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Secondary Crops Based Farming Systems and their Integration with Processing in Lampung, Indonesia

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ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

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Table of Contents

List of Tables

List of Figures

List of Abbreviations

AARD	:	Agency of Agricultural Research and Development
AIAT	:	Assessment Institute of Agricultural Technology
AMDAL	:	Analisis Mengenai Dampak Lingkungan (Environmental Impact Assessment)
ARM – II	:	Agricultural Research Management II
ASPEMTI	:	Asosiasi Pengusaha Ekspor Makanan Ternak Indonesia (Association of Indonesian Feed Exporters)
ATTI	:	Asosiasi Pengusaha Tepung Tapioka (Association of Tapioca Producers)
BAPPEDA	:	Badan Perencana Pembangunan Daerah (Office of Regional Planning Board)
BPN	:	Badan Pertanahan Nasional (National Agency for Land Certification)
BPP	:	Balai Penyuluhan Pertanian (Agricultural Extension Services Unit)
BPTP	:	Balai Pengkajian Teknologi Pertanian (Institute of Agricultural Technology Assessment)
BULOG	:	Badan Urusan Logistik (Logistic Agency)
CAPSA	:	Centre for Alleviation of Poverty through Secondary Crops' Development in Asia and the Pacific
CGPRT	:	Coarse grains, pulses, roots, and tubers
DI	:	Diversification Index
DPR	:	Dewan Perwakilan Rakyat (Parliament)
FAO	:	Food and Agriculture Organization
f.o.b	:	Free on Board
GDP	:	Gross Domestic Product
HPP	:	Harga Pembelian Pemerintah (Government Procurement Price)
IAMRI	:	Indonesian Agricultural Mechanization Research Institute
IAPOSTRI	:	Indonesian Agricultural Post-harvest Research Institute
ICASEPS	:	Indonesian Centre for Agricultural Social-Economic and Policy Studies
ICASERD	:	Indonesian Centre for Agricultural Social-Economic Research and Development (Now ICASEPS)
ICFORD	:	Indonesian Center for Food Crops Research and Development

ICRI	:	Indonesian Cereals Research Institute
IPB	:	Institut Pertanian Bogor (Bogor Agricultural University)
ITTARA	:	Industri Tepung Tapioka Rakyat (Small-scale Tapioca Processing Unit)
KKP	:	Kredit Ketahanan Pangan (Credit Programme for Food Security)
KUM	:	Kredit Usaha Mandiri (Self Help Credit)
KUT	:	Kredit Usaha Tani (Farm Credit Programme)
O&M	:	Operation and Maintenance
P3A	:	Persatuan Petani Pamakai Air (Water User Association)
PAATP	:	Participatory Development of Agricultural Technology Project
PELITA	:	Pembangunan Lima tahun (Five-Year Development Plan)
PMA	:	Penanaman Modal Asing (Foreign Investment)
PMDN	:	Penanaman Modal Dalam Negeri (Domestic Investment)
QPM	:	Quality Protein Maize
TOT	:	Training of Trainers
UNESCAP	:	United Nations Economic and Social Commission for Asia and the Pacific

Foreword

Most Asian countries succeeded in multiplying major cereal production through the '*Green Revolution*'. This was made possible by the introduction of high yielding varieties and policy support which promoted the construction of irrigation facilities and the use of modern inputs such as chemical fertilizers and pesticides. However, recently the growth in productivity of major cereals has reached a plateau. Agricultural diversification has a number of positive effects, among others, food security, risk mitigation, labour absorption and conservation of biodiversity. It is crucial to be aware of the driving forces and constraints to agricultural diversification to formulate policy options which realize the coexistence of sustainable agricultural development and poverty reduction in rural areas.

Responding to this vital need, UNESCAP-CAPSA conducted a three-year research project, "Identification of Pulling Factors for Enhancing the Sustainable Development of Diverse Agriculture in Selected Asian Countries (AGRIDIV)", from April 2003, in collaboration with eight participating countries, namely Bangladesh, India, Indonesia, Lao People's Democratic Republic, Myanmar, Sri Lanka, Thailand and Viet Nam.

It is my pleasure to publish "**Secondary Crops Based Farming Systems and their Integration with Processing in Lampung, Indonesia**" as a result of the second phase of the Indonesian country study of the project. This volume presents rural surveys and case studies utilizing primary data to support policy recommendations to realize poverty alleviation through agricultural diversification.

I thank Mr. Masdjidin Siregar for his efforts. Continuous support from the Indonesian Centre for Agricultural Social-Economic and Policy Studies (ICASEPS) is highly appreciated. Prof. Hitoshi Yonekura, Graduate School of Agricultural Science, Tohoku University, Mr. Tomohide Sugino and Dr. Parulian Hutagaol provided useful guidance at every stage of the study as Regional Advisor, Project Leader and Associate Project Leader respectively. I extend thanks to Mr. Matthew Burrows for his English editing.

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Taco Bottema
Director
UNESCAP-CAPSA

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Executive Summary

This report is the outcome of the second phase of the AGRIDIV project in Indonesia sponsored by UNESCAP-CAPSA with funding from the Government of Japan. The first phase of the study, which was carried out in 2003-2004, provided descriptive and quantitative analyses of the current status of CGPRT crops by analysing secondary data and reviewing related studies on CGPRT crops and crop diversification in Indonesia.

The general goal of the second phase study is to examine the performance of farming, marketing and processing CGPRT crops at two study dry land that have different cropping patterns. The goal is broken down into specific objectives as follows:

- Comparing cropping patterns, input use, costs and returns between the two study sites;
- Identifying factors that affect cropping patterns;
- Examining the marketing efficiency of CGPRT crops;
- Analysing the prospects of processing industries of CGPRT products;
- Computing employment creation and income generation in CGPRT commodity systems;
- Detailing desirable support of public policies for agricultural diversification.

The two selected sites were Siswa Bangun village (Seputih Banyak sub-district) and Restu Baru village (Rumbia sub-district) in Lampung province. At both sites farmers grow food crops on dry land areas. At each study site the study team randomly chose 20 of the farmers using the major cropping pattern to be sampled. These farmers were interviewed using a set of structured questionnaires. To collect information regarding the marketing problems of each crop produced, the team used open questionnaires to interview three middlemen for each type of food crop at each site.

Data and information regarding processing were collected from interviews with two owners/managers of processing units for each crop. In relation to cassava, the study team interviewed two small tapioca processing units (ITTARA) and two large tapioca processing companies. Information concerning local government policies relating to provincial development of food crops was gathered through interviews with government officials, particularly in the Office of Regional Planning Board (*Bappeda*), Office of Food Crops and

Food Security Services (*Dinas Pertanian dan Ketahanan Pangan*) and Office of Co-operatives, Industry and Trade (*Dinas Koperasi, Perindustrian dan Perdagangan*).

In Siswa Bangun, farmers grow rice in the wet season and cassava in the dry season. In Restu Baru, farmers grow maize in the wet season and intercrop maize and cassava in the dry season. Regardless of the cropping seasons, the analyses of costs and returns indicate that intercropping of maize and cassava provides higher returns to households than mono production. Among the food crops, maize provides higher returns to household resources than cassava, while rice provides the lowest returns.

The results of this study indicate that household resources such as the availability of working capital and the availability of labour are the two main factors affecting farmers concerning what crops to grow or what cropping patterns to practice in the study sites. It is interesting to note that the farmers sampled in Siswa Bangun grow rice instead of maize in the wet season, though maize production as shown in Restu Baru generates higher returns. There are two reasons for this. Firstly, the cost of maize production is 75 per cent higher than the cost of rice production. Therefore, is not easy for farmers in Siswa Bangun to secure the additional funds to grow maize instead of rice. The farmers sampled generally use their own savings for crop production as they have limited access to formal farm credit services. Average household income per year in Siswa Bangun is only about 53 per cent of that in Restu Baru. Secondly, since the farmers sampled in Siswa Bangun have fewer opportunities for non-farm activities, they do not have a shortage in meeting labour requirements for rice production.

Farmers in Restu Baru grow maize instead of rice in the wet season for three reasons. Firstly, maize production gives higher returns than rice production. Secondly, although maize production requires higher costs for inputs, farmers in Restu Baru can afford the costs. They have high household income that can be used as working capital for farming. Thirdly, even if the farmers sampled in Restu Baru were willing to grow rice, they could not meet the labour requirement. Note that the labour requirement for rice production per unit of land is much higher than that for maize or cassava, while the average farm size in Restu Baru is larger than that in Siswa Bangun. In other words, farmers in Restu Baru grow maize instead of rice because they need to minimize the use of labour since they have a larger farm size and more non-farm activities.

Fulfilling the labour requirement poses a serious problem for farmers in Restu Baru, making them dependent on hired labour. Farmers in Restu Baru use a small amount of family labour for maize production and in intercropping of maize and cassava because they have more non-farm activities than farmers in Siswa Bangun. If farmers in Restu Baru fail to take sufficient care of crop production due to the lack of labour availability, failure in rice production would be more serious than in maize.

Although the farmers sampled in the two study sites grow cassava in the dry season, the farmers sampled in Restu Baru intercrop cassava with maize, while the sample farmers in Siswa Bangun grow cassava as a single crop. The reason why the farmers sampled in Siswa Bangun do not intercrop cassava with maize in the dry season is also because they have limited savings to pay the relatively high costs of maize production. Intercropping cassava with maize actually provides much higher returns than a single crop of cassava or maize.

Not only does cassava production require lower cash costs and less labour, it also provides relatively high returns, much higher than the returns from dry-land rice production. Among the three crops, maize provides the highest returns per unit of land, but also entails the highest costs of production. Maize production also provides the highest value added despite the highest cost of material inputs.

In the study sites, farming during the dry season is riskier than in the wet season due to low precipitation. In addition output prices are low, in particular cassava prices. Farmers in Restu Baru, having the means to pay the higher production costs, can manage these risks by intercropping maize and cassava. Input subsidies and better access to affordable credit could improve farmers' flexibility in deciding their cropping patterns. This could foster crop diversification leading to higher returns.

The marketing channels of rice, maize and cassava are relatively simple in that there is only one middleman between farmers and the processing units. The main buyers of rice, maize and cassava are, respectively, rice-milling units, feed processing units and tapioca processing units. Based on the marketing margins, marketing rice is more efficient than maize; and maize is more efficient than cassava.

Marketing efficiency depends on three factors: (i) the nature of the products. The less perishable a commodity, the more efficient its marketing, ceteris paribus; (ii) the average distance from farmers to processing units, as the distance affects transportation costs, ceteris paribus; and (iii) the market structure. Market structure of rice is more competitive than for maize and cassava. Farmers can store rice when its price is low and wait until prices are better. The market structures of maize and cassava are less competitive due to the existence of oligarchic power in the hands of the feed mill industries and tapioca processing industries. To make maize and cassava marketing more efficient, farmers should have access to an information system that can disclose all information needed by farmers to reduce transaction costs and therefore make the local market more competitive. Co-ordination between farmer groups and processing units in deciding cropping patterns and the output prices in a particular area would be an effective means to achieve this end.

Both animal feed and tapioca processing industries have potential to develop because both are profitable and demand for their outputs are increasing. Recently, the demand for animal feed and tapioca products grew by 8 per cent and 5 per cent annually respectively. Tapioca processing firms sell their tapioca products to food processing industries (such as cracker and cakes industries) and non-food industries (such as plywood, hardboard, textile and paper industries).

Two critical problems that large feed and tapioca processing units face are the continuity of supply and quality of raw material. The continuous supply of maize and cassava depends on the cropping season. Cassava is frequently in short supply in the wet season but in over-supply in the dry season. The problem of short supply of maize for feed processing firms is not as severe as that of cassava for tapioca processing firms because they can substitute imported maize for locally produced maize. The quality of maize (relating to moisture content) and the quality of cassava (relating to starch and moisture content) are affected by harvest time, crop variety and the use of fertilizer. The starch content of cassava harvested 7-9 months after planting is lower than that of cassava after 9-11 months. The main reason to harvest cassava before nine months is the need for cash.

The aforementioned phenomenon of excess supply of cassava in the dry season indicates that prices created by the market mechanisms are not able to optimally co-ordinate the marketing process from cassava farmers to the processing units. This is particularly caused by the fact that most farmers grow cassava in the dry season for three reasons. Firstly, unlike other food crops, cassava is relatively resistant to drought and requires relatively low costs such that the risk of growing cassava in the dry season is relatively low. Secondly, farmers are unclear exactly how processing units determine moisture/starch content of cassava, which is more critical in the wet season. Middlemen and truck drivers, who act as marketing agents, provide limited information from farmers to processing unit or vice-versa. Thirdly, compared to maize in particular, cassava has weak competitive advantage in the wet season. In other words, processing units are not able to encourage farmers to grow more cassava in the wet season by further raising cassava prices that are already high in the wet seasons.

