Country	: The Republic of Indonesia
Project	: Langkeme Irrigation Project
Borrower	: The Republic of Indonesia
Executing Agency	: Directorate General of Water Resource Development (DGWRD)
Date of Loan Agreement	: December 1985
Loan Amount	: ¥6,951 million
Local Currency	: Rupiah (Rp)
Report Date	: November 1997 (Field Survey: February - March 1997)

Langkeme Trunk Water System

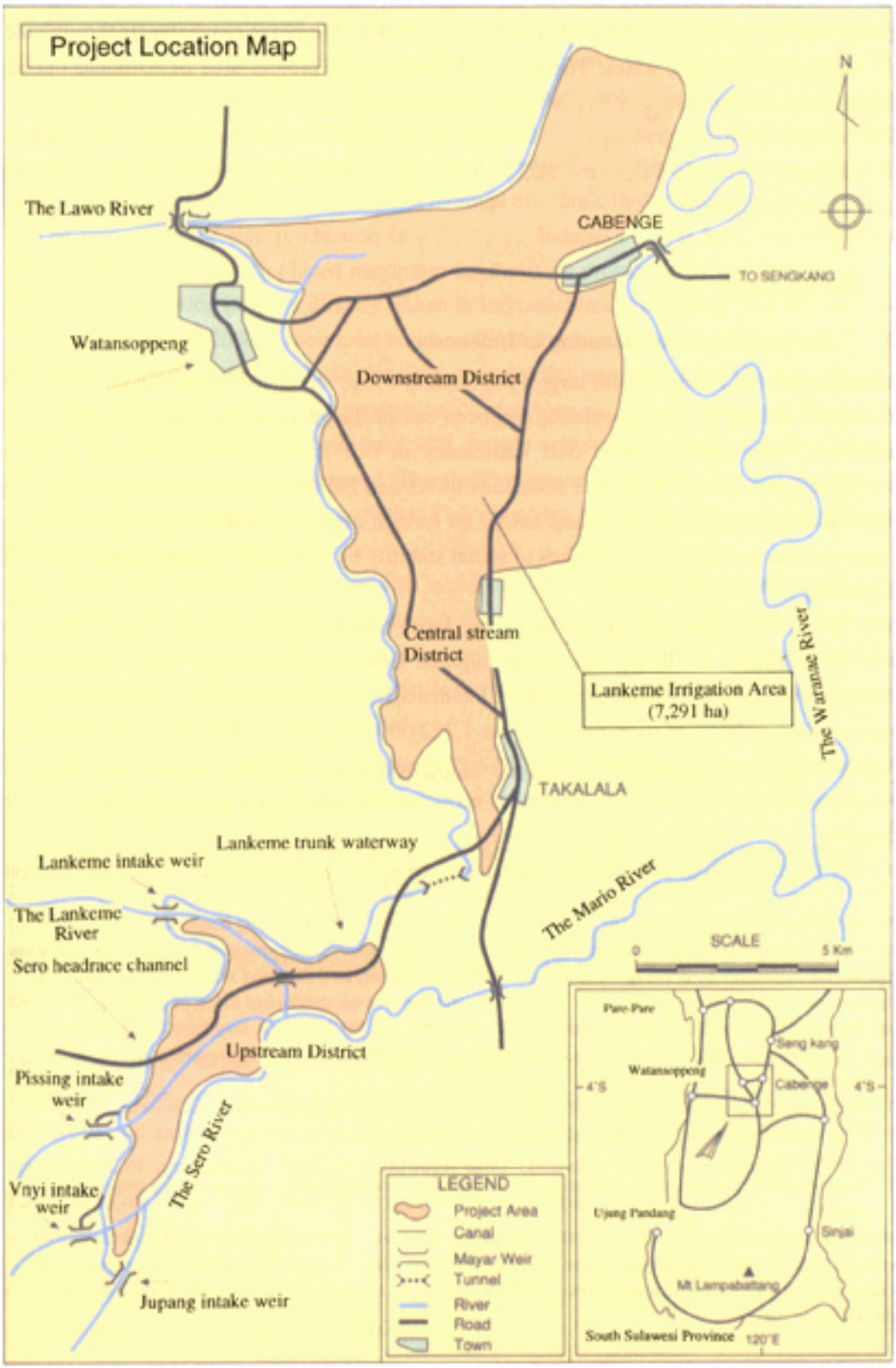
［**Reference**］

1. Abbreviation and Terminology:

- BAPPENAS：National Development Planning Agency
- Repelita I ~ V：The First to Fifth National 5-year Development Plan in Indonesia
  - Repelita Ⅰ：1969/70～1973/74
  - Repelita Ⅱ：1974/75～1978/79
  - RepelitaⅢ：1979/80～1983/84
  - RepelitaⅣ：1984/85～1988/89
  - Repelita Ⅴ：1989/90～1993/94
- MPW： Ministry of Public Works
- DGWRD： Directorate General of Water Resource Development: Executing Agency
- Intake weirs (four forms):
  - (1) Concrete fixed weir: This is a permanent weir structure of concrete. It lacks any moveable elements to adjust water level or flow volume. It is constructed in areas of large-scale irrigation where water users' association have high densities of water canals.
  - (2) Concrete tyrolean type: This is a simple, fixed weir faced with concrete. It is constructed in areas where the canal density and the scale of irrigation is medium.
  - (3) Wet masonry type: Stone is piled up and the gaps between stones are packed with concrete to create a structure similar to a stone wall.
  - (4) Mesh basket type: Stones are packed into baskets woven from steel cables and used as revetments and ground protection. These baskets are stacked to form weirs in small mountain streams and comparatively fast-flowing small rivers. This type is mainly used in relatively small-scale constructions.
- Irrigation efficiency: The proportion of the volume of water taken from the water source which is used as needed in the end paddy fields.
- Technical irrigation system: Irrigation facilities which have adjustment functions to adjust the water intake and distribution volumes. Their irrigation efficiency is comparatively high (50~60%). They are usually applied to large irrigated areas.
- Semi-technical irrigation system: Water volume can be adjusted, but adjustment (measurement) is only possible at headworks etc. at the point of intake. These are mid-range facilities with irrigation efficiency of 40~50%.
- Non-technical irrigation systems: Irrigation systems with no means of adjusting or measuring water flow. In most cases the headworks are not semi-permanent and are constructed from materials which can easily be obtained locally. Tertiary waterways have usually not been developed, with water being distributed by plot-to-plot irrigation, and there is usually no drainage system. These systems have the advantage of low cost but their irrigation efficiency is low, at 40% or less.

1. Project Summary and Comparison of Original Plan and Actual

1.1 Project Location



1.2 Project summary and OECF Portion

This project targeted approximately 7,300ha of the grain belt around Lake Tempe in the middle of South Sulawesi Province in Indonesia. Its objectives were to build or improve irrigation facilities such as intake weirs and canals in order to improve rice harvests through the stable supply of irrigation water. The initial plan was for a project area of 6,400ha, but an additional area of approximately 900ha was irrigated later[1].

According to the loan agreement, the loan was to finance the entire foreign currency portion of the total project cost (to a limit of ¥5.55 billion) and a portion of the local currency cost (to a limit of ¥1.401 billion).

1.3 Background

1.3.1 The position of rice farming in Indonesia

Indonesia has the world's fourth largest population, which stood at 193 million in 1995. The stable supply of food for this population has been one of the greatest tasks facing the country's development since independence. Self sufficiency in rice production is given the greatest emphasis as it is expected to deliver numerous direct and indirect benefits. Beyond stabilizing the domestic food supply situation and saving on foreign exchange in the long term by cutting rice imports, rice production contributes to social stability by raising the income of farmers and underpinning the rural economy.

In the late 1970s, when Indonesia was asking Japan for aid, it was still very difficult for the country to break free of its dependence on imports. Development policies for increased food production were of the highest importance. Incidentally, over the three years 1975~1977 the average annual volume of rice imports was 1,322,000 tons, worth US$484.8 million. This represented 11.7% of all imports and 53.9% of imports of consumption goods. These figures leave no room for doubt as to the enormous economic importance of increased domestic rice production.

In 1984 the Indonesian Government proclaimed complete self-sufficiency in rice production

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[1] The aim of this project, which targeted paddy fields extending over an area of approximately 7,300ha, was to allow irrigated rice cultivation by drawing water from the nearby Langkeme, Lao, Sero and Waranae tributaries. This irrigation was intended to raise agricultural productivity and improve the standard of living of people in the project area. The main targets of the project are listed below.

(1) To stabilize unit yield and wet-season rice crops through the introduction and improvement of irrigation techniques.
(2) To increase the cropped area for the dry-season rice crop by enabling year-round rice cultivation.
(3) To strengthen crops through improved irrigation technology.
(4) To diversify crops.
(5) To strengthen the organization of existing farming support services of all kinds to make this project more effective.

If the above objectives are to be achieved, the construction of a scientific irrigation system will have to be combined with improvement of existing non-scientific irrigation systems. These improvements are expected to increase the unit yields of agricultural produce and, by extension, contribute to the economic development of South Sulawesi Province.

(although the FAO put Indonesia's imports of rice in that year at 410,000 tons), but rice imports continued after that point. In 1988 imports remained above 30,000 tons, indicating that domestic supply of rice was failing to keep pace with rising demand. The improvement in diet which accompanies improved living standards was increasing the per-capita consumption of rice. At the same time, Indonesia's population was growing at an annual rate of 2.3% (the annual average between 1971 and 1980), so this also increased rice consumption. The increase in demand resulting from a growing population consuming more per head made increased domestic rice production, and the reduction of rice imports, extremely important. Accordingly, it was made one of the highest priorities of national economic development.

The importance of rice production is reflected in Indonesia's first four National Five-year Development Plans, which placed maximum emphasis on promotion of the agricultural sector, particularly irrigation projects directly linked to increased rice production. The first and second plans gave 30% and 20% of their total budgets, respectively, to agriculture and irrigation. These concentrated stimulation policies brought remarkable improvements in agriculture in a comparatively short period. The production of rice rose by around 60% over the ten years 1973~1983 (an average annual rise of 4.9%), largely achieving the goal of self sufficiency in rice, although some imports continued. The share of import value taken by rice imports, which had been 10%, plummeted to 1% by 1981. This must also have produced a considerable saving in foreign currency expenditure.

Such an increase in rice production also increases the purchasing power of farmers by raising their income from farming. This prompted the consumer product economy to spread into farming villages and rural areas, increasing employment opportunities in nearby agriculture-related industries and bringing major benefits for the Indonesian economy as a whole.

1.3.2 The position of rice cultivation under the Fourth National Five-year Development Plan

In the Fourth National Five-year Development Plan (Repelita IV) the projections for rice production were as shown in Table 1-1 for five years between 1984 and 1988. The Third Plan (1979~1984) increased production at an annual rate of 6.1%, far outstripping population growth, which was 2.3% over the same period. The target for production growth in Repelita IV was set at 4% per year.

Repelita IV continued to build on the success of Repelita III, setting self sufficiency in rice production as its target, without relying on gains due to fine weather and other natural conditions. This was to be achieved by ①intensification (increased use of agricultural chemicals and exhaustive water management to improve productivity), ②extensive cultivation (expansion of agricultural land area through land clearance and theonstruction of irrigation facilities in outlying reas[2], and ③the renovation of existing facilities.

Under the first three Repelita plans, new irrigation facilities were constructed to serve 1.8

[2] Refers to islands other than Java and Madura.

million ha, mainly in three provinces in Java, Lampon and South Sulawesi Provinces. The Fourth Plan called for the construction of additional irrigation networks of 550,000ha, mainly in East Java, Lampon and South and North Sulawesi.

【Table 1-1 Predicted Rice Production under Repelita IV】

Fiscal Year	1984/85	1985/86	1986/87	1987/88	1988/89
Production Volume of rice (thousand tons)	24,701	25,781	26,867	27,736	28,624

Source: Prepared from Indonesia's Fourth National Five-year Development Plan.

1.3.3 The position of this plan in relation to the "General Plan for Central Water Resources in South Sulawesi Province"

Of the 8.2 million hectares of paddy fields in Indonesia (as of 1991), some 54% (4.4 million hectares) is irrigated. Of the irrigated area, 57% (2.5 million hectares) is located in Java, followed by 21% (900,000ha) in Sumatra and 12% (500,000ha) in Sulawesi. The center of South Sulawesi Province is the most fertile ricebowl of all these areas. In 1982, before this project, the region's rice production had already reached 2.27 million tons. South Sulawesi Province transfers around 280,000 tons annually to compensate for rice shortages in East Kalimantan, Maluku, and Irian Jaya Island. Thus, this province has a very important role, underpinning the supplies of rice to neighboring areas of the country which do not produce enough.

This situation led the Indonesian Government to draw up the "General Plan for Central Water Resources in South Sulawesi Province"[3] as a comprehensive master plan for the development of agriculture in South Sulawesi Province. The plan was intended to improve unit yields and make rice crop irrigation more efficient through the construction of new irrigation facilities and the improvement of existing facilities. Specifically, the plan involved the implementation of nine irrigation projects around Lake Tempe in the center of the province. The Indonesian Government chose to make South Sulawesi one of its key areas for the promotion of agriculture, with emphasis on rice, because it combines a number of advantages. Among others, it enjoys exceptionally favorable conditions for rice production and it has long been irrigated by natural rainfall and small-scale irrigation facilities. This project among the nine irrigation projects was assigned on the basis of the consideration of the following factors:

①The state of infrastructure in the project area. ②Whether or not pumped irrigation will be required. ③How many people will have to be resettled from inundated areas. ④The readiness of existing irrigation facilities. ⑤The ripple effects which will propagate to surrounding areas.

The irrigation facilities constructed in the region were small in scale and obviously dilapidated, so the project work had to combine new construction of larger facilities with the enlargement,

[3] The Indonesian Government asked the Japanese Government for its assistance in the formation of this plan, and the plan was drawn up by JICA (completed in March 1980)

refurbishment and improvement of the existing facilities[4].

1.3.4 Summary of the project area

The Langkeme region, which is the target region for this project, is located in the center of South Sulawesi Province (area 72,781km^2, population 6.98 million (in 1990), which is the south end of Sulawesi Island. It is 30km south of Lake Tempe, part of the rich grain-producing belt which circles the lake. Administratively, it covers four districts (Marioriwawo, Liliriaja, Lalabata and Lilirilau) of Soppeng Prefecture (1,359km^2, approximately 240,000 people (at the time of the project))

The Project area includes 13 villages and 31 hamlets[5]. The province capital, Ujung Pandang, is 130km away to the south, while Parepare, the main port for shipping rice, is 70km away to the northwest.

The Langkeme region lies to the southeast of Watansoppeng, which is the district capital. To the west are hills which run from north to south at around 1,500m above sea level and have abundant water. The land slopes gently from west to east. The Waranae River runs north-south to the east of the project area, while the Langkeme and Sero Rivers, which draw their water from the hills to feed the Waranae, run from west to east. Water for the irrigation facilities will be taken mainly from the Langkeme River, which has plenty of water and is adjacent to the project area.

The subject area has 15,000ha of cultivable land, of which 9,700ha is under paddy fields. The existing paddy fields are located on comparatively sloping land at altitudes of 20~200m in an alluvial delta. The soil in the foothills which run alongside the mountains forms yellowish-red sedimentary uplands. Along the rivers and in the downstream plains the soil is dark brown and somewhat sandy. Agricultural production in Soppeng Prefecture is, with the exception of livestock, above the average for South Sulawesi Province, making this a comparatively prosperous area of the province. This prefecture and the neighboring Sidrup and Wajo prefectures have the productive capacity to provide rice for the nearby areas and provinces.

The center of South Sulawesi Province is located four degrees south of the Equator. It has a typical tropical monsoon climate, clearly divided between the rainy season (March to July), the dry season (August to October) and the middle season (November to February). The temperature stays in the range 26.1~28.2℃ all year, with relative humidity varying between 71% and 75%, so there are few differences between seasons.

The average annual rainfall in the area is 1,650mm, with most of that concentrated in the rainy and middle seasons. The dry season only has 37~86mm. The average volume of evaporation per year is 1,988mm, the average wind speed is 1~2.5m/s and the annual average hours of sunshine per day is 6.4h/day.

The favorable climate and abundant water enjoyed by the project area make rice cultivation possible all year round. As mentioned above, this is one of Indonesia's prime rice-growing regions, following the three provinces of Java. Before this project, 85% of the rice paddies in the region yielded two crops per year, producing 28,200 tons per year. The unit yield is 4.4t/ha, considerably above the 3.3t/ha which is the average for Indonesia as a whole.

