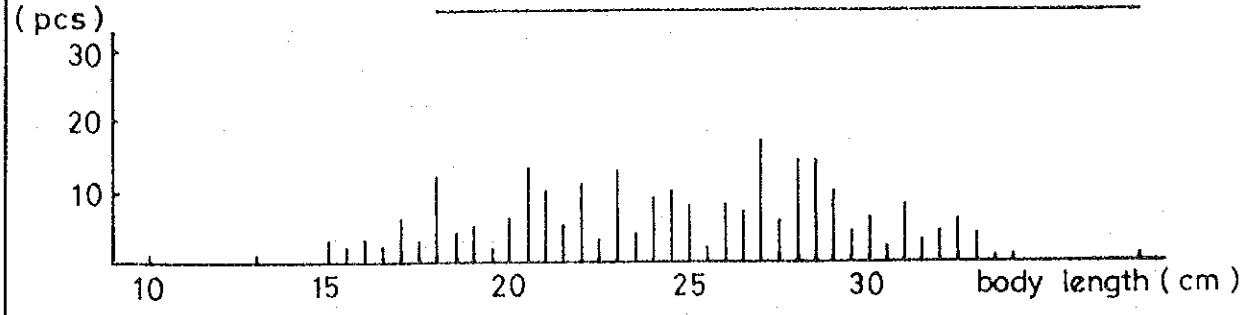


Fig. 4.5-(2) Body Length of Tawes from Lake Sidenreng

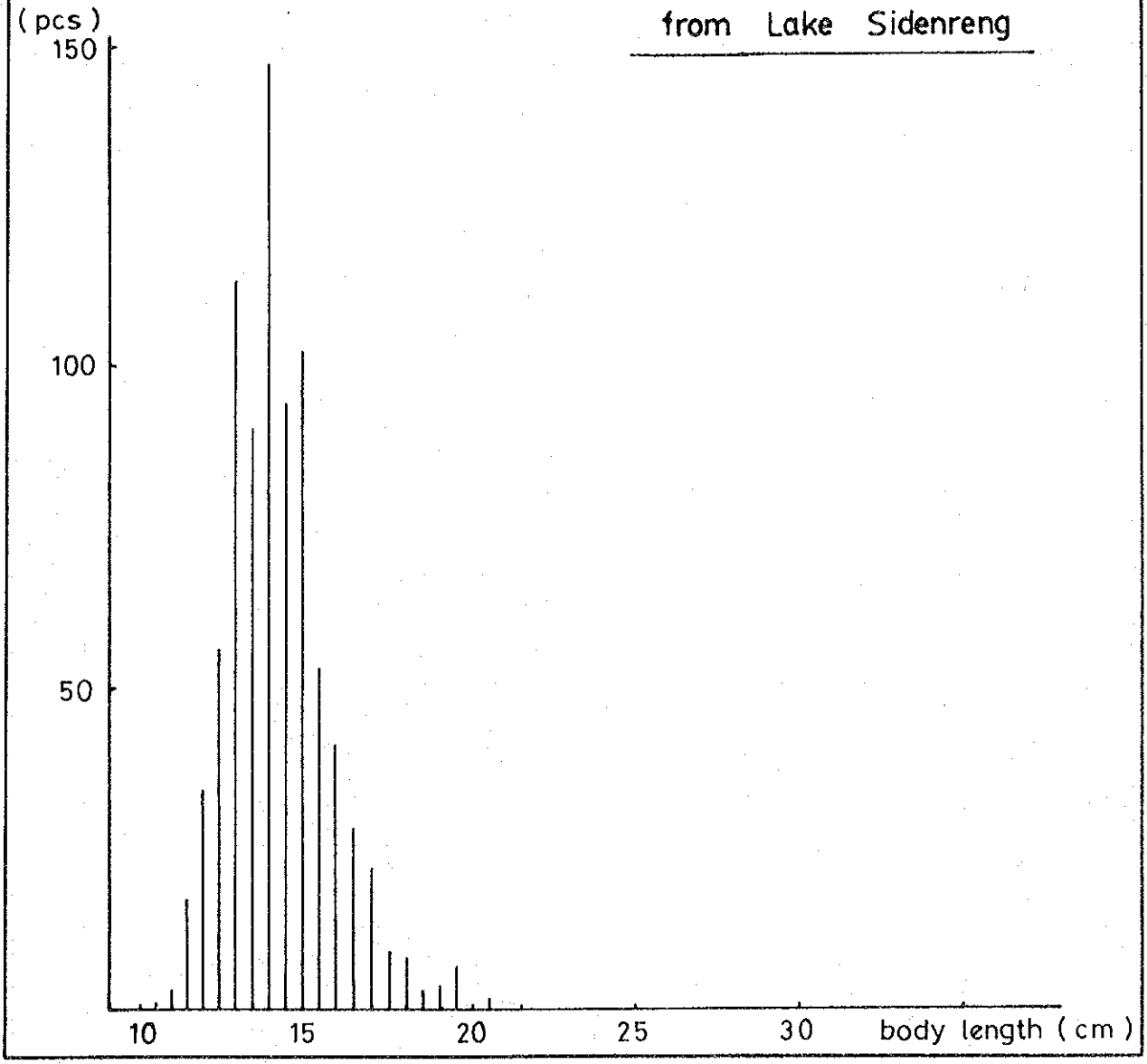