To reduce the problem of short supply of cassava for tapioca processing units, it is necessary that the provincial government facilitates co-ordination between the tapioca processing unit and farmer groups in balancing the supply of cassava and the capacity of the processing unit in a given locality. There must be a minimum cassava price that should be considered as the ‘floor price’ paid by tapioca processing units in order to encourage farmers to produce cassava. The cropping patterns in a particular locality should be adjusted to the capacity of the tapioca processing unit.

Two sites were compared, namely a site where a small-scale tapioca processing unit was present, ITTARA (its Indonesian acronym), and a non-ITTARA site where obviously a small-scale tapioca processing unit was not present. The ITTARA site showed to have more efficient cassava marketing. This was the result of the smaller distance between farmers and processing units in comparison to the non-ITTARA site and there was no involvement of middlemen. This shows that the planning and implementation of an ITTARA programme could have improved marketing efficiency and benefited farmers in Lampung. ITTARAs generate employment and raise the price of cassava. In addition, ITTARAs are equipped with better waste processing units, therefore creating less waste. Non-ITTARAs produce huge amounts of solid waste and liquid waste which is dumped into rivers. The waste reduces the water quality of the rivers, many of which are already above allowable toxic waste limits.

In spite of the advantages of ITTARAs versus Non-ITTARAs, almost all ITTARA units financed by private companies and the local government have collapsed because of managerial incompetence and inadequate monitoring and control from the related private companies and local government institutions. Most personally financed ITTARAs are still operating, however, they are dependent on the large tapioca processing units, especially for drying tapioca during the wet season, as small ITTARAs are usually not equipped with an oven. It is recommended that the local government rehabilitate ITTARA units. Rehabilitation of each ITTARA unit, however, should be based on a comprehensive benefit-cost study and sustainable incentives for maintenance and investment.

Crops generate employment and income during production as well as marketing and processing. For the three commodity systems analysed in this study, employment in farming was higher than in processing and marketing. In the case of rice, income generated in farming was higher than in processing. In the case of maize and cassava, income generation in processing is higher than in farming.

Farming offers many employment opportunities, reflected in high farm labour demand, especially in peak season. This demand can sometimes not be fulfilled. A reason for this could probably be that many young villagers are not interested in working as farm labourers despite limited non-farm employment opportunities.

Total employment generation in the rice commodity system is significantly higher than in both the maize and the cassava commodity system. Comparing total income generation of the three commodities, maize generates the most income followed by cassava and then rice. Income generated from intercropping maize and cassava is 25 per cent higher than mono-cropping maize. This indicates that horizontal crop diversification tends to significantly generate more income.

Up until now almost all institutional support in food crop production has been directed to rice production to attain rice self-sufficiently. Consequently, the food crop diversification index has dropped and rice is the only specialized crop in all provinces of Indonesia. This is not healthy for food security in Indonesia because it discourages food diversification, nor will it encourage the development of alternative industrial products of CGPRT crops such as bio-fuel. To change the current situation, rice-biased polices such as price support and import tariffs should be gradually phased out.

Some conclusions and policy recommendations can be drawn from the findings of this study:

1. It seems that the constraints faced by farmers at the study sites are low soil fertility, high input prices, low output prices and shortages of chemical fertilizer and labourers. In addition, unusually low precipitation sometimes takes place in the dry season. To loosen some of these constraints, the local government can play a significant role, for example in helping farmer groups to produce organic fertilizers, providing farmer groups with shallow tube-well pumps, and identifying and overcoming the causes of fertilizer shortages.
2. Working capital is the major factor influencing farmers' decisions about what to grow and the cropping pattern to use. To develop food crop diversification[1], therefore, it is necessary that farm inputs be subsidized and farmers' access to cheap credit be improved. Government-owned banks should be obliged to improve individual farmer's access to farm credit. Since land certificates are required to qualify for

[1] It is indicated in this study that crop diversification through intercropping creates more employment and generates significantly more income.

credit from the banks, the National Agency for Land Certification (BPN) must support this policy by accelerating a low-cost, land certification programme.

3. To make maize and cassava marketing efficient, the local government should provide farmers with information systems that may disclose all information on how processing firms weigh and determine moisture or starch content when they buy maize or cassava. Such information systems would reduce transaction costs and therefore result in more efficient markets.
4. On one hand, the major problem for cassava farmers in Lampung is low and fluctuating cassava prices. On the other hand, large tapioca processing companies have a problem of excess capacity. To solve the two problems simultaneously, local government should encourage or facilitate co-operation between a processing company and cassava farmers in a given locality, particularly in relation to how much and when to produce cassava, and more importantly the price level at the gate. Similar market co-ordination can be applied to feed processing companies and maize farmers.
5. The development of small-scale tapioca processing units in the ITTARA programme can improve marketing efficiency because the distance from farmers to tapioca processing units becomes shorter and market channels are shortened. Therefore, it is necessary that the local government rehabilitate ITTARA units that have collapsed such that market structure becomes more competitive. Rehabilitation of each ITTARA unit, however, should be based on a comprehensive cost-benefit study. Rehabilitation would be more successful if it follows a participatory approach involving the local community.
6. Research and development conducted by the Agency of Agricultural Research and Development (AARD), is another significant element of agricultural development in Indonesia; the accountability of AARD is dependent on the professionalism of the researchers. To improve this, it is essential to design a system that motivates researchers.
7. Thus far, AARD has placed low priority on research and development of CGPRT crops. Most probably this is because these crops are not the major staple food and the government has always had a tendency to bolster staple food production, rice in this case. To reduce the country's dependence on rice, research to create alternative foods based on the processing of CGPRT crops is essential. Research on developing alternative industrial products of CGPRT crops such as bio-fuel is also imperative for Indonesia.

1. Introduction

1.1 The main findings of the first phase study

The first phase of this study analysed secondary data and reviewed related studies on coarse grains, pulses, roots and tubers, hereafter to be referred to as CGPRT crops, and crop diversification in Indonesia. Results of this analysis indicated that the diversification indices of food crops (rice and CGPRT crops) and fruit crops were decreasing, while the diversification indices of vegetable crops and estate crops (rubber, oil palm, coffee, cocoa, etc.) were still increasing over the last ten years. As a whole, the crop diversification index for Indonesian agriculture has declined over this period of time.

The lessening diversification of food crops stems from government policies in irrigation development, floor price, farm credits, input subsidies, technological development and agricultural extension, which are all biased toward raising rice production to achieve as high a level of rice self-sufficiency as possible. Looking at the diversification of other crops; the diversification of fruit crops has declined as a result of more imports of fruits. Diversification indexes for vegetable and estate crops have increased due to higher domestic and export demand.

Among the major CGPRT crops, potato has the highest production growth rate (12 per cent per year), followed by maize (5 per cent per year) in the period 2000-2004. The production growth rates of cassava and groundnut were relatively low, while those of soybean and sweet potato were even negative. These differences result from the specific demand for each commodity and the relative profitability of production. The increasing number of fast food restaurants and supermarkets has boosted demand for potato. Higher demand for maize is attributable to the rapid development of animal feed industries. The consumption growth rates of potato, soybean and mung bean are positive, whereas the consumption growth rates of the other CGPRT crops are negative.

Since the rice self-sufficiency programme has brought about a decline in the diversification index of food crops and the programme itself has been very expensive, it is counter productive for the country to continue this programme. A substantial amount of the governmental budget for agriculture has been devoted to the most fertile irrigated lands while less attention has been paid to dry lands, which are 1.7 times larger than the irrigated land. A large number of farmers grow CGPRT crops in unfavourable dry-land areas. The rice self-sufficiency programme has not contributed much to the alleviation of poverty of this group. A way to reduce rural poverty in dry-land areas would be the development of diverse agriculture based on CGPRT crops and supported by the development of processing industries.

In order to provide guidance for future policies in agricultural research and development in Indonesia, specific recommendations to promote production and the utilization of CGPRT crops are given below. Each recommendation is followed by arguments derived from the study findings.

1.1.1 Removal of import tariff, import ban and price support for rice

All government policies related to crop production such as irrigation development policy, floor price policy, farm credit policy and technological development policy have been biased towards rice production to achieve rice self-sufficiency. Currently, rice is the only food crop for which its production is protected through a specific tariff (Rp 430 per kilogram) and a price support policy (HPP) for un-husked rice. These policy measures result in a high cost borne by society in the form of a net welfare loss. A net welfare loss is calculated by subtracting consumer loss from the producer surplus plus government revenue gain. As a result of the ban on rice imports implemented by the government in 2004-2005, the net welfare loss has strongly increased.

The domestic price of rice has been relatively high due to implemented import tariffs and rice import bans. This has encouraged farmers to produce more rice, resulting in less diversification. If these policies persist, the food security programme in Indonesia will become more and more dependent on rice.

Diversification indices for food crops have declined and rice has become the only specialized crop in almost all provinces in Indonesia. To diversify food crops, it is necessary that these pro-rice policies be stopped. Indonesian rice prices will then drop and become more in line with international rice prices. Rice production would become less favourable, encouraging farmers to diversify their cropping patterns. Rice can then be bought on the market for lower prices. In addition, the abolishment of pro-rice policies would reduce the net welfare loss and increase real wages without increasing nominal wages in non-agricultural sectors. Relatively low nominal wages and higher real wages would stimulate job creation and economic growth that are necessary for sustainable poverty alleviation.

1.1.2 Implementation of import tariffs for wheat and wheat products

In addition to rice, the government also address wheat in their policies. Wheat imports are subsidized; wheat flour processing, and the noodle industry are assisted through soft loans. This has led to higher noodle consumption, reflecting a diversification in food consumption. However, as all wheat is imported this does not reflect diversification in food production.

As long as the government imposes no or low tariffs on wheat and wheat products, the country will stay dependent on imported wheat and wheat products. Therefore, the promotion of food diversification can only be healthy, for the economy in general and food security in particular, if the government imposes import tariffs for wheat and wheat products. Food diversification would then mostly be based on the domestic production of CGPRT crops.

1.1.3 Implementation of import tariffs for net-imported CGPRT commodities

To launch a sustained pro-poor policy and diversify food crops, it is necessary that the prices of CGPRT commodities be sufficiently high, so that farmers are encouraged to diversify their cropping patterns with CGPRT crops. To raise the prices of CGPRT commodities, the government should impose import tariffs on net-imported CGPRT commodities such as maize and soybean.

1.1.4 Developing partnerships to raise the price of net-exported and non-traded CGPRT commodities

Net-exported CGPRT commodities (such as cassava and potato) and non-traded CGPRT commodities (such as sweet potato) are highly perishable. Policy measures to raise the prices of these products are therefore not easily developed. Floor price policies cannot be implemented for such products due to their perishable nature, not even when they are backed by procurement and storing (when the prices are low) and market operations (when the prices are high). The only way to secure the prices of these commodities is to encourage partnerships between farmer organizations and processing companies/ exporters. Such partnerships are not easy to develop; problems that may appear in developing the partnerships can be:

1. Processing companies/exporters might not consider a partnership with farmers necessary. To date their businesses may have been sufficiently profitable without it.

2. Price agreements between farmers and processing companies/exporters are difficult to establish. Farmers want the highest possible price whereas processing companies/exporters want to pay the lowest possible price.
3. Mutual trust is necessary to build these partnerships, which is difficult to establish quickly. In the case of cassava, for example, farmers are sometimes suspicious about the way tapioca processing companies determine the moisture and starch content of cassava. High price cuts are imposed for low starch content in cassava. The low starch content of cassava may result from inadequate amounts of fertilizers used or early harvesting. Farmers in need of immediate cash sometimes harvest their cassava too early (less than eight months after planting). Local (provincial or district) government should play a significant role in facilitating such partnerships. As facilitator and mediator, the government might not have to bear the high costs of penning a Memorandum of Understanding between the two parties because such tasks entail only minor costs.

1.1.5 According CGPRT crops high research priority

Based on the Policy Analysis Matrix Framework, the results of an economic analysis indicate that all CGPRT crops, except soybean, have comparative advantage. The comparative advantage of, for instance maize and groundnut, is relatively stable against changes in import prices or changes in yield. It is recommended that the government puts high priority on the research and development of industrial uses of CGPRT crops. This could boost the demand for CGPRT crops and encourage farmers to grow them. An example of an industrial use for CGPRT crops is the use of sweet sorghum for bio-fuel, developed by the Agency for Technology Assessment and Application (BPPT).

