REPUBLIC OF INDONESIA

MINISTRY OF PUBLIC WORKS
DIRECTORATE GENERAL OF
WATER RESOURCES DEVELOPMENT

FEASIBILITY STUDY ON THE LANGKEMME IRRIGATION PROJECT

ANNEX-I

SOILS AGRICULTURE AND AGRICULTURAL ECONOMY

MARCH 1981

JAPAN INTERNATIONAL COOPERATION AGENCY
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Glossary of Terms and Abbreviation

1. Local Administrative Organization

Kabupaten (Kab.)	:	District
Kecamatan (Kec.)	:	Sub-district
Desa	:	Village
Bupati	:	Chief of Kabupaten
Camat	:	Chief of Kecamatan
Kepala Desa	:	Chief of Desa

2. Organization for Irrigation and Agricultural Development

DPU	:	Ministry of Public Works
DGWRD	:	Directorate General of Water Resources Development
P3SA	:	Sub-directorate of Planning and Programming
PLN	:	Public Corporation of Electricity
BRI	:	Indonesia People's Bank
BIMAS/INMAS	:	Mass Guidance for Self-sufficiency in Food
DOLOG	:	Provincial Rice Purchasing Agency
BUUD/KUD	:	Village Unit Executive Body/Agricultural Cooperative Organization
P3A	:	Water User's Association
BPP	:	Rural Extension Center

3. Other Local Terms

Polowijo	:	Second Crops, Planted after Harveste of Wet Season Paddy
Pelita I	:	First Five-Year Development Plan
Pelita II	:	Second Five-Year Development Plan
Pelita III	:	Third Five-Year Development Plan
PPL	:	Field Extension Worker
PPM	:	Extension Supervisor
PPS	:	Subject Matter Specialist

4. Area and Volume

m^2	:	square meter
ha	:	hectare
km^2	:	square kilometer
l	:	liter
m^3	:	cubic meter
t	:	ton

5. Derived Measures based on the Same Symbols

m^3/sec	:	cubic meter per second
t/ha	:	ton per hectare
m^3/km^2	:	cubic meter per square kilometer
mm/day	:	millimeter per day
l/sec/ha	:	liter per second per hectare
l/day	:	liter per day
m^3/km^2/year	:	cubic meter per square kilometer per year
meq/100g	:	milli-equivalent per 100 gram of soil
km/sec	:	kilometer per second
kg/cm^2	:	kilogram per square centimeter
cm/sec	:	centimeter per second
t/m^3	:	ton per cubic meter
t/m^2	:	ton per square meter

6. Electric Measures

kV	:	kilovolt
kW	:	kilowatt
kWh	:	kilowatt-hour
MW	:	megawatt
kVA	:	kilovolt ampere
Hz	:	Hertz

7. Currency

US$	:	United States Dollars
Rp	:	Rupiah

US$1 = Rp 625

8. Others

%	:	percent
No.	:	number
Nos.	:	numbers
vs.	:	versus
MSL	:	Mean Sea Level

CHAPTER I SOILS

CHAPTER I SOILS

1.1 GENERAL

The findings of the reconnaissance land resources survey of the Langkemme Irrigation Project area are presented in two preceeding study reports:

- Reconnaissance land resources survey in the South Sulawesi area, soil map (scale: 1/500,000), 1968, Soil Research Institute, Bogor
- Master Plan for the Central South Sulawesi Water Resources Development Project, Soil Map (scale: 1/50,000), 1980, Japan International Cooperation Agency, Tokyo

The present soil study aims at identifying major soil groups and their distribution and examining the suitability of each soil group for irrigation farming on the basis of field investigation and the findings of past studies mentioned above.

This present report deals with the procedure of the field investigation, major characteristics and land capability of the soil units identified in the project area. The results of the present soil studies are summarized in the Soil Map (see Fig. 1.1.1).

1.2 PROCEDURE OF SOIL SURVEY

The field investigation was carried out over the area of about 20,000 ha by using the topographic maps and aerial photos scaled 1/25,000. The identification and delineation of land units are based primarily on the aerial photo interpretation for land-forms. The preliminary demarcation thus made through photo interpretation was checked and adjusted in the field. The soil profile survey was then made on the basis of the preliminary land unit map and 40 test pits were dug to a depth of about one meter. Each test pit was observed in accordance with the standards described in "Guidline for Soil Profile Description" of FAO.

In the course of the profile survey, 34 soil samples were taken from the representative soil horizons. These soil samples were analized in the Chemical Research Institute (BALAI PENELITIAN KIMIA), Ujung Pandang. The analytical items are pH, total carbon, total nitrogen, available phosphate, cation exchange capacity, exchangeable bases, free iron oxide and soil particle size distribution. The results of the soil analysis are given in Table 1.2.1.

1.3 SOIL CLASSIFICATION

The soils in the study area are classified into 7 soils units, according to the FAO-UNESCO soil classification system, i.e., Eutric Fluvisols (Je), Pellic Vertisols (Vp), Eutric Gleisols (Ge), Calcic Luvisols (LK), Eutric Regosols (Re), Rendzinas (E) and Lithosols (I). Major characteristics of each soil unit are outlined as follows:

Eutric Fluvisols (Je) or Hydromorphic Alluvial Soils in the Indonesian system mainly extend over the flat alluvial plain along the Langkemme river and small streams acrossing the project area from west to north-east. This soil group is developed on recent alluvial deposits and is generally immature with no predominant morphological characteristics. The effective soil depth is generally deep. The surface soils have dark brown to graish brown silty clay. Subsoils are generally yellowish brown coloured heavy clay. As for chemical properties, pH value of these soils shows over 6.5 throughout the profile. The cation exchange capacity is over 20 meq/100 g. Major exchangeable base is calcium. The base saturation degree averages around 60%. The most of these soils are presently put under cultivation of paddy. They are very suitable for irrigated rice farming. These soils occupy about 3,630 ha or 18.2% of the study area.

Pellic Vertisols (Vp) or Grey Grumusols develop over the undulating alluvial lands enclosed with flat plains and hilly lands. The soils have the gray or black heavy clayey surface soils formed on calcareous alluvium. These soils have swelling clay properties which cause them to be sticky when soils become wet, and to be hard, dry and deeply cracked when dry. As a results, micro-relief called gilgai is developed at the surface. This "vertic" surface soils are not very deep, generally within 30 cm from the ground surface. The subsoils underlaying vertic surface vary with the locations, from gravelly to clayey alluvial deposits. They are generally alkaline in soil reaction, therefore, the use of acid-reacting fertilizers is recommended. The cation exchange capacity shows over 40 meq/100 g. The average clay content is around 40%. These clays are mainly montmorillonitic. The lands covered with these soils are presently used for paddy cultivation. Adequate water supply is the key to the utilization of Vertisols. Where irrigation is practiced, these soils are very suitable for paddy cultivation. These soils occupy 5,730 ha in total or 28.7% of the survey area.

Eutric Gleysols (Ge) or Grey Alluvial Soils in the Indonesian system, are poorly drained soils, in low-lying areas and in depressions, that are influenced by high groundwater tables and therefore show hydromorphic property. The soils have a reducing condition in the lower part of the soils that is continuously saturated with water. The sub-soils are therefore grayish blue in general, with some orange or reddish spots. The soil structure is massive to weakly developed sub-angular blocky. The pH value ranges from 6.5 to 7.5. The cation exchange capacity is around 20 meq/100 g. The base saturation degree averages more than 60%. These soils are continuously cropped to rice. Because their inherent fertility is generally low, proper irrigation and fertilization will be essential. These soils occupy 370 ha or 1.8% of the survey area.

Calcalic Luvisols (Lk) are found in the hilly lands mainly on limestones. The soils are classified into Yellowish Brown Mediterranean Soils in the Indonesian National Soil classification system. The soil depth is veriable depending on topographic position. The horizon sequence of the soils is A/Bt/C in general. The soils have well developed argillic B horizon (clay accumulation). The pH value shows over 7.0 in general. The cation exchange capacity is over 20 meq/100 g. The base saturation degree is generally high throughout the profile, showing over 80%. Most of Calcic Luvisols are presently used for cultivation of upland crops. They have a modreate inherent fertility but are not intentively used owing to some specific limiting factors of topography, soil depth, stonines and water availability. The total area of these soils is about 2,990 ha or 14.9% of survey area.

Eutric Regosols (Re) are very young soils, almost no horizon differentiation, which are found along the Walanae river and on the alluvial terraces along the streams in the project area. The soil texture is generally very sandy throughout the profile. Most of Regosols are presently used for cultivation of tobacco and groundnuts. Regosols retains little water. The total area of the soils is about 2,480 ha or 12.4% the study area.

Rendzinas (E) are formed on calcareous rock materials and extends over the south eastern hilly lands. They are stony soils and have hardly any agricltural value. These soils occupy 530 ha or 2.6% of the study area.

Lithosols (I) extend over rolling hilly lands and mountaneous areas. These soils are mineral soils less than 10 cm thick over hard rock. These soils have no agricultural value. These lands are about 4,270 ha in total or 21.4% of the study area.

1.4 LAND CAPABILITY

1.4.1 General

Three major land classification systems have been applied for the water resources development projects in Indonesia. They are:

- USDA land capability classification system 1/
- USBR land classification system 2/
- FAO land suitability classification system 3/

1/: Land Capability Classification, Agricultural Handbook No. 210, 1961, Soil Conservation Services, USDA

2/: Bureau of Reclamation Manual Vol. 5 Irrigated Land Use, Part 2: Land Classification, 1953, US Bureau of Reclamation

3/: A framework for Land Evaluation, 1976. FAO

The USDA system is most widely used, but it does not meet the particular requirement for irrigation project. It is mainly used for rainfed agriculture in general. The USBR system was devised originally for irrigated land use. However, the basic concept of the USRB system is generally to assess the lands under arid climate and/or to assess land productivity for dry field crops like wheat, barley, cotton, etc. Some modification of this system is required under Indonesian condition due to the different requirements for irrigated paddy cultivation under humid climate. Although several approaches to the modification have been made by various study groups, none of them has been fully authorized at present. The FAO system is more flexible than US ones and can be applied to the full range of environments. It is the system that the Soil Research Institute, Bogor, recommends for use in Indonesia. This system is, however, still under development and does not serve the detailed criteria for suitability assessment on the irrigated paddy cultivation.

Considering all these, it is conceived that the Japanese land classification standard 1/ for paddy can be applied to the feasibility study on the Langkemme Irrigation Project. The Japanese system is devised originally for paddy cultivation and its classification criteria are detailed enough for land capability assessment on a feasibility study level. In the Japanese system, lands are classified into 4 capability classes, i.e., I, II, III and IV. Each class is defined as follows:

Class I: Land has almost no limitation for crop production and/or no risk of soil conservation. It is naturally fertile and has a great potential for crop production without any improvement practices of soils.

Class II: Land has some limitations for crop production and/or some risks of soil conservation, and requires some soil improvement practices for normal crop production.

Class III: Land has many limitations for crop production and/or is likely subject to risks of soil conservation, and fairly intensive improvement practices are required.

Class IV: Land has great natural limitations than these in Class III, but can be utilized for cultivation of some specific crops under very careful management.

In the USDA system, lands are classified into 8 classes and the lower 4 classes from V to VIII are ranked as "not suitable for agricultural production". The USBR system has 6 classes, I to III being arable, IV being suitable only for special uses and VI non arable. Class V is reserved for undecided suitability, but in practice this class is often omitted. The Japanese system, 4 class classification of arable land, is, therefore, correlative with these US systems.

1/: Outline of Land Classification based on Soil Survey in Japan, 1977, National Institute of Agricultural Science, Tokyo

The FAO system for land suitability classification is used for assessment of lands in terms of their relative suitability for a specific type of use. The Langkemme Irrigation Project aims at increasing rice production under irrigated condition and the land use type envisaged is double cropping of paddy as described in Chapter II. In the FAO system, the land suitability classes for each specific utilization type reflect degrees of suitability or of limitation, i.e., S1 (highly suitable), S2 (moderately suitable), S3 (marginally suitable), N1 (currently not suitable, having limitations which are considered unsurmountable with existing knowledge at currently acceptable cost) and N2 (permanently unsuitable). It is considered that the suitability classes from S1 to N1 nearly correspond to 4 classes described in the Japanese system.

In view of above consideration, the Japanese system seems to be most suitable for land capability classification for paddy fields due to its detailed specification and 4 class rating which can be correlative with other systems.

1.4.2 Specification of Land Capability Classification

In the Japanese system, there are 13 factors for assessment of land capability as shown below:

(1) thickness of top soil
(2) effective soil depth
(3) gravel content in top soil
(4) easiness of plowing
(5) permeability under submerged condition
(6) state of redox potentiality
(7) wetness of land 1/
(8) inherent fertility
(9) content of available nutrient
(10) degree of hazard
(11) frequency of hazard
(12) slope 1/
(13) erosion

The specification of land capability class are explained as follows:

(1) Thickness of top soil (code: t)

Top soil is the first horizon where plant roots can easily penetrate, and generally corresponds to the plowed layer. The classes are grouped according to the thickness of top soils as follows (when effective depth of soil (d) is placed to class IV, this factor also is placed to class IV):

1/: factors for upland crops only

t (cm)	Class			
	Paddy	Upland	Orchard	Glassland
25	I	I	I	I
25 - 15	I	II	I	I
15	II	III	III	II

(2) Effective depth of soil (code: d)

Effective depth of soil is the depth upto bedrock, hard pan and gravel layer which plant roots can not penetrate. The classes are grouped according to thickness of the effective soil depth as follows:

d (cm)	Class			
	Paddy	Upalnd	Orchard	Glassland
100	I	I	I	I
100 - 50	I	II	II	I
50 - 25	II	III	III	I - II
25 - 15	III	III	IV	II - III
15	IV	IV	IV	III - IV

(3) Gravel content in top soil (code: g)

Gravel contents in top soil are expressed by the percentage of the exposed surface area of gravel on the soil profile, and graded into the following classes:

g (%)	Class			
	Paddy	Upland	Orchard	Glassland
5	I	I	I	I
5 - 10	I	II	I	I
10 - 20	I	II - III	I - II	II
20 - 50	I - II	III - IV	II - III	III - IV
50	IV	IV	IV	IV

(4) Easiness of plowing (code: p)

Easiness of plowing largely depends upon the quantity and quality of clay and organic matter and moisture condition. In order to estimate the class of this factor, the following 4 sub-factors are used:

a. Soil texture of top soil: 3 grades, coarse to very fine.

b. Stickness of top soil: 3 grades, non stiky to very stiky.

c. Consistence when dry: 3 grades, loose to very hard.

d. Moisture condition: 4 grades, dry (2), moderate 1 to wet 3.

These sub-factors are combined together to determine capability classes as follows:

Sub-factors				Class	Criteria
a	b	c	d		
1	1	(2)	1	I	Easy to slightly
2	2	2	1	I	difficult
2	2	2	2	I	
2	2	3	2	II	Moderately difficult
3	3	3	1	II	
2	2	3	3	III	Very difficult
3	3	3	2	III	

(5) Permeability under submerged condition (code: 1)

This factor affects irrigation water requirement, soil temperature, and leaching of the nutrients or development of reduced condition of the soil. This standard factor is evaluated mainly by the combination of soil texture and the presence of compact layer within 50 cm of the surface, as sub-factors.

a. Soil texture: 3 grades, very fine to coarse

b. Compactness: 3 grades, compact to loose

Sub-factors		Class	Criteria
a	b	Paddy	
1	1	I	Poorly to imperfectly
1	2	I	permeable
2	2	II	Moderately to well
3	2	II	permeable
3	3	III	Well to excessively permeable

(6) State of redox potentiality (code: r)

This factor indicates the risk of root damage owing the strong reduction of soil, resulting in low rice production. The following sub-factors are used for the evaluation of this factor.

a. Contents of easily decomposable organic matter in top soil: 3 grades, low to high

b. Contents of free iron oxides in top soil: 3 grades, high to low.

c. Degree of gleyzation: 3 grades, weak to strong.

Sub-factors a	b	c	Class	Criteria (Risk of root damage)
1	1	2	I	
1	3	2	I	None to weak
2	1	2	I	
1	1-2	3	II	
1	3	3	II	Moderate to strong
2	1-2	3	II	
3	1	2	II	
2	3	3	III	
3	2	2	III	Very strong
3	1	3	III	
3	3	2	III	

(7) Wetness of land (code: w; wet condition, (w); dry condition)

This factor is only applied to upland, orchard, and grassland. This factor is used for the estimation of wet or drought injury of upland crops, trees and grasses, and is evaluated by the combination of the following three sub-factors:

a. Permeability: 3 grades high to low

b. Water-holding capacity: 3 grades, high to low.

c. Moisture condition: 4 grades, dry (2) to wet (3).

Sub-factors a	b	c	Class	Criteria (Risk of drought or wetness)
1	3	(2)	(IV)	High possibility of drought
1	3	1	(III)	Possibility of drought
1	2	1	(II)	Low possibility of drought
1	1	1	I	None
2	2	2	II	Low possibility of overwetness
1-3	1	3	III	Possibility of overwetness
3	2	3	IV	High possibility of overwetness

(8) Inherent fertility (code: f)

Inherent fertility is evaluated by the combination of the following three sub-factors.

a. Nutrient holding capacity (evaluated by CEC): 3 grades, high to low.

b. Nutrient fixation power (evaluated by coefficient of P2O5 absorption): 4 grades, very low to high.

c. Base status in soil (evaluated by base saturation degree: 3 grades, good to poor.

Sub-factors			Class	Criteria
a	b	c		
			For paddy	
1	1-2	2	I	Fertile
2	1-2	1	I	
1	1-2	3	II	
1	3-4	2	II	Medium
2	1-2	2	II	
3	1	2	II	
2	3-4	3	III	
3	2	2	III	Infertile
3	3-4	3	III	
			For upland, orchard and grassland	
1	2	1	I	Fertile
2	1	2	I	
1	2	3	II	
2	1	3	II	Medium
1	3	1	II	
1	3	2	II	
1	3	3	III	
3	1	1	III	Infertile
2	4	2	II - III	

(9) Content of available nutrients (code: n)

Content of available nutrients in soil are closely related to the inherent soil fertility, and are evidently influenced by cultivation practices. The value of the class is evaluated by the combination of the following sub-factors:

a. Content of exchangeable Ca: 3 grades, high to low.

b. Content of exchangeable Mg: 3 grades, high to low.

c. Content of available K: 3 grades, high to low.

d. Content of available phosphate: 3 grades, high to low.

e. Content of available nitrogen: 3 grades, high to low.

f. Content of avaialable silica: 3 grades, high to low.

g. Content of micro-elements (evaluated by the risk of deficiency): 3 grades, none and/or weak to serious.

h. Acidity (evaluated by pH and ex. acidity): 3 grades for paddy, 4 grades for upland and orchard, weak to very strong.