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[4] Note: Nine irrigation projects are as follows:
‡Langkeme Irrigation Project, ‡Bila-Boya Irrigation Project, ‡Lawo Irrigation Project, ‡Cenranae Irrigation Project, ‡Gilirang Irrigation Project, ‡Sanrego Irrigation Project, ‡Padangeng Irrigation Project,‡Cenranae Flood Control Project and ‡Walimpong Multi-porpose Dam Construction Project.

[5] The population of the subject area was approximately 98,000 in 1980, in a total of 16,100 households. Of these households, 78% (12,600) were farming families.

【Table 1-2 Rainfall (mm) 】

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Watansoppeng	189	161	170	237	276	219	125	59	50	96	145	165	1,889

Note: Averages for 1906~'41.

2. Analysis and evaluation

Field surveys were conducted in October 1996 and between late February and early March 1997 in order to evaluate this project. These surveys were a joint investigation with the Evaluation Office of the Japan International Cooperation Agency (JICA). It examined the project from many angles, including a survey of rural villages in the project area. The terms "field survey" and "survey" in the following text refer to these surveys, unless indicated otherwise.

2.1 Improvement of irrigation conditions

Dividing the project, for convenience, into upstream, central and downstream zones, the new irrigation systems introduced by the project achieved year-round water supply in the upstream zone from 1992, in the central zone from 1994 and in the downstream zone from 1995. The irrigated area was expanded from 6,400ha before the project to 7,291ha on completion, an increase of 14% (891ha).

Let us compare the state of crops in Soppeng Prefecture before and after the implementation of the project (see Table 2-1). Comparing the cropped area in each growing season, before the project 6,138ha was cultivated in the rainy season (96% of the total area at the time), rising to 7,291ha after the project, an increase of 19% (1,153ha). In the dry season the cropped area was 4,153ha (65%), rising to 6,699ha, an increase of 61% (2,546ha). However, at the planning stage of the project the dry season cropped area was expected to rise to 7,291ha, so two years after the project's completion it has yet to develop its full effect.

One point to note here is that the increase in the cropped area is much more pronounced in the dry season than in the rainy season. Accordingly, the ratio between dry season crop and rainy season crop in irrigated fields rose from 67.7% to 91.9%, a rise of over 20 points. This indicates that year-round irrigation has largely been achieved. Comparing year-round figures, the total cropped area before the project was 10,291ha, rising to 13,990ha, a rise of 35.9% (3,699ha). Of the increase, 68.8% (2,546ha) was the increase in dry-season cropped area. As we will see later, the delivery of water for both the dry and rainy season crops, backed up by the introduction of improved cultivation techniques, has brought great increases in the rice yields of each crop.

【Table 2-1　Increase of Cropped Area】

	Before the project	After the project	Increased
Rainy season crop	6,138ha	7,291ha	＋1,153ha
For semi-technical irrigated field	3,320ha	－	－3,320ha
For non-technical irrigated field	2,818ha	－	－2,818ha
For technical irrigated field	－	7,291ha	＋7,291ha
Dry season crop	4,153ha	6,699ha	＋2,546ha
For semi-technical irrigated field	2,225ha	－	－2,225ha
For non-technical irrigated field	1,928ha	－	－1,928ha
For technical irrigated field	－	6,699ha	＋6,699ha
Dry season crop / Rainy season crop	67.7%	91.9%	＋24.2%

Source:　JICA F/S (1981), Materials from OECF and executing agency.

The areas of crops planted after the rice in the rainy season, known collectively as Parawija[6], were also changed markedly by the implementation of the project, as shown in Table 2-2. Before the project 329ha were planted with maize, making it the most important of these crops. Other crops were only cultivated in very small amounts, including 12ha of peanuts, 7ha of legumes and 2ha of soy beans. In most of the project area, rice was the only crop. The implementation of the project brought an enormous improvement in the dry season cultivation conditions, raising the cropped areas to 3,781ha of maize, 2,064ha of peanuts, 247ha of legumes and 1,049ha of soy beans. These areas represent increases of 12, 172, 35 and 525 times, respectively. Clearly, major progress has been made in crop diversification.

The improvements described above, namely a 36% increase in the irrigated area and the conversion of all irrigation to scientific irrigation, have produced increases in agricultural productivity as shown below.

【Table 2-2　Cropped Area in Parawija】

	Before the project (ha)	After the project (ha)
Maize	329	3,781
Peanuts	12	2,064
Green beans	7	247
Soy beans	2	1,049

Source:　JICA F/S, Materials from the executing agency.

[6] This is the general name for secondary crops on paddy fields. In the project area this generally means maize, peanuts, green beans and soy beans.

2.2 Advances in agricultural productivity due to the irrigation project

2.2.1 Increased crop rates

Looking at the changes in crop rates made possible by the improvements in irrigation conditions described above, the rate before the implementation of the project was 159%, rising to 282% afterwards. For rice alone, the crop rate after the project rose to 188%. The crop rates for each irrigation zone within Soppeng Prefecture in 1995/96 rose to 285% in the highest case and 189% in the lowest case. This means that the project area has attained the highest crop rates in the prefecture.

2.2.2 Increased agricultural production

(1) Rice

Before the implementation of the project (at the time of the appraisal), the unit yields for rice were 4.6t/ha in the rainy season and 4.75t/ha in the dry season, an average of 4.66t/ha. Judging from the results of sample surveys conducted before the post-evaluation survey, these seem to be reasonable values. The rural survey divided the project area into the upstream zone (which began year-round irrigation from 1992), the central zone (from 1994) and the downstream zone (from 1995). The unit yields for rice in each zone before the implementation of the project, averaged between the rainy season and the dry season, were 4.51t/ha, 3.95t/ha and 5.21t/ha, respectively (see Table 2-3). For the project area as a whole, the unit yields were 4.25t/ha in the rainy season and 4.70t/ha in the dry season, averaging to 4.48t/ha. These figures largely agree with those found in the appraisal. The low level of the rainy season crop relative to the dry season crop was also seen in both the appraisal survey and the current rural survey. The unit yield figure was rather low for the rainy season, while the dry season figure was at approximately the same level.

The above demonstrates that before the project the unit yield was higher in the dry season than it was in the rainy season. This is a common phenomenon in rice crops in tropical Asia[7], but what should be noted here is that the highest yields in each season were achieved in the downstream zone, with the upstream zone in second place and the central zone achieving the lowest yields. Despite the fact that these three zones are all within a comparatively small area, there is a disparity of over 30% in their unit yields. As we will see later, this disparity remains after the project.

[7] Because there is more sunshine in the dry season, the abundant solar energy will lead to high yields, provided there is water. For example, in Thailand unit yields are reported as 3.7t/ha in the dry season and 2.0t/ha in the rainy season. ("Asia Shaped by Water - Topography and Agricultural Water Usage" by Toru Mase, Ie no Hikari Kyokai, p22).

【Table 2-3　Increases in Unit Rice Yields (based on unhulled rice)】

(Unit: ton/ha, %)

	Upstream zone (45 households)	Central zone (30 households)	Downstream zone (15 households)	Overall (90 households)
Rainy season crop				
Before (t/ ha)	4.25	3.76	5.02	4.25
After (t/ ha)	4.95	4.55	5.98	5.01
Increased rate (%)	16.5	21.0	19.1	17.9
Dry season crop				
Before (t/ ha)	4.77	4.14	5.41	4.70
After (t/ ha)	5.04	4.85	7.05 (5.98)	5.32
Increased rate (%)	5.7	17.1	30.3 (10.5)	13.2
Average				
Before (t/ ha)	4.51	3.95	5.21	4.48
After (t/ ha)	5.00	4.70	6.52	5.17
Increased rate (%)	10.9	19.0	25.1	15.4

Source: Calculated from sample surveys for the rural survey.
Note: Refer to the text for commentary on figures in ( ).

So what has happened to unit yields since the implementation of the project? According to the executing agency, the unit yields in the project area have reached 7.9t/ha in the rainy season and 8.4t/ha in the dry season, an average of 8.15t/ha. These are major increases on the yields before the project, up by 172%, 177% and 175% respectively. The target value for unit yield before the project was 6.00t/ha for both rainy and dry seasons. If the above figures are accurate, the target has been exceeded by 32% in the rainy season and by 40% in the dry season. The expected results have been achieved and exceeded within two years of the project's completion.

What about the results of the rural survey? As Table 2-3 shows, the results put the unit rice yields in the project area at 5.00t/ha in the upstream zone, 4.70t/ha in the central zone and 6.52t/ha in the downstream zone, the overall average being 5.17t/ha. These figures are up on the pre-project figures by 11%, 19% and 25% respectively, a rise of 15% overall. Separating into figures for the rainy and dry seasons, the rainy season yield was 5.01t/ha and the dry season yield was 5.32t/ha. If we assume that the results of the rural sample survey accurately reflect the level of unit yields for the project area as a whole, the figures are 84% and 89% respectively of the target yields set in the initial plan. Although it can be seen that the expected effects are being achieved gradually, the planed yields have yet to be attained.

Thus the record of unit yields in the project area depends greatly on whether the figures from the executing agency or those from the rural survey are used. In this evaluation we will, as a rule, base unit yield figures on the results of the rural survey, referring to the executing agency's unit yield figures only where necessary.

On the basis of the rural survey results, let us look in more detail at the movements in unit yields for each zone (upstream, central, downstream).

Firstly, in the upstream zone, the rainy season unit yield rose by 16.5% from 4.25t/ha before the project to 4.95t/ha afterwards. This is largely in line with the average trend of rising unit yields in the project area as a whole. For the dry season crop the increase was only 5.7%, from 4.77t/ha to 5.04t/ha. This survey was unable to determine the reason for this small rise, which was less than half that achieved in the project area as a whole. As far as it can be seen from the results of the sample survey, the level of fertilizer use was not lower in the upstream zone than elsewhere, so the reason remains unclear.

In the central zone, the rainy season crop had the lowest unit yield of the three zones before the project, at 3.76t/ha, but this rose 21% to 4.55t/ha after the project. This was the highest rate of improvement among the zones. The dry season unit yield rose 17% to 4.85t/ha. Yields in the central zone were still lower than those in the other zones, even after the implementation of the project. Taking the average unit yield for the project area as a whole as 100, the point score for the central zone rose three points from 88 to 91, closing the gap slightly.

The downstream zone had the highest unit yields before the project, and this tendency was even more pronounced after the project. The rainy season unit yield rose to 6.00t/ha and the dry season unit yield to 7.00t/ha, rises of 19% and 30% respectively. The dry season unit yield of 7.00t/ha exceeds the project's target yield of 6.00t/ha by nearly 17%. According to the "Implementation Survey Report" for the JICA plan for this project (JICA, 1981), in the area of plentiful supply of irrigation water yields of over 6.00t/ha have already attained in 1980. The yield survey even showed cases where yield climbed to 9.00t/ha and the average yield between 1970 and 1980 was over 7.00t/ha. Therefore the dry season yield figure of 7.00t/ha seen in the results of this survey seems reasonable. On the other hand, when we look more closely at the responses concerning yields from individual farmers in the sample survey, there were four responses indicating outstandingly dry season high yields, averaging 9.00t/ha. The average dry season yield in the upstream zone, excluding these four exceptional values, was 5.98t/ha (the figures in parentheses in Table 2-3), a result which is in line with the rainy season unit yield. This means that although there were a few farmers who far exceeded the yield targets of the irrigation project, the remaining farmers when these advanced farmers were excluded were largely at the project's target levels for both the dry and rainy seasons.

Factors which could be behind the relatively high yields in the downstream zone include the abundant irrigation water, the widespread use of the sharecropping system[8], the custom of sharing fertilizer costs between sharecroppers and landowners which leads to heavy fertilizer use to boost yields, and the soil, which is more fertile than that in other zones. This survey did not uncover any reasons for the low unit yields seen in the central zone.

Next we will consider the level which the unit yields now achieved in the project area reach within Indonesia as a whole. Compared to the national average yield for Indonesia (4.34t/ha in

[8] The system where landowners rent out land to sharecroppers for fixed rents. The landowners also take a fixed amount of the produce from the land.

1995), the average yield in the project area (5.17t/ha) was about 20% up. This yield is on a par with the average unit rice yields in Bali Province and the island of Java, which are the ricebowls of the nation (yielding 5.12t/ha and 5.25t/ha respectively in 1994, according to "Statistik Indonesia 1994" by Biro Pusat Statistik), so the project area has reached the level of Indonesia's finest rice growing areas. Within Sulawesi, South Sulawesi Province has the highest yields on the island, at an average of 4.73t/ha (in 1995). In Soppeng the yield was 4.34t/ha in 1989, but this rose to 5.47t/ha by 1995, ranking third within South Sulawesi Province. Therefore, the yield in the Langkeme Irrigation Project area is 19% above the average unit yield for the province, but it is also 5.5% below the average unit yield for Soppeng as a whole. However, this was the situation only two years after the completion of the project, when it was still developing its effects. Unit yields in the project area can be expected to rise in the future.

The figures in Table 2-4 show the changes in rice production volume in the project area after the implementation of the project, based on the findings of the rural survey. According to these figures, the production of rice after the project was 36,528t in the rainy season and 35,639t in the dry season, a total of 72,167t of unhulled rice. Before the project, the production of unhulled rice was estimated at 26,087t in the rainy season and 19,519t in the wet season. Therefore the increase in production was 10,441t in the rainy season and 16,120t in the dry season, for a total increase of 26,561t. Thus, the project has achieved a 58.2% rise in production.

【Table 2-4 Movements in Rice Production: Case 1
(based on the findings of the rural survey)】 (Unit: ton)

	Before	After	Increases (%)
Rainy season crop	26,087	36,528	10,441 (40.0)
Dry season crop	19,519	35,639	16,120 (82.6)
Total production volume	45,606	72,167	26,561 (58.2)

Source: Estimated from the findings of the rural survey

The movements in rice production based on unit yield figures provided by the executing agency (7.9t/ha in the rainy season and 8.4t/ha in the dry season) are shown in Table 2-5. According to these figures, the rainy season crop after implementation of the project was 57,599t, up 104%, and the dry season crop was 61,244t, up 210%. The total is 118,843t, up 148%. This level is rather high, compared to the results of the rural survey.

【Table 2-5 Movements in Rice Production: Case 2
(based on the unit yields indicated by the executing agency) 】 (Unit: ton)

	Before (at the time of appraisal)	After	Increases (%)
Rainy season crop	28,235	57,599	29,364 (104.0)
Dry season crop	19,727	61,244	41,517 (210.4)
Total production volume	47,962	118,843	70,881 (147.8)

Source: Estimates based on documentation provided by the executing agency.

(2) Parawija

Table 2-6 below shows movements in unit yields of parawija crops. Yields before the project were 0.79t/ha for maize, 0.81t/ha for peanuts and 0.67t/ha for soy beans (as green beans). Before the project was implemented, the forecast unit yields for these crops were 2.0t/ha, 1.2t/ha and 1.2t/ha respectively. The actual yields seen after the project in 1996 were 2.79t/ha for maize, 1.6t/ha for peanuts, 0.83t/ha for green beans and 1.57t/ha for soy beans. With the exception of green beans, these figures represent increases of 253%, 98 and 134% respectively over the pre-project yields. They exceed the forecasts by 40%, 33% and 31% respectively. Therefore even now, when the project is still developing towards its full effects, the Parawija crop yields have already improved beyond expectations.

【Table 2-6 Unit Yields of Parawija】 (Unit: t/ ha)

	Maize	Peanuts	Green beans	Soy beans
Before the project implementation (at the time of appraisal)	0.79	0.81	0.83	0.67
Estimate after the project implementation (at the time of appraisal)	2.00	1.20	1.20	1.20
Actual after the project implementation	2.79	1.60	0.83	1.57

Source: Prepared from the materials at the time of appraisal and findings of the rural survey

Table 2-7 shows the production of Parawija crops based on the above unit yields. After the implementation of the project, production was 10,549t of maize, 3,302t of peanuts, 205t of green beans and 1,647t of soy beans. Total production was 15,703t. These figures represent increases of 10,289t, 3,293t, 199t and 1,646t over the pre-project production, for a total increase of 15,423t. The forecast at the time of the appraisal was for an increase of 8,680t. Actual production has exceeded the forecast increase by 78%, so the project has surpassed expectations in terms of production volume as well.