1.1.6 Improving marketing efficiency

Marketing systems of soybean and potato are relatively efficient, whereas the marketing systems of maize, fresh cassava and dried cassava are relatively inefficient. This is the result of the oligarchic power of processing industries (feed mills and tapioca industries) and poorly developed infrastructure. The way to increase marketing efficiency is to improve infrastructure, enhance market information, expand access to credit for traders and for those who are willing to enter the business of marketing and processing, and to develop vertical co-ordination between farmers and processing units.

1.1.7 Improving support for agricultural diversification

Factors that might hamper the diversification of crops on irrigated land are: (i) rice is the major staple food; (ii) lack of technological competence; (iii) low access to capital; and (iv) marketing problems associated with non-rice crops. Crop diversification to reduce the risks and stabilize farm income could be supported by several programmes focusing on, for instance, (a) improvement of the agricultural extension programme concerning both farm and off-farm activities (post harvest, processing and marketing); (b) improving the availability and accessibility to credit, especially for CGPRT crop production; (c) improving the market structure of CGPRT commodities; and (d) strengthening farmer institutions and encouraging partnerships between farmers and private companies to overcome marketing constraints of CGPRT commodities.

1.2 Research issues

In order to meet the demand for food, the government has been attempting to raise food production, particularly rice production, since the 1960s. As a result, the country achieved rice self-sufficiency in 1984. However, this rice self-sufficiency could not be maintained due to a growing population and stagnation in rice productivity.

To reduce the country's dependency on rice as a staple food, consumption needs to be diversified. Therefore, revising existing food crop-related policies seems imperative. Policies to develop processing industries for CGPRT crops are important in this aspect.

1.3 Study objectives and the second phase field study

The general goal of the second phase of this study is to examine the performance of farming, marketing and processing of CGPRT crops. This was done by analysing two dry-land sites where farmers were using different cropping patterns. The goal was broken down into specific objectives as follows:

- Identifying factors affecting cropping patterns;
- Analysing input use, costs and returns by season;
- Examining the marketing efficiency of CGPRT crops;
- Analysing the prospects of processing industries of CGPRT products;
- Computing employment and income generation in CGPRT commodity systems;
- Detailing desirable support of public policies for agricultural diversification.

2. Conceptual Framework, Method and Scope of the Study

2.1 Conceptual framework

The study consisted of two phases. Phase I, of which the main findings were discussed in the previous chapter, was conducted from August 2003 to August 2004 and included a descriptive and quantitative analysis of the current status of CGPRT crops, it also identified driving and constraining factors for the diversification of CGPRT crops in terms of the potentials benefits for poverty alleviation.

Phase II of the study, described in this report, was performed from September 2004 to August 2005. It embodied a descriptive and quantitative assessment of farming system performance of CGPRT crops and their vertical co-ordination, including institutional arrangements with the private sector in marketing and processing.

The agricultural processing industry plays an important role in generating employment and adding value to agricultural products. Data indicated that agricultural processing industries account for up to 30 per cent of total employment in Indonesia; the total value of output was approximately 25 per cent of the total value of all industrial outputs (Simatupang *et al*., 1990).

For the agricultural sector itself, development of agricultural processing industries is undoubtedly a pull factor for the development of agricultural commodities. For example, the development of cassava farming needs the involvement of tapioca and *gaplek* processing industries and, conversely, the development of these industries requires the development of cassava farming. This is also true for maize farming and animal feed processing industries.

Agricultural products in general are seasonal, voluminous and perishable, middlemen that connect farmers and processing units as well as transport the products play an important role in the market chain. The question is how to make the relationship between farmers and processing firms profitable not only for both parties but also for marketing agents. The extent to which an agricultural commodity system provides benefits to farmers, middlemen and processing firms is dependent on the behaviour of all these players.

2.2 Research method

2.2.1 Selection of crops, research sites and respondents

In Indonesia, rice and CGPRT crops are called food crops. Since rice is the major staple food, CGPRT crops are classified as secondary food crops (*palawija*). CGPRT crops are explicitly included in this study from the beginning. The first step of the selection of study sites was based on the available secondary data on food crops published by the Central Bureau of Statistics (BPS) of Lampung province. Secondary data on the harvested areas, yields and productions of food crops are usually available for the most important food crops: rice, maize, soybean, mung bean, groundnut, cassava and sweet potato. Rice, although not a CGPRT crop, was included in the selection of study sites since farmers often grow it with CGPRT crops.

To find out how crop diversification varies between the different provinces in Indonesia, diversification indexes of rice and CGPRT crops were calculated per province in the first year of this study. DIY Yogyakarta province had the highest diversification index, followed by Lampung and East Java. Lampung was chosen in the second year of this study as the province to be sampled.

Within Lampung a district was selected on the basis of the diversification index. The district of Central Lampung, which had one of the highest diversification indexes (Table 2.1) was chosen. Diversification indexes for its sub-districts (*kecamatan*) were assessed. The sub-districts of Siswa Bangun, which is less-diversified and Restu Baru, which is highly diversified, were then randomly chosen as sites to be sampled. Restu Baru village (in Restu Baru sub-district) and Siswa Bangun village (in Siswa Bangun sub-district) were chosen as the study sites (see Appendix 1).

Cropping patterns vary from farmer to farmer at both sites. Appendix 1 presents estimations made by extension workers concerning the proportion of area per cropping pattern at each site. At each site, 20 farmers were randomly chosen from the group of farmers that were using the most common cropping pattern (Table 2.2). They were interviewed using a set of structured questionnaires. Marketing data per crop was collected through open questionnaires with three middlemen for each food crop grown.

Table 2.1 Area proportion and diversification index of rice and CGPRT crops by district in Lampung province, 2003

District/Township	Rice	Maize	Soybean	Groundnut	Mung bean	Cassava	Sweet potato	Total	DI**
West Lampung	89.3	4.1	0.4	1.7	0.4	1.9	2.1	100	0.20
Tanggamus	74.0	18.3	0.7	1.1	0.6	4.6	0.7	100	0.42
South Lampung	48.0	45.1	0.1	0.5	0.4	5.5	0.4	100	0.56
East Lampung	31.4	50.3	0.2	0.7	0.5	16.6	0.2	100	0.62
Central Lampung	36.7	29.5	0.1	0.7	0.5	32.3	0.3	100	0.67
North Lampung	33.2	27.7	0.1	1.3	0.6	36.7	0.5	100	0.68
Way Kanan	49.8	17.6	3.5	4.8	2.5	21.1	0.8	100	0.67
Tulangbawang	40.1	3.4	0.2	0.4	0.1	55.8	0.1	100	0.53
Bandar Lampung	82.2	8.7	0.0	1.8	0.6	5.5	1.2	100	0.31
Metro	90.0	4.2	0.0	1.0	0.6	3.6	0.7	100	0.19
Total (thousands of hectare)	472.6	330.9	4.2	10.9	6.0	299.0	4.3	1 128	0.67
Area proportion (%)	41.9	29.3	0.4	1.0	0.5	26.5	0.4	100	-
GR of production (%/yr)*	2.3	-1.6	-45.3	17.4	5.3	14.9	0.8	-	-

Source: Statistical Yearbook of Indonesia, 2003.

Note: [a] GR = growth rate of production in 1999-2003.

[b] DI = Diversification Index; the Diversification index decreased from 0.72 in 1995 to 0.67 in 2003. Rice area and the diversification index are strongly and negatively correlated with a correlation coefficient of –0.9441.

Table 2.2 Study sites and the major cropping patterns

Sample sub-districts			Sample study sites	
Sub-district	DI [a]	Classification	Village	Major cropping pattern
Seputih Banyak	0.34	Less diversified	Siswa Bangun	Rice - Cassava
Rumbia	0.69	More diversified	Restu Baru	Maize-(Maize+Cassava) [b]

Source: Field survey.

Note: [a] DI = diversification indices based on secondary data by type of food crops. The average diversification index of Central Lampung district as a whole is 0.67.

[b] The sample farmers in Restu Baru grow maize in the wet season and intercrop maize and cassava in the dry season.

To collect processing data on rice, maize and cassava, two rice mill owners, two feed processing companies, two small tapioca processing units (ITTARA) and two large tapioca processing companies were interviewed. Some government officials, in particular the Office of Regional Planning Board (*Bappeda*), Office of Food Crops and Food Security Services (*Dinas Pertanian dan Ketahanan Pangan*) and Office of Co-operatives, Industry and Trade (*Dinas Koperasi, Perindustrian dan Perdagangan*) were interviewed to obtain information on local government policies relating to the provincial development of food crops.

Rice, not being a secondary crop, was included in this study to serve two goals. First, this will significantly add to socio-economic information on dry land rice production, which is thus far limited. Second, it is important to discover the effects of governmental pro-rice policies on CGPRT crop production as well as on dry land rice production.

The study was conducted from September 2003 to August 2004. Commonly in the region this period consists of two cropping seasons (dry and wet), reflecting a cropping index of 200. Only a small number of affluent farmers in Restu Baru have three cropping seasons per year. These farmers have access to swamp water that they pump to irrigate the land in the dry season. This allows them to have two cropping seasons in the dry season. They grow maize in the first and second cropping seasons and vegetables such as eggplant, red pepper, cucumber, water melon, *gambas* and *pare* in the third season. The area on which this cropping pattern is used is small, therefore it is not included in this study.

2.2.2 Analytical methods and scope of study

Input use, costs and returns

Input use, costs and returns were compared between the two sites to assess the impacts of crop diversification. Restu Baru was considered more diversified than Siswa Bangun (see Table 2.2). In this analysis, farm inputs were classified as material inputs such as seeds, fertilizers, pesticides and herbicides; and labour including hired and family labour, male and female labour. An important aspect of the input use analysis was the impact of diversification on farm employment. Therefore, annual labour of the two sites was compared. Total labour used for the production of a specific crop was calculated as the sum of hired and family labour expressed in man-days per hectare.

Farm income was expressed in this study as the returns to farm household resources and calculated by the following formula:

$$R_C = \Sigma\, Q_C\, P_{C.} - \Sigma\, M_i\, P_{M.\,i} - \Sigma\, L_i\, P_{L\,i.} \qquad (1)$$

Where:

R_C = Returns to farm household resources in producing a crop (Rp per hectare)

Q_C = Output quantity of the crop (kilogram per hectare)

P_C = Output price of the crop (Rp per kilogram)

M_I = Quantity of the-ith paid material input (unit per hectare)

$P_{M.\,i}$ = Price of the-ith paid material input (Rp per unit)

L_i = Quantity of a particular type of paid labour in the-ith farm activity (man-days)

P_{Li} = Wage rate of paid labour in the-ith farm activity (Rp per man-day)

This analysis could be extended by defining income as returns to land and management by computing family labourers and interest rates as the imputed costs of production. Further analysis could also be carried out by defining income as returns to farm management where family labour, interest rates and land rents are imputed as the costs of production. However, since most farmers cultivate their own land and they use their own savings for working capital, analysis in this study focuses on equation (1).

Analysis of marketing efficiency

All decisions made by farmers, marketing agents and processing firms in relation to a particular commodity are dependent to a large extent on the market structure. A market consists of one or more buyers and one or more sellers. The relationship among sellers or among buyers is called competitive relationship, while the relationship that exists between sellers and buyers is referred to as negotiative relationship. A market structure may be classified as competitive (many buyers and sellers), oligopolistic (few sellers) or oligopsonistic (few buyers), and monopolistic (single seller) or monopsonistic (single buyer).

A successful, purely competitive market should have the following conditions. First, the numbers of sellers and buyers are sufficiently large that no individual alone can influence price. Second, the product is sufficiently homogeneous. Third, there is no artificial restriction or distortion such as government intervention or collusion among firms. Fourth, new firms should be free to enter the market (Tomek and Robinson, 1982).

The nature of both competitive and negotiative relationships may be individual (how firm *a* interacts with firm *b*) or aggregative across the whole market (how all firms interact). Factors that influence competitive or negotiative relationships are numerous and difficult to categorize. Aggregated relationships among buyers and/or sellers are frequently referred to as market conduct, which is the pattern of behaviour that they follow in relation to their markets. In other words, market conduct includes the method of determining price and output, the nature of product sold, and various tactics to achieve specific market results (Dahl, 1977). The result of market conduct is called market performance, that is the appraisal of how far the results fall short of the best possible contribution to achieve such goals as efficiency and equity (Caves, 1987).

Marketing efficiency is a relative concept in a sense that the lower the marketing-margin, the higher the marketing efficiency. Marketing margin, defined as the difference between final-user price and producer price is affected by marketing costs and market structures at all levels of marketing channels. In the case of maize, for example, marketing costs consist of labour costs (for threshing, packing, loading and unloading), and transportation costs.