Class	Criteria
I	High
II	Medium
III	Low

(10) Degree of hazard (code: i)

This factor means limitation caused by the presence in excess of substances such as sulphur compounds, soluble salts, heavy metals, etc. Dependent sub-factors for this factor are as follows:

a. Presence of harmful substances:

1) Harmful sulphur compounds: 4 grades, none to seriously.

2) Salts content (evaluated by chlorine content as an indicator): 3 grades, low to high.

3) Heavy metals: 4 grades, none to seriously.

4) Irrigation water quality: 4 grades, good to polluted.

b. Physical hazard: Precence of bedrock, pan, compact layer or gravel layer that disturb root development within 50 cm of the surface, and difficulty of their removal: 3 grades, none to very difficult.

The class of this factor is decided by the lowest grade among the dependent sub-factors.

Class	Criteria
I	None
II	Slightly
III	Moderately
IV	Seriously

(11) Frequency of hazard (code: a)

This factor is mainly influenced by natural environmental condition. The class of this factor is determined by the combination of the following two dependent sub-factors:

a. Risk of overhead flooding inundation: 3 grades, non and/or rarely to frequently.

b. Risk of land creep: 3 grades, none and/or rarely to frequently.

The class of this factor is determined by the lowest grade of two dependent sub-factors.

Class	Criteria
I	None to rarely
II	Moderately
III	Frequently

(12) Slope (code: s)

This factor is applied to upland and orchard only. The class of this factor is decided by the combination of the following sub-factors:

a. Natural slope as a main dependent sub-factors: 5 grades as shown in the following table.

b. Direction of slope.

c. Artificial slope.

Steepness of Slope (^{o})	Class	
	Upland	Orchard
3	I	I
3 - 18	II	I - III
8 - 15	III	I - III
15 - 25	IV	II - III
25	IV	IV

(13) Erosion (code: e)

The class of this factor is determined by the combination of the following sub-factors:

a. Occurrence of rill or gully: 4 grades, none to frequently.

b. Resisting power to water erosion: 3 grades, strong to weak.

c. Resisting power to wind erosion: 2 grades, strong or weak.

Class	Criteria
I	None or very slightly
II	Slightly
III	Seriously
IV	Very seriously

1.4.3 Land Capability

The land is evaluated by using the assessment factors mentioned above. The land capability class is determined at the lowest class of the factors, as shown in the following example.

code :	t	d	g	p	l	r	f	n	i	q
class:	I	I	I	II332	III3	II213	III2	III112222	III	III

Land Capability Class: II pln

The land capability class is generally expressed with the code(s) of factors which lower the capability class.

Based on the specifications of the Japanese land capability classification system, the lands in the project area are classified into 4 classes as shown below:

Soil Unit	Land capability		Area (ha)	Propotional extent (%)
Eutric Fluvisols (Je)	I		3,630	18.2
Pellic Vertisols (Vp)	II	pn	3,880	19.4
	III	dg	1,850	9.3
Eutric Gleysols (Ge)	II	gr	370	1.8
Calcalic Luvisols (Lk)	III	te	2,990	14.9
Eutric Regosols (Re)	III	l	2,480	12.4
Rendzinas (E)	IV	dg	530	2.6
Lithosols (I)	IV	di	4,270	21.4
Total			20,000	100.0

The land capability map is shown in Fig. 1.4.1.

Table 1.2.1 Results of Soil Analysis

Sample No.	pH		Total Carbon	Total Nitrogen	Available Phosphate	Cation Exchange Capacity	Exchangeable Base				Free Iron	Soil Particle Size Distribution			
	H_2O	KCl					Ca	Mg	Na	K		Clay	Silt	Sand	Gravel
			(%)	(%)	(ppm)	(meq/100g)	(%)	(%)	(ppm)	(ppm)	(%)	(%)	(%)	(%)	(%)
1/1	7.2	6.7	0.70	0.22	17.81	22.77	1.16	0.99	75.28	307.57	0.87	34.96	56.53	5.67	1.63
1/2	7.3	6.2	0.59	0.16	17.53	20.83	1.15	1.57	74.36	400.0	1.13	44.06	41.44	7.13	3.85
2/1	6.6	5.8	0.71	0.08	62.33	34.48	0.62	0.55	44.04	486.72	1.94	39.96	28.07	8.44	9.52
2/3	7.1	5.7	-	0.05	8.76	29.91	0.62	0.84	59.08	310.19	2.07	31.07	19.02	12.38	37.17
3/1	7.2	6.5	0.48	0.31	8.66	21.56	1.41	0.81	58.76	105.76	1.35	37.51	39.23	18.52	1.16
3/2	7.7	7.1	0.32	0.07	8.77	17.84	0.82	0.67	44.98	236.15	0.82	24.05	35.24	18.82	20.55
3/3	7.8	6.6	0.30	0.07	17.53	11.07	0.93	0.80	60.75	256.49	1.37	27.54	38.69	22.78	9.53
3/4	7.9	7.1	0.24	0.04	8.77	5.89	0.57	0.68	70.92	56.73	1.21	14.62	64.24	10.78	4.72
4/1	7.2	6.7	1.55	0.19	8.80	13.22	0.64	0.77	57.01	128.30	0.18	11.94	17.51	29.06	40.43
4/2	6.9	6.4	0.17	0.06	8.78	30.97	1.33	1.41	71.87	311.42	0.78	24.46	24.16	14.18	34.84
4/4	6.9	6.6	-	0.05	8.76	20.74	1.33	1.02	56.67	207.79	1.76	37.94	27.54	17.07	15.25
5/1	7.2	6.2	0.47	0.06	71.34	29.86	0.63	0.80	61.57	718.33	1.64	10.39	27.87	51.68	-
5/2	7.2	6.3	0.31	0.06	51.62	26.79	0.56	0.69	56.77	573.88	1.62	9.18	30.21	45.68	0.19
5/3	7.8	6.6	-	0.02	26.28	18.00	0.46	0.62	70.06	510.43	1.39	7.42	14.92	74.74	-
5/4	7.6	6.0	0.25	0.03	26.27	18.86	0.45	0.73	68.24	568.64	1.14	35.11	53.61	3.01	2.67
6/1	6.0	5.8	-	0.14	8.93	39.05	0.70	1.66	57.76	327.29	1.86	48.85	33.70	15.02	0.82
6/2	6.7	6.4	-	0.06	8.77	21.53	0.95	1.98	60.76	328.12	0.64	45.15	15.52	15.76	23.31
6/3	7.7	7.1	0.05	0.03	8.78	11.62	0.65	1.79	78.36	606.67	0.60	24.77	65.78	4.55	-
11/1	7.3	6.5	0.17	0.09	8.77	34.15	0.68	1.57	8.15	657.30	1.61	47.42	46.17	2.11	0.79
11/2	7.2	6.6	0.26	0.07	29.50	38.43	0.61	0.84	108.84	649.80	1.21	8.97	41.74	47.18	-
11/3	7.4	6.2	0.43	0.14	52.60	12.41	1.07	0.55	63.12	564.40	1.72	50.28	30.70	8.87	8.23
12/1	6.5	6.2	0.03	0.10	8.93	62.37	1.27	1.89	57.09	418.65	1.21	61.49	34.83	0.55	0.26
12/2	6.5	6.2	0.10	0.08	35.04	58.45	1.21	2.10	36.10	234.68	1.39	67.47	28.08	0.44	-
14/1	6.9	5.5	0.36	0.14	53.73	16.07	0.58	1.56	56.62	245.37	1.76	39.21	41.36	9.75	2.94
14/2	7.3	6.1	0.03	0.08	26.31	27.28	0.82	1.07	82.22	356.28	1.00	24.14	17.77	17.27	39.81
14/3	7.5	6.7	-	0.07	17.51	14.03	0.91	1.10	60.59	282.74	0.75	24.10	13.0	10.4	53.2
14/4	7.7	6.3	0.10	0.06	17.51	22.01	0.95	1.54	51.45	520.97	0.36	26.40	15.7	13.9	41.6
15/1	5.4	5.2	0.47	0.14	8.96	38.48	0.55	1.46	34.45	340.29	1.03	77.90	14.2	2.07	0.97
15/2	7.6	5.3	-	0.12	17.53	13.90	0.37	0.92	40.69	820.24	4.50	79.30	14.4	1.86	0.79
15/3	6.9	5.5	0.27	0.10	8.77	24.51	0.39	0.69	35.68	220.36	2.71	79.14	13.61	3.95	1.66
18/1	7.3	5.6	0.25	0.04	8.77	52.17	0.97	2.49	96.99	328.28	1.50	28.5	62.0	4.00	0.21
26/1	7.3	5.6	-	0.14	8.78	37.49	0.52	1.35	65.83	541.25	3.58	59.2	36.2	2.41	-
26/2	6.9	5.9	0.10	0.06	26.28	39.45	0.64	0.85	34.22	230.96	2.67	62.6	34.3	0.62	-
26/3	7.3	5.3	0.07	0.07	8.77	59.08	0.64	1.18	38.14	209.75	3.18	62.0	31.8	1.35	0.18

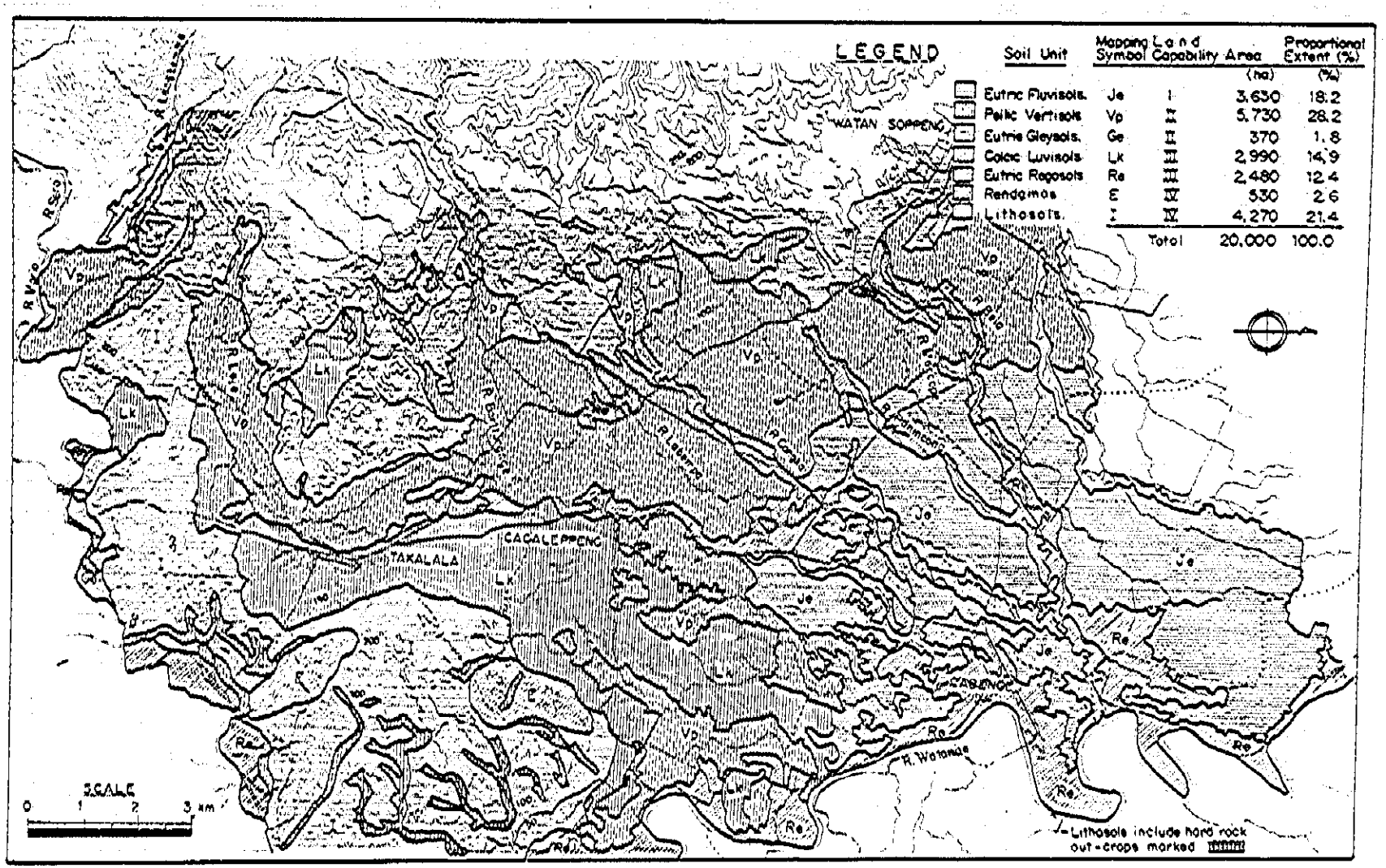

Fig. 1.1.1 SOIL MAP

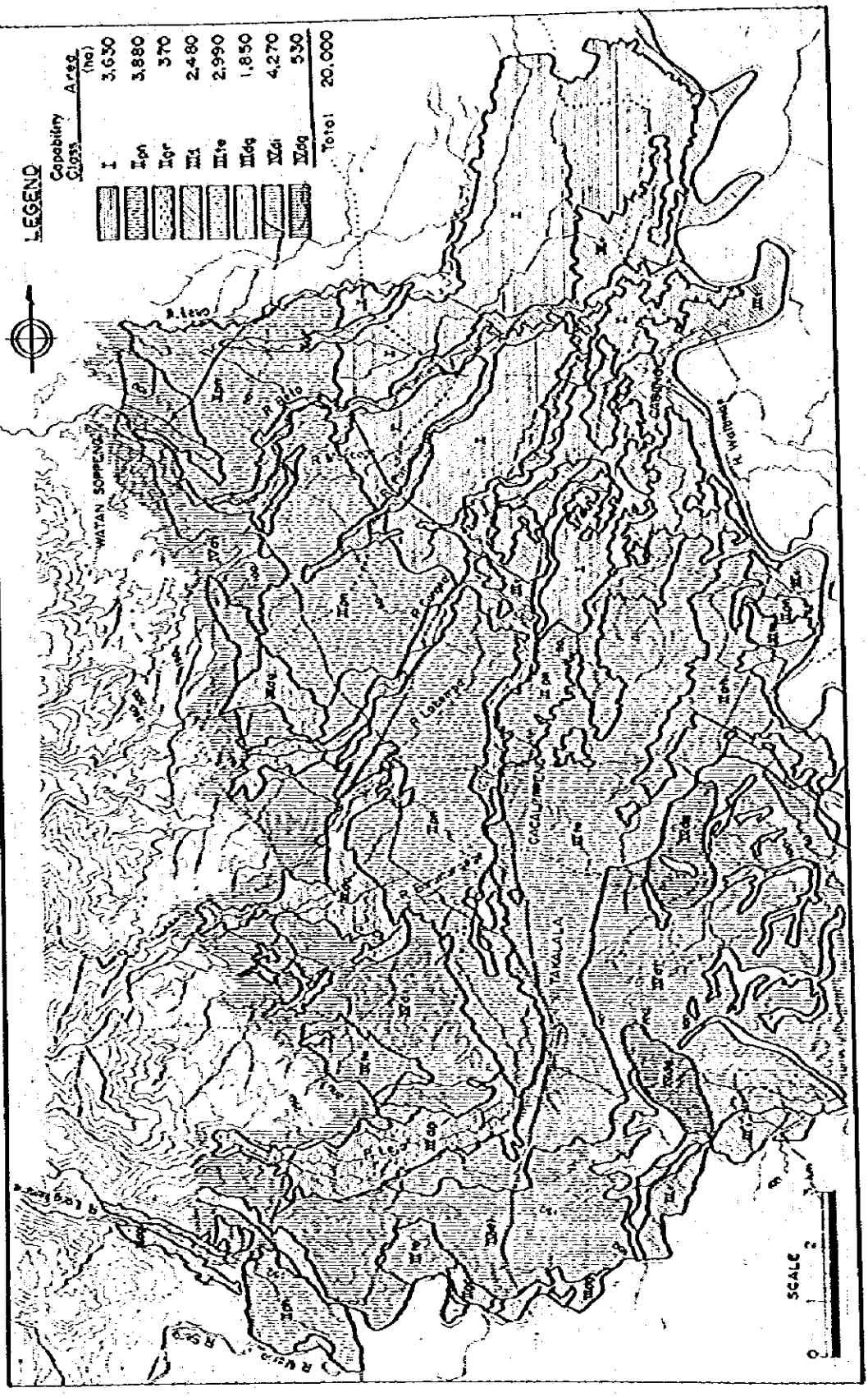

Fig. 1.4.1 LAND CAPABILITY MAP

CHAPTER II AGRICULTURE AND AGRICULTURAL ECONOMY

CHAPTER II AGRICULTURE AND AGRICULTURAL ECONOMY

2.1 GENERAL

The present studies of agriculture and agricultural economy in the project area were mainly designed for the purpose to measure the possible differences in agricultural production between conditions with and without the Langkemme irrigation project and to estimate the repayment capacity of the project-benefited farmers.

The main objectives of these studies are:

(1) to study the present status of agricultural production and rural economy in the project area,

(2) to find the optimum cropping patterns in the area and evaluate the development potential in agricultural production,

(3) to estimate the improvement of agricultural outputs and farmer's economy under the with-project condition, and

(4) to measure the irrigation benefits derived from the project and repayment capacity of the benefited farmers, and of the social economic institutions.

