Preliminary Survey Report
on
Maize Development Cooperation Project
in Indonesia

SEPTEMBER 1971

OVERSEAS TECHNICAL COOPERATION AGENCY
TOKYO
JAPAN

FOREWORD

Under commission of the Ministry of Foreign Affairs, the Overseas Technical Cooperation Agency dispatched the Maize Preliminary Survey Team to Indonesia for a period of one and a half months from November 10, 1970.

The survey was carried out in compliance with a request by Indonesia for Japan's technical cooperation in expanding the production and export of maize in Central Java, South Sulawesi and Lampung, Indonesia's major maize producing areas, excluding East Java where the project for the development of maize production and export had already been in progress since 1968 under Japanese aid. Owing to the wide scope of the survey and the limited time allowed for it, it was not possible for the survey team to conduct a complete analysis of the existing state of maize production. It is believed, however, that the team's findings will prove useful in determining policies for detailed surveys for the implementation of further technical assistance by Japan.

This report has been prepared as a summary of the team's findings in the above-mentioned three provinces.

Besed on the survey results, the team has designated Lampung as the top priority area for Japan's cooperation in the development of maize production and export, with the second and third priority to be given to South Sulawesi and Central Java, respectively. Accordingly, a second maize survey team will be dispatched in 1971 for a detailed survey in Lampung to establish the basis for Japan's cooperation.

Acknowledgement is due to the Department of Agriculture, Ministry of Agriculture and to the local government authorities of Indonesia for their unstinted assistance and cooperation which proved most valuable in achieving objective of the survey.

September 1971

Keiichi Tatsuke
Director-General
Overseas Technical Cooperation Agency

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CHAPTER I INTRODUCTION

Indonesia covers an area of 1.9 million km^2 and has a population of 120 million. Though the country abounds in various natural resources, the livelihood of farmers, who comprise 80 % of the total population, is still on a low level. It is believed that, the development of agricultural products and their export in order to gain increased foreign exchange earnings are the most effective means to provide real hope for a more decent life for farmers as well as to accelerate the pace of Indonesia's economic development. Schemes for such development should be pushed forward in close relation to technical and financial aids.

The preliminary maize survey described in this report was conducted in conformance with ATA20, Corn Production Centre Development in Central and East Java, Bulukumba and Djeneponto Area (South Sulawesi) and Lampung, List of Technical Assistance Proposal 1971 - 1972. The primary objective of the survey was to grasp the existing condition of maize production in these areas.

The survey activities centered on the clarification of the following.

(1) Condition of Maize Production
   - Meteorological, Soil and Drainage Conditions and Actual Finding of Plots -

(2) Conditions of Cultivation
   - Varieties, Method of Cultivation, and Yield -

(3) Quality Control
   - Drying, Processing and Quality of Maize -

(4) Marketing
   - Supply and Demand, Mechanism for Marketing Transportation, and Price of Maize -

(5) Selection of Areas and Consideration of System for Project

Based on the survey results described in the following chapters, the team gave top priority for Japan's cooperation to Lampung, followed by South Sulawesi and Central Java.

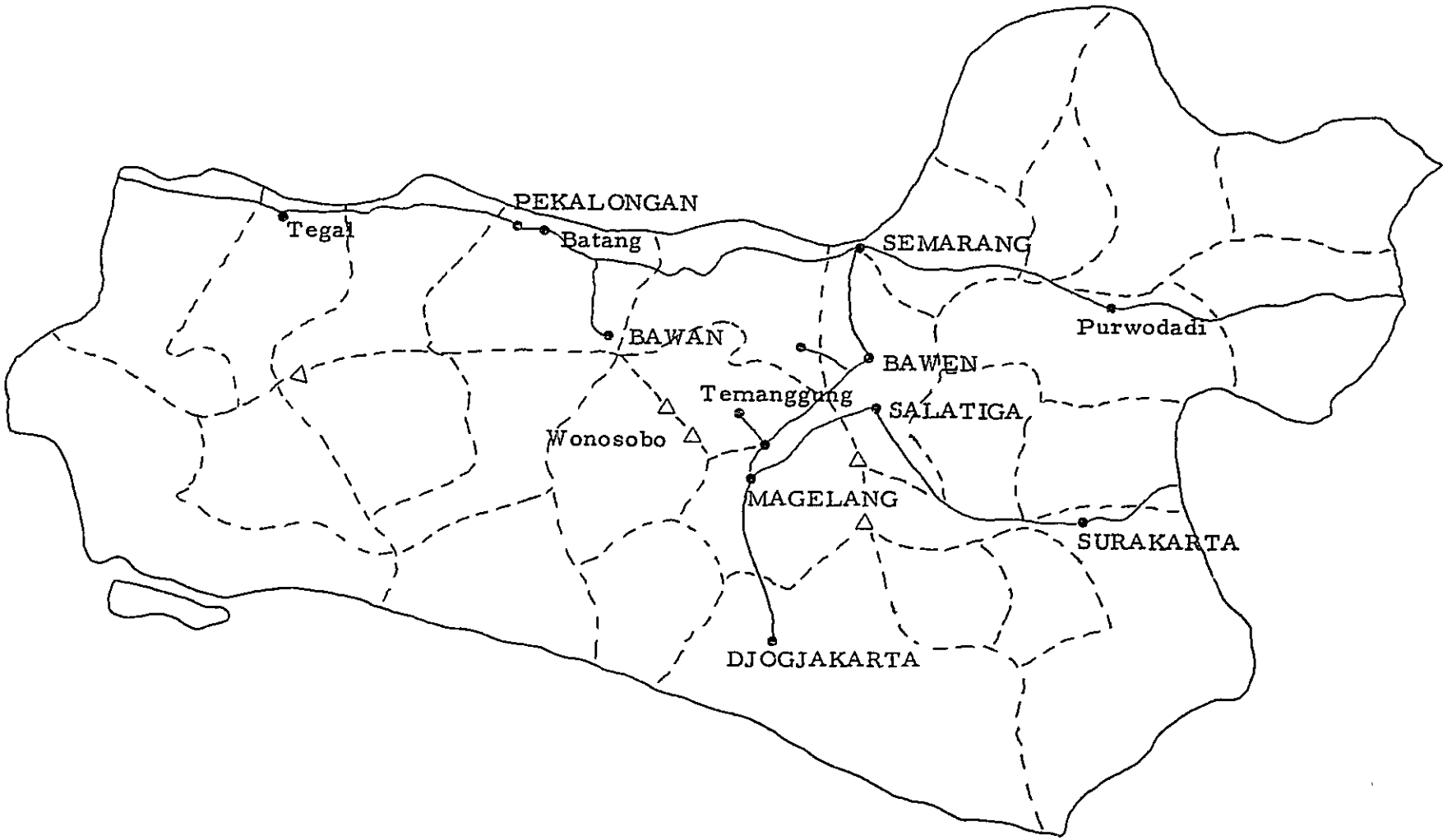
The formation of the survey team was as follows.

Leader	Keiji Urano	Councillar, Overseas Technical Cooperation Agency

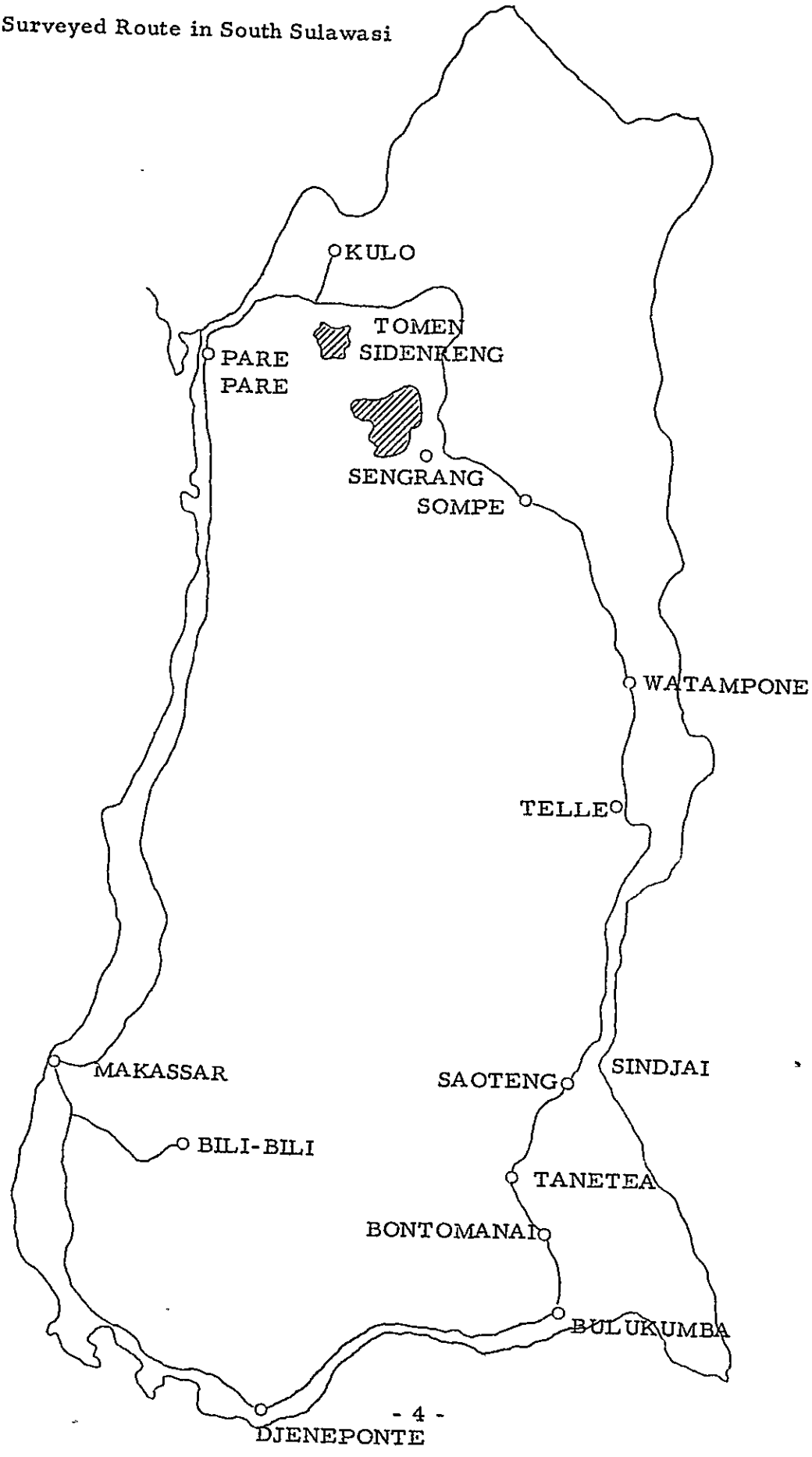
Member	Yoshiyuki Shimokawa	Adviser, Pacific Consultants Co., Ltd.
"	Hisashi Kobayashi	Chief of Entomological Division, Tohoku National Agricultural Experiment Station, Ministry of Agriculture and Forestry
"	Yoshio Sato	Technical Staff, Economic Cooperation Policy Section, Ministry of International Trade and Industry
"	Yoshio Matsubara	Head, Primary Products Development Cooperation Office, Overseas Technical Cooperation Agency
"	Hidekazu Komuro	Team Leader, Maize Development Project, East Java in Indonesia
"	Masaru Matsuo	Agricultural Economist, Current Affairs Division, Institute of Developing Economies

The team gratefully acknowledges the valuable and unlimited assistance offered by the officials concerned of the Department of Agriculture and local government authorities which proved most instrumental in fulfilling the purpose of the survey.

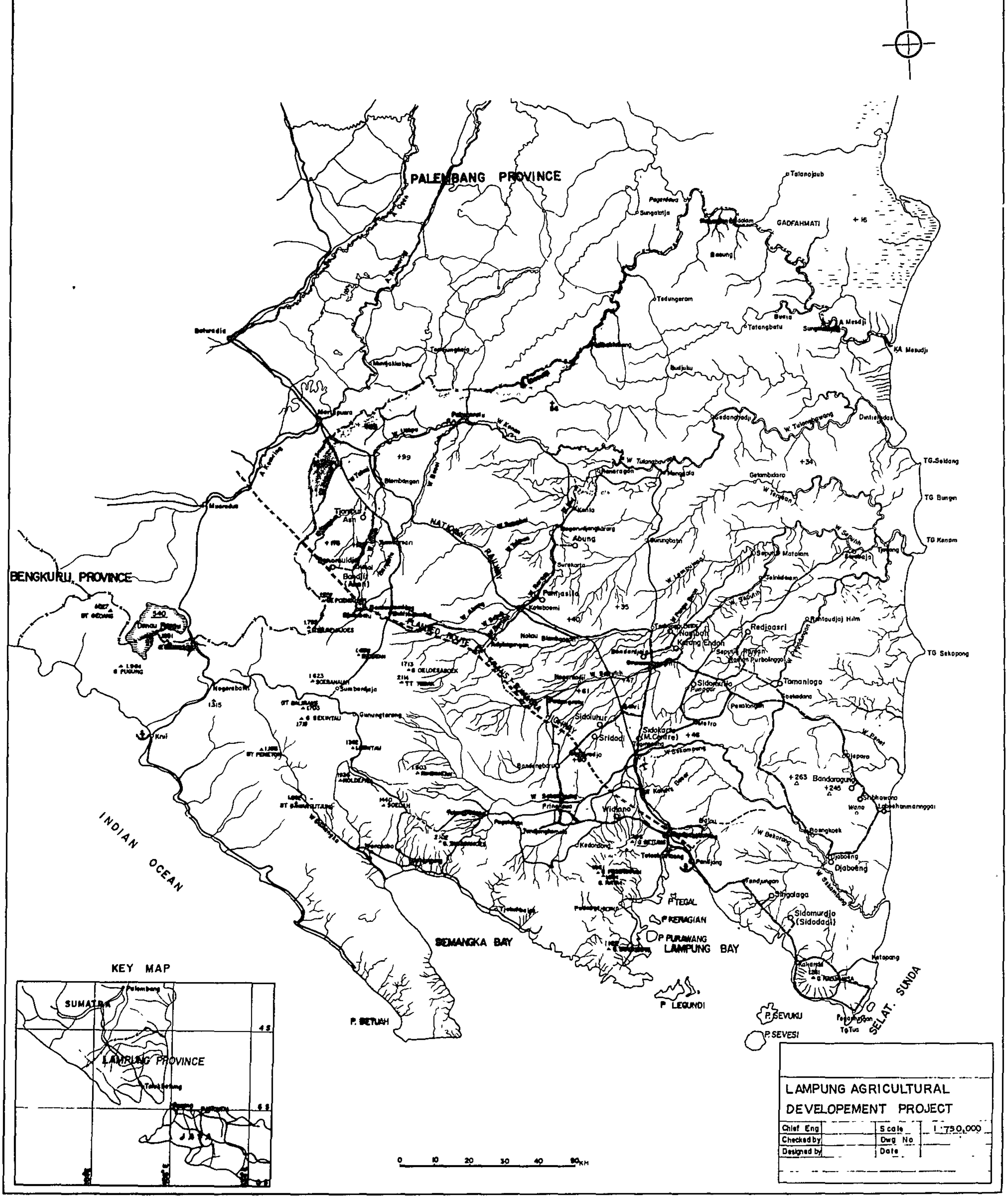
Surveyed Route in Central Java



Surveyed Route in South Sulawasi



Survey Route in Lampung



CHAPTER II EXISTING STATE OF MAIZE PRODUCTION IN CENTRAL JAVA

1. Socio-economic Background - Population and Land -

Central Java has six Keresidenans which are subdivided into 29 Kabupatens. The population of the province is estimated at 22,354,000 as of 1969. Since the 1961 census registered a population of a little over 18,407,000, the province recorded a population increase of more than 21 % during the nine-year period. Central Java's industry centers on agriculture, particularly on the production of food crops. The 1964 census disclosed that 69.9 % of the province's total working population was engaged in agriculture, 7.5 % in mining and manufacturing industries, 19.1 % in transport and commerce, and 3.5 % in other activities.

The 1961 census also revealed that the total number of farm households was approximately 2,623,000 and the total farm land area about 1,813,000 ha, indicating that the average operational holding per household was no larger than 0.69 ha. Of these farm households, 1,378,675 (52.55 %) have an average holding of less than 0.5 ha and 731,946 (27.9 %) hold land averaging from 0.5 - 1 ha, indicating that the majority of the households are on a low subsistence level. Farm households possessing farm land of 1 ha or larger account for slightly less than 20 %.

A study of population and land based on a limited number of samples drawn during the survey showed general conformity to the above description.

In Desa Danjang (Katjamatan Purwodadi, Kabupaten Grobogan), 20 farm households taken as samples have paddy fields and upland fields totalling 642 a and 567 a, respectively, with the per household holding averaging 32.1 a for paddy fields and 28.4 a for upland fields. In Desa Surjo (Katjamatan Bawang, Kabupaten Batang), the total holding of 20 other farm households sampled was 408 a for paddy fields and 504.6 a for upland fields, with the per household holding standing at 20.4 a for the former and 25.2 a for the latter.

If class disintegration develops against such a low subsistence level of land ownership, this would result in an increased number of landless farmers and farm laborers.

The farmers' classes in Kabupaten Klaten situated in the southern part of Central Java is shown below as an example of class disintegration in the province.

Farmers with paddy fields and dry fields within garden compounds	66,874
Farmers with paddy fields only	7,986
Farmers with dry fields within garden compounds only	49,132
Farmers with no paddy fields and living in leased houses	59,013
Farmers with no paddy fields and boarding with other farmers	21,899
Total	204,904

As shown above, 40 % of farm households in Kabupaten Klaten do not own paddy fields. It is considered that the developed cultivation of sugar cane, tobacco and other commercial crops in this Kabupaten has given rise to accelerated class disintegration as suggested by the above high rate, and that 25 % to 30 % of farmers throughout the country in general have no lands of their own.

Against such a background of land ownership, there exists a complicated tenant system. There is no system of large land ownership in Java, and farm households with more than 3 ha of land account for less than 2 % of all farm households in Central Java. And these farm households tend to lease their lands for tenancy rather than to cultivate them for themselves.

Since the lease contracts are verbally concluded for each harvesting season, the farmers' economic footing is extremely unstable. The rent is paid either by the flat sum system or by the fixed percentage system. It appears that the former system, though practiced in Klaten and Surakarta where the cultivation of commercial crops is developed, is adopted only in those limited areas where the land productivity is high enough to allow its implementation. In most of the country's agricultural areas, the fixed percentage system is employed with the rent paid being usually 1/2 of the crop. However, varying rates such as 2/3, 1/3 and 1/4 the crops are adopted according to the productivity of land, cultivation expenses and other production factors incumbent upon the tenants. The acreage of farm land per tenant farmer is extremely small, in many cases not even reaching 10 a. It is often the case that a landowner leases his land to a number of tenant farmers. Under such circumstances, only subsistence farming is possible, making the introduction of commercial crops almost impossible, not to speak of new investment for increased production.

2. Existing State of Agriculture

(1) Crops and Their Production

Since farmers cultivate only an extremely small farm land the cultivation of food crops centering on rice for their own consumption constitutes the basis of Javanese agriculture.

Table 1. Production of Major Crops (1969)

Crop	Harvested Area (ha)	Production (t)	Average Yield (t/ha)
1. Paddy	1,240,485	3,904,149	3.147
2. Upland Paddy	52,170	79,552	1.524
3. Maize	454,651	325,312	0.716
4. Cassava	349,529	1,793,449	5.131
5. Sweet Potatoes	49,248	202,480	4.111
6. Groundnuts	76,515	47,683	0.377
7. Soybeans	76,520	37,147	0.485
8. Green beans	3,375	1,064	0.315
9. Javanese Tobacco	* 56,794	19,389.38	0.341
10. Vorstenland Tobacco	* 1,109	1,439.35	1.298
11. Sugar Cane	3,344	234,642	70.168
12. Coffee	* 12,660	5,164.65	4.080
13. Clove	575,429	519.89	0.009
14. Rossela	2,266	2,408.2	1.063

Remarks: * Planted Area

Items 1 to 8 shown in the above table are raised mostly for the farmers' own consumption. Against the estimated per capita annual demand of 150 kg for cereals and potatoes in Central Java, the production of these crops was about 130 kg per capita in 1969, excluding seeds. Thus, in the province there is an absolute shortage of cereals and potatoes which must be covered by other crops. Accordingly, increased maize production is liable to be consumed within the province unless the production of food crops as a whole is increased within a short time.

(2) Major Farm Crops

(a) Rice

Rice, the most important crop in Central Java, is cultivated throughout

the province where water is available. Of a total of about 1.83 million ha of the province's farm land area, excluding dry fields within garden compounds, about one million ha of paddy fields (rain-fed paddy fields inclusive) are planted with paddy in the wet season. In upland fields covering an area of about 780,000 ha, upland paddy also is cultivated in the wet season. Food crops other than rice are raised in rain-fed paddy fields and upland fields in the dry season as well as in the rain-fed paddy fields in the wet season with small rainfall. Production of crops other than rice recorded about 1.95 million tons in 1969 in terms of milled rice.

Table 2. Acreage of Paddy Field

Paddy Fields with Well Established Irrigation (Established and managed by Government finance)	351,422 ha
Half-Irrigated Paddy Fields (Established by Government and managed by Desa)	144,046 ha
Paddy Fields under Desa-Managed Irrigation System	208,859 ha
Total of Irrigated Paddy Fields	704,327 ha
Rain-fed Paddy Fields	342,311 ha
Total of Paddy Fields	1,046,638 ha
Upland Fields	783,328 ha
Dry Fields within Garden Compounds	581,176 ha
Total Acreage of Farm Land	2,411,142 ha

Yield of rice per ha is on a low level of 1.5 tons in terms of milled rice. Thus, the average per capita rice production does not reach the 85 kg level in Central Java, although rice production is the major industry of the province. Shortage of rice supply is therefore a common phenomeon observed even in farm villages.

Order to increase food production, the Government is installing new irrigation facilities and repairing and rehabilitating the existing ones. But considering the fact that 550,000 ha of paddy fields now irrigated on the village level and of rain-fed paddy fields must be taken into a account, the Government's efforts have not yet yielded any appreciable effect. The drive for increased agricultural production is being implemented under the Bimas Scheme which aims at the increased supply of fertilizers, improved varieties and agro-chemicals

through the Agricultural Credit System and also at the diffusion of improved farming practices through the provision of necessary techniques and guidances. As is well known, however, the implementation of the said scheme exposed a number of problems, such as the need for consolidating the distribution and financing systems, the shortage of extension workers, the lack of interest in the scheme on the part of farmers, etc. As a result, the Government has run into a huge deficit and the scheme now calls for a reconsideration.

(b) Other Food Crops

As described earlier, double cropping of rice is carried out if water is abundantly available. In rain-fed paddy fields or in the dry season when available irrigation water is not sufficient, however, Cereal and leguminous (Pro Prowidjo) are cultivated for double cropping together with rice. Cereal and leguminous crops (polowidjo) cultivated in Central Java include maize, soybean, groundnuts and green beans. As shown in Table 3, the acreage of harvested area of food crops is far smaller than that of rice. Cassava is cultivated in an area of about 380,000 ha, soybeans 110,000 ha, groundnuts, 80,000 ha, sweet potatoes 40,000 ha and maize 60,000 ha. Though most food crops other than rice are cultivated in upland fields, a substantially large percentages of them are grown in paddy fields. For instance, 63.7 % of soybeans, 45.2 % of groundnuts and 36.2 % of maize are cultivated in paddy fields.

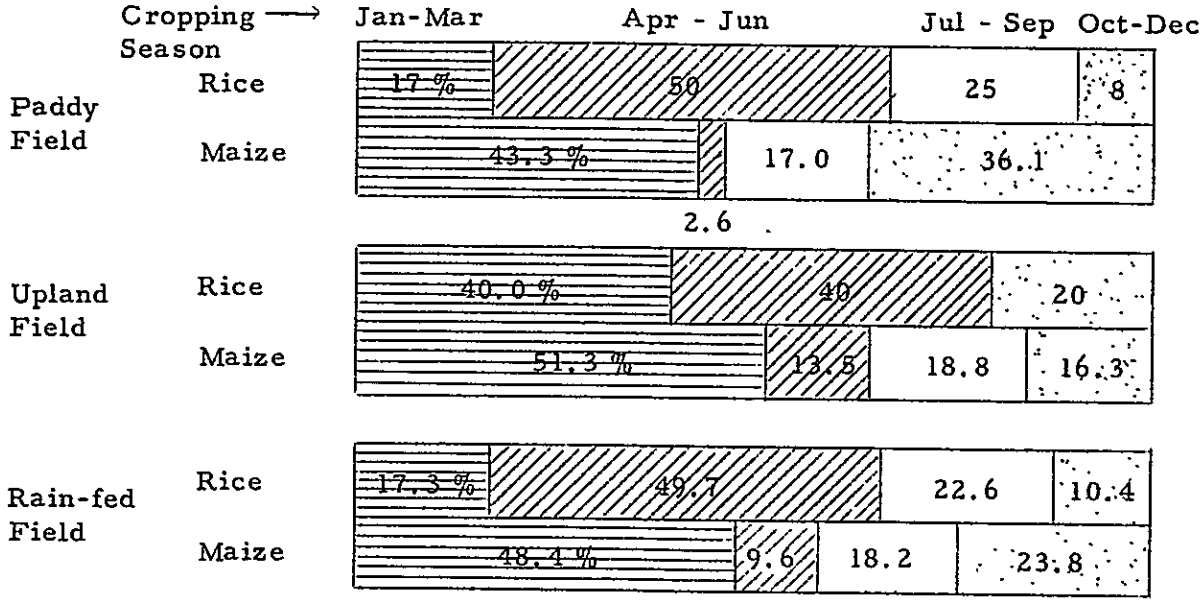
Table 3. Acreage of Harvested Area of Food Crops in Paddy Fields and Upland Fields in Central Java (Average for 1965 - 1969)

Kind of Crop	Paddy Field		Upland Field		Total	
	Acreage (ha)	%	Acreage (ha)	%	Acreage (ha)	%
Paddy	3,268,772	97.2	93,012	2.8	3,361,784	100
Maize	213,865	36.2	377,165	63.8	591,030	100
Cassava	39,770	10.4	343,704	89.6	383,474	100
Sweet Potatoes	19,006	31.3	41,793	68.7	60,799	100
Groundnuts	38,125	45.2	46,215	54.8	84,340	100
Soybeans	70,253	63.7	41,755	37.3	112,010	100

The harvested area of maize cultivated under the above-mentioned conditions is statistically shown for a five-year period in Table 4; and in Table 5 and Fig. 1, it is shown by the type of harvested area (paddy field, upland field or rainfed field) and by the cropping season.

The harvested area of maize has not shown much increase over the past years and has maintained the 50,000 ha level, and upland fields are used much more than paddy fields for maize cultivation. Cultivation in paddy fields, however, should be given due consideration for increased maize production since it can take advantage of higher soil fertility and less damage of drought.

Fig. 1. Harvested Area of Rice and Maize in Central Java by Type of Field and Cropping Season in Percentages



From 70 % to 80 % of maize cultivated in paddy fields and rain-fed fields are harvested during the October - March period. Maize harvested during this period is sown from the August - September period to the October - December period, and mostly in the latter period, as a succeeding crop of paddy. Maize cultivation in upland fields, on the other hand, is conducted by the double cropping of paddy and maize on some occassions and more commonly by the simul-

Table 4. Harvested Area of Maize in Central Java by Cropping Season (ha)

Year	Jan - Mar			Apr - Jun			Jul - Sep		
	Paddy Field	Upland Field	Total	Paddy Field	Upland Field	Total	Paddy Field	Upland Field	Total
1965	48,309	169,571	217,880	6,586	61,255	67,841	70,390	73,174	143,564
1966	178,171	340,482	518,573	5,654	42,908	46,562	41,137	88,804	129,941
1967	66,402	1,826	68,228	5,901	58,805	64,806	11,466	71,943	83,409
1968	136,883	288,227	425,110	5,335	46,985	52,220	11,266	70,956	82,222
1969	32,841	167,714	803,464	3,911	45,321	49,232	48,202	50,523	98,725
Total	462,606	967,740	1,430,352	27,387	255,374	282,761	182,461	355,400	537,861
Average	92,521	193,549	286,070	5,477	51,075	56,552	36,492	17,080	157,572

Year	Oct - Dec			Total		
	Paddy Field	Upland Field	Total	Paddy Field	Upland Field	Total
1965	48,969	26,096	75,065	174,254	330,096	504,350
1966	155,669	116,281	271,950	380,631	388,395	969,026
1967	55,655	29,214	84,869	139,424	161,888	301,312
1968	58,307	73,820	132,127	211,791	479,988	691,779
1969	78,271	61,892	140,163	163,225	325,450	488,675
Total	396,871	307,303	704,174	1,069,325	1,885,817	2,995,142
Average	79,374	61,461	140,835	213,865	377,165	591,030

Table 5. Harvested Area of Food Crops in Central Java by Type of Field and Cropping Season (ha)

Kind of Crop	Jan - Mar		Apr - Jun		Jul - Sep		Oct - Dec		Total	
	Acreage	%	Acreage	%	Acreage	%	Acreage	%	Acreage	%
a. Paddy Field										
Paddy	544,795	17.00	1,634,386	50.00	817,193	25.00	272,398	8.00	3,268,772	100
Maize	92,521	43.26	5,477	2.56	36,492	17.05	79,374	36.13	213,865	100
Cassava	6,684	16.30	7,591	19.08	20,134	50.62	5,361	17.50	39,770	100
Sweet Potatoes	5,735	30.17	2,587	13.61	4,129	21.72	6,554	34.50	19,006	100
Groundnuts	8,582	22.51	7,672	20.12	11,952	31.34	9,919	16.03	38,125	100
Soybeans	14,303	26.47	14,334	26.53	25,381	46.98	3,501	0.02	70,255	100
b. Upland Field										
Upland Rice	37,206	40.00	37,204	40.00	-	-	18,602	20.00	93,012	100
Maize	193,549	51.31	51,075	13.54	71,080	18.84	61,461	16.31	377,165	100
Cassava	52,334	15.22	70,333	20.46	173,646	50.52	67,191	13.80	343,704	100
Sweet Potatoes	11,942	30.16	12,379	31.20	10,118	25.55	5,154	12.09	41,793	100
Groundnut	14,499	51.37	19,907	43.07	7,764	16.79	4,045	8.77	46,215	100
Soybeans	16,032	38.39	19,732	47.25	2,490	5.96	3,501	7.40	41,755	100
c. Rain-fed Field										
Paddy	582,001	17.31	1,671,590	49.72	817,193	22.59	291,000	10.38	3,361,784	100
Maize	286,070	48.40	56,552	9.56	107,572	18.20	140,835	23.84	591,030	100
Cassava	59,018	15.39	77,924	20.32	193,780	50.53	52,752	13.76	383,474	100
Sweet Potatoes	17,677	30.16	14,964	25.54	14,247	24.31	11,708	20.09	60,799	100
Groundnuts	23,081	27.36	27,579	32.69	19,716	23.37	13,964	16.58	84,340	100
Soybeans	30,335	27.05	34,066	30.41	27,871	24.87	19,750	17.70	112,010	100

taneous cultivation of both.

3. Maize Production

(1) Outline

As shown in Table 6, the harvested area, production and yield of maize in Central Java are about 60,000 ha (1970), 452,000 tons and 7.64 qt/ha, respectively. The table indicates that both the harvested area and the yield per ha have declined from the high rates recorded in the past. Farmers cultivate maize as a substitute food crop for rice and consume it for their own home use. Therefore, no large difference is observed between the harvested areas of respective Kabupatens. Maize production somewhat larger than the province's average is observed only in some coastal and inland Kabupatens in Keresidenans Pekalongan, Semarang and Pati.

Table 6. Harvested Area and Production of Maize in Central Java

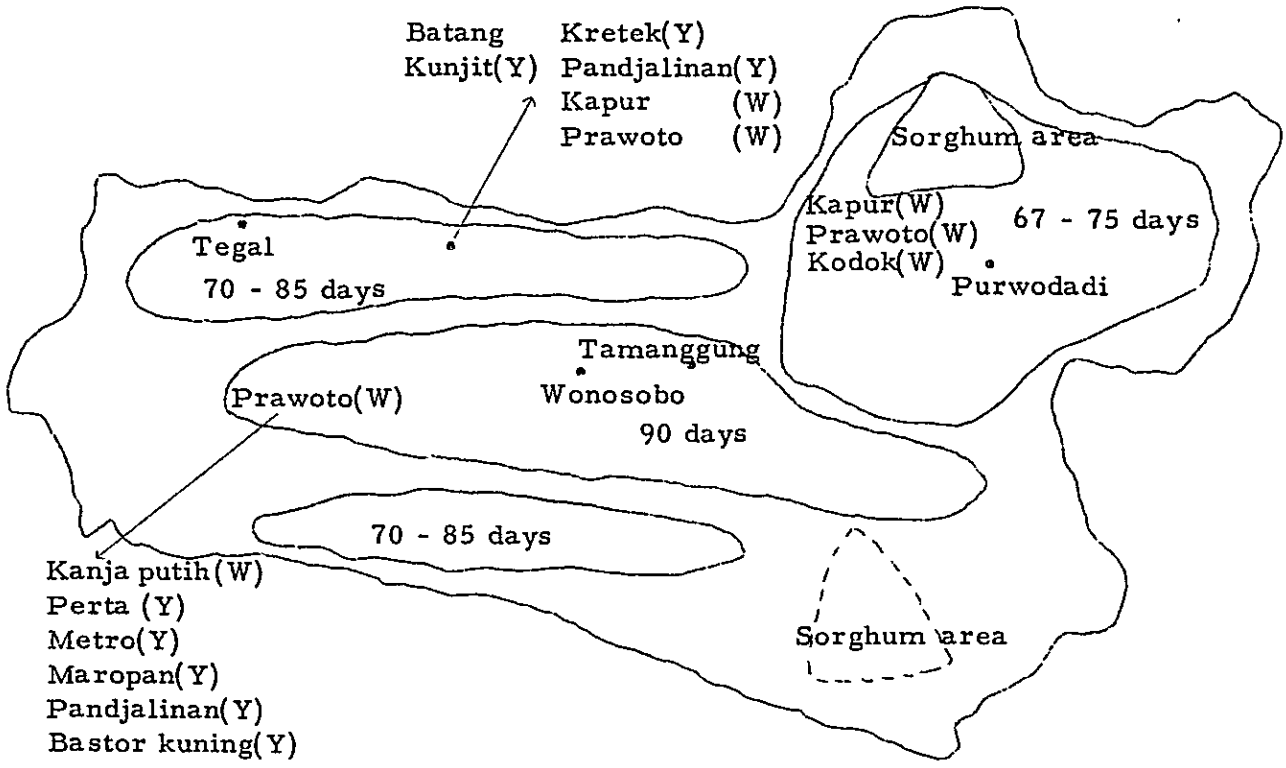
Year	Harvested Area (ha)	Production (t)	Yield per ha (qt/ha)
1960	623,234	611,772	9.82
1961	555,118	570,240	10.27
1962	824,716	1,023,426	12.41
1963	564,431	568,419	10.07
1964	948,812	1,043,664	11.00
1965	500,204	482,257	9.33
1966	947,561	1,065,959	11.30
1967	502,328	565,632	11.26
1968	724,318	821,197	11.34
1969	448,791	483,045	10.76
1970	591,044	451,927	7.64

(2) Variety

As shown in Fig. 2 (Distribution of Varieties), early maturing varieties with a growth period of 65 to 85 days are cultivated mostly in paddy fields, in the flat northern and southern areas, whereas somewhat late maturing varieties having a growth period of 90 days or more are cultivated in the central highland area. White or yellow flint occupies a predominantly large portion of the vari-

eties cultivated, with some improved varieties such as Perta, Metro and Harapan also grown to a limited extent. It is often the case that yellow and white flint varieties are cultivated within a same area so that the harvested maize grains lack uniformity in color and their commercial value is thus reduced.

Fig. 2 Distribution of Maize Varieties in Central Java



Note: Numbers indicate the growth period.

(3) Method of Cultivation

(a) Kabupaten Grobogan

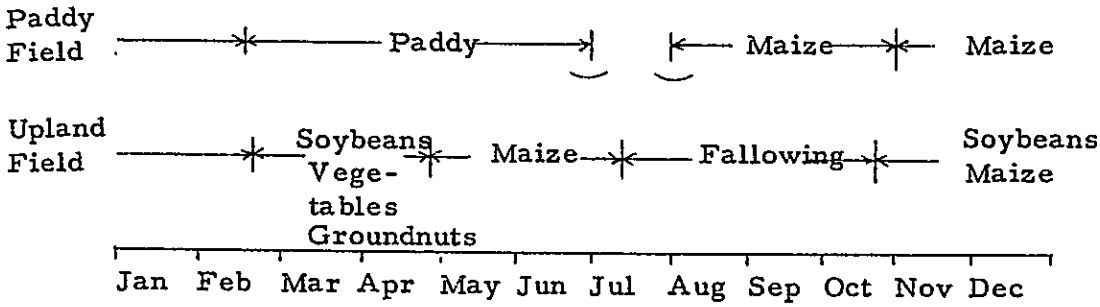
The farm land in this Kabupaten comprises 60,000 ha of paddy field, 30,000 ha of upland field and 25,000 ha of dry garden field, totalling 115,000 ha. 25 % of the paddy fields are irrigated and 75 % are rain-fed fields where the double cropping of paddy and maize is carried out.