【Table 2-7 Movements of Production Volume in Parawija】 (Unit: ton)

	Before the project implementation	After the project implementation	Increases (%)
Maize	260	10,549	10,289 (3,958.3)
Peanuts	10	3,302	3,292 (32,920.0)
Green beans	6	205	199 (3,316.7)
Soy beans	1	1,647	1,646 (164,600.0)
Total production volume	277	15,703	15,426 (5,569.0)

Source: Estimates based on the mateials by the executing agency

(3) Other crops

Another form of production since the implementation of the project is the greater and more widespread use of paddy field fish farming. This practice predates the project, but since the implementation of the irrigation project, water has been more plentiful, making fish farming more common. The methods of fish farming can be divided into four groups according to the ways the fish-rearing area is constructed or obtained.

(a) By releasing baby fish into the paddy field at least 25 days after transplanting seedling to grow there for around 45 days (twice per year).

(b) By building a water tank (6m x 4m x 1.5m deep) to raise fish all year round in running water (in cycles of 3~4 months).

(c) By using poorly-drained paddy fields in the dry season to build a fish preserve and raise fish for three months.

(d) by building a fish-raising pool in a paddy field and raising fish in stagnant water.

Method (b) came into use after the project in eight places, including Timusu Village in Soppeng Prefecture. The areas occupied by the other methods in the prefecture are 400ha for method (a) and 150ha for method (d). Method (c) is hardly used. All the fish produced are shipped to local markets, except those that are consumed by their producers. One common feature of all the above methods is that baby fish are bought, raised and sold. Nobody produces baby fish by collecting and hatching fish eggs. In the future, as people's diets improve, they will demand more fish as a source of protein, and fish farming will become an increasingly important industry for the region.

2.3 Analysis and evaluation of the project

2.3.1 Project scope

(1) The area which benefited from the project

In the plan for this project which was drawn up at the appraisal stage, an area of 6,400ha was to be irrigated. This decision was based on the topography, the volume of water available from water sources and other factors. During the construction period this beneficiary area was expanded by 891ha to 7,291ha. The reasons for this additional construction included the following:

① The adoption of new planning and design standards in Indonesia, and the design changes they required.
② The requests of the local beneficiaries for additional irrigation.
③ A reduced water leakage rate due to lining of the canals. The saving in water losses made it possible to irrigate a wider area.
④ The internal profitability of the additional irrigation was recognized to be appropriate.

The additional construction involved a detailed design of the irrigation facilities and foreign 12M/M and local 62M/M as the terms of reference for supervision of the construction works. The addition led to slight increases in the planned unit water volumes taken from each point of intake, as shown in Table 2-8, but as the water available was adequate for these increases there is no effect on existing facilities. Therefore, the additions to the plan appear to be appropriate in terms of effective use of water resources.

【Table 2-8 Changes in Planned Water Volumes at Key Points in the Langkeme Area Water Canal System due to the Expansion of the Beneficiary Area】

Position of waterway system	Old: Planned water volume (m^3/sec.)	Revised planned water volume (m^3/sec.)	Old: Planned unit water volume (1/sec./ha)	New: Planned unit water volume (1/sec.ha)
Sero headrace channel	5.10	7.52	0.79	1.03
Langkeme trunk waterway	8.09	9.96	1.26	1.36
Start point	8.09	9.96	1.26	1.36
Ending point	1.78	2.21	-	-

Source: Materials by the executing agency etc.

(2) Specifications for the facilities, their construction methods and finished form

Table 2-9 compares the content of the initial plan against actual construction for each of the facilities constructed in this project.

One important feature of this project is that it makes the maximum use of the existing facilities in the project area, upgrading the traditional non-technical and semi-technical irrigation systems. The main trunk canal for the Langkeme area was newly constructed, but, with a few exceptions, the secondary and smaller canals used existing canals or natural water courses. The density of canals in this project area is broadly similar to that in other projects of this type, and there is an adequate system for the level of water management required.

The intake weirs for the trunk canal system were initially planned to be mesh basket or concrete Tyrolean types, but at the design stages the standard concrete fixed weir was adopted instead. This was a change for the better, considering strength of the structures,the stability of water intake, and the reduced maintenance and management expenses after completion. The field survey also found that the design and construction of the intake weirs was of adequate strength, with no problems. However, there were no sedimentation pools to prevent sand from flowing into the canals, so diligent work may be necessaryto remove accumulated soil. As will be mentioned later, heavy rains washed out the sloping

banks of one canal, causing accumulations of earth and sand in the canals.

【Table 2-9 Scale of Major Facilities in the Plan Area at the Planning Stage and After Completion】

Project scope	F／S	Plan at the time of appraisal	Actual
1. Irrigated development area	6,400ha	6,400ha	7,291ha (Additional irrigation district 891ha)
2. Intake weir		18 (4 basic intake weirs) (5 supplementary weirs for water) (9 integrated weirs)	22 (4 concrete weirs) (18 stone masonry weirs)
3. Sero headrace channel	14. 9km	13. 2km	13.89km
4. Lankeme trunk water system	29. 4km	26. 50km	26.79km
5. Secondary waterway system		22. 50km (9 routes) 118 incidental facilities	23.64km (7 route) 117 incidental facilities
6. Small waterway system		20.50km (9 routes) 110 incidental facilities	18. 80km (9 routes) 93 incidental facilities
7. Connecting waterway		4. 0km (5 routes) 22 incidental facilities	3.44km (4 routes) 18 incidental facilities
8. Drainage canal		10.25km (3 routes) 2 incidental facilities	2.84km (1 route) 2 incidental facilities
9. Terminal improvement		6,400ha	7,291ha
10. Road		40km (along the trunk waterway)	Unknown
11. Consulting service		400M/M	1,628M/M

The canals themselves are completely lined with concrete. In the initial plan, some canals were to be simple earth canals, but the concrete lining is appropriate for reasons of efficient water use and ease of maintenance and management.

In the initial plan, 10.2km of drainage canals were to be constructed, but 7.4km were dropped, leaving 2.8km constructed. This change was due to concerns expressed by the authorities responsible for fisheries that drainage canals would have an adverse effect on paddy field fisheries in the project area. As a result, the length of drainage canals was reduced during the construction

process. The project area is sloping land on which stepped paddy fields are linked together, so this change is not likely to result in any drainage difficulties.

The building of terminal facilities for this project (the tertiary and quaternary channels) is handled as on-farm development. Terminal channels are to be laid out at a density of 70m/ha, which is not necessarily lower than densities used in other developing countries. In areas which already had irrigation canals they were largely left with earth sides, but additions were made where necessary for level changes on sloping ground and for diversion works. Both the new and old facilities are functioning adequately.

2.3.2 Implementation schedule

Table 2-10 summarizes the implementation schedule of this project. At the time of the feasibility study it was expected that the loan agreement for this project would be concluded in January 1982, and that the overall project implementation period would be five years (with the actual construction period being 45 months), for completion in January 1987. In fact, after the feasibility study, the detailed design for the project began in April 1982, using an ODA loan. After that, the request for this project was put to the Japanese Government in 1985, and the exchange of notes and the loan agreement were signed in that year. In the plans made at the time of the appraisal, procurement procedures were to begin immediately after the conclusion

【Table 2-10 Implementation Schedule】

	F/S	At the time of appraisal	Actual result	Difference
Date of loan agreement	1982.1	1985.11	1985.12	+1 month
Start of selecting consultants	1982.2	1985.11	1987. 1	+14 months
Selection of consultants	1982.6	1986.11	1988. 2	+15 months
Start of bidding procedures	1983.1	1986.11	1988. 3－1992. 9	+16～70 months
Completion of contract procedures	1983.6	1987.11	1989. 3－1994.1	+16～74 months
Start of construction (Notice of starting approach)	1983.7	1987.11	1989. 5－1994. 2	+18～74 months
Completion of construction (Issue of completion certificate)	1987.1	1990. 3	1992.10－1995.1 ◎	+31～58 months
Start of consulting service	1982.7	1986.11	1988. 3	+16 months
Completion of consulting service	1987.1	1990. 3	1995. 1 ◎	+58 months

Source: Materials by the executing agency etc.
Note 1: ◎ indicates project completion.
Note 2: Denominators of fractions are the numbers for quarters of the year.
Note 3: The "Differences" column compares the times planned at the time of the appraisal with the actual completion times, and indicates the number of months of delay relative to each plan.

of the loan agreement, and were expected to take two years. With the construction works starting in November 1987 and a construction period of 28 months, construction was expected to be complete by March 1990. In practice, the start of construction was delayed until May 1989, three years and five months after the conclusion of the loan agreement. Construction was completed in January 1995, four years and ten months behind the initial plan.

There were two main reasons for these delays. Firstly, the Indonesian Government's procedures at the procurement stage, after the loan agreement, took far longer than expected, causing a delay of around 18 months before the construction started in May 1989. Secondly, even after construction started, the contracts for some lots had to be dissolved and the tendering process repeated, causing a further delay of around three and a half years.

The delay in procurement resulted from a major delay in the Indonesian Government's internal procedures concerning the employment of consultants. It took a year to reach the start of the selection process and a further year to reach contracts with the selected consultants. As a result, the consultant selection process overran its scheduled length by one year and three months. If the consultants are selected before the detailed design is drawn up, as in this project, a more spontaneous contracting procedure could easily be adopted to ensure technical consistency, reduce the time required for selection and contracting and allow an earlier construction start. However, the executing agency wanted a short list for selection. We would like to see swifter completion of internal procedures by the borrowing country and its executing agency. At the time of the OECF appraisal it was pointed out that, in general, procedures within Indonesia take time and could have an impact on the implementation schedule. This indication was intended to encourage appropriate and cautious monitoring of the construction process.

The second delay, in the construction itself, was due to various factors, including the alterations in the scope of the project, poor performance by the construction contractors and climatic disasters. In particular, poor performance by one contractor was such that it was incapable of completing the work and this caused delays. The lack of supervisory ability also led to defective construction and legal action ensued with the executing agency. Fearing delays, the executing agency broke off the contract and chose another contractor, but this procedure also caused a major delay in the construction process. It is clear that, from the start, the initially-selected contractor had little understanding of the contract and a low level of ability in construction and management, and had neither the will nor the enthusiasm to get the job done. The fact that the selection procedure could lead to the selection of such a contractor indicates that there are serious shortcomings in the procedure itself. The executing agency's swift action in breaking off the contract and finding another contractor was commendable, but it should have made a more comprehensive evaluation of candidates from the pre-qualification stage. This evaluation should go beyond the price of the tender to consider the candidates' technical and managerial abilities.

2.3.3 Project cost

The planned project cost and the record of actual expenditures are shown in Tables 2-11 and 2-12. The cost estimate at the planning stage was ¥11.142 billion, comprising ¥5.55

billion in foreign currency and ¥5.592 billion in local currency. Finance was to cover the entire foreign currency cost and some of the local currency cost (equivalent to a maximum of 1.401 billion). The limit of loan provision was set at ¥6.951 billion.

As the tables show, the actual foreign currency cost was ¥4.659 billion against the planned figure of ¥5.55 billion, a major cost underrun. The reasons for this underrun include the rise of the Yen, the bids of the local contractors and the promotion of local procurement.

The local currency portion of the project cost, including administrative costs, was approximately Rp10.1 billion, which was only 41.7% of the expected Rp24.1 billion, another major underrun. This was due to constraints on Indonesia's domestic development budget, which restricted budget allocations. The shortage of local currency allocation was covered to some extent by a reallocation from the foreign currency portion, and is not a serious problem.

【Table 2-11　Plan of Project Cost (at the time of appraisal) and Actual Result of Expenses】

	Plan at the time of appraisal			Actual result		
	For ODA loans		For not ODA loans	For ODA loans		For not ODA loans
	Foreign currency portions (million yen)	Local currency portions (million yen)	Local currency portions (million yen)	Foreign currency portions (million yen)	Local currency portions (million yen)	Local currency portions (million Rp.)
Civil works	4,290	1,401	3,229	3,928	1,314	3,873
Consulting fee	831	－	238	731	－	700
Reserve fund	429	－	487	－	－	－
Expropriation of land expenses	－	－	237	－	－	3,722
Administrative expenses	－	－	－	－	－	1,756
Total	5,550	1,401	4,191	4,659	1,314	10,051
Total project cost	¥11.142 billion (Rp.48.111 billion) (1¥ = Rp.4.318)			Rp.118.18 billion (1¥＝Rp13.35～21.50)		

Source:　Prepared from the materials of the executing agency etc.
Note:　Figures are rounded to the nearest million, so the totals may not agree.

【Table 2-12　OECF's ODA Amounts and Actual Expenses】

Division	Loan amounts (million yen)	Actual result (million yen)	Difference (million yen)
For foreign currency portions	5,121	4,659	－462
Civil works	(4,290)	(3,928)	(－362)
Consulting serivce	(831)	(731)	(－100)
For local currency loan portions	1,401	1,314	－87
Reserve fund	429	-	－429
Total	6,951	5,973	－978

Source:　OECF materials etc.
Note:　Figures are rounded to the nearest million, so the totals may not agree.

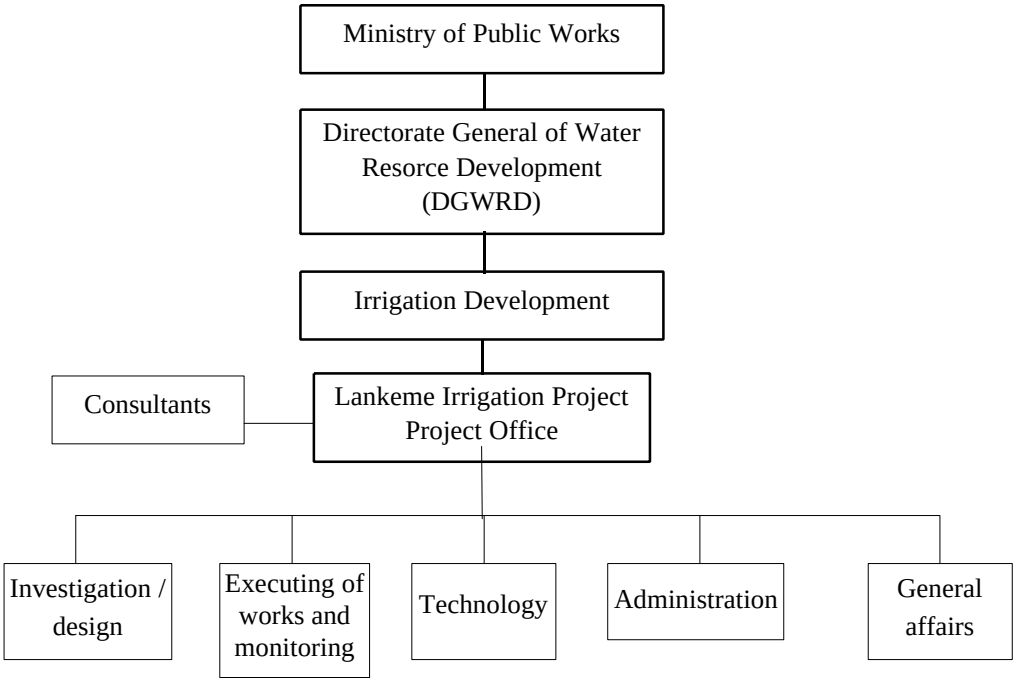
2.3.4 Implementation scheme

(1) Executing agency

The executing agency for this project was the Directorate General of Water Resources Development (DGWRD) of the Indonesian Ministry of Public Works. A Langkeme Irrigation Project Office under its authority was established locally to handle all stages of the project from the selection of consultants through construction contacting and execution. Appendix 2-1 shows the project implementation scheme and the organization of Langkeme Irrigation Project Office. The irrigation office, which is positioned under the DGWRD, handles central budget procedures and coordination.

At the state level, there are related offices such as the Water Use Department of the Province Public Works Directorate (a branch of the central agency) and the Agriculture Bureau, but in general these were not involved beyond technical support and coordination. The local budget was under the control of BAPPENAS (Badan Perencanaan Pembangunan Nasional, the national development planning agency) which distributed the budget from the Ministry of Finance to the Ministry of Public Works. Under this system the project proceeded with a close linkage between the local project office and the various ministries, departments and bureaus. As was mentioned above, the project encountered problems in implementation due to delays in the selection of consultants, vast delays of main contract procedures and delays during the construction itself, but such problems are not unique to this project. One cause of such problems is a lack of coordination ability on the part of the executing agency. Other than those noted above, there were no notable problems with the executing agency in the course of construction.