In order to clarify the prevailing agricultural conditions and the development potential, the following field investigation and data collection have been made in and around the project area:

(1) present land use survey using aerial photographs and topographic maps scaled 1/25,000,

(2) collection of data and information on present agricultural production including crop being grown, present cropping pattern, crop yield and production, farming practices, etc.,

(3) yield survey on wet season paddy at representative paddy fields,

(4) data collection on current market flows and prices of agricultural commodities,

(5) farm economy survey for collecting more practical information on farming practices, farm inputs and farming expenses, and

(6) collection of data on existing agricultural support systems including agricultural extension, BIMAS/INMAS programme, research, credit, farm inputs supplies and farmers' cooperatives.

The data and information are mainly obtained from the government authorities concerned such as various departments of Provincial Ministry of Agriculture, agriculture office in Kab. Soppeng, Central Research Institute of Agriculture (CRIA), Bogor, South Sulawesi Branch

Research Station of CRIA in Maros, Soil Research Institute in Bogor, BAPPEDA office, IPEDA office, DOLOG office, Indonesia People's Bank (BRI) of South Sulawesi Province and their branch offices in Kab. Soppeng, and Bupati office, Census and Statistics office, Rural Extension Centers of Kab. Soppeng. The data and information collected during the survey period are listed in Table 2.1.1.

In parallel with such data collection, an extensive field investigation was made over about 8,000 ha of the study area and on the basis of the overall results of field investigation and preliminary results of data analysis, the farmer's interview were made on 48 representative farm house holds so as to confirm the data and information mentioned above and also to obtain more practical and realiable information on farm economy. In addition to these activities, yield diagnosis survey for wet season paddy was also carried out for the purpose to identify the defects hampering increase of unit yield of paddy under present condition.

2.2 PRESENT CONDITION OF AGRICULTURE

2.2.1 Location

The project area is located at about 130 km northeast along the provincial road remote from Ujung Pandang, the capital of South Sulawesi Province. It extends due southward of Watan Soppeng, the capital of the District (Kabupaten) Soppeng and is approximately bounded by the provincial road from Takalala to Sengkang on the east, the Lawo river on the north and the Mario river on the south. The western boundary is skirted along the foot of hilly ranges extending westward. The total net irrigable area is delineated to be 6,400 ha, out of the total gross area of about 8,000 ha.

Administratively, the area comes under four (4) sub-districts (Kecamatan) of the Kabupaten Soppeng, viz. Lalabata, Liliriaja, Marioriwawo and Lilirilau, and covers thirteen (13) village (Desa) and thirty one (31) hamlets (Kampung). The administrative divisions are illustrated in Fig. 2.2.1.

2.2.2 Human Resources

The population in the project area is estimated at about 89,000, as of 1979, on the basis of data collected from the Bupati Office. The population growth rate is also estimated at about 1.0% per annum, according to the same data from 1972 to 1979 (see Table 2.2.1). The total working population is about 42,000 which corresponds to 47.2% of the total population, out of which about 25,700 inhabitants are engaged in agriculture.

The total number of household is about 16,100. The average size of family is 5.53 persons per household. The farm household accounts for about 80% of the total number of households. The details of demographic feature in the project area are given in Table 2.2.2. The population structure by age groups is illustrated in Fig. 2.2.2.

The demographic features in the project area are characterized by low rate of population growth and high rate of female population. The population in the South Sulawesi has increased at an annual rate of 2.1% during the recent decade. The annual growth rate of 1.0% in the project area is very low as compared with the provincial average. The rate of male population to the total population is 48.8% in the project area. In the age group of 20 to 49 years, this rate shows only 45.3%. These facts seem to indicate that there is a considerable population outflow from the project area and most of them are working outside of the area. This presumption has been evidenced by the farm economy survey; the farmers in the project area supplement their livelihood with some off-farm incomes because of insufficient crop income.

2.2.3 Land Resources

The results of soil survey carried out over the study area inclusive of the surrounding areas, show that about 9,700 ha of arable lands suitable for paddy cultivation extend over the study area.

The soil of these lands are Eutric Fluvisols, Pellic Vertisols and Eutric Gleysols. Most of these lands are presently under rice cultivation. In addition, about 3,000 ha of upland fields occupy the south-eastern parts of the study area. The soils of the upland area are Calcalic Luvisols developed on coral limestones, and are not suitable for rice cultivation due to undulating topography, shallow soil depth, stoniness and limited water availability. These lands are presently used for cultivation of upland crops. Regosols, young sandy soils, extend along the Walanae river and its tributaries. The total area of these soils is about 2,500 ha. Most of these lands are under cultivation of tobacco and groundnuts. The total arable lands in and around the study area are thus estimated at approximately 15,000 ha, of which the land suitable for rice cultivation is only 9,700 ha.

The lands in the surrounding areas are generally covered with Lithosols which are not suitable for agricultural production. These lands are presently covered with low productive forests and bushes. In recent years, however, some parts of the forests and bushes have been gradually reclaimed for shifting cultivation of upland crops, resulting from the limited availability of arable land and large number of farm population. Further extensive development of this lands, however, surely cause serious erosion problems. In view of soil and land conservatin, the development of these non-productive lands should be limited and the maximum use of existing arable land should first be envisage.

2.2.4 Present Land Use

The present land use survey was carried out on the basis of aerial photographs and topographic maps scaled 1/25,000. The lands in the study area are classified into five (5) land use categories, comprising paddy field, upland field, orchard, forest and bush, village land and

others. The present land use map is shown in Fig. 2.2.3. The present land use in the study area are summarized as shown below:

Land use category	Area (ha)	Propotional extent (%)
Paddy field	7,800	39
Upland field	4,700	23
Orchard	750	4
Forest/bush land	5,800	29
Village/others	950	5
Total	20,000	100

The farmland comprising paddy field, upland field and orchard amounts to about 13,250 ha or 66% of the total study area (see Table 2.2.3). Paddy field occupies about 7,800 ha or 38% of total area. It has been mainly developed in the northern part of the survey area where topographic condition is relatively flat.

The main crop grown in the project area is paddy, followed by polowijo crops such as maize, groundnuts, greenbeans and soybeans. Other crops grown as an adjunct to rice farming are banana, coconuts, cassava, tobacco, clove, pepper, kapok, etc. They are generally grown in the upland areas of 4,700 ha, located in the southeastern and the western parts of the study area. Most of the areas extend on the hilly land on limestones and are topographically sharply undulating. These uplands are mainly covered with forests and bushs at present, and are topographically not irrigable. Some upland area are also found on the alluvial terrace near the Walanae river and along the streams in the study area, and presently used for cultivation of tobacco and groundnuts. Most of the orchard are sporadically located around the village areas.

In due consideration of the possibility of irrigation development, the existing paddy fields of 6,400 ha have been delineated for the project. Most of the selected paddy fields are already well developed, compared with those in other areas, and are presently served by three types of irrigation system, i.e.;

a.	Desa non-technical area	2,900 ha
b.	Desa semi-technical area	1,400 ha
c.	D.P.U. semi-technical area	2,100 ha
	Total	6,400 ha

2.2.5 Cropping Patterns

The paddy cultivation is concentrated in the wet season and is limiteed in the dry season. The cultivation pattern is generally affected by seasonal distribution of rainfall. The areas harvested and/or planted fluctuate year by year, depending on the available water. The wet season paddy (1st paddy) is planted at the onset of the monsoon, generally in April and May, and harvested in August and September. The dry season paddy (2nd paddy) is planted during the period from November to January and harvested from February to April. Such prolonged planting period for the dry season paddy is attributable to the shortage of available irrigation water.

The average harvested area of paddy, from 1975 to 1979, is 6,138 ha for wet season paddy and 4,153 ha for dry season paddy as shown in Table 2.2.4. These figures correspond to 96% and 65% of the total paddy field, respectively. It is considered that the paddy fields unused are basically due to shortage of available irrigation water. The polowijo crops are generally planted after harvest of wet season paddy. The planted area of polowijo crops is, however, quite limited to only 350 ha or 5% of the total paddy field. This low percentage of planting is also due to shortage of available water. Thus, the present multi-cropping intensity is estimated at 166% on an average.

The extensive agricultural survey has been made in the project area and it has been found that on account of differences in the degree of irrigation, the crop rotation patterns adopted in the project area can be classified into five major types. They are:

Patterns	Cropping intensity (%)	Area (ha)
I. Paddy - paddy - paddy (3 crops a year)	260 - 300	70
II. Paddy - paddy (High cropping intensity)	180 - 200	2,080
III. Paddy - paddy (Low cropping intensity)	130 - 180	3,370
IV. Paddy - polowijo - paddy (3 crops a year)	260 - 300	140
V. Paddy - polowijo crops (2 crops a year)	100 - 120	740
Total	166 (ave.)	6,400

The pattern I is found in the D.P.U. semi-technical irrigation area (Lalange area) where the irrigation water is sufficiently available throughout the year. The pattern IV is practiced mainly in the upstream areas commanded by Desa irrigation system. In these areas, dependable water sources are small streams and therefore available water for irrigation is extreamly decreased in the dry season. Due to limited availability of dry season water, very limited areas mainly in upstream areas can be planted with polowijo crops in the dry season. Pattern II is double cropping of paddy under sufficiently irrigated condition. The cropping intensity is 180 - 200%. Pattern II is same as pattern II, but cropping intensity is lower due to limited availability of irrigation water in the dry season. Pattern IV is found in lower parts of existing irrigation schemes where irrigation water is not available. These cropping patterns are illustrated in Fig. 2.2.4.

The areas under these present cropping patterns are summarized in Table 2.2.5 and are also illustrated on Fig. 2.2.5.

2.2.6 Farming Practices and Farm Inputs

Paddy is the most important crop in the project area. The paddy cultivation is carried out by labour intensive form from the stage of seeding to harvesting. All members of family contribute their labour to the paddy cultivation. Animal power, mainly buffaloes and oxen, is extensively utilized for land preparation. The use of mechanical equipment is not common, except for spraying of agro-chemicals.

In the project area, improved high yielding verieties have been widely spread over through the extension of BIMAS programme and occupied about 82% of the total paddy fields for the dry season paddy and 67% for wet season paddy as shown in Table 2.2.6. The local varieties are still used mainly for home consumption and local marketing.

High yielding varieties such as IR-26, IR-30, IR-36, C4-63, etc. have been introduced to the Kab. Soppeng area in the recent years as shown in Table 2.2.7 and 2.2.8. The most predominant variety is IR-36, the early matured high yielding variety, which was introduced in 1977 and has been widely spread over the area. The introduction of this variety enables the farmers to grow paddy twice in the limited period of wet season (about 7 months). Furthermore, it enables the introduction of triple cropping pattern in the project area, provided irrigation water is available.

Paddy seed is selected from last harvested or is provided through the seed center. Paddy seed is generally sown at rate of 25 to 30 kg per ha in the nursery which is prepared in the size of about 1/20 to 1/25 of the paddy field to be transplanted. The seedlings are generally grown for 20 to 25 days.

The field preparation, ploughing and harrowing, is made before transplanting by using animal power. Puddling is also carried out immediately after irrigation water become available. Transplanting is generally carried out by hand. Mutual exchange of labour among the farmers group is common for transplanting. The space of transplanting varies from 20 cm x 20 cm to 30 cm x 30 cm. After transplanting, weeding is practiced twice or three times by hand for each cropping season.

The fertilizers and agro-chemicals are widely used under the BIMAS programme. The farmers are very much aware of effects of these inputs and of proper application methods. The fertilizers being used in the project area are urea and triple super phosphate (TSP). The average dosages are 100 kg/ha of urea and 50 kg/ha of TSP for semi-technical area. Potasium fertilizers are not generally applied. Use of insecticides and rodenticides is common. Major insecticides are Diazinon and Sumithion. They are applied to the field by use of knapsack type sprayers. Zinc phosphate is widely used as rodenticide. Fungicides, Kasumin and Furadin are recently introduced to the area for the prevention of blast disease.

Harvesting is generally practiced in two methods depending on the varieties. One is the cutting all straws using sickles for high-yielding varieties. The other method is the traditional method for local varieties, so-called "ani-ani" cutting only the penicles.

As for polowijo crops, cultivation method is very primitive. Neither fertilizers nor improved varieties are used. Unit yields of polowijo crops are generally low. The farm input and labour requirements for cultivations of paddy and polowijo crops under present condition are estimated on the basis of farm economy survey and as shown in Table 2.2.9 and 2.2.10.

2.2.7 Crop Yield and Production

Yield and production of major crops under present condition in the project area are estimated on the basis of production data obtained from agriculture offices in 4 Kecamatan. The yields and production largely fluctuate year by year due to wide variation of annual rainfall and unexpected damages caused by insects and diseases. The present crop yields and production are therefore estimated at the averaged from 1975 to 1979 (see Table 2.2.4 and 2.2.11).

The averaged unit yield of paddy (dry stalk paddy) is 4.60 tons/ha for wet season paddy and 4.75 tons/ha for dry season paddy. The results of paddy yield survey carried out by the Team in August/September, 1980 (wet season paddy) are given in Table 2.2.12. In the yield survey, 22 paddy fields were selected at random for sampling, and laboratory analysis of 22 samples are made for determination of yield components. The results of yield survey carried out by the Master Plan Team in March/April, 1978 (dry season paddy) are also given in Table 2.2.13.

There is a clear correlation between unit yield and number of grains per m^2 for dry season paddy. While, there is no clear correlation, for the wet season paddy. Only percentage of ripened grains is generally low (see Fig. 2.2.6 and Fig. 2.2.7).

The present paddy yields in the project area are not very low. Nevertheless, it is considered from the results of yield survey that the present unit yields still remain at low level by following unfavourable condition:

for wet season paddy

a. insufficient irrigation water in volume throughout the growth period,

b. improper water control at individual farm, especially at the panicle formation stage,

c. damages caused by insects and disease, especially blast diseases, and

d. realtively heavy application of fertilizers in early stage of growth (over-growth of panicles).

for dry season paddy

a. insufficient irrigation water, especially during early stage of growth,

b. improper water control at individual farm,

c. low level of farm inputs application, and

d. Insect damages, especially stem borers.

The unit yields and production of polowijo crops also fluctuate year by year and place by place, depending on availability of water. Since no farm inputs like fertilizers and agro chemicals are used, unit yields are generally low. Table 2.2.14 shows planted areas, unit yields and annual production of polowijo crops in past 5 years. The average unit yields of polowijo crops are 0.79 ton/ha of maize, 0.81 ton/ha of groundnuts, 0.83 ton/ha greenbeans and 0.67 ton/ha of soybeans.

The average annual production of paddy and polowijo crops in the project area is summarized as shown below:

Crops	Planted area (ha)	Unit yield (ton/ha)	Production (tons)
Wet season paddy	6,138	4.60	28,280
Dry season paddy	4,153	4.75	19,770
(Total)	(10,291)	(4.66)	(48,050)
Polowijo crops			
- Maize	329	0.79	260
- Groundnuts	12	0.81	10
- Greenbeans	7	0.83	6
- Soybeans	2	0.67	1
(Total)	(350)	(-)	(-)

2.2.8 Livestock Production

Livestock raising is not a mainline of agricultural activities in the project area. Most of livestocks are grazed on a small scale in and around the paddy fields. The number of livestock animals in and around the project area are summarized as follows:

Livestock	Total number (head)	Per farm household (head)
Horse	6,179	0.48
Cow	16,916	1.32
Buffalo	264	0.02
Goat	3,544	0.03
Fowl	146,009	11.36
Duck	39,021	3.04

Source: Livestock Services Office, Kab. Soppeng, 1980

The livestock plays an important role in farm operation and transportation as motive power, and also in protein food supplies. Annual income from livestock is, however, of little significance to the project as well as farm economy. It can be excluded from project economy.

2.2.9 Processing and Marketing

Rice is the main marketing farm product in the project area. The annual marketed amount of rice is estimated at about 37,000 tons. There are three channels of rice marketing in the project area, as shown in Fig. 2.2.8. The surplus of paddy produced by the farmers is generally sold to KUD and/or middle men through brokers. The paddy collected by KUD is sold to DOLOG after milling, while the paddy collected by middle men is generally transported to outside of project area, especially to Ujung Pandang and Pare-Pare. About 80% of surplus

paddy is marketed through these two channels. The remaining 20% of the surplus paddy is sold at local markets in and around the project area by small brokers and/or directly by farmers.

The price of rice is generally controled by the Government through DOLOG. In 1980/81, the floor price of milled rice is set at Rp.175/kg and the ceiling price at Rp.190/kg. When the market price is down under the floor price, DOLOG purchases the marketed rice and when the price is over the ceiling price, DOLOG sells its stock.

There exist about 370 rice mills in and around the project area as shown in Table 2.2.15. Most of these rice mills are privately owned. The average standard capacity of these rice mills is about 1.09 ton per hour but actually 0.65 ton per hour. The annual working days are estimated at 122 days on an average. The total amount of paddy processed in and around the project area is about 28,000 tons per annum. In general, most of existing milling facilities are of one-pass system (simultaneous husking and whitening) and produce a lot of broken rice.

2.2.10 Present Agricultural Production Values

The studies on the present farm economy are made on basis of the data and informations obtained from the agriculture office, Kab. Soppeng, and the results of farm interview.

The gross production value under present condition is estimated at Rp.4,586 million (US$7.3 million) as shown below:

Crops	Annual production (tons)	Unit price (Rp/kg)	Production value (10^6 Rp)
Wet Season Paddy	28,280	95	2,687
Dry Season Paddy	19,770	95	1,878
(Total)	(48,050)	95	(4,565)
Polowijo Crops			
- Maize	260	60	16
- Groundnuts	10	300	4
- Greenbeans	6	250	1
- Soybeans	1	250	-
Total	-	-	4,586

The farming expenses are varied by kind of crops and degree of irrigation. The detailed estimates of present unit farming expenses per ha given in Table 2.2.16 (paddy) and Table 2.2.17 (polowijo crops). The crop production cost under present condition totals Rp.1,243 million (US$2.0 million) for 6,400 ha of paddy field as summarized below:

Crops	Planted area (ha)	Unit production cost (Rp/ha)	Total production cost (10^6 Rp)
Wet Season paddy			
- Semi-technical area	3,320	127,000	422
- Non-technical area	2,818	105,000	296
Dry Season paddy			
- Semi-technical area	2,225	134,000	298
- Non-technical area	1,928	113,000	218
Polowijo Crops			
- Maize	329	23,000	8
- Groundnuts	12	79,000	1
- Greenbeans	7	56,000	-
- Soybeans	2	56,000	-
Total	-	-	1,243

The annual net production value under present condition is then calculated at Rp.3,343 million (US$5.3 million) in total, by deducting the total production costs from the total gross production value.