In this study, analysis of marketing efficiency begins with a description of marketing channels and marketing costs from farm gate to processing industries. The impact of market structure on marketing efficiency is scrutinized by looking at the number of buyers and sellers and the possibility of entry barriers at each marketing level.

The way the processing industries determine prices and price-cuts related to the quality of maize and cassava will be described. Price-cuts (*rafaksi*) related to moisture content of maize and cassava, starch content of cassava, and other quality-related matters can become the object of disputes among farmers, middlemen and processing companies.

Prospects of processing industries of CGPRT commodities

Three major aspects of the prospects of processing industries of CGPRT commodities can be analysed: (i) the supply of raw materials; (ii) the demand prospects of the industries' outputs; and (iii) the profitability of the industries. The first and the second aspects are descriptively analysed, using data and information gathered from the industries, middlemen, government officials, researchers who have carried out similar analyses, and from data published by Provincial Office of Co-operatives, Industry and Trade and Provincial Office of Statistics.

Profitability is an important factor determining the prospect of processing industries. In this study, it is defined as follows:

$$\pi = \Sigma Q . P_Q - \Sigma B . P_B - \Sigma R_i . P_{R\,i} - \Sigma M_j . P_{M\,j} - \Sigma L_k . P_{L\,k.} \qquad (2)$$

Where:

π = Profit of processing company

Q = Quantity of main output (e.g. tapioca and feed products)

B = Quantity of by-product (e.g. *onggok* in the case of tapioca processing)

R_i = Quantity of the-ith raw material

M_j = Quantity of the-jth other material input

L_k = Quantity of the-kth labour input

P = Price of respective input or output

Total employment and income generation in a commodity system

Equations (1) to (5) are used in analysing the impacts of crop diversification on farm employment and income. To have the complete figures of employment and income impacts of crop diversification in commodity systems, it is necessary to analyse employment and income generation not only in farming but also in marketing and processing. Kawagoe *et al*. (1990) provide an example of the analysis.

Techniques to analyse employment generation in commodity systems are rather straightforward. It is just a summation of labour involved in each activity in farming, marketing and processing. Since labour in farming is computed on a per hectare basis, labour in marketing or processing is also computed for the amount of farm production per hectare when it is marketed or processed. Employment generation in a commodity system can be computed by equation (3).

$$E_{CS} = \Sigma E_{if} + \Sigma E_{im} + \Sigma E_{ip} \qquad (3)$$

Where

E_{CS} = Employment generation in the-cth commodity system for the quantity of farm output of the-cth commodity per hectare (kilogram per hectare).

E_{if} = Labour used for the-ith activity in farming of the commodity per hectare (man-days per hectare). Let Q_C be the quantity of farm output of the-cth commodity per hectare (kilogram per hectare).

E_{im} = Labour used for the-ith activity in marketing of the commodity (man-days per Q_C).

E_{ip} = Labour used for the-ith activity in processing of the commodity produced from per hectare farming (man-days per Q_C).

Similarly, income generation in a commodity system is also just a summation of value added in the three sub-systems (farming, marketing and processing) of a commodity system. Since value added in farming is computed on a per hectare basis, value added in marketing or processing is also computed for the amount of farm production per hectare.

$$I_C = \Sigma V_f + \Sigma V_m + \Sigma V_p \qquad (4)$$

Where:

I_C = Income generated in the-cth commodity system

V_f = Value-added generated in farming of the commodity per hectare (Rp per hectare). Let Q_C be the quantity of farm output of the-cth commodity per hectare (kilogram per hectare)

V_m = Value-added generated in marketing of the commodity produced from per hectare farming (Rp per Q_C)

V_p = Value-added generated in processing of the commodity produced from per hectare farming (Rp per Q_C)

Note that income generation here is defined as value added that is the total value of outputs minus the value of intermediate inputs (see among others: Hall and Taylor, 1986 for the definition of value added). In other words, total value added is the total returns to land, labour, fixed assets and management in all sub-systems of a particular commodity system.

Scope of the study

As this study is limited to two sites, the results would by no means represent a national average. Hence, the description of farming, marketing and processing of CGPRT crops given here forms a source of in-depth quantitative and qualitative information that might have wider validity. Findings relate to maize and cassava commodity systems.

3. Profiles of the Study Sites, the Respondents and their Households

3.1 Profiles of the study sites

3.1.1 Geographical and administration setting

The two study sites are located in Central Lampung district (Appendix 1). Lampung itself is located at the most southern part of Sumatra Island. This area has been one of the major areas for transmigration from Java since the beginning of the twentieth century. The Dutch regime directed early transmigration, mainly to develop plantations of export crops and irrigated rice farming. The development of irrigated rice farming was the source of food supply for plantation workers. After independence, the government carried out transmigration programmes in virgin upland areas for small-scale farming by Javanese migrants. Spontaneous transmigrations continued flowing into Central Lampung through their connections with previous migrants.

Lampung province has a unique geographical position in a sense that it is a gateway for the movement of people and goods from Java to Sumatra and vice-versa. Bandar Lampung, the capital of this province, can be reached within 6-7 hours from Jakarta using land transportation and crossing the Sunda Strait.

Lampung presently consists of eight districts as the result of splitting up the four previous districts in 1999. The former Central Lampung district was divided into Central Lampung district, East Lampung district and Metro municipality. The present Central Lampung district consists of 26 sub-districts (*kecamatan*) and 277 villages.

Geographically, Central Lampung is located at a latitudinal range of 104°35'- 105°50' East and longitudinal range 4°15'- 4°30' South. Most of the area is lowland plains. The altitudes of most sub-district capitals are less than 60 metres above sea level. The average temperature in the area is 27° C, ranging from 22° to 33° C. Humidity ranges from 80 per cent to 88 per cent. Rainfall is 2,475 millimetres, which falls in 126 days, or on average, 206 millimetres in 11 days per month. April, May and June are the driest months.

3.1.2 Demographic profile

Adequate demographic data at the village level was not available for the region; therefore data for the two sample sub-districts is presented in Table 3.1. Population growth rate in Rumbia is higher than in Seputih Banyak, as this migrant settlement is relatively new in comparison with Seputih Banyak. However, population density in Seputih Banyak is higher than in Rumbia. The average size of household in these sub-districts is higher than in Lampung province because data at the provincial level includes both rural and urban populations.

Table 3.1 Population growth rates, density and household numbers in the sample sub-districts and Lampung province, 2003

Items	Sample sub-districts[a]		Lampung Province[b]
	Seputih Banyak	Rumbia	
Population (thousands)	38.6	47.4	6 963
Population growth rate (per cent per year)	1.43	1.45	1.14
Population density/sq km	265	236	196
Sex ratio	1.07	1.05	1.05
Number of households (thousands)	9.5	11.6	1 771
Number of household members	4.05	4.08	4.0

Source: [a] *Lampung Tengah Dalam Angka* (Central Lampung in Figures), 2003.
[b] Statistical Yearbook of Indonesia, 1996 and 2003.
Since secondary data at village level is not sufficiently available, Seputih Banyak and Rumbia sub-districts are used respectively to represent Siswa Bangun and Restu Baru sample villages.

3.1.3 Economic and agricultural profiles

Shares of agriculture in regional GDP and employment

Like in many provinces in Indonesia, the agricultural sector in Lampung contributes significantly to both GDP and employment. In 2003, for example, the agricultural sector contributed the highest share (35 per cent) to total GDP, and this sector grew at a rate of 4.9 per cent per year for the period of 1993-2003 (Appendix 2). In the same year, the agricultural sector's share in employment was 68 per cent, which is much higher than its share in regional GDP. Labour absorption in agriculture grew at 3.4 per cent per year in the period of 1999-2003 (Appendix 3).

Even though several non-agricultural sub-sectors grew at relatively high rates, Appendixes 2 and 3 indicate that it is unlikely that non-agricultural sectors can significantly absorb employment in the near future. The manufacturing sector, for example, grew at a rate of 4 per cent per year but its share in GDP was only 13 per cent in 2003 while employment in this sector grew at a negative rate because of the economic crisis. The construction sector grew at a rate of 6.6 per cent per year in 2003, but its share of GDP was only 7 per cent and the growth in employment of this sector was only 1 per cent per year. Therefore, it is clear that the agricultural sector in Lampung will continue to play a significant role in generating income and employment. This implies that development of the agricultural sector would have an enormous affect on reducing poverty. Development of agro-industry that can raise the demand for agricultural commodities seems to be an essential means to this end.

Performance of CGPRT crops

Appendix 4 shows that dry land, where most CGPRT crops are grown, occupies a much larger area than wetland, but the growth rate of dry land is lower than that of wetland. This could be explained by the fact that the government has accorded high priority to boost rice production through the development of irrigation infrastructure. This policy is expensive and does not encourage crop diversification. Many farmers earn their living from dry land; the development of dry land agriculture based on CGPRT crops should therefore be prioritized. The government may implement this development programme by providing dry-land farmers with better farm roads, better accessibility to cheap farm credits, cheap farm inputs (such as good crop varieties, organic and inorganic fertilizers), and post-harvest and marketing facilities.

Based on crop areas, maize and cassava are the major CGPRT crops in Lampung (Table 3.2). The growth rates of the area cropped with the two crops are the same (5.1 per cent per year). However the total area of maize cropping is 37 per cent larger than that of cassava, leading to a much higher product growth rate of maize. Among the CGPRT crops, the production of soybean is the only one with a negative growth rate of -4.1 per cent per year. This could indicate that soybean is less competitive compared to the other CGPRT crops.

Although the growth rate of maize production is the highest among the CGPRT crops in Lampung, this province is a net importer of maize because domestic production cannot meet the demand for maize from the animal feed industry. In 2004, for example, maize exports from Lampung were only 271 tons whereas maize imports were 3,700 tons. In the case of cassava, Lampung is net exporter. In 2004, exports of cassava products increased drastically, particularly to China, as a result of a free trade agreement between ASEAN and China (see Appendix 5).

Table 3.2 Area, yield and production of food crops in Lampung in 2004, and their growth rates in 1994-2004

Crops	In 2004			Growth rates in 1994-2004		
	Area (thousand hectares)	Yield (ton/ha)	Production (thousands tons)	Area (%/year)	Yield (%/year)	Production (%/year)
Rice	495.5	4.2	2 092.0	1.6	1.1	2.8
Maize	364.8	3.3	1 217.0	5.1	4.4	11.2
Cassava	265.7	17.5	4 656.7	5.1	4.9	9.8
Sweet potato	4.7	9.7	45.8	1.7	0.1	1.8
Groundnut	10.5	1.1	11.4	2.1	0.3	2.5
Soybean	5.1	1.1	5.4	-14.3	0.3	-14.1

Source: Office of Food Crops and Food Security, 2005.

Development of small-scale tapioca processing units (ITTARA)

When farmers sell their cassava to middlemen or directly to tapioca processing firms, farmers usually have a weak bargaining position in influencing the price. Moreover, farmers are often dissatisfied with the high price cuts due to starch content imposed by the firms. In order to overcome the low and fluctuating prices of cassava, the Governor of Lampung chaired a committee of price agreement in 1987. The members are the representatives of farmers, the Associations of Indonesian Feed Exporters (ASPEMTI), and the Association of Tapioca Processing Firms (ATTI). It is currently agreed upon that the buying price of cassava by tapioca processing units or by *gaplek* processing units is 13.6 per cent of the tapioca price or 70 per cent of the dried cassava (*gaplek)* free-on- board price (f.o.b. price). Although the agreement brought about the same price level of cassava at the processing units, cassava price transmitted to the farm gate was still below the agreed price level. The ratio of cassava price to tapioca price was always less than 9.5 per cent during 1995-2004.

The second policy concerning the weak bargaining position of farmers, vis-à-vis middlemen and large tapioca processing companies, was the development of Community's Tapioca Processing Units or ITTARA (abbreviated from Industry Tepung Tapioka Rakyat) in 1997. The objectives of this policy were to raise the cassava price, expand employment and improve the rural economy. A unit of ITTARA is an autonomous business unit of a farmer co-operative.

It was stated in the governor's directive that the area of cassava required by each ITTARA unit with a capacity of 5 tons per day was 100 hectares. In addition, each ITTARA unit had to buy cassava from farmers at a price of Rp 85 per kilogram and sell tapioca for Rp 900 per kilogram. This implies that the ratio of cassava price to tapioca price is around 9.4 per cent. As a matter of fact, this ratio has never been achieved even after the ITTARA programme was implemented. Nevertheless, the growth rates of the ratio increased from -7.3 per cent per year before ITTARA to -5.0 per cent per year after the programme (Siregar, 2005). This implies that, to some extent, the ITTARA programme has had a positive impact on the price of cassava, despite the fact that many tapioca processing units of ITTARA, except the ones that are personally funded, have gone bankrupt.