(b) Desa Danjang (Katjamatan Purwodadi, Kabupaten Grobogan)

Maize cultivation in this Desa is carried out in an area of 258 ha comprising 215 ha of paddy field and 43 ha of upland field. Varieties cultivated are

Kapur and Kodok which are both white flint and ripen in 70 days. Varieties which mature later than these two are not grown because of the crop rotation in this Desa. For fertilization, 200 kg of urea is applied at the beginning, followed by two or three top dressings of about 10 kg. The ridge width ranges from 50 to 75 cm, the spacing in the row from 50 to 75 cm, and the number of seeds sown per hill being from two to three, which are reduced by thinning to a single plant in years with abundant rainfall.

The crop rotation adopted in this Desa is illustrated below.



Double cropping of paddy is not conducted even in paddy fields. The surface layer is composed of dark clayey soil grayish in color having a thickness of about 35 cm, beneath which is a clayey soil layer of somewhat yellowish color. The groundwater level is rather high. As an inter-crop of maize, soybeans are sometimes cultivated.

(c) Desa Jamansuri (Katjamatan Lebaksiu, Kabupaten Tegal)

Medok (yellow flint), Gendjah murati (white flint) and Kunjit (yellow flint) are cultivated in this Desa. These three varieties have a growth period of 90 to 105 days and are planted in May and September-October period each year. About 270 kg/ha of urea is applied for fertilization. Urea is also applied for paddy cultivation preceding the maize planting at a rate of 150 - 250 kg/ha. After the paddy is harvested, the field is harrowed with a plough or a hoe (patjul), and ridges having a width of 60 to 80 cm are prepared using a hoe (patjul). Following this, two or three grains of seed are sowed in sowing holes provided at intervals of 40 to 60 cm in the row. Observations made at farmer's fields disclosed a ridge width of 59 cm, a spacing in the row of 30 cm, and 2.6 plants per hill. The Desa was noted to be employing a high density planting system with about 147,000 plants grown per ha.

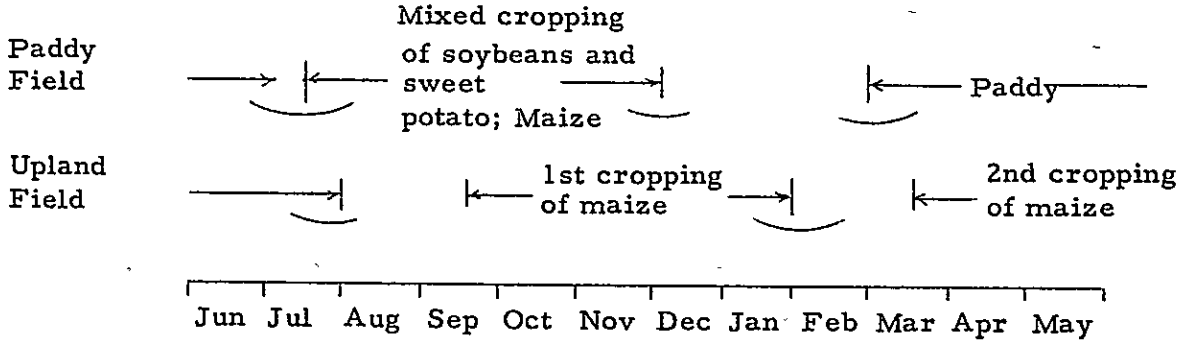
Both yellow and white varities are cultivated in this Desa. Farmers interviewed stated that the yellow variety is better suited for food.

(d) Desa Surdjo (Katjamatan Bawang, Kabupaten Batang)

Maize varieties cultivated in this Desa are Djoloworo (white flint; growth period - 120 days) and Metro and Perta (yellow flint; growth period - 120 days). The team learned that Metro was introduced in this Desa in 1963 and Perta in 1957. The white variety is cultivated for marketing in mountainous districts as well as for food. As for the planting density in paddy fields, the ridge width ranges from 60 to 70 cm, the spacing in the row is 40 cm, and two to three seeds are sown per hill. In upland fields, the ridge width ranges from 60 to 70 cm and the spacing in the row is 35 cm. Fertilization is carried out in both paddy fields and upland fields. In paddy cultivation, no fertilizers are applied to local varieties, but 100 kg/ha of urea and 50 kg/ha of TS are applied to Bugawan variety. For maize cultivation after the paddy is harvested, 100 - 150 kg/ha of urea are applied. Further, about 3 t/ha of compost and staple manure, and occasionally urea, are applied for cultivation in upland fields. The compost is dressed on top of seeds, whereas urea is applied, 50 % in 20 days after sowing and another 50 % in 50 days, into a hole 10 cm away from the hill. Then the hole is covered with soil.

Latosol soil prevails in the vicinity of the Desa Office. The 30 cm thick brown surface soil is underlain by a layer of reddish deposit. The soil productivity is considered relatively high. With respect to the planting density, the observation made at farmers' fields revealed that the ridge width is 66 cm, spacing in the row 52 cm, and the number of plants per hill 1.8. The number of plants grown per ha stands at about 52,000 which is considered reasonable.

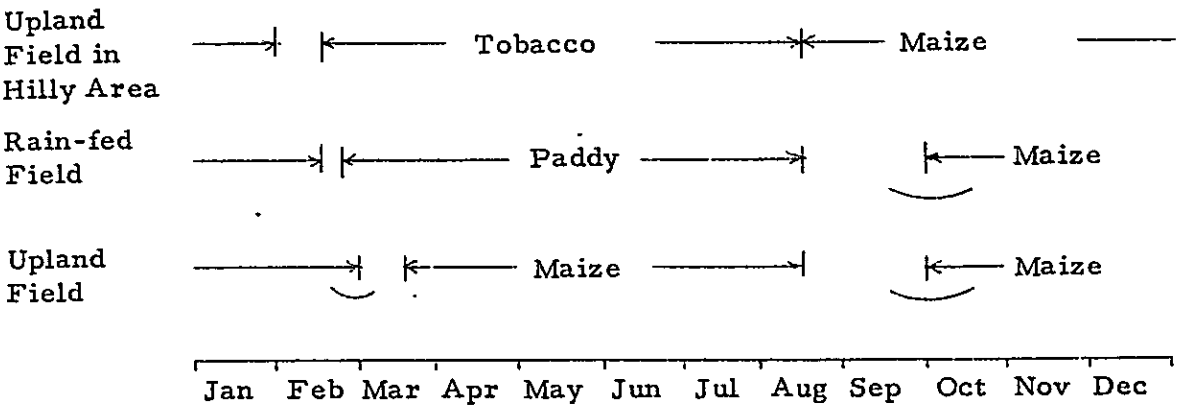
The crop rotation generally adopted in this Desa is illustrated below.



(e) Temanggung Agricultural Experiment Station

Located at Soropadan (El. 550 m), this experimental station is carrying out experiments on sorghum. The team learned that the station is encouraging the farmers in neighboring areas to set the ridge width at 100 cm and spacing in the row at 30 cm for two-plant planting and also to apply 100 kg/ha of urea and 50 kg/ha of TS in its agricultural guidance activities, but that most of farmers still adhere to the conventional farming method in which the ridge width and spacing are both 80 cm and three to four plants are planted per hill. The team further learned that practically no fertilizers are applied.

The patterns of crop rotation adopted by the farmers in the neighborhood of the station are shown below.



(f) Desa Redjosari (Katjamatan Pringsurat, Kabupaten Temanggung)

Though Kapur, a local white flint variety, is cultivated in addition to Perta and Metro, improved varieties account for about 90 % of maize in this Desa. The team was informed that the yellow varieties are better suited for food, and the yield of improved varieties is 1.5 t/ha while that of the local variety is less than 1 t/ha. As for the planting density, observations made at farmers' fields disclosed that the ridge width is 90 cm, spacing in the row 92 cm, and the number of plants per hill 3.5. The planting density of 42,000 plants per ha discovered by the observation is considered suitable. A mixed cropping of maize and cassava is adopted in this Desa, with cassava planted 15 cm away from the maize hill. Most farmers apply 100 kg/ha of urea for fertilization, 50 kg each in 14 - 20 days and in 30 - 45 days after sowing. A spoonful of urea is poured into a hole dug by the hill. When compost is used for fertilization, it is filled in the sowing hole which is covered with soil after a rainfall, after which seeds are

sown in the hole and covered with soil again.

4. Quality and Distribution

In reviewing the quality of maize, not only the quality of existing varieties must be clarified, but also studies should be made of natural conditions and of distribution and comsumption of maize since these factors bear heavily on the quality and grading. In other words, no definite description can be given on the maize quality without investigating the climate, soil and other farming conditions, quality control after harvesting, storage conditions for farmers' own use, as well as marketing, transport and werehousing conditions. Though these conditions could not be fully ascertained because the survey was not conducted during the harvesting season, they can be summarized as follows on the basis of the team's findings.

(1) Existing State in Surveyed Areas

(a) Desa Danjang

(i) Of the five brokers in this Desa, two are actively engaged in the purchase of maize. Farmers sell the harvested maize to Desa brokers either in the Desa market or in the brokers' compounds. 50 to 100 kg of maize is sold in each transaction. When harvested, maize is carried into the farmers' yard for husking, threshing, drying and sorting, and sold after setting aside whatever amount is required for home consumption. Maize thus set aside is stored as earcorn.

The sales price in this Desa averages Rp 15 per 1 kg during the harvesting season.

(ii) The Desa brokers sell maize to local brokers in Solo or Semarang in about four days after the purchase. Since the delivery is made at the warehouse of Desa brokers, the local brokers provide the transport equipment, fill the collected maize into two or three bales and transport them to Solo or Semarang.

(iii) Quality

The team noted that the quality of yellow flint maize sold in this Desa is as described below.

Water Content	:	13.5 - 14.5 %
Damaged Grains	:	5 %

Impurities : 0.5 %

Admixture of White Flint : 2 %

Maize produced in this Desa is suited for export if the above quality level is maintained.

(b) Katjamatan Purwodadi (Kabupaten Grobogan)

(i) The local brokers either purchase maize from Desa brokers of dispatch 10 to 15 agents to the markets in neighboring Desas for direct purchase. The purchase price is Rp 15 - 17/kg.

(ii) The local brokers are either the agents (branches) of urban brokers in Semarang (shipping port) or conduct their business independently. In the former case, they work on a commission basis and receive Rp 0.5 per kg from the urban broker, and in the latter case, 50 % of the necessary purchase fund is advanced by the urban broker and the remaining 50 % is borne by themselves.

(iii) Brokers do not as a rule purchase insufficiently dried maize. On few occasions when they do purchase such maize, the purchase price is discounted by a rate determined according to the degree of drying. The maximum discount rate is about 25 % of the average sales price. Maize purchased at a discount rate is treated by solar drying in a concrete drying yard. (The drying yard employed by the brokers in this Katjamatan covers an area of 120 m^2.)

(iv) The local brokers sell maize to urban brokers at about Rp 1.75/kg on an average.

(v) It is estimated that the quality of maize produced in this Katjamatan is generally on the same level as in Desa Danjang, though this was not confirmed on the maize collected by the brokers.

(c) Desa Jamansari (Katjamatan Lebaksiu, Kabupaten Tegal)

(i) As this Desa is situated close to the Katjamatan Lebaksiu Office, it has no Desa brokers. Farmers therefore sell the harvested maize in the Lebaksiu market. The sales price is Rp 10 - 15/kg during the harvesting season.

(ii) The quality is generally satisfactory except that the admixture of grains of other varieties shows as high a rate as 10 % to 20 %. For export, therefore, guidance should be provided for grain sorting.

(d) Desa Surdjo (Katjamatang Bawang, Kabupaten Batang)

(i) No brokers are found in and around this Desa. Farmers there-

fore sell the harvested maize in Bawang where the Katjamatan Bawang Office and the only market for agricultural products in the Katjamatan are found.

(ii) The harvested maize is strapped together into a bundle of about 100 earcorns without removing the husk. Bundles of earcorns this prepared are dried by hanging them over the kitchen furnace. With the exception of some portion of the crop for home consumption which remains in this state, the maize is then threshed by hand and spread on mats for solar drying which requires about a day and half if the weather is fine. The dried maize is carried into the market in Bawang mostly on the farmers' shoulders due to the shortage of bullock carts and other transport means. For each trip to Bawang, about 60 kg of maize is carried by a farmer.

(e) Katjamatan Bawang (Kabupaten Tegal)

(i) The only market in this Katjamatan is found in Bawang where the Katjamatan Bawang Office is located. Farmers carry the harvested maize to this market from 20 Desas of the Katjamatan. The farthermost Desa is 9 km from Bawang, and though the average distance to these 20 Desas is 6 km, the route to Bawang is invariably a steep mountainpath and the farmers are mostly obliged to carry maize on their shoulders.

(ii) Maize brought to Bawang is sold to four to six brokers who operate regularly, or to 10 non-regular brokers operating on a smaller scale, and from these brokers to local brokers.

(iii) The market in Bawang is not a permanent one, but is opened twice in five days. The brokers acting between the farmers and local brokers purchase maize from the former and sell it to the latter in the market. The sales price averages Rp 18/kg during the harvesting season, rising occasionally to Rp 25/kg during the pre-harvesting period.

(iv) The local brokers who purchase maize in the Bawang market distribute it to Tamanggung, Purwokerto and other areas deficient in maize supply, either immediately after the purchase or in January or February after a certain period of temporary storage. Most of the local brokers come from Semarang, Pekalongan and Tegal.

(f) Desa Ringit and Desa Redjosari (Katjamatan Prinsrut, Kabupaten Temanggung)

(i) No brokers are found in Desas such as Redjosari which are small

both in area and in the size of maize shipments. Farmers in Desa Redjosari are therefore compelled to either spread the unprocessed earcorns on the main road waiting for the local broker to come from Ringit or carry the dried and threshed maize by themselves to the market in Ringit. Since the brokers in Ringit mostly lack drying facilities, it is believed earcorns are rarely sold in this Desa.

(ii) In Desa Ringit, farmers sell the harvested maize either in the market or in the brokers' compounds. On the market, maize is sold to individual consumers in small quantities, or to the brokers operating in the market, or to other farmers in exchange for commodities other than maize.

(iii) The sales price on the Ringit market is Rp 16 - 17/kg during the harvesting season.

(iv) The local brokers visiting Ringit sell the collected maize to consuming areas like Wonosobo and Purwokerto. The profit they gain against the sales of 1 kg of maize is said to range from Rp 0.5 to 1.0, and transportation is provided by the merchants in these consuming areas. No rigid quality standard appears to be applied to these maize transactions.

(2) Demand-Supply Situation

In Central Java, there is no maize shipment to other provinces excluding Jogjakarta, nor does export amount to any noticeable value. The province's entire maize production excluding seeds and loss is consumed solely for food. The demand-supply situation of maize must therefore be considered in relation to that of other food crops (starch crops in this case).

Production and consumption of crops in 1969 are as tabulated below.

	Production (t)	Seeds and Others (t)	Total Consumption (t)	Population (persons)	Per Capita Consumption in Terms of Rice (kg)
Rice	3,904,149	269,393	3,634,756	22,354,181	84.54
Maize	325,312	41,103	284,209	"	12.71
Cassava	1,796,449	-	1,796,449	"	29.73
Sweet Potatoes	202,480	-	202,480	"	3.16
Total					130.14

As compared with the total per capita consumption target of starch crops set by the Ministry of Health (Kesehatan) for 1969, the actual consumption is smaller by 19.36 kg. The actual maize consumption, in particular, falls short of the conservative target value established by the same Ministry. Compared with East Java, the shortage of maize production in Central Java is quite prominent.

	Ministry of Health	East Java
Rice	109 kg	89.5 kg
Maize	20.4	34.17
Cassava	20.1	39.65
Sweet Potatoes		4.20
Total	149.5 kg	167.52 kg

Consequently, the prospect for maize exports for the coming several years is not bright. Further, the above consumption level of 130 kg per capita per annum cannot be maintained unless an increase of about 75,000 tons in terms of rice is achieved annually in the food crop production to counterbalance the annual population growth rate of 2.5 %. Hence, rapid increase in food production is necessary to provide any surplus maize for export. It must also be borne in mind that Central Java is responsible for the supply of food to the Java District.

(3) Distribution

Reflecting the above-mentioned demand-supply situation, the maize distribution is limited to intra-province distribution. Maize produced in Central Java is supplied to consuming areas in the same province. It is noteworthy that rural areas where the maize production falls short of demand constitute heavier consuming areas than urban areas in Central Java. As indicated by arrow marks in the following Fig., there is a strong trend for concentrated maize supply going to inland areas rather than to port areas, and this is manifested in the purchase and transport of maize by brokers.

(a) Maize Distribution in Central Java

As already described, maize distribution is limited to intra-province movement. As will be clear from the per capita consumption shown in the following table, none of the six Keresidenans of the province produces any appreciable surplus for export.

Kersidenan	Annual Per Capita Consumption (kg)	Annual Production (t)
Pekalongan	14.94	69,295
Semarang	15.50	59,405
Pati	15.73	51,810
Banjumas	12.31	46,862
Kudus	14.52	58,204
Surakarta	6.16	39,736
Total Central Java	12.71	325,312

Reviewed by Keresidenan, however, per capita consumption (production/population) exceeds 30 kg in three Keresidenans and 20 kg in two Keresidenans.

(b) Barter Trade of Maize for Tobacco

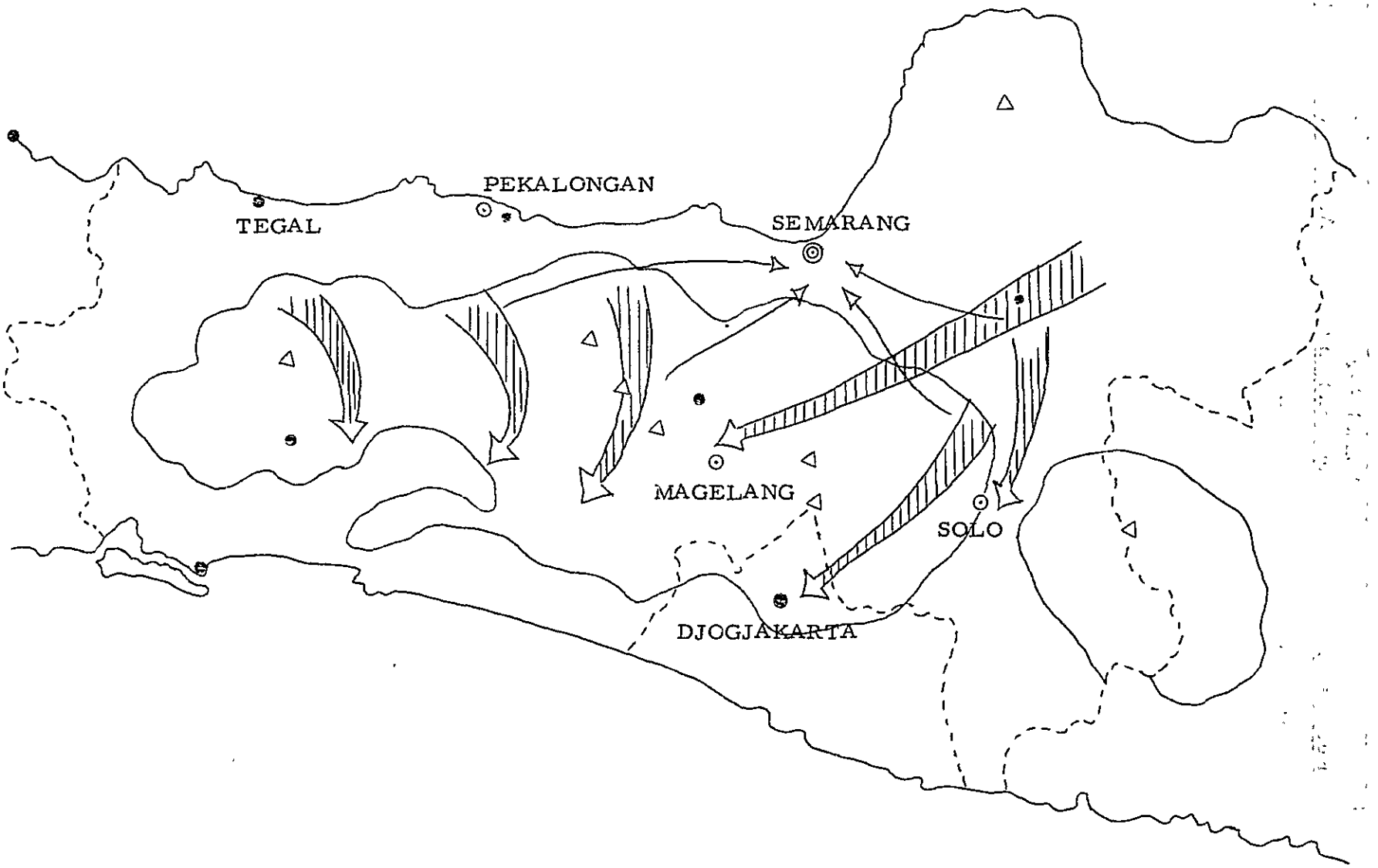
In Java Island, Central Java together with East Java, leads in tobacco production. In 1969, for instance, tobacco production in the province recorded 21,305 tons, but most of the producers are smallholders with only about 0.3 ha of operational holding. Among the six Keresidenans, Kudus produces 8,600 tons of tobacco but it suffers from a shortage of foodcrops. In this Keresidenan, therefore, barter trading of maize for tobacco is carried out by local brokers who provide tobacco producing farmers with the desired amount of maize in January or February, the pre-harvesting period of maize, and collect tobacco of equal value from them in the April - June period, the harvesting season of tobacco.

This barter trading is intended solely for the supply of maize for food.

(c) Producer's Price of Maize

In Indonesia, maize is produced for farmers' own consumption and serves as a subsidiary food crop for rice. Due to the absolute shortage of rice production and the low income level of the people, many consumers are unable to afford rice. The lowest income class substitutes cassava and then maize for a substantially large portion of their food supply. In Central Java where the food crop production does not meet the demand, the producer's price of maize is high relative to rice, amounting to Rp 17 - 18/kg. Calculated on the basis of the current producer's price, FOB Indonesia price per ton would be about US$65.50 and CIF Japan price higher than US$80.00 per ton. As things stand now, therefore, there is little export potential.

Existing State of Distribution on Maize



(4) Quality

Since the survey was not conducted at the peak of the harvesting season, the team was unable to make a through study on the quality of maize. The team's findings can be summarized as follows.

(a) Drying and Processing

Since maize is cultivated primarily for farmers' own consumption, the drying process after harvesting is carried out without much care for shipment and marketing. The earcorns are piled up in the kitchen garret for gradual drying by furnace heat or by a specially made blazing fire. Threshing work is conducted prior to each meal. By this drying method, the maize can be dried to a pointwhere the water content is reduced to 14% to 15 % in three months.

Maize to be sold soon after harvesting, on the other hand, is threshed and spread on mats for solar drying. Each shipment being no larger than 60 kg, this drying work can be readily carried out by family labor. The abundant family labor makes it possible to dry the maize grains even in the wet season, spreading them outside if the weather is fine and putting them back inside on the earth floor if it rains. Hence, no problems appear to be involved in the dryness and the admixture of damaged or broken grains or impurities.

(b) Large Scale Drying and Processing

The existing drying and processing method is utterly incapable of satisfying the need for large-scale drying that may arise from the attainment of the planned production increase. In the absence of any suitable drying yards, the adoption of thermal drying system will not be economically acceptable for such large-scale drying. Very few of Desa and local brokers own drying yards and drying facilities since all brokers are engaged in small lot transactions. Central Java lags behind the maize producing areas of East Java in the development of a large-scale drying and processing system.

(c) Varieties

Since maize is produced as a subsidiary food crop, white varieties prevail except in limited areas. Predominance of white varieties is ascribable, on the one hand, to their white grain color which is preferred for both cooking ground grains and mixed cooking with rice, and on the other, to the fact that they are usually flint varieties and taste better than yellow varieties which are mostly dent maize.

In producing maize for export, white varieties must be replaced by yellow ones over an extensive area since most of export maize supplied to the world market today is intended to be used as feed, particularly for poultry farming. However, unless there is a good prospect for securing markets, the shifting of varieties would be difficult.

Further, even if conditions for shifting are favorable, it would be almost impossible to replace all white varieties with yellow ones at one time because of the existing state of consumption, farming conditions and practices. This in turn will give rise to the problem of admixture of two or more different varieties in harvested maize grains and will consequently call for the difficult task of sorting, purchasing, storing, processing, and transporting by varieties.

5. Fundamental Approach to Maize Production Project

Conditions in Central Java are still immature for the establishment of a maize production project which aims at increased export. However, if a project is to be established for increased maize production which will eventually lead to surplus production for export at some future date, then the area surrounding Mt. Prahu is considered to be suitable as the project area.

(1) Project Area

The project area extends around the mountainous district formed by Mt. Prahu (2,565 m), Mt. Rogodjembangan (2,177 m) and Mt. Slamet in the northwestern part of Central Java. It covers an area of about 21,000 ha and embraces eight Kabupatens shown below.

Kabupaten	Area
Tagal	3,000 ha
Pemalang	2,000
Pekalongan	2,000
Batang	3,000
Tamanggung	1,000
Wonosobo	3,000
Bandjarnegara	4,000
Purbolingga	3,000
TOTAL	21,000 ha

(2) Advantages of Project Area

(a) Situated on highland rising from 600 m to 1,000 m in elevation, the area is little subject to the damages by insects and diseases, especially sclerospora.

(b) The white local varieties cultivated in the project area have a long growth period of 120 days. This incurs little trouble in growth period when the local varieties are replaced by improved ones.

(c) Agricultural guidance can be provided with ease since the area forms an estate.

(d) The area is within 100 km of the shipping ports, Semarang and Tagal.

(e) The area is composed of upland fields so that maize cultivation can be promoted with little or no regard to the competition with paddy or vegetable cultivation.

CHAPTER III EXISTING STATE OF MAIZE PRODUCTION IN SOUTH SULAWESI

1. Socio-economic Background - Population and Land -

South Sulawesi has 21 Kabupatens and two cities, and is inhabited by about 5,643,000 people as of 1969. The annual population growth rate of the province is estimated to be 2.3 %. The population density averages 63 persons per square kilometer. The density is higher in the south registering 80 persons/km^2; Kabupatens such as Banta Eng, Bulukumba and Sindjai have an even higher density of 140 persons/km^2. Conversely, Luwu and other Kabupatens in the north have a low density of 26 persons/km^2.

The province's major industry is agriculture which is estimated to occupy about 70 % of the total population.

The total paddy field area is about 338,000 ha as against the total number of owners of about 466,000, indicating that the average operational holding per farmer is about 0.73 ha. If the upland fields and cleared plots for shifting cultivation are added, the average holding per farm household is about 0.93 ha. Though this value differs little from the average holding in Central Java, it is to be noted that paddy fields occupy a large percentage in South Sulawesi. The average holding of paddy field per farm household is 16 times as large as that in Central Java, and this gives an immense effect on the demand-supply situation of food crops in the province.

Table 7. Acreage of Farm Land in Maize Producing Areas (1966)

Kabupaten	No. of Desa	No. of Owners	Total Acreage of Paddy Fields (ha)	Average Holding (ha)	No. of Owners by Size of Holding (ha)		
					0 ~ 0.5	0.5 ~ 1.0	1.1 ~ 2.0
Djeneponto	62	29,296	13,333	0.45	18,276	6,979	2,651
Bulukumba	111	25,291	9,342	0.36	17,638	4,366	2,242
Soppeng	155	24,701	20,567	0.86	13,057	6,356	3,588
Wadjo	209	46,734	50,261	1.08	19,341	11,660	9,356
Bone	274	77,919	57,086	0.73	43,742	18,933	11,096
Total South Sulawesi	2,156	466,120	338,141	0.73	256,712	115,367	68,394

2. Existing State of Agriculture

(1) Crops and Their Production

Farm land in South Sulawesi comprises about 457,000 ha of paddy fields, 77,000 ha of cleared plots for shifting cultivation, 23,800 ha of upland fields and 78,000 ha of palm plantations.

Major crops are food crops such as rice and maize. In addition, groundnuts, green beans, soybeans and cassava are cultivated. Commercial crops include palm trees, coffee, kapok, clove, rubber, sweet potato and sugar cane, but none of them bears much importance excepting palm and coffee.

Livestock farming, though not directly related to agriculture, plays an important role in the economy of the province. Souch Sulawesi is the second largest livestock farming area of the country and the cattle and buffaloes raised number 300,000 and 250,000, respectively. The livestock farming is carried out principally in the northern part where the sparsely settled extensive plateaus provide excellent conditions.

The per capita production of rice, maize and cassava combined reaches 200 - 240 kg annually. Assuming that the per capita consumption is 150 kg, the said annual production provides a substantial surplus of food crops. The problem now faced by the province is therefore the take-off from the current self-supporting economy to a market economy.

Table 8. Production of Major Food Crops

	1968		1969	
	Harvested Area (ha)	Production (t)	Harvested Area (ha)	Production (t)
Paddy	459,282	1,279,484	460,550	1,237,459
Upland Paddy	50,414	77,732	52,242	69,734
Maize	324,901	287,451	287,168	221,066
Cassava	47,758	398,380	35,527	288,905
Sweet Potatoes	11,052	67,291	11,197	60,712
Groundnuts	18,885	14,959	25,815	18,921
Green Beans	31,273	18,095	20,244	10,386
Soybeans	5,807	4,295	6,825	5,525

(2) Major Farm Crop - Rice -

The harvested area of rice is about 460 ha for paddy and 50, 000 ha for upland paddy, with the total rice production reaching 650, 000 tons in milled rice. With its per capita rice production amounting to about 120 kg annually. South Sulawesi is one of the few areas producing surplus rice which is said to account for 8 to 10 % of total production. This high level of rice production is attributable to the fact that the average holding of paddy field per family is 16 times as large as that in Central Java. Though the provincial government of South Sulawesi gives top priority to rice production in its agricultural development scheme and appropriates 63 % of its agricultural development funds to double the rice production in five years, it appears that farmers show less concern for rice cultivation than in Java. In Central Java, for instance, the planted area of rice is about 1.6 times as large as the total paddy field area, indicating that the double cropping of rice is conducted in all fields, except for the dry season rain-fed fields. In South Sulawesi, on the other hand, the harvested area (which is naturally smaller than the planted area) is approximately the same as the paddy field area, and the rain-fed fields and a portion of paddy fields not planted with paddy are used for maize cultivation. The lack of farmers' interest in rice cultivation is caused by the deficiency in transport means. The team learned that the shortage of vessels and inland transport means are causing the surplus rice to be kept in stock despite the fact that Java, a heavy rice consuming area, is situated nearby.

Paddy fields are primarily used for rice production, but they are also utilized for cultivation of other crops depending on the availability of irrigation water and labor force and on distribution conditions.

Paddy fields in South Sulawesi can be classified as follows.

Paddy Fields under Well-Established Irrigation Farming	111,412 ha
Half-Irrigated Paddy Fields	27,685
Paddy Fields under Desa-Managed Irrigation System	106,706
Rain-fed Paddy Fields	209,933
TOTAL	455,736 ha

Table 9. Harvested Area and Production of Maize in South Sulawesi

Year	Harvested Area (ha)	Production (t)	Average Yield (qt/ha)
1960	268,437	251,643	9.37
1961	276,726	259,814	9.39
1962	332,795	336,690	10.12
1963	285,643	274,245	9.60
1964	332,690	371,075	11.15
1965	271,419	241,994	8.92
1966	408,592	344,855	8.44
1967	288,161	236,807	8.22
1968	324,901	287,451	8.85
1969	282,050	217,090	7.69
1970	373,823	325,398	8.70

3. Maize Production

(1) Outline

Maize is the next important agricultural product in South Sulawesi after rice. As shown in Table 9, its harvested area was 324,900 ha in 1968 and 282,100 ha in 1969 and its production was 287,400 tons in 1968 and 217,100 tons in 1969. Major producing areas are, as shown in Table 10, Kabupaten Djeneponto and Bulukumba in the south producing 20,000 tons and 24,000 tons, respectively; Kabupaten Bone and Wadjo on the east coast producing 49,000 tons and 10,000 tons, respectively; and Kabupaten Soppeng in the central part of the province which turns out 19,000 tons. The outlook for surplus maize production, as indicated by the food situation in the five Kabupatens, is not very promising. As shown in Table 11, the per capita rice production in Djeneponto, Bulukuma and Bone is low, registering 70 kg, 94 kg and 90 kg, respectively, and Wadjo and Soppeng alone provide surplus rice, with their per capita production marking 221 kg and 140 kg, respectively. These two Kabupatens are the only areas assuring substantially large production of surplus maize.

With the overall food situation and the maize production taken into consideration, it can be generally said that a surplus of about 50 tons of food crops involving rice, maize and cassava is produced in the entire province.

Table 10. Major Maize Producing Areas in South Sulawesi (1969)

Kabupaten	Population	Total Harvested Area	Total Production	Average Yield/ha	Varieties under Cultivation
Djeneponto	271,893	32,847	20,577	0.7	Local white varieties: Pakkelo, Baku[2] & Dadi
Banta Eng	84,178	40,736	16,731	0.63	Local white varieties; Baku[2] & Dadi
Bulukumba	247,979	31,069	24,855	0.8	Local white varieties; Baku[2] & Dadi
Sindjai	145,178	20,310	15,166	0.74	Local white variety: Dadi
Bone	786,254	67,254	48,926	0.72	Local white variety: Dadi
Wadjo	416,850	9,780	10,357	1.06	Local white varieties: Impa[2] & Baku[2]
Soppeng	235,060	18,688	18,617	0.9	

However, surplus maize is produced only in two of the aforementioned five major producing Kabupatens, and other surpluses are produced in a number of small areas scattered throughout the province. Accordingly, what is needed to secure a large supply of maize from the province is to collect the surplus maize from the said two Kabupatens (which produced a total of about 57,000 tons in 1968) and from small producing areas, but this will entail many difficulties considering the existing road conditions. The loop road which surrounded South Sulawesi in pre-war days is in a state of virtual destruction excepting for the section connecting Makassar and Pare-Pare. For this reason, the transport cost from the southern and eastern parts of the province to Makassar and Pare-Pare is often as high as the production cost. The only exception is Soppeng which is close to Pare-Pare port. Under the circumstances, maize export is quite limited, and the largest export volume ever recorded was 41,200 tons in 1967. In 1968 and 1969, the value stood at a low level of 24,800 tons and 23,200 tons, respectively.

Export of maize involves many other problems. Problems to be solved on the part of producers include varieties, quality and storage. The six varieties now cultivated are all local varieties, mostly white maize, and their yield

per ha is on a low level of about 1 ton. In the absence of common drying yards or common collecting yards, harvested maize is dried under the sun for several days, and then threshed for marketing or piled up in shells in the garret for home consumption. Another problem is the mechanism of distribution. With no agricultural cooperative associations or similar organizations yet established, maize is sold to brokers visiting or living in each Desa, though farmers in some districts deal directly with the terminal organs of exporters.

The two shipping ports, Makassar and Pare-Pare, are located far from the major producing areas in the south and east. In pre-war days, therefore, sampans were used to carry maize from the coast of these areas to vessels anchored offshore.

Table 11. Production of Food Crops (1968)

Kabupaten	Paddy	Maize	Paddy Field (ha)	Population	Milled Rice/ Population (kg)
Djeneponto	35,445	23,911	14,355	271,893	70
Bulukumba	44,923	27,368	15,033	247,979	94
Bone	155,494	48,145	63,604	786,254	99
Wadjo	184,777	29,254	65,612	416,850	221
Soppeng	67,357	28,076	20,612	235,060	140

(2) Varieties

As shown in Table 10, most of the varieties cultivated in South Sulawesi are local white flint maize. Varieties grown in major producing areas are Pakkelo, Baku Baku, Impa Impa and Dadi. Besides these local varieties, Bulu, an introduced white glutinous variety, and white flint varieties such as Bods, Adin, Landrus and Tjanru are cultivated, and Metro, an improved variety, is also grown though in a limited area. Of the white flint varieties listed above, Baku Baku and Impa Impa are known to have a high resistance against sclerospora by the experiments conducted at the Central Research Institute for agriculture in Bogor.

(3) Method of Cultivation

(a) Makassar Branch of Bogor Central Research Institute for Agriculture

Located at Bill Bill, Makassar Laboratory is a branch of the Bogor Central Research Institute for Agriculture. Research activities conducted by this branch laboratory include seed multiplication (Metro, composite) as well as the tests of planting density, fertilizer tests, adaptability tests of various international varieties, and comparative tests on the resistance against sclerospora. The laboratory provided the team with an explanation on the maize varieties cultivated in South Sulawesi. The varieties cited by the laboratory are given below by way of reference though they are somewhat different from the description given in the foregoing pages.