2.2.11 Land Tenure and Land Holding

The size of farms in the South Sulawesi, as measured by the cultivated area per farm household, is generally small because of the limited availability of arable land and large number of farm population. According to the agricultural cencus taken in 1973, the average size of farms is about 1.74 ha of which 1.13 ha is paddy field.

In the project area, the size of farms average 1.03 ha, out of which paddy field accounts for 0.61 ha. This average size is smaller by 0.71 ha as compared with that of the whole province. According to the IPEDA office of Kab. Soppeng, about 65% of total farmers is owner farmers and partially owner farmers. Tenant farmers account for about 35%. Tenant systems are complicated but most of them are of share cropping. Tenant charge is generally about 50% of total products.

Studies on the frequency distribution of the size of farms indicate that farmers with farm land less than 0.5 ha constitute about 40% of the total number of farmers in the project area, as shown in Table 2.2.18. As the crop incomes of these peasant farmers are not abundant and insufficient to maintain the livelihhod of farmers, most of these farmers are engaged in various sideline business.

2.2.12 Farm Economy

At present, the average size farmer in the project area cultivates 1.03 ha of farm land comprising 0.61 ha of paddy field and 0.42 ha of upland field, out of which only 0.50 ha of paddy field are within the project area.

Farmers in the project area get their income mainly from farming activities particularly the paddy production, partly supplemented by sale of polowijo crops. As animal husbandary is not a mainline of agriculture in the project area and the income from the sale of livestock is very limited.

Total annual gross farm income is estimated at Rp.445,500 for the average size farmer. The farming expenses are estimated at about Rp. 86,600 on the average size farm. Accordingly, net farm income is estimated at Rp. 358,900. The farm investments on livestock and farm equipment are not generally large in the project area.

Total family living expenses is estimated at Rp.358,000 for the average size family of 5.53 persons. The food expenses are most important, amounting about 58% of the total living expenses.

The net reserve of the average size farmer is generally negligible small as shown in Table 2.2.19. This indicates that in spite of the relatively high agricultural production in the project area, the farm economy present average size farmer is on the subsistance level.

2.2.13 Present Water Charge

Farmers are required to make two different kinds of payment for their irrigation water. One is the payment to "Ulu-Ulu" (water distributor) for daily operation and maintenance. It is generally paid in kind, and on an average, it amounts to about 1% of crop production. The other is the "Special desa tax" for amortization of capital expenditures. It varies desa by desa, reflecting the difference of the capital investments, but on an average, about Rp.2,000 of the desa tax are lived on member farmers for every cropping.

In addition, there is a traditional custom called "Gotong Royong" in which all the member farmers have to contribute their labour for betterment of irrigation facilities. According to the results of farm interview, every farmer spends about five days annually for this "Gotong Royong".

The annual charges of irrigation water paid by farmer are then estimated at about Rp.15,000 per ha or in total 2.1% of annual crop income per ha.

2.3 AGRICULTURAL SUPPORT SYSTEM

2.3.1 General

The South Sulawesi Province, one of 27 Provinces in whole Indonesia, is administratively divided into 21 Kabupaten (Districts) and 2 Kota Madya (Municipalities), headed by "Bupati" and "Wali Kota" respectively nominated by the Governor of the Province. These Kabupaten and Kota Madya are subdivided into 169 Kecamatan (Sub-districts) headed by "Camat" nominated also by the Governor. Under the Kecamatan, there are 1,136 Desa (Villages) which are the basic units of administrative structure in Indonesia. Average number of Kecamatan per Kabupaten is counted about 7. One Kecamatan covers about 7 desa on an average in South Sulawesi Province.

The village chief (Kepala Desa), elected from among the people in the village every five years, has the responsibility of carrying out the following functions under the supervision and guidance of respective governmental authorities concerned.

- Agricultural development
- Public health and sanitation
- Public education
- Village welfare and security
- Encouragement of industries and co-operatives, and
- Construcction, maintenance and repair of public transportation facilities

The Kabupaten Soppeng, where the project area is entirely covered, has 5 Kecamatan and 34 desa. In the project area, 4 Kecamatan and 13 desas are included.

2.3.2 BIMAS and INMAS Programme

As for the agricultural development, the agricultural intensification programme so called "BIMAS (Bimbingan Massal) and INMAS (Intensification Massal) has been promoted by Indonesian Government in the irrigated area in order to facilitate production increase with coordination of all the efforts of agricultural support services and so as to provide a "package" of agricultural inputs to the farmers since 1963.

Since 1973, for further development of the BIMAS and INMAS Programme, the Government has initiated to organize a village unit (Wilayah Unit Desa) as the lowest executive unit of the Programme.

According to the Presidential Decree No. 4, 1973, the aims of establishing the village unit are: a) to assure the realization of agricultural product increasing programme, particularly food production effectively and efficiently, and b) to give the certainty to procedure farmers in particular and village community in general, that they have the responsibilities not only to take part in increasing the said production, but also to raise their living standard and welfare.

Each village unit generally comprises 2,000 farmers in 6 villages, with 600 to 1,000 ha of irrigated paddy field and the following functions would be set up in each village unit:

(1) At least one Field Extension Workers (PPL) equipped with information appliances in order to diffuse the necessary information to the farmers in the village unit concerned.

(2) Village unit branch of Indonesia People's Bank having the main function of BIMAS credit service within its service area that may consist of more than one village unit area.

(3) Kiosk of village unit assigned to distribute farm inputs such as fertilizer, perticides, seeds and farm machineries and tools, etc.

(4) BUUD/KUD (Village Unit Executive Body/Village Unit Cooperative) having the function of processing and marketing of agricultural product. The BUUD is established as an economic institution in the form of co-operative which may constitute joint undertaking merger of agricultural co-operative found in the village unit area at its initial stage of growth, and be merged in one village unit co-operative (KUD) under the regulation of Ministry of Man-power, Transmigration and Co-operative in a certain period of time according to its progres.

Following to the direction of the policy, the Provincial Government has been initiated to establish the village units with other related institutions covering whole province since 1973. Total number of village unit in the Province is 620 in 1979.

In the project area, there are 13 village units with 6 BUUD/KUD, 13 KIOSK, 6 BRI and 14 Field Extension Workers. The average hectarage of irrigated paddy field and number of farm household per village unit are 402 ha and 989 farm households, respectively. As compared with the said general standard of village unit in the project area is far exceeded on size, however on the aspect of functional institution, it has much rooms to be developed.

It would be recommended that the number and equipment of KUD and KIOSK should be developed for the successful implementation of the irrigation projects.

Under these executive units, the BIMAS and INMAS programme has been steadily developed, especially in the area where the irrigation facilities were well developed. The area served by the BIMAS and INMAS Programme in the project area is estimated at 2,800 ha for wet season paddy and 2,200 ha for dry season paddy respectively, or about 46% for wet season paddy and 56% for dry season paddy.

In order to further promote the BIMAS programme, Special Intensification Programme (Intensifikasi - Khusus) so-called "INSUS" has been launched since 1979. The INSUS programme is the special form of BIMAS for farmer's groups which are voluntarily organized by the

progressive farmers. There is no special BIMAS package for the farmer's groups under INSUS programme. Each farmers group can decide and apply any form of package with the advise of PPL, who visits the farmer's group once a week. In the project area, about 120 farmer's groups have been organized and about 20% of farmers are served by the INSUS programme.

2.3.3 Research

The research works of agriculture in Indonesia are centralized and undertaken by the Central Research Institute of Agriculture (CRIA) at Bogor in Java. There are 6 branch research stations in whole Indonesia, namely, East Java, West Java, South Kalimantan, West Sumatra, North Sumatra and South Sulawesi.

The South Sulawesi Branch Research Station of CRIA located at Maros about 40 km north from Ujung Pandang, consists of 7 Divisions and 2 Experimental Farms. This Branch Research Station has 146 ha of experimental fields of which 110 ha are for rice experimental fields. One of the Experimental Farm located at Lanrang, Kabupaten Sidrap, is mainly carrying out rice experimental works with 44 ha of experimental field. The other located at Gowa, is mainly undertaking upland crops such as maize, sorghum, peanut, soybean, sweet potato and cassava. The Maros branch station plays an important role in technical for promotion of BIMAS/INMAS programme.

About 40% of experimental works are devoted to the experiment of rice such as variety test, fertilizer test and test for control of pests and dideases on irrigated paddy.

For the execution of experimental works, about 60 senior technical staff are engaging with 220 personnel including administrative staff under the technical assistance of the International Rice Research Institute, Philippines.

This Branch Research Station is playing an important role in technical aspect of increase of rice productivities through BIMAS Technical Team consisting of the experts from Hasanuddin University, Provincial Agricultural Extension Service and South Sulawesi Branch Research Station .

2.3.4 Extension Services

In order to promote and accelerate the agricultural extension education activities on field level by separating extension service with general agricultural administrative services, the Agricultural Extension Service Development Programme has been launched in Indonesia since 1974. In the Central Government, the Agency for Agricultural Education, Training and Extension was established as one of the extra-ministerial bureaus under the Ministry of Agriculture. At the same time, in the provincial level, the establishment of the

Agricultural Development Center has been promoted with the provision of functions of adaptation tests of new recommended agricultural techniques recomended by research institutions and in-service training for extension workers in addition to the seed multiplication. In the Kebupaten level, several Rural Extension Centers have been established as a base camp for extension education activities with functions of preparation of extension programme dissemination of agricultural information and training for leading farmers at the local level.

Following the basic policy, the Agricultural Extension Service Development Programme in South Sulawesi has also been developed year by year since 1974. Although an Agricultural Development Center is not formally decided yet, but the Rural Extension Centers have already commenced their daily works.

As illustrated on Fig. 2.3.1, the organization of Agricultural Extension Service in South Sulawesi is formed by two separate lines, i.e. administrative line and operational line under the supervision of Inspector of Provincial Agricultural Extension Service.

The Subject-matter Specialist (PPS) staying in each Kabupaten assists and advices about 10 Extension Supervisors (PPM) of which 2 to 4 are working in Kabupaten office and remains are staying in the Rural Extension Center (BPP) assist and advise about 10 Field Extension Workers (PPL).

Every Field Extension Workers are requested to visit a farmers group in each extension once a week. There are 16 extension areas under each village unit. The extension worker visits 4 extension areas a day and whole 16 areas during 4 days from Monday to Thursday every week, and receives training on Friday and Saturday. This system is called T.V. system (Training and Visit system).

In the project area, there are two Rural Extension Centers, located at Malanroe and Pattojo. The center at Malanroe has the function of extension programme, dissemination of new agricultural techniques and training for leading farmers. The Pattiojo center is carrying out the demonstration work of recommendable agricultural operation. They have recently started the demonstration of irrigated polowijo cultivation. The original set-up for extension services and agricultural administration in Kab. Soppeng is shown in Fig. 2.3.2 and Fig. 2.3.3.

Taking the future agricultural development into consideration, it would be recommended that the practical rice cultivation technique of Field Extension Workers have to much raise up so as to judge and advise properly to the farmers timely in their own fields.

2.3.5 Seed Multiplication

Provincial Seed Center located at Maros about 40 km North from Ujung Pandang is only one institute which produces stock seeds of new recommended varieties of paddy in the South Sulawesi. The foundation

seeds supplied from the Central Research Institute of Agriculture are multiplied to the stock seed at this Center. The seed Center distributes these stock seeds to 37 Seed Stations managed by Kabupaten offices. These Seed Stations produce the extension seeds and distribute them to seed growers. The seed growers produce paddy seeds and supply them to the farmers through BUUD/KUD according to the BIMAS/INMAS programme.

In the project area, there exists a seed station with 5 ha of irrigated paddy field at Malanroe. The rice variety, IR36, was first introduced to this station in 1976 and this variety is now used on greater than 60% of total paddy fields. This has evidenced good performances of this station and other agricultural support services.

2.3.6 Agricultural Credit

The Indonesia People's Bank (BRI - Bank Rakyat Indonesia) is the state bank specialized in agricultural credit covering whole country and has a broad network composed of many regional offices, branch offices and sub-branch offices (village unit BRI). The bank is authorized to finance BIMAS package credit for farmers. There are several kinds of BIMAS packages. The credit amount is fixed for each BIMAS package as shown in Table 2.3.1 and 2.3.2. The loan condition is fixed at the interest rate of 1% per month and the repayment period of 7 months.

In the project area, there are one Branch office and 6 sub-branch offices. The loan amount for BIMAS package has steadily increased and it exceeds Rp.300 million in 1979/80 in the project area.

2.3.7 Farm Inputs Supply

Distribution of fertilizers and agro-chemicals is handled by PT. PUSRI, the governmental enterprise in the South Sulawesi Province. According to the BIMAS/INMAS programme, fertilizers and agro-chemicals are supplied to 6 sub-distributors appointed by PT. PUSRI at Ujung Pandang and then the necessary amounts of such farm inputs are transported by sub-distributors to the retailers and/or KUD at the local level.

The distribution prices of these agricultural inputs are controlled by the Government. Distribution prices of Urea and TSP to the farmers are fixed at Rp.70/kg at present.

2.3.8 Farmers Cooperatives

Farm inputs supplies, processing and marketing of farm products are primarily made through the establishment of cooperatives (BUUD/KUD) which have been promoted by the Government through the Coperative Office in each Kabupaten since 1945 when the Cooperative Acts in

Indonesia was enacted. In spite of government efforts, however, the cooperative movement has not been well developed mainly because of weakness in management and shortage of operational fund.

In order to improve such stagnant condition of cooperative movement, establishment of Village Unit Cooperative (KUD) has been promoted since 1973 when the President Degree for Village Unit was enforced, as previously mentioned.

In the project area, 6 KUD have been organized so far. These KUD presently cover about 70% of the project area. The total number of KUD members including candidates is about 5,100, which corespond to about 40% of total farm households in the project area. As for the irrigation water management, the traditional "Ulu-Ulu" system is still predominant in the project area. There exists only one water user's association (P3A) covering only about 530 ha with 285 members.

2.3.9 Recommendation

Taking the future agricultural development into consideration, following improvements of agricultural support systems would be recommended:

(1) To promote the establishment of KUD with KIOSK up to the same number of the village unit (13) at least in the proposed irrigation projects' area by the end of the construction of irrigation facilities. In parallel with the establishment of KUD the number of members of KUD should be expanded to the maximum extent in project area,

(2) To establish water user's association (P3A) in each tertiary irrigation block comprising all the farmers in the beneficial area as the member of P3A before the completion of construction works of project,

(3) To raise up the practical rice cultivation technique of the Field Extension Workers (PPL) through practical training conducted by the South Sulawesi Branch Research Station so as to be able to judge plant condition of rice and advice to the farmers properly and timely in their own paddy fields,

(4) To promote the INSUS programme in the project area through the expansion of grouping activities under adequate advise of PPL,

(5) To strengthen the operation of seed station in the project area so as to provide the project-benefited farmers with the necessary quantity of certificated extension seeds, and

(6) To strengthen the agronomic research on irrigated cultivation of polowijo crops and to propagate the recommendable farming practices including new varieties to the farmers through the existing extension channels.

2.4 BASIC CONCEPT FOR AGRICULTURAL DEVELOPMENT

2.4.1 Present Situations

The Langkemme Irrigation Project area of 6,400 ha in net is completely covered with well-developed paddy field. There exist fourty four (44) small-scaled Desa irrigation schemes and four (4) D.P.U. irrigation schemes, covering over 99% of the existing paddy field. These schemes mainly depend their irrigation water on the small tributaries of the Walanae river, the total catchment area of which extends to about 100 km^2. The water resources endowed in the tributaries widely fluctuate year by year according to the fluctuation of annual rainfall in the watershed of the tributaries. In light of the ratio between the area being irrigated by the tributaries and the total catchment area of the tributaries, the shortage of irrigation water is extremely serious in and around the project area.

The existing irrigation systems covered the project area still remain non-technical level and semi-technical level, consisting of about 3,000 ha of non-technical level and 3,500 ha of semi-technical level. Ephemeral cobble weirs are constructed in the non-technical Desa irrigation schemes. The weirs have been periodically washed away during flood season and reconstructed by farmers themselves, so called "Gotong Royong". Meanwhile, perennial cobble masonry and concrete weirs are also constructed in the semi-technical Desa and DPU schemes, but most of them are considerably deteriorated owing to poor maintenance.

Paddy cultivation in the project area is concentrated in the wet season and it is extremely limited in dry season because of the exhausted water sources.

The cultivation pattern is directly affected by the seasonal distribution of rainfall. The planting and harvesting areas widely fluctuate year by year, depending on endowed rainfall and available water resources in the tributaries of the Walanae river. In the wet season from April to July, almost all of the paddy fields are planted with paddy. While, in the transitional season from November to February, only about 65% of the existing paddy fields is cultivated with paddy under irrigated condition. The remaining paddy fields are under cultivation of polowijo or fallow. Most of the paddy fields are not used for cropping during the dry season from August to October.

Improved high yielding varieties (HYV) of paddy have been widely spread over the project area through extension of BIMAS/INMAS programme. Although unit yield of paddy in the project area is not very low showing the average yields of 4.60 tons/ha for wet season paddy and 4.75 tons/ha for dry season paddy, there will be still much room for further improvement.

The cultivation of polowijo crops is quite limited in the project area due to shortage of irrigation water. Since the polowijo crops are cultivated mostly under rainfed condition without use of any improved farm inputs, the unit yields of polowijo crops are generally low.

The size of farms in the project area is generally small because of the limited availability of arable land and a large number of farm population. The average size of farms is estimated at 1.03 ha of which only 0.61 ha is the paddy fields. The study on present farm economy shows that crop income from such small farmland is not sufficient to maintain the livelihood of the farmers. Under such circumstances, the crop income of such small farmers can be improved only through the improvement of land productivity.

2.4.2 Constraints

The project area has been recently created as one of rice granaries in the South Sulawesi region. Nevertheless, the land productivity thereabout still remains to be much improved due mainly to shortage of irrigation water, lack of perennial irrigation system, shortage of agricultural inputs, improper water management and ineffective application of agricultural inputs and insufficient agricultural support services. The decisive constraints among them are shortage of irrigation water resources and lack of perennial irrigation system.