Presently, almost all ITTARA units financed by private companies and local government have collapsed because of managerial incompetence and inadequate monitoring and control from the related private companies and local government institutions. Most personally financed units are, however, still operating. However, they are dependent on the large tapioca processing units, especially to dry tapioca in the wet season, as they are not equipped with an oven.

Having learned this unsatisfactory achievement, the provincial government has assigned each district government to rehabilitate all ITTARA units in their administrative area. It is still believed that the development of small-scale tapioca processing units is necessary to spark competition that would lead to better cassava prices and, therefore, would help cassava farmers raise their income.

3.1.4 Extent of unemployment and poverty

Table 3.3 shows that the proportion of the labour force of working age in Lampung increased from 68.4 per cent in 1999 to 69.4 per cent in 2003 with a growth rate of 1 per cent per year. Unemployment in this group increased from 5 per cent to 6 per cent at an alarming rate of 6.2 per cent per year. Table 3.4 indicates that the proportion of people below the poverty line was about 22 per cent. This number might have increased in 2006 due to the shock hikes in fuel prices in 2005 that triggered a high inflation rate and higher input prices.

Table 3.3 Employment of labour force in Lampung, 1999 and 2003

I t e m	1999	2003	GR (%/year)
Percentage of labour force in working-age population [a]	68.4	69.4	na
Labour force (thousand)	3187	3316	1.0
Employed (%)	95	94	0.7
Unemployed (%)	5	6	6.2

Source: Statistical Yearbook of Indonesia, 1999 and 2003.
Note: [a] Since 1999, working age has been defined as 15 years and older. Before 1999, it was 10 years and older; Na=not applicable.

Table 3.4 Population below poverty line in Lampung, 2002 and 2003

I t e m	2003	2004	GR (%/year)[b]
Nominal Poverty line (Rp 000/cap/month)[a]	111.1	117.1	5.40
Population below poverty line (thousands)	1 567.9	1 561.7	-0.40
Proportion of population below poverty line (%)	22.6	22.2	n.a.

Source: Statistical Year Book of Indonesia, 2003.
Note: [a] Poverty line is defined as a minimum amount of currency that can meet the basic needs of human life for food (2,100 kg cal/cap/day) and non-food (housing, clothing, education, transportation etc.).
[b] GR = Growth rate; n.a. = not applicable.

3.1.5 Extent of environmental problems

Since Lampung is an important rice-producing province in Indonesia, the government has implemented a rice intensification programme in this province since the mid 1960s. This programme has introduced high-yielding varieties, which are highly dependent on chemical fertilizers. Consequently, the use of chemical fertilizers increased rapidly but the use of organic fertilizers declined. The declining use of organic fertilizers for more than 30 years has caused a low organic content in the soil leading to low water holding capacity and rapid erosion.

The inadequate yet high level of nitrogen fertilizer use, when the supply of nitrogen from fertilizers exceeds the nitrogen uptake by plants, leads to nitrate leaching. Nitrate that leaches into drinking water may cause severe health problems, while nitrate that leaches into rivers and lakes may cause excessive algae growth, oxygen depletion and fish mortality (FAO, 2004).

The intensification of rice production has also increased the use of pesticides that lower the resistance of high-yielding varieties to pests and diseases. High pesticide application also kills pest predators and is harmful to human health as residues of pesticides may be present on vegetables.

Lampung has been the major designated area for smallholder resettlements in transmigration programmes, particularly since 1960s, which has led to deforestation. Another cause of deforestation is the conversion of forestland to estate crop plantations, such as oil palm, coffee and cocoa. The conversion of forestland has been ongoing since 1970. In the period of 1995-2002, the area of production forest decreased at an alarming rate, at -4.5 per cent per year (Appendix 6). Convertible forest has been totally exhausted for various purposes.

Table 3.5 shows that total critical land in Lampung is about 299,157 hectares, 68 per cent of which is within designated forest areas and the remaining 32 per cent is not. Land degradation has occurred because poor people without access to fertile or irrigated land have been forced to cultivate marginal fragile lands that lack infrastructure and public services. Without external assistance, these poor farmers will not be able to stop their activities that risk degradating the environment.

Table 3.5 Critical land inside and outside designated forest area in Lampung and its rehabilitation during 1999-2002

Critical land	Hectares	Percentage
Inside forest area	203 887	68
Outside forest area	95 270	32
Total	299 157	100
Rehabilitation in 1999-2002.	37 840	13

Source: Statistical Yearbook of Indonesia, 1999 and 2003.

3.1.6 Condition of public infrastructure

Roads from Jakarta to Bandar Lampung and to the district and sub-district centres are generally asphalt roads, but roads to dry land areas, where CGPRT crops are mostly grown, are dirt roads that are not in a good condition, especially during the wet season. If the local authorities could improve these dirt roads, it would certainly increase the marketing efficiency of agricultural production by reducing transportation costs, but it seems impossible for the authorities to rehabilitate the road in the near future because of their limited capability to finance the rehabilitation. In general, road infrastructure in Lampung is far from sufficient. Data indicates that in 1996, the ratio of road length to total area, excluding forestland area was only 5.2 kilometres per 1,000 hectares, which is far below that on Java. In East Java, for example, the figure is 10 kilometres per 1,000 hectares.

3.2 Profiles of respondents and their households

Farmers in the area are relatively old (Table 3.6). Many of them do not know exactly when they were born; therefore overestimations of ages may have been made. Most of them only finished elementary school. The average number of household members was four, of which most were involved in farming. The time spent per household member varied across the farm households.

Almost all farmers at the two sites cultivated their own land. Only land near the source of water in Restu Baru that has access to swamp water in the dry season, is rented to grow vegetables such as melon, red pepper and cucumber in a third cropping season. The cropping pattern there is maize-maize-vegetables. The land rent is around Rp 250,000 for 0.25 hectares for the third season, which is relatively high because of its good accessibility to water. Although not common, renting dry land costs Rp 300,000 per hectare per season.

Farmers at the study sites originally came from Java, the most densely populated island in Indonesia. They moved to Lampung when the government implemented transmigration programmes. The objective of these programmes was to relocate people from densely populated islands to less populated ones. Initially, the government provided each migrant with 1.75 hectares of dry land for food crops and 0.25 hectares for a house and garden. Now, land in Siswa Bangun is more fragmented than in Restu Baru village as the transmigration programme started earlier there; 1956 versus 1973. Fragmentation occurs when land is sold or divided amongst the children of the owner. The average farm size in Siswa Bangun is therefore smaller than that in Restu Baru. The farmers usually grow tree crops and food crops near the house and some of them raise cows, goats and chickens in cages on this land.

Table 3.6 Profiles of respondents and their farm households

I t e m	Siswa Bangun	Restu Baru
Age (years)	48.9	43.4
Education (years)	6.9	6.4
Number of household members (persons)	3.9	4.1
Household members working in farming (persons)	2.3	2.6
Farm size (ha)	1.15	1.70
Number of land parcels	1.1	1.2
Farm income	8 260	16 653
- Income from food crops (Rp 000/year)	5 750 (100)	15 888 100)
- Cows, goats and chicken (Rp 000/year)	2 292 (95)	689 (10)
- Backyard crops (Rp 000/year)	218 (45)	76 (43)
Non-farming income	1 211	1 250
- Farm labourers (Rp 000/year)	515 (15)	88 (5)
- Construction workers (Rp 000/year)	331 (5)	345 (20)
- Processing workers (Rp 000/year)	350 (15)	371 (15)
- Traders (Rp 000/year)	15 (5)	446 (20)
Total household income (Rp 000/year)	9 471	17 903
Income per capita		
- Rp 000/year	2 428	4 263
- US$ /year	249	437
Prop. of farm households below poverty line (%)	20	15

Source: Field survey.

Note: Figures in parentheses are percentage of sample households. The income may be earned not only by household heads but also by household members. Number of sample farmers at each site is 20.

Farm income can be broadly classified as income from food crop production (rice and CGPRT crops), livestock (cows, goats and chicken**),** and backyard crops. Income from food crop production in Restu Baru is more than 100 per cent higher than in Siswa Bangun because of three reasons. Firstly, the average farm size in Restu Baru is larger than that in Siswa Bangun. Secondly, in the wet season, income from maize production per hectare in Restu Baru is also higher than income from rice production per hectare in Siswa Bangun (see Table 4.4 and the cropping patterns in Table 2.2). Thirdly, income from intercropping of maize and cassava during the dry season in Restu Baru is higher than income from single crop cassava production per hectare in Siswa Bangun. Conversely, income from livestock and backyard crops in Siswa Bangun is higher than in Restu Baru. Raising cows in Siswa Bangun is the second most important source of income.

Non-farm income at the study sites can be classified as income from working as farm labourers, construction workers, processing workers or traders. Many people in Siswa Bangun work as farm labourers as farm sizes are small. Income for this activity is therefore higher in Siswa Bangun than in Restu Baru. In Restu Baru the proportion of people engaged in non-farm activities is larger than in Siswa Bangun, because the district centre is nearer. About 15-20 per cent of the farmers have household members working in food processing, particularly in tapioca processing units.

Since farm size in Restu Baru is larger than that in Siswa Bangun, the total farm household income in Restu Baru is higher than that in Siswa Bangun. Consequently, income per capita per year in Restu Baru (Rp 4.263 million or around US$ 437) is higher than that in Siswa Bangun (Rp 2.428 million or around US$ 249). Average per capita income at the study sites are above the national poverty line presented in Table 3.6 (US$ 161/capita/year). Average per capita income in Siswa Bangun is still below the poverty line proposed by the World Bank (US$ 365/capita/year). Due to the hikes in fuel prices in 2005 that triggered a high inflation rate, it can be assumed that poverty has increased, resulting in more people falling below the poverty line.

3.3 Concluding summary

Unemployment and the proportion of the population that live below the poverty line in Lampung are relatively high as is the case in many provinces of Indonesia. In the near future, it is unlikely that non-agricultural sectors can significantly absorb employment and alleviate poverty, though several such non-agricultural sectors are growing at relatively high rates. Therefore, the agricultural sector, which has been growing at a relatively high growth rate, will play a significant role in generating income and employment, and thus in alleviating poverty. Development of agro-industry seems to be an essential means to this end.

In terms of crop area, maize and cassava are the major CGPRT crops in Lampung. The area proportions of maize and cassava are respectively 32 per cent and 23 per cent, while the production growth rates of maize and cassava over the last ten years were respectively 11.2 and 9.8 per cent per year. Although the area proportion and the production growth rate of maize are relatively high, Lampung is still a net importer of maize because production cannot meet demand from the animal feed processing industry.

In spite of the fact that Lampung is a net exporter of cassava products, cassava production in this province is still below the total capacity of tapioca and dried cassava processing industries. There is great potential for this province to further develop the production of these two crops, as demand exceeds local production.

On average, total household income of farmers in Restu Baru is higher than in Siswa Bangun. This is the result of differences in land holdings and cropping patterns influencing farm income. Land holding differences are the result of land fragmentation that started at different points in time. Cropping patterns are dependent on total household income. Since farm households in Restu Baru earn higher total household income, they have more savings that can be used in farming.

It is recommended to create more access to farm credit programmes with reasonably low interest rates as this might allow farmers to be more flexible when choosing their cropping patterns under prevailing market circumstances.

4. Analysis of CGPRT Farming System

4.1 Farm size and patterns of cultivation

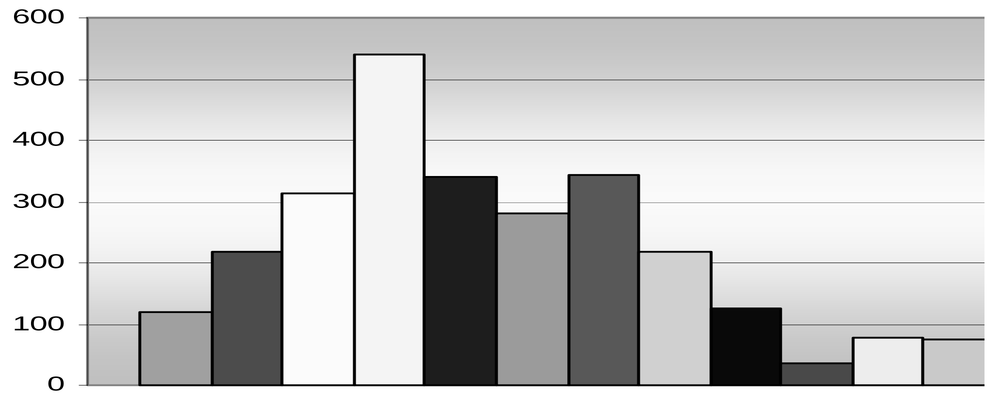
As mentioned earlier (section 3.2), average farm size in Siswa Bangun (1.15 hectares) is smaller than that in Restu Baru (1.70 hectares) (Table 3.10). This is because land fragmentation in the former has been taking place longer. Since most farmers at the two sites cultivate their own land, they can be classified as owner/operators. Other land holding status, such as leasing and shared-cropping are hardly found at the sites, except for the lands surrounding the swamp in Restu Baru.