Major Producing Kabupatens	Varieties (* indicates important varieties)
Bone	Baku Baku, Dadi*, Metro
Soppeng	Baku Baku, Adin, Teldring Bulu, Tjawa, Atjil
Wadjo	Impa Impa*, Baku Baku, Todjankali*, Metro
Djeneponto	Pakkelo*, Toro, Tomong rurulu, Baku Baku, Dadi*
Bulukumba	Baku Baku, Dadi
Sindjai	Dadi, Metro, Malin

Introduced below are the results of some of the tests conducted by the laboratory.

Fertilizer Test:

The laboratory carried out a test on optimum dosage of three fertilizer ingredients using dent varieties introduced from Japan and local flint varieties. (See Table 12)

The test revealed, as shown in Table 12, that the introduced dent varieties produce a smaller yield than the local white flint variety. It is noteworthy that the Japanese white dent variety shows the poorest yield, though the source of this variety is unknown. The yield of the Japanese variety declines with increased application of fertilizer. Though the cause of this yield drop is not known, it works to reduce the fertilizer effect. Effect of N is observed up to a dosage of 90 kg in other varieties, but that of P and K is not clear.

Table 12. Fertilizer Test on Introduced Maize Varieties

(Conducted at Bontobili in the wet season of 1969/70)

Fertilizer	Yield by Varieties			Average Yield
	South African Dent Variety	Japanese White Dent	Local Variety V 351	
0- 0- 0	1434	1058	1267	1253
0-30-50	1533	717	1700	1316
60-30-50	1239	417	1588	1081
90-30-50	1725	692	2000	1472
120-30-50	1438	550	1804	1264
120- 0-50	1625	1038	1904	1522
120-60-50	1050	800	1800	1216
120-60- 0	1425	646	1646	1239
Average	1434	740	1714	

Notes:	L.S.D	0.05 %	0.01 %
	Fertilizer	-	-
	Varieties	278	373

Test of Effect of N, P and K on Yield:

As will be clear from Table 13, this test was conducted on Baku Baku, a local white flint variety, and two improved varieties, Permadi and Metro. The N effect presented itself clearly up to a dosage of 120 kg, the P effect up to 30 kg, but K showed no clear effect even at a dosage of 30 kg. The fertilizer effect was manifested more by the improved varieties than by the local variety.

The planting density adopted at this laboratory is 40,000 plants for Metro and 60,000 plants for local varieties, and the dosage of fertilizer per ha was 60 - 90 kg for N, 30 - 60 kg for P_2O_5, and 30 kg K_2O. N stands for urea, P_2O_5 for T.S. and K_2O for potassium chloride.

Table 13. Effect of N, P and K Fertilizers on Maize Yield at Bontobili, South Sulawesi

Fertilizer Dosage (kg/ha)			Yield by Varieties (kg/ha)			Average Yield
N	P_2O_5	K_2O	Baku Baku	Permadi	Metro	
0	0	0	1,465	2,039	2,243	1,716
30	0	0	1,762	2,234	3,150	2,382
30	30	0	2,029	3,253	3,906	3,063
30	30	30	2,563	3,661	3,946	3,390
60	0	0	2,368	3,811	3,718	3,290
60	30	0	1,809	4,085	3,774	3,223
60	30	30	2,134	-3,663	2,816	2,871
60	60	30	2,090	3,994	3,876	3,320
120	0	0	2,627	3,443	4,306	3,859
120	30	30	2,897	4,754	4,460	4,037
120	60	30	2,657	4,159	3,716	3,511
Total			24,401	39,097	39,911	-
Aver-age			2,218	3,554	3,628	

Notes:

	5 %	1 %
L.S.D.		
Fertilization	582.37	682.56
Varieties	950.04	1530.62
Fertilization x Varieties	460.82	582.36

(b) Kabupaten Bulukumba

Paddy Field	20,000 ha	950 ha planted with maize in the dry season
Upland Field	30,400 ha	
Ladang	4,406 ha	
Dry Field in Garden Compounds	1,519 ha	

Maize is cultivated in an area of 34,000 ha as a second crop in paddy fields and also as an upland crop. In paddy fields, maize is planted in the November - December period after rice harvesting, whereas in upland fields, it is sown in the March - April period for the first cropping covering 15,000 ha (partially used for mixed cropping of 60 % maize and 40 % soybeans) and then in the November - December period for the second cropping covering 18,000 ha.

(c) Desa Bontomanai (Katjamatan Bulukumpa, Kabupaten Bulukumba)

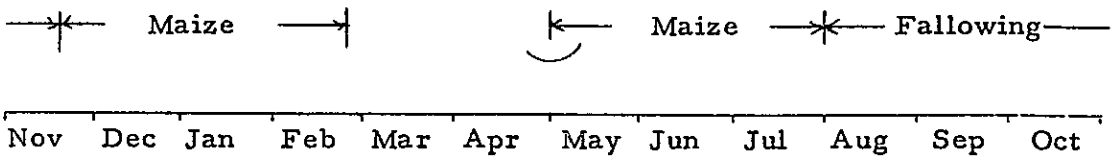
Varieties:

Landras	(White flint)	
Pakkelo	(")	
Boda	(")	
Dadi	(")	Growth period: 90 days
Bulu	(White glutinous)	
Metro	(Yellow flint and dent)	Growth period: 110 days

The team was informed that Metro is vulnerable to insect damages after harvesting though its yield is higher than the white flint varieties. It was learned that the white flint varieties taste and sell better than Metro.

Observation made at farmers' fields disclosed that the ridge width is 50 cm and two to three seeds are sowed in each row at intervals of 57 cm with green beans also sown alongside the maize plants. A tool called Tugal is employed to dig the sowing holes.

The crop rotation of upland maize is illustrated below.

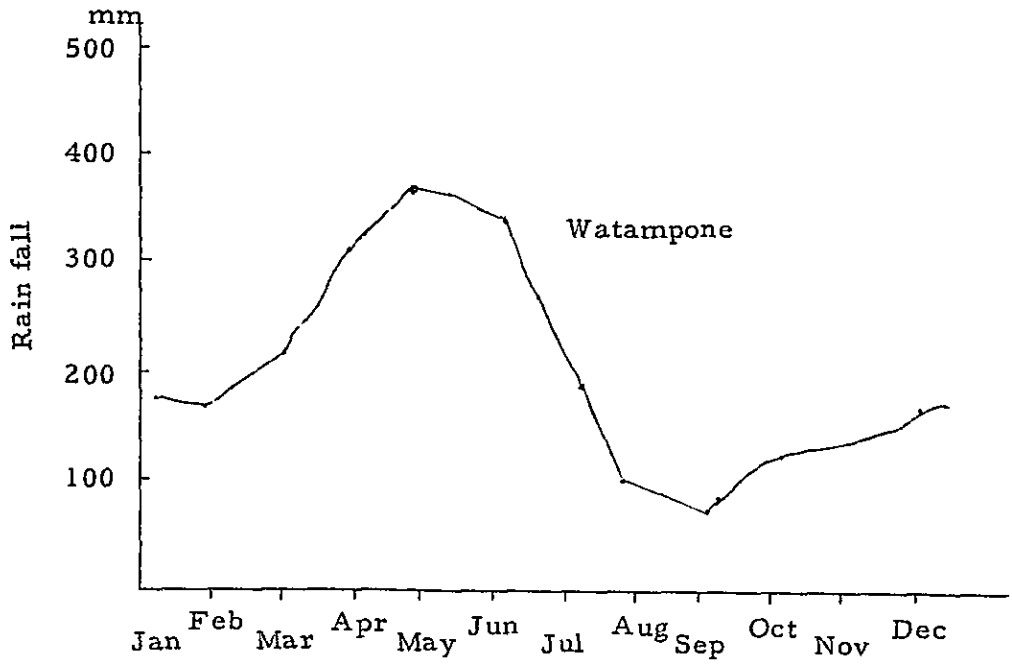


Latsol soil prevails in this Desa. The 11 cm-thick dark brown surface soil contains reddish gravels and is underlain by a layer of reddish brown clayey soil. The soil productivity is considered relatively high.

(d) Kabupaten Bone

Output of both rice and maize surpasses the demand in this Kabupaten. In paddy fields under adequately consolidated irrigation farming, double cropping of paddy is practiced, whereas in half of the irrigated paddy fields and rainfed fields, double cropping of paddy and cereal and leguminous crops is carried out. The interrelationship between the rainfall and the crop rotation is illustrated in Fig. 3.

Fig. 3



Crop Roation in Half-Irrigated Field → Paddy → Fallowing ← Maize

Crop Rotation in Rain-fed Field ← → ← Paddy → ← Maize or Groundnuts

Crop Rotation in Upland Field → Plowing ← Upland Paddy (Planted between maize rows) → Plowing ← Maize

As will be clear from Fig. 3 shown above, paddy and upland paddy are cultivated in the wet season, and maize and groundnuts are grown in the dry season, excluding the driest period. In upland fields, double cropping of maize and upland paddy is generally practiced, and triple cropping of maize is occasionally conducted when rainfall is plentiful.

(e) Desa Telle (Katjamatan Adjang Ale, Kabupaten Bone)

This Desa is formed by an alluvial deposit extending along a river. The 16 cm-thick surface layer is composed of black clayey soil. The survey conducted in paddy fields revealed that tobacco and vegetables are cultivated besides maize, and that the soil productivity is relatively high.

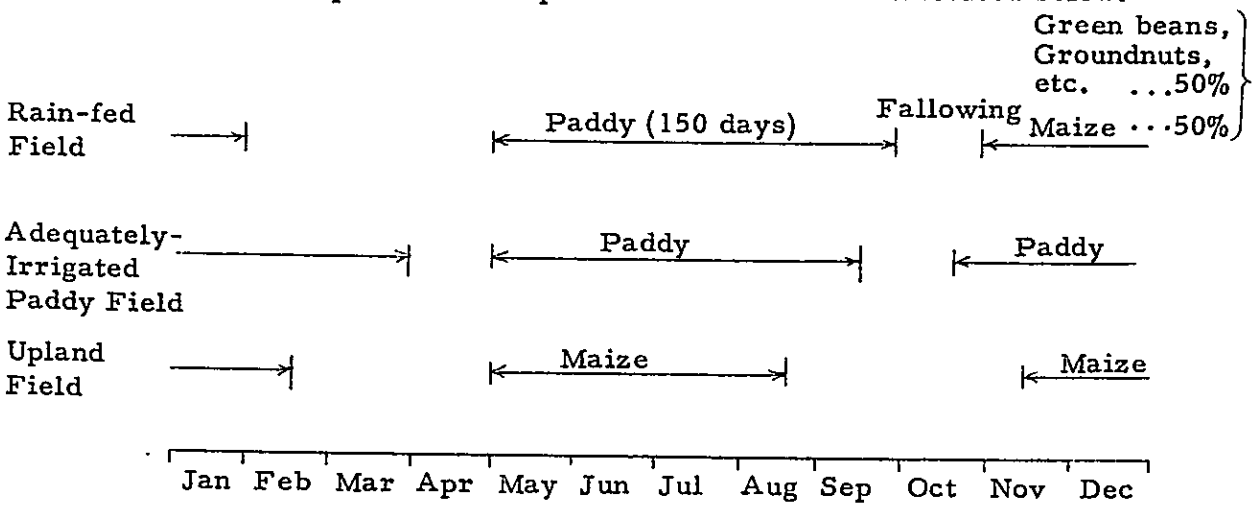
Adin, a white flint variety having a growth period of 90 days, prevails in this Desa. The ridge width measures 90 cm, and four to six seeds sown at intervals of 90 cm are not thinned. Observation of planting density of two selected fields disclosed the following.

Field A: 90 cm x 95 cm, 4.1 plant planting, 46,000 plants/ha.

Field B: 122 cm x 101 cm, 5.3 plant planting, 43,000 plants/ha.

The planting density was thus discovered to be rather thin in both fields.

Patterns of crop rotation adopted in this Desa are illustrated below.



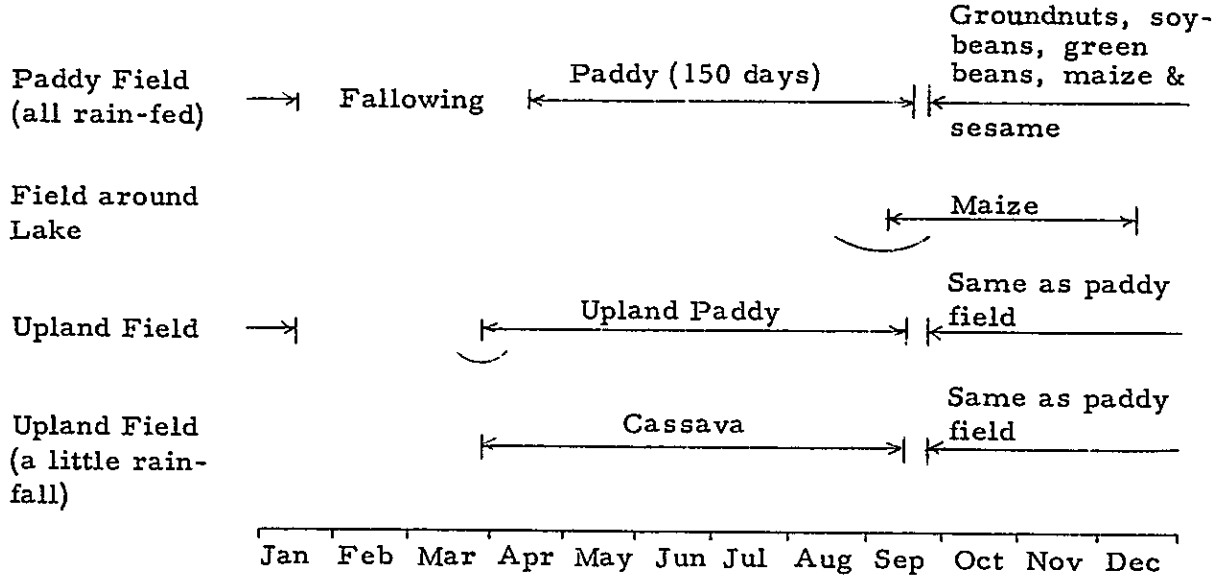
Double cropping of paddy is practiced every three years, covering 80 % of adequately irrigated paddy fields. In the first cropping of maize in upland fields, seeds are sown in the April - May period and harvested in the August - September period from 90 % of the total upland field area, and in the second cropping, sowing is carried out in the November - December period for harvesting in February - March period from 50 % of the total upland field area. If no maize

is planted in the November - December period, green beans, grounuts and and other crops are cultivated in its place.

(f) Kabupaten Wadjo

Variety: Baku Baku is preferred for its early maturing characteristic which is required for cultivation in areas encircling a lake found in this Kabupaten. As for Metro, the team was told that it had been introduced some time before but its supply was suspended by the supplier, a Japanese firm, with which a contract had been signed. The team was also informed that the farmers were indignant at this one-sided action of the Japanese firm. Metro is hard and not suited for food. Fertilizers are applied to Bimas paddy in smaller dosages than in usual cases, and no fertilizers are used for maize cultivation.

Patterns of crop rotation in this Kabupaten are illustrated below.



(g) Desa Wanna Sompe (Katjamatan Sabbangparu, Kabupaten Wadjo)

Rivers flowing on all sides make this Desa appear like an island. Major products are tobacco and cocoons. Maize varieties are Adin (75 %) and Baku Baku (25 %), and also include some Katja Katja. Under the triple cropping of maize practiced in this Desa, seeds are sown in March, June and September-October for harvesting in June, September and December.

No fertilizers are applied for maize cultivation. Both ridge width and the spacing in the row measure 100 cm. A stick-shaped implement is used to dig sowing holes which are stamped after sowing. The planting density observed at farmers' fields was thin with only about 30,000 plants planted to the hectare

(133 cm x 112 cm; 4.6 plant planting).

4. Quality and Distribution

(1) Existing State in Surveyed Areas

(a) Kabupaten Bulukumba

This Kabupaten is one of the major maize producing areas in South Sulawesi, and its average annual output over a five year period from 1964 to 1968 amounted to 27,525 tons of which about 13,000 tons were shipped to outside areas.

Annual per capita consumption of rice, maize and sweet potatoes is 170 kg in terms of rice. Production of food crops amply meets the intra-Kabupaten demand and provides surplus for shipment to other areas. However, the overland transport of maize to Makassar by the 120-km road which is in a poor condition costs as high as Rp 6,000 per 3-ton truck or Rp 2 per kg.

(b) Desa Bontomansi (Katjamatan Bulukumpa, Kabupaten Bulukumba)

(i) This Desa is inhabited by 7,211 people and has 3,297 ha of cultivated land comprised of 1,342 ha of paddy field and 1,955 ha of upland field.

Maize is cultivated in 600 ha of paddy field as a second crop after rice, as well as in 1,600 ha of upland field by double cropping with 800 ha covered by each cropping. The total planted area is therefore 2,200 ha. Local white varieties such as Boda and Dadi are most widely cultivated.

(ii) The peak harvesting season lasts from February to March. Though no brokers are found in this Desa, merchants in Makassar have their agents stationed in the Desa. About 50 % of maize sold to these agents is collected by trucks sent from their principal offices. The sales price in the harvesting season is Rp 10 - 12/lit.

(iii) Harvested maize is threshed and dried outside on mats for about three days. Maize to be preserved for home use is suspended without husking from the eaves or under the raised floor for drying.

The team inspected some of earcorn bundles suspended from the eaves and noted that they were dried to 13 - 14 % of water content. The team also discovered with surprise that earcorns so preserved were little affected by insects.

(c) Kabupaten Bone

(i) This Kabupaten is the largest maize producing area in South Sulawesi. Maize production in the Kabupaten over the past several years is as tabulated below.

1967	59,251 ha	45,135 t
1968	49,570	48,145
1969	55,500	37,177 (estimate)
Average	54,924	43,505

Production in this Kabupaten usually surpasses the 45,000 ton level, though 1969 recorded a decrease in both production and planted area due to heavy rainfalls.

(ii) The population in 1969 stood at 743,375, and the per capita consumption of food crops (rice, maize and sweet potatoes) at 161 kg in terms of milled rice. In 1968 surplus production for shipment to outside areas amounted to 13,375 tons for rice and 6,495 tons for maize.

(iii) The 148-km road connecting Watampone and Pare-Pare (which is in a poor condition with the exception of a 40-km section) must be used in order to export through Pare-Pare port, and the 199-km road leading to Makassar via Uyunglamusa for shipment from Makassar. Overland transport of maize by these two roads, which are not in a satisfactory condition, costs as much as Rp 3/kg to Pare-Pare and Rp 4/kg to Makassar. The high transport cost is impeding the growth of maize exports.

(d) Desa Telle (Katjamatan Adjang Ale, Kabupaten Bone)

(i) This Desa is inhabited by 5,470 people, and has 900 farm households and 1,800 ha of cultivated land comprising 1,000 ha of paddy field and 800 ha of upland field. Maize is cultivated in 500 ha of paddy field as a second crop after paddy as well as in a total of 1,350 ha of upland field covered by double cropping. Average yield per ha ranges from 0.7 to 0.8 tons, and the total output is 1,300 tons.

(ii) After harvesting, earcorns are dried for two days, threshed, dried again for one day when the weather is fine, and then sold. Some farmers suspend earcorns from the eaves without drying them on the ground.

(iii) Two Desa brokers purchase maize from farmers. Farmers usually carry the product into the broker's compounds. About 50 lit. of maize grains is delivered for each transaction. If a draught animal is used, 150 lit. is carried each time. (70 horses, 21 head of cattle and 200 buffaloes are raised in this Desa. Buffaloes are not used for transporting goods.)

(iv) About 70 % of the maize produced in this Desa is shipped to outside areas. To be precise, about 900 tons (= 1,300 tons x 70 %) of maize grains is shipped each year chiefly to Pare-Pare. The sales price per litre during the harvesting season is Rp 7.5 at the lowest and Rp 12 - 13 at the highest.

(v) A one-litre dry measure is always used for maize transaction between the producer and the broker. The team was informed that this measure is manufactured and sold by the provincial government of South Sulawesi. The team also learned that the farmers shy away from using 10-litre measures in fear of possible overmeasure.

(vi) Quality of maize offered for sale in the harvesting season could not be inspected. Maize is harvested in the September - November period from paddy fields and in April and October from upland fields. Since all harvesting periods, excepting April, are within the dry season, it is believed that no difficulties are involved in the drying and processing of harvested maize.

(e) Kabupaten Wadjo

(i) This Kabupaten is another large maize producing area of South Sulawesi and its average annual production over the past five years recorded 29,000 tons. With its population standing at 397,440 in 1968 and per capita food consumption registering 170 kg, the Kabupaten produces about 17,000 tons available for shipment to outside areas.

(ii) For overland transport of export maize, the 80-km Sengkang - Pare-Pare road is used. A 40-km section of this road is in good condition, but the remaining 40-km section is in extremely bad condition. Transport cost per kg is Rp 2.

(iii) The Kabupaten has 71,170 ha of paddy field and 43,411 ha of upland field. The area extending around Lake Tempe offers farm land of 22,000 ha in the wet season and 33,000 ha in the dry season (April to September). The team was informed that the land close to the lake's shore is so fertile that a

local variety cultivated without plowing and fertilization promises a yield of 1.1 t/ha.

(f) Desa Wanna Sompe (Katjamatan Sabbangparu, Kabupaten Wadjo)

(i) This Desa is a small village inhabited by 2,225 people and has 526 farm households and 321.4 ha of cultivated land. Since it is segregated from other areas by the rivers flowing on all its sides, it forms a small island and could not be regarded as a typical Desa of Kabupaten Wadjo though the soil was noted to be quite fertile.

(ii) Maize is cultivated in a total of about 210 ha by triple cropping with 70 ha covered by each cropping. With its annual maize production of about 200 tons and per capita maize consumption of 45 kg. the Desa produces 100 tons of surplus maize shipped to outside areas.

(iii) During the harvesting season, maize brokers from Limbung visit the Desa by boat. Since most farmhouses are built along the rivers, maize is sold in bags at the farmhouse. The sales price during the harvesting season is Rp 7.5 per lit. The brokers furnish the bags and pay the farmers or laborers Rp 25 per bag for carrying bagged maize from farmhouses to the boat (distance: 5 - 10 m) and for loading them on the boat.

(iv) Drying and Processing

Drying and processing work is conducted in the same manner as followed in other Desas.

(g) Pare-Pare Port

(i) Port Facilities

Berth	:	1 berth of 35 m
Water Depth	:	8.5 m at low tide and 10 m at high tide
Accommodation	:	12,000-ton class carrier
Capacity of Transit Shed:		14,000 t

(ii) Cargo Handling

Since the berth has a length of 35 m, two-hatch cargo handling is feasible with two-gang operation (each gang comprising 10 to 12 laborers). The carrier must be shifted for cargo handling involving more than two-hatch operation.

Cargo handling charge per ton, including the stevedorage charge of Rp

396/t, unloading charge from trucks, metage charge, and storage for 10 days is Rp 500.

(iii) Drying Facilities

Tank Capacity	:	11 t + 17 t = 28 t
Engine Horsepower	:	26 Hp
Fan Diameter	:	90 cm
Drying Capacity	:	28 t x 3 times (10 hrs) - 84 t/day Rate of drying shrinkage: 18% - 14 % = 4 %
Automatic Packer	:	Available
Insecticide Sprayer	:	MINTEX-13 sprayer is used at time of packing but its control effect is not considered sufficient.

(h) Makassar Port

Port Facilities -

Berth 2	:	1,350 m 500 m
Water Depth	:	8 m at low tide and 9.5 m at high tide
Accommodation	:	1,200-ton class carrier
Capacity of Transit Shed	:	200,000 t (bagged grain basis)

(2) Distribution

(a) Demand-Supply Situation of Food Crops

Population of South Sulawesi totaled about 5,420,000 in 1968 and about 5,530,000 in 1969. The province's demand-supply situation of food crops in 1968 is as shown below.

Crop	Production	Per Capita Annual Consumption	Surplus for Export or Shipment to Other Provinces
	(t)	(kg)	(t)
Rice	678,236 t	98 Kg	76,515 t
Maize	276,451 "	49 "	23,864 "
Potatoes	450,000 "	25 "	-
Total		172 "	

As is clear in the above table, the province offers surplus rice and maize

for export and shipment to other provinces. Therefore, any increase in the producting of these two crops increases the surplus available for shipment.

(b) Price

The sales price varies to some extent according to areas and seasons, but appears to range from Rp 6 to 7 per kg in Desas. In Pare-Pare or Makassar, the price is higher, ranging from Rp 10 to 12 and rising to Rp 12 to 14 at the highest. It appears that the higher price quoted in the two cities is ascribable to the high transport cost from the producing areas and to the lack of an integrated collecting system such as the one established in Java.

The said high price is not too immoderate compared to the FOB Java price and can stand international competition provided the world market price is held at a normal level. However, the annual export volume is prevented from growing higher than the current level of 20,000 to 30,000 tons by the prevalence of white varieties and their poor quality.

(3) Quality

(a) Cultivation of Yellow Varieties

As already described, the greater part of the varieties now cultivated are the local white varieties which cannot be readily shifted to yellow varieties. To shift the existing maize cultivation for food supply to the cultivation of varieties serving as cash crop, the market for a certain fixed amount of annual export should be secured but this cannot be materialized readily under existing conditions.

(b) Processing and Damages

(i) Drying and Processing

No problems will be entailed in drying and processing insofar as maize is produced and dried for farmers' own consumption as at present when individual farmhouses which spread small lots of maize grains on mats for solar drying find no difficulties at all in balancing the threshing capacity and drying capacity or in processing maize grains on rainy days. However, if production increase progresses and large lots of maize grains are required to be dried and processed immediately after harvesting, farmers will find themselves helpless just as in Central Java and will inevitably be compelled to sell the harvested but unhusked maize because they are not equipped with the necessary threshing and drying facilities. Under the circumstances, farmers are incapable of rapidly

drying large quantities of harvested maize grains to a water content of 18 %.

Brokers are equally incapable in this respect. Relying solely on the farmers' drying and processing work at present, they competely lack any drying and threshing facilities of their own. The problem cannot be solved by the drier with a daily capacity of 85 tons installed in Pare-Pare. It is believed that the only solution to this problem can be brought about by the installation of drying and threshing facilities in common working yards and by the establishment of an integrated purchasing and collecting system through the agricultural cooperative association, though this task will naturally be accompanied by many difficulties. It is hoped that the provincial agricultural cooperative association of South Sulawesi (Gakoperta South Seravece) which is now actively engaged in the organization of lower level cooperative associations will find a way to solve the problem.

(ii) Damaged Grains

As stated earlier, the quality of maize is affected decisively by the drying work. Deficient drying develops larger percentages of damaged grains in the course of collection, storage and transportation, and could lead, in the worst case, to an increase in grains damaged by fermentation heat or by germination resulting from excessive water content. It is to be noted that unlike broken grains or impurities, damaged grains cannot be readily sorted, once the damaged takes place, and therefore seriously impair the quality.

(iii) Insect Damage

Fumigation using methyl bromide should be conducted in addition to the spraying of insecticide at shipping ports for export maize. Fumigation is not practiced at present in South Sulawesi.

(4) Activities of Gakoperta in South Sulawesi

Gakoperta South Seravece was established on December 18, 1967. Affiliation with this central agricultural cooperative association is allowed on condition that five or more individual cooperative associations organized by 20 or more members are established within a single Katjamatan. As of November 1970, there were 103 individual cooperative associations affiliated with Gakoperta. Associations on the Kabupaten-level have their own offices.

Purposes of Gakoperta are as described below.

(1) Organization and education of farmers.

(2) Augmentation of production and mechanization.

(3) Processing of farm produce. Rice-hulling machines have already be installed at eight places, with an additional 25 machines expected to be installed shortly.

To attain the purposes cited above, Gakoperta engages in activities covering the following areas.

(1) Collection of farm produce.

(2) Storage (and installation of warehouses).

(3) Transportation.

(4) Marketing.

(5) Production means.

Since the farmer's economy is still in the initial stage of development in South Sulawesi, Gakoperta now faces the following problems.

(1) Shortage of funds.

(2) Inadequacy of management.

(3) Organization,. production and shipment are systematized into routine actitivies but the creation of a favorable climate for Gakoperta's activities has not yet been attained due to the shortage of warehouses and transport means,

The team was informed that the payment rate of membership fee, which remained at a low level, registering 10 % in 1968, 5 % in 1969 and 25 % in 1970. has recently shown a rapid increase.

5. Fundamental Approach to Maize Production Project

South Sulawesi as a whole produces surplus rice and maize for shipment to other provinces, and there is hope that future production increase of maize in the province would lead directly to the acceleration of exports. Growth of maize export is hampered at present by poor road conditions and high transport costs despite the fact that the province includes large producing areas each as Bulukumba and Bone. Between Bendoro and Pare-Pare, however, the road is in a good condition and the distance between the two places is short.

In the course of the survey, the team was attracted by many fallowed or deserted lands found in paddy fields around lakes in Wadjo and Sidrap and in upland fields spreading around these paddy fields. Insofar as was clarified by the survey, it is believed that the shortage of labor force and the lack of a consolidated distribution mechanism are the major causes for so many fallowed or

deserted farm lands. To minimize the fallowed area, introduction of powered farming equipment is considered useful. It was learned that in a large portion of paddy fields encircling the lakes, either irrigation water is insufficient for paddy cultivation or stagnant rain water prevents the planting of paddy and cereal and leguminous crops in the wet season. Irrigated farming should be introduced to these paddy fields to stabilize the cropping. Owing to the many fallowed or deserted farm lands mentioned above, it is considered that a maize production project to be established in South Sulawesi should aim primarily at the introduction of mechnized farming in Wadjo and Sidrap and secondly at the implementation of an irrigation scheme. The project, it is believed, should be so implemented that it will eventually cover the neighbouring areas such as Soppeng. The improvement of distribution should be promoted in parallel with the fostering of agricultural cooperative associations.

CHAPTER IV EXISTING STATE OF MAIZE PRODUCTION IN LAMPUNG

1. Socio-economic Background

(1) General

Though not confirmed by accurate statistical data, Lampung is said to cover an area of 33,200 km^2 and have a population of three million of which 70 to 80 % are engaged in agriculture. The population density is high in and around Telukbetung, the capital of the province, and in the paddy field areas of Metro and Prinsewu and surrounding areas, becoming lower towards the north. The forest area spreading along the Mesudji river in the north, the hilly areas on the west coast and the swampy coastal forest areas are all trackless or very sparsely settled.

The province was estimated to have a small population of 420,000 in 1940. The population increase noted during the survey was occasioned by the post-war development. The migration of Javanese farmers into the province showed a sharp increase from around 1950, reportedly accounting for a population increase of 10 % in 1967.

The native people of Lampung, including Central and Southern Sumatras, account for 60 % of the province's total population and are found mostly in the northern and southern hilly areas. The Javanese, comprising the remaining 40 % of the population, live mostly in the flat farm land area in the central and southern parts of the province. The native people of Lampung are engaged in shifting cultivation or perennial crop cultivation, whereas Javanese settle themselves in newly cleared lands where they cultivate aquatic and upland paddies, cassava, maize, soybeans, etc. The two groups of people differ from each other in language, customs and mode of life.

No harmony between the two groups has not yet been fully attained.

The province is administratively divided into the special city of Telukbutung Tanjung Karang and into the South, Central and North Kabupatens, with the Kabupaten Office being located in Tanjung Karang, Metro and Kotabumi, respectively.

A governor is appointed for each of the three Kabupatens.

Telukbetung, where the provincial government is located, and Tanjung Karang form a special city having population of 120,000 and equipped with power

Table 14. Annual Export Volume at Pandjang

Item / Year	Rubber	Coffee	Pepper	Maize	Dried Cassava	Powdered Cassava	Copra	Timber	Others	Total	Total Value in US$
1960	35,351	6,061	8,430		800		2,150		329	53,121	
1961	48,800	14,005	15,629		470		3,733		535	83,898	
1962	48,991	11,563	3,757				864		10	65,185	
1963	38,990	18,398	13,489	200	600		1,058		340	73,045	
1964	52,399	13,554	16,654				3,873		139	86,619	
1965	53,119	33,203	11,048	4,400	9,200		2,638		1,200	115,308	
1966	44,659	28,618	13,282	29,871	2,847	2,996	4,893	289 M^3	2,263	132,327 +289 M3	24,000,000
1967	44,465	42,662	29,295	26,650	2,700	3,666	4,330	4,512.2M^3	3,540.5	156,490 +4,512.2M^3	32,000,000
1968	50,592	24,935	20,756	29,047	15,000	1,250	4,250	5,904.12M^3	8,649	152,529 +5,904M^3	32,500,000
1969	53,902	40,579	10,910	38,546	45,300	1,450	3,600	24,716.32M^3	9,156	1,303,064 +24,716.32 M^3	38,000,000

generator facilities, hospitals and colleges. About 7 km to the southeast of this special city is Pandjang port. The special city is connected with Djakarta by telephone and telegraph service and two flights a day by regular airplane service. Both railways and roads leading far into Palembang start from this city. Thus the special city functions as the political, cultural and industrial center of the province.

Metro located at the middle of an irrigated paddy field area and surrounding upland field area serves as the center of the newly developed agricultural area.

Kotabumi, an old local city developed on the bank of the Rarem, lies along the railway line and the national highway leading to Palembang. In the area extending to the hilly districts in the north and west of this city are found many native people of Lampung. The city is also the collecting and trading center for rubber, coffee and hot pepper produced in inland areas.

The above three cities and Pandjang port are supplied with electric power by independent non-utility small-scale generator facilities, but all lack a city water and sewer system.

(2) Transport and Traffic

(a) Railway, Road and Port

The traffic arteries of the province are the railway line and a 5 - 6 m wide fully paved highway running approximately parallel to it. Access to various parts of the province is made by branch roads leading out of these highways.

The railway line starting from Pandjang reaches Palembang via Kotabumi and provides two round-trip services by express train and three round-trip services by regular train. Though both trucks and wagons are rather old, the availability of 10 to 30 wagons including new ones offers ample transport capacity to meet the existing traffic demand.

The network of branch roads in the province has been greatly improved over the past five years by the incessant efforts of the provincial government. However, new construction or improvement of branch roads is being carried out to meet the immediate demand since the pressure of rapid development and sharp population increase far surpasses the financial and technical capability of the provincial government. For full-scale development of Lampung, therefore, top priority should be given to road construction and port facilities in future

public investment. As part of such investment, the construction project of the 64-km road connecting Djabung and Pandjang has been selected for presentation to the World Bank to obtain necessary financing. At present, temporary surfacing of branch roads is conducted only on major routes.

Transport and traffic to other parts of the archipelago resort chiefly to Pandjang port.

Pandjang is a port favored with good natural conditions. It provides an anchorage for two 10,000-ton class vessels and its berth facilities can accommodate one of 10,000-ton class vessel and one 3,000-ton class ferry steamer for cargo handling. It also has transit sheds of 20,853 m^3 operated by private and government enterprises and providing a total storage capacity of 20,315 tons.

There is a traffic of 300,000 passengers between Sumatra and Java by the regular liner plying four times a day between Pandjang and Merak. Further, coastal liners and ocean-going vessels call at Pandjang for inter-regional and foreign trade of timber, agricultural products, heavy machinery and accessories, cement, sundry goods and so forth.

Export items handled at Pandjang are as shown in Table 14. The port is active throughout the year, and in and around July when the export volume reaches its peak, outstripping the port's one-wharf cargo handling capacity, five to six ocean-going vessels must often wait outside the port for berthing.

The existing congestion at Pandjang points to the necessity of expanding the port including its cargo handling and wharf facilities before the full-scale development of Lampung is launched. The port expansion and the ferry boat operation to connect Merak port and Tua point now being studied by the parties concerned are expected to be taken up by the Central Government of Indonesia. Their early materialization is hoped for.

(b) Others

Reflecting the increasing importance of Pandjang port, factories and werehouses built along the road connecting Pandjang and Telukbetung for drying, processing and storing agricultural export products have recently shown a rapid expansion in both scale and number.

Operation of these facilities and collection and transport of export products are undertaken, as in the past, by Chinese enterprises in Telukbetung.

Warehouses of Agricultural Products

(As of the end of December 1968, surveyed by The Division of Commerce, Lampung provincial government)

	Province-Operated (m^2)	Privately Operated (Indonesian)(m^2)	Privately Operated (Chinese)(m^2)
Telukbetung	9 (7,654)	333 (103,512)	88 (8,290)
Tandjung Karang	0	67 (5,163)	41 (1,013)
Kabupaten South Lampung	3 (701)	167 (20,436)	2 (306)
Kabupaten Central Lampung	0	49 (6,938)	19 (638)
Kabupaten North Lampung	0	157 (16,501)	9 (576)
TOTAL	12 (8,355)	773 (152,550)	159 (10,823)

Notes: 1. It is estimated that the number of warehouses in Telukbetung and Tandjung Karang increased by 50 % during the two-year period from 1968 to 1970.

2. Coffee and pepper are the major products stored in the warehouses. Increased storage of maize has resulted in the construction of additional warehouses in recent years.