2.4.3 Basic Concept for Agricultural Development

The project aims at increase of agricultural production and thereby improvement of the farmer's living standard in the Langkemme project area through exploitation of new water resources from the Langkemme and Sero rivers as well as up-grading of existing irrigation systems.

The major concept for agricultural development would be as follows:

(1) Unit yield and production of wet season paddy should be stabilized and improved through proper supplementary irrigation and introduction of improved irrigation farming,

(2) Total planted area of dry season paddy must be increased with year-round irrigation systems and thereby total production of paddy be maximized,

(3) Cropping intensity should be increased to the maximum extent to make maximum use of newly exploited water resources to be supplied by the project,

(4) Special attention should be given to crop diversification in conformity with government policy, and

(5) For effective operation of the project, the existing institutions for agricultural support services should be maintained and strengthened.

2.5 AGRICULTURAL DEVELOPMENT PLAN

2.5.1 Assumptions

The project area is a considerable matured area for agricultural production, where rather efficient irrigation networks have been established with a fixed crop rotation system. Under such condition, the agricultural economy of the area is rather stable even if no large scale irrigation projects are implemented and no significant improvement is made in agricultural production techniques.

In the project area, available water resources from the tributaries of the Walanae river are already in full use and there is no possibility for increasing the irrigation water unless new water resources are exploited. In the logn run, however, the production techniques such as new varieties, efficient use of fertilizers, prevention of pests and diseases as well as water management techniques are always changing and gradually progressing and certainly lead to changes in agricultural production. These changes, however, are neglected in the estimation of possible changes attributed to the Langkemme Irrigation Project, partly because they have influence on both with and without the project and partly because the effect of these factors is generally so insignificant.

It is considered that the future agricultural economy of the project area with the Langkemme Irrigation Project is in the conditions reflecting the changes attributable to the project. The forecast on the changes of agricultural condition would be made under the following assumption that:

(1) The existing paddy field in the project area is up-graded from non- and/or semi-technical level to fully technical level,

(2) The construction of the project is completed according to schedule, and

(3) The agricultural productivity in the project ara gradually increases to a slight extent under future without-the-project condition, but it is disregarded in the analysis of agricultural benefits.

2.5.2 Change in Land Use

Following the completion of the Langkemme Irrigation Project, all of the paddy fields in the project area are up-graded to the technical irrigation paddy fields and more intensive use of the farmland becomes possible.

As most of the project area have more or less been under irrigation and the lands covered by the project are well-developed paddy field, there should be major changes in kind of crops to be adopted in the project area except the increase of cropping area. The paddy rice remains as the most important crop.

There are no additional arable lands to be newly reclaimed under the project. In view of the unavailability of additional arable land and population growth, the size of farm can not be expanded, and even tends to become rather small. According to the results of farm economy survey, the average size farmer who cultivates a total of 1.03 ha including 0.61 ha of paddy fields earns only equivalent to his living expenses. Under these circumstances, the only possibility to enlarge the farm income is to increase the cropping intensity. The project provides the farmers with good opportunities to expand the volume of their farm business.

The land use patterns can not basically be changed without provision of irrigation development. The land use in the surrounding areas excluded out of the project area is obliged to remain as it is. However, shifting cultivation of upland crops being proceeded on the southeastern hilly lands should be restricted and afforestation would be required for prevention of soil erosion.

2.5.3 Cropping Pattern

The adequate supply of irrigation water within the project area inevitably leads to certain change of crops and cropping pattern. However, it is difficult to forecast how the farmers of the project area change their cultivation of crops.

Despite differences of opinion, the following principles which should govern the selection of crops and cropping patterns under the project, have been generally accepted among the authorities concerned:

(1) The crops and cropping pattern must create maximum benefits for the farmers as well as the nation as a whole,

(2) The crops and cropping pattern must make maximum utilization of water to be supplied by the project,

(3) The crops and cropping pattern must conform with the existing social tranditions and be acceptable to the farmers, and

(4) The crops and cropping pattern should be practical with the limited number of family labour.

On the basis of the four principles described above, four alternatives for future cropping pattern are considered as follows:

(1) Pattern A: Paddy - Polowijo - Paddy
(3 crops a year)

(2) Pattern B: Two crops of paddy a year

(3) Pattern C: Paddy - Paddy - ½ Paddy
(5 crops in 2 years)

(4) Pattern D: 4 crops of Paddy and 1 polowijo in 2 years

These four (4) alternatives are illustrated in Fig. 2.5.1. For determination of the most optimum cropping pattern, comparative studies on these alternatives are made on the basis of profitability, water requirement and labour requirement for each alternative pattern. The profitability of major crops designed in the alternative cropping patterns has been studied both under with and without project conditions and is summarized in Table 2.5.1. The unit profitability of each alternative pattern per ha, calculated by net production value per ha per annum, is shown in Table 2.5.2. The labour requirement for each alternative pattern is estimated on the basis of data obtained from the agriculture office of Kab. Soppeng and results of farm economy survey. The labour requirement is estimated on a 10 day basis and compared with available labour force of average size family in the project area. The results of labour requirement study is illustrated in Fig. 2.5.2. Water requirement for each alternative pattern is estimated under same assumption given in Chapter IV. The results of the comparative studies are summarized as follows:

Alternatives	Profitability /1 (10^3Rp/ha)	Labour requirement /2 (man-days/ha)	Water requirement /3 ($10^3 m^3$/ha)
Pattern A	1,268	371.4	14.9
Pattern B	1,050	292.1	14.0
Pattern C	1,215	363.5	16.7
Pattern D	1,159	331.8	14.4

The pattern A is the most profitable, followed by the pattern C. Other patterns are less profitable. The results of balance study on labour requirement and available family labour force show that all the alternative patterns are possibly carried out by average size family. The pattern A is of water saving type, as compared with the pattern C. The pattern A will create the largest economic return from irrigation water to be supplied by the project as shown below:

Alternatives	Profitability (10^3Rp/ha)	Water requirement ($10^3 m^3$/ha)	Unit profitability (Rp/m^3 of water)
Pattern A	1,268	14.9	85.1
Pattern B	1,050	14.0	75.0
Pattern C	1,215	16.7	72.8
Pattern D	1,159	14.4	80.5

Hence, the pattern A is proposed to be adopted under the project.

/1: net production value per ha per annum
/2: unit labour requirement per ha per annum
/3: total diversion requirement per ha per annum

These comparative studies were explained to the representatives of local farmers and agricultural extension workers with the presence of Bupati (Chief of Kabupaten Soppeng) and his agricultural staff on Sept. 3, 1980. In this meeting, the pattern A was recognized as the most acceptable pattern to the farmers. The minutes of the meeting is shown in Attachment-I.

The proposed cropping pattern is illustrated, together with agro-climate data, in Fig. 2.5.3. In the project area, there is no limitation for germination of seeds throughout year, blessed with relatively constant temperature. Setting of harvest period should be, however, so considered that the rainy period are excluded for the smooth operation of harvesting and processing. The framework of cropping calender is also designed so as to expand the irrigable area as much as possible, taking into account the results of preliminary water requirement study. In order to ensure the proposed triple cropping a year, early matured varieties like IR28 and IR36 have to be used.

The proposed cropping pattern is not possibly introduced during the construction period. The proposed pattern is gradually adopted after completion of the Langkemme main canal when sufficient water becomes available from the Langkemme and Seró rivers. Double cropping of paddy provisionally practiced until irrigation water explaited in the new water source will be available.

2.5.4 Proposed Farming Practices

Proper irrigation farming is the most essential factor for realizing the full exploitation of agricultural potential in the project area. In this sense, the following farming practices are proposed:

In order to ensure the proposed triple cropping a year, early-matured high-yielding varieties like IR28 and IR36 have to be used. The seed requirement is 30 kg per ha. In the project area, the seed treatment is not commonly carried out at present. The paddy seeds to be used have to be the certificated extension seeds and be selected by using a solution of 1.13 specific gravity before pre-germination. The selected seeds also have to be disinfected by using adequate disinfectant like Benrate. Pre-germination practice is recommendable for increasing the germination percentage.

The nursery have to be prepared as flat as possible. The size of nursery is about 1/20 of the paddy field to be transplanted. Fertilization is essential. The recommendable dosage is 5 kg of Urea per ha. Careful water management is very important for healthy growth of seedlings. The nursery period is 15 - 20 days after seeding.

The field preparation is carried out by animal power, at latest 10 days before transplanting. Puddling work also is required after ploughing. The puddling is carried out by animal power. In the project area, there exist sufficient number of oxen and buffaloes for this purpose.

Transplanting is made by manual labour with a spacing of 30 cm x 15 cm. In due consideration of close correlation between numbers of panicles per m^2 and unit yield for dry season paddy (Fig. 2.2.7, to be referred), dense planting is recommendable for the dry season paddy. The irrigation water have to be drained just before transplanting so that transplanting in shallow depth is enforced for accerelating vigorous tillering. Irrigation water is taken into the field again after rooting.

Proper application of fertilizer is essential for full exploitation of agricultural potential under irrigated condition. The soils of the project area are generally poor in plant nutrient, especially nitrogen and phosphate. These chemical element have to be supplimented by fertilization. Considering the soil condition, the suitable fertilizers are urea, triple super phosphate (T.S.P.) and pottasium cloride (KCl). The total fertilizer requirement for sustaining the target yields would be 200 kg/ha of urea, 50 kg/ha of T.S.P. and 50 kg/ha KCl. The basic fertilizer application is 65 kg/ha of urea, 50 kg/ha of T.S.P. and 50 kg/ha of KCl when field preparation is practiced. Top dressing is made in 2 times, i.e., at the maximum tellering stage of about 15 days after transplanting and at the initial young panicle formation stage of about 45 days after transplanting. The amount of fertilizer to be applied per hectar is about 65 kg of urea for each dressing time.

After transplanting, weeding is carried out in 3 times, depending the conditions of weed growth, by manual operations. For effective operation of weeding, it is recommended that the rotary weeder, being widely used in Java, be introduced to the area.

As regards the plant protection, intensive application of insecticides are required for control of plant hoppers, stem borers, etc. Considering the life-cycle of these insects, 3 to 4 lit/ha of insecticides are required for 3 to 4 times application during one cropping season. In addition, it would be necessary to apply one lit/ha of fungicides for control of diseases and 100 gr/ha of rodenticide for ratting, for each cropping season. In selecting suitable insecticides and fungicides, chemical toxicity which directly or indirectly affects the humanbeing should be taken into consideration. On this context, carbonate and organophosphate, i.e. Diazinon, Sumithion, Dimecron, etc. are recommendable as insecticides and antibiotic chemicals, i.e. Kasumin, Kasurabcide, etc. as fungicides and Zinkphosphate as rodenticides. It is recommended that plant protection works should be carried out in a systematic way through the farmer's cooperatives.

Harvesting is carried out by manual labour. The harvested paddy is dried on the ground. In future, artificial dryer have to be considered because a lot of harvested grains are damaged by unexcepted rains. For treshing, use of treadle thresher, instead of traditional hand threshing, is recommendable.

As for polowijo cultivation, the present primitive methods have to be improved with use of improved varieties, fertilizers and agro-chemicals under irrigated condition. Farm inputs for polowijo crops would be same as the amounts recommended in BIMAS package. The design criteria of the proposed farming for the selected polowijo crops are prepared on the basis of the data obtained from Central Research Institute for Agriculture, Bogor, and Agriculture Office in Kab. Soppeng.

The proposed farming practices are summarized in Table 2.5.3 (paddy) and Table 2.5.4 (polowijo crops).

Rapid introduction of farm mechanization to the project area seems to be difficult because of undulating topography, small size of farm land, large number of farm population, lack of farm access, etc. In principle, farm mechanization has a lot of advantages such as (1) increase of labour productivity, (2) speedy and smooth work flow from harvesting to field preparation for next cropping (3) more timely and effective farm operation, (4) emancipation of farmers from laborious work and (5) more efficient use of land, irrigation water and labour. At present, farm mechanization in the project area has been gradually progressed in the field of rice processing and spraying of agro-chemicals. Tractorization is still not common. In the project area, there still remains some sociological and technical problems for smooth expansion of mechanization as mentioned below:

(1) The farm plot is generally small due to undulating topography. The average size of farms is only 1.03 ha comprising paddy field and upland field. The proposed farming practices could be carried out by the presently available family labour force, and cheap labour for temporary works is also easily obtainable from the surrounding areas,

(2) The research and experiment works for proper farm mechanization have not been fully carried out, and there is no technical criteria for effective and efficient farm mechanization at present,

(3) The price of farm machinery is very high as compared with other agricultural commodities, for example, the price of 12 Hp tractor amounts to about Rp.3.2 million,

(4) The agricultural support system for farm mechanization has not been developed yet. There is no guidance services for proper operation and maintenance of farm machinery, and

(5) Land consolidation works including construction of farm roads, large farm plots and drainage facilities, which provide sufficient bearing for efficient operation of machinery, have not been carried out.

Under such circumstances, it seems that rapid introduction of farm mechanization is not practical the project area. However, farm mechanization for farmers having larger farmland is further proceeded, and it is expanded to other areas where the present conditions are more suitable for mechanization. With this in view, it is recommended that research works for proper farm mechanization be started as early as possible and technical training of extension workers be also followed.

2.5.5 Anticipated Yields and Crop Production

The present paddy yields in the project area are relatively high as compared with those in other areas. However, due to unstable irrigation water supply, the unit yields of paddy fluctuate year by year. After completion of the project, the paddy yields are stabilized and increased through improvement of irrigation practices and further expansion of agricultural support services. The present low yields of polowijo crops are much improved by irrigation and use of farm inputs.

The anticipated crop yields are estimated as follows:

Crops	Without Project (ton/ha)	With Project (ton/ha)
Wet season paddy	4.60	6.0
Dry season paddy	4.75	6.0
Polowijo crops		
- Maize	0.79	2.0
- Groundnuts	0.81	1.2
- Greenbeans	0.83	1.2
- Soybeans	0.67	1.2

These anticipated crop yields are rather conservatively estimated on the basis of past 5 years production data and results of yield survey. As seen from Table 2.2.11, the present average yields in Kecamatan Marioriwawo, where irrigation water is relatively abundant, already exceed over 6 tons/ha. The results of yield survey also show that unit yield of all the improved varieties averages over 6 tons/ha. The maximum yield recognized in the yield survey shows over 9 tons/ha. It is reported that the average unit yield of paddy under "INSUS" programme exceeded over 7 tons/ha in 1979/80. The anticipated unit yield of 6 tons/ha is therefore rather conservative. The anticipated unit yields of polowijo crops are estimated, on the basis of experiment data from CRIA at Bogor, at about 70% of average crop yields of their experiments.

The planted area for each polowijo crop not is fixed due to various uncertain factors such as farmer's intension, marketing prospects, price forecast, etc. In the cropping pattern, therefore, the area to be planted with polowijo crops is to be equally allocated

to four selected polowijo crops, i.e., maize, groundnuts, greenbeans and soybeans. The anticipated annual production of these polowijo crops are thus estimated at about 3,200 tons of maize and about 1,900 tons each of other polowijo crops.

The annual paddy production at the full development stage would amount to 76,800 tons of dry stalk paddy. The expected annual increment of paddy production would be about 28,700 tons (Table 2.5.5, to be referred). The total annual production of the four kinds of polowijo crops at the full development stage would sharply increase to about 8,960 tons. The incremental production of these crops would be about 8,680 tons, deducting the current annual production of about 280 tons all over the project area.

2.5.6 Marketing and Price Forecast

(1) Marketing

The south Sulawesi Province is the largest rice surplus province in Indonesia. Total production of paddy in the Province is estimated at about 1,720,000 tons in 1978, and on the contrary the total consumption is about 1,440,000 tons with the surplus of 280,000 tons. It is reported that the rice surplus conditions increasingly continue in the Province. The project area is also one of the rice supply regions in the province. The annual surplus is estimated around 37,000 tons in total, 13% equivalence of the surplus rice of the province. Most of these surplus rice are transported to the rice-deficit regions, like Kab. Bone and Wajo, and even other provinces.

There are 7 provinces under the jurisdiction of South Sulawesi DOLOG, among which only the South Sulawesi Province produces the surplus rice; other provinces are subject to serious deficits of rice. The total deficit in all the jurisdictions of DOLOG is estimated at about 780,000 tons. With the completion of the project, about 60,000 tons of paddy would be marketed to these rice-deficit regions; this marketable amounts are requivalent to about 21% of the surplus-rice of the province.

The present low production of polowijo crops has resulted from poor marketability together with large fluctuation of market prices. Such poor marketability is mainly due to poor quality of products. According to the results of farm economy survey, the best quality products of polowijo have no problem for marketing. In the project area, the polowijo crops are grown under irrigated condition with proper farming practices and therefore it is anticipated that the best quality products are produced. Although there are no marketing problem, strong government support is necessary for stabilization of market prices of polowijo crops.

(2) Price Forecast

Indonesia is still rice import country. In recent five years, about 1.4 million tons of rice were imported on an average as shown below:

(x103 tons)

1974	1975	1976	1977	1978	Average
1,132	693	1,301	1,973	1,842	1,388

Considering the growth rate of population, per capita consumption and increase rate of rice production, the shortage of rice in Indonesia is continued as a whole. It is reported, however, that the South Sulawesi Province continuously remains a rice supply region.

The increased production of paddy after the completion of the project would be marketed in domestic markets in Indonesia, as the substitute of import rice. In this meaning, import substitution price of paddy is forecasted for the economic evaluation. The economic farm gate price of dry stalk paddy is thus estimated at Rp.120,000 per ton, as shown in Table 2.5.6.

For the financial analysis, the farm gate price of dry stalk paddy is estimated at Rp.106,000 per ton on the basis of market price in Kab. Soppeng.

The market prices of polowijo crops largely fluctuate year by year, as shown in Fig. 2.5.4. For the evaluation of project benefits to arrive at a stable level, the price of rice, which is rather stable under government control, is adopted as a basis for adjusting the prices of polowijo crops. The details of the calculation are given in Table 2.5.7 and the adjusted farm gate prices of polowijo crops are estimated at Rp.92,000/ton maize, Rp.351,000/ton for groundnuts, Rp.310,000/ton for greenbeans and Rp.328,000/ton for soybeans.