【Figure 2-1 Project Implementation Scheme】



(2) Consultants

Consultants were employed in this project to supervise tendering and construction. Following on from the detailed design, these tasks were conducted jointly with the consultants from Japanese companies. As was mentioned above, the selection and hiring of consultants were delayed and there were other delays in the construction process, so the project was lengthened considerably from 400M/M to 1,628M/M. There were no notable problems in the performance of the consultants.

(3) Contractors

The civil engineering works were initially scheduled to be carried out in five lots, based on consideration of the international competitive bidding (ICB) and the nature of the work. All bidding followed on from the prior qualification investigation. The contractors made general untied bids after which the selected contractors, all of them local, were hired. A further lot was drawn up for the additional works, so procurement was for six lots in total. Package five was further divided into six sub-lots, with contractors being hired for each sub-lot.

As was mentioned earlier, the performance of the contractor in one of the packages was extremely poor and the construction was delayed. The Indonesian side cancelled the contract with this contractor and hired the contractors in all other packages performed well. There were no notable problems in these packages.

2.3.5 Operations and maintenance of the irrigation facilities

(1) Condition of the facilities

The constructed facilities (water intake weirs, headworks, water canals etc.) have been used largely without problems. However, the Sero irrigation canal near the Japan water intake weir in the upstream zone suffered a landslide on the mountainside left bank during heavy rains at the end of 1996 (although some of those concerned state the date as January 1997). The resulting accumulation of soil in the canal completely blocked it. At the time of the field survey the damage had still not been repaired[9]. This was because the budget was lacking at the end of the year and also because of fears that repairs might collapse again if carried out before the end of the rainy season. It was explained that in the rainy season there would still be no problem in securing an adequate supply of water.

There were also some points where the lining of canals was visibly cracked, but most had already been repaired and maintenance is clearly being handled well. We hope that proper maintenance of the facilities, including the repair and prevention of cracks and the removal of soil buildups, will continue. However, the budget allocation for this purpose is inadequate, so repairs could easily become delayed.

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[9] We have been told that the repair of the above landslide area is to be given top priority within the new year's budget after April 1997. The cost is expected to be Rp500 million. Apparently it will be possible to repair damage of this scale within two weeks.

(2) The maintenance scheme

The total irrigated area in Soppeng Prefecture, including areas of both technical and semi-technical irrigation, is 15,685ha (at the end of 1996). The area irrigated under this project (7,291ha) constitutes 46.5% of the total area. After construction was completed, maintenance of the hardware of the irrigation facilities in the project area was transferred to the jurisdiction of the Soppeng-Wajo Prefectural Operational Management Office under the Irrigation Division of the Soppeng-Wajo Prefectural Public Works Bureau (Cabang DPU Pengairan). A number of Divisional Irrigation Offices (Ranting DPUP) were established under the Irrigation Division, and under these divisions there are further sub-divisions (Sub-Ranting). Water users' associations (P3A) are organized within each sub-division. The project area is under the jurisdiction of the South Soppeng Division Irrigation Office.

Farmers' demands for irrigation water etc. are passed from the water users' associations, at the end user level, through the Divisional Irrigation Offices to higher authorities[10]. The project area is divided into four zones for the supply of irrigation water (water distribution) and water is delivered to these zones sequentially[11]. The sequence of zones for the supply of water is fixed, with no system of annual rotation in the sequence to ensure fairness. We were interested to find whether or not this situation stirred discontent among the farmers, but the field survey did not necessarily get to the bottom of this question. The South Soppeng Division Irrigation Office has 47 sluice gate operators to control water supply. These operators, comprising 13 intake weir supervisors and 34 diversion sluice supervisors, are mainly farmers' children and other relatives. So far the system seems to have been functioning without problems.

This project also introduced a computerized water distribution system to devise the irrigation water plan. It helps to manage water distribution effectively and produce draft irrigation plans for water distribution by calculating water demand in each end area in the short term. This system is divided into two main sub-systems for operation purposes (the Irrigation Scheduling System and the Irrigation Operating System)[12]. (Computerized systems for maintenance have not been introduced yet). The former system is intended to take crop plans and other factors into account in drawing up a suitable irrigation schedule for each year. The latter system is to review water allocation plans in the light of the actual condition of crops and the level of water in the rivers to produce revised plans every 15 days.

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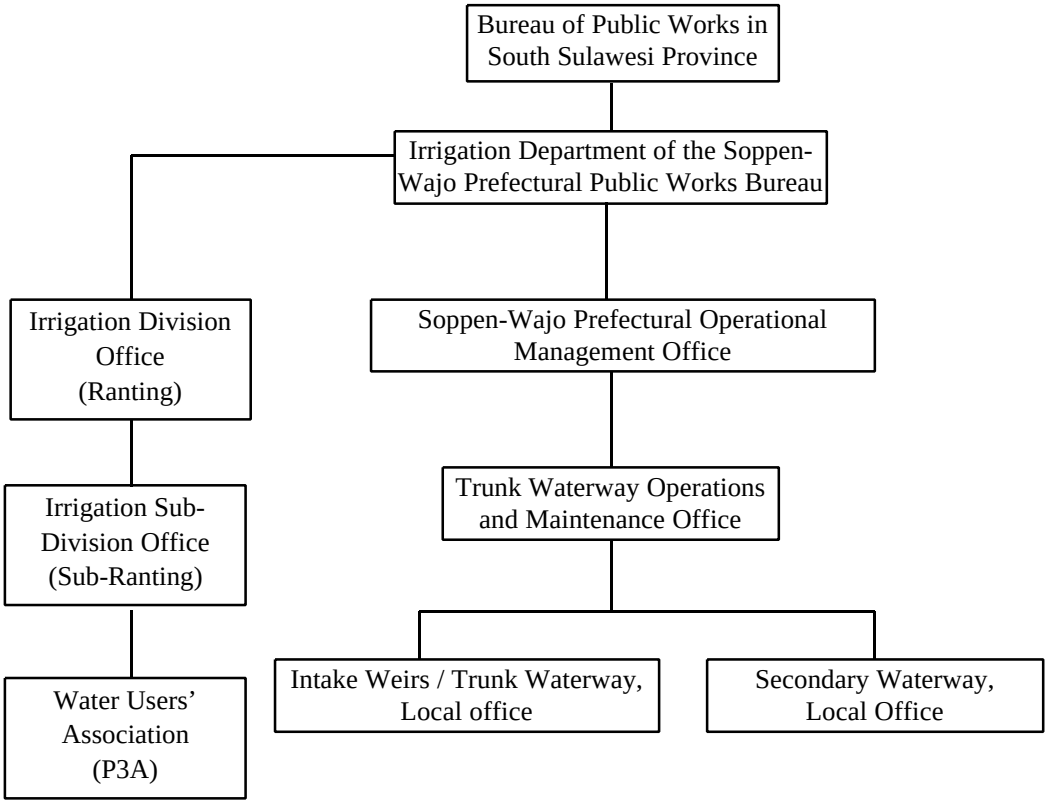
[10] The water users' associations at the irrigation sub-district level hold meetings on the 10th and 25th of each month. Office meetings at the irrigation district level are held every month on the 27th in the light of these meetings. Meetings at the prefectural irrigation department level are held on the 28th or 29th after the other meetings, followed by the meeting of the Province Public Works Bureau on the third day of the following month. This series of meetings held at each level passes information on problems and water demands at the grass-roots irrigation area level up to the upper levels. However, the survey did not ascertain whether or not this system functioned smoothly in practice.

[11] For example, in the rainy season water supply to zone one begins in the period 1st~15th of April, that to zone two in 16th~30th April, zone three in 1st~15th May and zone four in 16th~30th. The water supply periods are similarly staggered in the dry season.

[12] The programs which operate this system are developed from "FoxPro", a database program by Microsoft. Compared to other applications of this type, FoxPro provides a clear, simple and user-friendly operating environment which allows easy entry and alteration of data. This system, which was built into the O&M department of this project, is controlled from three computers, which are interlinked by a LAN (using "Netware").

【Figure 2-2　Maintenance Scheme】



The budget allocated for the maintenance of irrigation facilities in the project area, which is managed by the Prefectural Public Works Bureau, stands at Rp150 million. As was mentioned earlier, this is certainly not an adequate budget, but the exact budget which is required is unclear.

There are several problems in maintenance beyond that of the budget. One is the lack of machinery, tools and infrastructure for thorough maintenance. For example, the means of transport for maintenance teams to move around the beneficiary area are lacking, and the roads in the upstream zone are inadequate.

(3) Water Users' Associations

The Irrigation Department of the Prefectural Public Works Bureau handles the maintenance of the trunk and secondary canals, but the tertiary and smaller terminal waterways are the responsibility of the water users' associations (P3A). Traditional systems of non- and semi-technical irrigation existed in the project area before the implementation of the project, and there were independent irrigation organizations in each village. With the implementation of this project, these traditional water users' organizations were reorganized by the government into new water users' associations (P3A). These associations comprise the farmers who share ownership of the newly-constructed terminal irrigation waterways[13].

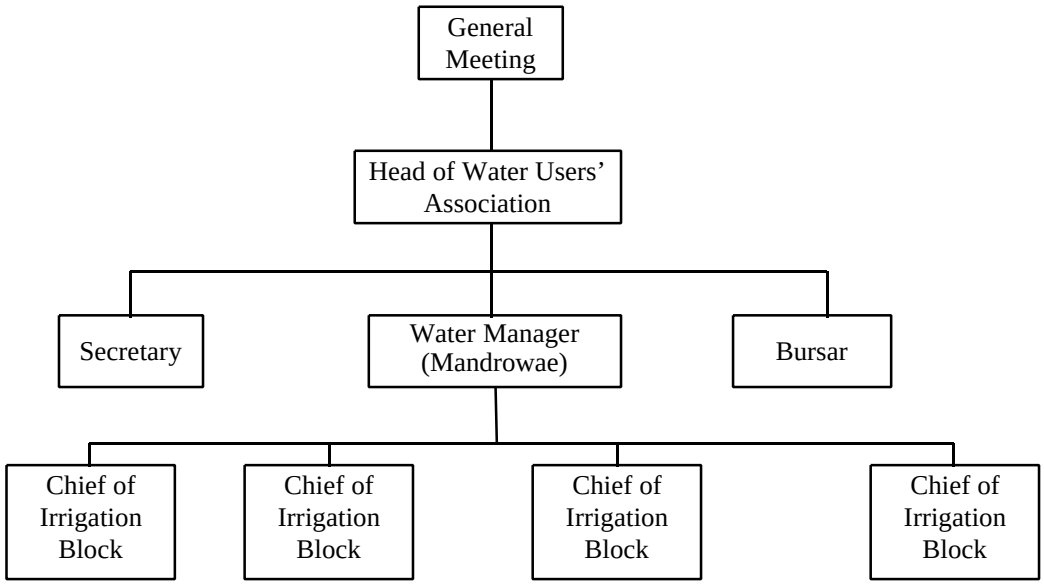
[13] As a general rule, one P3A was formed for each unit of tertiary waterways, but some associations are based around multiple units.

When the new water users' associations were organized, officials from the Prefectural Irrigation Department toured the villages, holding direct meetings with the farmers and guiding the formation of the associations. Two pilot associations were formed in the project area in 1992, followed by 52 in 1994 and 54 in 1995. A total of 108 associations have been formed to date. These water users' associations should be described as registered associations, which are approved by the prefectural governor (the Bupati) and are formed with the guidance of higher authorities. In the project area, the reliance on rice is high and traditional water users' organizations already existed, so the organization of the farmers was said to be a very simple process.

In most cases one member of each household, usually male, participates in the water users' association. Within the project area the associations have a total membership of over 7,800 people.

The highest executive body for the water users' associations is the general meeting of all the member farmers. In addition to the association heads there are secretaries, bursars, water managers (known as mandrowae, or as ulu-ulu in Java) and irrigation block heads responsible for the smallest terminal irrigation waterways (see Figure 2-3). In general the association heads are directly elected by the membership of each association. Normally the general meetings are held twice a year, before the rice planting and after the harvest (before the planting of the second crop). The main topics on the agenda are the selection of cropping systems and seed varieties and other farming issues. The duty of the water managers is to convey the demands of the member farmers to the sluice gate controllers, negotiate with them and receive water allocations.

【Figure 2-3　Water Users' Association】



The water users' associations operate on subscriptions collected from members. In general, around 50% of the fees collected are allocated to maintenance, with the remainder being spent on general meeting and administrative expenses and allowances for the association heads and water managers. The association fees are usually paid in cash, but in some cases payment is made in the form of unhulled rice[14]. There are differences in fees between associations because each association can have a different way of operations and maintenance, volume of work by association officials and different standards for assessing their remuneration. In addition to the payment of fees, the work of repairing waterways is a further burden on the members. This work usually amounts to around 1~2 days of obligatory work each year. In general, farmers are apparently very willing to participate in the associations and keen to manage the facilities and water resources by their own efforts.

The water users' associations play a major role in farming. The cropping systems for each growing season are determined in advance through discussions between the water users' associations and the irrigation authorities. The allocations of irrigation water, which are also determined before the growing season as mentioned above, and the demands for these allocations, are passed through the water users' associations to the higher irrigation authorities[15].

(4) Problems with the collection of water use fees

Since 1987 the Indonesian Government has shifted its previous policy to transfer some of the burden of maintenance costs for trunk and secondary canals from the government to the beneficiaries. The area covered by this policy is to be gradually expanded to cover the entire country. These "water use fees" (Iuran Pemakai Air: IPAIR) are said to be collected in 30% of the irrigated areas of the country, and fees are collected in some parts of South Sulawesi Province[16].

At the time of the field survey, collection of IPAIR fees had not yet started in the project area, so all maintenance expenses for the trunk and secondary canals are borne by the national budget. The association fees collected by each water users' association, as mentioned above, are now only applied to the maintenance of terminal facilities. However, IPAIR fees are to be introduced in the project area from the next crop season. The Irrigation District Offices are explaining the situation to each water users' association and the preparations are proceeding smoothly.

The collection of water use fees is intended to transfer the burden of costs for the maintenance of irrigation facilities, which had been borne by the national budget, to the beneficiaries. This is

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[14] The average association fees in the upstream zone are Rp5,900/ha/crop. The average is Rp10,200/ha/crop in the central zone and Rp14,700/ha/crop in the downstream zone (according to documentation from the executing agency).

[15] The water supply plan for irrigation water is determined through discussions between the Prefectural Irrigation Department, the Agricultural Cooperative Societies (Koperasi Unit Desa - KUD), branches of the Indonesian National Bank (Bank Rakyat Indonesia - BRI) and the Prefectural Agriculture Department. In practice, the water distribution plan for irrigation water is set as a fixed plan for each irrigation district. It is not calculated from the farming plans adopted by individual farmers for the coming season. This is an extreme example of the current supplier-led irrigation system.

[16] For example, in the North Soppeng Division, which is adjacent to the project area, IPAIR fees of Rp11,000/ha/crop was collected in 1994. Association fees in that district were set at Rp5,000/ha.

really the abolition of what was, in effect, a subsidy. It also serves to motivate the farmers to work independently to maintain their irrigation facilities.

(5) Agriculture support activities

The various forms of agriculture support activities in the project area are being implemented vigorously. Their main objective is to reinforce the functions of the water users' associations. The associations cooperate with the Prefectural Irrigation Department to train their members, and the membership is also made aware of the work of the associations[17]. In addition, agricultural education workers (PPLs) of the Prefectural Agriculture Department tour the villages, giving training in farming knowledge and techniques such as fertilization, sowing, and agricultural chemicals. There is around one PPL worker for every two villages. They can give their approval for a farmer's crop plan for the coming season and issue an approval certificate which is a prerequisite for borrowing farming loans from the Indonesian National Bank (BRI). In this and other ways, the PPL workers are closely involved with the daily lives of farmers.

Small loans from the BRI are a commonly-used form of financial support. These are provided to farmers for operating finance or to fund equipment investment, with the upper limit being Rp450,000 per crop. For farmers, this system for obtaining loans is said to be very important[18].

The distribution of agricultural produce consists mainly of farmers selling their produce directly from their fields to agents. The agents visit farmers after every harvest, buying produce, which they collect and ship out of the villages. The private sector purchase price from the producer is slightly higher than the purchase price through the Agricultural Cooperative Societies (KUDs)[19], which are the official channels, so purchasing through KUDs is now largely inoperative.