Farming is practiced during the wet and the dry season. The wet season is from October to January when the average monthly rainfall is about 350-mm. In general, the dry season lasts three months from June to August with an average monthly rainfall of 65 mm. Table 2.2 and Figure 4.1 depict the most typical cropping patterns in the study sites. Farmers tend to select cropping patterns that minimize risks or maximize expected income due to uncertainties of output prices and climate. Section 4.3 elaborates more on decisions concerning cropping patterns.

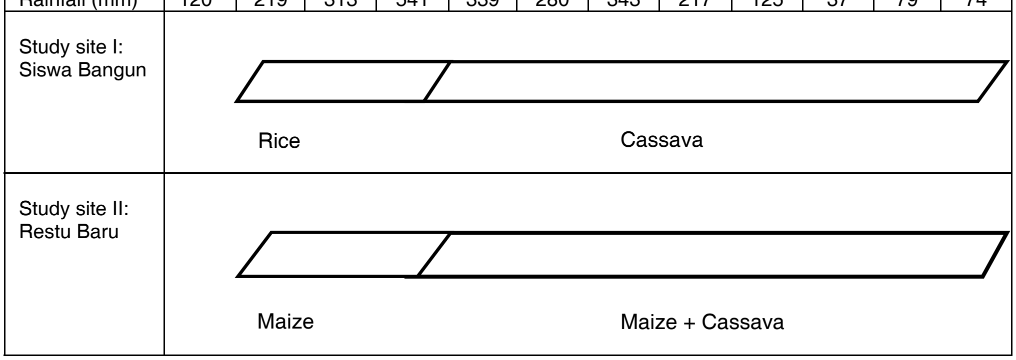
Farmers at the study sites only cultivate dry land. In Siswa Bangun, rice is grown in the wet season and cassava in the dry season. Planting distances of rice and cassava are 30x30 cm and 80x100 cm respectively**.** Farmers in Restu Baru, grow maize during the wet season with a planting distance of 20x70 cm. In the dry season, they intercrop maize with cassava; cassava is planted two months after planting maize. The planting distances of maize and cassava are 40x80 cm and 80x100 cm respectively.

At both sites, farmers begin preparing land at the end of the dry season. They plant rice or maize at the beginning of October and harvest it in January. Appendix 7 shows different cropping patterns used by farmers at the study sites. About 15 per cent of the farmers in Siswa Bangun grow cassava twice a year. Cassava requires at least seven months to grow before it can be harvested. The second crop of cassava is therefore intercropped with the first three months before the first crop is harvested. In Restu Baru, about 20 per cent of the farmers grow maize as a mono-crop in the wet season after which they mono-crop cassava in the dry season.

Figure 4.1 Rainfall and major cropping patterns at the study sites



Months	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Rainfall (mm)	120	219	313	541	339	280	343	217	125	37	79	74



Source: Data on rainfall is collected from the Officer of Food Crops and Food Security, Lampung province, Bandar Lampung; while the information on cropping patterns is gathered from field survey.

4.2 Input use and farm productivity

The major sources of hired labour are neighbours and people from adjacent villages. Two types of hiring farm labour are seen; labour on a daily wage basis or on a task basis. Rates for labour on a daily wage basis are Rp 12,500 per day for female labourers, Rp 15,000 per day for male labourers and Rp 25,000 per day for draught animals. Rates for labour on a task basis were Rp 250,000 per hectare for land preparation using draught animals, Rp 150,000 per hectare for planting or weeding, and Rp 200,000 per hectare for harvesting.

Farmers at the study sites prepare land using either hired or their own draught animals. Most farmers in Siswa Bangun raise cows, therefore the use of their own draught animals in land preparation is higher than in Restu Baru. The total labour requirement in the production of dry land rice is 142 man-days per hectare. This total labour requirement is much higher than the total labour requirement for the production of maize or cassava; around 80-100 man-days per hectare. The labour requirement for rice production is 47 per cent higher than cassava production, 73 per cent higher than maize production and 58 per cent higher than intercropping maize and cassava (Table 4.1). Harvesting requires the most labour, around 35 to 42 man-days per hectare. After harvesting, rice planting requires most labour, 31 man-days per hectare. Planting maize and cassava requires only 13-15 man-days per hectare.

Table 4.1 The use of labour per hectare by farm activity and crop

Activities	Siswa Bangun				Restu Baru			
	Rice (WS)		Cassava (DS)		Maize (WS)		Maize & Cassava (DS)	
	Man-days	%	Man-days	%	Man-days	%	Man-days	%
Land preparation[a]	13.2	9.3	20.7	21.3	6.9	8.4	0	0
Planting	30.9	21.7	14.5	14.9	12.6	15.3	27.4	30.4
Weeding	24.1	16.9	8.2	8.4	6.3	7.7	6.3	7.0
Fertilizing	14.1	9.9	15	15.4	16.4	20.0	16.4	18.2
Plant-protection	5.2	3.6	0.9	0.9	4.3	5.2	4.3	4.8
Harvesting	40.8	28.6	38	39.1	35.7	43.4	35.7	39.6
Drying	14.3	10.0	0	0.0	0	0.0	0	0.0
Total	142.6	100.0	97.3	100.0	82.2	100.0	90.1	100.0

Source: Field survey (summarized from Appendices 8 to 11).
Notes: [a]Including draught animal; WS=wet season, DS=dry season.

In Siswa Bangun more family labour is used compared to hired labour. The opposite is the case in Restu Baru (Table 4.2). Differences are the result of farm size and access to non-farm employment, which differ between sites. Farmers in Restu Baru have on average larger farms and more access to non-farm employment than in Siswa Bangun, therefore, in Restu Baru they use more hired labour.

Local varieties of dry-land rice grown in the wet season by farmers in Siswa Bangun are Lampung Kuning (50 per cent), Lampung Klimas (30 per cent), Samariti (10 per cent) and others (10 per cent). In Restu Baru, farmers grow many varieties of hybrid maize in the wet season: P-12 (60 per cent), NK-77 (20 per cent), Bisi-II (15 per cent), and others (5 per cent). During the dry season the same cassava varieties are grown at both sites, namely Kasetsa (80 per cent) and Adira (20 per cent).

Table 4.2 The use of labourers[a] by type of labourer and crop at the study sites

(man-days per hectare)

Types of labours	Siswa Bangun		Restu Baru	
	Rice (WS)	Cassava (DS)	Maize (WS)	Maize & Cassava (DS)
Family labour:	88.7	55.5	10.5	10.3
- Male	41.6	29.2	8.7	9.2
- Female	39.6	20.0	1.2	1.1
- Draught animal	7.5	6.3	0.6	0
Hired labour:	53.5	41.9	71.6	79.8
- Male	36.7	31.4	41.5	51.2
- Female	14.9	8.8	23.4	27.8
- Draught animal	1.9	1.7	6.7	0.8
Total labour	142.2	97.4	82.1	90.1
Proportion of family labour (%)	61	55	13	11
Proportion of male labour (%)	59	68	67	67
Total paid wages (Rp 000)	748	600	921	951

Source: Field survey (summarized from Appendices 8 to 11).
Note: [a] The use drought animal is excluded; WS = wet season, DS = dry season.

Farmers in Siswa Bangun use four types of fertilizers (urea, SP-36 and KCL and manure) for rice production, but they only use SP-36, manure and seasoning residue (*tetes*) for cassava production (Table 4.3). Farmers use seasoning residues to improve the fertility of sandy soil, to increase cassava production and to substitute manure. They believe that the amount applied should increase every year.

In Restu Baru**,** the amount of fertilizer (except SP-36) used in maize production is twice as high as for rice production in Siswa Bangun. They use more urea, SP-36 and KCL, but less manure for cassava production. In both sites, farmers do not use pesticides and the use of herbicides is negligible.

Productivity of rice in Siswa Bangun is around 2.7 tons per hectare (weighed right after harvest), cassava yields around 22.5 tons per hectare. In Restu Baru, the productivity of maize is around 7 tons per hectare. Intercropped maize and cassava provide 5.6 tons per hectare of maize and 17.6 tons per hectare of cassava (Table 4.3).

Table 4.3 Material input per hectare by crop and season

Inputs and productivity	Unit	Siswa Bangun		Restu Baru	
		Rice (WS)	Cassava (DS)	Maize (WS)	Maize and Cassava (DS)
Seeds (rice and maize)	kg	60	n.a.	18	18
Plant material (cassava)	bunch	n.a.	77	n.a.	70
Urea	kg	155	0	300	200
SP-36	kg	131	14	115	54
KCl	kg	42	0	88	95
Manure	packs	48	13	95	0
Seasoning-residue	litre	0	4 000	0	0
Herbicides	litre	0	1	3	3.46
Productivity*	kg/ha	2 697	22 600	6 942	5 630 and 1 7631

Source: Field survey (summarized from Appendices 12 to 15).
Notes: WS = wet season, DS = dry season.
* Forms of production: un-hulled rice, unpeeled fresh cassava, and maize grain (all have not been dried).

4.3 Cost-revenue structure and farm profitability

Costs of material inputs are higher than costs of paid labour in the production of the three crops (Table 4.4). Total value of maize production per hectare is higher than that of both rice and cassava. Consequently, total costs (material inputs and paid wages) for maize production are the highest, however, returns to household resources in maize production (Rp 3.365 million per hectare) are also the highest among the three crops. Cassava has the highest returns to household resources because material input costs for cassava production are much lower than either rice production or maize production.

Even though maize results in higher returns, farmers in Siswa Bangun grow rice instead of maize. They do so for two reasons; firstly, costs of maize production are 75 per cent higher (Rp 1.3 million per hectare) than for rice. It is not easy for farmers in Siswa Bangun to obtain additional funds to grow maize instead of rice. They usually use their own savings for crop production because they have limited access to formal farm credit services. Household income in Siswa Bangun is only about 53 per cent of that in Restu Baru (Table 3.6). Secondly, the high labour requirement for rice cropping is not a problem for farmers in Siswa Bangun as they do not have many opportunities for non-farm activities.

Table 4.4 Costs and returns for dry land rice and cassava production per hectare, Central Lampung, 2004/05

Item	Siswa Bangun		Restu Baru	
	Rice (WS) [a]	Cassava (DS) [a]	Maize (WS) [a]	Maize+Cassava (DS) [a]
1. Production (kg)	2 697	22 600	6 942	5 630 & 17,631
2. Prices (Rp/kg)	1 550	170	913	978 & 167
3. Production values (thousands)	4 180 (100)	3 842 (100)	6 338 (100)	8 451 (100)
4. Material inputs (thousands)	947 (23)	718 (19)	2 052 (32)	1 519 (18)
5. Value added (thousands):(3)-(4)	3 233 (77)	3 124 (81)	4 286 (68)	6 932 (82)
6. Paid wages (thousands)	748 (18)	600 (16)	921 (15)	951 (11)
7. Returns to household resources (thousand): (5)-(6)	2 485 (59)	2 524 (65)	3 365 (53)	5 981 (71)
8. Returns to costs ratio (R/C): (3)/(4+6)	2.46	2.92	2.13	3.42

Source: Primary data.
Notes: [a] WS = wet season; DS = dry season; Figures in parentheses are percentages of total production.

In Restu Baru farmers grow maize instead of rice in the wet season for two reasons. Firstly, maize production gives higher returns to household resources than rice production. Secondly, farmers in Restu Baru can afford higher costs of inputs for maize production as they have high household income. Thirdly, farmers in Restu Baru cannot meet the high labour requirement for rice production.

Fulfilling the labour requirement is a problem for farmers in Restu Baru, where farmers use, due to the amount of non-farm activities, a small amount of family labour to monocrop maize and intercrop maize with cassava (Table 4.2). Failing to fulfil the labour requirement for rice is more severe than for maize, this might be another factor influencing farmers in their crop choices.