Fig. 4.5-(3) Body Length of Sepat in Lake Tempe

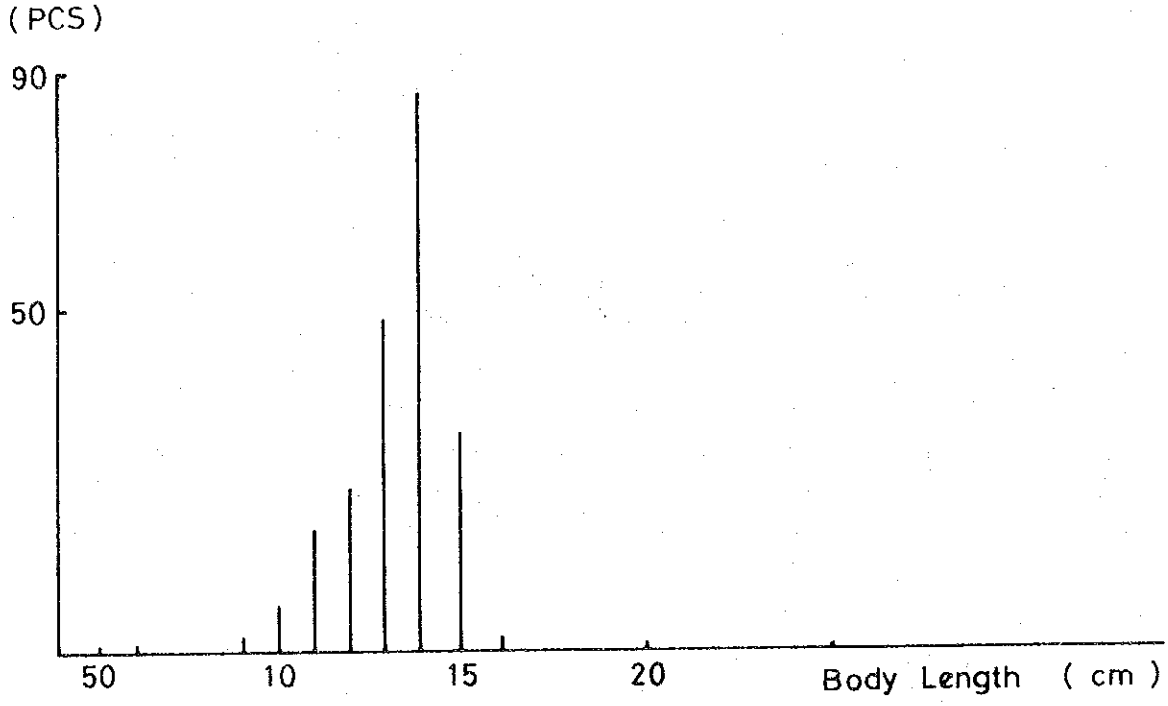