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[17] The budget for this training in the year from April 1996 to March 1997 was Rp12 million, which paid for three-day training courses four times in the year. These were attended by around 20 members of each of 56 water users' associations for a total attendance of around 1,120 people. Over two years, 2,240 farmers, approximately 29% of the farmers in water users' associations, attended these courses. However, the content of the course focuses on the associations themselves and there is little training in farming techniques and knowledge. This is because the core work of the water users' associations is maintenance, and the functions and organization of the associations must be reinforced for the maintenance work to go smoothly. With this need in mind, the courses concentrate on the water users' associations in order to improve the maintenance system in the irrigated area as a whole. The new water users' associations have only just started operating and the training at this stage is intended to help their growth and maturity.

[18] Farmers must first present a written plan to the agricultural education workers. This plan is submitted to the Agricultural Cooperative Society (KUD) for scrutiny before it is finally scrutinized by the BRI.

[19] In addition to buying agricultural produce, the KUDs distribute or lend fertilizer and agricultural chemicals, provide low-interest loans and provide other support services.

2.4 Analysis and evaluation of cooperation with JICA

This project is an example of aid to a developing country through cooperation with JICA. For the purposes of this evaluation, to confirm the effectiveness of cooperation between the two agencies, we conducted a joint field survey with the Evaluation and Monitoring Office of JICA. In the cooperative relationship between the two agencies, the assistance of JICA experts can easily become skewed towards the “upstream” stages of project formation and the implementation of the project. If JICA efforts in the “downstream” area of project evaluation can be stepped up, it will enhance the objectivity of the OECF’s evaluation work. Benefits can also be expected in the consideration of possibilities for cooperation between ODA loan projects and JICA schemes in developing countries, and in the feedback to project operations.

2.4.1 JICA support to the Langkeme area

JICA's contribution to the Langkeme area began in the early 1970s with the dispatch of a preliminary investigation team by its predecessor, the Overseas Technical Cooperation Agency (OTCA). Since then, JICA has conducted feasibility studies for various projects in the area.

Acting on a request from the Indonesian Government, JICA drew up the development master plan for the center of South Sulawesi Province, and the General Plan for Central Water Resources in South Sulawesi Province, followed by the feasibility study for this project in 1980. This work has made a direct contribution to the planning of this project.

Following on from the JICA feasibility study, it should be noted that the granting of an E/S loan by the OECF and the other stages up to project implementation proceeded continuously and smoothly. In addition, when the detailed design was drawn up under the E/S loan, JICA made an indirect contribution through the individual participation of JICA experts.

Of the nine projects surveyed in the M/P, the irrigation projects in the Bila and Sanrego areas proceeded to implementation by the OECF and the World Bank, respectively, following feasibility studies by JICA. A further project in the Gilirang area is awaiting the start of construction following another JICA feasibility study.

Since this project's implementation by the OECF, JICA's contributions have all been indirect rather than direct. One example of this is the establishment of the "Irrigation and Drainage Construction Technology Center" in Bekasi near Jakarta through project-type technical assistance. This center provides training in construction management as well as training overseas in third countries. Forty eight people from South Sulawesi Province have studied there, and although none of them were directly involved in the Langkeme Irrigation Project, the center transferred project implementation and construction techniques to local staff at the province and prefectural level, which must have been of some use. A further contribution made through the same center is the testing of irrigation canal lining materials which were used in the Langkeme area. The results were not actually used in the Langkeme project area, but such activities are an interesting way of supporting the technical assistance delivered by ODA loan projects. When the fruits of surveys,

research and testing etc. conducted in JICA technical centers are applied in ODA loan projects, this is technology optimized for local conditions rather than simply transferred as it stands from developed countries. Therefore we would like to look into the possibilities for further cooperation in this field.

2.4.2 The potential for further JICA support in the Langkeme area

The project area lacks an adequate buildup of experience and techniques for operation and maintenance, and continuing local efforts will be required to build and reinforce organizations and raise the level of technical ability. There appears to be considerable scope for ongoing support through JICA's technical assistance, and the local authorities strongly desire such support. The specific fields which most need support in the future are maintenance for facilities, water management at the terminal level, farming guidance for wet rice and secondary crops in paddy fields, and the reinforcement and stimulation of water users' associations.

The OECF can use Special Assistance Funds (SAF) and other existing schemes to support local efforts such as these, but where JICA support, and the close exchange of opinions and information between the two agencies, is both necessary and possible, efforts should be made to achieve these results.

2.4.3 The importance of cooperative progress with JICA

In the implementation of ODA loan projects there should be planned and continuous cooperative support by the two agencies from the earliest stages. Beyond working together with development surveys and other survey-related technical assistance, there should be cooperation for the communication and diffusion of technology. In cases such as this project, where the area covered by the project is broad and proper operations and maintenance after the project's completion is essential for the full development of its effects, all the agencies concerned should coordinate before the project begins in order to develop a comprehensive concept for assistance, including the full range of technical and economic assistance and further elements of assistance added where necessary, so that they can cooperate smoothly. This kind of assistance should include elements selected from among the following, with reference to local conditions.

① Support for the supervision of construction work in progress.

② Assistance to develop and sustain the effects of projects. (Trial facilities, support for the building and operation of demonstration farms, support for training and education etc.).

③ Support to raise the level of expertise in operation, maintenance and monitoring, and to reinforce and stimulate the organizations responsible for operations and maintenance.

④ Support for the manifestation of project effects.

Some degree of investment in facilities, machinery and other equipment is necessary to make technical assistance fully effective. For example, in regions where experts live and work, measures, such as providing the buildings and equipment they need through loans, should be considered to build an environment which will make technical cooperation more efficient and far-reaching.

2.5 Project effects and impacts

2.5.1 Quantitative effects

At the time of the field survey, this project had only been in full operation for less than two years, so it can be assumed that the effects envisaged at the planning stage had not been fully developed. Therefore, the benefits realized by the project can be expected to increase over the coming years. We will bear that in mind when recalculating the internal rate of return (IRR) for the project after its completion in order to evaluate its economic aspects. At the time of the appraisal the completion of the project was expected to increase annual rice production from 47,900t to 76,800t. This increase in production was expected to bring a net added benefit of Rp5.304 billion. These figures produced an expected IRR of 12.3%.

To calculate the IRR after the completion of this project, benefits of "With project" and "Without project" were calculated on the basis of the findings of the field survey. Two cases were considered for each. The first case assumes that the planned unit yields for rice(6.00t/ha) are achieved in 1997. The second case was calculated from the rice yield level which had already been achieved at the time of the field survey (7.90t/ha in the rainy season and 8.40t/ha in the dry season, based on documents provided by the executing agency). As for Parawija, the increase in production volume was set at 15,426t/year for both cases, based on documets provided by the executing agency. In either case, the "Without project" assumes that the cropped area and unit yield remained as they were before the implementation of the project.

Comparing the "With project" and "Without project", the calculated net increases in benefits are Rp12.248 billion/year for rice and RP6.070 billion/year for Parawija crops, a total net increase of Rp18.318 billion.

For the second case, the net rise in rice was Rp21.277 billion/year and that in Parawija was Rp6.07 billion/year, for a total increase in net profit of Rp27.347 billion/year.

Based on these benefits, IRR for two cases were recalculated. The results put IRR in the first case at 13.9% and in the second case at 19.4%. Both these levels are higher than those anticipated at the time of the appraisal. In the first case in particular, IRR is high despite a relatively conservative estimate of the increase in unit yields. This indicates that the project is quite well justified economically.

In the long term the Indonesian Government can also be expected to reap some savings in foreign exchange due to reduced rice imports.

Table 2-13 shows movements in Indonesia's rice import and export volumes. According to these figures there are extreme fluctuations in the volume of rice imports from year to year and there is no discernible fixed trend. In 1994 the country had still not reached self sufficiency in rice and required a considerable volume of imported rice. If the Langkeme Irrigation Project reaches its initially-planned unit yield for rice, production in the area will reach 87,492t/year. This is an increase of 39,530t/yr over the pre-project production (47,962t/yr). If this increase is achieved, it will replace around 6% of Indonesia's rice imports for 1994. The total cost of Indonesia's rice

imports in that year was US$157.3 million[20], so the saving in foreign exchange due to this project will be in the region of US$9 million. This is a major benefit which can certainly not be overlooked.

【Table 2-13 Movements in Import/Export Volume of Rice in Indonesia】

(Unit: Thousand tons)

	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Import volume	414	34	28	55	33	268	50	171	610	24	630
Export volume	—	259	138	13	12	11	191	64	42	351	169

Source: FAO Yearbook,1986,1988, 1990, 1992, 1994

2.5.2 The impact on farming in the irrigation development areas

In this section we will examine the impact of the project farming and the economic situation of farmers, based on the findings of the rural survey.

Firstly, at the farm level, the irrigation project has had the direct effect of making irrigation water abundant and raising the efficiency of crop cultivation, and the farmers are well aware of this benefit. The first rice crop (the rainy season crop) proceeds through transplantation of seedlings in April and May and harvesting in July and August. The second crop (the dry season crop) is transplanted in November and December and harvested in February and March of the following year. Parawija crops are also cultivated in the remaining period from September to November and their units yields and cropped areas have been greatly increased. The parawija crop was uncertain before the project due to the risk of water shortages, but this situation has been stabilized, which is a very major benefit for most farmers.

Secondly, it should be noted that new cultivation techniques, particularly for rice, are spreading and taking hold. The most common varieties of rice, in order of importance, are Ciliwung, IR64 and Memberamo for the first crop. In the second crop the order changes to Memberamo, IR64 and Ciliwung. The actual work of rice cultivation is unchanged between the two crops. Draft animals were used for plowing in the past, but now farmers mainly pay to have their land plowed using hand tractors. Various changes of this kind can be seen.

The work of transplanting seedlings is contracted out or given to day laborers. Fertilizer is applied after transplantation in two batches. Rice is harvested by the traditional practice of "Bawon", which is the free participation of farmers in the work. Both women and men join in the work of transplanting and harvesting. The changes in rice cultivation techniques are represented by the increasing use of new varieties and chemical fertilizers and hand tractors for plowing.

Thirdly, there is the large disparity between farming in the different zones of the project area. In particular, the differences in unit yields between the upstream, central and downstream zones, the

[20] Source: FAO Yearbook, 1994.

large scale of farming in the downstream zone and the existence of sharecropping are notable.

Fourthly, the expanded range of economic activity among the farmers is notable. The economic activity of farmers in the project area does not consist of self-sufficiency within closed villages. Rather, there are remarkably strong influences of modernization and urbanization. Particularly, the downstream zone is strongly affected by the urban influence of Watansoppeng, the prefectural capital. There are absentee landlords of paddy fields and there is likely to be increasing demand for the conversion of farm land to other applications in future. Some observers have indicated a shortage of agricultural labor in recent years. The increased use of mechanized cultivation and the drift to work outside the villages are factors behind this trend. In some areas the young people are leaving the land and abandoning farming. Clearly the traditional economics and way of life of the farmers are being shaken to their foundations as they begin to move within broader economic frameworks.

Fifthly, there is the linkage between the irrigation project and the price of, and demand for, farm land. Even now, it has been pointed out that it is becoming difficult for sharecroppers to find land to rent. The price of land, which was around Rp5 million/ha before the project, has now jumped to RP15~20 million. This is because the increased productivity of the land has led to outside investment in paddy fields and made them attractive assets to hold. Furthermore, there is a strong risk that this trend could spur the unregulated and disorderly conversion of paddy fields to other uses, place sharecroppers in an increasingly difficult position, make it difficult to enlarge the scale of farms and bring other undesirable effects.

Finally, there is the impact of the irrigation project on the way of life of the farmers. Their incomes have risen, enabling them to buy televisions and other consumer durables, enlarge their houses, and increase their spending on education, pilgrimages and other expenses. This means that this rural area has been pushed much more deeply into the cash economy.

Other than these main effects, one notable secondary effect is that the raised water table in the area has stabilized the availability of water from wells. Farming households in the beneficiary area are also using wells on the land around their own homes to supply irrigation water. Electric pumps are widely used to raise water from these wells.

(Research Report)

How Maintenance for Irrigation Projects Should Adapt to Changes in the Local Community

~ Taking the Lankeme Irrigation Project in Indonesia as a Case Study[1] ~

November 1997 (Final Draft)

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＜CONTENTS＞

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Introduction

~ What does the Maintenance of an Irrigation Project Mean? ~

For an irrigation project to succeed, it must maximize and sustain the increase in production afforded by the project. The key to this success is the effective and efficient use of the completed irrigation facilities by those who stand to benefit from them. By now, executing agencies and the donor countries have come to look at the project as a continuing whole, including the maintenance of the facilities as well as their construction.

The physical side of maintenance means the cleaning and repair of the waterways themselves, but maintenance is commonly given a much wider interpretation, which includes the creation of water distribution plans by water users' associations organized by the beneficiary farmers, the collection of water use fees to pay for repairs, and the provision of communal labor. This could be called "irrigation management", which covers the full range of activities related to the irrigation facilities[4]. In this report we would like to discuss a form of maintenance of irrigation projects which builds a suitable environment within which farmers can come forward to join water users' associations, pay water use fees, provide their labor and generally take an active role.

The aspect of the environment surrounding the farmers, who are the main beneficiaries of the project, which is easiest to overlook, is the ongoing change in the community in which they live. The Lankeme Irrigation Project is far from unique in taking over ten years from the development study to completion. It is easy to see that by the time the project is complete the community it serves could be very different from that which existed when the project was planned. It is also important to be aware that there are two types of change that can occur in the community. One type is the change that would have happened in the long term even if the project had not been implemented, but have been assisted and accelerated by outside intervention. The other type is the emergence of new situations and conditions which would have been impossible without the implementation of the project.

Thus, an intervention made for a certain objective (improvement of crops, in the case of the Lankeme Irrigation Project), creates new attendant circumstances in the local community. If maintenance is pushed forward with only the initial planned objectives in mind and ignores these new circumstances, it will never be possible to motivate the farmers who are expected to take on the task of maintenance. In order to sustain the main objective, which is to increase crop production, the problems of new circumstances must be solved and the operation guided into a more suitable direction. Where obvious changes such as large-scale population migration or environmental degradation are observed during the construction stage of a project, some revision of the scope of the project must be made. At the maintenance stage which follows the completion of construction, I believe the farmers will not be able to carry on the task effectively before the system has adapted responsively to new changes which have happened or are happening.

The implementation of the Lankeme Irrigation Project has achieved its anticipated targets by increasing unit yields of rice and the efficiency of cultivation (these effects have been described in detail in the preceding post-evaluation report). At the present stage this project is unarguably successful. However, less than two years have passed since the completion of the construction

[4] For example, Kikuchi (1991) defined irrigation management as "the hydrological, engineering, systematic, organizational and operational management issues involved in the maintenance of irrigation systems".

stage and there are already unmistakable changes in the way farmers work, and in other economic activities.

Chapter I of this report will examine the changes caused by the Lankeme Irrigation Project in the project area. These changes were clearly observed in a sample survey of farmers[5] conducted by a contracted local consultant between December 1996 and January 1997, and a two-week interview-based field survey conducted in late February and early March 1997.

Chapter II will study promising individual measures and support methods which could be employed to cope with the changes which were clarified in Chapter I. Chapter III will take the Lankeme Irrigation Project as a case study to draw lessons which are common to the whole field of maintenance in irrigation projects, and suggest guidelines which should be incorporated into future efforts in this field.

[5] Ninety farms were sampled in a questionnaire survey. The sampled farms comprised 44 farms in two villages in the upstream zone, 31 farms from one village in the central zone and 15 farms from one village in the downstream zone. The average household size of the selected farms was 4.7 people. Nearly all of the farmers were of the indigenous Bugis people, with no migrants from Java or other new settlers.

Chapter I Changes Brought by the Lankeme Irrigation Project in Its Subject Area

The greatest change produced by this irrigation project is the attainment of the intended effect, namely increases in the unit yield and production volume of rice. However, in this chapter we will concentrate on the changes in attendant circumstances which, although they were not main objectives of the project, have happened or are happening now.

Firstly, there are the changes which would have reached farming society even without the implementation of this project, but which are accelerated by the project. In the case of this project, visible changes of this type include diversification of farming, in the form of [1] expanded production of secondary crops in paddy fields, [2] more widespread raising of livestock and [3] more widespread raising of fish in paddy fields, and also [4] shortage of labor and [5] changes in farming practices. Next there are the changes which would never have occurred if the project had not been implemented, but appeared when it was. These were [1] fixing of cropping into set patterns, [2] the organization and operation of water users' associations, [3] new disparities between areas and [4] rising land prices.