Not only does cassava production involve less cash costs and less labour, it also provides relatively high returns to household resources. These returns are much higher than that of dry-land rice production (Table 4.4). Among the three crops, maize provides the highest returns to household resources per unit of land, but it also incurs the highest production costs. Maize production also provides the highest value added despite the high material input costs.

Farming in the dry season is riskier due to low rainfall and low output prices, especially for cassava. Farmers in Restu Baru manage these risks by intercropping cassava with maize. Farmers in Siswa Bangun do not have this opportunity as they lack the resources for intercropping. This seems to show that the choice of cropping pattern is more influenced by the farmers' resources than by the expected returns to family resources.

4.4 Potentials and constraints in farming operations

Most farmers stated that the major source of working capital was their own savings. Only 10 per cent borrowed money from individuals, the bank (BRI) or farmer groups. In general, they save money from the sales of their products the previous season, especially from cassava sales. Although working capital is not a serious problem, they feel that the prices of recommended seeds (of maize and rice) and fertilizers are too expensive, while output prices are too low. Output prices often fluctuate and are sometimes low whereas input prices steadily rise. Another classic problem faced by farmers is the shortage of fertilizer and labour at the time when it is most needed, in the peak season.

Most farmers are aware of the important role crop diversification plays in managing risks, raising income, optimizing land use and maintaining soil fertility. However, they do not grow more than two crops because they feel that the current cropping pattern gives the highest expected net returns for their available resources and the given market constraints. They are aware that risks may result from various causes such as price drops, bad weather and pest/disease. They understand that growing cassava as the only crop may reduce soil fertility drastically, therefore, they use high quantities of organic fertilizers such as manure and compost.

Production constraints are low soil fertility, high input prices, low output prices and shortages of chemical fertilizer, labourers and sometimes low rainfall in the dry season. Local governments play various roles in assisting farmers to cope with these constraints. For example, they can help farmer groups produce organic fertilizers, provide them with shallow tube-well pumps, and identify and overcome fertilizer shortages.

Crop diversification through maize and cassava has great potential in the area. The demand for cassava is growing. Cassava is a raw material for the processing of tapioca. Tapioca itself is the raw material for various products such as sweeteners for food and beverage industries and sorbitol for food and chemical industries. Dried cassava (*gaplek*) is used in the food industry (crackers, cakes and bread) and exported. Indonesia is only able to produce 50 per cent of its quota of dried cassava exports to the European market. In Lampung, tapioca is used by non-food industries such as plywood, hardboard, textile and paper.

Previous studies indicate that maize farming has comparative advantage (e.g. Siregar, 2001; Simatupang, 2002). Presently, the maize trade in Indonesia is free from governmental intervention such as import tariffs and quotas. Until 1977, Indonesia was a net exporter of maize. Since then, however, the country has become a net importer. Imports have risen as domestic production has not been able to keep pace with the growing demand from the domestic feed industry that grew at about 8 per cent per year over the last two decades.

4.5 Concluding summary

Choice of crops and cropping pattern depend on household resources such as farm size and availability of working capital and labour. In Siswa Bangun, farmers have smaller farms and less non-farm activities, therefore, they grow rice instead of maize as they have sufficient labour to meet the higher labour requirements of rice growing. Whereas they do not have the economic means to pay higher input costs of maize.

Conversely, farmers in Restu Baru grow maize instead of rice. They have higher incomes than in Siswa Bangun and can, therefore, afford the higher input costs of maize. In Restu Baru, higher household incomes result from their relatively large farms and from their non-farm income. Most farmers use their own savings for working capital. Fulfilling labour demand is a serious problem for these farmers as they are highly dependent on hired labour. They use a small amount of family labour for maize production or intercropping maize with cassava because they have more non-farm activities available. If farmers in Restu Baru fail to take sufficient care of crop production due to a lack of labour availability, failure in rice production is more serious than in maize, making maize a better choice for them (Table 4.2).

Cassava is grown at both sites during the dry season either as a monocrop (Siswa Bangun) or intercropped with maize (Restu Baru). Farmers see cassava as a ‘saving’ crop as its production does not require high cost and provides moderate returns to household resources.

Farming depended mostly on the availability of working capital. This implies that expanding farmers’ accessibility to formal credit with reasonable interest rates would enable farmers to diversify their farms with secondary and vegetable crops to boost their income.

Currently, maize and cassava are the main secondary crops grown in the area due to their demand. On the basis of agro-ecological conditions in the area, groundnut also has potential, but only if prices are high enough to encourage farmers to grow it.

5. Analysis of the Marketing System for CGPRT Products

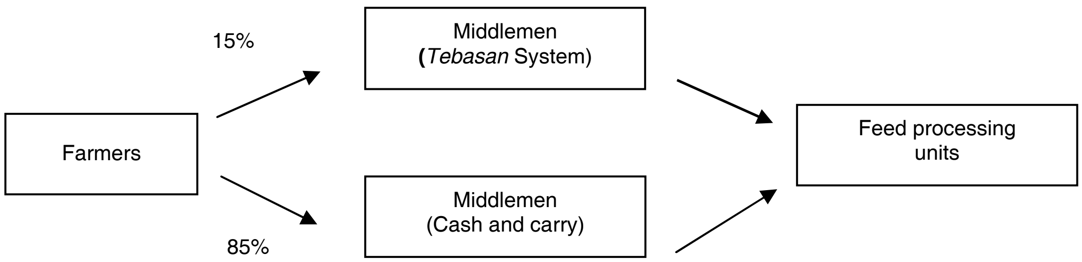
5.1 Forms of products traded and distribution channels

In the case of rice marketing in Siswa Bangun, local collectors usually go to farmers to buy un-husked rice. They pay in cash and then sell on to a local rice miller. However, the majority of rice produced, around 75 per cent, is for home consumption. This rice is de-husked at local rice mills by paying a rate of 10 per cent in kind.

Maize is sold in two ways; it is either sold as grains to a middleman or as a standing crop yet to be harvested (called the *tebasan* system) to a middleman called *penebas* (Figure 5.1). About 85 per cent of farmers sell their maize in the form of grains, while the remaining 15 per cent sell their maize through the *tebasan* system (Rp 3.5 million per hectare of maize). In the *tebasan* system, all harvest and post-harvest activities are carried out by *penebas*. Selling maize in this way involves making estimations of the quantity of production. Therefore, unless farmers do not have enough time to harvest themselves, this system is not used.

Maize farmers usually do not have the equipment necessary for shedding the grains from corncobs. When a farmer sells maize in the form of grains, he/she usually pays the cost of shedding to the middleman who buys the grains. The costs is about 2.5-3.0 per cent of the selling price. After shedding, the middleman weighs, packs and loads the grains onto a truck and sends it directly to a feed mill, wholesaler or exporter in South Lampung or Teluk Betung, about 150 kilometre from the sites.

Figure 5.1 Marketing channel of maize

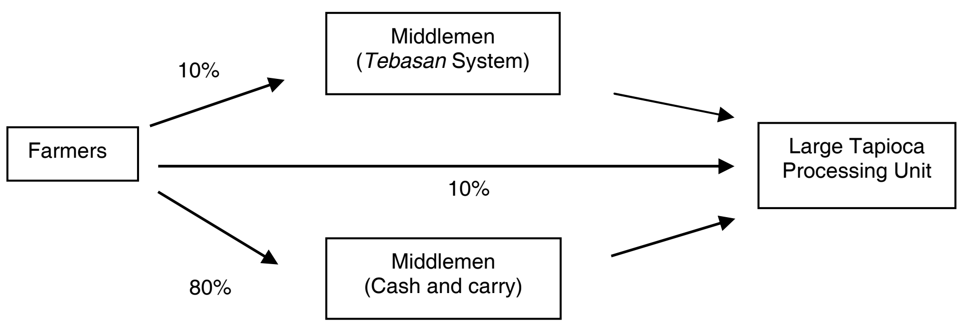


Source: Field survey.

In general, farmers and middlemen do not dry the grains because drying requires additional labour and costs, while they are not sure about the price of dried grains in relation to moisture content. Before middlemen load the grains onto trucks, the moisture content of maize is around 30-40 per cent in the wet season and a little less in the dry season. To reduce the moisture content of the grains, feed processing units or buyers in South Lampung or Teluk Betung dry the grains using mechanical dryers before they store the grains.

In the case of cassava marketing at non-ITTARA sites (see ITTARA programme in section 3.1.3), the proportions of farmers selling fresh cassava to middlemen through ordinary transactions and through the *tebasan* system are 80 per cent and 10 per cent respectively (see Figure 5.2). Only 10 per cent of farmers have their fields relatively close to tapioca processing units and, therefore, sell their cassava directly to the processing units. In both maize and cassava cropping, farmers are frequently unsatisfied with the ways buyers determine the moisture and starch contents of cassava, thereby determining the price. Therefore they have no incentive to perform post-harvest activities to add value.

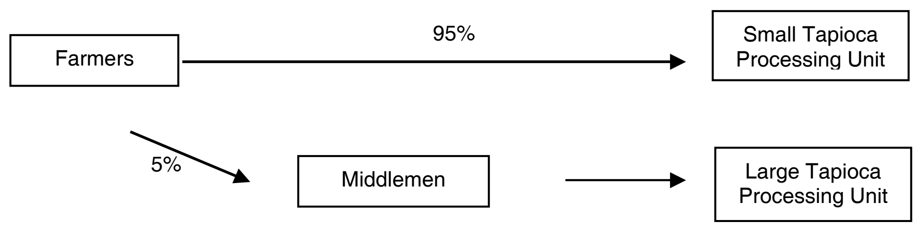
Figure 5.2 Marketing channel of cassava from non-ITTARA site



Source: Siregar, 2005.

Figure 5.3 illustrates the marketing channel of cassava from ITTARA sites. In order to overcome the problem of oligarchic large-scale tapioca processing units, the provincial government initiated the ITTARA Programme in 1997 by developing many small-scale tapioca processing units. If the programme had been successfully implemented, the marketing channel of cassava would have been shorter. Farmers could have directly sold to ITTARA units, and the marketing margin would have been less because of the absence of middlemen (Figure 5.3). Unfortunately, most ITTARA units financed by the local government and private companies collapsed, while most personally financed ITTARA units continue to operate. This is attributable to differences in managerial competence (Siregar, 2005).

Figure 5.3 Marketing channel of cassava from ITTARA site



Source: Siregar, 2005.

5.2 Nature of market structure and margin distribution

Around three to five collectors come to each village to purchase rice (paid in cash) at farmers' houses. They then immediately send it to local rice mills. Although all transactions are in cash, rice millers sometimes provide credit to collectors to insure their delivery. The capacity of rice mills does not exceed 3 tons per day. Rice mills sell polished rice to retailers in local markets.

The farm gate price for rice paid by local collectors was, at the time of the field survey, Rp 1,125 per kilogram. These collectors sell to local mills at a price of Rp 1,250 per kilogram. To transport the rice from farmers' houses to local rice mills, a local collector rents a small truck carrying a load of 2 tons of rice. As the truck service costs Rp 25 per kilogram, and an additional Rp 30 per kilogram is required for loading and unloading, the transportation costs from farmers' houses to a local rice mill is Rp 55 per kilogram. Hence, the profit of the middlemen is Rp 70 per kilogram (Table 5.1).

Since most rice production is used for home consumption, farmers may not sell their rice when the price is low. If farmers want to sell their rice, they can choose the buyer offering the highest price. Middlemen also choose a rice-milling unit that offers them the best price. This implies that the marketing of rice at the study site is competitive and relatively efficient. The marketing margin from farmers to rice milling units is only 10 per cent and the proportion of middlemen' profit is relatively small; that is 6 per cent of the price at the rice milling level.

Five of the 65 large maize feed processing companies in Indonesia are located in Lampung. All these mills together use around 146.2 thousand tons per year (Tangendjaja, *et al*., 2002). Hadi, *et al*., (1993) found that maize feed processing companies have oligopsonistic power to determine the price, which is then transmitted down to the farm gate through middlemen. The way to measure the moisture content and quality of maize is not clear for farmers or middlemen. In other words, the animal feed industry is the price maker while middlemen and farmers are price takers.

The marketing margin of maize is higher than that of rice mainly because maize is transported 125 kilometres from Restu Baru to feed processing units in South Lampung.

Maize middlemen earn Rp 60 per kilogram, where the marketing margin of maize is Rp 150 per kilogram, transport costs are Rp 50 per kilogram, and the costs of loading and unloading are Rp 40 per kilogram. Profit for the middleman is relatively small: 6 per cent of the price at the feed processing units. Farmers receive 85 per cent of the price at the feed processing units.