2.5.7 Production Cost

The direct production costs of proposed crops are estimated for both future without project and future with project conditions. The production costs without project are estimated on the basis of those under present condition. As mentioned in Chapter 2.5.1 (Assumption), the present agricultural condition does not change significantly unless the new irrigation project is implemented. For the estimation of production costs without project, therefore, only unit prices of production expenses are forecasted by using general price index of major commodities in the South Sulawesi, without changing the unit requirement for farm inputs and labour.

After the Langkemae Irrigation Project is completed, the crop production costs increase as shown in Table 2.5.8 and 2.5.9. The average increase of production cost is 83.4% per ha per year.

This anticipated increase is primarily attributable to the increase of cropping intensity per ha. The increase of production costs per ha per crop is only 1.7% on average. This small increment is attributed to the increase of expenses for seeds, chemicals and labour.

2.5.8 Net Production Value without and With Project

The net crop production value without project is estimated at approximately Rp.4,044 million (US$1,011/ha) per annum on the basis of the forecasted unit prices of crops and production costs aforementioned. It is assumed that crop yields and production are same as those under present condition.

After completion of the project, the net crop production value amounts to Rp.8,135 million (US$2,034/ha) per annum at the full development stage. The details are given in Table 2.5.10.

2.6 IRRIGATION BENEFITS AND PAYMENT CAPACITY

2.6.1 Irrigation Benefits

(1) Increased crop production

The irrigation benefits of the Langkemae Irrigation Project primarily accrue from the increased crop production due to stable irrigation water supplies. These benefits are estimated as the difference of the annual net crop production values under future with- and without- the project conditions. The crop production gradually increases after commencement of the pertial operation of the project. The second paddy in non-technical area of 370 ha is firstly benefited with the implementation of the project and some amount of benefits initially accrue in 1984. The irrigation development for the whole project area is ended in 1987. After the completion of the irrigation development, about 10 years of build-up period are taken into account. The full development stage is, thus, attained in 1996. The increased crop production value at the full development stage is estimated at Rp. 4,091 million per annum (details are given in Table 2.5.10).

(2) Crop yield reduction due to shortage of irrigation water

Owing to the uncertainty of annual rainfall and also its erratic distribution during the year, it is anticipated that even after completion of the project, the shrtage of water for irrigating the crops designed in the proposed cropping pattern might occasionally occur and cause the reduction of crop yields to some extent. This kind of loss, therefore, should be conservatively deducted from the net crop production values with the project. The net production value without project condition is calculated on the basis of actual yields and production data in the past 5 years from 1975 to 1979, and it is, therefore, considered that the estimated net production value without project already excludes the such crop losses in its calculation.

The estimate of the yield reduction caused by the occasional water shortage are made as follows: When any water shortage for polowijo crops occurs, the estimation of yield reduction for these crops is made by reducing the harvesting areas and then estimate the losses of crops arising from the reduced area of harvest. In this estimate, period of

water deficit is disregarded and only rate of total water deficits to total water requirement is used. For paddies, the estimation of yield reduction is made by following the relationship of water shortage and crop yield (see Fig. 2.6.1).

The yield reduction of each crop is thus estimated and shown in Table 2.6.1. The annual average crop losses are estimated at about Rp.275 million in total.

(3) Direct irrigation benefits

The primary irrigation benefits are estimated at about Rp.4,091 million in total (US$1,023/ha) per annum. These are, however, gross benefits, because there is crop yield reduction due to the water shortage that should be deducted from the estimated net production value with the project. Table 2.6.2 shows the calculation of the annual direct irrigation benefits. The annual direct benefits amount to about Rp.3,816 million (US$954/ha) at the full development stage of the whole project.

2.6.2 Farm Budget Analysis and Payment Capacity

Payment capacity is the ability of farmers to bear the expenses required for development of irrigation facilities. Such capacity is measured by the increase of net income which the project benefited farmers can earn annually from the project.

In order to assess the payment capacity of the farmers, the farm budget analysis is tentatively made on the average size farm under future with and without project conditions as shown in Table 2.6.3.

With the completion of the project, the net reserve of payment capacity increases from Rp.1,800 to Rp.197,600 per annum (US$632/ha/annum) at full development stage. The increased net reserve would offer incentives for further development to the farmers, and the substantial payment capacity would enable them to pay some charges for irrigation water.

Table 2.1.1 List of Data Collected

1. Statistical Pocketbook of Indonesia, 1978/1979, Central Bureau of Statistics, Jakarta.

2. Monthly Statistical Bulletin, March 1980, Central Bureau of Statistics, Jakarta.

3. Sulawesi Selatan Dalam Angka Tahun 1978, ensus and Statistic office, South Sulawesi Province.

4. Statistik Harga Hasil Pertanian Tanaman Pangan Priode Pelita I dan II (Tahun 1969 s/d Juni 1978), 1978 Sub. Dinas Bina Sarana Usaha Tanam Pangan, Inspeksi Dinas Pertanian Rakyat Propinsi Daerah Tingkat I Sulawesi Selatan.

5. Annual Statistic Report of Foods Stuffs 1979, Inspeksi Dinas Pertanian Rakyat Propinsi Daerah Tingkat I Sulawesi Selatan, Ujung Pandang.

6. Sulawesi Selatan Kabupaten Soppeng Dalam Angka, 1969 to 1980, Sensus and Statistics Office, Kab. Soppeng.

7. Annual Report, 1978 to 1980, Agriculture Office, Kab. Soppeng.

8. Kumpulan Data Pelaksanaan Intensifikasi (BIMAS-INMAS) Selama Pelita II Propinsi Dati I Sulawesi Selatan, Mei 1979, Sekretariat Badan Pembina Harian BIMAS Propinsi Dati I Sulawesi Selatan.

9. Laporan/Tinjauan Hasil Pelaksanaan Program Intensifikasi Padi, Palawija, dan Sayuran 1979/1980, Sekretariat Satuan Pembina Harian BIMAS Prop. Dati I Sulawesi Selatan.

10. Annual Progress Report Phase III (June 1979 - July 1980), South Sulawesi Regional Agricultural Development Planning/ATA 140 - Project, July 1980, Team of Project on RADP/ATA - 140 South Sulawesi.

11. Rencana Intensifikasi Padi, Palawija dan Sayuran Tahun Anggaran 1980/1981, Satuan Pembina BIMAS Propinsi Daerah Tingkat I Sulawesi Selatan, Maret 1980.

12. Highlight Hasil Penelitian Pelita II 1979, Lembaga Penelitian Petanian, Maros.

13. Daeskripsi Varitas Kacang-kacangan 1977 and 1980, Diperbanyak oleh Lembaga Penelitian Pertanian, Maros.

14. Pedoman Tatalaksana Intensifikasi Padi, Palawija dan Sayuran dalam Pelita III, Maret 1979, Sekretariat Badan Pembina Bimas Propinsi Sulawesi Selatan.

- to be continued -

15. Buku Potensi Wilayah Kerja Kelompok (WILKEL), Disetiap Wilayah Unit Desa (WILUD), Dinas Pertanian Rakyat Kabupaten Daerah Tingkat II Soppeng, 1978.

16. Indikator Ekonomi, Biro Pusat Statistik Jakarta Indonesia, 1980.

17. Hasil Pengelolahan Registrasi Penduduk/Kartu Keluarga Kabupaten Dati II Soppeng, 1979, Kantor Sensus dan Statistik Kabupaten Dati II Soppeng.

18. Data-data Luas, Kelas dan Golongan Tanah, Sawah dan Darat, 1980, Kantor Ipeda Kabupaten Dati II Soppeng.

19. Pola Pertanaman pada Areal Sawah Berpengairan dan Areal data Hujan (Lokasi Proyek Langkemme), 1980, Kantor Dinas Pertanian Rakyat Kabupaten Daerah Tingkat II Soppeng.

20. Livestock Production in Kabupaten Soppeng from 1975 to 1980, Livestock Services Office, Kabupaten Soppeng.

21. Annual Agricultural Production data from 1975 to 1979, Agriculture Offices in Kecamatan Lalabata, Lilirilau, Liliriaja and Marioriwawo.

Table 2.2.1 Population Growth in and around the Project Area

Kecamatan/Desa	Year							
	1972	1973	1974	1975	1976	1977	1978	1979
Lalabata								
Maccile	-	-	-	-	-	-	3,764	3,822
Lalabatarilau	10,545	10,635	10,912	11,116	11,275	11,521	7,839	7,971
Liliriiau								
Pajalesang	15,740	15,840	16,032	16,201	16,342	16,525	11,336	11,457
Macanre	-	-	-	-	-	-	5,205	5,242
Liliriaja								
Ganra	10,913	10,949	11,103	11,210	11,302	11,411	6,243	6,287
Belo	-	-	-	-	-	-	5,249	5,302
Galung	7,032	7,041	7,049	7,093	7,122	7,193	7,244	7,284
Pattojo	8,160	8,268	8,338	8,382	8,401	8,455	8,515	8,576
Jennae	5,807	5,858	5,936	6,011	6,053	6,121	6,164	6,231
Mariorivawo								
Labessi	-	-	-	-	-	-	5,000	5,069
Tet.rarae	10,531	10,559	10,619	10,748	10,873	10,923	6,000	6,039
Watu	14,665	14,933	14,972	15,122	15,203	15,344	6,000/1	6,699/1
Gottareng	-	-	-	-	-	-	8,774/1	9,032/1
Goaric	8,470	8,467	8,471	8,342	8,843	8,934	8,997	9,101
Total	91,863	92,550	93,432	94,225	95,414	96,427	97,009	98,112

Source : Annual eport 1980, ensus and Statistics Office, Kab. Soppeng

/1 : Desa Watu was divided into 2 desas in 1978 and a new desa Gottareng is not included in the project area

Table 2.2.2 Present Agro-economic Condition in and around the Project Area (1979)

Kecamatan	Desa	Total Area (km^2)	Popu-lation (1979)	Working Population		House-Hold		Ave. Size of Family	Family Labour
				Total	Farming	Total	Farm		
Lalabata	Maccile	10	3,822	1,679	897	673	475	5.68	1.89
	Lalabatarilau	126	7,971	3,353	2,457	1,538	1,322	5.18	1.86
Lilirilau	Pajalesang	11	11,457	7,708	2,832	1,868	1,270	6.13	2.23
	Macanre	4	5,242	2,138	812	801	532	6.54	1.53
Lilirlaja	Ganra	31	6,287	2,904	2,069	1,177	1,026	5.34	2.02
	Belo	14	5,302	2,472	1,732	876	783	6.05	2.21
	Galung	16	7,284	3,214	1,987	1,413	1,098	5.15	1.81
	Pattojo	34	8,576	3,860	2,684	1,673	1,479	5.13	1.81
	Jennae	13	6,231	2,059	1,416	1,077	781	5.79	1.81
Mariorlwawo	Labessi	29	5,069	2,471	1,692	961	810	5.27	2.09
	Tet. ranrae	17	6,039	2,608	1,561	1,110	706	5.44	2.21
	Watu	32	6,699	3,398	2,323	1,153	948	5.81	2.45
	Goarie	57	9,101	4,147	3,232	1,782	1,629	5.11	1.98
	13	394	89,080	42,011	25,694	16,102	12,859	5.53	1.99

Source : Annual Report 1980, ensus and tatistics Office, Kab. Soppeng

Table 2.2.3 Present condition of Farmland in and around the Project Area

(ha)

Kecamatan	Desa	Total Area	Paddy Field					Total Upland Field	Total Farm-land
			Tech.Irri. Area	Semi-tech. Irri.Area	Non-tech. Irri.Area	Rainfed Area	Total		
Lalabata	Maccile	1,020	-	-	561	159	720	113	833
	Lalabatarilau	12,600	-	-	439	-	439	258	697
Lilirilau	Pajalesang	1,130	-	170	-	339	509	194	703
	Macanre	400	-	-	98	-	98	219	317
Liliriaja	Ganra	3,100	-	417	-	175	592	52	644
	Belo	1,400	-	702	322	19	1,043	158	1,201
	Galung	1,600	-	400	600	104	1,104	402	1,506
	Pattojo	3,400	-	200	1,160	-	1,360	746	2,106
	Jennae	1,320	-	327	218	-	545	405	950
Marioriwawo	Labessi	2,900	-	230	366	-	596	628	1,224
	Tet. ranrae	1,700	-	-	-	60	60	701	761
	Watu	3,200	-	171	278	90	539	1,290	1,829
	Goarie	5,700	-	-	88	117	205	284	489
	Total	39,470	-	2,617	4,130	1,063	7,810	5,450	13,260

N.B. Classification of paddy fields has been made only on the basis of the estimated availability of irrigation water, irrespective of grade of irrigation facilities.

Source : Agriculture Office, Kab. Soppeng and Kecamatan Offices: Liliriaja, Lalabata, Marioriwawo and Lilirilau.

Table 2.2.4 Paddy Production in Past 5 Years in the Project Area (6,400 ha)

(Dry stalk paddy)

	Desa Non-technical Area			Desa Semi-technical Area			D.P.U. Semi-technical Area			Total		
	Planted Area (ha)	Unit Yield (ton/ha)	Production (ton)	Planted Area (ha)	Unit Yield (ton/ha)	Production (ton)	Planted Area (ha)	Unit Yield (ton/ha)	Production (ton)	Planted Area (ha)	Unit Yield (ton/ha)	Production (ton)
Wet Season Paddy												
1975	2,830	4.00	11,320	1,360	4.00	5,440	1,990	4.09	8,140	6,180	4.03	24,900
1976	2,830	4.19	11,860	1,050	4.29	4,500	2,020	4.85	9,790	5,900	4.42	26,150
1977	2,880	4.45	12,820	1,330	4.50	5,980	2,040	4.50	9,180	6,250	4.48	27,980
1978	2,900	4.77	13,830	1,400	4.77	6,680	2,100	4.75	9,980	6,400	4.76	30,490
1979	2,650	5.49	14,550	1,290	5.44	7,020	2,020	5.09	10,280	5,960	5.36	31,850
Average	2,818	4.57	12,880	1,286	4.59	5,930	2,034	4.64	9,470	6,138	4.60	28,280
Dry Season Paddy												
1975	2,260	4.78	10,800	1,170	4.86	5,690	1,410	5.33	7,510	4,840	4.95	24,000
1976	2,190	4.01	8,780	1,050	4.12	4,330	1,490	4.84	7,210	4,730	4.28	20,320
1977	1,870	4.38	8,190	870	4.51	3,920	1,220	5.12	6,250	3,960	4.62	18,360
1978	1,430	4.88	6,980	430	4.98	2,140	1,070	5.25	5,620	2,930	5.02	14,740
1979	1,890	5.18	9,790	1,020	5.18	5,280	1,400	4.54	6,360	4,310	4.99	21,430
Average	1,928	4.62	8,910	907	4.71	4,270	1,318	5.00	6,590	4,153	4.75	19,770
Total	4,746	-	21,790	2,193	-	10,200	3,352	-	16,060	10,291	-	48,050

Source: Agriculture Office, Kab. Soppeng and Kecamatan Office, Liliriaja, Lalabata, Marioriwawo and Lilirilau.

Table 2.2.5 Present Crop Rotation Patterns in the Project Area

(ha)

Crop Rotation Pattern	Desa Non-technical Area	Desa Semi-technical Area	D.P.U. Semi-technical Area	Total
I. Paddy - Paddy - Paddy (3 crops a year) Cropping intensity : 260-300%	-	-	70	70
II. Paddy - Paddy (2 crops a year) Cropping intensity : 180-200%	830	720	530	2,080
III. Paddy - Paddy (2 crops a year) Cropping intensity : 130-180%	1,610	580	1,180	3,370
IV. Paddy - Polowijo crops - Paddy (3 crops a year) Cropping intensity : 260-300%	40	100	-	140
V. Paddy - Polowijo crops (2 crops a year) Cropping intensity : 100-120%	420	-	320	740
Total	2,900	1,400	2,100	6,400

Source : Agriculture Office, Kab. Soppeng

Table 2.2.6 Ratio of Planted Areas under Varieties of Paddy in Kab. Soppeng (1977 - 1980)

Year	Planted Area (ha)	High Yield Variety (ha)	High Yield Variety (%)	Local Variety (ha)	Local Variety (%)
1977					
Wet Season Paddy	21.038	14,225	67.6	6.813	32.4
1977/1978					
Dry Season Paddy	8.660	7,199	83.1	1,461	16.9
1978					
Wet Season Paddy	21.560	11,495	53.3	10.066	46.7
1978/1979					
Dry Season Paddy	17.524	14.049	80.2	3,475	19.8
1979					
Wet Season Paddy	21.696	17.572	81.0	4,124	19.0
1979/1980					
Dry Season Paddy	11.621	9,873	85.0	1,748	15.0
Average					
Wet Season Paddy	21,431	14,430	67.3	7,001	32.7
Dry Season Paddy	12,575	10,347	82.3	2,228	17.7

Source : Annual Report 1980, Agriculture Office Kab. Soppeng

Table 2.2.7 Planted Area by Different Paddy Varieties in Kab. Soppeng
(1978 - 1979)

(ha)

Varieties \ Kec.	Lalabata		Lilirilau		Liliriaja		Marioriwawo		Kab. Soppeng	
	W.S.P.	D.S.P.	W.S.P.	D.S.P.	W.S.P.	D.S.P.	W.S.P.	D.S.P.	W.S.P.	D.S.P.
High Yield Variety										
IR 5	52	14	-	-	2	-	10	-	228	14
IR 8	-	-	-	-	-	-	-	-	46	-
IR 20	359	586	-	2	-	18	-	-	558	754
IR 26	548	1,412	91	225	873	2,272	276	756	3,325	6,078
IR 28	53	-	-	-	-	-	-	-	94	-
IR 29	34	25	-	-	32	101	19	-	85	126
IR 30	126	160	-	18	263	1,715	145	207	728	2,159
IR 32	2	508	-	27	3	113	4	229	98	1,133
IR 34	-	19	-	-	-	-	-	8	-	27
IR 36	5	18	-	1	89	300	-	-	94	329
IR 38	-	2	-	-	-	-	-	-	-	2
Asahan	-	-	-	-	-	11	-	-	-	11
C4 - 63	1,589	1,566	758	219	2,478	1,058	1,026	269	6,239	3,380
Pelita 1/1	-	36	-	-	-	-	-	-	-	36
Sub-total	2,768	4,346	849	492	3,740	5,588	1,480	1,469	11,495	14,049
Local Variety										
Kretek	1,154	-	532	-	1,580	-	-	-	3,508	-
B. Kamandi	46	-	160	-	35	13	16	-	256	13
Asc Tellang	-	-	904	-	-	-	-	-	904	-
Pulut	1,811	1,631	294	93	743	823	63	158	3,375	2,815
B4 - 62 C	977	349	41	-	410	-	387	60	2,023	547
LP3 lainnya	-	99	-	-	-	-	-	-	-	100
Sub-total	3,988	2,079	1,931	93	2,768	836	466	218	10,066	3,475
Total	6,756	6,425	2,780	585	6,508	6,424	1,946	1,687	21,561	17,524

Source : Annual Report 1979, Agriculture Office, Kab. Soppeng

Remarks : The new variety, IR36, has been rapidly spread over the project area after 1978/79.