1. Changes which were promoted by the irrigation project

As **Table 1** shows, the results of the sample survey reveal the expected increase in income from rice cultivation after the implementation of the Lankeme Irrigation Project. However, the rate of increase in non-rice income was higher, and the share of farmers' incomes generated by non-rice crops rose. This clearly indicates that farmers are now working to diversify the crops they grow.

【Table 1 Changes in the Average Income of Farmers】 (Unit: Rp.1,000)

Rice income	Before the project	Income	2,429.5
		Share of total income	87.2%
	After the project	Income	3,030.8
		Share of total income	85.3%
	Growth rate		24.7%
Non-rice income	Before the project	Income	357.8
		Share of total income	12.8%
	After the project	Income	521.8
		Share of total income	14.7%
	Growth rate		45.8%
Total income	Before the project		2,787.3
	After the project		3,552.6
	Growth rate		27.5%

Note 1: Total income is the income of the household for the year, excluding remittances from members working outside the village and wages from other work.

Note 2: Non-rice income is derived by subtracting rice income from total income. It includes income from upland cropping, livestock, fish, timber, handicrafts, shipping of agricultural products, retail sales and other commercial income.

The trends for diversification towards secondary paddy field crops, livestock and paddy field fisheries are examined below in detail.

(1) Expanded production of secondary crops in paddy fields

In the JICA Lankeme Irrigation Development Plan Implementation Study Report (March 1980), the fourth of the five key points of development was "to introduce a diversity of crops, while concentrating on rice"[6]. A recommendation given for a desirable crop system was "rice crop - secondary paddy field crop - rice crop". Clearly despite the fact that increased rice production was still accorded the highest priority[7], consideration was already being given to crop diversification as a secondary effect of the irrigation project, and to the introduction of the secondary crops generally known as parawija (maize, peanuts etc.).

According to the Ministry of Public Works, there has been a great improvement in irrigation conditions in the dry season, resulting in a marked increase in the area of land under parawija crops in the beneficiary area after the project. The area under maize rose from 329ha before the project to 3,781 after, peanuts rose from 12ha to 2,064ha and soy beans from 2ha to 1,049ha. These are extraordinary jumps in the cultivated areas, which indicate that many farmers began to cultivate parawija crops after the implementation of the project.

In the sample survey which surveyed 90 farms, there were seven farms which began parawija cultivation after the project (all of which began growing peanuts) and 28 which continued such cultivation. Most farmers increased their rice income after the project, so some 60% of the farmers (55 farms) still felt that their rice crop alone was adequate. This includes those who stopped cultivating parawija after the project to concentrate on rice. The other 40% were diversifying their crops rather than relying entirely on rice, and so managed to increase their agricultural production (see **Table 2**). Furthermore, considering the following points, there is clearly a will among farmers to pursue efficient secondary crop production, and we can expect more farmers to start doing so in future.

①All farmers who continued to grow the same crop experienced an increase in income from that crop. ②Ten farmers switched from maize to more profitable peanuts. ③All the farmers who made a new start in secondary crops chose to grow peanuts.

【Table 2　Production Situation in Parawija】 (Unit: farm)

	Before the project	After the project		
Rice only	47 (52%)	55 (61%)		
Rice + maize	5 (6%)	0 (0%)		
Rice + peanuts	32 (35%)	35 (39%)	Switch from maize to peanuts	10 (11%)
			Start of new production	7 (8%)
			Continued production	18 (20%)
Rice + maize + peanuts	6 (7%)	0 (0%)		
Total (100%)	90	90		

[6] The other key points are as follows:
①To stabilize the yield and the production volume from the unstable rainy season rice crop. ②To increase the cropped area for rice in the dry season. ③To raise crop efficiency as far as possible. ⑤To strengthen agriculture support organizations.

[7] Self sufficiency in rice production was achieved in 1984. However, production since then has been unstable, and the country is still not completely independent of imports.

(2) More widespread raising of livestock

The more widespread raising of livestock is another example of the diversified activity of farmers. Livestock did not feature at all in the development plan, and stock farming is still far from becoming one of the area's main industries[8]. Nevertheless, the results of the sample survey show that the number of farms owning poultry and livestock (either for their own consumption or for sale) rose from 16 farms (17%) before the project to 39 farms (43%) after the project. Of those, 23 farms had newly begun raising chickens. These farms also saw considerable rises in their income from rice after the project. Most of them were in the downstream zone near Watansoppeng. Of those farms which were able to buy poultry using the increased income from greater rice production, those farmers with good access to markets were the fastest to move into this new area of business.

Nine farms (10%) had the sale of eggs and other livestock produce as their second largest source of income. Eight of these saw their income from the sale of such produce increase dramatically after the project[9]. The number of farms earning income from the sale of the livestock themselves rose to 16, of which 14 had increased their income by buying new stock to expand their business after the project. Overall, the expansion of livestock-related businesses made possible by increased income from rice is small in scale, but it should be regarded as one of the secondary effects of the Lankeme Irrigation Project.

(3) More widespread raising of fish in paddy fields

The 1980 development survey did not find out the state of enclosed fisheries at that time, but it seems to have been almost nonexistent. However, the recommendations section contained in the report of that development survey contained this conservative suggestion which hinted at future possibilities: "Freshwater fisheries in the project area, particularly the breeding of freshwater fish in the trunk canals and immediately upstream of intake weirs, present a good opportunity for farmers to broaden their range of operations. Therefore research and investigation into freshwater fisheries should be strongly promoted".

As **Table 3** shows, fish were raised in paddy fields before the implementation of the project, but farmers were not particularly enthusiastic in this type of work. However, although the statistics have yet to reflect this, many people in the area say that the abundant availability of water since the project has made fish rearing more common. For example, in the village of Timus, which I visited, the local community independently constructed water tanks (6m x 4m x 1.5m deep) in the branch of the irrigation canal, although this was not part of the government plan. After the project, tanks of this kind were constructed at eight places in the prefecture. Fish have been introduced to 6% of the paddy field area in Timus village and 20% in the village of R. Gading.

[8] In the whole of South Sulawesi Province, livestock did not represent more than 4.1% of the GRDP for the agricultural sector in 1994. (Source: Sulawesi Selatan Dalam Angka 1995).

[9] One of these farms began to sell livestock produce after the project and this became the farm's primary source of income (55% of total income), surpassing rice.

【Table 3　Movements in the Production Volume of Paddy Field Fisheries in Soppeng Prefecture】

(Unit: tons)

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Production volume	50.1	53.1	52.4	55.5	60.7	57.3	71.6	117.9	97.9	47.0	14.6	64.6	90.3
Share of the entire fisheries industry *	0.68%	0.86%	0.98%	1.25%	1.37%	1.21%	1.42%	2.22%	1.65%	0.69%	0.27%	1.16%	1.65%

Source:　Kabupaten Soppeng Dalam Angka 1991 and 1994

* The four classifications are lake, marsh, river, paddy field (including ponds).

The current method employed is to buy baby fish, raise them and sell them. Nobody collects eggs and hatches them to obtain baby fish. The fish produced are only shipped to Watansoppeng and other local markets and there are no agents to sell fish to. There is only the most simple distribution route. It is possible to use farmers' startup credit (Kredit Usaha Tani: KUT) for the construction of fishery pools for fish raising, and there is a general trend toward increased consumption of fish as consumers' diets improve, so increasing numbers of farmers can be expected to begin operating paddy field fisheries.

(4) Shortage of labor

In the area of the Lankeme Irrigation Project at the time of the development survey, it was noted there was a severe shortage of employment opportunities in the dry season, which was the main cause of seasonal migrations from the area to Kalimantan . These migrations were growing larger every year. In short, the surplus workforce in the area was becoming a problem by 1980. There are various documents which convincingly suggest that the increased cropping rate caused by the irrigation project increased the workforce employed in agriculture in the area. In the sample survey, 16 of the 90 farms sampled increased their workers after the project, three increased the number of days they employed day laborers and two increased both the number of workers and the number of days of labor. The remaining 69 farms reported no change. None of the farms decreased their employment. Another factor which indicates the increase in employment is that the wages of agricultural laborers rose by 40~50% after the project[10]. In our field interviews, some respondents indicated that they had problems finding enough laborers.

In Soppeng Prefecture in 1993 the population depending on agricultural labor for their livelihood amounted to 10,318 households (29% of the total population)[11]. Regrettably, we have been unable to find sufficient documentation to support any judgement on the position and standard of living of agricultural laborers relative to land-owning farmers and sharecroppers. This is because there are various social strata of residents in the area who can become agricultural

[10] According to the results of the sample survey, the daily wage before the project was Rp4,000~5,000, rising to Rp6,000~7,000 after the project. Employment opportunities are greater the further the position down stream and wages rise similarly. At the average exchange rate for 1995, US$1=Rp2,249. (Source: The Economist Intelligence Unit, Country Profile - Indonesia 1996~97, London). The price of fertilizer, another input commodity in the area, rose by 10~30% after the project, so it can be inferred that even compared to other commodities the rise in demand for hired labor was large.

[11] Source:　Dinas Pertanian Tanaman Pangan, Propinsi Sulawesi Selatan, Statistik Pertanian Tanaman Pangan Tahun 1994, Ujung Pandang 1995.

laborers. The sample survey showed that in 16 of the 90 farms the farmers were working their own farms and were also supplementing their income by supplying their labor to other farms. Of these, 13 increased their employment income as a result of the increased demand (and increased wages) for labor after the project.

An interview survey of the village of R. Gading revealed that the village took in laborers from other nearby villages at harvest times. These workers were mainly cocoa growers, who have a higher level of income than the inhabitants of R. Gading, but are able to take on additional work because they have free time. As the development survey indicated, most agricultural laborers come from poorer areas which have fewer employment opportunities, but it is not true to say that they are all from poorer social strata with less chances to find jobs.

Therefore it is illogical to assume that as the opportunities for agricultural labor increase, the incidence of working on other islands will decrease (in other words, that agricultural laborers will return to South Sulawesi to work in rice farming). In the interview survey, farmers in the region said that the demand for labor in Malaysia and elsewhere is still an attractive opportunity for the young people of Sulawesi, and there is no change in the trend towards leaving Sulawesi for work elsewhere. Furthermore, even if the parents are farmers, the children commonly leave to study in Ujung Pandang or on other islands and find jobs there. The survey revealed that there are already concerns over succession in farming. In any country, economic progress is accompanied by long-term demographic shifts away from agriculture and from rural areas to the cities, which lead to rural depopulation problems. The reliance which already exists in the Lankeme Irrigation Project area on seasonal labor from outside the area indicates that the area will face a labor shortage at least until labor saving through mechanization compensates for the increase in agricultural work brought by this project.

(5) Changes in farming practices

In the rice-growing region of Asia the so-called "Green Revolution", which combined the building of modern irrigation facilities with innovations in agricultural techniques, proceeded under state guidance towards the great political and economic target of self-sufficiency in food supply. This process has also brought considerable changes to the farmers themselves. Let us examine these changes in more detail in the case of the Lankeme Irrigation Project.

The increases in unit yields and crop rates, which have been steadily increasing rice production, are not simply products of the increase in water supply. Farmers have been working to introduce intensive techniques such as the adoption of high-yielding varieties and thorough fertilization. The interview survey in the area showed that farmers have been conducting cultivation trials to find the varieties best suited to their farms from the list of recommended varieties, as well as trying different varieties to match the rainy and dry seasons. The results of the sample survey of farmers showed that the quantity of chemical fertilizer applied to each hectare rose by 23% from 299.7kg/ha before the project to 369.8kg/ha afterwards. This is a high level of fertilizer use compared to the national average for Indonesia, which was 303.2kg/ha in 1992 and 284.2kg/ha[12] in 1994[13].

[12] Source: Central Bureau of Statistics, Statistik Indonesia 1995.

[13] Under the sharecropping system in the downstream zone of the Lankeme Irrigation Project, it is customary for the landowners and the sharecroppers to share the cost of fertilizer. The landowner can only judge whether or not the

However, while it is true that the farmers take a very positive attitude to farming, they do not have a clear sense of themselves as commercial farmers. In the above figures for fertilizer application, many of the sampled farmers may have simply answered that they were applying the standard amount recommended by their agricultural improvement officer (315kg/ha, according to the Prefectural Bureau of Agriculture). In the course of field inspections, other researchers and authors of this report have seen fertilizer usage below the standard amount, or fertilizer which was not applied evenly over the field.

The state of the education service, which attempts to propagate uniform farming techniques set by the government, is behind these problems. It is still unable to provide prescriptions for fertilizer application and other actions to match the conditions of each farming area.

Furthermore, most farmers in the area do not seem to have any opportunity to accurately grasp the amount they produce (or the amount they have available to sell) and their unit yields. The field interview survey found that the custom of "Bawon", in which a number of harvest workers share the harvest they have gathered with the farm owner in fixed shares, is still practiced widely in the project area[14]. Therefore the amount known as the harvest gathered by a farmer who has worked the land is not the same as the actual production from any single field. Rather, it is the production of his land minus the amount he has given as payment in kind to others for their work in the harvest (which is a portion of the cost of production for the farmer). Thus the owner or manager of the farm never sees more than around 90% of the total produce from the farm. The distribution of harvested produce first between the other farmers and laborers who work for the harvest is seen as more important than finding out exactly how much was produced. When this kind of method is used, it is clearly not the kind of strategic farming which tries to gauge the relationship between an increase in fertilizer application and the resulting increase in unit yield.

Overall, while the farmers have an enthusiastic and positive approach to farming, there has been no great change in their ideas and attitude to farming practices since the project. To look at it another way, there is still ample scope for further increases in yield.

2. Changes generated by the irrigation project

(1) Fixing of cropping into set patterns

A traditional water use organization centered on water managers (known as ulu-ulu or mandruwae) has apparently existed in the project area for a long time. A water distribution system agreed between farmers operated when non-scientific or semi-scientific irrigation was used. When the modern irrigation facilities constructed for the project are used, their management is divided between government administration, which handles trunk and secondary canals, and water users' associations (P3As) formed by farmers, which handle tertiary and smaller waterways. This arrangement has created a point of contact between the administration and the farmers, and while decisions are taken after adequate dialog with water users' associations, the form of the system is undeniably that the administration sets the water supply plans and the farmers follow them.

The method employed is to divide the project area into four zones and supply water to these zones sequentially. For example, for the rainy season crop water is supplied to Zone I over 1st~15th April, to Zone II over 16th~30th April, to Zone III over 1st~15th May and to Zone IV

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fertilizer which he paid for was applied properly from the harvest yield, but the landowner has power over the sharecroppers and can ensure that a certain level of fertilizer application is maintained.

[14] The shares of the harvest volume varies between farm owners, but in general in this region the harvesters receive one tenth of what the owner receives.

over 16th~30th May. The supply periods are staggered in the same way for the dry season crop. The sequence in which the zones receive their irrigation water and their boundaries are fixed, with no annual rotation between zones. When this kind of water supply plan is rigidly set and the farmers must follow it, they are unable to exercise the same level of independent discretion in their farming, and all details down to the cropping systems become rigidly fixed.

Now, only a short time after the completion of the project, farmers are well satisfied with the benefits of an increased and stabilized supply of water, so we did not hear any notable complaints, but once farmers have become used to the current level of supply they are likely to dislike the lack of freedom inherent in the present restricted type of water supply planning.

The sample survey of farmers found almost no dissatisfied farmers in the upstream and central zones, but in the downstream zone some 40% of farmers responded that "Water distribution is not fair". If we assume that the diversification of farming which was indicated in the preceding section (1. Changes which were promoted by the irrigation project) is the pattern of the future, the fixed water supply plan will be an impediment to the expanded production of parawija crops, and it will be difficult to make arrangements for hired labor, which is in short supply, within the narrow time frame.

(2) The organization and operation of water users' associations

The building of modern facilities after non-scientific or semi-scientific irrigation has, naturally, changed the design of water canals. Therefore it was not possible to convert the existing, traditional, water use organizations into new water users' associations (P3As) without making some changes, and the change involved some alteration of the membership composition. Even though the organization of the P3As was handed down from above (from the administration), it is not surprising to see that the reorganization was a comparatively simple process. The farmers of the Lankeme Irrigation Project area are highly reliant on rice and they are well aware of the importance of water. However, though the organization of the water users' associations was completed uneventfully, whether or not associations with an organization imposed from above will function smoothly is another question.