Fig. 4. 6 Yearly Price Change Wet Fish and Exported Dry Fish

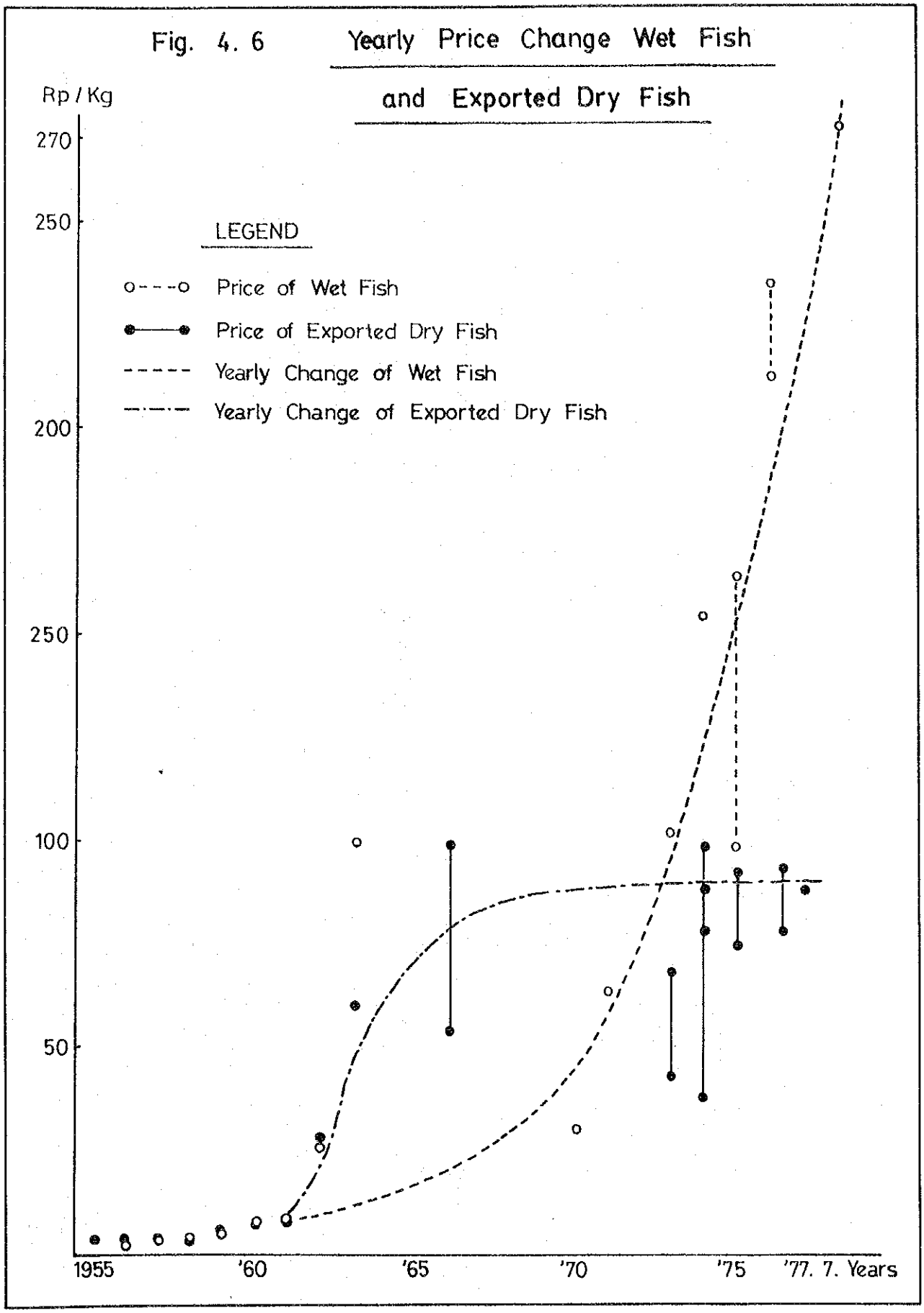


Fig. 4.7 Local Market Area of Lake Fish