Table 2.2.8 Planted Area by Different Paddy Varieties in Kab. Soppeng
(1979 - 1980)

(ha)

Varieties \ Kec.	Lalabata		Lilirilau		Liliriaja		Marioriwawo		Kab. Soppeng	
	W.S.P.	D.S.P.	W.S.P.	D.S.P.	W.S.P.	D.S.P.	W.S.P.	D.S.P.	W.S.P.	D.S.P.
High Yield Variety										
IR 5	7	25	-	-	-	-	7	-	14	25
IR 20	631	35	237	3	17	-	432	237	970	49
IR 26	1,274	615	627	58	1,866	1,139	-	-	6,144	2,493
IR 28	-	-	-	-	-	-	-	-	120	-
IR 29	16	-	-	-	62	6	-	16	78	22
IR 30	422	136	147	74	597	674	210	58	1,565	1,014
IR 32	668	410	146	-	1,212	144	350	154	2,882	995
IR 34	-	24	-	-	-	2	-	-	-	26
IR 36	394	460	109	51	1,237	1,526	234	135	2,110	2,342
IR 38	87	55	-	-	53	139	-	34	140	253
IR 42	-	-	-	-	-	-	-	6	-	6
Asahan	44	34	1	2	-	22	18	-	112	58
Berantas	-	-	-	-	-	-	-	5	-	5
Citarum	75	816	3	13	10	220	-	40	149	1,130
Serayu	-	9	-	-	-	-	-	-	-	9
C4 - 63	1,019	645	782	11	1,022	560	377	105	3,283	1,431
Pelita 1/1	5	15	-	-	-	-	-	-	5	15
Sub-total	4,642	3,279	2,052	212	6,076	4,432	1,628	790	17,572	9,873
Local Variety										
Kretek	118	-	134	-	169	-	-	-	421	-
B. Kamandi	181	-	260	-	-	-	-	-	441	-
Pulut	1,082	790	198	-	174	116	28	-	1,810	982
B4 - 62C	544	400	194	-	60	10	277	75	1,235	560
S.P.R.	-	105	-	-	-	-	-	-	217	206
Sub-total	1,925	1,295	786	0	403	126	305	75	4,124	1,748
Total	6,567	4,574	2,838	212	6,479	4,558	1,933	865	21,696	11,621

Source : Annual Report 1980, Agriculture Office, Kab. Soppeng

Table 2.2.9 Unit Farm Input and Labour Requirement per Ha under Present Cultivation (Paddy)

		Semi-technical Irrigation Area		Non-technical Irrigation Area		
		W.S.P./1	D.S.P./2	W.S.P./1	D.S.P./2	Rainfed area
A. Farm Input						
1. Seed		25 - 30 kg	25 - 30 kg	25 - 30 kg	25 - 30 kg	25 - 35 kg
2. Fertilizer	Urea	200 kg	200 kg	100 kg	100 kg	100 kg
	T.S.P.	50 kg	50 kg	35 kg	50 kg	-
	K.Cl	50 kg	50 kg	-	-	-
3. Chemicals	Insecticide	2 lt	2 lt	1.5 lt	2 lt	-
	Rondenticide	100 gr	100 gr	-	-	-
B. Labour	(man/day)					
1. Nursery Preparation		4.3	4.3	4.1	4.1	4.1
2. Ploughing		11.3	12.3	11.3	12.3	11.3
3. Harrowing/Puddling		13.6	14.5	13.6	14.5	13.6
4. Transplanting		25.7	25.7	25.7	25.7	25.7
5. Weeding		12.1	15.5	11.1	14.5	11.9
6. Fertilizer Application		5.5	5.5	4.3	4.3	4.3
7. Chemical Application		5.3	5.3	4.3	4.3	-
8. Harvesting		21.9	23.0	18.3	19.2	16.5
9. Threshing		17.2	18.2	14.3	15.2	12.8
10. Drying		5.1	5.6	4.2	4.7	3.8
11. Transportation		11.8	11.9	9.8	9.9	8.8
12. Water Management		3.0	3.0	2.5	2.5	-
Total		136.8	144.8	123.5	131.5	112.8
C. Miscellaneous						
Bags, mats, tools etc.		about 10% of total production cost				

/1: Wet Season Paddy /2: Dry Season Paddy
Source: Agriculture Office Kab. Soppeng

Table 2.2.10 Unit Farm Input and Labour Requirement per Ha under Present Cultivation (Polowijo Crops)

	Maize	Groundnuts	Greenbeans	Soybeans
A. Farm Input				
1. Seed	25 - 30 kg	80 - 100 kg	25 - 30 kg	30 - 40 kg
2. Chemical (Insecticide)	-	-	2 lt	2 lt
B. Labour (man/day)				
1. Land Preparation	5.0	8.5	7.0	8.5
2. Seeding/Planting	3.0	7.5	10.0	5.0
3. Weeding	12.5	20.0	20.0	15.0
4. Chemical Application	-	-	4.0	4.0
5. Harvesting/Drying	7.5	28.0	24.0	24.0
6. Transportation	1.5	1.0	1.0	1.0
7. Water Management	1.0	1.0	1.0	1.0
Total	30.5	66.0	67.0	61.5
C. Miscellaneous				
Bags, mats, tools etc.	about 8% of total production cost			

Source : Agriculture Office

Table 2.2.11 Unit Yields of Paddy in and around the Project Area (1975 - 1979)

Unit : dry stalk paddy (tons/ha)

Kec./Desa	Wet Season Paddy						Dry Season Paddy					
	1975	1976	1977	1978	1979	Ave.	1974/75	1975/76	1976/77	1977/78	1978/79	Ave.
Lalabata												
Maccile	3.85	3.65	4.85	5.11	5.25	4.54	3.15	3.15	3.74	3.73	4.56	3.67
Lalabatarilau	3.75	3.49	4.67	4.95	5.16	4.40	3.04	3.62	3.62	3.73	4.43	3.69
Lilirilau												
Pajalesang	4.30	3.80	4.64	5.58	5.85	4.83	4.90	5.07	5.30	5.38	3.42	4.41
Macanre	-	-	3.04	4.08	4.35	3.82	-	-	-	-	-	-
Liliriaja												
Ganra	3.29	4.98	4.33	4.62	4.62	4.37	5.56	4.37	5.01	5.19	5.02	5.03
Belo	3.79	4.98	4.33	4.62	4.62	4.47	5.26	4.57	5.01	5.11	5.02	4.99
Galung	4.72	4.98	4.53	4.62	4.86	4.74	5.26	5.17	5.01	5.19	5.15	5.16
Pattojo	3.99	4.98	4.53	4.62	5.03	4.43	5.46	4.37	5.01	5.19	5.21	5.05
Jennae	3.99	5.18	4.93	4.79	5.03	4.79	5.54	4.97	5.51	5.53	5.21	5.35
Marioriwawo												
Labessi	3.29	2.68	3.96	4.78	5.93	3.47	3.73	3.39	4.43	4.88	5.98	4.48
Tet. rarae	3.59	2.10	3.95	4.32	6.54	4.12	5.22	3.11	4.02	4.79	6.67	4.79
Watu	3.69	3.02	3.02	4.88	7.06	4.44	5.32	3.59	3.59	4.78	7.06	4.98
Goarie	3.60	2.68	3.96	4.71	6.96	4.26	5.23	3.39	4.43	4.79	7.06	4.84
Average	3.82	3.88	4.21	4.74	5.48	4.43	4.81	4.06	4.56	4.86	5.40	4.74

Source : Agriculture Office, Kab. Soppeng and Kecamatan Offices: Liliriaja, Lalabata, Marioriwawo and Lilirilau.

Table 2.2.12 Results of Paddy Yield Survey (Wet Season Paddy)

	Variety	Sampling Place (Kampung/Desa)	Nos. of Hills per m^2	Nos. of Panicles per Hill	Nos. of Grains per Panicle	1000 Grain Weight	% of Ripened Grains	Unit Yield/1 (paddy)	Unit Yield/2 (Dry Stalk Paddy)
			(Nos)	(Nos)	(Nos)	(gr.)	(%)	(ton/ha)	(ton/ha)
1.	IR36	Timparaja/Pattojo	21.0	22.8	52.6	22.8	72.0	4.13	5.40
2.	IR36	Tengngapa/Pattojo	22.3	18.0	96.2	23.7	80.6	7.38	9.65
3.	IR36	Jampu/Jampu	16.0	22.3	84.1	22.8	65.6	4.49	5.87
4.	IR26	Akampeng/Maccile	21.0	14.3	99.0	24.1	88.4	6.33	8.27
5.	C4-63	Mallanroe/Maccile	18.7	15.0	111.3	25.1	58.0	4.54	5.93
6.	IR30	Belo/Belo	16.3	25.9	93.5	21.8	66.0	5.68	7.44
7.	IR36	Launga/Galung	20.7	16.3	101.4	21.5	64.8	4.77	6.24
8.	Local	Kubba/Lalabatarilau	14.7	8.0	168.1	26.0	68.7	3.53	4.61
9.	IR36	Lawara/Pattojo	20.3	18.8	71.6	24.0	77.3	5.07	6.63
10.	IR36	Awo/Jennae	20.3	20.0	86.6	21.4	55.9	4.21	5.50
11.	IR36	Tokebbeng/Watu	20.7	20.2	109.2	21.7	73.6	7.29	9.53
12.	IR36	Tokebbeng/Watu	20.3	22.0	77.8	21.3	77.8	5.76	7.53
13.	IR36	Toddalobo/Pattojo	18.7	20.3	58.5	20.1	78.7	3.51	5.59
14.	IR26	Makuntung/Botto	19.7	13.4	93.7	21.4	60.8	3.22	4.21
15.	Local	Malaka/Ompo	12.4	7.2	185.3	22.5	76.9	2.86	3.74
16.	Local	Salokaraja/Ompo	15.1	7.3	172.4	26.5	60.0	3.02	3.95
17.	IR36	Cangadi/Ompo	22.0	27.8	61.9	20.8	61.9	4.87	6.37
18.	C4-63	Cenrana/Ompo	15.3	12.6	66.4	30.5	85.1	3.32	4.34
19.	Citarum	Paoe/Ompo	11.3	25.7	89.1	28.7	69.8	5.18	6.77
20.	IR36	Pattojo/Pattojo	21.7	15.3	81.1	22.0	68.0	4.03	5.27
21.	IR38	Mallanroe/Maccile	16.6	17.5	94.6	21.2	62.9	3.66	4.78
22.	IR36	Mallanroe/Maccile	17.3	23.5	85.2	21.1	68.2	4.98	6.51

/1 : Unit Yield (Paddy) = Nos. of hills per m^2 x Nos. of panicles per hill x Nos. of grains per panicle x % of ripened grains x 1,000 grain weight ÷ 1,000 x 10,000 m^2

/2 : Conversion rate of paddy / Dry stalk paddy = 76.5/100

Table 2.2.13 Results of Paddy Yield Survey (Dry Season Paddy)

	Variety	Sampling Place (Desa/Kecamatan)	Nos. of Hills per m^2 (Nos)	Nos. of Panicles per Hill (Nos)	Nos. of Grains per Panicle (Nos)	1000 Grain Weight (gr.)	% of Ripened Grains (%)	Unit Yield/1 (paddy) (ton/ha)	Unit Yield/2 (Dry stalk Paddy) (ton/ha)
1.	C4 - 63	Baru/Lalabata	15.2	10	61.4	21.5	69.2	1.39	1.82
2.	IR - 30	Labessi/Marioriwawo	20.0	22	57.7	24.7	53.9	3.38	4.42
3.	IR - 30	Galung/Lilirlaja	17.3	26	115.9	21.1	73.6	8.12	10.61
4.	IR - 32	Otting/Dua Pitue	18.8	20	75.8	23.7	77.6	5.23	6.84
5.	Local 46	Otting/Dua Pitue	15.3	14	120.4	22.5	75.0	4.40	5.75
6.	IR - 32	Lanairang/Dua Pitue	15.3	23	90.6	24.3	80.3	6.22	8.13
7.	IR - 26	Baru/Lalabata	16.0	20	114.6	21.3	64.5	5.03	6.57
8.	IR - 26	Baru/Lalabata	16.0	17	99.8	20.8	73.7	4.17	5.45
9.	IR - 5	Patangkai/Lappariaja	13.4	21	67.3	21.9	77.0	3.21	4.20
10.	IR - 5	Samaenre/Lappariaja	21.0	15	65.6	22.7	76.5	3.59	4.69
11.	C4 - 63	Maddumpa/Lalabata	16.0	15	63.1	22.1	70.4	2.35	3.07
12.	IR - 26	Attangsolo/Marioriawa	21.8	26	104.8	21.0	66.4	8.29	10.48
13.	IR - 5	Jenreng Palie/Lappariaja	16.0	16	105.1	26.8	76.2	5.49	7.18

/1 : Unit Yield = Nos. of hills per m^2 x Nos. of panicles per hill x Nos. of grains per panicle x % of ripened grains x 1,000 grain weight ÷ 1.000 x 10,000 m^2

/2 : Conversion rate of paddy / Dry stalk paddy = 76.5/100

Source : Supporting Report (volume 2) of Master Plan for The Central South Sulawesi Water Resources Development Project, March 1980

Table 2.2.14 Planted Area, Unit Yield and Production of Polowijo Crops in and around the Project Area (Average 1975 - 1979)

Kec./Desa	Maize			Groundnuts			Greenbeans			Soybeans		
	P.A./1 (ha)	U.Y./2 (ton/ha)	Pro./3 (ton)	P.A./1 (ha)	U.Y./2 (ton/ha)	Pro./3 (ton)	P.A./1 (ha)	U.Y./2 (ton/ha)	Pro./3 (ton)	P.A./1 (ha)	U.Y./2 (ton/ha)	Pro./3 (ton)
Lalabata												
Maccile	119	0.85	101	2	0.80	2	-	-	-	2	0.60	1
Lalabatarilau	58	0.71	41	-	-	-	71	0.84	60	2	0.80	2
Lilirilau												
Pajalesang	389	0.81	315	-	-	-	-	-	-	-	-	-
Macanre	113	0.73	82	-	-	-	-	-	-	-	-	-
Liliriaja												
Ganra	-	-	-	-	-	-	-	-	-	-	-	-
Belo	55	0.98	54	-	-	-	2	0.72	1	7	0.61	4
Galung	99	0.96	95	2	0.90	2	-	-	-	-	-	-
Pattojo	106	0.96	102	45	0.90	41	-	-	-	-	-	-
Jennae	92	0.95	87	20	0.90	18	-	-	-	-	-	-
Marioriwawo												
Labessi	385	0.63	243	26	0.63	16	-	-	-	-	-	-
Tettikengraraе	456	0.64	292	7	0.68	5	-	-	-	-	-	-
Watu	734	0.62	455	11	0.68	7	-	-	-	-	-	-
Goarie	1.138	0.64	728	28	0.73	20	-	-	-	-	-	-
Total/Average	3.744	0.79	2.595	141	0.81	111	73	0.83	61	11	0.67	7

/1 : P.A. : Planted Area /2 : U.Y. : Unit Yield /3 : Pro. : Production

Source : Agriculture Office, Kab. Soppeng and Kecamatan Offices; Lalabata, Lilirilau, Liliriaja, Marioriwawo.

Table 2.2.15 Number of Rice Mills in and around the Project Area

Kec./Desa	No. of Machine	Average Working Day	Capacity			Horse Power	
			Total Standard	Total Actual	Average	Total	Average
		(day/year)	(ton/hr)	(ton/hr)	(ton/hr)	(P S)	(P S)
Lalabata							
Maccile	25	116	19.35	19.35	1.54	170	6.80
Lalabatarilau	14	141	24.00	24.00	3.42	135	9.64
Lilirilau							
Pajalesang	16	59	15.40	13.05	1.77	110	6.88
Macanre	27	51	26.05	20.8	1.73	170	6.30
Liliriaja							
Ganra	46	160	73.65	73.65	3.42	428	9.95
Belo	36	84	45.20	45.20	2.58	331	9.45
Galung	42	113	56.60	52.60	2.76	313	7.63
Pattojo	68	158	59.15	55.65	1.73	469	7.10
Jennac	38	131	38.60	36.10	2.96	291	7.65
Marioriwawo							
Labessi	12	84	9.10	-	0.82	84	7.63
Tet.rarae	15	89	13.70	-	0.91	116	7.73
Watu	21	234	17.25	-	0.82	152	7.24
Goarie	11	164	8.15	-	0.74	57	5.18
Total	371	122	406.20	-	1.09	2,286	7.60

Source : Annual Report 1980.