After the reform to the new water users' associations, the next major change to affect farmers is the addition of management fees for terminal waterways, which have not been charged in the past, to the existing association fees which have been charged so far. The policy of the Indonesian Government has been to bear the costs of maintenance management for the terminal waterways as well as the secondary and trunk canals. Since 1987 the government has been working towards the collection of water use fees (which were called IPEP at the time and which were renamed IPAIR in 1989). However, even now when nearly ten years have passed since the introduction of water use fees, their collection cannot be described as a success. According to the Ministry of Public Works, the rate of introduction of IPAIR charges is no more than 30% in South Sulawesi as a whole, and the actual collection rate is apparently considerably lower still. In the Lankeme Irrigation Project area, the completion of the irrigation works was followed by a program of explanations to farmers in the region to prepare for the introduction of IPAIR charges for the rainy season crop of 1997.

The collection of water use charges in order to make the beneficiaries of irrigation bear the maintenance costs for irrigation facilities, which had previously been borne by the government, should be seen as the scrapping of a de facto subsidy. Now that irrigation development has made two rice crops a year possible on most paddy fields, the actual level of water use charges is so low as to present no problem[15]. A more significant problem is the lack of clear incentives for the independent involvement of farmers in the maintenance management of irrigation facilities. This problem can be summarized in three points:

(i) It is difficult for association members to grasp how the charges they pay will be used. The fees they had paid in the past were used for the maintenance of the terminal waterways they used for themselves, so all the farmers who formed the membership of the associations could clearly see where the money went. IPAIR fees are collected from each water users' associations and combined into a lump sum payment to the Irrigation Department of the Prefectural Bureau of Public Works. This money is widely used for trunk and secondary canals and even for the terminal waterways used by other associations, so there is no way for those who pay the charges to clearly grasp what is done with the money.

(ii) Both the association members and the administration are unclear as to the appropriate level of water use charges. Even if an IPAIR figure is decided with reference to those set for other regions, there is no way of knowing whether such a charge will be sufficient to cover all the maintenance needs or how much of the necessary work it will cover.

(iii) When the above-mentioned diversification of agricultural production is assumed, the farmers will be unable to accept the payment of water use fees if the water supply plan and the maintenance of irrigation canals does not support this diversification.

In this way, the modern irrigation facilities have posed new problems to both the farmers and the government concerning the running of the associations' various activities, including the organization of new types of water users' associations and the collection of new water use charges.

(3) New regional disparities

Originally there was very little disparity between different parts of the project area, and at the time of the development survey no consideration was given to this issue. **Table 4** shows the results for the ninety farms sampled in the sample survey, which were divided between upstream, central and downstream zones. Although the table shows almost no disparity between the cropped area in each zone (per crop), there are significant differences between unit yields and income per household.

[15] Considering the examples of other regions, the annual water use charge is around 1% of gross farming income. The amount is determined by each prefecture, but the decision in Soppeng prefecture has been delayed.

【Table 4　Disparities Within the Project Area】

		Upstream Zone			Central Zone			Downstream Zone			Average of the Whole		
Cropped area per household		1.3			1.0			1.1			1.1		
		Before	After	Growth rate	Before	After	Growth rate	Before	After	Growth rate	Before	After	Growth rate
Unit yields (ton/ ha)	Dry	4.77 (101)	5.04 (95)	5.7%	4.14 (88)	4.85 (91)	17.1%	5.41 (115)	7.05 (133)	30.3%	4.70 (100)	5.32 (100)	13.2%
	Rainy	4.25 (100)	4.95 (99)	16.5%	3.76 (88)	4.55 (91)	21.0%	5.02 (118)	5.98 (119)	19.1%	4.25 (100)	5.01 (100)	17.9%
	Average	4.51 (101)	5.00 (97)	10.9%	3.95 (88)	4.70 (91)	19.0%	5.21 (116)	6.52 (126)	25.1%	4.48 (100)	5.17 (100)	15.4%
Rice crop income per household (Rp./year)		2448 (101)	2886 (95)	17.9%	2028 (83)	2683 (89)	32.3%	3205 (132)	4173 (138)	30.2%	2430 (100)	3031 (100)	24.7%
Total income per household (Rp./year)		3203 (112)	3709 (102)	15.8%	2168 (76)	3197 (88)	47.4%	3326 (116)	4352 (120)	30.9%	2867 (100)	3639 (100)	26.9%

Note:　Figures in (　) are indices, with 100 being the averages for all zones for before and after the project.

Before the implementation of the project, the rankings of the zones in both productivity and income levels were the downstream zone the highest, then the upstream zone and the central zone the lowest. This ranking remained unchanged after the project, but the central zone showed considerable improvement and the downstream zone became even more prosperous. Overall, the effects of the Lankeme Irrigation Project became increasingly pronounced with increasing distance downstream. This is generally because the downstream zone had more difficulty than the upstream zone in securing water supplies, and this problem was solved by the project. The downstream zone also enjoys greater access to educational services and markets for its produce and this advantage can be seen as another factor behind improved productivity and increased income in areas further downstream. The results of the sample survey show that the number of times each area received educational services of some kind (the monthly average for each household) was the lowest in the upstream zone, followed by the central zone, and highest in the downstream zone. This is because the distance to the nearest educational service station is shorter further downstream (see **Table 5**). Also, in the three zones the farmers receive educational contacts from the Prefectural Bureau of Agriculture only, but the downstream zone receives a wider range of services from three or four agencies.

【Table 5　Access to Educational Service】

	Upstream Zone		Central Zone		Downstream Zone		Average of the Whole	
	Before	After	Before	After	Before	After	Before	After
Number of uses (No./ months)	1.5	2.3	2.1	2.7	1.0	3.1	1.6	2.6
Distance to the nearest educational station	8.6	3.5	1.2	1.2	2.4	0.9	5.0	2.3

Note:　Services include cultivation guidance, water management, loan, marketing, post-harvest processing etc.

The reasons are unclear, but this project made a contribution to narrowing disparities between the zones by improving the productivity and income levels of the central zone, which was somewhat depressed before the project. On the other hand, it was the springboard for the downstream zone to rise to a better position than those of the other zones. The downstream zone also has an edge in opportunities to diversify agriculture, and this edge will widen the economic disparity between the downstream zone and the other two. Clear disparities are very likely to emerge in what had been a comparatively homogenous society.

(4) Rising land prices

As the project raises the productivity of the land, the value of that land naturally rises. The interview survey in the field found the price of paddy fields to be Rp5 million before the project. After the project this rose three or four times to Rp15~20 million. This makes it difficult for sharecroppers to become landowning farmers, and for farmers to increase the size of their farms. In the long term, this could easily become an obstacle to the development of agriculture.

It is also becoming difficult for sharecroppers to find land even to rent. As the land price rises and water becomes plentiful, the land becomes an attractive asset holding for the owner, leading some to take land that they had been renting to sharecroppers and start farming it for themselves. The increasing difficulty faced by would-be sharecroppers in finding land could become another factor driving them to work elsewhere.

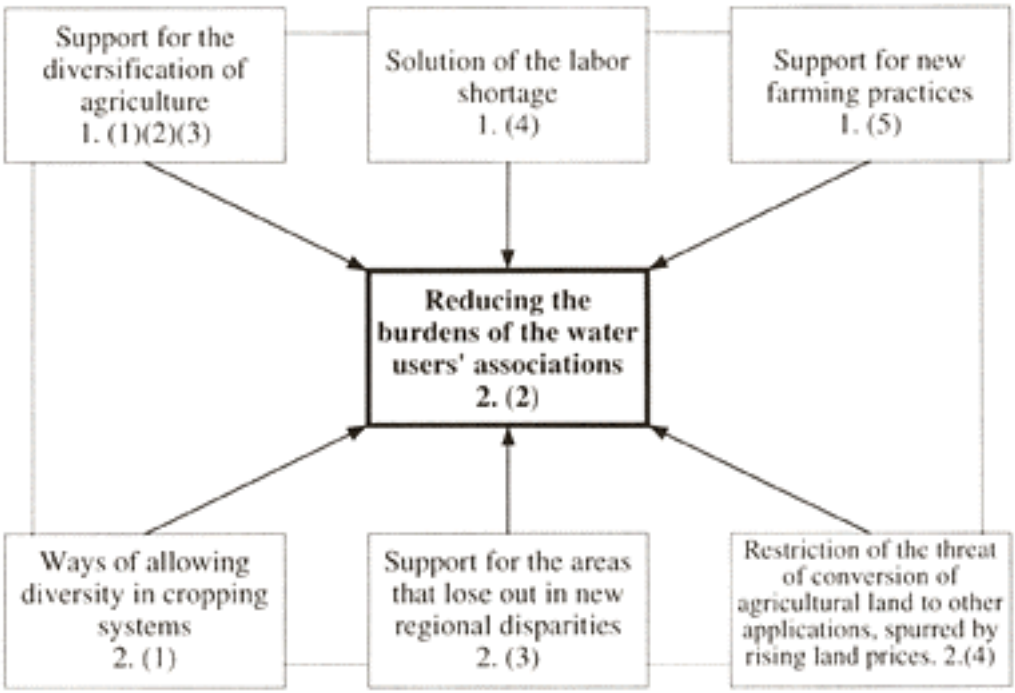
As a long-term change, when land prices rise they can encourage the conversion of paddy fields, particularly in the downstream zone near to the town, to more profitable non-agricultural uses. Ironically, a project which aimed to boost the rice crop could end up promoting industries other than agriculture.

Chapter II How to Deal with These Changes

In the sample survey of farmers, 100% of respondents said "We now receive an adequate water supply" and 99% said "Our water supply volume increased after the project". Furthermore, 92% of the sampled farmers were satisfied with the current distribution of water. At first sight there does not appear to be any impediment to participation in water users' association activities and payment of water use fees. However, the changes indicated in the preceding chapter are certainly under way in the project region, and if they are overlooked the project will not earn such a favorable evaluations in two, five or ten years. This is because to sustain the farmers' satisfaction with the project, the effects of the project must be sustained.

If we bring the changes explained in the preceding chapter within the broad scope of the maintenance of the irrigation project, it includes the burden of the "organization and operation of the water users' associations" as shown in **Figure 1**. This is one of the changes created by the project, and it can be reduced and suitably distributed using the effects of other changes. This is a part of the project's maintenance. Below, we will examine how each item should be incorporated into the broad definition of maintenance. In other words, how incentives should be raised to make the farmers enthusiastic in their approach to the operation of the water users' associations and the payment of the water use charges.

【Figure 1 Broad View of Maintenance for the Irrigation Project
— Case of the Lankeme Irrigation Project —】



Note : The final figures in each box are references to the numbers of the corresponding sections.

1. Support for the diversification of agriculture

(1) The direction of diversification

The diversification of agriculture can be considered on at least three levels. First, there is diversification away from food crops to include produce such as garden plants, livestock and fish raising. Basically this direction of diversification selects highly profitable crops for which rising demand can be expected. Second there is expansion of production into the food processing industries "downstream" of agricultural production. The third direction is to expand into non-agricultural production in rural areas.

In connection with the first direction, it should be pointed out that the irrigation project has made rice production itself a more valuable cash crop than it was before. Farmers regard rice as a far more commercial crop than they did before, and this awareness may have prompted them to try other commercial crops. Therefore to promote rice, the secondary paddy field crops and other upland crops, stock raising and fish raising must also be supported. The land in this area is not suitable for a complete switch away from rice to other crops. In the future, land-intensive agriculture, to make the maximum use of limited land area, will be more in evidence, but the combination of paddy field rice and secondary crops should be promoted. This approach avoids the dangers of price fluctuations and pest damage, as well as problems of upland cropping such as soil salination and damage due to repeated crops[16].

The necessity of combining elements of directions two and three in the strategy for agricultural diversification is confirmed by the high population density, which there has always been in Indonesia's rice-growing areas, and the small per-capita area of cultivable land available to the farming population. If the income level of farmers is to be raised, problems of economic adjustment will inevitably surface in the agricultural sector in the future in the forms of farmers combining occupations or leaving farming, their villages, or both. However, the third direction for diversification, that towards the promotion of non-agricultural sectors, is not a desirable choice when the commercial value of rice is sufficiently high. Rice milling businesses already exist in the project area in some numbers, and the path to diversification should begin with the integration of these and other agricultural produce processing industries, which are examples of the second direction, into the economy of the region.

(2) Educational services to support diversification

Access to the educational services, which were provided after the implementation of the project, was greatly improved following the findings of the sample survey of farmers. The increase in rice production, which has been seen since the irrigation project, can be seen as the fruit of providing irrigation facilities as a package with other services[17]. Therefore, educational services of all kinds certainly have a major role to play in the pursuit of the first two diversification directions listed above.

In the tropics, as in temperate regions, commercial vegetable cultivation must satisfy at least one of two conditions to be successful. The conditions are proximity (in travel time) to a city as a major center of consumption and favorable cultivation conditions (in the tropics, this means a

[16] Watanabe, other (1996), p.89.

[17] Refer to Table 5.

relatively cool climate and irrigation facilities)[18]. The greatest consumption center of South Sulawesi Province is the province capital, Ujung Pandang, which is over six hours away along the paved road which is passable by truck. This makes it difficult to start the commercial cultivation of vegetables with only the addition of irrigation facilities. The same applies to raising livestock and fish. Therefore, for the time being, consumption in local markets should be the prime concern when providing educational services to improve the production techniques of the farmers.

The field interview survey found that the farmers are highly interested in cocoa and other plantation crops. In recent years Indonesia has overtaken Malaysia as a Southeast Asian cocoa producer, and cocoa aimed at markets in Java and in nearby countries is certainly a more promising crop than vegetables destined for Ujung Pandang and other large consumption centers nearer at hand[19]. However, if this kind of market-oriented production is to be taken up, the effort must be made in concert with the distribution sector. To this end, educational services must go beyond their narrower scope and build up an improved support service to nurture the region as a production center. This service must constructively coordinate local administrators, cooperative societies, farmers' organizations, water users' associations and any other relevant agencies existing in the community.

(3) Water distribution systems to enable diversification

Individual farmers must be guaranteed the freedom to draw up their own crop plans if the diversification of production is to succeed. If the water supply system divides the project area into four zones as it does now, limitations are placed on the farmers' range of options. Mizutani (1996) listed three factors related to the performance of irrigation among the factors which restrict the diversification of crops in paddy field irrigation areas:

(i) The communal nature of water use
(ii) The public nature of water use
(iii) The individuality of water use

Mizutani holds that "The agencies which guide the formation of water users' associations appear to aim to make the communal and public aspects of water use the core of the associations, but these aspects are not the targets of the participating farmers. For the farmers, the associations are no more than one means of achieving the kind of individual water use that can lead to crop diversification"[20]. Looking at the Lankeme Irrigation Project area in the light of Mizutani's interpretations, the formation of water users' associations and the setting of clear water supply plans can secure the communal and public aspects of water use, but it will be extremely difficult to reconcile these aspects with that of individuality.

As crops become increasingly diverse, the demand for individual water use will inevitably intensify. This is not a problem which can be handled internally by each water users' association; it is truly an issue for the community as a whole. As such, water rights at the level of individual fields must be considered. The optimum form of irrigation as a whole must be re-examined,

[18] Watanabe, other (1996), p.88

[19] According to the FAO Production Yearbook Vol.49 - 1995, the average annual production of cocoa beans in 1989-'91 was 240,000 tons in Malaysia and 140,000 tons in Indonesia. However, in 1995 Malaysia produced 130,000 tons and Indonesia produced 240,000 tons. Indonesia has a clear advantage in the level of wages.

[20] Mizutani (1996), pp. 207-218.

including the facilities themselves, and in some cases plot-to-plot irrigation between paddy fields can be improved, the density of waterways can be increased or other measures taken.

2. Solution of the labor shortage

(1) Promotion of labor saving

The trend towards labor shortage was unimaginable in Indonesia until recently, but since the start of the 1990s a shortage of agricultural labor began to emerge, centering on Java. We must calmly accept the fact that this problem has reached South Sulawesi Province.

If this trend continues, a gradual shift can be expected from rice cultivation by transplantation of seedlings to the direct sowing method, which requires less labor. This development can already be seen in Java, where research is progressing to spread techniques for more productive direct-sowing cultivation. This research must go beyond the development of suitable techniques suitable for Java, to adapt such techniques for conditions in Sulawesi. The research and propagation of labor-saving agricultural techniques is a suitable field for cooperation with JICA.

On the other hand, considering the fact that the majority of farmers rely on hired plowing by hand tractors[21], the region has clearly begun to show a drift towards mechanization for labor saving[22]. However, the sample survey revealed that of the ninety farms sampled, only one actually owned a hand tractor. The agricultural cooperatives must take steps to make it easier to use hand tractors. Measures could include the joint purchase and use of tractors and the use of credit to buy tractors.