(3) Desa and Immigrants

Lampung has three Kabupatens which are divided into 52 Katjamatans each having 10 to 30 Desas. Desas can be classified into three kinds by the racial composition of the inhabitants. There are Desas inhabited either solely by the natives of Lampung or by Javanese settlers, while in some Desas both live together.

Communities of Javanese settlers are placed under the jurisdiction of the provincial government for incorporation into Desas when their inhabitants, who have settled in designated areas under the immigration plan of the Ministry of Immigration, are considered to have attained a stabilized livelihood. The settlers communities which are still in the initial stage of development and have not therefore reached a stabilized stage remain under the control of the Ministry of Immigration for its continued assistance and guidance.

Settlers' communities also include those established to receive retired soldiers or police officers with protection and guidance provided by competent ministries. Since the farming in these communities is not yet stabilized, none of them has so far been included into a Desa. The settlement plan largest in scale is that of the Ministry of Immigration. Under this plan which was initiated

in 1952, 53,257 families or 220,326 people started a new life in a total of 251,163 ha of designated settlement area up to the end of 1969.

Number of settlers and areas designated for them during the period from 1952 to 1967 are shown below.

South Lampung	(4 places)	5,107 families	21,631 people	43,100 ha
Central Lampung	(16 places)	43,311 "	174,012 "	162,063 "
North Lampung	(4 places)	5,839 "	24,943 "	46,000 "
TOTAL	(24 places)	53,257 "	220,306 "	251,163 "

Of the above listed settlers, those who have already been placed under the jurisdiction of the provincial government of Lampung are as follows.

South Lampung	4,205 families	20,226 people	41,000 ha
Central Lampung	44,096 "	158,464 "	135,863 "
North Lampung	2,594 "	11,413 "	26,000 "
TOTAL	50,895 "	190,103 "	202,863 "

Settlers who were under the direct control of the Ministry of Immigration as of the end of 1969 are as shown below.

South Lampung	5,000 families	21,600 people	42,500 ha
Central Lampung	3,800 "	15,500 "	28,000 "
North Lampung	3,240 "	13,500 "	40,000 "
TOTAL	12,107 "	50,709 "	110,500 "

Number of settlers placed under the provincial administration is as shown below.

	2,426 families	10,257 people	15,000 ha

Land concession has so far been obtained for an area of 220,500 ha as detailed below.

North Lampung (6 places)	182,500 ha
South Lampung (2 places)	30,000 "
Central Lampung	8,000 "

Land concession is planned to be obtained also in other areas.

A total of Rp 150,000 is required on the average for the settlement of one family including the transport cost to the designated settler's community. Of this amount, Rp 35,000 is for construction and the remaining Rp 115,000 is for food, medical treatment and transport.

Settlers are required to pay back to the Government Rp 12,000 which is about 8 % of the cost of food, house and land in 10 % of farm products each year over a maximum payment period of 20 years starting from the third year after settlement.

In earlier days, communities of Javanese settlers developed along highways. With the subsequent increase in immigrants prompted by the settlement plan of the Ministry of Immigration, suitable settlement sites were selected first with roads constructed afterwards to connect them with the Desas in the neighboring area. This has expedited the construction of many development roads in Central Lampung where a large number of people have settled, eventually contributing to the formation of the road network now observed.

2. Existing State of Agriculture

(1) Crops and Their Production

Crops cultivated in Lampung are comprised of perennial crops such as coffee, pepper, rubber and copra and ordinary farm crops such as aquatic and upland paddies, maize, cassava, soybeans and green beans. Export products are the perennial crops, maize and cassava.

All ordinary farm crops excepting maize are produced for the farmers' own consumption, and the rice production exceeds the island's demand. Approximately 5,000 tons of milled rice are shipped to Djakarta in normal years.

Export of agricultural products is as tabulated in Table 14. Coffee, pepper and rubber are cultivated mostly on lands with favorable climatic and soil conditions which are found in the vicinity of Kotabumi and in the hilly area to the northwest of the city. These crops are also cultivated, though to a limited degree, in the area extending on the right bank of the Sekampung river in the east of Tanjung Karang.

It is said that in pre-war days, there were 35 large and small estates where these crops were produced. The neglect and destruction during and after the war have caused the devastation of these estates, and there now remain only two relatively large estates, the rubber estate at Naku (6,000 ha) and the palm estate at Bekri (4,300 ha), but both are past their prime period and in need of replanting.

Ordinary farm crops are cultivated by the farmers comprising mostly Javanese who have settled in respective villages. The native people of Lampung

Table 15. Major Farm Crops in Lampung

Crop / Item \ Year		1965	1966	1967	1968	1969
Paddy (in ears)	Planted Area (ha)	61,659	63,492	62,140	67,705.5	70,532
	Production (t)	209,526	233,698	198,700	235,468	222,847
	Average Yield (t/ha)	3.4	3.68	3.2	3.47	3.6
Upland Paddy (in ears)	Planted Area	129,392	161,465	142,447	170,417	138,908
	Production	202,364	267,832	159,232	219,848	144,112
	Average Yield	1.56	1.65	1.12	1.3	1.04
Total of Aquatic & Upland Paddy (in ears)	Planted Area	191,051	224,957	204,587	238,122	209,440
	Production	411,890	501,530	357,932	455,316	366,959
	Average Yield	2.16	2.23	1.75	1.91	1.75
Maize (in dried grains)	Planted Area	51,825	67,220	53,101	62,214	57,730
	Production	46,518	46,799	32,278	49,345	45,667
	Average Yield	0.91	0.69	0.61	0.79	0.79
Cassava (raw)	Planted Area	33,290	34,393	27,078	26,442	34,696
	Production	337,076	319,518	191,509	223,834	295,635
	Average Yield	10.29	9.28	7.07	18.46	8.52
Soybeans	Planted Area	21,221	19,246	14,336	21,904	14,749
	Production	13,668	7,904	6,020.95	12,929.75	6,439.6
	Average Yield	0.63	0.41	0.42	0.59	0.44

occupy themselves mostly with pernnial crop cultivation and many of them are still engaged in shifting agriculture.

Production and planted area of ordinary farm crops are shown in Table 15.

(2) Major Farm Crops

The most important crop in the province is rice. The total planted area of aquatic and upland paddies combined ranges from 200 to 240 thousand ha, and the production amounts to from 360,000 to 500,000 tons in ears (Padi) and from 180,000 to 250,000 tons in polished rice.

Upland Paddy:

Rice cultivation in Lampung is characterized by the large planted area of upland paddy which is more than 140,000 ha each year. Production of upland paddy in Padi, totalling 200,000 tons, is slightly smaller than the aquatic paddy production but accounts for almost half the total rice output of the province.

The favorable rainfall distribution allows upland paddy to be cultivated in every part of the province. In Central and North Lampung, transplanting is conducted in the beginning of the wet season, i.e., during the period from November to December, for harvesting in the February - March period. In South Lampung, both transplanting and harvesting are carried out one month earlier.

Aquatic Paddy:

Planted area of paddy was 70,532 ha in 1969. Since the paddy field area was 58,866 ha, the total planted area under double cropping system was 11,666 ha.

Irrigated paddy fields cover an area of 24,458 ha, of which 20,830 ha are provided with irrigation facilities and 3,628 ha are cultivated with the partial use of irrigation facilities. The irrigated paddy field area is composed of the 23,300 ha which is irrigated by the water from the Sekampung river and of a small area extending to the west of Bandardjaja where the water is drawn from the mid-stream of the suputih river. The former area of 23,300 ha comprises the 18,000 ha land around Metro, Central Lampung, and the 5,300 ha land in the lower basin of the Tarangpadang, South Lampung.

Irrigation Facilities:

Construction of irrigation facilities for the above-mentioned three paddy

field areas was carried out according to a plan worked out during the Dutch colonial days. Construction of weirs on the Sekampung river to supply irrigation water to the said 23,300 ha area was the first irrigation project ever conducted in Lampung and manifested the development efforts of pioneer settlers from Java. As for the irrigation canal downstream of Metro and the Nagaradji canal of the Suputih river, construction work was resumed recently to extend both canals and to fulfil the dream which Javanese farmers settlers have cherished over the past ten-odd years.

Rain-fed Fields:

The paddy field area excluding the irrigated area of 24,500 is either watered only by rain or irrigated with water obtained by constructing weirs on slow streams, and covers an area of 34,500 ha. Such paddy fields are found in basins and swampy, low-lying areas in the mountainous districts in Kotaagung, Sumberdjaja, Talangpatang, Kaliredjo, Bolau and Kalinda, and are concentrated near the southern mountainous district. The southern part of the province produces a higher yield per ha than the central part, indicating that it is favored with fertile soils and abundant rainfalls. The limited paddy cultivation observed in North Lampung is attributable to the fact that most of the inhabitants are natives of Lampung and Javanese settlers are smaller in number than in other parts of the province.

Variety:

Cultivation of IR varieties is encouraged by the Government together with fertilization and chemical control of insects and diseases. IR-5 and IR-8 introduced in 1967 are said to account for 30 % of all varieties cultivated in the province. It is expected that these varieties will give a yield of 4 tons per ha in unpolished rice.

Table 16. Harvested Area and Production of Maize in Lampung

Year	Harvested Area (ha)	Production (t)	Average Yield (qt/ha)
1960	34,494	31,818	9.22
1961	34,589	27,683	8.00
1962	68,796	70,549	10.25
1963	40,639	22,374	5.50
1964	55,900	44,584	7.98
1965	51,824	46,527	8.98
1966	67,220	46,799	6.96
1967	53,101	32,278	6.08
1968	62,214	49,345	7.93

Year	Harvested Area (ha)	Production (t)	Average Yield (qt/ha)
1969	49,870	44,760	9.00
1970	58,607	47,218	8.05

3. Maize Production

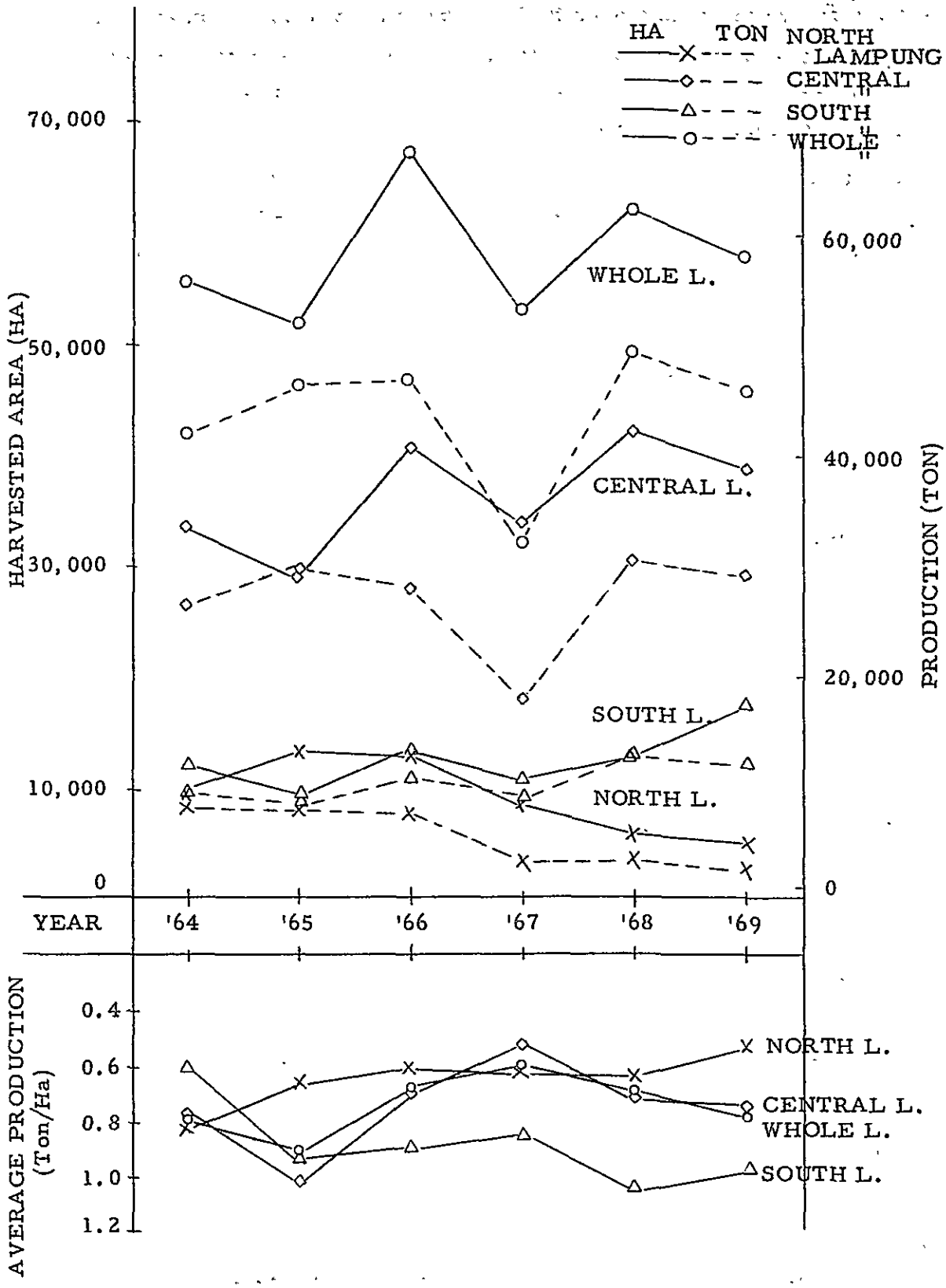
As shown in Table 16, the harvested area of maize in Lampung is 50,000 to 60,000 ha, production 40,000 to 50,000 tons, and yield per ha 0.8 tons. The lowest annual production over the past several years was recorded in 1967 when many areas of the province suffered heavy drought damage. Export of maize has been on a steady increase in recent years, registering 45,000 tons in 1970. Central Lampung leads other areas in both planted area and production which account for 60 - 70 % and 60 %, respectively, for all Lampung. South Lampung ranks next to Central Lampung. Both planted area and production of North Lampung are the smallest in the province, occupying less than 20 % of whole Lampung in 1968 and less than 10 % in 1969.

In terms of unit yield, however, South Lampung ranks at the top. Yield per ha in South Lampung is 140 % to 150 % of that of Central and North Lampung. It is considered that this high yield is due to the rich soil fertility and favorable rainfall distribution as well as to the estate agriculture which employes advanced farming techniques. Since farm management and yield vary according to whether maize is cultivated by individual farmers or estate agriculture, explanation will be given separately for the two types of agriculture.

(1) Maize Cultivation by Individual Farmers

Unlike the case in Central and East Java where monoculture of maize is conducted, maize cultivation in Lampung is carried out under mixed cropping with soybeans, upland paddy and cassava. As an upland field product, maize is a secondary rather than a principal crop in Lampung. Under the Intensified maize production in recent years which was occasioned by the increasing demand, maize is cultivated as a cash crop and not as a subsidiary food crop. This explains the predominance of yellow varieties, mostly Metro, and the limited production of white varieties for the farmers' own consumption. Harvested maize is sold to the brokers dispatched to respective Desas at a price determined chiefly by the export price at Pandjang. Since the exporters deduct from the sales price the transport cost, expenses for processing work including dry-

Fig. 4. Harvested Area and Production of Maize in Lampung



ing and sorting, interest, and broker's margin, they pay higher purchase prices to the farmers in areas closer to Pandjang and lower prices in areas far from the port. The transport cost is affected not only by the distance to Pandjang but by the road condition because trucks are used for maize transportation in almost all cases. The survey revealed that maize cultivation does not bring much profit to the farmers in distant places such as Baradatu, located 160 km from Pandjang, where the exporters must pay a total of Rp 3,500 to the ton (see Table 17) and a large broker's margin, unless bulk buying is possible. This explains why maize is used for the farmers' own consumption in Baradatu.

Table 17 clearly shows that the maize production is affected by the purchase price, indicating the necessity for improving the road condition for future production increase.

Maize cultivation is carried out mostly by Javanese settlers, and it is only a few years since the native people of Lampug started maize cultivation outside the garden compounds.

Among a number of crops cultivated under the mixed cropping system practiced in Lampung, soybeans constitute the major crop in South Lampung, but in areas north of Tegineneng, upland paddy takes the place of soybeans. These crops are cultivated with groundnuts and cassava, and also with maize. In South Lampung, seeds for the first cropping are sown in the October - November period, and soybeans and maize are harvested in January and February and upland paddy in April and May. Cassava is planted one to two months later than maize and harvested in seven months. In Central Lampung, seeds are sown in the November - December period, i.e., one month later than in South Lampung, for harvesting in February and March.

Maize for second cropping is sown in the February - March period in South Lampung and in the March - April period in Central Lampung. In most cases, maize is cultivated with other crops such as groundnuts and soybeans, though cultivation of maize along is also carried out in exceptional cases.

(2) Maize Cultivation by Estate Agriculture

Estate cultivation of maize was initiated in 1969 by Mitsugoro Farm. As of 1970, a total of 1,600 ha of land was cleared and 1,400 ha was planted with maize by Mitsugoro Farms Nos. 1, 2 and 3. This was followed by the development efforts made by Singalaga Farm located 40 km to the southwest of Pandjang.

Table 17. Relationship between Purchase Price and Transport Distance
(Surveyed in December 1970)

Location	Purchase Price (RP/kg)	Transport Distance	Road Condition	Remarks
Sulibahwono	9-10 ~ 12.5	To Pandjang : 130 km	Relatively good	Rp 3,000/ton to Pandjang
Redjosari	7-8 ~ 14	T.K. - Metro : 53 km	Good	
		Metro - Red. : 39 km	Relatively good	
		Total : 92 km		
Bandardjaja	10 ~ 17	44 km	Good	Rp 1,500/ton to T. Karang
Kaliredjo	7.5-8 ~ 11	T.K. - Bekri : 45 km	Good	
		Bekri - Kal. : 31 km	Rather poor	
		Total : 76 km		
Sidokarto	6 ~ 15-17	40 km	Good	
Bumiagung	12 ~ 15	T.K. - Branch point of National Highway : 35 km	Good	
		Branch point - B.A. : 5 km	Rather poor	
		Total : 40 km		
Bandongbaru	12.5 ~ 15	T.K. - Prins. 30 km	Good	
		Prins. - B.B. : 10 km	Rather poor	
		Total : 40 km		
Baradatu	10 ~ 25	To Pandjang : 150 km		Consumed locally; Rp 3,500/ton to Pandjang
Singalaga	No purchases	To Pandjang : 40 km	Good	Rp 750/ton to Pandjang
Sidodatu	12 ~ 12.5	To Pandjang : 55 km	Good	Rp 1,000/ton to T. Karang

Note: Though there is a distance of 7 km between Tandjung Karang and Pandjang, the two may be considered as a single unit because warehouses are located between them. Information given in the above table was obtained through interviews.

Singalaga, which started planting maize around the end of 1969, cleared 1,800 ha of land and completed maize planting on this land as of the end of 1970. Expansion of planted area is planned by both farms. The first stage target set by the two farms is the development of an additional 4,000 - 3,000 ha of land. Modern farming techniques and large tractors are employed at both farms to establish an integrated production system involving harvesting, processing, transport and storage. Production activities of the two farms, on which the attention of many people concerned is focused, are progressing smoothly at present. Both farms are planning to carry out double cropping and attain an average yield of 4 tons or more per ha by fertilization. Singalaga Farm is hoping to realize triple cropping.

The unit yield recorded at the two farms is still subject to fluctuation and is considered to require some years of further study before it is stabilized. It is noteworthy, however, that the maximum yield so far attained surpassed 4 tons per ha.

The two farms are seeking a rationalized farm management based on a self-supporting accounting system. Their employment of advanced techniques deserves high evaluation in that it will not only stabilize their own production and management but also has given an immense spill-out effect on the maize production in the whole of Lampung as described below.

(a) Feasibility of developing alang-alang fields was evidenced:

Alang-alang (Imperata Cylindrica) has a subterranean stem extending to a depth of about 15 cm below the ground surface and grows to a height of 1 to 2 m depending on soil fertility. It has been hampering farming work from olden times and its complete eradication has so far been considered very difficult. Equipped only with poor farm implements, the farmers have found it impossible in the past to cut its roots and remove the network of its subterranean stem. Therefore, weeding has had to be carried out 10 times a year at coffee plantations to prevent its spread, and the development of alang-alang fields has been considered to be virtually impossible.

The advanced techniques put in use at the two farms proved that alang-alang can be removed completely by turning up the soil at a depth of 15 cm or more with a bottom plow attached to a heavy tractor and by applying a disk plow twice in diagonal directions. It was also discovered that the cut leaves and

stems serve as good green manure if plowed into the soil.

This method is already applied at Mitsugoro's Djabung Farm, a 1,000 ha thick alang-alang field was cleared and prepared for crop raising within a year at a cost of less than US$60 per ha, and no weeding was required after planting.

This is good evidence to show that vast alang-alang fields which have refused man's development efforts over the past years can be transformed into cultivated land within a short period and at low cost. Thus, fertile fields where alang-alang grows to a large height have now emerged as new and promising developement areas. As a matter of fact, alang-alang fields around Sulibahwono are being snuffed out of existence by the farmers' manual labor.

(b) It was shown that Monoculture of maize by fertilization was proved possible, and that proper farm management for good raising involving the selection of suitable varieties and the control of insects and diseases could bring about a large increase in unit yield.

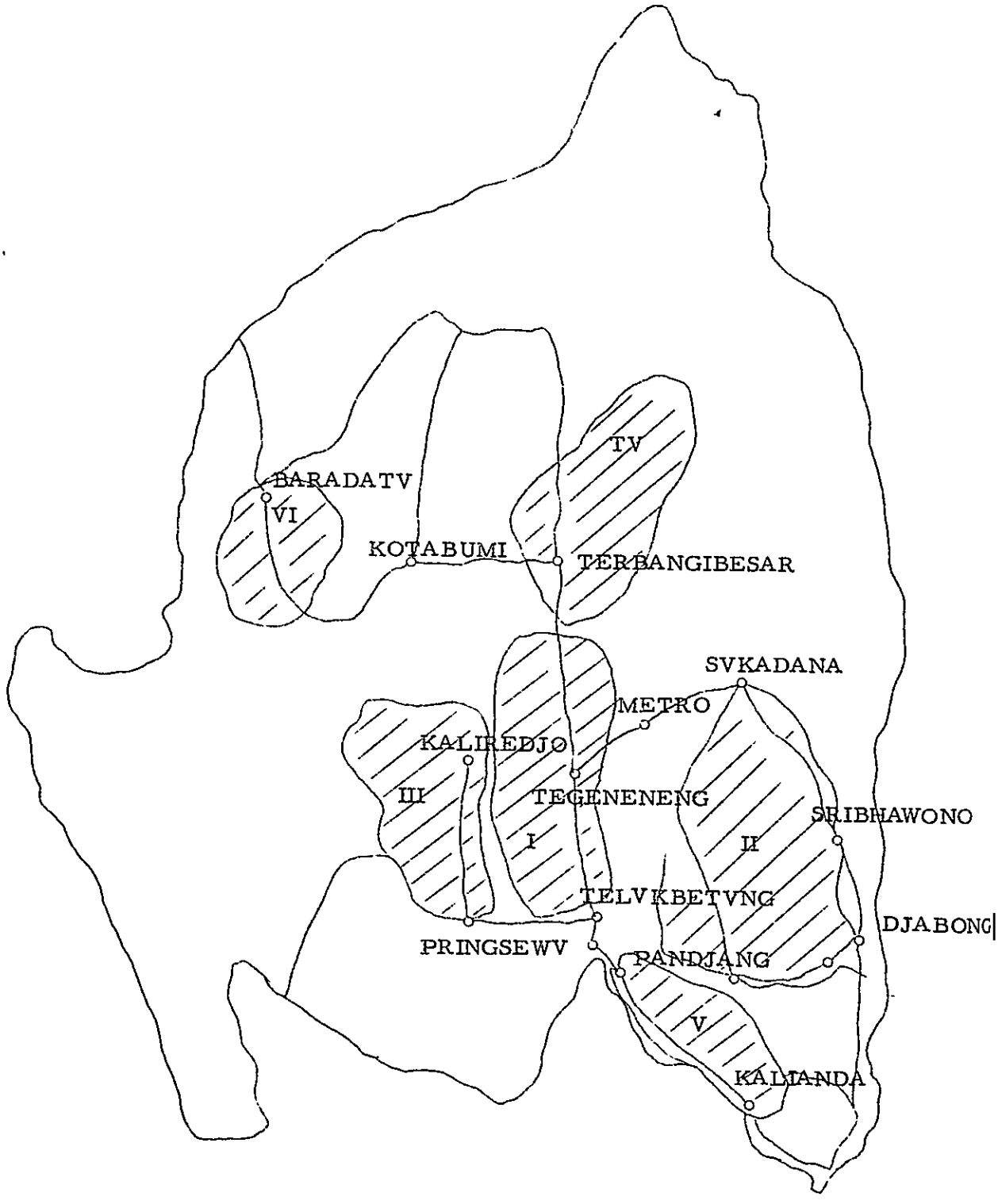
It was demonstrated that the yield per unit planted area can be increased from the current level of less than 1 ton to 4 tons or more by the application of fertilizers and other proper farm management for good raising. This has induced native Lampung farmers around the farms to embark upon maize cultivation on small lots of land, and also encouraged Javanese farmers to start the monoculture of maize.

(3) Variety

Practically all varieties cultivated at present are those deriving from Metro, though white varieties are reported to have been cultivated in many areas until about three years ago. White varieties are now grown in small areas in the vicinity of Kaliredjo and Baradatu.

Lampung has six major maize producing areas as illustrated in Fig. 5.

Fig. 5. Maize Producing Areas in Lampung



Producing Area	Centre of Producing Area	Estimated Harvested Area	Yield (t/ha)	Soil Type
1	Tegeneneng	3,000	0.8 - 0.9	Yellow Podosolic soil including Latosol soil.
2	Sribhawono	7,000	2.0	Reddish gray Latosol originating from Sukadana basalt.
3	Kaliredjo	8,000	0.8 - 0.9	Reddish yellow Padosolic soil including Latosol soil.
4.	Terbangibesar	5,000	0.6	Same as above.
5	Kalianda	3,000	0.8 - 0.9	Latosol soil including dark brown soil.
6	Baradatu	5,000	0.6 - 0.7	Latosol soil including reddish gray soil.

The provincial government of Lampung is hoping to attain increased maize production by concentrating its efforts in the above listed areas.

(4) Method of Cultivation

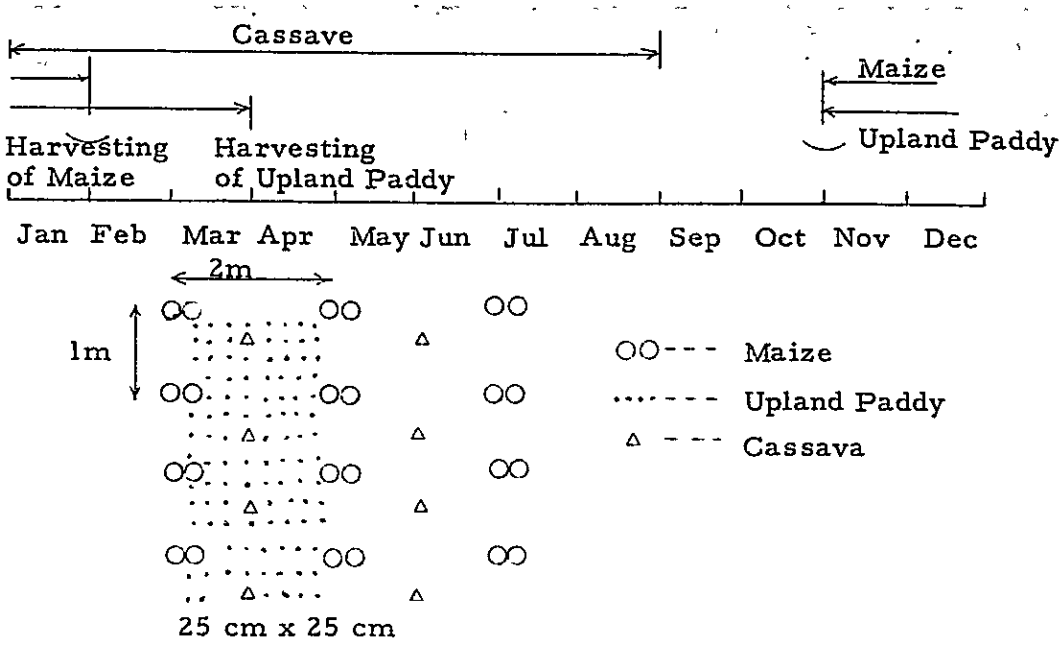
The farming practices and techniques employed in Lampung are described below based chiefly on the team's findings.

Area I:

(a) Desa Sidokarto (Katjamatan Gunun Sugih, Kabupaten Lampung Tengah)

The total farm land area of 410 ha found in this Desa in 1970 comprises 231 ha of Ladang, 20 ha of rain-fed paddy field, 32 ha of uncultivated land and 127 ha of dry field within garden compounds. The Desa is inhabited by 1972 people and has 387 farm households.

Mixed cropping of upland paddy + maize + cassava covers 90 % of the farm land. The crop rotation is as illustrated below. The team was informed that the farm land in this Desa is not suited for soybean cultivation.



Statistics of Lampung indicate the yield by mixed cropping by the product of the standard yield per ha and the ratio of the actual number of plants to the standard number of plants. The standard yield per ha is 0.5 tons for upland paddy in ears, 0.3 tons for maize and 10 tons for cassava (raw). Hence, in the case of this Desa, the yield of maize to be indicated in the statistics is 1.2 tons (= 0.3 t x 4) because the actual number of plants or the actual planted area, 2 m x 1 m, is four times as large as the standard value of 1 m x 0.5 m. Similarly, the yield of cassava per ha which will be shown in the statistics is 20 tons (= 10 t x 2) because the actual planted area is twice as large as the standard value (2 m x 1 m : 1 m x 1 m).

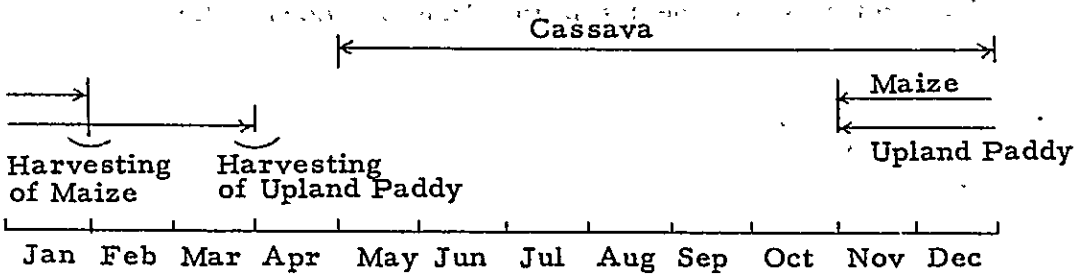
The maize variety cultivated in this Desa is a local Metro except for about 10 % of a white flint variety which is produced for the farmers' own use. Farmers interviewed stated that the white variety tastes better than Metro.

Farmers in this Desa apply 0.5 kg of DDT and 0.1 oz of aldrin dust to each 30 kg of seeds at time of sowing maize and upland paddy.

(b) Desa Bumi-Agung (Kabupaten Lampung Selatan)

Major upland crops in this Desa are upland paddy, maize and cassava. Cassava accounts for a substantially large percentage of upland crops because it is sold to the cassava processing plant in the nearby village.

A crop rotation adopted in this Desa is illustrated below.



Area II:

(c) Mitsugoro Farm No. 1

Maize varieties cultivated are Metro including a variety bred by the farm by line isolation from Metro. All varieties have a growth period of 100 - 110 days, and the ridge width varies by cropping season. For early first cropping, the ridge width measures 100 cm and the spacing in the row 55 cm for 2.5 - 3 plant planting. For the late first cropping, this arrangement changes as follows: 130 cm x 50 cm for 3 plant planting. In the second cropping, 130 cm x 50 cm for 3 plant planting or 200 cm x 2 rows x 50 cm for 3 plant planting is adopted.

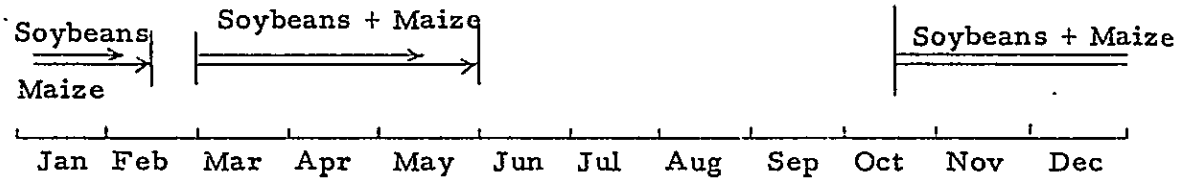
Standard dosage of fertilizers comprises 50 kg each of 45 % TSP and urea applied as basic fertilizers to each ha and 50 kg of urea applied as additional fertilizer to each ha 30 days after sowing. Intertillage is conducted 12 (13) days and 25 days after sowing with a ridger employed for mulching. For the control of corn borers, ear worms and arm worms, endrin emulsion is sprayed. Endrin emulsion is also sprayed immediately before earing and upon full growth of silk to prevent ear worm damage.

The Latosol soil found in the farm is fertile and suited for maize cultivation.

(d) Desa Bandaragang (Kabupaten Lampung Tengah)

A mixed variety of Metro and Harapan is cultivated by mixed cropping with soybeans. Maize is sown at intervals of 100 cm in the ridge having a width of 400 cm. In about 3 - 5 days after the maize is sown, soybeans are sown between the maize rows at a planting density of about 40 x 40 cm in sowing holes dug by a stick.

The crop rotation adopted in this Desa is shown below.



After soybeans are harvested, maize is harvested while the soil is plowed. Soybean plants pulled out are dried on the field with the root set on top. The soil in this Desa is dark clayey Latosol soil, but it is less clayey than the soil in Mitsugoro Farm No. 1.

Area III:

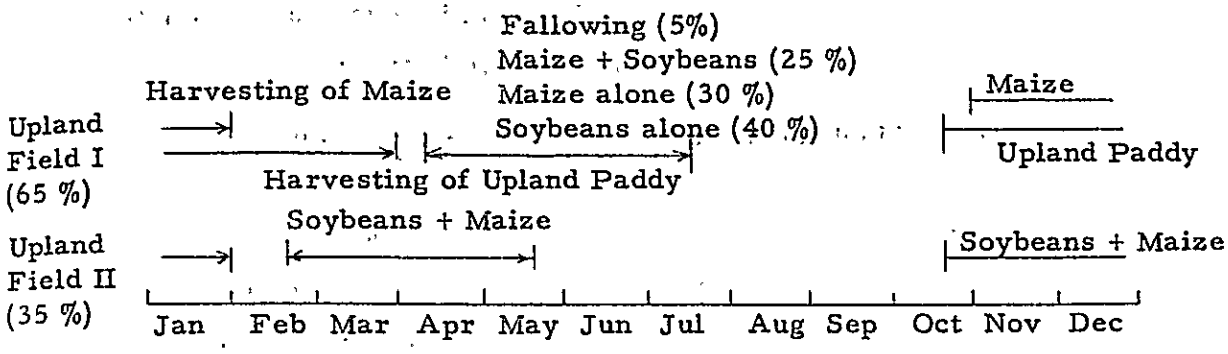
(e) Katjamatan Keliredjo (Kabupaten Lampung Tengah)

Total Farm Land Area	:	16,435 ha
Maize	:	1,500 " (harvested area of one cropping)
Soybeans	:	2,500 "
Coffee	:	1,000 "
Paddy (mostly upland paddy)	:	3,900 "
Paddy Field (Desa-level irrigation-40 %, Rain-fed-60 %)	:	1,300 "
Ladang	:	3,900 "
Dry Fields in Garden Compounds	:	2,335 "

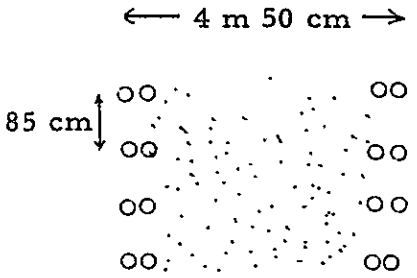
This Katjamatan is composed of 12 Desas and has a population of 30,104 people and 12,231 farm households. The team noted that maize was planted with cassava in one of the farmers' fields observed in Desa Sidoluhur. This field has ridges having a width of 165 - 210 m, and 2.2 plants per hill were planted in the row spaced at intervals of 81 cm. The 13 - 14 cm thick surface soil is sandy soil containing brown humus soil, and is underlain by a layer of somewhat clayey and reddish brown soil.

(f) Desa Sri Dadi (Katjamatan Kaliredjo, Kabupaten Lampung Tengah)

All inhabitants are Javanese farmers who settled in this Desa in 1952/3. Major patterns of crop rotation adopted in this Desa are shown below.



Maize production is 3,000 tons for the first cropping and 1,000 tons for the second cropping. The mixed cropping observed at farmers' fields is illustrated below.



.... Upland paddy is sown at an average planting density of 28 cm x 30 cm forming an approximate parallelogram, with stems numbering about seven per hill.