Table 2.2.16 Production Cost of Paddy under Present Condition

	Unit Price	Semi-technical Irrigation Area				Non-technical Irrigation Area					
		W.S.P. /1	(Rp)	D.S.P. /2	(Rp)	W.S.P. /1	(Rp)	D.S.P. /2	(Rp)	Rainfed Area	(Rp)
A. Farm Input											
1. Seed	Rp150/kg	30 kg	4,500	30 kg	4,500	30 kg	4,500	30 kg	4,500	30 kg	4,500
2. Fertilizer											
Urea	Rp70/kg	200 kg	14,000	200 kg	14,000	100 kg	7,000	100 kg	7,000	100 kg	7,000
TSP	Rp70/kg	50 kg	3,500	50 kg	3,500	35 kg	2,450	50 kg	3,500	-	-
KCl	Rp70/kg	50 kg	3,500	50 kg	3,500	-	-	-	-	-	-
3. Chemicals											
Insecticide	Rp1,230/lt	2 lt	2,460	2 lt	2,460	1.5 lt	1,845	2 lt	2,460	-	-
Rodenticide	Rp4,000/kg	100 gr	400	100 gr	400	-	-	100 gr	400	-	-
Sub-total			28,360		28,360		15,795		17,860		11,500
B. Labour Cost	(Rp/day)	(M/D)		(M/D)		(M/D)		(M/D)		(M/D)	
1. Nursery Preparation	700	4.3	3,010	4.3	3,010	4.1	2,870	4.1	2,870	4.1	2,870
2. Ploughing	750	11.3	8,475	12.3	9,225	11.3	8,475	12.3	9,225	11.3	8,475
3. Harrowing/Puddling	750	13.6	10,200	14.5	10,875	13.6	10,200	14.5	10,875	13.6	10,200
4. Transplanting	700	25.7	17,990	25.7	17,990	25.7	17,990	25.7	17,990	25.7	17,990
5. Weeding	700	12.1	8,470	15.5	10,850	11.1	7,770	14.5	10,150	11.9	8,330
6. Fertilizer Appl.	350	5.5	1,925	5.5	1,925	4.3	1,505	4.3	1,505	4.3	1,505
7. Chemical Appl.	550	5.3	2,915	5.3	2,915	4.3	2,365	4.3	2,365	-	-
8. Harvesting	600	21.9	13,140	23.0	13,800	18.3	10,980	19.2	11,520	16.5	9,900
9. Threshing	600	17.2	10,320	18.2	10,920	14.3	8,580	15.2	9,120	12.8	7,680
10. Drying	700	5.1	3,570	5.6	3,920	4.2	2,940	4.7	3,290	3.8	2,660
11. Transportation	350	11.8	4,130	11.9	4,165	9.8	3,430	9.9	3,465	8.8	3,080
12. Water Management	350	3.0	1,050	3.0	1,050	2.5	875	2.5	875	-	-
Sub-total		136.8	85,195	144.8	90,645	123.5	77,980	131.2	83,250	112.8	72,790
C. Miscellaneous Cost (Equipment, tax, etc.)	12% of (A+B)	-	13,445	-	14,995	-	11,225	-	11,890	-	9,710
Total (A+B+C)			127,000		134,000		105,000		113,000		94,000

/1 : Wet Season Paddy /2 : Dry Season Paddy

Table 2.2.17 Production Cost of Polowijo Crops under Present Condition

	Unit Price	Maize		Groundnuts		Greenbeans		Soybeans	
			(Rp)		(Rp)		(Rp)		(Rp)
A. Farm Input									
1. Seed	-	30 kg	1,800	100 kg	30.000	25 kg	6,250	40 kg	10.000
2. Fertilizer									
Urea	Rp70/kg	-	-	-	-	-	-	-	-
TSP	Rp70/kg	-	-	-	-	-	-	-	-
3. Chemicals									
Insecticide	Rp1,230/1t	-	-	-	-	2 1t	2,460	2 1t	2.460
Rodenticide	-	-	-	-	-	-	-	-	-
Sub-total			1,800		30,000		8,710		12,460
B. Labour Cost	(Rp/day)	(M/D)		(M/D)		(M/D)		(M/D)	
1. Land Preparation	700	5.0	3,500	8.5	5,950	7.0	4,900	8.5	5,950
2. Seeding/planting	600	3.0	1,800	7.5	4,500	10.0	6,000	8.0	4,800
3. Weeding	700	12.5	8,750	20.0	14,000	20.0	14,000	15.0	10,500
4. Fertilizer Application	350	-	-	-	-	-	-	-	-
5. Chemical Application	550	-	-	-	-	4.0	2,200	4.0	2,200
6. Harvesting/Drying	600	7.5	4,500	28.0	16,800	24.0	14,400	24.0	14,400
7. Transportation	350	1.5	520	1.0	350	1.0	350	1.0	350
8. Water Management	350	1.0	350	1.0	350	1.0	350	1.0	350
Sub-total		30.5	19,420	66.0	41,950	67.0	42,200	61.5	38,550
C. Miscellaneous Cost (Equipment, Tax etc.)	10% of (A+B)		2,180		7,050		5,090		4,990
Total (A+B+C)			23,400		79,000		56,000		56,000

Table 2.2.18 Land Holding Size Distribution in and around the Project Area

Unit : Nos. of farm

Kecamatan/Desa	Land Holding Size					
	0-0.5	0.5-1	1-2	2-3	3-	Total
Lalabata						
Maccile	355	106	19	19	2	492
Lalabatarilau	355	108	69	3	1	536
Lilirilau						
Pajalesang	916	504	70	22	8	1,520
Macanre	204	142	72	25	13	456
Liliriaja						
Ganra	39	58	45	19	16	177
Belo	141	208	160	70	46	625
Galung	184	275	210	93	58	820
Pattojo	255	435	292	128	81	1,191
Jennae	130	195	150	66	41	582
Marioriwawo						
Labessi	175	250	120	2	-	547
Tet. rarae	25	17	30	5	-	77
Watu	515	500	116	45	-	1,176
Goarie	85	60	35	15	-	195
Total	3,379	2,858	1,388	503	266	8,394
%	40.3	34.0	16.5	6.0	3.2	100

Source : IPEDA Office, Kab. Soppeng
Kec. Offices ; Lalabata, Lilirilau, Liliriaja and Marioriwawo.

Table 2.2.19 Farm Budget of Average Size Farmer under Present Condition

Total Farm Land : 1.03 ha
- Paddy field : 0.61
- Up-land field : 0.42

Family Size : 5.53 persons

	(Rp)
1. Gross Farm Income	
Wet season paddy	231,400
Dry season paddy	172,400
Polowijo crops	1,600
Up-land crops	19,900
Non-farm income	20,200
Sub-total	445,500
2. Gross Out-go	
Farming expenses	
Paddy	68,800
Polowijo crops	100
Up-land crops	1,700
Irrigation expenses	11,800
IPEDA tax, others	4,200
Sub-total	86,600
3. Net Farm Income (1 - 2)	358,900
4. Family Living Expenses	
Food	208,700
Residence	46,900
Clothing	38,300
Luxury	22,900
Education	18,600
Social-expenses	15,800
Miscellaneous	6,800
Sub-total	358,000
5. Net Reserve (3 - 4)	900

Table 2.3.1 Amount of BIMAS Package Credit per Ha.
(Paddy)

1980/1981	Category - I						Category - II					
	Package A		Package B		Package C		Package A		Package B		Package C	
	Amount	Value (Rp)	Amount	Value (Rp)	Amount	Value (Rp)	Amount	Value (Rp)	Amount	Value (Rp)	Amount	Value (Rp)
1. Seed	-	5.000	-	-	-	5.000	-	5,000	-	-	-	5.000
2. Fertilizeres												
Urea	200 kg	14.000	100 kg	7.000	250 kg	17.500	130 kg	9,100	65 kg	4,550	160 kg	11,200
T.P.S.	50 kg	3.500	35 kg	2.450	75 kg	5.250	50 kg	3.500	35 kg	2,450	75 kg	5.250
D.A.P.	-	-	-	-	-	-	150 kg	9.750	75 kg	4.875	185 kg	12,025
Kcl/K_2O	50 kg	3.500	50 kg	3.500	50 kg	3.500	50 kg	3.500	50 kg	3,500	50 kg	3,500
3. Chemicals												
Insecticide	2 lt	2.460	2 lt	2,400	2 lt	2.460	2 lt	2,460	2 lt	2.460	2 lt	2.460
Rodenticide	100 gr	400	100 gr	400	100 gr	400	100 gr	400	100 gr	400	100 gr	400
4. Sprayer	-	2.000	-	2.000	-	2.000	-	2.000	-	2.000	-	2.000
5. Other Expenses	-	10.000	-	10.000	-	10.000	-	10,000	-	10.000	-	10,000
Total		40.860		27.810		46.110		45.710		30.235		51.835

Source : Report of Intensification Programme of Paddy, Polowijo and Vegetable 1980/1981, 1980, South Sulawesi Province.

Table 2.3.2 Amount of BIMAS Package Credit per Ha

(Polowijo Crops)

1980/1981	Maize		Groundnuts		Greenbeans		Soybeans	
	Amount	Value (Rp)	Amount	Value (Rp)	Amount	Value (Rp)	Amount	Value (Rp)
1. Seed	-	3,250	-	35,000	-	8,000	-	15,000
2. Fertilizeres								
Urea	250 kg	17,500	100 kg	7,000	50 kg	3,500	75 kg	5,250
T.P.S.	100 kg.	7,000	100 kg	7,000	50 kg	3,500	100 kg	7,000
3. Chemicals								
Pesticide	0.5 kg	615	2 liter	2,460	2 liter	2,460	-	-
Fungicide	-	-	-	-	-	-	4 liter	4,920
Rodenticide	-	-	-	-	-	-	-	-
4. Sprayer	-	-	-	1,000	-	1,000	-	2,000
5. Other Expenses	-	4,000	-	4,000	-	4,000	-	4,000
Total	-	32,365	-	56,460	-	22,460	-	38,170

Source : Report of Intensification Programme of Paddy, Polowijo and Vegetable 1980/1981, 1980, South Sulawesi Province.

Table 2.5.1 Profitability of Major Crops

	Wet Season Paddy	Dry Season Paddy	Maize	Groundnuts	Greenbeans	Soybeans
Without Project						
(Present Condition)						
Unit Yield (ton/ha)	4.43	4.74	0.79	0.81	0.83	0.67
Unit Price (Rp/ton)	120,000	120,000	92,000	351,000	310,000	328,000
Gross Prod./1 Value (Rp/ha)	531,600	568,000	72,680	284,310	257,300	219,760
Production Cost (Rp/ha)	183,000	192,000	34,000	96,000	80,000	80,000
Net Prod./1 Value (Rp/ha)	348,600	376,000	38,680	188,310	177,300	139,760
With Project						
Unit Yield (ton/ha)	6.0	6.0	2.0	1.2	1.2	1.2
Unit Price (Rp/ton)	120,000	120,000	92,000	351,000	310,000	328,000
Gross Prod./1 Value (Rp/ha)	720,000	720,000	184,000	421,200	372,000	393,600
Production Cost (Rp/ha)	191,000	199,000	113,000	142,000	122,000	121,000
Net Prod./1 Value (Rp/ha)	529,000	521,000	71,000	279,200	250,000	272,600
INCREMENT (Rp/ha)	180,400	145,000	32,320	90,890	72,700	132,840

/1 : Prod.: Production

Table 2.5.2 Comparison of Alternative Cropping Patterns in Profitability

	Pattern A (Paddy-Polowijo-Paddy)	Pattern B (Paddy-Paddy)	Pattern C (Paddy-Paddy-1/2 Paddy)	Pattern D (Paddy-Paddy-1/2 Polowijo)
1. Planted Area (ha)				
1st Paddy (Wet season paddy)	1.0	1.0	0.5	0.5
2nd Paddy (Dry season paddy)	1.0	1.0	0.5	0.5
3rd Paddy (Wet season paddy)	-	-	0.5	-
4th Paddy (Wet season paddy)	-	-	0.5	0.5
5th Paddy (Dry season paddy)	-	-	0.5	0.5
Polowijo crops	1.0	-	-	0.5
2. Cropping Intensity	3.0	2.0	2.5	2.5
3. Unit Yield (ton/ha)				
Wet season paddy (Dry stalk paddy)	6.0	6.0	6.0	6.0
Dry season paddy (Dry stalk paddy)	6.0	6.0	6.0	6.0
Polowijo crops	1.2 - 2.0	-	-	1.2 - 2.0
4. Unit Prices of Farm Product (Rp/ton)				
Dry stalk paddy	120,000	120,000	120,000	120,000
Polowijo crops	270,000	-	-	270,000
5. Gross Production Value (1x3x4) (Rp/ha)	1,782,700	1,440,000	1,800,000	1,611,400
6. Production Costs (Rp/ha)				
Wet season paddy	191,000	191,000	191,000	191,000
Dry season paddy	199,000	199,000	199,000	199,000
Polowijo crops	124,500	-	-	124,500
7. Net Production Value (Rp/ha)	1,268,200	1,050,000	1,215,000	1,159,100

Table 2.5.3 Design Criteria of Proposed Farming for Paddy

1.	Varieties	IR-28/IR-36
2.	Growing Period	105-110 days
3.	Amount of Seed	30 kg/ha
4.	Nursery Period	15 - 20 days
5.	Area of Nursery Bed	1/20 of paddy field
6.	Land Preparation	One time of ploughing and 2 time hallowing/puddling
7.	Planting Method	Transplanting
8.	Planting Density	30 cm x 15 cm, 3 seedlings/hill
9.	Planting Depth	3 cm from the surface
10.	Fertilization	
	- Nursery bed	5 kg or Urea
	- Paddy field	195 kg of Urea/ha 50 kg of TSP/ha 50 kg of KCl/ha
	Time in Paddy Field	
	All TSP and KCl	Basic dressing at land preparation time
	35% Urea	Basic dressing at land preparation time
	35% Urea	First top dressing at 15 days after transplanting time
	30% Urea	2nd top dressing in the late period of a young panicle formation stage
11.	Weeding	at 15th, 30th and 50th day after transplanting
12.	Application of Chemicals	Insecticide 3 lt/ha Fungicide 1 lt/hr Rodenticide 100 gr/ha
13.	Water Control	
	. Transplanting to rooting period	Deep water depth
	. Most tillering period	Shallow water depth with intermitted irrigation
	. Neck-node differentiation period upto panicle formation period	Drying method
	. Full ripening period to harvested	Water drained
14.	Harvesting	By sickle

Note : This table compiled on the basis of data obtained from Central Research Institute for Agriculture, Bogor and Agriculture Office in Kab. Soppeng.

Table 2.5.4 Design Criteria of Proposed Farming for Polowijo Crops

	Maize	Groundnuts	Greenbeans	Soybeans
1. Varieties	BAKU BAKU, IMPA IMPA KURETEK KUNING, MENADO KUNING	GAJAH SWARCH	BAKTI B - 129 SIWALIK	ORBA DAVROS RINGGIT
2. Growing Period	75 - 90 days	85 - 100 days	65 - 75 days	80 - 95 days
3. Amount of Seed	30 - 50 kg/ha	80 - 100 kg/ha	25 - 30 kg/ha	40 - 50 kg/ha
4. Land Preparation		2 times of Ploughing and Hallowing		
5. Planting Method		Direct seeding		
6. Planting Density	50 cm x 100 cm	25 cm x 25 cm	30 cm x 50 cm	30 cm x 50 cm
7. Fertilization				
Basic dressing	100 kg/ha of Urea 100 kg/ha of TSP	50 kg/ha of Urea 100 kg/ha of TSP	50 kg/ha of Urea 100 kg/ha of TSP	50 kg/ha of Urea 100 kg/ha of TSP
Top dressing	150 kg/ha of Urea	25 kg/ha of Urea	50 kg/ha of Urea	50 kg/ha of Urea
8. Weeding		at 10th, 30th and 60th day after seeding		
9. Application of Chemicals				
Insecticide	2 lt/ha	2 lt/ha	2 lt/ha	2 lt/ha
Rodenticide	100 gr/h	100 gr/ha	100 gr/ha	100 gr/ha
10. Water Control		Intermittent Irrigation (5 - 10 day Interval)		

Note : This table compiled on the basis of data obtained from Central Research Institute for Agriculture, Bogor and Agriculture Office in Kab. Soppeng.

Table 2.5.5 Annual Paddy Production without and with Project

	Without Project			With Project			Increment		
	W.S.P./1	D.S.P./2	Total	W.S.P./1	D.S.P./2	Total	W.S.P./1	D.S.P./2	Total
1. Planted Area/3 (ha)									
- Desa non-tech. irri. area	2,818	1,928	4,746	2,900	2,900	5,800	82	972	1,054
- Desa semi-tech. irri. area	1,286	907	2,193	1,400	1,400	2,800	114	593	707
- D.P.U. semi-tech. irri. area	2,034	1,318	3,352	2,100	2,100	4,200	66	682	748
Total	6,138	4,153	10,291	6,400	6,400	12,800	262	2,247	2,509
2. Unit Yield/4 (ton ha)									
- Desa non-tech. irri. area	4.57	4.62	-	6.0	6.0	-	1.43	1.38	-
- Desa semi-tech. irri. area	4.59	4.71	-	6.0	6.0	-	1.41	1.29	-
- D.P.U. semi-tech. irri. area	4.64	5.00	-	6.0	6.0	-	1.36	1.00	-
3. Production (ton)									
- Desa non-tech. irri. area	12,900	8,900	21,800	17,400	17,400	34,800	4,500	8,500	13,000
- Desa semi-tech. irri. area	5,900	4,300	10,200	8,400	8,400	16,800	2,500	4,100	6,600
- D.P.U. semi-tech. irri. area	9,400	6,500	15,900	12,600	12,600	25,200	3,200	6,100	9,300
Total	28,200	19,700	47,900	38,400	38,400	76,800	10,200	18,700	28,900

/1 : Wet Season Paddy. /2 : Dry Season Paddy

/3 : See Table 2.2.4. /4 : Dry Stalk Paddy

Table 2.5.6 Economic Price of Dry Stalk Paddy in the Project Area

- Import substitution price -

(Unit = Rp/ton)

1.	International Market Price (F.O.B. Bangkok)/1 US$368	230,000
2.	External Transportation Cost (Bangkok - Ujung Pandang)	8,125
3.	Port Handling Charge and Storing Cost (including cost of sacks)/2	5,290
4.	Inland Transportaion Cost (Ujung Pandang - Watan Soppeng)	4,000
5.	Selling Price of Rice at Ex-mill Gate	247,415
6.	Conversion to the Price of Dry Stalk Paddy (0.52)	128,656
7.	Milling Charge	- 6,000
8.	Handling and Transportation Cost (Farm gate to mill)	- 2,700
9.	Economic Farm Gate Price of Dry Stalk Paddy	119,956 ≒ 120,000

Note ; /1 : Source : Price Prospects for Major Primary Commodities, IBRD, 1980

Projected price to 1985 in 1977 constant US dollars.

/2 : Handling charge at harbor 30 Rp/ton
Storing charge 7 Rp/ton/day x 180 days
Cost of sacks 4000 Rp/ton