(2) Rational water distribution systems

When the same cropping system is used under a rigid water distribution system in any region, it compels all farmers in the region to transplant seedlings at the same time and to harvest at the same time. This concentrates demands for large numbers of workers in certain restricted time frames. Considering the trend towards labor shortage, a rigidly fixed water distribution plan risks concentrating the excessive labor demand in one period and leaving a labor surplus at other times. The water distribution plan should be altered to avoid this situation by staggering the timing of each operation by appropriate amounts. This makes it easier for employers to hire workers and provides workers with employment opportunities throughout the year. Furthermore, it allows farmers to supply their labor to other farmers in busy seasons.

(3) Support for agricultural laborers

There are many variables concerning the people who earn income by taking on agricultural work on a short-term basis, and they must be studied further, but most do not own their own land and also have difficulty farming and paying sharecropping fees. Among agricultural laborers, there are some who leave their areas to work in Malaysia and elsewhere, and these are

[21] Hired plowing refers to paying wages for the work of plowing only. Some workers own or rent hand tractors and specialize in plowing for pay to supplement their income.

[22] The sample survey found that of the 90 farms, 60 (67%) used tractors before the project, rising to 73 farms (81%) after the project. However, the work of plowing was either given to other laborers in the form of hired plowing or done by the farmer in person, and the distinction was not necessarily made clear. The charge for tractor plowing per hectare rose by approximately 50% after the project.

comparatively prosperous, while others form the lowest stratum in the community, and this disparity must not be overlooked. For these laborers at the bottom of the heap, the irrigation project has brought a temporary benefit in the form of increased employment opportunities, but for as long as they remain no more than a convenient source of muscle for their employers, they cannot put down roots and become productive farmers. They are like a reserve army, saving some money while waiting to be posted to work elsewhere. To avoid a shortage of labor in the future, it is very important that agricultural laborers be given more opportunities to acquire skills and the chance to start farming as sharecroppers.

3. Support for new farming practices

(1) Provision of more detailed and responsive educational services

As was mentioned briefly in the preceding chapter, the main aim of the grassroots educational services is to spread the uniform package of agricultural techniques which has been defined by the government. They have not reached the stage of trying to deliver better, more individualized services to farmers who have begun to take an enthusiastic approach towards farm management. Such detailed farming techniques will be learned by each farmer individually over a period of time, and the true role of the educational services and farmer training is to support them in this process. Interviews with the Prefectural Bureau of Agriculture found that there were six education field workers to cover the nine villages in the Lankeme Irrigation Project area, which is probably not enough.

The number of educational field workers must be increased, but these workers themselves require training. Rather than uniformly dispensing what they have learned, it is important that they learn the flexibility and adaptability they need to make suitable choices of techniques for each field.

(2) Improving the abilities of water users' associations

The water users' associations do not exist solely to collect the water use charges required by the government. Their true duty is to represent the interests of their members and to secure the maximum possible amount of water for their needs. At the moment, however, the supply of water is stable and increasing, so as organizations they are not facing any very difficult problems, and they lack any opportunity to affirm that duty. However, the perception of farming among the farmers who make up the water users' associations is gradually shifting, and their expectations and demands of the associations are rising.

The first thing that is needed to support the growth of this kind of organized activity is a systematic framework. According to a circular from the Indonesian Ministry of Home Affairs (dated 11th November 1989), they were considering a system organizing multiple water users' associations around single secondary canals into water users' association federations to respond more broadly to the demands of their membership. This idea must be put into practice, rather than ending as no more than a proposal on paper. Another idea is to provide each association with opportunities to learn from the work of the best associations.

At preset the water users' associations do not have to negotiate with external bureaucratic organizations for the interests of their members and struggle to win the water they need when they

need it. There are no significant issues to be faced in the coordination of interests within and between associations. Nevertheless, the very absence of problems makes this an important time for the associations to build their experience of association activity, and hone their problem-solving abilities.

4. Securing diversity in cropping systems

The cropping systems, which the administration have pressed on the farmers through the implementation of the irrigation project, restrict the natural drift of the times towards diversity, which would have carried on if the project had never happened. If the kind of independent water supply mentioned above can be achieved and used to allow farmers the freedom to choose crop plans at their own discretion, the potential for agricultural diversification will be secured and the labor shortage alleviated. Moreover, this is an essential step towards the autonomy of the farmers in agricultural production, considering the fact that the administration side can transfer the maintenance of irrigation facilities, including the burden of water use charges, to the farmers.

5. Dealing with new regional disparities

(1) Building farm roads in the upstream and central zones and securing transport access

Of the newly-emerging regional disparities, the most serious problem is presented by the physical access to markets and educational services, which is very much less convenient from the upstream and central zones than it is from the downstream zone. Also, all official activities and service in the upstream and central zones are fettered by the inconvenience of transport to those zones. This is true when the staff of the terminal irrigation office inspect the irrigation canals, and when the water managers open and close the sluice gates, and when the officials responsible for water users' association finances tour the associations to collect their association fees and water use charges. The implementation of the irrigation project has caused a real increase in traffic volume, which makes the building of farm roads and the securing of light trucks, motorbikes and other means of transport essential elements of the project's maintenance.

(2) Strengthening educational services in the upstream and central zones

An interview survey of the Prefectural Bureau of Agriculture revealed that there was no increase in the number of educational field workers after the project, just an increase in their workload. It has already been indicated that the level of usage of educational services in the upstream and central zones is not high (see table 5), but considering the inconvenience of transport to these zones, the frequency of visits by educational field workers to farmers there is lower than the frequency in the downstream zone, and the quality of the service has probably declined further following the project. Services in the upstream and central zones should be improved in all areas, including cultivation guidance, water management, loan, marketing and post-harvest processing.

6. Restrictions on conversion of farm land to other applications

The impact which rising land prices will have on farming and other economic activity is closely related to another big subject: the type of land use plan Indonesia will have in the future (or, what the direction of Japan's aid policy will be). The area requires more detailed study, and with the data now available it would be inappropriate to state a policy direction. In this report I will go no further than to indicate two necessary objectives:

(i) Sharecroppers in the downstream area, which can be expected to be converted away from agriculture relatively early, should be made into landowning farmers and given whatever support they need to continue farming there.

(ii) Legal restrictions should be put in place to prevent the uncontrolled conversion of farm land to other applications.

7. Empowerment of farmers' organizations

The six points above put forward methods for responding to change in order to reduce the burden on the farmers involved in water users' associations, but of course these aspects do not exist independently in the community. They are all interlinked within the community and it is impossible to take any one and discuss it in isolation. To put the six types of support mentioned in this chapter into effect, the farmers must be given full opportunity to speak their views and there must be a mechanism for transmitting their wishes, clearly and accurately, to the administration. If this mechanism is to come from what already exists in the community, it will be based on the activities of the water users' associations, cooperative societies, farmers' organizations, village development committees (LKMD) and other organizations with farmers as their membership.

This survey did not find enough data about these organizations which involve farmers, but at present it is true to say that cooperation and coordination between the various organizations and their work is poor, and they are not being put to effective use. Perhaps this is because there has been no reason so far to rely on their strength. However, the implementation of the project was the start of a gradual process for the farmers of greater assimilation into a broader economic sphere. In the course of this process, it will be extremely important for the farmers to be effectively organized in order to deal with the changes they face. Specifically, coordination between the roles of the many existing organizations and the establishment of a regional federation unifying the smaller organizations should be seriously considered.

Chapter III General Lessons on the Maintenance of Irrigation Projects

Drawing on the observations of the Lankeme Irrigation Project contained in the preceding chapters, this chapter examines the major lessons which can be learned for the maintenance of irrigation projects.

1. Points which should be considered at the development survey stage

(1) Finding out who are the beneficiaries

Of course, the beneficiaries of an irrigation project are the farmers of the area, but while they are the beneficiaries they are also the main group responsible for maintenance. If the farmers are taken to be beneficiaries only, it can be said that nearly all farmers who own paddy fields in the project area will benefit to some extent, so there is no reason not to lump them all together without any more detailed classification. However, if the farmers are regarded as the ones who take on the task of maintenance, that is to say, if they become the people with the most control over the sustainability of the project, the diversity of the farmers becomes highly significant. The farmers, or the members of village communities, are not a homogenous group. They must be divided into at least three groups, landowning farmers, sharecroppers and agricultural laborers, and studied in those groups. On the basis of these groupings, the development survey should prepare some kind of outlook for each group, covering the following aspects.

- Will each grouping benefit from the project or not?
- How will the roles to be played in maintenance management differ between the groups?
- Will each group derive a degree of benefit in proportion to the burden the project will place on them?

(2) Use of traditional water users' organizations

In regions which have a history of paddy field agriculture, there is likely to be an existing organization of farmers to mediate in the use of agricultural water resources. In the Lankeme Irrigation Project area there were village irrigation organizations which predated the project, which ordered water distribution in a system centered on the mandruwae, a water manager. Water use charges were already being collected, in the form of donated labor, a fixed amount of unhulled rice, or cash. In this way the beneficiaries bore the expenses of maintenance, including an allowance for the mandruwae. However, in government-implemented irrigation projects, these methods, which are already rooted in the community, are not reinforced or helped to revive. Instead they are dissected and discarded to be reassembled into new water use organizations operating on completely different principles. After this process, it takes a lot of time and effort to get the operations of the new organizations on track. This is true in many areas, not just in the Lankeme Irrigation Project area.

In the development surveys for agricultural projects in recent years, the staff concerned with technical aspects and economic analysis have been joined by additional staff concerned with farmers' associations and other organizational aspects, enabling survey teams to consider these matters in more detail. In future, the existing, traditional organizations should be used as the base, and projects should be planned with a view to revitalizing these organizations, and rooting modern irrigation techniques in the community.

(3) Finding out what the traditional farming practices are

The character of a community must not be forgotten when positioning the irrigation project within that community. At the very least, any farming practices peculiar to that area must be found and studied. Taking Indonesia as an example, when rice farmers (both landowning and sharecropping farmers) have to harvest their crops, they allow anyone who wants to take part in the harvesting to do so, without limit. These volunteers receive, between them, between one tenth and one sixth of the farmer's harvest in payment (the share varies with regional practice). This long-standing traditional way of harvesting is generally known as baon.

The grasp the survey gains of the economics of farmers in the above three groups (landowning farmers, sharecroppers and agricultural laborers) will be greatly influenced by whether or not it is known that this social custom of mutual redistribution and help is used. Also in Indonesia, when there are great population pressures and the number participating in the harvest becomes unmanageably large, there is a visible shift from baon to the use of specialist agents who are contracted to bring in the harvest. Under this method, which is usually called tebasan, the contracted agent has total control over all stages of the harvest and determines the distribution rates. It is easy to see that the methods of determining a farmer's production and the parts played by the workers will differ enormously between regions which use tebasan and regions which use baon. The conclusions reached by the development survey will be changed depending on whether or not these differences are understood. In short, it has an impact on whether or not it will be possible to reach an understanding with farmers over the broader meaning of maintenance for the irrigation project.

The inclusion of someone in the development survey team, who is well aware of farming practices in the project area, is a necessity. We must absolutely avoid the situation where those working on the survey base the survey's assumptions on the practices they are familiar with (for example, Japanese practices), while they are unaware of how things are really done.

2. Matters to consider during the construction period

(1) Methods to grasp changes in the community

In general, when construction begins, the construction workers and the management of construction become the prime concern of those in charge of the project. There does not seem to be enough time to take another look at the impact the project is having on the community. Where it takes a long time, ten years or more, to complete the project, the points studied at the time of the development survey must be reviewed at some intermediate stage. What the community wants from the project must also be rechecked.

At present the OECF may conducts a SAPI (Survey to Assist Project Implementation) survey at the implementation stage, but the budget is limited, and these are only conducted when there are clearly problems with the project which may prevent its completion. Ideally, a survey should be conducted partway through the implementation of every project to grasp changes in the community before problems come to the surface. In practice, it is difficult to do this with SAPI surveys. A more practical approach is for the grassroots officials of the executing agency, or the consultants responsible for the site, to keep an eye on the situation, and be forthright in reviewing the project plan and making comments on the maintenance system and support services which

should follow the project.

(2) Preparation of a broad irrigation management strategy

If irrigation management means the building of physical management systems and the organization of water users' associations, two or three years before the completion of the project is not too soon to start preparing, and work should certainly have begun immediately after the completion. However, as was noted above, work on broadly-defined irrigation management as defined in this report must be based on a knowledge of the long-term changes that happen before the project is completed. Ways of dealing with these changes must be prepared in parallel with the progress of the project.

3. Matters to consider after construction is complete

(1) Ongoing post-evaluation

The OECF conducts successive post-evaluations of completed projects, with at least one being conducted before the executing agency loses the relevant information (usually within five years of project completion). However, one survey is not enough if we are to improve the sustainability of the project by responding appropriately to changes in the community.

In an ideal situation the donor side would be able to monitor the situation continuously. In practice, the project is finally transferred to the authority of the local authorities of the area and to the farmers themselves, so these groups must be armed with the ability to keep a grasp on changes at the level of regional administrative, and take suitable action.

(2) The provision of services to respond to changes

The full effects of an irrigation project will not be realized just by building the irrigation facilities. It is essential to combine them with support services[23] (technical guidance, introduction of improved varieties, finance, marketing etc.). The content of these support services must be tailored to match the changes that the project has caused, both directly and indirectly, in the community.

The services which should be provided to farmers after the completion of the irrigation project are the most promising field for the dispatch of JICA experts and other forms of cooperation with a JICA scheme. An accurate grasp of changes in the community is also essential to the successful combination of OECF hardware and JICA software.

[23] There are many studies which point to this conclusion, and that by Shibuta (1995) is a good example for reference.

Afterword

~ Challenges for the Future ~

This report has been built around an awareness of problems which we gained through post-evaluation of the Lankeme Irrigation Project. An accurate portrayal of change in a community really requires long-term observation and time series analysis spanning the planning stage and the construction period and continuing beyond completion. This paper does not have the backing of such data and therefore I am doing no more than advancing a supposition. For the Lankeme Irrigation Project, follow-up surveys should be conducted, and the changes that arise in the significance of water management in the community should be observed. If it is possible to track changes continuously in the future, this monitoring will provide many insights into subjects which are currently being debated, such as the sustainability of irrigation projects and participatory irrigation management.

There is no doubt that irrigation projects are a form of outside intervention which stimulates the subject community by raising agricultural production. However, when something new is brought into a traditional society, that thing, however good it is, also places a burden on the society. What the people responsible for development must do is take this situation seriously and add further interventions as necessary, once they have a clear understanding of what needs to be done.

＜BIBLIOGRAPHY＞

Kanazawa, Natsuki, *"Changing Agriculture and Farmers in Asia"*, The University of Tokyo Shuppankai 1993.

Kikuchi, Masao, *"Strategies for Proper Management of Irrigation System in Asian Developing Countries ―Case Study Primarily on Sri Lanka―"*, Agricultural Integrated Research Vol. 46, No.1, January 1992

International Agriculture and Forestry Cooperation Association ed. Dec. 1994 *"Agriculture and Forestry Industries in Indonesia ―Present Status and Issues for Development―"*.

Japan International Cooperation Agency *"Lankeme Irrigation Development Project"*, March 1981.

Shibuta, Kenichi *"Sustainability of Agricultural Issues ― Case Study on Sri Lanka" The Mahabeli Regional Development Project (C District)*, Journal of Development Assistance Vol.2, No.3, Dec. 1995.

Nippon Koei Co., Ltd. *"Final Investigation Report on Gililan Irrigation Development Project in the Republic of Indonesia"*, June 1995.

Mizutani, Shoichi *"Water Utility System Under Energy Restriction ―Experience of "Sbuck" in Indonesia―"*, Drain and Distribution of Water Energy Resources, Chapter 2, Association of Agriculture, Mountain, Fishing Village and Culture 1996.

Watanabe, Hiroyuki etc. ed. *"Tropical Agriculture"*, Asakura Shoten 1996.

Asian Productivity Organization, *Management of Irrigation Facilities in Asia and the Pacific*, 1991, Tokyo.

B.Bruns and Helmi, *Participatory Irrigation Management in Indonesia: Lessons from Experience and Issues for the Future* (A background paper prepared for the Economic Development Institute, World Bank and the Food and Agriculture Organization, U.N.), November 1996.

Fish Raising in Paddy Fields

Training at a Water Users' Association