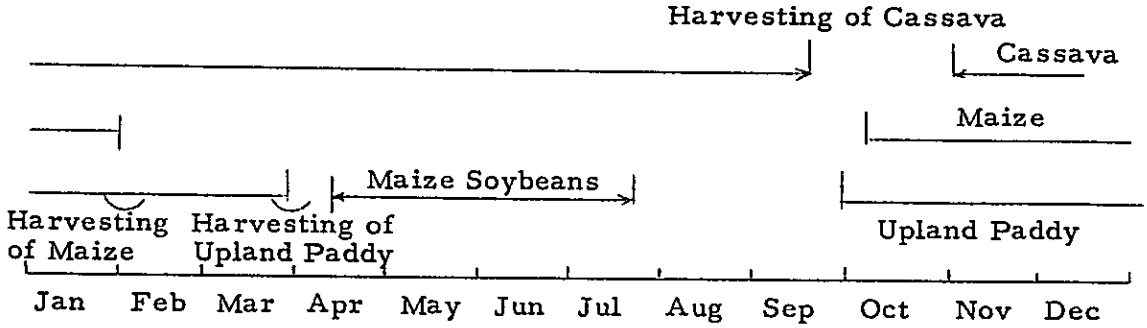
(g) Desa Sri-Dadi

Test Variety	:	Local Metro
Soil	:	The soil type found in this Desa is typical of this area. The 19 cm thick surface layer is composed of dark brown clayey loam of single grained structure underlain by a layer of reddish brown clayey soil. It was noted that the soil is a type of posodolic soil. The soil productivity is not considered very high.
Sowing Time	:	October 10
Ridge Width and Spacing Row	:	90 cm x 40 cm
Fertilization	:	Application of 90 kg of N and 30 kg of P_2O_3 per ha resulted in the growth to a height of 114 cm in non-fertilized section and 156 cm

in fertilized section. Thus, fertilization produces an immense effect partly due to the low soil fertility.

(h) Desa Sidoluhur (Katjamatan Bangunredjo, Kabupaten Lampung Tengah)

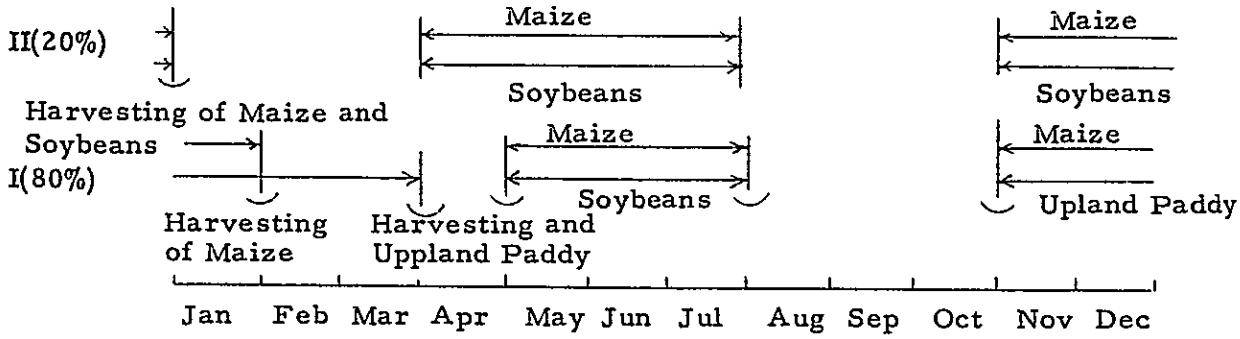
Upland paddy is sown after plowing soils in the October - November period. Then maize is sown 3 - 5 days after plowing, followed by the planting of cassava which takes place 21 - 31 days after plowing. In addition to these crops, soybeans are sometimes sown between the upland paddy rows. Mixed cropping not including soybeans covers 65 % of total farm land area, and that for soybeans 35 %.



Maize + Soybeans in April - September Period ..... 50 %
Single Cropping of Maize in " ..... 30 %
Fallowing in " ..... 20 %

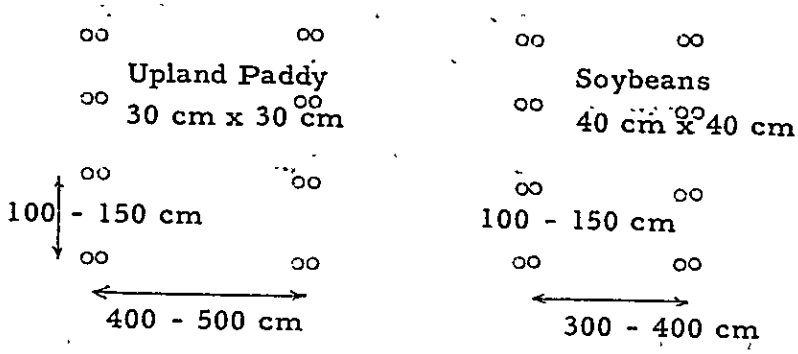
(i) Desa Bandungbaru (Katjamatan Bandungbaru, Kabupaten Lampung Tengah)

Soybeans carry a heavy weight in the crop rotation in this Desa.



On certain occasions, soybeans and maize are sown not simultaneously but with a certain time lag between them.

In case of rotation I:



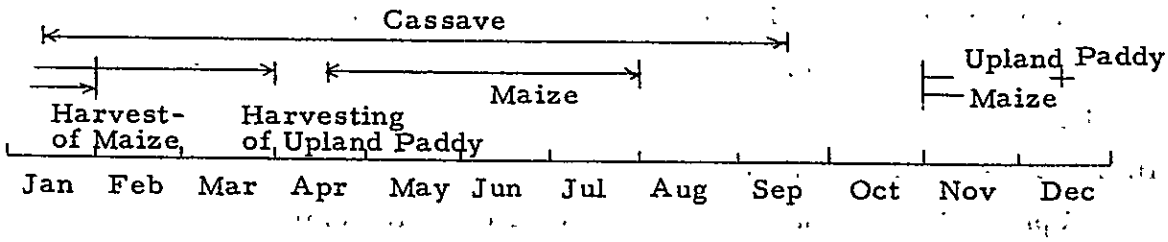
Since upland paddy grows quicker and to a larger height than soybeans, maize cultivated with soybeans is planted at a higher density than when it is grown with upland paddy. In such mixed cropping, no fertilizers are applied and maize seeds supplied by the Agricultural Extension Office at Prinsewu are multiplied for sowing.

Area IV:

(j) Desa Redjosari (Kabupaten Lampung Tengah)

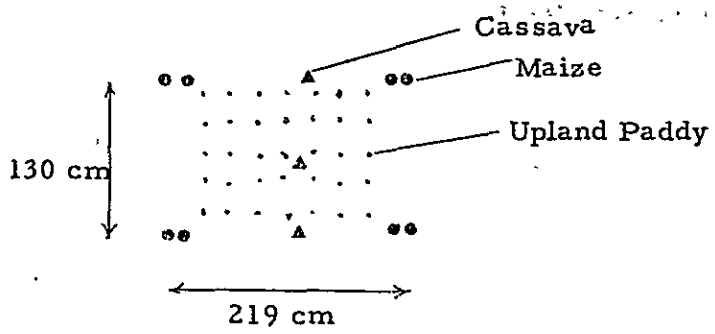
This Desa is inhabited by 33,612 people composing 638 farm households. Its 1,106.75 ha farm land comprises 415.5 ha of paddy field (used as upland field at present), 553 ha of upland field and 138.25 ha of dry field within garden compounds. Maize is cultivated without fertilization, but 10 tons/ha of staple manure is applied occasionally.

The crop rotation adopted in this Desa is shown below.



If a field used for mixed cropping illustrated above has a ridge width of 400 cm, the planted area of maize is considered to be 1/4 of the area of that field assuming that the ordinary width of a maize ridge is 100 cm. This planted area is employed in indicating the yield per unit area. It follows, therefore, that A ha of planted area of maize actually covers an area of 4A ha.

Observation made at one of the farmer's fields revealed that maize, upland paddy and cassava are planted as illustrated below.

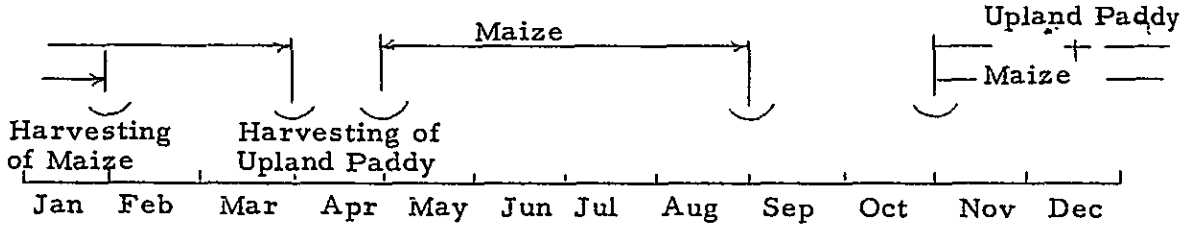


In the above case, the planted area of maize is one half of the actual field area.

(k) Desa Nambah Dadi (Kabupaten Lampung Tengah)

In the total farm land area of 1,387 ha found in this Desa, upland field and dry fields within garden compounds, respectively, occupy 1,196 ha and 184 ha. In these fields, 275 ha is used for production of maize, 312 ha for cassava, 5 ha for coffee 2 ha for rubber and 4 ha for coconut.

The crop rotation adopted in this Desa is shown below.

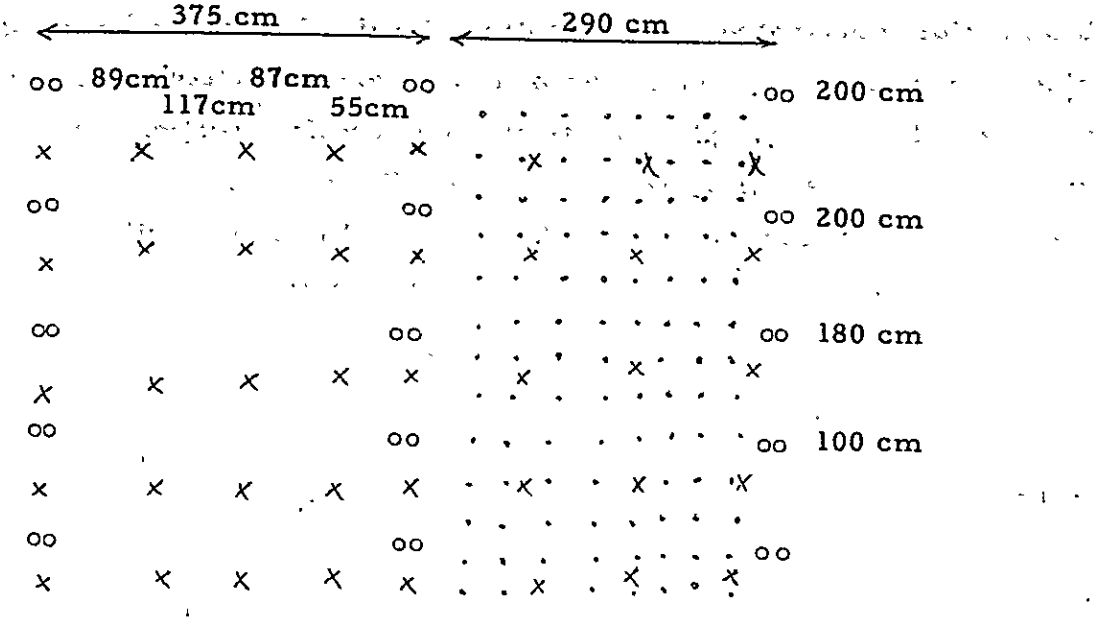


When cassava is to be planted with other crops for mixed cropping, it is planted at a planting density of 125 cm x 125 cm between upland paddy hills 60 days after sowing maize. In this case, second cropping of maize becomes impossible, and cassava alone remains growing in the field until around August after harvesting upland paddy.

Upland Paddy + Maize + Cassava (125 cm x 125 cm)	20 %
Upland Paddy + Maize ------ Maize	75 %
Upland Paddy + Maize + Cassava (125 cm x 300 cm) + Maize	5 %

Under the first cropping, maize is planted at a density of 300 cm x 125 cm. Double cropping of maize is the commonest practice in this Desa. Maize cultivated for second cropping is planted at a density of 125 cm x 125 cm for 3 plant.

planting. The yield of maize per ha planted for the second cropping at a density of 125 cm x 125 cm is 3.5 tons. The planting density of crops cultivated by mixed cropping in one of the farmers' fields is illustrated below.



o..... Upland Paddy: 240 cm x 280 cm (average density), 5 - 8 plant planting

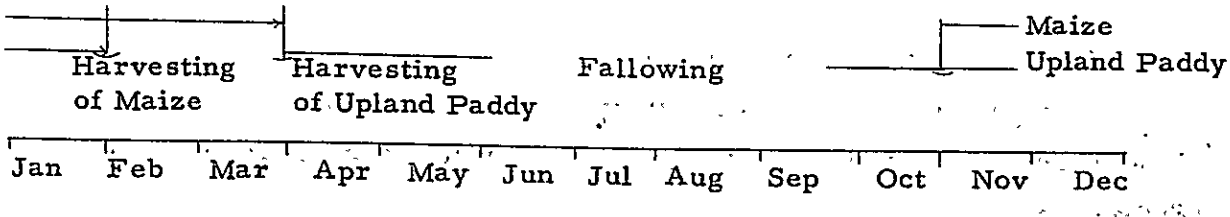
x..... Cassava : 107 cm x 85 cm (average density)

o..... Maize : 333 cm x 170 cm for 1.4 plant planting (average)

The soil is podosolic soil. The 23 cm thick surface layer is composed of sandy clayey soil of dark brown color.

(1) Desa Bandardjaja (Katjamatan Terbanggibesar, Kabupaten Lampung Tengah)

Mixed cropping of upland paddy and maize prevails in this Desa. The crop rotation adopted is as shown below.



When cassava is to be cultivated with other crops, it is planted 35 days after sowing maize and harvested in the August - September period. The yield per ha of the three crops cultivated by mixed cropping is 6 quintals for paddy (in Padi), 2.5 quintals for maize and 15 tons for cassava.

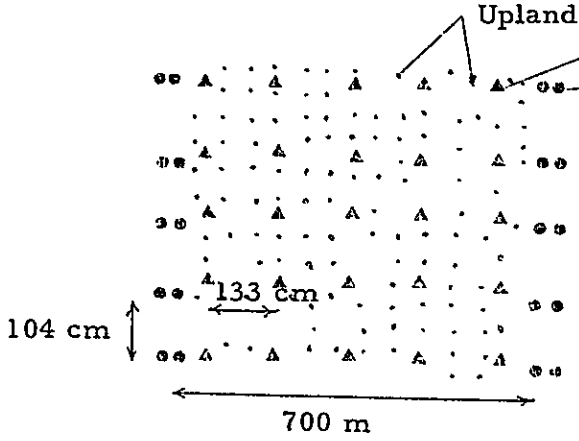
(m) Desa Kalang Endah (Katjamatan Terbanggibesar, Kabupaten Lampung Tengah)

The soil found in this Desa, presumably posodolic, is sandy loam of dark brown color with a not very high fertility. Application of 90 kg of N and 30 kg of P_2O_5 per ha to local Metro sown on November 23 resulted in the growth to a height of 49.7 cm (3.4 plant planting) in the fertilized section and to a height of 33.7 cm (3.7 plant planting) in the non-fertilized section, clearly indicating the effect of fertilizer application. The low fertility of posodolic soil found in this Desa points to the necessity of applying fertilizers for increased production.

(n) Dess Sidomuljo (Katjamatan Purgur, Kabupaten Lampung Tengah):

Cassava constitutes the greater part of the crops cultivated by mixed cropping because a starch plant is in operation in this Desa and both the land fertility and labor force are deficient.

The pattern of mixed planting of maize, cassava and upland paddy is shown below.



2.1 plant planting is practiced for maize.

Upland paddy is planted at a density of 26 cm x 23 cm.

Area V:

(o) Kabupaten Lampung Selatan

South Lampung has a population of 1,200,000 of which 60 % are the natives of Lampung and the remaining 40 % are immigrants from other areas of the archipelago.

The Kabupaten is administratively divided into 15 Katjamatans and has 34,000 ha Ladang area of which 22,000 ha is uncultivated land including lots cleared for shifting cultivation. Upland paddy is actively cultivated in the wet season, often by mixed cropping with maize. However, natives of Lampung

engaged in maize cultivation are rather limited in number. Many uncultivated fields are found in the Ladang area. The Ladang area includes upland fields, called Tegalang in other provices, because the majority of the inhabitants are natives of Lampung who occupy themselves with the cultivation of coffee and rubber and the harvesting of these two crops do not allow them to engage in the raising of ordinary farm crops.

The first cropping of maize in the wet season covers an area of 2,500 ha of Ladang and the second cropping also 2,500 ha (excluding the area covered by estate agriculture).

For the first cropping (wet season), maize is sown in the September - October period and harvested in the January - February period, whereas for the second cropping, sowing is carried out in the February - March period for harvesting in the July - August period. In the first cropping, upland paddy (32 cm x 40 cm) and maize (150 - 200 cm x 80 cm, 2 - 3 plant planting) are usually raised together. The second cropping is mostly the monoculture of maize (100 cm x 100 cm, 2 - 4 plant planting), with soybeans mixed at a small ratio of 5 % or lower. The harvested area and production of soybeans, maize and cassava during the period from 1965 to 1969 are shown below.

Soybeans	4,000 ha	1,800 tons
Maize	12,500 "	12,500 "
Cassava	6,000 "	4,900 " (raw)

(p) Singalaga Farm (Katjamatan Tjampangtiga, Kabupaten Lampung Selatan)

This farm has a farm land area of 1,500 ha and is planning to develop 5,000 ha of land into farm land. It is staffed by six clerical personnel and has 200 full-time workers and 300 temporary laborers. Farming equipment installed at this farm are 18 tractors (11 of 45 hp and 7 of 60 hp), three bulldozers, two corn planters, and accessories and attachments for these equipment. All these equipment are loaned out by mekatani. Seven tractors with a horsepower ranging from 45 to 60 hp and three disk plows are the equipment initially employed for soil preparation. For the first planting carried out at this farm, disk plows were applied twice at an interval of one week, and harrowing was carried out on the second day after the second plowing work. From the second and subsequent plantings, plows were applied only once. Planting in an area of 500

ha required a manpower of 1,500 laborers.

First Planting (500 ha): Sowing in November and harvesting in March; Yield - 1 t/ha.

Second Planting (750 ha): Sowing in April and harvesting in June; Yield - 2 t/ha.

Third Planting (800 ha): Sowing in September and no harvesting conducted yet.

In an attempt to obtain as good seeds as possible, earcorn harvested by the first planting from the Harapan seeds supplied from the Seed Farm at Tegineneng were subjected to a mass selection at this farm. The dosage of fertilizers presently applied per ha consists of 50 kg of urea and 40 kg of triple superphosphate. The farm is planning to adopt a heavier dosage by increasing urea from 50 to 100 kg/ha and triple superphosphate from 40 kg to 50 kg/ha. The present dosage is rather small considering the planting density of 50,000 - 100,000 plants/ha (100 cm x 20 cm, 1 - 2 plant planting). Urea is applied 15 cm away from the maize hill upon sowing as well as one month after sowing with a cultivator employed for covering. Harvested maize is husked on the field and carried to the concrete drying yard for two to three dryings. This is followed by the threshing work using Lonsoms threshers (hourly capacity: 3 tons) and by approximately two days of drying to reduce the water content to 14 to 15 %. Endrin dust is sprayed to prevent damage by stem borers and ear worms. The team learned that a 5-ton truck can make three trips a day to and from Pandjang port which is 40 km away from the farm and the transport cost is Rp 750 per ton. The mechanized farming practiced at this farm brings a gross production cost of Rp 12,000/ton. 7,000 - 8,000 tons of maize exported from this farm annualy is shipped mostly to Singapore, and the FOB Indonesian port price was about US$60.00 in 1970.

The 20-cm thick surface soil is Latosol having a pH value of 5.6. It was noted that the surface soil includes ashes of burnt plants in some places. The soil productivity is considered satisfactory.

(q) Katjamatan Kalianda (Kabupaten Lampung Selatan)

This Katjamatan is divided into 56 Desas and has 14 maize cultivation districts which cover an area of 1,400 ha at present. The Katjamatan is inhabited by 92,261 people composing 80,197 farm households and has 815 ha of paddy fields irrigated on the Desa level. The area of Ladang is not known. As

shown below, three patterns of crop rotation including maize are adopted in this Katjamatan.

Pattern and Percentage	First Cropping	Second Cropping
I 60 %	Upland Paddy + Maize	Soybeans + Maize
II 30 %	Soybeans + Maize	- do. -
III 10 %	Groundnuts + Maize	- do. -

(r) Desa Sidodadi (Katjamatan Kalianda, Kabupaten Lampung Selatan)

Yellow and white flint varieties predominate in this Desa and a small portion of the fields is used for yellow dent cultivation. This prevalence of flint varieties is considered to have been occasioned by the immigration of farmers from Central Java.

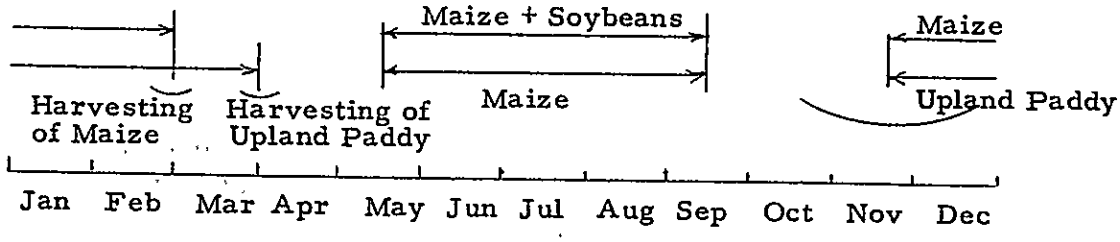
No paddy fields are found in this Desa, and the major patterns of crop rotation are as shown below.

First Cropping	Second Cropping	
I. Upland Paddy + Maize (70 %)	Maize alone	60 %
	Soybeans + Maize	30 %
	Groundnuts + Maize	10 %
II. Soybeans + Maize (30 %)	- do. -	

Area VI:

(s) Katjamatan Kotabumi (Kabupaten Lampung Utara)

The main crop rotations adopted in this Katjamatan are as shown below.



(t) Desa Abung (Bandit Settlement Area, Katjamatan Bandit, Kabupaten Lampung Utara)

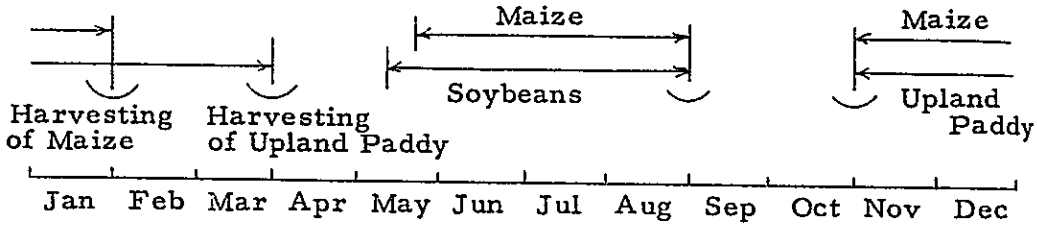
Bandit Settlement Area is composed of 10 Desas of which four are under the control of the Ministry of Immigration and six are inhabited by many native

people of Lampung. Maize cultivation is active in the four settlers' Desas but it is carried out on a limited scale in the other six Desas. In the first cropping, mixed cropping of upland paddy and maize is conducted, whereas maize alone is raised in many cases for the second cropping (100 cm x 100 cm). Varieties cultivated for the first cropping comprise 75 % of yellow varieties and 25 % of white varieties, and young earcorns are used for food. The second cropping is intended for production of dried maize grains.

(u) Desa Tjampur Asri (Baradatu Settlement Area)

A local white flint variety is cultivated in this Desa which is situated within Baradatu Settlement Area. Although yellow varieties are a cash crop saleable on the world market, the farmers prefer white varieties be cause of the taste. Hence, the maize produced in this Desa is used for local consumption.

The crop rotation adopted in this Desa is shown below.



Second Cropping:	Maize + Soybeans	30 %
	Maize alone	65 %
	Soybeans alone	5 %
Upland Paddy + Maize:	Upland Paddy	30 cm x 30 cm
	Maize	200 cm x 100 cm
Maize + Soybeans:	Maize	200 cm x 100 cm
	Soybeans	30 cm x 30 cm

Planting density observed at one of the farmers' fields is as follows.

Upland Paddy + Maize:	Upland Paddy	30 cm x 30 cm
	Maize	300 - 400 cm x 135 - 160 cm, 3-plant planting
Maize + Soybeans:	Maize	500 - 600 cm x 140 cm, 3-plant planting

The soil is of a type midway between Latosol and Andosol. The 15-cm thick surface layer is composed of grayish brown loam soil of well developed single grained structure underlain by a layer of clayey loam soil. The soil

fertility is substantially high.

4. Distribution

(1) Existing State in Surveyed Areas

Area I:

(a) Desa Sidokarto

This Desa has 387 families and is inhabited by 1,972 people engaged in agriculture. 93 % of the population are Javanese settlers and the remaining 7 % are South Sumatrans from Palembang. The total land area of 410 ha is composed of 127 ha of dry field within garden compounds, 20 ha of rain-fed field, 231 ha of upland field and 32 ha of undeveloped land. This Desa was originally developed by the farmers settled in 1953 under the provincial immigration plan of Lampung.

The operation of a tapioca plant in this Desa makes its cassava cultivation highly intensive. Major crops are aquatic and upland paddies, maize and cassava. Rice is consumed as farmers' food, but 50 % of maize and 90 % of cassava are sold.

Harvested maize is carried to the farmyard without husking, dried for two to five days, threshed, dried again for two days, and then sold. For preservation for farmers' own consumption, unhusked ears are suspended in the kitchen. The sales price per kg stands at Rp 6 for maize, Rp 15 for rice and Rp 2.5 for cassava (raw with the peel removed).

The white varieties which accounted for an overwhelming percentage until four or five years ago have now given place to yellow varieties. 15 advanced farmers of this Desa received training at the maize production center in 1970. Preparations are now being made by the Agricultural Extension Office of Lampung to implement the maize production development project in this Desa with materials and equipment to be provided under the food production aid extended by the United States as part of its Kennedy Round policies. Implementation of this project, however, must be preceded by a careful study of the cropping pattern followed in this Desa where upland paddy and maize are cultivated in the wet season by mixed cropping as in other parts of the province but where the cassava cultivated with these two crops grows in the dry season and thus makes the cultivation of maize impossible.

(b) Desa Buni Agung

This Desa has 1,100 families and a population of 6,000 people who are mostly natives of Lampung. The total farm land area of 1,600 ha is composed of 300 ha of dry field within garden compounds, 350 ha of rain-fed field, 800 ha of upland field and 150 ha of coffee farm.

Rain-fed fields produce a yield of 2 tons of paddy per ha, and upland fields provide a yield of 1 t/ha of upland paddy, 0.7 t/ha of maize and 7.5 t/ha of cassava. Of the total crop production, 25 % of rice, 75 % of maize and 70 % of cassava are sold to the four brokers in this Desa. During the harvesting season, maize is sold for Rp 12 per kg. As of December 1970, the sales price stood at Rp 15 per kg, and maize delivered in repayment of loans advanced to the farmers including interest is sold at Rp 5 - 6 per kg.

It was learned that both planted area and production of maize increased by 5 - 10 % due to the favorable climate and to the recent rise in maize price which is ascribable to the activities of Mitsugoro Farms. As in Desa Sidokarto, 18 advanced farmers of this Desa received training to participate in the forthcoming maize production development project.

Area II (Vicinities of Mitsugoro Farms)

(c) Desa Bandaragung

This Desa has eight brokers, each employing a number of purchasers. In the case of broker A who employes 10 purchasers, an advance of Rp 5,000 per day is paid to each of eight purchasers who purchase an average of 0.5 tons of maize each day at Rp 15 per kg. In each harvesting season, broker A handles 800 to 1,000 tons of maize for delivery to Mitsugoro Farm several km from the Desa and receives the price and commission from the farm. Maize used to be shipped to Tandjung Karang, but delivery to Mitsugoro Farm is now preferred by brokers because of the quicker collection of payment.

Besides soybean cultivation carried out over an extensive and fertile area, maize production encouraged by Mitsugoro Farm also carries an important weight is this Desa.

Area III:

(d) Desa Sidoluhur

Major crops are upland paddy, maize, cassava and soybeans. In the total production of these crops, sales percentage stands at 75 % for maize, 50 % for

rice, 75 % for cassava and 100 % for soybeans (excluding seeds). Harvested and unhusked maize is dried for about two days, and sold immediately after being threshed. Brokers refuse to accept undried maize grains and reduce the purchase price if the drying is deficient. Maize is sold at the market 1 km away from the Desa at Rp 8 - 9 per kg.

(e) Katjamatan Kaliredjo:

This Katjamatan is divided into 12 Desas which are inhabited by a total of 60,104 people composing 12,231 families. All inhabitants are Javanese settlers who developed this Katjamatan during the 1952 - 1953 period. In the total area of 13,600 ha, dry fields within garden compounds occupy 2,635 ha, paddy fields 1,300 ha (of which 60 % is watered by rain), and upland fields 3,900 ha.

Major crops are rice, maize, soybeans and coffee. Marketing percentages of these crops are 80 % for maize, 50 % for rice, 100 % for coffee and 100 % for soybeans excluding seeds. The sales price per kg is Rp 7.5 - 8 for maize and Rp 35 for soybeans.

In three of the 12 Desas, and agricultural cooperative society called L.S.D. (Lambaga Social Desa) is organized for joint planting and harvesting of coconut, banana and paddy.

(f) Katjamatan Prinsewu

This Katjamatan has 20,338 families and a population of 123,886 who are mostly farmers. The inhabitants of the 27 Desas in the Katjamatan are composed of Javanese settlers (85 %), native people of Lampung (5 %), South Sumatrans (10 %) and others.

The 14,630 ha land area is composed of 1,570 ha of dry field within garden compounds, 2,684 ha of rain-fed paddy field, 725 ha of irrigated paddy field, 6,037 ha of upland field, and others.

The Katjamatan was developed by Javanese farmers settled in 1927.

Desa Bandungbaru:

The 7,171 inhabitants composing 1,526 families in this Desa are mostly farmers. The 2,140 ha land area is composed of 80 ha of dry field within garden compounds, 35 ha of rain-fed paddy field, 325 ha of upland field, and others.

Major crops are upland paddy, maize and soybeans, of which soybeans constitute an important cash crop as in Area I. Marketing percentages of these crops are 20 % for rice, 90 % for maize and 100 % for soybeans excluding seeds.

Since the Desa is close the consumer market, maize is sold for Rp 12.5 - 15 per kg, and Rp 2.5 is paid for one young earcorn and Rp 5 if it is boiled. Rice is sold at Rp 30 - 45 per kg (in milled rice), and soybeans at Rp 35 - 40 per kg. Maize is dried for about two days before threshing, and threshed maize is dried for two to five days before marketing.

Area IV:

(g) Katjamatan Terbanggibesar

This Katjamatan has a population of 66,252 composed of 12,370 families. 75 % of the inhabitants are farmers, and 70 % of the total population are Javanese settlers and 30 % are native people of Lampung. The greater part of the 63,400 ha land area is now covered by upland fields, most of which are expected to be converted into paddy fields upon completion of the irrigation canal construction work in progress since 1960.

(h) Desa Redjosari

The 3,361 inhabitants composing 638 families are mostly farmers. The total farm land area of 1,106 ha consists of 138 ha of dry field within garden compounds and 968 ha of upland field. Irrigation facilities are now under construction, and upland fields of 415 ha are expected to be transformed into paddy fields in 1975.

The majority of the inhabitants are Javanese farmers who settled in this area in 1956.

Crops planted in October (1970) are upland paddy (360 ha), cassava (195 ha) and maize (45 ha).

The Government has allocated 2 ha of farm land to each farm household in this Desa, but 45 % of this area, or 0.9 ha, is left uncultivated at present presumably due to the shortage of manpower.

90 % of harvested maize is sold to the nine brokers in the Desa at a price of Rp 6 - 7 per kg during the harvesting season. The price per kg of maize in December when the team visited the Desa was Rp 15. Rice is sold at Rp 20 - 35 per kg (Rp 45 per kg in December). Brokers carry the collected crops to Tandjung Karang.

(i) Desa Bandardjaja

This Desa has a population of 4,000 consisting of 800 families of which 75 % are farm households. Javanese account for 95 % of all inhabitants and the

natives of Lampung 5 %.

The total land area of 500 ha is composed of 65 ha of dry field within garden compounds, 235 ha of upland field and 200 ha of alang-alang field. It is expected that 75 ha of paddy field will be created in future.

Each farm household in this Deas which was developed by Javanese settlers in 1957 has an average operational holding of 1.75 ha.

Crops raised are upland paddy, maize and cassava, and production per ha of these crops is 6 quintals for paddy, 2.5 quintals for maize and 15 tons for cassava. 50 % of paddy and maize and 75 % of cassava are sold.

The sales price per kg during the harvesting season is Rp 10 for maize, Rp 30 for paddy and Rp 7 for cassava (dried). In December 1970, the sales price was Rp 17 for maize and Rp 45 for paddy. Maize is sold in grains on the market when cash income is needed. No brokers are found in this Desa, and harvested maize is carried to the farmyard without husking, dried for four to five days after husking, and then either threshed for sales or preserved without husking.

(j) Desa Nambah Dadi

This Desa has a population of 4,958 composed of 893 families of which 90 % are farm households. 70 % of the inhabitants are Javanese settlers.

The total land area of 1,387 ha is composed of 184 ha of dry field within garden compounds, 1,196 ha of upland field and 6 ha of other areas.

Crops raised in this Desa are upland paddy, maize and cassava. The team was informed that while maize output is totally put to sale, marketing percentage of paddy is 70 %. The villagers' daily diet consists of rice mixed with cassava.

Maize is sold either to the three brokers in the Desa or on the market. A broker interviewed by the team stated that the brokers use bicycles to collect 500 to 700 kg of maize grains each time from the farmers. The sales price of half-dried and undried maize grains is 75 % and 50 % respectively, of the of well-dried grains. The team was informed that the maize grains dry well in June and July but not in other months of the year. The sales price per kg is Rp 8 - 9 for well-dried grains and Rp 5 - 6 for poorly dried grains. The total shipment of maize handled by the three brokers in the Desa is estimated to be 600 tons per year.

Area V

(k) Desa Sidodadi

This Desa has a population of 3,300 constituting 681 families which are mostly farm households. The total farm land area is 1,500 ha and each farm household is allocated an area of 2 ha. Development of this Desa, which was undertaken by Javanese farmers settled in 1958, aims at the creation of 0.25 ha of dry field within garden compounds, 0.75 ha of upland field and 1 ha of paddy field for each farm household, though at present each farm household has an average of 0.75 ha of paddy field alone because the construction of an irrigation canal has not yet been started.

Located close to Pandjang port, this Desa has a relatively large planted area of maize. Marketing percentage stands at 50 % for maize, 25 % for paddy and 100 % for soybeans. The sales price per kg is Rp 35 - 50 for soybeans and Rp 25 - 50 for paddy. Maize sold without husking to the brokers is carried to Pandjang after husking and threshing. One piece of unhusked maize is sold for Rp 1.

Area VI:

(l) Desa Pantjasila

This Desa is a community of farmers settled in 1967, and does not belong to the provincial government of Lampung. Of a total of 1.25 ha allocated to each settler, 0.75 ha is under cultivation and the remaining 0.5 ha is left intact. Existing number of farm households is 190.

Farm households settled in 1967 and 1968 received a credit of US$8.00 in 1967 and US$32.4 in 1968, and were provided with food (10 kg of rice per month) for the initial three months after settlement. They were also given free medical treatment for one year after settlement.

Farm households settled in 1969 were provided with 5 kg of rice per month for six months and were also exempted from medical expenses for one year.

(m) Abung Settlement Area

This settlement area embraces 1,037 farm households and a population of 4,844. Four districts constituting the area and their settlement year are as shown below.

Takakarja	1965
Purabasaki	1965

Bangunsari 1967

Pengaturan 1970

The four districts combined have an area of 20,000 ha. Since each farm household settled is allocated 2 ha of land, a total of about 2,000 ha was alloted to individuals and about half of this area is now under cultivation.

(n) Balaratu Settlement Area

This area was developed by 1,796 farm households settled in 1959 and covers an area of 21,500 ha. The settlement has continued since that time, and the area now has 13 communities and 2,500 farm households. Each farm household was allocated 2 ha land (totalling 5,000 ha for the 2,500 farm households) which was planned to be developed into dry fields within garden compounds (0.25 ha), coffee and coconut farms (0.75 ha) and upland fields (1 ha to be converted into paddy fields in future). At present, however, only half of the planned upland field area of 1.75 ha is under cultivation.