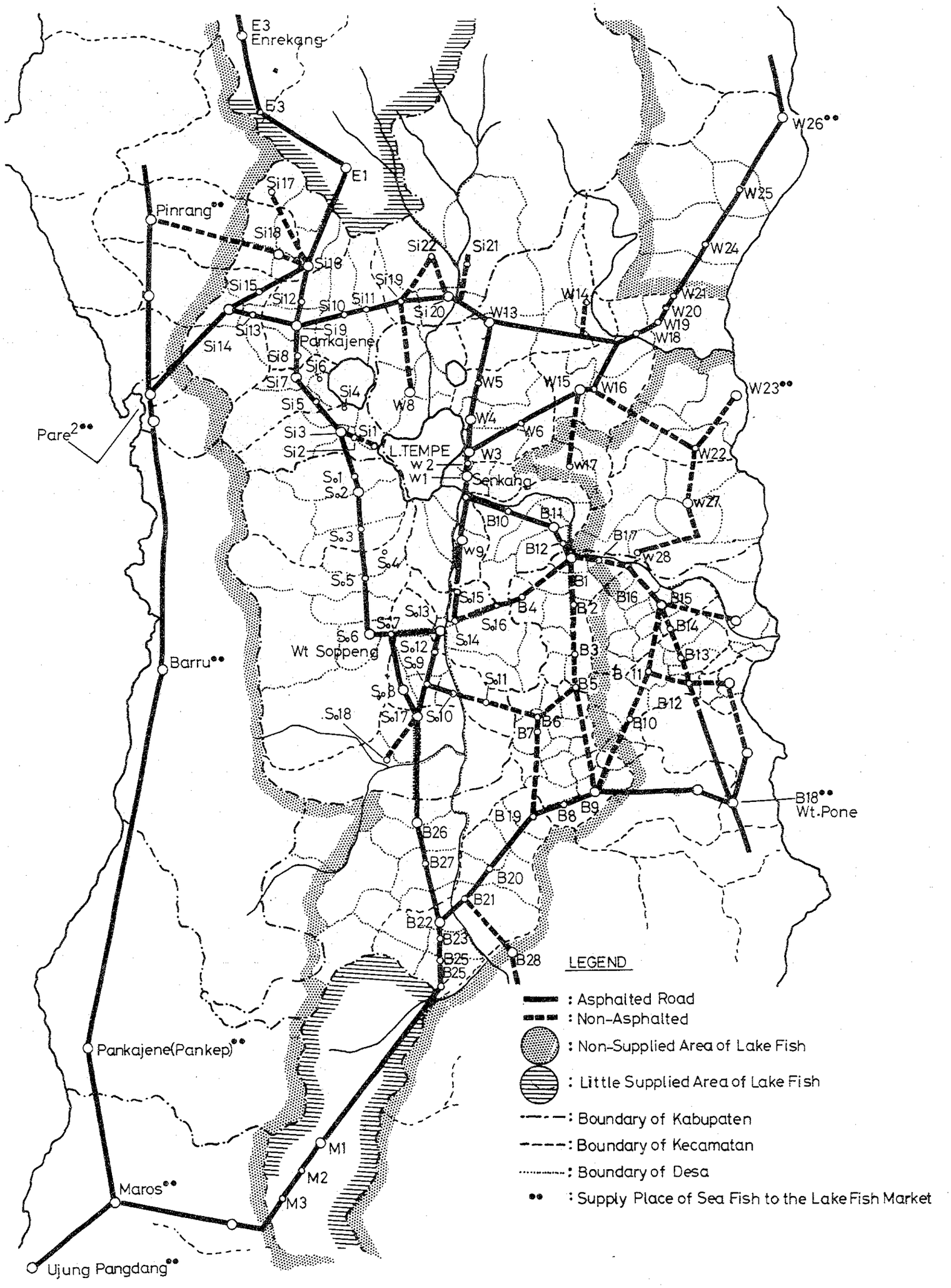


Fig. A. 2.1 Location of Protection Area

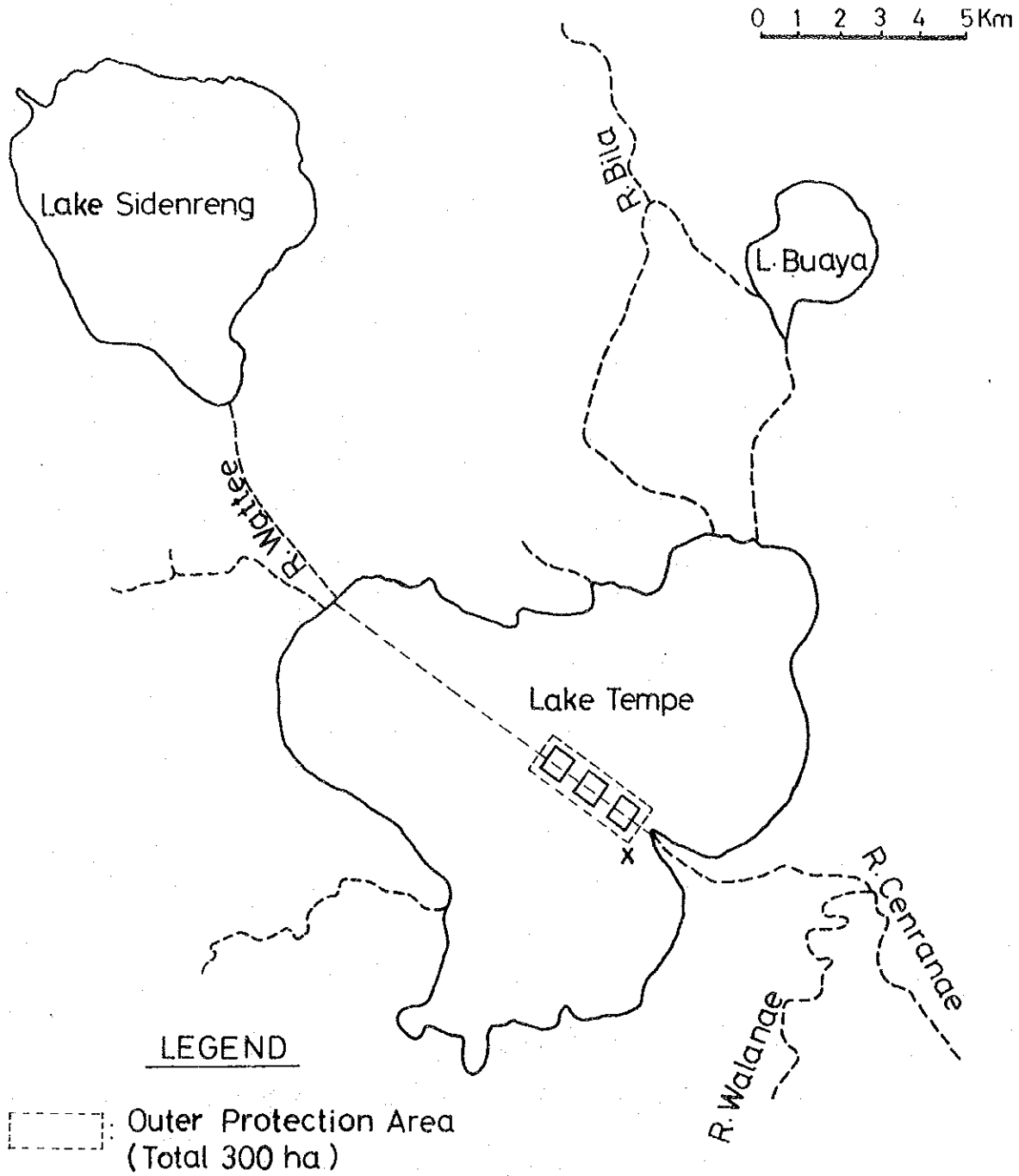