This area was placed under the jurisdiction of the provincial government of Lampung in October 1969.

(o) Desa Tjampur Asri

This Desa has 354 farm households and a farm land area of 780 ha where upland paddy, maize and soybeans are raised by mixed cropping. 50 % each of paddy and maize and 100 % of soybeans are marketed. Since both white and yellow varieties are cultivated, the former for food and the latter for marketing, maize grains of one variety include a large percentage of those of the other. It appears that the maize output is sold in the neighboring area or finds its outlet in areas closer to Palembang because the Desa is situated far from Pandjang.

While the Agricultural Extension Office has been encouraging the cultivation of yellow varieties over the past three years, farmers are hoping for the provision of tractors, fertilizers and agro-chemicals required for converting upland fields into paddy fields and for farming work.

The sales price of maize offered for local consumption is rather high considering the distance to Pandjang, and averages Rp 10 per kg during the harvesting season and Rp 25 in December.

(p) Bandit Settlement Area

Bandit Settlement Area is composed of 10 communities established in 1962 and four of them, now under the control of the provincial government, are

inhabited many Central Javanese and Balinese settlers. Of the six communities unhabited mostly by the natives of Lampung, four have already been placed under the jurisdiction of the provincial government of Lampung.

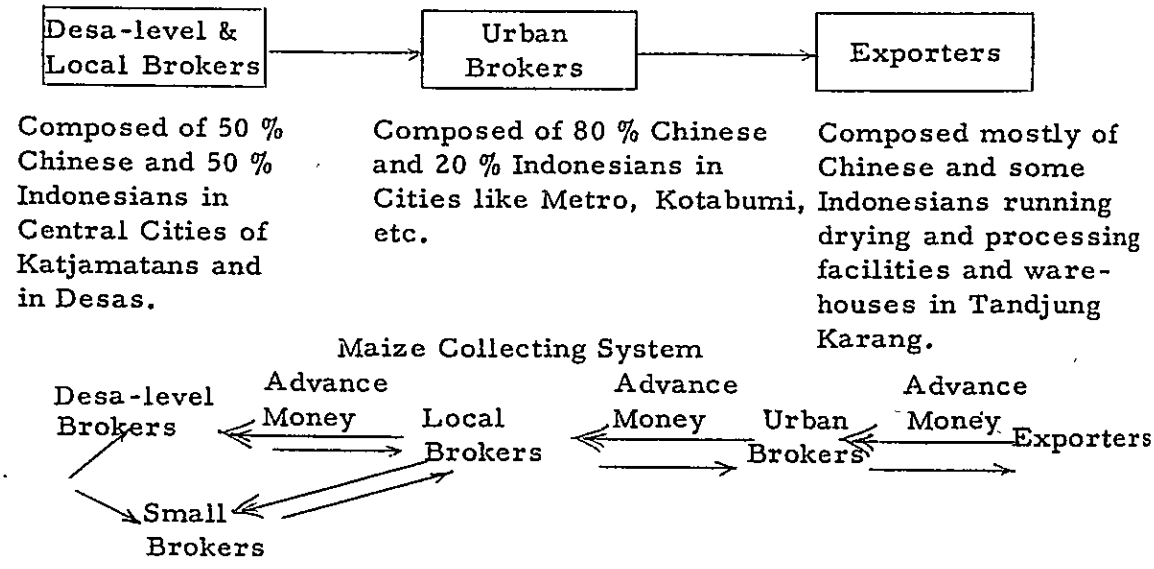
In the four settlers' communities having a total of 1,018 farm households and a farm land area of 10,000 ha, maize is cultivated only on the 2 ha land allocated to each settler. Maize cultivation in other areas is negligible. In this settlement area, the first (wet season) crop of maize is almost wholly consumed as food while still young, and half of the second crop is dried and sold locally. Maize production in the area is not yet large enough to provide surplus for export. Nor is the quality of marketed maize grains of an acceptable level due to the excessive admixture of yellow and white varieties.

The sales price is Rp 15 per kg of dried maize grains and Rp 1 per piece of young earcorn.

(2) Marketing Mechanism

As described above, surveyed areas differ from each other in the distribution of maize but all have certain things in common. The marketing mechanism common to all the areas is as illustrated below.

Marketing Mechanism



5. Future Prospect of Maize Production

(1) Production

The province's annual maize production of about 50,000 tons is very small when compared to the 1,000,000 ton level already acheived in East Java. However, 70 % of total output is appropriated for export even at present due to the low local demand, and this clearly indicates that any large increase in production can directly to increased export. (See Table 18)

Table 18. Production and Export of Maize in Lampung

Year	Production (A)	Export (B)	B/A (%)
1968	62,214 tons	29,000 tons	46.6
1969	49,870 "	38,600 "	77.4
1970	58,607 "	45,300 "	77.2

Note: The export drop in 1968 is due to the sharp production decrease of the second crop of paddy and upland paddy in 1967 caused by heavy drought damage.

Further, the province is provided with a number of ingredients which promise accelerated production of maize, the most prominent of which are the province's favorable topographic, soil and climatic conditions, availability of vast undeveloped land, and large room for improving existing farming techniques. One of the measures to be taken to materialize the production increase is, therefore, to provide an incentive to farmers for taking advantage of these favorable conditions.

However, farmers in Lampung grow maize as a secondary and cash crop and not as a main crop like upland paddy, beans, cassava or perennial crops, and this sets a limit on increased maize production. Firstly since maize is grown by mixed cropping with other crops, its production increase can be realized only in relation to the production of such other crops, and secondly, the cultivation of maize as a cash crop calls for a high producer's price and a low production cost.

Maize production by individual farmers in Lampung has been and will be carried out predominantly by Javanese settlers. Alleviation of these two restrictive factors is therefore the key to encouraging farmers to increased maize production.

(2) Estimate of Production Increase

Production increase is possible as described above, but it must be preceded by the fulfilment of various preconditions such as the construction of roads and port facilities, setting of adquate floor prices, improvement of farming techniques, and so forth. From the existing conditions of Indonesia, these conditions cannot be expected to be satisfied in the near future. Trial calculation of maize production is therefore made assuming that half of these preconditions will be met in the forthcoming ten years.

In this calculation, the annual cultivation rate (α), planting rate (β) and average yield per unit area (Y) are estimated for the following six types of maize cultivation to estimate the production (X).

Production (X) = Cultivated Area (A) x Annual Cultivation Rate (α)
x Planting Rate (β) x Average Yield per Unit Area (Y)

(a) New Communities Showing Stabilized Development under the Immigration Plan of the Ministry of Immigration Implemented from 1952 to 1970.

A: 1.1 ha per farm household x 53,320 households 58,600 ha
0.2 ha increase per farm household x 53,320 16,640 "
Total A = 75,240 "

: Estimated present rate of 1.6 is applied.

: Estimated present rate of 1/4 is to be raised to 1/3.

Y: Existing level of 0.85 t/ha achieved without fertilization is to be raised to 2.5 t/ha (Target set by the Agricultural Extension Office is 2.5 t/ha).

Therefore, X_1 = 75,240 x 1.6 x 1/3 x 1.7 ≒ 69,500 tons

(b) New Communities to be Developed under the Immigration Plan of the Ministry of Immigration from 1971 to 1980.

The plan envisages the settlement of 100,000 farm households. Assuming the 50,000 farm households, or half the target value, will be settled, on the basis of past settlement records, and that each farm household will be allocated with 1.2 ha land,

A : 1.2 x 50,000 = 60,000

α & β : 1.6 and 1/3, respectively, as in the case of Item (a) above.

Y : 1.5 t/ha

X_2 + 60,000 x 1.6 x 1/3 x 1.5 ≒ 48,000 tons

(c) 30,000 Farm Households of Voluntary Settlers

Assuming that each household will be allocated with 1.0 ha land,

A = 30,000

α, β & Y = Same as in Item (b) above.

X_3 = 30,000 x 1.6 x 1/3 x 1.5 = 24,000 tons

(d) Farmers Not Related with the Ministry of Immigration

Assuming that 20 % of the farmers in Lampung, including retired soliders, natives of Lampung and Javanese, occupy themselves with the cultivation of upland fields (ordinary farm crops) and, that 1.1 ha per farm household is actually used as upland field, the total number of farm households raising ordinary farm crops will be 150,000 and the total acreage of upland field area under cultivation 224,500 ha.

α: 1/3

β: 1.5

Y: 1.5 t/ha

X_4 = 165,000 x 1/3 x 1.5 x 1.5 ≒ 121,500 tons

(e) Estate Agriculture Carried Out with Land Concession

The existing two farms cover an area of 3,300 ha (1,500 ha + 1,800 ha) which will be expanded to 11,500 ha (5,500 ha + 6,000 ha).
Assuming that this area will be doubled in future to 20,000 ha,

α : 2

β : 1.0

Y : 3.5 (average of the first and second cropping)

X_5 = 20,000 x 2 x 1.0 x 3.5 = 140,000 tons

(f) Maize Cultivation in Paddy Fields after Paddy Harvesting

Assuming that 1/3 of the paddy field area, to be shortly increased from the present 58,866 ha to 65,000 ha, will be used for maize cultivation,

β : 1/2

Y : 1.7 t/ha

X_5 = 65,000/3 x 1/2 x 1.7 = 18,300 tons

Σ = 421,300 tons ≒ 420,000 tons

Thus, the estimated annual production turns out to be 420,000 tons according to the above trial calculation. However, since α, β and Y, respectively, represent an estimated value and the production rises to 460,000 tons if 10 %

is taken as Y, it is rather difficult to make a definite forecast. As an expedient, therefore, the annual production is estimated to range from 400,000 to 50,000 tons.

6. Measures for Problems Entailed in Production Increase

(1) Improvement and Diffusion of Production Techniques

(a) Variety

A variety called Local Metro which is derived from Metro or Harapan accounts for more than 90 % of maize varieties raised in Lampung. Metro varieties are known to be susceptible to Sclerospora. The occurrence of Sclerospora is still very limited at present in the province, but it is expected that the increased planting of hybrid varieties bred by crossing Metro varieties with dent or flint varieties will give rise to an intensive development of this disease. Efforts must therefore be made in advance to breed resistant and high yielding varieties suited for the natural conditions of Lampung. It is also necessary to breed and introduce varieties resistant against Helminthosprium maydis and Kabatiella Zeae which are liable to occur at many places in future. These efforts must be accompanied by researches and experiments on major diseases and climatic conditions of Lampung.

(b) Farming Techniques

As already described, maize is grown by mixed cropping with upland paddy and soybeans. Increased maize production can be most quickly achieved by expanding the planted area, and this calls for the intensified development of idle land and increase in the utilization rate of farm land. It is to be noted, however, that the production increase is now hampered by the shortage of manpower incurred by the cultivation of perennial crops such as coffee and pepper and by the complicated mixed cropping system prevalent in the province. A solution to this problem should be brought about by the introduction of machines, and if this proves successful, the farm land area can be undoubtedly expanded. But the expanded farm land area demands a larger manpower, causing a shortage of manpower again. This then will require the introduction of mechanized farming techniques which, if established, will inevitably alter the existing mixed cropping to row cropping, and this in turn could lead to a larger degree of soil erosion and productivity decline.

The problem, therefore, is how to solve these relations of cause and effect in seeking to increase production. A balanced progress must be maintained to avert the evils incidental in production increase. Attention must be directed to the fact that even at the present stage, there is strong demand for technical improvement in fertilization, insect and disease control and general farming. It is therefore advisable that a maize production center be established in Lampung to undertake the breeding of improved varieties as well as studies on the drying, processing and quality control of maize. Satisfactory functioning of the center cannot be assured without the establishment of pilot farms. Solutions and findings attained at the center should be confirmed by field tests at pilot farms so that any problems arising from such tests will be put to further studies at the center for the development of higher techniques.

Needless to say, new techniques must be diffused among farmers. For this purpose, the center's activities should preferably be carried out in parallel with the training and education of farmers' representatives and members of L.S.D. In connection with these development activities, it is desirable that the facilities of the Seed Farm at Tegineneng, now being expanded, will be further extended in future.

(2) Expansion of Farm Land and Improvement of Its Utilization Rate

Undeveloped alang-alang fields are said to cover an area of 400,000 to 600,000 ha. They remain intact either for natural reasons including soil condition, fertility and insects and diseases or for social reasons such as land ownership, labor force and traffic conditions. To develop these fields into farm land, rational introduction of mechanized farming must be implemented together with the establishment of a maize center and pilot farms. Further detailed studies will be required to clarify the cause of the high rate of uncultivated land and the low rate of land utilization. The maize center must assume the central role in investigating these problems and establishing measures for their technical solution.

(3) Purchase Price

As described already, the purchase price of maize is closely related to the transport conditions, and the marketing route is in the hand of exporters and brokers.

Table 19 shows the trial calculation of export profits of purchased maize.

Table 19. Trial Calculation of Export Profit of Purchased Maize

Unit : Rp per ton
US$ 1 = Rp 375

Item	Calculation with Bandaldjaja taken as Standard	Calculation for Mitsugoro Farm (Estimate)
1. Purchase Price from Farmers 70 km from Pandjang; roads assumed to be mostly paved and partly unpaved	12,000	12,000
2. Broker's Cost	500	400
3. Bagging Cost	700	700
Cost of bags - Rp 500/t		
Bagging cost - Rp 200/t		
4. Transport Cost	1,200	3,000
Mitsugoro - Rp 3,000		
Singalaga - Rp 50		
Sidodadi - Rp 1,000		
5. Drying and Storage Cost	2,500	2,000
Drying from 18 % to 12 % of water content		
6. Delivery and Loading Cost	700	700
7. Tariff		
10 % of check price of US$60	2,250	2,250
(10 % of check price of US$10)	(375)	(375)
8. Overhead Cost	500	500
Subtotal (Items 1 to 8)	20,350	21,550
	(18,475)	(19,675)
9. Interest		
For two months at a monthly rate of 5 %	2,035	431
(1 % for Mitsugoro Farm)	(1,848)	(394)
TOTAL COST (Items 1 to 9)	22,385	21,981
	(20,323)	(20,068)
GROSS INCOME		
At FOB US$65 per ton	24,375	24,375
At FOB US$60 per ton	22,500	22,500
PROFIT		
At FOB US$65 per ton and check price of US$60	1,990	2,394
(At FOB US$65 per ton and check price of US$10)	(4,052)	(4,307)
At FOB US$60 per ton and check price of US$60	115	519
(At FOB US$60 per ton and check price of US$10)	(2,177)	(2,432)

If the costs before shipment can be reduced, the purchase price can be stabilized on a higher level than at present, stimulating the farmers' willingness for increased production. Efforts must therefore be directed to cutting down the factor costs.

The check price (Item 7) largely affects the profit and its rise should be included in the producer's price, transport cost and drying and storage expenses. A decrease in the producer's price, however, will make the farmers reluctant to engage in production increase.

(4) Improvement of Roads and Port Facilities

The FOB and producer's prices of maize stand at US$50 - 60 and US$30 - 45 per ton, respectively. The current price level of maize is far lower than that of coffee and pepper. The former's price is 6 to 8 times as high as maize, and the latter 10 to 15 times as high. The bulkiness and low export price of maize make it imperative to cut down the factor prices such as for transport, storage and loading in order to provide sufficient international competitive power.

Just as the purchase price is dependent on the road conditions and Lampung's future development on the improvement of the road network, so will the growth of maize export of the province be largely affected by the scale of port facilities at Pandjang.

The loading capacity of Pandjang port is no larger than 500 tons on the current one-shift system so that a period of 20 days is required to load a 10,000 ton class vessel. The present capacity is far too small to assure smooth future shipment of maize, the production of which is estimated to increase to about 400,000 tons. It is known that four to five vessels must wait for berthing outside the port even today during the coffee harvesting season. The situation calls for the immediate commencement of port expansion work including new and additional installation of loading facilities and construction of silos.

Need for port expansion work can be justified by the expected sharp increase in cargo and passenger traffic through Pandjang arising from the production increase of maize to the 400,000 ton level. The increase in maize production will be accompanied by the increased output of other agricultural crops including those raised by mixed cropping with maize. Thus, the agricultural development scheme of Lampung must be reviewed from a comprehensive view-

point.

(5) Amplified and Systematized Transmigration of Javanese Farmers

New communities of Javanese settlers established under the transmigration plan of the Ministry of Immigration now embrace 60,000 farm households and are about to play the principal role in the production of ordinary farm crops. The Ministry's plan envisages the input of additional Javanese settlers in an area of 330,000 ha (concession already given for 100,000 ha) of alang-alang fields.

In addition, an area of more than 50,000 ha is planned to be settled by retired soldiers. These active transmigration schemes will leave only areas of land for future settlement. Transmigration of Javanese farmers is a must for Lampung's development. It is expected, however, that the future settlement of Javanese farmers will face increasingly exacting conditions and will demand huge capital input for the construction of public facilities such as roads, irrigation facilities and settlers' facilities as well as for the extension of advanced farming techniques. Coordination between respective organs concerned should therefore be maintained in future to ensure rationalized transmigration.

(6) Consolidation of Distribution System

As already described, the promotion of the province's export calls for a reduction in the cost of production, transport and loading. Equally important for the planned export growth is the establishment of a consolidated distribution system in which the purchase can be stabilized and export of quality maize can be assured. This task care be left to the maize traders, but should be basically supported by the development of agricultural cooperative associations for which necessary measures should be taken immediately.

7. Fundamental Approach to Project Establishment

The most outstanding problems noted in the upland crop cultivation are the low rate of land utilization caused by the shortage of manpower and the common practice of mixed cropping.

Improvement of the prevailing farming practices calls for the establishment of a project under which a comprehensive study should be made on the general and economic desirability of introducing improved varieties, new farming equipment and advanced farming techniques.

To meet this purpose, the Seed Farm established at Tegineneng, South Lampung, is planning to undertake research and training activities besides seed multiplication. In view of the immense impact which the planned activities will have on the development of maize production, it is hoped that the Farm will use every possible means to make the activities rich in both scope and substance.

It is to be noted that in order to establish most economical patterns of mixed cropping and crop rotation studies must be made not only on maize but also soybeans, groundnuts and green manure. Such studies should include breeding, establishment of farming standards, quality control, introduction of farm machinery and equipment, soil survey, fertilizer test, agro-economic survey, training, seed multiplication and distribution, and insect and disease control. Project areas should be selected from among the major maize producing areas, with Tegineneng Seed Farm serving as the central organization in introducing new farm machinery and equipment, improved varieties and advanced farming techniques as well as in providing guidances on farm management and drying of maize grains.

The fostering of farmers' organizations is indispensable for improving the quality and distribution of maize. In the face of the deficient development of farmers' organizations, it is imperative to provide guidances for such improvement and to extend technical as well as financial cooperation to ensure the smooth growth of agricultural cooperative associations into organs capable of undertaking the development on their own.

Further, a detailed land utilization plan should be mapped out for promising development areas to insure the smooth progress of Japan's non-governmental agricultural development cooperation programmes, development of non-estate agriculture, and promotion of transmigration of Javanese farmers. Drafting of such a land utilization plan should be preceded by a survey and preparation of data relating to natural conditions such as topography, soil, land use, climate and river discharge as well as to social conditions such as local customs and practices, land servitude and distribution channels. Since a survey of these items will require a lengthy period of time, it should be carried out parallel with the project implementation.

CHAPTER V MAIZE INSECT PESTS AND DISEASES IN INDONESIA

Since the survey was conducted within a limited time in the beginning of the wet season when the occurrence of maize insect pests and diseases is considered small, the team was able to collect only a limited number of specimens and failed to sample some important ones. However, the team's findings on the insect pest occurrence in the beginning of the wet season were sufficient to clarify the problems entailed in the control of maize insect pests and diseases and in the guidance of farming techniques.

1. Occurrence of Insect Pests and Diseases

Specimens collected in maize fields and maize storehouses were identified by professional taxonomists, and classified into new record species (N), uncertain species (?) and important species (I) of the maize insect pest and diseases in Indonesia according to the reports prepared by - Kalshoven (1950 & 1951), Diterbitkan untuk Djawatan penjelidikan pertanian di Bogor (1953), Shirakami (1967) and Kawasaki (1967; not published yet).

In the following items, the locality where the specimen was collected is indicated simply by the name of Desa or town or larger area (detailed description of the locality and collecting date are shown in Table 20), and actual states of occurrences and notable points in them are briefed for major species. Names of the known species which were not collected during the survey are also shown. (See Table 20.)

(1) Insect Pests of Maize and Their Natural Enemies

(a) Order ORTHOPTERA

(Identified by: Mr. Narao Fukuhara, National of Agricultural Science)

Suborder SALTATORIA

Family Acrididae

1. Acrida exaltata Walker?[N] (Photo 1-1)
   Locality: Tandjung Karang
2. Gonista bicolor DeHaan[N] (Photo 1-2)
   Locality: Bandardjaja, Pantjasira
3. Aiolopus tamulus Fabricius[N] (Photo 1-3)
   Locality: Tanetee

Table 20. Locality and Date

Locality	Propinsi	Kabupaten	Katjamatan	Sampling Date
Bandardjaja	L.	C.L.	Terbangi Bussar	Dec. 9
Bandung Baru	L.	S.L.	Bandung Baru	Dec. 14
Banrungan	C.J.			Nov. 20
Bendro	S.S.	Sidrap		Nov. 28, 29
Bogor	W.J.			Nov. 12 - 14
Bone	S.S.	Bone		Nov. 27
Bontomanai	S.S.	Bulukumba	Bulukumpa	Nov. 26
Danjang	C.J.	Grobogan	Purwodadi	Nov. 17
Djakarta	W.J.			Nov. 11 - 13 Dec. 3
Donomurjo	L.	N.L.	Baradatu	Dec. 16
Jamansari	C.J.	Tegal	Lebaksiu	Nov. 18
Kulo	S.S.	Sidrap	Pantja Ridjang	Nov. 29
Kotabumi	L.	N.L.		Dec. 15
Makassar	S.S.			Nov. 25, 30
Malang	E.J.	Malang		Nov. 21
Mitsugoro Farm No. 1	L.	C.L.	Labuhanmaringen	Dec. 6
Mitsugoro Farm No. 2	L.	C.L.	"	Dec. 7
Mitsugoro Farm No. 3	L.	C.L.	"	Dec. 7
Nambah Dadi	L.	C.L.	Terbangi Bussar	Dec. 9
Pare Pare	S.S.			Nov. 29
Pantjasira	L.	N.L.		Dec. 15
Pengatura	L.	N.L.		Dec. 15

Locality	Propinsi	Kabupaten	Katjamatan	Sampling Date
Redjoasri	L.	C.L.	Seputih Raman	Dec. 8
Redjosari	C.J.	Temanggung	Pringsurat	Nov. 20
Salatiga	C.J.			Nov. 19
Semarang	C.J.			Nov. 16
Sidodadi	L.	S.L.	Kalianda	Dec. 18
Sidokarto	L.	C.L.	Gunung Sugih	Dec. 12
Sidomuljo	L.	C.L.	Pungur	Dec. 9
Sidrap	S.S.	Sidrap		Nov. 29
Sidoluhur	L.	C.L.	Bangunredjo	Dec. 10
Sindjai	S.S.	Sindjai	Sindjai Timur	Nov. 27
Singalaga	L.	S.L.		Dec. 11
Sompe	S.S.	Wadjo	Sabbang Paru	Nov. 28
Soropadan	C.J.	Temanggung		Nov. 20
Surdjo	C.J.	Batang	Bawang	Nov. 19
Tanetee	S.S.			Nov. 26
Tamanlogo	L.	C.L.		Dec. 8
Tamanroia	S.S.	Djeneponto	Tamalatea	Nov. 25
Tandjung Karang	S.L.			Dec. 4, 11 - 15, 17, 18
Tegineneng	L.		Gunung Sugih	Dec. 12
Telle	S.S.	Bone	Adjangale	Nov. 27
Tjampurasri	L.	N.L.	Baradatu	Dec. 16
Tretes	E.J.	Surabaja		Nov. 22

Note: C: Central, E: East, J: Java, L: Lampung, N: North, S: South, S.S: South Sulawesi, W: West.

4. Phlaeoba fumosa Serville?[N] (Photo 1-4)

Locality: Djakarta, Bogor, Tretes, Tandjung Karang

5. Atractomorpha sp. ? (Photo 1-5)

Locality: Bogor, Djakarta, Kotabumi

6. Gesonula mundata pulchra Rehn[N] (Photo 1-6)

Locality: Bogor

7. Oxya intricata Stal[N] (Photo 1-7)

Locality: Bogor, Makassar, Sidrap, Bandardjaja, Tandjung Karang

8. Oxya velox Fabricius[N] (Photo 1-8)

Locality: Bogor, Jamansari, Makassar, Tanetee

9. Valanga sp.[I] (Photo 1-9, 17, 18)

Locality: Djakarta, Sompe, Sidrap, Singalaga Farm

10. Oedaleus infernalis DeSaussure[N] (Photo 1-10)

Locality: Malang

11. Heteropternis respondens Walker[N] (Photo 1-11)

Locality: Banrungan, Tretes, Tamanlogo Agricultural Experiment Station, Bandardjaja, Tandjung Karang

12. Trilophidia annulata Thunberg[N]

Locality: Tretes

13. Gen. sp. (Photo 1-12)

Locality: Djakarta, Bogor, Surdjo, Tamanlogo Agricultural Experiment Station, Bandardjaja, Tandjung Karang

Family Tetrigidae

14. Euparatettix sp. (A)[?] (Photo 1-13)

Locality: Semarang, Telle, Tandjung Karang

15. Euparatettix sp. (B)[?] (Photo 1-14)

Locality: Tandjung Karang

16. Euparatettix? sp.[?]

Locality: Tandjung Karang

17. Criotettix sp. (A)[?] (Photo 1-15)

Locality : Bogor

18. Criotettix sp. (B)[?] (Photo 1-16)

Locality: Tandjung Karang

Family Tettigoniidae

19. Conocephalus maculatus LeGuillou[N] (Photo 2-1)
    Locality: Tandjung Karang
20. Conocephalus sp.[N] (Photo 2-2)
    Locality : Makassar
21. Euconocephalus sp.[N] (Photo 2-3)
    Locality : Bogor

Family Gryllidae

22. Brachytrupes orientalis Burmeister[N] (Photo 2-4)
    Locality : Tandjung Karang
23. Gen. sp. (A)[?] (Photo 2-5)
    Locality : Bulukumba
24. Gen. sp. (B)[?] (Photo 2-6)
    Locality : Tanetee
25. Gen. sp. (C)[?] (Photo 2-7)
    Locality : Semarang, Salatiga, Banrungan
26. Gen. sp. (D)[?] (Photo 2-8)
    Locality : Malang
27. Gen. sp. (E)[?] (Photo 2-9)
    Locality : Tanetee
28. Velarifictorus aspersus Walker?[?] (Photo 2-10)
    Locality : Tanetee
29. Velarifictorus sp.[?]
    Locality : Semarang
30. Pteronemobius sp. (A)[N]
    Locality : Semarang

Family Gryllotalpidae

31. Gryllotalpa africana Palisot de Beauvois (Photo 2-11)
    Locality : Bogor, Tandjung Karang

Family Tridactylidae

32. Tridactylus? sp.[?] (Photo 2-12)
    Locality : Tandjung Karang

Suborder MANTODEA

Family Manteidae

33. Hierodula sp. (Photo 2-13)

Locality : Tanetee, Tandjung Karang

34. Gen. sp. (Photo 2-14)

Locality : Tandjung Karang

Suborder BLATTARIA

Family Blattellidae

35. Blattella sp.?

Locality : Bogor

36. Gen. sp. (A)? (Photo 2-15)

Locality : Bandardjaja

37. Gen. sp. (B)?

Locality : Bandardjaja

Species listed above belong to order ORTHOPTERA and are considered either to inflict damages on maize or to prey on the insects causing such damages. The above list therefore includes the species collected outside maize fields.

It was noted that the most severe damage is caused by Valanga. sp. which tends to show heavy occurrence in fields adjoining grassland area. In upland fields of mountainous areas of Kabupaten Sidrap, South Sulawesi, vartually all maize leaves were subjected to the heavy attack of this species.

Of the two species of genus Valanga, V. nigricornis melancornis Serville (= V. n. zehntneri) and V. transiens Walker, which are both known to be insect pests of maize in Indonesia, the former is not the one sampled, but it is not known if the latter is the same as the one collected.

Besides Valanga sp., Locusta migratoria manilensis Mey., Mecopoda elongata L. and Isotima javanica Br. v. W. are believed to attack maize in Indonesia. None of these, however, was collected during the present survey.

Insects belonging to family Mateidae are known to be predacious. The two species listed above are therefore considered to prey on maize insects.

Species of family Blattelidae listed above were all observed on maize plants subjected to the parasitism of aphids. Since the insects of family Blattelidae are omnivorous, the above-listed three species are considered to eat the excretory matter of aphids or prey on aphids or eat the softer parts of maize plants.

(b) Order DERMAPTERA
(Idenfified by: Mr. Masaru Nishikawa,
Tokyo University of Agriculture)

Family Carcinophoridae

1. Euborellia plebeja Dohrn[?]

Locality : Bandardjaja, Sidodadi

Family Labiduridae

2. Nala lividipes Dufor[?] (Photo 3-1)

Locality : Bontomanai

Family Chelisochidae

3. Proreus simulans Stal[?] (Photo 3-2)

Locality : Sidoluhur, Singalaga Farm

All the three species listed above were found mostly between leaves, particularly in between folded leaves and husks where corn leaf aphids were observed. They are considered to eat the excretory matter of the aphids or lavae of insects pests of order Lepidoptera or eat the young maize leaves.

(c) Order THYSANOPTERA

Heliothrips striatoptera Kob., a species of this order, is known to be infurious to maize plants, but was not obtained during the survey.

(d) Order HEMIPTERA

Suborder HETEROPTERA
(Identified by: Dr. Shoichi Miyamoto,
Tsukushi Women's Junior College)

Family Pentatomidae

1. Scotinophara coarctata Fabricius[?] (Photo 4-2)

Locality : Bandardjaja

2. Nezara viridula Linne[I] (Photo 4-1)

Locality : Sompe, Bandung Baru

3. Menida formosa Westwood[N] (Photo 4-3)

Locality : Mitsugoro Farm No. 1, Bandardjaja

Family Coreidae

4. Riptortus linearis Fabricius[N] (Photo 4-4)

Locality : Jamansari, Sidrap

5. Leptocorisa acuta Thunberg[N]

Locality : Sidrap

6. Leptocorisa oratoria Fabricius[N] (Photo 4-5)

Locally : Sompe, Sidrap

Family Lygaeidse

7. Pamerana sp.[?] (Photo 4-6)

Locality : Bandung Baru

Family Colobathristidae

8. Phaenacantha kruegeri Breddin[?] (Photo 4-7)

Locality : Bandung Baru

Family Miridae

9. Creontiades sp. (Photo 4-8)

Locality : Bandardjaja, Sidoluhur

Family Reduviidae

10. Allaeocranum biannulipes Montrouzier et Signoret (Photo 4-9)

Locality : Warehouse of Singalaga Farm

Of the above-listed insects, Nezara viridula and Leptocorisa oratoria were noted to be abundant in the maize field in Desa Sompe, Katjamatan Sabbang Paru, Kabupaten Wadjo, South Sulawesi. (Maize plants cultivated in the said field which is adjacent to a field where tobacco had been harvested were in the tasseling period. The grass height was about 1.5 m, and 4 - 5 plant planting at a density of 90 cm x 90 cm was adopted) The population density of adult insects per 20 plants was 17 for the former species and 7 for the latter. Damage caused by them was very severe. Sucked and dead spots were observed on stalks and tassels, and leaves also presented small wrecked spots which had become larger with the development of leaves (See Photo 7-7, 8). The former species is distributed throughout the district from the southern part of Honshu Island of Japan, to the oriental tropical region, Australian region, South Europe and North and South America, and is known to be polyphagous. It is believed that an outbreak of this species in Indonesia incurs heavy damages on rice, sorghum, beans, vegetables and other crops.

Riptortus linearis was found in large numbers in upland fields in the hilly areas of Kabupaten Sidrap, South Sulawesi where mixed cropping of maize and cowpeas is conducted. The population density was about 5 per 20 plants. Damages by this species were observed chiefly on cowpeas, and maize was relatively free from its attack.

All the other species were noted to be low in population density and causing no damages. Allaeocranum biannulipes, found in maize storehouses, may be a useful insect that preys on insects injurious to stored cereals.

Besides the insects listed above, the following species are known to be injurious to maize, but none of them was collected during the survey.

Cydnus indicus Westwood, Scotinophara inermis Hag., S. motginus Schiodt., Antestia anchora Thunberg, Megarramphus hastatus Fabricius, Pygomenida varipennis Westwood.

Suborder HOMOPTERA

(Identified by: Dr. Tamotsu Ishihara,
Faculty of Agriculture, Ehime University
(Aphididae and Pseudococcidae exclusive))

Family Delphacidae

1. Peregrinus maidis Ashmead[I] (Photo 5-1, 2, 3)
   Locality : Sidoluhur, Singalaga Farm, Bandung Baru, Sidodadi
2. Tropidocephala formosana Matsumura[?]
   Locality : Sidoluhur

Family Derbidae

3. Phenice moests Westwood[N] (Photo 5-4)
   Locality : Sidoluhur
4. Vekunta sp[?] (nov. ?)
   Locality : Pantjasira

Family Ricaniidae

5. Ricania marginalis Walker[?] (Photo 5-5)
   Locality : Redjosari
6. Ricania binotata Walker[?] (Photo 5-6)
   Locality : Tamanroia

Family Hecalidae

7. Hecalus sp.[?] (Photo 5-7)
   Locality : Sidrap

Family Cicadellidae

8. Orosius albicinctus Distant[?]
   Locality : Makassar Agricultural Experiment Station

Family Deltocephalidae

9. Exitianus indicus Distant[?] (Photo 5-8)
   Locality : Makassar Agricultural Experiment Station

10. Aconura? sp.[?] (Photo 5-9)

Locality : Bandardjaja

Family Aphididae

(Identified by: Dr. Tadashi Tanaka,
Faculty of Agriculture, Utsunomiya University)

11. Rhopalosiphum maidis Fitch[I] (Photo 5-10)

Locality : Danjang, Jamansari, Mitsugoro Farms No. 1, 2 & 3, Bandardjaja, Nambah Dadi, Sidoluhur, Singalaga Farm

Family Pseudococcidae

(Identified by: Dr. Sadao Takagi,
Faculty of Agriculture, Hokkaido University)

12. Gen. sp.[N] (Photo 5-11)

Locality : Danjang

Peregrinus maidis, a well known insect pest of maize distributed widely in tropical areas, was observed in many fields in Lampung. Ants (Anoplolepis longipes Jesdon, Camponotus sp. described later) were observed gathering around this insect, eating its excretory matter and protecting it as well (See Photos 5-3 and 9-7). No noticeable damages were noted to be caused by this species.

Phenice moesta which attacks palm trees in India was found to be injurious to maize and upland paddy in Lampung. However, it had a low density and was not causing noticeable damages.

Rhopalosiphum maidis is a common species living on the surface of folded leaves and leaf sheaths and inside husks. This species is a little divergent from the one found in Japan and is expected to be classified as a separate species in future. No appreciable damages were noted to be caused by this species which was found in high fertile fields.

Besides this aphid, Rhopalosiphum padi L., an aphid injurious to maize, is reported to be distributed in Indonesia (Kalshoven, 1950 & 1951; Kawasaki, not published yet), but no specimens could be collected during the survey.

A species of family Pseudococcidae found by the team lives in the husks and is protected by pits of small soil particles made by black ants of about 6 mm body length. Danages by this insect and its distribution are not known.

(e) Order LEPIDOPTERA

(Identified by: Miss Isoko Hattori,
National Institute of Agricultural Science
(Hesperiidae and Satyridae excluded))

Family Gelechiidae

1. Sitotroga cerealella Oliver[I]

   Locality : Soropadan Agricultural Experiment Station

Family Pyralidae

2. Ostrinia furnacalis Guenée (O. nubilalis Hübner)[I] (Photos 6-1 & 7-1, 9)

   Locality : Danjang, Jamansari, Surdjo, Redjosari, Malang, Tamanlogo Agricultural Experiment Station, Bandung Baru

3. Cnaphalocrocis medinalis Guenée[I] (Photos 6-2, 3 & 7-2)

   Locality : Surdjo, Redjosari, Telle, Sompe, Makassar, Mitsugoro Farms No. 1, 2, 3, Nambah Dadi, Sidoluhur, Singalaga Farm, Sidokarto, Tegineneng Seed Farm, Bandung Baru, Pengatura, Tjampurasri, Donomurjo, Sidodadi

4. Gen. sp.[?]

   Locality : Tegineneng Seed Farm

Family Cochlidionidae

5. Gen. sp.

   Locality : Surdjo

Family Lasiocampidae

6. Gen. sp.[N]

   Locality : Malang

Family Lymantriidae

7. Laelia suffusa Walker (Photos 6-4 & 7-3)

   Locality : Surdjo, Malang

Family Noctuidae

8. Sesamia inferens Walker[I] (Photo 7-4, 10, 11)

   Locality : Redjosari, Telle, Sompe

9. Helicoverpa (= Heliothis) assulta Guenée[I] (Photos 6-5 & 7-5, 12)

   Locality : Danjang, Jamansari, Surdjo, Telle, Sompe, Mitsugoro Farm No. 1

10. Spodoptera (= Prodenia) litura Fabricius[I] (Photos 6-6 & 7-6)

    Locality : Semarang, Redjosari, Sindjai

11. Laphygma exigua Hübner (Photo 6-7)

    Locality : Bendro

Family Arctiidae

12. Amsacta latinea Cramer[N]

Locality : Surdjo, Bandardjaja, Bandung Baru

Family Hesperiidae

(Identified by: Dr. Masaro Okano,
Faculty of Education, Iwate University)

13. Telopidas (= Baoris) conjuncta conjuncta Herrich-Schaffer[N] (Photo 6-8)

Locality : Bogor

14. T. agna agna Moore[?]

Locality : Bogor

Family Satyridae

(Identified by: Dr. Masaro Okano,
Faculty of Education, Iwate University)

15. Mycalesis perseus cepheus Batler[N] (Photo 6-9)

Locality : Temanlogo Agricultural Experiment Station

Compared with other orders, order Lepidoptera includes the largest number of important insects injurious to maize. Sitotroga cerealella injures on stored cereals including maize just as such other species like Corcyra cephalonica Stt., Ephestia cautella Walk and Plodia interpunctella Hbn. Though this species was found only at Soropadan Agricultural Experiment Station in Central Java, there is high probability that it is inflicting damages on stored cereals throughout Indonesia because its widespread distribution is observed all over the world.

Oriental corn borer which is injurious to maize plants in Indonesia was hither to considered to be Ostrinia nubilalis Hübner (European corn borer), but it was later confirmed by Matuura and Munroe (1970) as a different species Ostrinia furnacalis Guenée distributed in Japan and in the temperate and tropical regions. Prior to the survey, the team entertained the misgiving that this species might not be completely identical to the one found in Japan. A good number of specimens of this species were therefore brought back to Japan for identification by Miss Hattori. The team's misgiving, however, was dispelled as the close examination of the specimens led to the same conclusion as reached by Matuura and Munroe. This species is one of the most important injurious insects of maize distributed all over Indonesia and is considered to show heavy outbreaks on dry season crops just as Sesamia inferens. The heaviest damage

was observed in the maize development project fields at Malang, East Java, and in the fields of Tamanlogo Agricultural Experiment Station, Lampung. In an examination of 100 maize plants, percentages of injured plants of which stalk or ear at maturing stage were damaged by the grown larvae were 30 % at the Maize Development Project and 90 % at Tamanlogo Agricultural Experiment Station.

Cnaphalocrocis medinalis rolls young leaves lengthwise and its larva hides itself in the rolled leaf and feedson the mesophyll so that the leaf becomes partially thin. It is found distributed widely in Japan, oriental temperate region and Australia, and attacks maize, paddy and sugar cane. Its occurrence is considered to prevail in virtually all fields in Indonesia. The heaviest damage was observed in Desa Surdjo, Katjamatan Bawang, Kabupaten Btang, Central Java. In this Desa, about 30 % of maize plants having grown to a height of about 50 cm were noted to have damaged leaves.

As for the insects of Cochlidionidae, two species have so far been identified, i.e., Thosea sijthoffi Sn. and T. sinensis Walk. However, the specimens obtained during the survey could not be identified.

Sesamia inferens is another important insect pest of maize which eats into the stalk and ear like Ostrinia furnacalis. The heaviest occurrence of this insect was observed in Desa Telle, Katjamatan Adjangale, Kabupaten Bone, South Sulawesi. In the maize field of the said Desa where Adin variety and been planted after harvesting tobacco at a density of 90 x 90 cm (5 plants planting) and had grown to a height of about 40 cm, 56.6 % of 113 stems observed were noted to be damaged. A heavy damage was also observed in Desa Sompe, Katjamatan Sabbang Paru, Kabupaten Wadjo, of the same province. Stems of 25 % of maize plants cultivated in the observed field adjoining an area where tobacco had been harvested were noted to be subjected to the mixed damage incurred by both Sesamia inferens and Ostrinia furnacalis. This species is widely distributed over the district from Honshu island of Japan to the oriental tropical region. It is considered that its occurrence is causing heavy damages on maize, sorghum, sugar cane, paddy and other crops throughout Indonesia.

Helicoverpa (= Heliothis) assulta is also an important insect pest which feeds on the folded leaves and ears. In many parts of the country, this insect was noted to be causing damages, of which the heaviest was noted in Mitsugoro Farm No. 1 in Sribahwono, Central Lampung, where maize (Metro variety),

planted at a fairly high density of 40,000 plants/ha and grown to a height of 50 - 60 cm, was subjected to the attack of the larvae in the final instar. Of 70 stems inspected, 41 % were damaged. This species is widely distributed over the district from Honshu island of Japan to the oriental tropical region, and damages on various crops. It is considered that its occurrence in Indonesia is causing damages on maize, tobacco and vegetables cultivated throughout the country.

Heliothis armigera Hbn. belonging to the sams genus as Helicoverpa (= Heliothis) assulta is an important insect pest in Indonesia known by the English name of corn ear worm. This species could not be obtained during the survey. Since its adult and larva closely resemble those of Helicoverpa assulta in both morphological and biological features, one is often taken for the other by agricultural engineers.

Spodoptera (= Prodenia) litura is widely distributed over the district from Honshu island of Japan to the oriental tropical region, coastal area of Mediterranean Sea and Africa, and inflicts damages on the leaves of beans, vegetables and many other crops. Its occurrence during the survey period was rather limited.

Telopidas (= Baoris) conjuncta of family Hesperiidae was collected on the field of Central Research Institute for Agriculture in Bogor. T. matthias Fab. is known to be injurious to maize, but its occurrence appeared to be very low and no damages were observed. This species could not be obtained during the survey.

Besides the above-mentioned species, the following insects are known as species injurious to maize in Indonesia, but none of them was obtained during the survey.

Agrotis ipsilon Hfn., Euxoa (= Agrotis) interjectionis Gn. and E. segetum Schiff which cut the bottom of young plants;

Proceras polychrysa Meyr. and Chilo sp. which feed on inside the stem of young plants; and

Cacoecia micaceana Walk., Leucophlebia lineata Westw., Dreata petola Mr., Anticyra combusta Walk., Creatonotos gangis L., Laphygma exempta Walk., Leucania unipuncta Haw., Mocis frugalis Fab., Plusia signata Fab., Spodoptera mauritia Boisd., Dasychira securis Hbn. and Euproctis minor Sn. which feed on leaves of maize.

(f) Order COLEOPTERA

Family Trogossitidae
(Identified by: Mr. Sadanari Hisamatsu,
Faculty of Agriculture, Ehime University)

1. Tenebroides mauritanicus Linne (Photo 8-1)

Locality : Singalaga Farm

Family Nitidulidae
(Identified by: Mr. Sadanari Hisamatsu,
Faculty of Agriculture, Ehime University)

2. Uropholus sp.[N] (nov. ?) (Photo 8-2)

Locality : Sompe, Singalaga Farm

3. Carpophilus marginellus Motschulsky[N] (Photo 8-3, 23)

Locality : Nambah Dadi, Singalaga Farm, Sidodadi

4. Carpophilus mutilatus Erichson[N] (Photo 8-4, 23)

Locality : Jamansari, Surdjo, Singalaga Farm, Sidodadi

Family Rhizophagidae
(Identified by: Mr. Sadanari Hisamatsu,
Faculty of Agriculture, Ehime University)

5. Europs sp.[N] (Photo 8-5)

Locality : Singalaga Farm, Sidodadi

6. Mimemodes monstrosus Reitter[N] (Photo 8-6)

Locality : Jamansari, Singalaga Farm, Sidodadi

Family Silvanidae
(Identified by: Mr. Sadanari Hisamatsu,
Faculty of Agriculture, Ehime University)

7. Ahasverus advena Waltl[N] (Photo 8-7)

Locality : Singalaga Farm

8. Oryzaephilus surinamensis Linne[N] (Photo 8-8)

Locality : Singalaga Farm

Family Tenebrionidae
(Identified by: Mr. Mutsuo Miyatake,
Faculty of Agriculture, Ehime University)

9. Alphitobius laevigatus Fabricius (Photo 8-9, 10)

Locality : Singalaga Farm

10. Tribolium castaneum Herbst[I] (Photo 8-11)

Locality : Pare Pare Maize Storehouse, Singalaga Farm

11. Gnathocerus cornutus Fabricius[N]

Locality : Pare Pare Maize Storehouse

12. Martianus dermestoides Fairmaire

Locality : Tandjung Karang

Family Mycetophagidae

(Identified by: Mr. Mutsuo Miyatake,
Faculty of Agriculture, Ehime University)

13. Litargus sp.^{N} (Photo 8-12)

Locality : Sidodadi

14. Typhaea sp.^{N} (Photo 8-13, 24)

Locality : Surdjo, Singalaga Farm

Family Coccinellidae

(Identified by: Mr. Mutsuo Miyatake,
Faculty of Agriculture, Ehime University)

15. Scymnus (Pullus) fuscatus Boheman (Photo 8-14)

Locality : Sidoluhur

16. Cryptogonus sp.(resemble to c. fulvoterminatus Boh.)

Locality : Singalaga Farm

17. Chilocorus sp. (nov. ?)

Locality : Nambah Dadi

18. Menochilus sexmaculatus Fabricius (Photo 8-15)

Locality : Mitsugoro Farm No. 3

19. Micraspis afflicta Mulsant

Locality : Bandung Baru

20. Micraspis lineata Thunberg

Locality : Mitsugoro Farm No. 3, Nambah Dadi

21. Coccinella repanda Thunberg (= C. transversalis Fabricius)

Locality : Mitsugoro Farm No. 1

22. Harmonia octomaculata Fabricius (H. arcuata Fabricius)

Locality : Mitsugoro Farm No. 3

Family Elateridae

(Identified by: Dr. Hitoo Ohira,
Aichi College of Education)

23. Aeoloderma brachmana Candeze ? (Photo 8-16)

Locality : Sidoluhur

Chrysomelidae

(Identified by: Dr. Shinsaku Kimoto,
Faculty of Medicine, Kurume University)

24. Dactylispa setifera Chapuis[N] (Photo 8-17)

Locality : Mitsugoro Farm No. 1

25. Chaetocnema (Tlanoma) basalis Baly[N] (Photo 8-19)

Locality : Mitsugoro Farm No. 3

26. Monolepta sp.[?] (Photo 8-18)

Locality : Surdjo

Family Curculionidae
(Identified by: Dr. Katsura Morimoto,
Kyushu Branch of Forestry Experiment Station)

27. Gen. sp. (Photo 8-20)

Locality : Sidokarto

28. Sitophilus zeamais Motschulsky[I]
(= calandra oryzae) (Photo 8-21)

Locality : Surdjo, Redjosari, Pare Pare Maize Storehouse, Mitsugoro Farm No. 1, Singalaga Farm, Tandjung Karang

29. Araecerus fasciculatus DeGeer

Locality : Pare Pare Maize Storehouse

30. Hilaus sp.[?] (Nov. ?)

Locality : Pantjasila

Family Scarabaeidae
(Identified by: Dr. Hiromasa Sawada,
Tokyo Univeristy of Agriculture)

31. Adoretus compressus Weber[?] (Photo 8-22)

Locality : Bandardjaja, Tamanroia

As compared with other orders, Coleoptera contains the largest numbers of species that feed on stored maize grains. Tenebroides mauritanicus, two species of family Silvanidae, three species of family Tenebrionidae, and Sitophilus zeamais and Araecerus fasciculatus of family Curculionidae are all known as injurious to cereals and grain flour in storage. Many of them are widely distributed over the world and are suspected to be inhabiting extensively in Indone[illegible].

The three species of family Nitidulidae, two species of family Rhizophagidae and two species of family Mycetophagidae feed on the ears or grains of maize in fields and maize storehouses. In the fields, these species intrude through the parts eaten by Lepidopterous borer (such as Ostrinia furnacalis, Sesamia inferens, Helicoverpa assulta, etc.) and enlarge the affected and rotten parts or bore into the cobs of tip burren ears or into milky stage

grains, causing them to be rotten. Many fields in Lampung and Central Java were found affected by the intrusion of these species. In maize storehouses, they inflict heavier damages on unthreshed and particularly unhusked maize grains. Ears harvested from about 20 ha fields in Kediri maize development project area were rotten in 1969. Insects that have caused this damage are suspected to belong to the above-mentioned families, specially Nitidulidae, though the names of the species cannot be given since their specimens were not examined.

Besides these insects, the following species are known to be injurious to maize in Indonesia, but their specimens could not be collected during the survey.

Carpophilus dimidiatus Fab., Laemophloeus minutus Oliv., Oryzaephilus mercator Fauv., Alphitobius piceus Oliv., Tribolium confusum Duv. and Rhizopertha dominica Fab.

Aeoloderma brachmana is widely distributed from the southern part of Honshu island of Japan to oriental temperate region. According to Miwa (1943), this species injures the root of sugar cane in Formosa and other countries, and some species of genus. Conoderus which is close by related to this species are known to be causing damage on maize in Mexico. It is therefore suspected that larvae of this species feed on the seeds, bud and roots soon after germination.

Larvae of Dactylispa setifera Chapuis intrude into the leaves and feed on the mesophyll, leaving only the epidermis discoloured into white colour over a wide area. Damage by this species was found only with the Metro variety in the ripending period which was observed at Mitsugoro Farm No. 1, Sribahwono, Central Lampung. The damage observed at this farm, however, was considerably heavy, with 30 % of all leaves noted to be injured by the larvae: It had not been known that this species inflicts damage on maize in Indonesia, but its distribution in Java, Sulawesi, Batchian and Krakatau points to the possibility of its occurrence throughout Indonesia. Hispa armigera Oliv., which belongs to the same family as the said species, is known to be injurious to maize, but its specimens could not be obtained during the survey.

Chaetocnema (Tlanoma) basalis Baly damages young plants, particularly those soon after germination. Adult insects feed on leaves and larvae intrude into the base of inner leaves, causing them to dry and die away. This species

is known to be distributed in India, Ceylon, Burma, Indo-China, South China, Arabia, Formosa and Ryukyu Is., however its inhabitation in Indonesia was not known in the past. At Mitsugoro Farm No. 3, Djaboeng, Central Lampung, this species was found at a high population density of 20 per 100 plants. It is therefore suspected that its occurrence covers the entire area of Sumatra.

Monolepta sp. and Hilaus sp. were both collected from maize, but their damage was not confirmed.

Gen. sp. (Photo 8-20) of Curculionidae was collected in maize fields. It could not be identified whether this species is identical to Hypomeces inflatus Chevr. or H. squamosus Fab. which are both known to be injurious to the root of maize plants.

The following insect pests of Scarabaeidae are known to inhabit Indonesia but their specimens could not be obtained during the survey.

Adoretus sundaicus Ohs., Anomala aerea Perty, Euchlora viridis Fab., Apogonia destructor Bos., A. cribricollis Burm., Holotrichia helleri Brsk., Lepidiota stigma Fab. and Leucopholis rorida Fab.

The team collected Adoretus compressus Weber, a species not recorded Indonesia before. Damage by this species could not be confirmed, but it is considered that its adult feeds on the leaves and larva the roots.

The ten species belonging to Coccinellidae are all predaceous and are therefore considered to prey on aphids parasitic on maize.

(g) Order HYMENOPTERA
(Identified by: Dr. Keizo Yasumatsu,
Faculty of Agriculture, Kyushu University)

1. Solenopsis geminata ?[N] (Photo 9-1)
   Locality : Mitsugoro Farm No. 1
2. Gen. sp.[N] (Related to Solenopsis) (Photo 9-2)
   Locality: Redjosari
3. Anoplolepsis longipes Jesdon (photo 9-3)
   Locality : Bandung Baru
4. Camponotus sp. (Photo 9-4)
   Locality : Bandardjaja
5. Gen. sp. (Photo 9-5)
   Locality : Redjosari
6. Gen. sp.[?] (Photo 9-6)
   Locality : Redjosari.

Species given in Items 1. and 2. above are fairly important insect pests which incur heavy damages on maize bud if seeds are thinly covered with soil. Items 3. and 4. have the habit of gathering around corn plant hopers to eat their excretory matter or protect them (See Photos 5-3 and 9-7). As for Items 5. and 6., it is unknown whether and to what extent they are injurous or useful for maize.

(h) Order DIPTERA

(Identified by: Mr. Narao Fukuhara,
National Institute of Agricultural Science)

Family Muscidae

1. Atherigona exigua Stein[I] (Photo 10-1, 2)

Locality : Malang, Mitsugoro Farm No. 3

2. Gen. sp.[N] (Photo 10-3, 4)

Locality: Danjang, Jamansari

Family Agromyzidae

3. Gen. sp.[N] (Photo 10-5)

Locality: Telle, Sidoluhur

Atherigona exigua is one of the most important injurious insects of maize in Indonesia. Its occurrence is small in the latter half of the dry season and becomes heavy in the wet season. It lays eggs mostly on the primary and secondary leaves. Since the hatched larvae intrude into the base of inner leaves, leaves start withering away when the tertiary and fourth leaves begin shooting. The damage by the larvae is said to last for two to three weeks (Suga, 1969). In the maize development project field in East Java, an average of 3.1 egges were found laid per plant of maize in the shooting period of tertiary leaves, and in Mitsugoro Farm No. 3 in Central Lampung, 100 % of plants in the shooting period of fifth and sixth leaves were found damaged. No heavy damages were observed in Central Java and South Sulawesi, but this is considered ascribable not to the low population density of this species but to the team's inability to cover the fields where maize plants are in the stage immediately after germination and vulnerable to its damange.

A species belonging to Family Agromyzidae was collected in Desa Sidoluhur, Katjamatan Kaliredjo, Central Lampung, and in Desa Telle, Katjamatan Adjangale, South Sulawesi. This species resembles Gen. Dactylispa and Gen. Hispa in that its larvae mine into the mesophyll, but can be discrimated

from them because of the smaller width of eaten part.

The species given in Item 2. was obtained from the markedly rotten part of ears found in Desa Danjang, Kabupaten Grobogan and in Desa Jamansari, Kabupaten Tegal, Central Java. The extent of its occurrence and damage could not be clarified.

(2) Diseases of Maize
(Identified by: Dr. Toshihiro Kajiwara,
National Institute of Agricultural Science)

1. Sclerospora maydis

   Locality: Central Research Institute of Agriculture in Bogor, Danjang, Bawang, Malang, Tamanroia, Tjampurasri

2. Trichometasphaeria turcica (= Helminthosporium turcicum)

   Locality: Sidoluhur, Singalaga Farm, Tegineneng Seed Farm

3. Cochliobolus heterostrophus (= Helminthosporium maydis)

   Locality: Mitsugoro Farms No. 1, 2, 3, Sidoluhur, Singalaga Farm, Tegineneng Seed Farm

4. Helminthosporium carbonum?

   Locality: Sidoluhur

5. Puccinia sorghi

   Locality: Jamansari, Singalaga Farm

6. Kabatiella zeae

   Locality: Mitsugoro Farms No. 1, 3, Singalaga Farm, Tegineneng Seed Farm

Of the above-listed diseases, Sclerospora maydis is the most dangerous disease in Indonesia and found in almost the entire area of Java and Sulawesi. It is said to cause heavy damages on wet season crops. In Lampung, however, occurrence of this disease was detected only on three leaves of one plant in Desa Tjampurasri, Baradatu area, North Lampung. The past record of this disease in Lampung shows only an instance of slight occurrence in Labuhan Ratu, South Lampung (Bagian Agronomi Lembaga Pusat Penelitian Pertanian Bogor, 1969), indicating that the distribution of this disease is still limited in Lampung. This needs to be taken into consideration in planning the future control of this disease in Lampung. It is suspected that the infestation of this disease is affected by altitude. In Katjamatan Bawang, Kabupaten Batang, Central Java, for instance, it was not found in Desa Surdjo located at an elevation of 820 m, but affected plants were found in increasing numbers with the

decrease in altitude down to about 450 m.

The infestation of Cochliobolus heterostrophus, Puccinia sorghi and Kabatiella zeae? was generally slight. However, local but intensive outbreak of these diseases was observed in some fields.

Infestation of Trichometasphaeria turcica and Helminthosporium carbonum? was found in limited area in a small degree.

2. Peculiarities of occurrence and Control of Insect pests and Diseases in Central Java, South Sulawesi and Lampung

(1) Central Java

Because of the small farming scale prevalent in Central Java, maize is cultivated more or less by intensive farming. About 30 % of maize, comprising mostly local flint varieties, is grown in paddy fields either by monoculture or mixed cropping with soybean at a planting density close to the standard density. Cultivation is carried out by rotation with paddy without fallowing the land. It is often the case that nitrogen fertilizers are applied. No insecticides are used except that endrin or basudin are sprayed when the occurrence is heavy. The Agricultural Extension Office of the province stated that when no heavy fertilizer application is effected, occurrence of insects and diseases is limited and calls for no control measures, but this gives rise to conspicuous of rats occurrence in mountainous areas, calling for the application of zinc oxide agent or endrin. It was learned that black cut worms occasionally occur heavily to inflict a serious damage on young maize plants. Judging from its ecological peculiarity, this insect is considered to be Agrotis or a species close to it.

Investigation of fields revealed the occurrence of Cnaphalocrocis medinalis, Ostrinia furnacalis, Sesamia inferens, Helicoverpa (=Heliothis) assulta, Rhopalosiphum maidis and Carpophilus mutilatus. These insect pests, however, are causing only slight damages except for Cnaphalocrocis medinalis which is incurring rather heavy damages in some fields where the heaviest occurrence in all the three provinces surveyed was observed. In mountainous areas, small yellow ants (see Photo 9-2) harm the buds of maize. Damage by these ants is mentioned to be the largest obstacle for maize production in Desa Redjosari. Atherigona exigua occurs on wet season crops but is reported to cuase little damage.

As for diseases, farmers are most afraid of the spread of Sclerospora maydis. Insofar as the team found during its survey, infestation of this disease is limited. It was found in a small degree in lowland area, but could not be found in hilly areas. Puccinia sorghi was found infested locally.

In brief, Central Java is free from the periodical outbreak of insect pests and diseases for which control measures should be taken, but the occasional heavy occurrences of the afore-mentioned insect pests, which takes place in some areas, will call for the application of insecticides.

(2) South Sulawesi

Since the survey was carried out off the cropping season, the team was unable to investigate the large and collective maize cultivation in South Sulawesi. Insofar as the team discovered, maize is cultivated by rather extensive farming due perhaps to the large size of cultivated area. In most cases, local white flint varieties are planted by monoculture at a density of about 90 cm x 90 cm (4 - 5 plants planting), with virtually no fertilizers being applied. Application of aldrin for Agrotis and of endrin and dimecron for army worms is encouraged by the Agricultural Extension Office but the use of these agricultural chemicals is not very active among the farmers.

Investigation of fields revealed the development of Sesamia inferens*, Ostrinia furnacalis, Helicoverpa (= Heliothis) assulta, Spodoptera litura, Cnaphalocrocis medinalis, Nezara viridula*, Leptocorisa oratoria*, L. acuta, and Valanga sp.* In some fields, the four asterisked species presented the heaviest occurrence observed in all the three provinces surveyed. The team learned that Agrotis which frequently shows heavy outbreaks in the vicinity of Lake Tempey is the most important insect followed by Ostrinia, Helicoverpa and army worm which occasionally make a heavy occurrence.

As for diseases, Sclerospora maydis and Helminthosporium maydis are the most important. The former was found affecting about 60 % of plants of Dadi variety about 20 days after sowing which was observed in Desa Tamanroia, Katjamatan Tamalatea, Kabupaten Geneponto. The damage observed in this Desa was the heaviest in all the three provinces surveyed. No disease infestation, however, was observed in many fields north of Makassar where the maize plants were in the susceptible stage. The instance in Desa Tamanroia, therefore, may have to be considered an exception.

To summarize the situation in South Sulawesi, there exist no insect pests or diseases which call for constant control measures, but the frequent and heavy occurrences of the many important insect pests will demands an equally frequent application of insecticides.

(3) Lampung

Maize cultivation by individual farmers is entirely different in nature from that by estate agriculture, and should therefore be treated separately.

(a) Maize Cultivation by Individual Farmers

Farmers in Lampung have an average holding of 2 to 4 ha, but they are prevented from cultivating the entire holding due to the insufficiency of plowing measures. They adopt a special mixed cropping and crop rotation, not using fertilizer in usual. Under the mixed cropping, they sow upland paddy or soybean (or other beans) at a planting density of about 30 cm x 30 cm, maize at a dencity of about 200 - 400 cm x 50 - 100 cm, and plant cassava at the same or somewhat smaller density. The growth of maize by such mixed cropping was noted to be satisfactory because crop rotation is conducted by fallowing one half or more of land on which alang-alang (a kind of reed) is allowed to grow and burnt the following year for maize planting. The satisfactory growth of maize is also attributable to the thick and fertile surface soil. About 30 to 50 % of farmers apply insecticides such as endrin, aldrin, dieldrin and DDT twice to soybean, but no such chemicals are used for maize. In many cases, however, maize seeds are dressed with DDT or aldrin dust before sowing.

Investigation of fields revealed the occurrence of Ostrinia furnacalis, Cnaphalocrocis medinalis, Peregrinus maidis, Rhopalosiphum maidis, and insect pests of Nitidulidae and Rhizophagidae. The population density of these insect pests, however, was extremely low and no damages at all were discovered. The Agricultural Extension Office stated that Sitophilus zeamais and other insects injurious to stored cereals and army worms, rats and wild boars are most detrimental to maize growing.

As for diseases, investigation of Sclerospora maydis in many fields planted with maize in the susceptible stage disclosed that only one plant in Desa Tjampurasri was affected. The past record indicates that this disease occurred only once in Labuhan Ratu, South Lampung (Bagian Agronomi Lembaga Pusat Penelitian Pertanian Bogor, 1969). Infestation of other diseases was not

observed except in Sidoluhur. In Desa Sidoruhur, Katjamatan Kaliredjo, Central Lampung, severe infestation of Helminthosporium spp. covered 80 % of all maize plants. This unusual occurrence may be attributed to the shortage of a certain soil ingredient, possibly K, but no details are known.

In brief, maize cultivation by individual farmers is virtually free from the damages of insect pests and diseases probably because of the exhaustive rotation of peculiar mixed cropping in which maize is planted at an extremely low density.

(b) Maize Cultivation of Estate Agriculture

Improved maize varieties (mostly Metro varieties and partly Harapan varieties) are grown by monoculture under heavy dosage of chemical fertilizers in Mitsugoro Farms No. 1, 2 and 3 in Central Lampung, Singalaga Farm in South Lampung, Seed Farm at Tegineneng and Agricultural Experiment Station at Tamanlogo. In all the farms, continuous maize cropping is conducted in an area ranging from 100 to 1,800 ha. In Mitsugoro Farms, a 1/200 to 1/300 endrin solution is applied three times (in about 35 days after sowing, in the tasseling period and in the silking stage). If the growth of ear is delayed, the endrin solution is applied once again. At the Seed Farm, Agricultural Experiment Station and Singalaga Farm, however, endrin is sprayed only twice, in one week and one month after germination, under the guidance of the Agricultural Extension Office.

Investigation of fields revealed the occurrence of Atherigona exigua, Helicoverpa (= Heliothis) assulta, Chaetocnema basalis and Dactylispa setifera in some limited parts of Mitsugoro Farms which are still in the initial year of development and used for the second or third maize cropping. The investigation also disclosed the occurrence of insect pests of Nitidulidae and Rhizophagidae in some parts of Singalaga Farm which are likewise in the initial year of development and used for the second or third maize cropping. Further, Ostrinia furnacalis was noted to have occurred at the Agricultural Experiment Station in Tamanlogo. All these insect pests were noted to have occurred in abundance, incurring heavy damages in each farm. The team was informed that the damage by rats and wild boars is also conspicuous in some parts of the farms.

As for diseases, no infestation of Sclerospora maydis was noticed. It was noted, however, that Mitsugoro Farms are partly subjected to the substantial outbreak of Cochliobolus heterostrophus (= Helminthosporium maydis) and

Kabatiella zeae?, and Singalga Farm to these two diseases as well as to Trichometasphaeria turcica (= Helminthosporium turcicum) and Puccinia sorghi. Summarizing the existing situation, it may be said that large farms cultivating improved maize varieties under monoculture system with heavy dosage of fertilizer application and experiment farms under the similar farming conditions are infested with the habitual outbreak of important insect pests and diseases, and should therefore take systematic measures for the control of insect pests and diseases including the spraying of insecticides.

3. Control of Insects Pests and Diseases in Future

(1) Central Java

In Central Java, maize is grown either by monoculture or mixed cropping with soybean at a planting density close to the standard value so as to make full use of the limited size of farm land area. In most cases, maize is cultivated alternately with paddy for year-round cultivation with the application of nitrogen fertilizers. Maize fields are concentrated over some extensive areas. The cultivation method adopted in Central Java is suited for the collective and mass production of maize, but entails a great danger when considered from the viewpoint of insect pest and disease control. Production increase of maize, if implemen ted under such cultivation system, will invite an increasingly large population and outbreaks of the following insect pests and may ultimately call for systematic spraying of insecticide three to four times a year as practised at Mitsugoro Farms.

Seed fly (Atherigona exigua), Leaf roller (Cnaphalocrocis medinalis) Stem borer (Ostrinia furnacalis, Sesamia inferens,) Ear worms (Helicoverpa assulta, H. armigera), Army worms (Leucania unipuncta, Laphygma exigua, Spodoptera litura, S. mauritia), Cut worms (Agrotis ipsilon, Euxoa (= Agrotis) interjectionis, E. segetum, etc.), Corn sap beetles (Carpophilus mutilatus, C. dimidiatus)

As for diseases, outbreak of downy mildew, leaf spots, leaf bright and common rust is liable to occur. To cope with the expected increase of these diseases, it is advisable to resort not to chemicals but to the breeding or introduction of resistant varieties. Infestation of downy mildew in the province is rather limited at present despite the fact that the pattern of maize cultivated currently adopted is susceptible to its occurrence. This is considered due to the high resistance of local flint varieties which constitute the majority of maize

grown in the province. The resistance of local varieties should therefore taken into due consideration in planning the introduction of improved varieties.

(2) South Sulawesi

Collective cultivation of maize could not be investigated in South Sulawesi because the survey was conducted off the cropping season. No detailed description can therefore be given on the maize cultivation in this province.

As described earlier, the team noted that the insect pest occurrence in South Sulawesi was marked by the larger population and larger number of different species than in the other two privinces. The highest infestation rate of downy mildew throughout the three provinces was found in a field of Desa Tamanroia situated on the west coast of the province. Implementation of a plan for increased maize production is therefore likely to be accompanied by the heavy occurrence of Stink bugs (Nezara viridula, Leptocorisa oratoria, L. acuta) and Grass hoppers (Valanga spp., etc.) in addition to those insects described in Item (1) above. Control of insect pests should be given a closer attention than in Central Java.

(3) Lampung

(a) Insect pest and Disease Control for Maize Cultivation by Individual Farmers

Because of the large size of farm land area, maize is planted by mixed cropping with upland paddy, beans and cassava at extremely large intervals in between these crops. Farm land is left fallowed so that alang-alang grown on it is burnt before seeds are sown, and no fertilizers are usually applied. Uplike the case in Central Java where paddy and maize, which both belong to Gramineae, are cultivated successively on a same land, rotation of these crops is carried out by fallowing land. This cropping pattern may appear to be a hindrance to the rapid increase of maize production, but it serves to suppress the outbreak of insect pests and diseases which would otherwise occur under the existing favourable conditions including the year-round rainfall.

To accelerate the increased maize production, draught animals or farming machines must be introduced to make full use of fallowed land; to riase the efficiency of draught animals or machines, monocultural pattern must be adopted; and to increase the yield per unit area, introduction of improved varieties and application of fertilizers must be promoted for continuous cropping without

fallowing. The cropping pattern ultimately reached by the said process in liable, as pointed out in Item (1) (Central Java) above, to give rise to the outbreak of insect pests and diseases and to the difficulty in controlling them. Insect pests may well be controlled by the currently available insecticides though there may arise some troublesome problems. Control of diseases by agro-chemicals, however, does not appear feasible for economic reasons and no other suitable means than the application of chemicals have yet been established.

The population of insect pests and diseases is extremely low in Lampung. However, since the number of species of insect pests and diseases is larger than that in Central Java and approximately equivalent to that in South Sulawesi, any imprudence committed in the promotion of increased maize production could lead to the occurrence of the many insect pests and diseases described in Item (3) (South Sulawesi). If the production increase plan is to be implemented, therefore, resistant varieties should be bred or introduced and an effective control measure should be established through the application of suitable cultural and ecological methods before the infestation of insect pests and diseases become severe.

(b) Insect pest and Disease Control of Maize Cultivation by Estate Agriculture

Improved maize varieties are grown by monocultural system under heavy dosages of chemical fertilizers in Mitsugoro Farms, Singalaga Farm, Tegineneng Seed Farm and Tamanlogo Agricultural Experiment Station. Heavy local outbreaks of insect pests and diseases are therefore observed in these farms contrary to the small occurrence noted in the maize cultivation by individual farmers. The first planting was conducted in July 1969 in Mitsugoro Farms and in November of the same year in Singalaga Farm, and endrin is applied three times (or four times) for each cropping in Mitsugoro Farms and two (or three times) in Singalaga Farm, Seed Farm and Agricultural Experiment Station. The afore-mentioned heavy local occurrence of insect pests despite of such heavy endrin application is a good evidence to show that the insect pest and disease control entails great difficulties under the cropping pattern of these farms.

Heavy local occurrence of Corn sap beetles (of Nitidulidae and Rhizophagidae) in Singalaga Farm and of Oriental corn borer (Ostrinia fur-

nacalis) in Tamanlogo Agricultural Experiment Station caused heavy damages on ears and stalks. It is probable, however, that the damages have resulted from the inadequate guidance on insect pest control. To be more precise, endrin was sprayed at these farms and station one week and one month after germination according to the instructions given by the Agricultural Extension Office, but this method is not effective in controlling the insect pests which bore into ears and stalks in the latter growth period of maize, though it may be useful for preventing the insect pests attacking maize plants in the early growth stage. It is therefore advisable to apply chemicals after the tasseling stage as currently practised in Mitsugoro Farms. In Singalaga Farms, the team noted that the remaineder of maize stalks after harvesting is not fully buried into soil but scattered on the field surface because of the deficient capacity of tractors. The scattered stalks enhance the occurrence of insect pests and diseases, particularly diseases. Hence, remedy should be brought to this situation immediately.

The heavy damage incurred by Seed fly (Atherigona exigua) and Flea beetle (Chaetocnema basalis) on maize plants in Mitsugoro Farms about 10 days after germination is considered to be ascribable to the improper past control plan under which insecticides were sprayed about 35 days after germination, during the tasseling stage, and in the silking stage. Under this control plan, it is impossible to prevent the occurrence of insect pests in the initial growth stage of maize. An additional spraying should be carried out in about one week after germination as practised in Singalaga Farm and Tamanlogo Agricultural Experiment Station.

These farms are free from the infestation of downy mildew which is considered most detrimental to the maize cultivation in Indonesia. They are subjected, however, to the local but heavy outbreaks of other several kinds of diseases. If the present cropping pattern continues to be employed in future, it would lead to the infestation of downy mildew soon or later and to the heavier occurrence than at present of other diseases.

In the management of these farms, therefore, closer attention than that is required for maize cropping on an individual farming basis should be given for the control of insect pests and diseases with efforts also exerted to rationalize the insecticidal application so as to devise and employ a farming method and techniques that can minimize the damages.

(4) Selection and Application of Insecticides

Insecticides employed in Indonesia for maize cropping are mostly organic chlorinated hydrocarbons such as endrin, aldrin, dieldrin and DDT, and the use of organic phosphorous insecticides like dimecron (phosphamidon) or basudin (diazinon) is very limited. Organic chlorinated hydrocarbons are inexpensive, have a low vapour pressure and maintains a long lasting residual effect on crops and in soil. They are more effective than the phosphorous insecticides whose effective period is shorter in hot tropical areas, but this long residual effect contributes to the heaview accumulation of these chemicals in the organs of animals which take them in either directly or indirectly through food chain. This leads to the death of those smaller animals having a small resistance against such chemicals and also incurs an adverse phisiological effect on larger animals with a stronger resistance. Endrin, in particular, has an acute toxicity. Taking it in by mistake or to inhale just a small bit of it continuously while spraying gives a fatal effect on health. Use of organic chlorinated hydrocarbons is generally prohibited with some exceptions in Japan. It is therefore hoped that the insecticides mentioned above will be replaced by an equally effective but harmless insecticide and that a suitable application method will be established for such agricultural chemicals.

Endrin is applied after diluting it in water at a ratio of 1 to 200 - 500 using a manual sprayer of a shoulder type powered sprayer. Both of the two types of sprayer are not only inefficient but entail danger for health. Efforts must be made for the development of a safe and efficient spraying equipment and for the establishment of its application method.