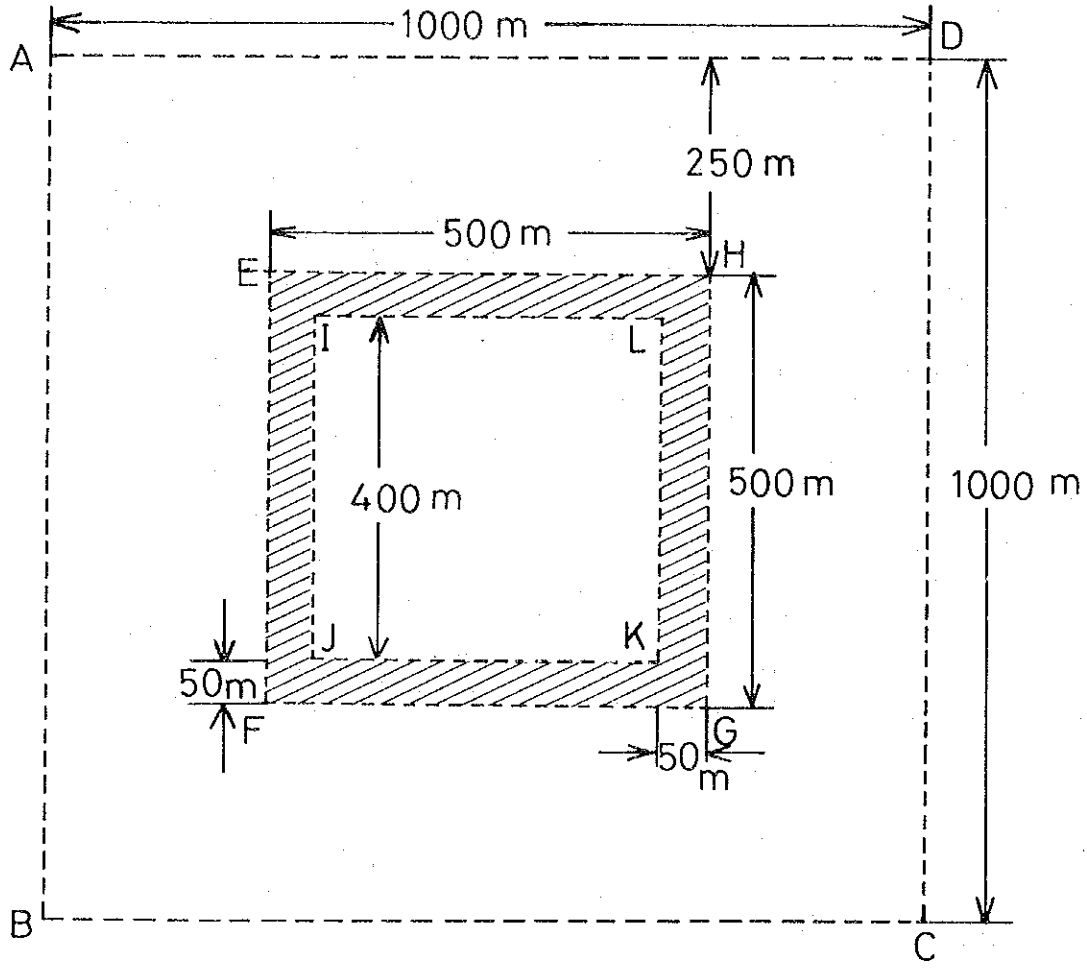


Fig. A.2.2 Figure of Protection Area(1Unit)



LEGEND

Area(ABCD): Outer Prtection Area (100 ha)

Area(EFGH): Inner Prtection Area (25 ha)

Area($^{EFGH}_{IJKL}$): BUNKA TODDO Area (9 ha)