4. Problems and Conclusions

1. 117 species of insects (belonging to 48 families of seven orders) and specimens of six diseases were collected mostly in maize fields and maize storehouses. Of the 117 insects collected, 39 were newly found to be injurious to maize by the survey and 14 were estimated to be the natural enemy to the insects inflicting damage on maize.

2. In Central Java, damages by Chaphalocrocis medinalis Guenée, Ostrinia furnacalis Guenée, sesamia inferens, Helicoverpa (= Heliothis) assulta Guenée, Rhopalosiphum maidis Fitch, and Carpophilus mutilatus which belongs

to Nitidulidae were observed. These damages however, were generally slight and there were found no insect pests or diseases which call for the constant application of agricultural chemicals. Nevertheless, it is believed that the implementation of a maize production development project in this province will encounter the spread of the above-mentioned insect pests as well as of such other insect pests and diseases as army worms, cut worms, seed fly, downy mildew, leaf spots, northern leaf blight and common rust.

3. In South Sulawesi, insects occurred covered a large number of different species and had a high population. Implementation of a maize production development project in this province will be accompanied by the occurrence of the same kinds of insect pests and diseases expected in Central Java and will also be subjected to the heavy occurrence of stink bugs. Insect pest and disease control for increased maize production in South Sulawesi should therefore be given a closer consideration than in the case of Central Java.

4. The population of insect pests and diseases occurring on maize cultivated by individual farmers is extremely small in Lampung, and this is considered attributable to the special mixed cropping system and to the fallowing of farm land. Favoured with some rainfall even in the dry season, the natural conditions in Lampung are suited for the occurrence of insect pests and diseases. Species of insect pests and diseases found in this province are just as diversified as in South Sulawesi. It is therefore considered that prime efforts must be directed to the development of a cultural method which serves to suppress the outbreak of these insect pests and diseases.

5. Maize cultivation by estate agriculture has a history of only one year, but the continuous and large scale cropping of maize by monoculture under heavy fertilizer application has already given rise to local but heavy occurrences of insect pests and diseases despite of the systematic spraying of insecticides. It is believed that downy mildew will soon penetrate into respective farms and that insect pests and diseases will become the largest hindrance to the maize cultivation. Control measures should therefore be established in advance.

6. Chlorinated hydrocarbons such as endrin, aldrin, dieldrin and DDT are the main insecticides used in Indonesia. All these agricultural chemicals have a strong residual effect; endrin, in particular, is known for its acute toxicity.

'igure 1

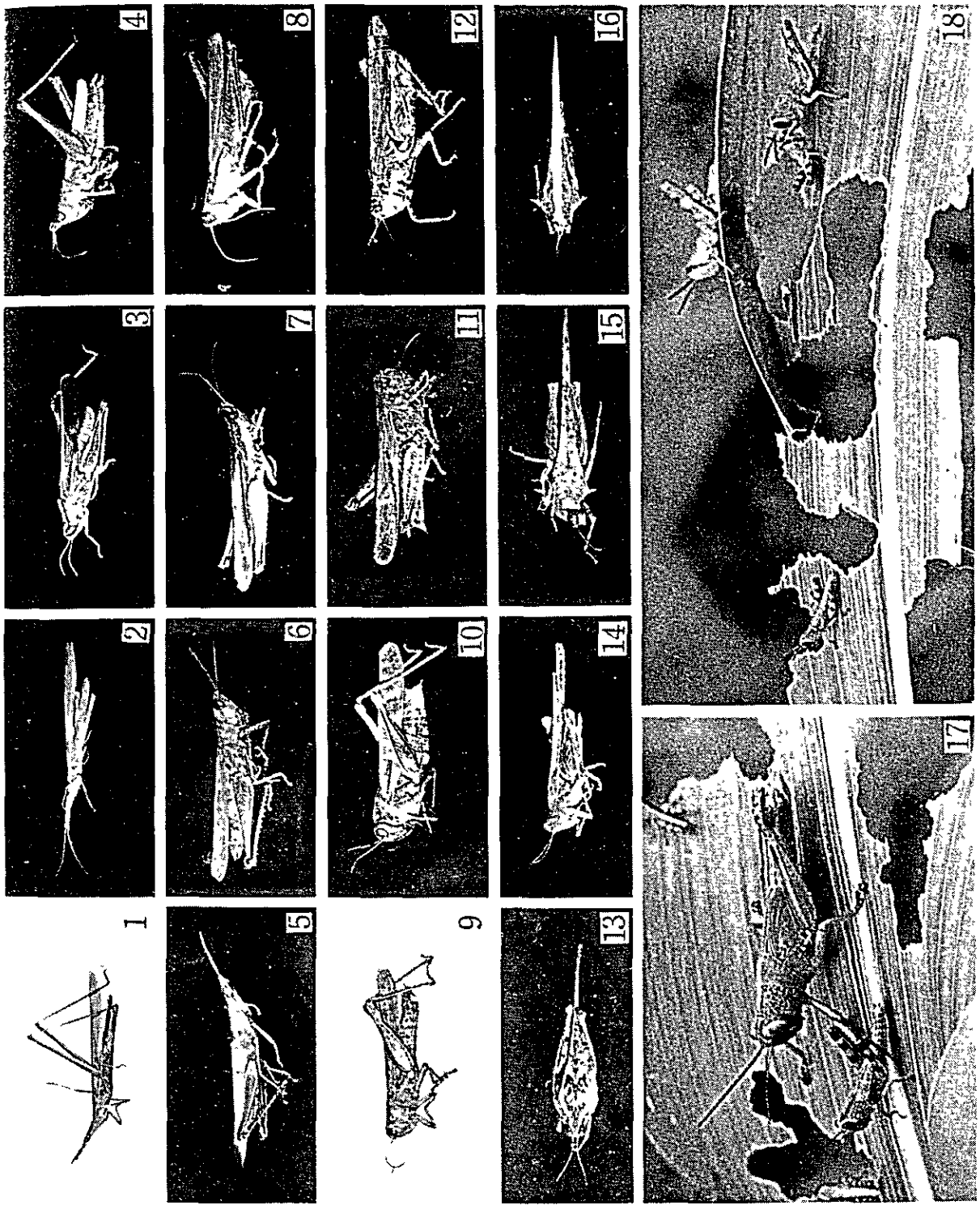


Figure 2

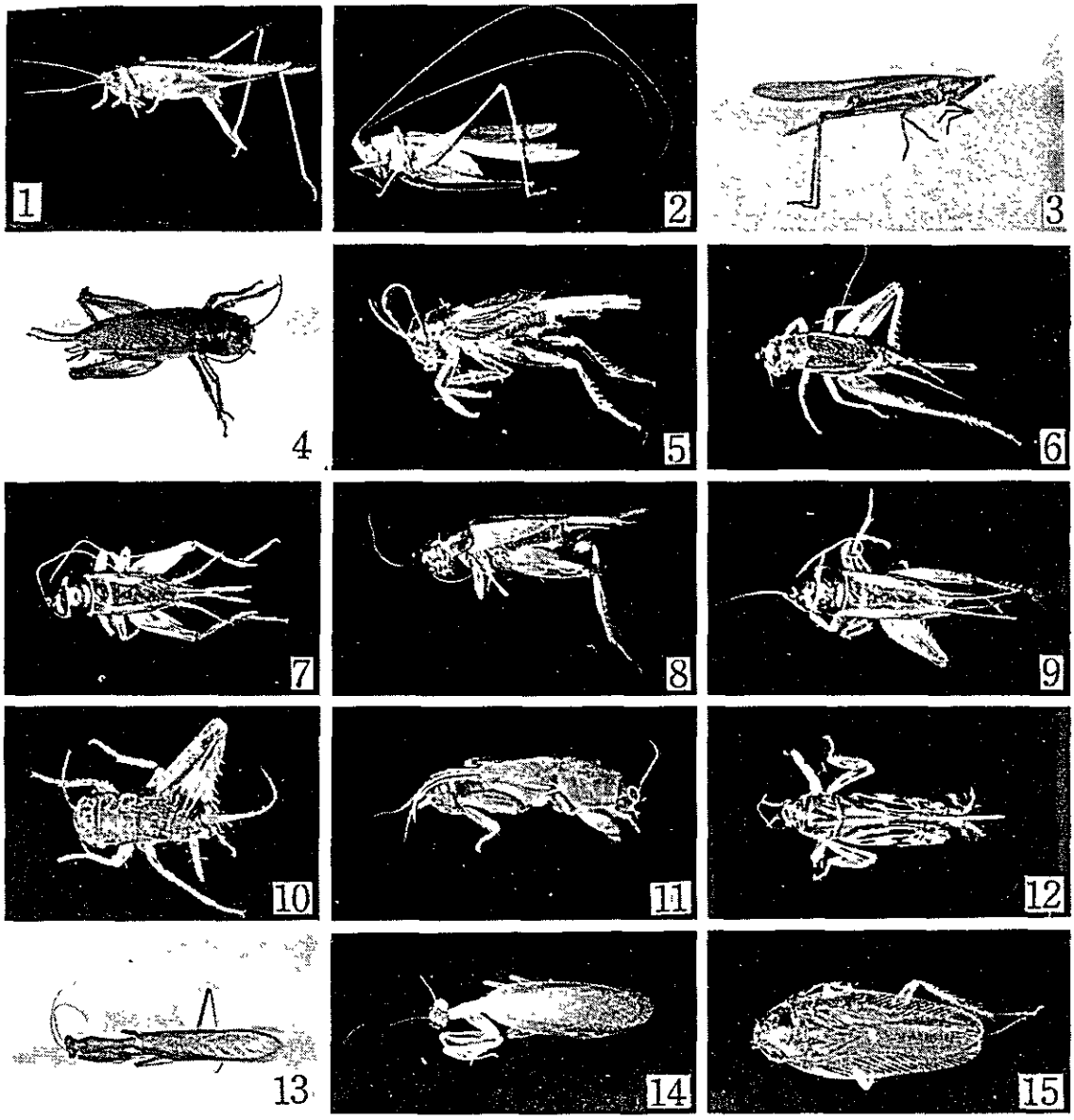


Figure 3

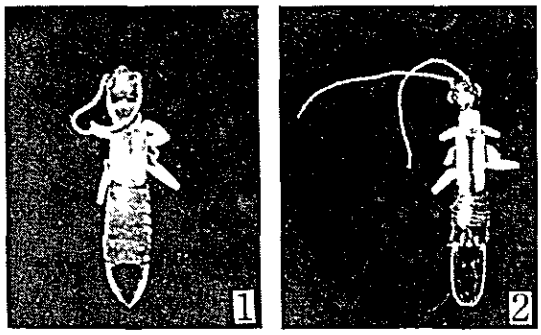


Figure 4

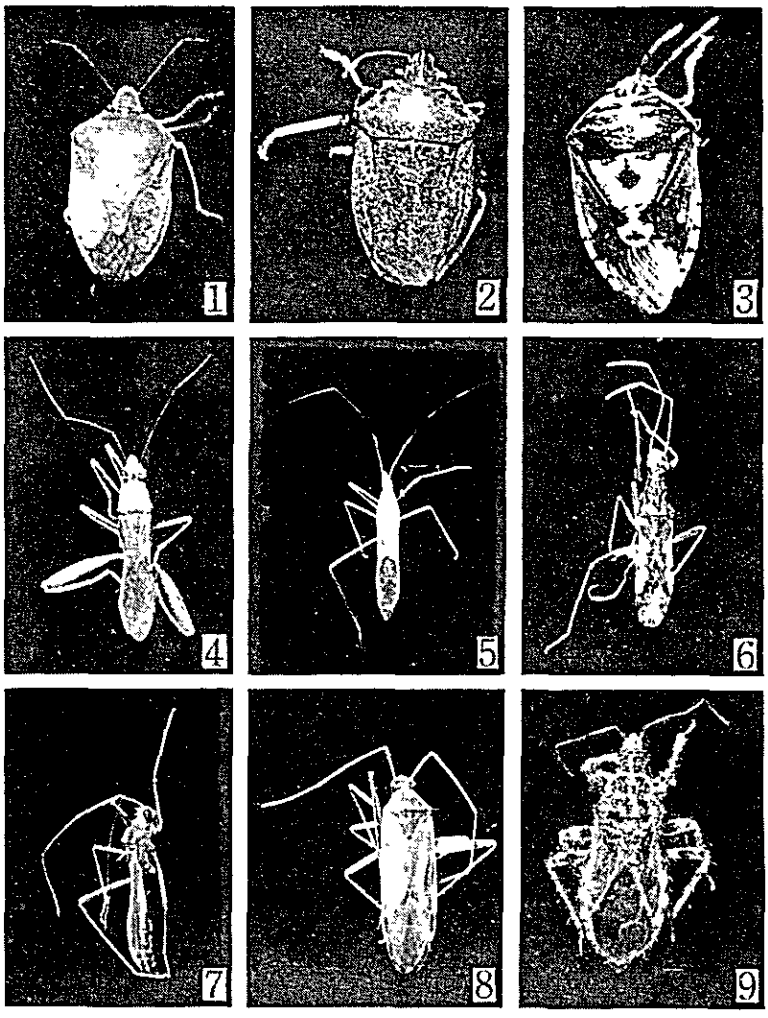


Figure 5

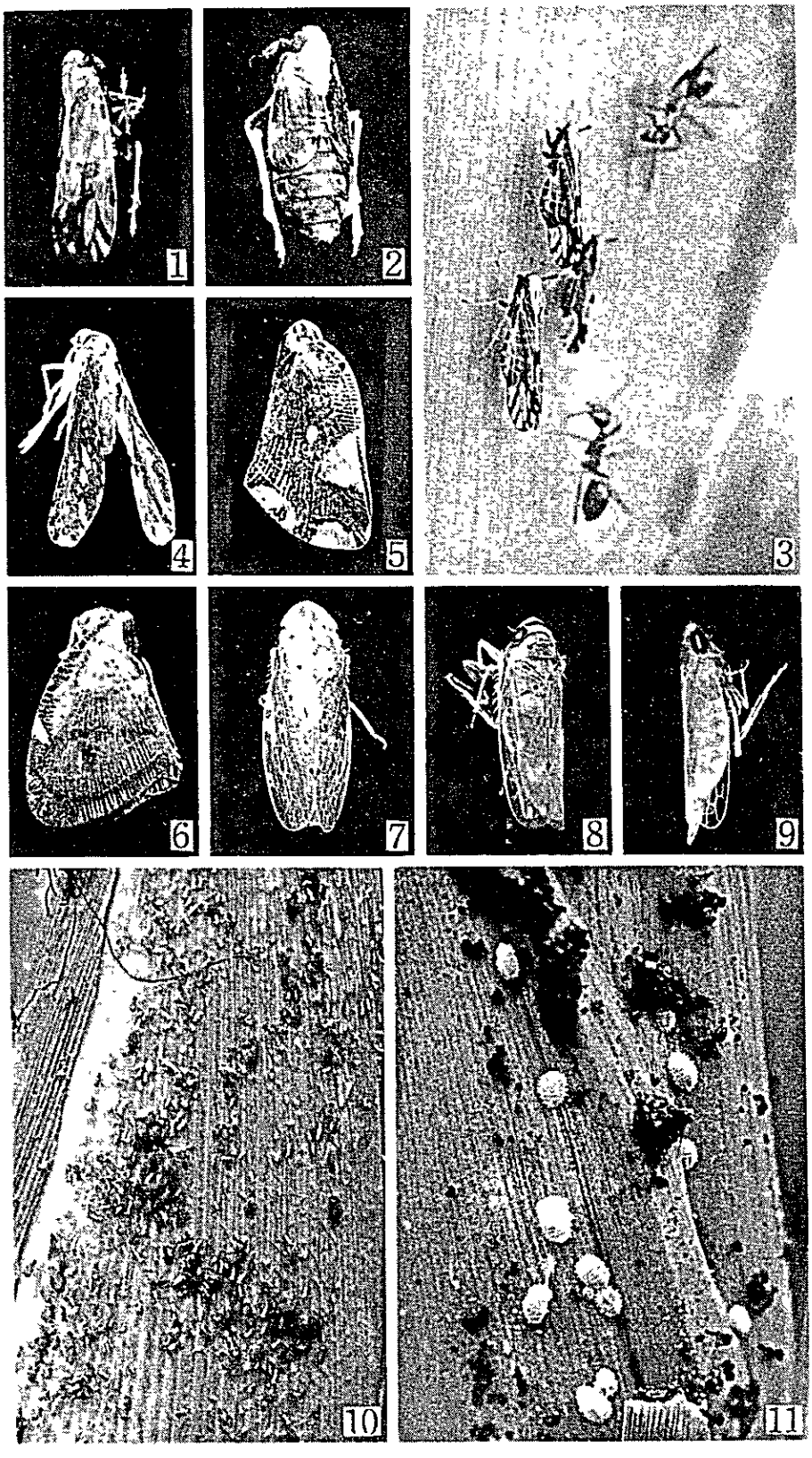


Figure 6

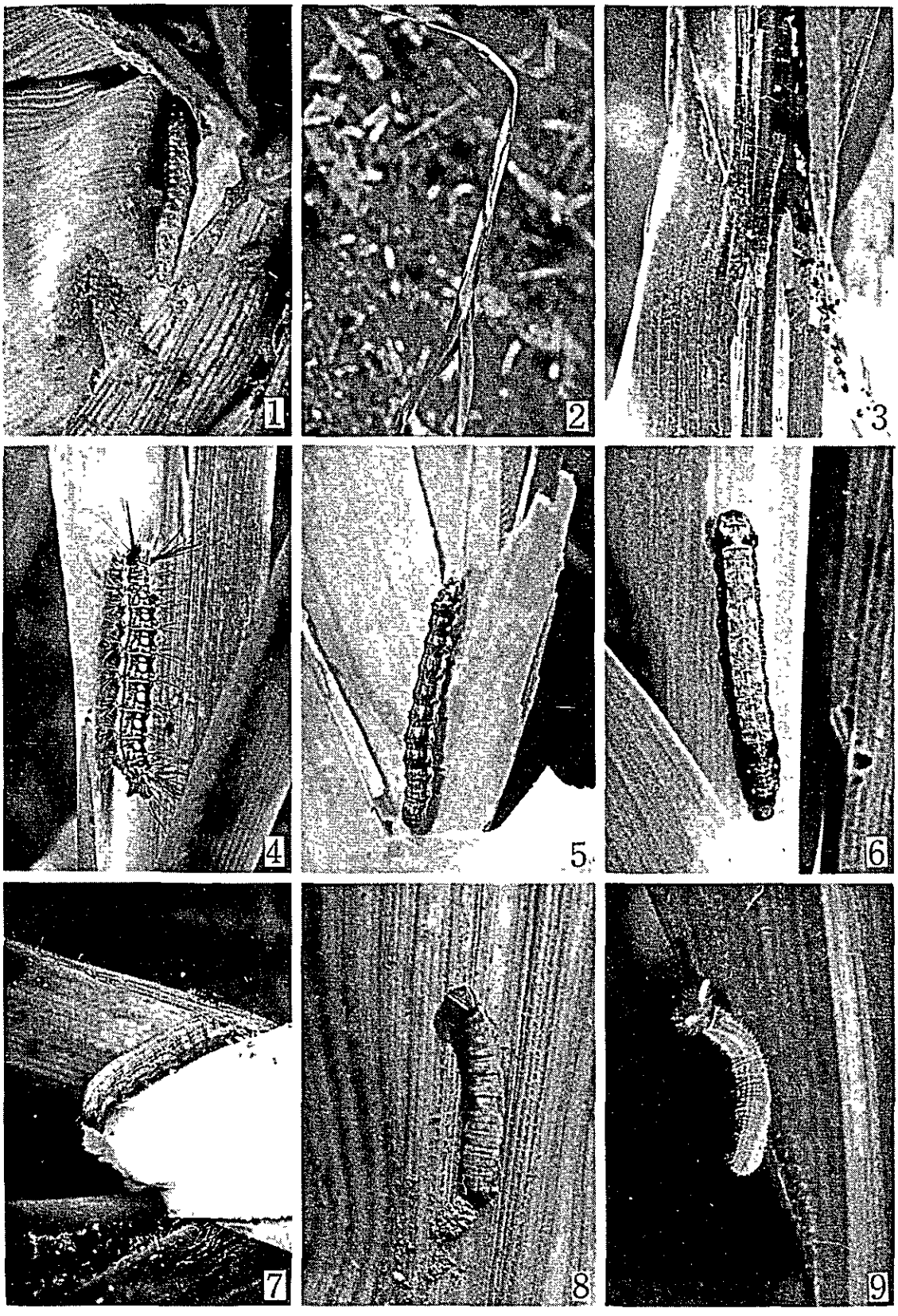


Figure 7

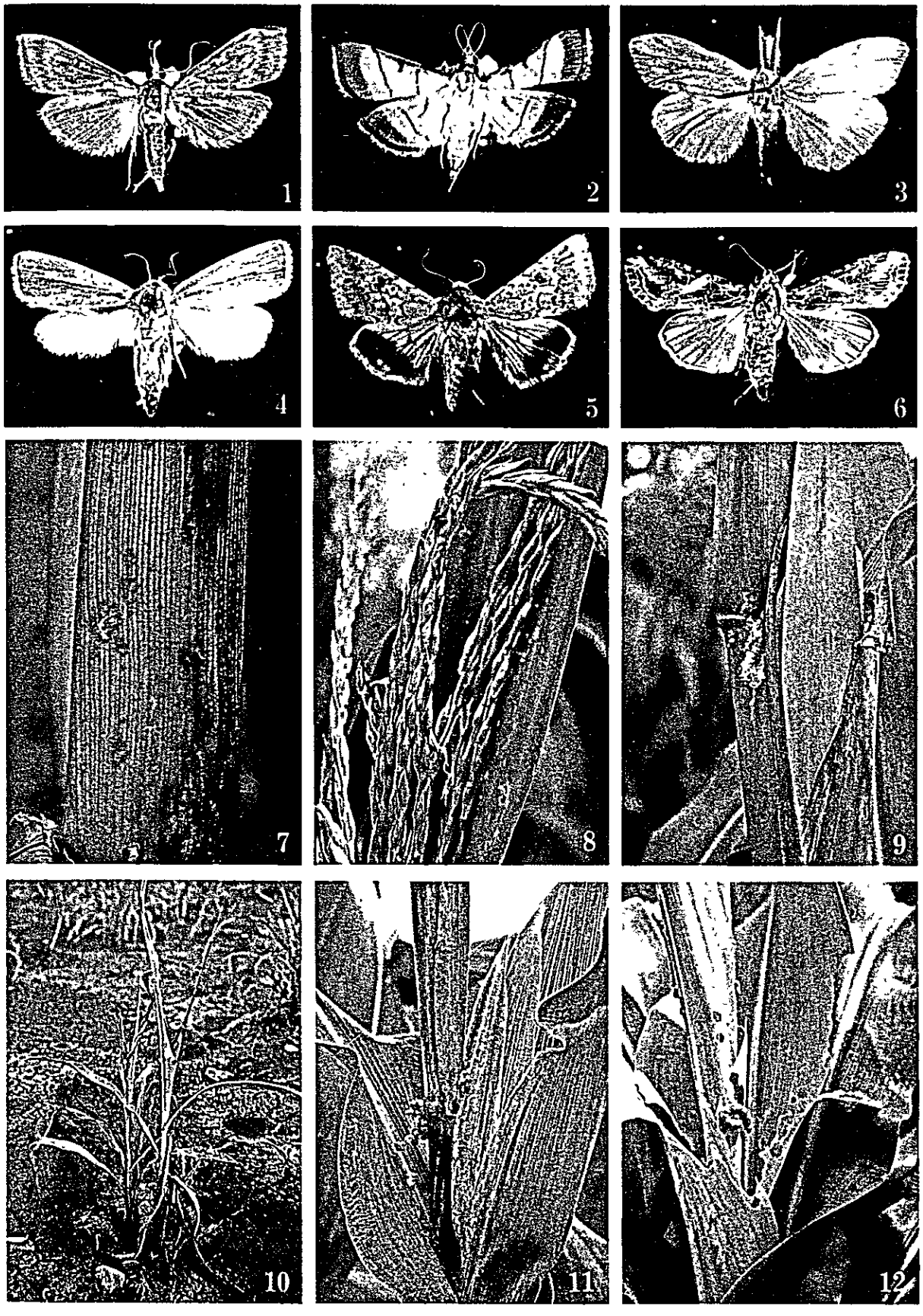
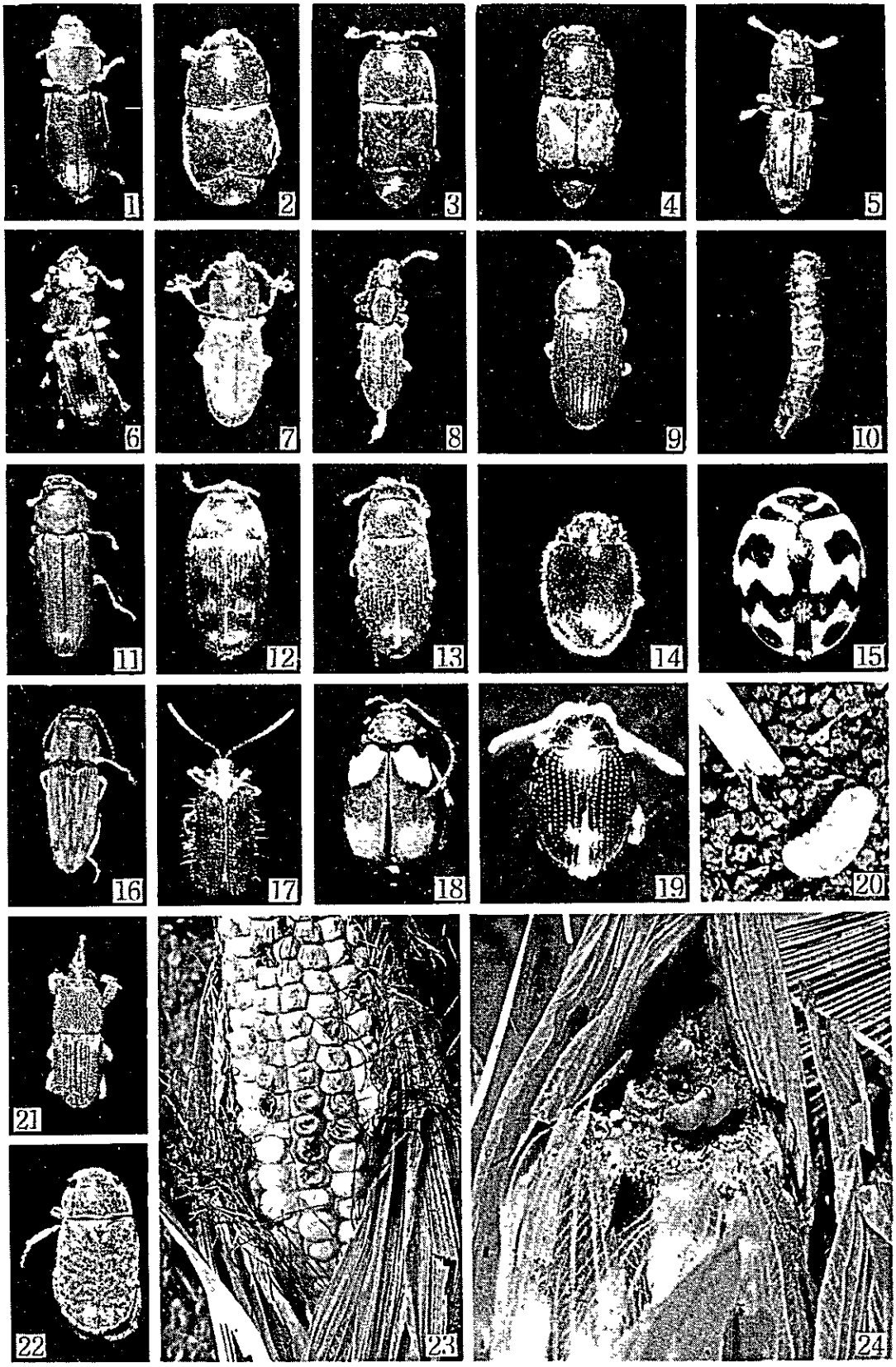


Figure 8



The team considers it necessary to develop effective and low toxicity insecticides that can take the place of the chlorinated hydrocarbons. It is also considered necessary to replace the existing manual spraying system with the application of a safe and high efficient spraying equipment, and mesures.

NOTES TO PHOTOS

Photo-1 Adults and larvae of SALTATORIA, ORTHOPTERA, and damage on maize incurred by them.

1. Acrida exaltata (85 mm, yellowish green)
2. Gonista bicolor (45 mm, light yellowish green with a reddish brown dorsal streak)
3. Aiolopus tamulus (25 mm, blackish brown, with white tibiae)
4. Phlaeoba fumosa (19 mm, dark brown)
5. Atractomorpha sp. (33 mm, yellowish green)
6. Gesonula mundata pulchra (25 mm, yellowish green)
7. Oxya intricata (21 mm, yellow-greenish brown)
8. Oxya velox (25 mm, yellowish green)
9. Valanga sp. (44 mm, yellowish green with black spots)
10. Oedaleus infernalis (42 mm, mottles in yellowish green, blackish brown and light brown)
11. Heteropternis respondens (27 mm, mottles in blackish brown and light brown)
12. Acrididae Gen. sp. (17 mm, dark brown)
13. Euparatettix sp. (A) (16 mm, dark brown)
14. Euparatettix sp. (B) (16 mm, dark brown)
15. Criotettix sp. (A) (17 mm, dark brown)
16. Criotettix sp. (B) (17 mm, dark brown with a white dorsal streak)

17 & 18. Larva of Valanga sp. (yellowish green with black spots) and damaged maize leaves.

Note: Values indicated between parentheses are the approximate length from the head to the wing end or to the end of the body farthest from the head. Colours indicate the general impression.

Photo-2 Adults or larvae of SALTATORIA, MANTODEA and BLATTARIA, ORTHOPTERA.

1. Conocephalus maculatus (24 mm, dark green)

2. Conocephalus sp. (30 mm, yellowish green)
3. Euconocephalus sp. (56 mm, yellowish green)
4. Brachytrupes orinentalis (50 mm, blackish brown)
5. Gryllidae Gen. sp. (A) (22 mm, light black)
6. Gryllidae Gen. sp. (B) (27 mm, blackish grey)
7. Gryllidae Gen. sp. (C) (27 mm, blackish brown)
8. Gryllidae Gen. sp. (D) (33 mm, blackish brown)
9. Gryllidae Gen. sp. (E) (30 mm, blackish brown)
10. Larva of Velarifictorus aspersus? (14 mm, mottles in light brown and dark)
11. Gryllotalpa africana (38 mm, brown)
12. Tridactylus? sp. (11 mm, mottles in black and dark)
13. Hierodula sp. (62 mm, light yellowish green)
14. Manteidae Gen. sp. (25 mm, light yellowish green)
15. An insect of Blattellidae Gen. sp. (14 mm, light yellowish brown)

Note: Values indicated between parentheses are approximate length from the head to the wing end or to the abdominal end or to the ovipositor end, whichever is the largest; colours indicate the general impression.

Photo-3 Adults of DERMAPTERA.

1. Nala lividipes (10 mm, black)
2. Proreus simulans (14 mm, black with yellowish brown thorax and wings)

Photo-4 Adults of HETEROPTERA.

1. Nezara viridula (9 mm, green)
2. Scotinophara coarctata (6 mm, brownish black)
3. Medida formosa (7 mm, mottles in yellow and blackish brown)
4. Riptortus linearis (15 mm, brown)
5. Leptocorisa oratoria (16 mm, light yellowish green)
6. Pamerana sp. (7 mm, blackish brown)
7. Phaenacantha kruegeri (9 mm, blackish brown)
8. Creontiades sp. (7 mm, light yellowish brown)
9. Allaeocranum biannulipes (7 mm, dark brown and black)

Photo-5 Adults of HOMOPTERA and their parasitic situation.

1. Peregrinus maidis, long-winged form (4 mm, transparent with black markings wings)

2. Peregrinus maidis, short-winged from (3 mm, light brown and black)
3. Adults of the same species as the above two parasitic on leaf sheath of maize, and ants gathering around them.
4. Phenice moests (7 mm, wings blackish purple)
5. Ricania marginalis (11 mm, wings with markings transparent
6. Ricania binotata (9 mm, mottles in amber and black)
7. Hecalus sp. (7 mm, brown)
8. Exitianus indicus (5 mm, wings light yellowish green)
9. Aconura? sp. (6 mm, light yellowish brown)
10. Rhopalosiphum maidis parasitic on maize ear (2 mm, green)
11. Pseudococcidae Gen. sp. parasitic on maize ear (4 mm, white)

Photo-6 Larvae of LEPIDOPTERA and damages of maize incurred by them.

1. Larva of Ostrinia furnacalis (= O. nubilalis) feeding on maize ear (2 cm, light brown)
2. Maize leaves damaged by the larva of Cnaphalocrocis medinalis
3. Larva of the same species as above found in a damaged leaf (2 cm, light yellowish green)
4. Larva of Laelis suffusa (3 cm, mottles in black and orange yellow)
5. Larva of Helicoverpa (= Heliothis) assulta (3.5 cm, light green, light reddish brown, dark brown, etc.)
6. Larva of Spodoptera (= Prodenia) litura (3.5 cm, light green with black markings)
7. Larva of Laphygma exigua (3 cm, light brown)
8. Larva of Telopidas (= Baoris) conjuncta conjuncta (3 cm, light green)
9. Larva of Mycalesis perseus (2.5 cm, light green)

Photo-7 Adults and larvae of LEPIDOPTERA and damages on maize incurred by them and by stink bugs.

1. Ostrinia furnacalis (=O. nubilalis) (length of fore-wing: 9 - 15 mm)
2. Cnaphalocrocis medinalis (length of fore-wing : 9 - 10 mm)
3. Laelia suffusa (length of fore-wing: 15 mm)
4. Sesamia inferens (length of fore-wing: 11 - 15 mm)
5. Helicoverpa (= Heliothis) litura (length of fore-wing: 14 - 15 mm)
6. Spodoptera (= Prodenia) litura (length of fore-wing: 16 - 17 mm)
7. Maize leaf sheath damaged by Nezara viridula

8. Maize ear damaged by the same insect as above
9. Maize stalk damaged by the larva of Ostrinia furnacalis
10. Young maize plant damaged by the larvae of Sesamia inferens
11. Maize stalk damaged by the same larva as above. (Larva of Sesamia inferens discharges rougher and more excretory matter than that of Ostrinia furnacalis)
12. Young maize plant damaged by Helicoverpa assulta

Photo-8 Adults and larvae of COLEOPTERA and damages on maize incurred by them.

1. Tenebroides mauritanicus (6 - 10 mm, brown)
2. Uropholus sp. (3.8 mm, blackish brown)
3. Carpophilus marginellus (3 mm, blackish brown)
4. Carpophilus mutilatus (2.6 mm, blackish brown)
5. Europs sp. (2.4 mm, blackish brown)
6. Mimemodes monstrosus (2.5 mm, reddish brown)
7. Ahasverus advena (2 - 2.5 mm, dark yellowish brown)
8. Oryzaephilus surinamensis (2.3 mm, blackish brown)
9. Alphitobius laevigatus (6.5 mm, black)
10. Larva of Alphitobius Laevigatus (7 mm, brown)
11. Tribolium castaneum (3.4 mm, blackish brown)
12. Litargus sp. (1.9 mm, blackish brown)
13. Typhaea sp. (2.4 mm, brown)
14. Soymnus fuscatus (1.9 mm, black)
15. Menochilus sexmaculatus (6 - 7 mm, mottles in orange yellow and black)
16. Aeoloderma brachmans (5 mm, brown)
17. Dactylispa setifera (5 mm, black with yellowish brown thorax)
18. Monolepta sp. (4.7 mm, brown with four white spots)
19. Chaetocnema basalis (1.6 mm, black)
20. Larva of Curculionidae Gen. sp. (10 mm, light yellowish white)
21. Sitophilus zeamais (= Calandra oryzae) 4 - 4.7 mm, blakish brown)
22. Adoretus compressus (10 mm, dark with white hairs)
23. Maize ear damaged by Carpophilus marginellus and C. mutilatus
24. Maize ear demaged by Carpophilus mutilatus and Typhaea sp.

Photo-9 Workers of FORMICIDAE

1. Solenopsis geminata? (2.5 mm, light brown, partialy dark)
2. Gen. sp. (3 mm, light brown)
3. Anoplolepis longipes (4 mm, light brown, partialy dark)
4. Camponotus sp. (8 mm, dark brown)
5. Gen. sp. (2.5 mm, black)
6. Gen. sp. (8 mm, black)

Photo-10 Eggs and larvae of DIPTERA and maize damaged by the larvae.

1. Eggs of Atherigona exigua laid on the under surface of maize leaf (1 mm, white)
2. Larva of the same species given above. (8 mm, pale yellowish brown)
3. Larva of Muscidae Gen. sp. (8 mm, white)
4. Maize damaged by the larva given Item 3. above.
5. Maize leaf damaged by Agromyzidae Gen. sp.

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