There are 58 active tapioca processing companies in Lampung. Nonetheless, this does not mean that the market is competitive since sellers do not know the real weighing procedure and starch content of cassava. Note that when a seller is not satisfied with the price offered, it is not easy for him/her to sell his cassava elsewhere since this means additional transport costs. This implies that to make cassava marketing efficient, the government should provide particular information to farmers such that transaction costs can be reduced and consequently the market becomes more competitive.

Ten per cent of the farmers sell their fresh cassava directly to the closest tapioca factory using an oxcart. Another 10 per cent sell their cassava while it is standing in the field (*tebasan* system) to local assemblers. The remaining 80 per cent sell their cassava to middlemen after the harvest. Depending on the distance from farmers' fields to local tapioca processing units, these three selling alternatives offer different returns and selling times.

The best time to harvest and sell cassava is 9-11 months after planting, when the starch content is sufficiently high. However, many farmers sell their cassava earlier, 7-9 months after planting, because of the need for direct cash. Prices of early-harvested cassava are lower, because a price deduction (*rafaksi*) is imposed for the low starch content. Although farmers accept this price deduction, they do not understand the rules applied in determining the starch content.

During the peak of the harvest season, cassava sellers, both traders and co-operatives, have to wait in a long queue at the gates of tapioca producers. This waiting reduces the quality of cassava and in turn reduces its price (e.g. Pakpahan and Nasution, 1992).

The market structure of cassava, as described above, can be seen as oligopsonistic, because farmers do not have perfect information concerning the way tapioca processing companies determine starch content. When a farmer is not satisfied with the offered price, it is unlikely that he/she would go to another processing unit because it would entail additional transportation costs.

Comparing ITTARA and non-ITTARA sites showed that the farm gate price of cassava was higher at ITTARA than non-ITTARA sites, namely 74 per cent versus 66 per cent of cassava price at processor level (Table 5.1). This is due to the need for middlemen at non-ITTARA sites. Transport from farmers' houses to large tapioca processing units (non-ITTARA units) costs on average Rp 35 per kilogram. An additional Rp 25 per kilogram is required for loading and unloading (Table 5.1). At ITTARA sites, no middlemen are involved as farmers directly sell their cassava to small tapioca processing units. Unfortunately, most ITTARA units that were financed by the local government and private companies have collapsed. Nevertheless, most personally financed ITTARA units continued to operate.

Table 5.1 Marketing margin, handling and transportation costs of rice, maize and cassava at the study sites (rupiah per kilogram)

Commodities	Farm gate price	Processor price	Margin	Loading/ unloading	Truck/ Oxcart	Middlemen Profit
1	2	3	4=3-2	5	6	7=(4-5-6)
Rice	1 125	1 250	125	30	25	70
	(90)	(100)	(10)	(2)	(2)	(6)
Maize	920 [c]	1 070	150	40	50	60
	(85)	(100)	(15)	(4)	(5)	(6)
Cassava: non-ITTARA [a]	175	265	90	25	35	30
	(66)	(100)	(34)	(8)	(15)	(11)
Cassava: ITTARA [b]	185	250	65	30	35	0
	(74)	(100)	(26)	(12)	(14)	(0)

Source: Primary data; Figures in parentheses are percentages to processors' prices.
Note: [a] Tapioca is processed by large-scale processing units (see Figure 5.3)
[b] Tapioca is processed by small-scale processing units (see Figure 6.1)
[c] After deducting the costs of shedding the grains, which is about 2.5-3.0 per cent of the selling price.

Marketing rice is more efficient than maize, which in turn is more efficient than cassava (Table 5.1). To avoid large price fluctuations for cassava, middlemen tend to suppress the farm gate price. As shown in Table 5.1, the proportions of marketing margin of cassava at non-ITTARA sites and ITTARA sites are respectively 34 per cent and 26 per cent. Marketing efficiency seems to stem from three factors: (i) the nature of the products; (ii) transportation costs that are affected by distance from farmers to processing units; and (iii) market structure.

5.3 Potentials and constraints in the marketing system

Maize and cassava production and processing have potential in Lampung. Demand for these commodities is growing. Maize is the major raw material used to produce animal feed and the poultry and livestock sectors are developing rapidly. Cassava is the main raw material for tapioca, dried cassava and pellet processing. Food industries that use tapioca are increasing, and the international market demand for dried cassava and pellets is also rising.

The classic constraints facing maize and cassava farmers are (i) price fluctuations caused by seasonal harvests; (ii) high transportation costs caused by bad road conditions; and (iii) imperfect market structure due to the oligarchic processing firms and imperfect information regarding the way firms determine weight and moisture content.

5.4 Concluding summary

The main problem in marketing CGPRT crops lies at the processing level and not at the farm level. Processing units tend to be price makers while middlemen and farmers are price takers. In relation to maize, feed mills are the major end users while the number of large feed mills is small. Moreover, farmers and middlemen encounter problems of a lack of transparency regarding weighing and determining moisture content. In the case of cassava, even though there are many tapioca processing units, farmers and middlemen do not have a fair opportunity to sell their cassava to another unit as this usually implies additional transport costs.

Based on the proportions of marketing margins, marketing rice is more efficient than maize, and marketing maize is more efficient than cassava. It seems that the differences in marketing efficiency stem from three factors: (i) the nature of the products; (ii) transportation costs that are affected by distance from farmers to processing units; and (iii) market structure. To improve the marketing efficiency of maize and cassava, the local government could provide additional market information, which is needed by farmers such that markets can become more competitive.

Marketing cassava at ITTARA sites is more efficient than non-ITTARA sites because the distance between farmers and processing units is smaller and there is no involvement of middlemen at the ITTARA sites. If the ITTARA programme could be implemented in the whole of Lampung, marketing efficiency of cassava could be improved to a larger extent. It is recommended that local governments rehabilitate ITTARA units that have collapsed so that cassava market structure would become more competitive.

6. Analysis of Processing Industries

6.1 Rice milling[1]

In rural areas, rice mills fulfil a very important role by polishing the rice. The daily capacity of a mill is around 3 metric tons of unpolished rice, which becomes 2 metric tons of polished rice with a conversion factor of 63 per cent. To avoid over capacity of rice mills, the new construction of rice mills is usually located based on government recommendations through the Office of Food Crops (Dinas Pertanian).

Seventy five per cent of the rice produced in Siswa Bangun is for household consumption. To polish rice, farmers pay rice-millers a rate of 10 per cent. The remaining 25 per cent of rice production is bought by rice millers through middlemen. To simplify the analysis in this section, it is assumed that rice millers purchase rice from farmers, process it and finally sell it to the markets.

From a field survey in Siswa Bangun it was seen that a rice milling unit processed 3,100 kilogram of rice into 1985 kilogram of polished rice per day and turned a profit of Rp 1.2 million per day (Table 6.1). The rice miller hired three labourers who each worked eight hours per day, making the value added generated from rice milling Rp 1.245 million per day. It should be noted that a rice miller in Siswa Bangun, due to the harvest period of rice, can only operate 200 days per year. During harvest time, from January to March, it operates every day, but in the off season, it only operates every other day or twice a week depending on the availability of rice to mill.

Table 6.1 Cost structure, value added and profit of rice milling per day in Siswa Bangun village

I t e m	Unit	Quantity	Price (Rp/unit)	Total value (Rp 000)	Percentage
1. Output:				5 176	100
Polished rice	kg	1 953	2 600	5 078	98.1
By product: Bran	kg	248	330	82	1.6
Husk	kg	713	22	16	0.3
2. Raw material (rice)	kg	3 100	1 250	3 875	74.9
3. Material input (fuel)	litre	25	2 200	55	1.1
4. Labourer input	manday	3	15 000	45	0.9
5. Profit: (1)-(2)-(3)-(4)	n.a.	n.a.	n.a.	1 200	23.2
6. Value added: (4)+(5)	n.a.	n.a.	n.a.	1 245	24.1

Source: Field survey.

[1] Although rice is not a CGPRT crop, rice is included in this report in order to see the complete picture of farming, marketing and processing at the CGPRT crops based farming sites.

6.2 Feed processing industry

Since the 1970s, the use of maize has shifted gradually from direct human consumption to processed animal feed, particularly for poultry that produces both meat and eggs. The demand for meat and eggs has increased due to rising per capita income, as a result of economic growth prior to the economic crisis. Around 85 per cent of the maize used for animal feed is for poultry, while the remaining 15 per cent is for pigs and dairy cows (Tangendjaya *et al*., 2002).

The poultry industry has been developing since the government opened the door to foreign and domestic investment in 1975 that especially focused on developing large-scale breeding and animal feed processing. The policy has resulted in spectacular growth of the poultry industry. Therefore, demand for maize as animal feed also grew dramatically. Domestic production of maize has not been able to meet this strong increase in demand for maize from the poultry sector. To solve this problem, the government began to import maize and imposed low import tariffs. As a matter of fact, foreign investors were free from import tariffs for several years after their establishment. Consequently, maize imports increased considerably and, in turn, lowered farm gate prices of maize (Tangendjaya *et al*., 2002).

In 1985, the government tried to encourage domestic maize production. A floor price for maize was set and the Logistic Agency (BULOG) was assigned as the sole importer of maize and to procure maize from farmers. This policy, however, was not effective because wholesalers and large animal feed processing companies were able to dominate the maize market (Tangendjaya *et al*., 2002). Hence, small feed processing units could not continue operating because they could not compete with the large feed processing companies in acquiring maize.

Consequently, small units of poultry were totally dependent on the large feed processing companies. Three large animal feed processing companies produce around 85 per cent of all animal feed (Tangendjaya *et al*., 2002). In addition, animal feed processing companies did not want to buy maize procured by BULOG because the international price of maize was relatively low. In 1990, the government abolished the floor price policy as it had not been effective.

In 1996/97, the government initiated the *Gema Palagung* programme, a breakthrough to boost rice production, maize and soybean. To increase maize production, farmers were encouraged to use hybrid and composite maize seeds. To prevent the farm gate price from falling due to greater production, the government banned maize imports and urged animal feed processing companies to procure maize from farmers at an agreed price.

However, when the price of maize fell during the peak of the harvest season, feed processing companies did ceased buying maize at the agreed price level because the government did not determine measures to enforce the companies to do so.

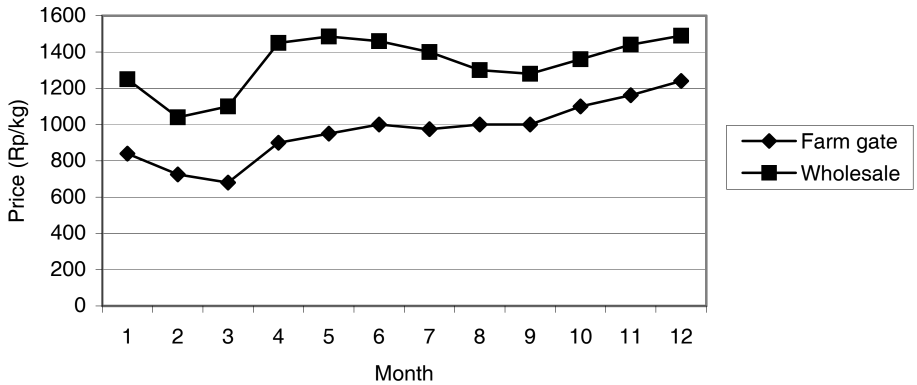
Experiences learnt from the development of feed processing units in Indonesia urge caution for future development of the agro-industry in general. In 1980, Indonesia established 200 small-scale feed processing units operating in agricultural production centres. Ten years later, most of these small feed processing units were bankrupt because foreign investment (PMA) policy in the past did not necessitate that the industry should maintain backward linkages to domestic agriculture. The result was that these industries only used imported maize.

In 1990, there were five registered feed processing units, producing 90 per cent of domestic demand for animal feed, however, these giant processing units did not have linkages to domestic maize production. Therefore, the role played by these industries in stimulating rural economic development was small. In 1999, after the monetary crisis, almost all of the feed processing firms were bankrupt because the importation of maize as the raw material was extremely costly. In response to this, the firms began to link themselves to domestic maize production (Yusdja and Iqbal, 2002).

The animal feed processing industry in Lampung province has good prospects when they use domestically produced maize. Lampung is one of the major maize producing provinces in Indonesia. In 2003 for example, maize production in Lampung totalled more than 1 million tons with a growth rate of 7.8 per cent per year (Agricultural Statistic, 2003). The amount of maize required by the five feed processing companies in Lampung totalled only around 146.2 thousand tons (Tangendjaya *et al*., 2002). The remaining maize went to other provinces within Indonesia; a relatively small amount was exported.

Feed-processing companies use imported maize during the off season when domestic maize production is short or when prices are high. In 2004, for example, imported maize totalled 3,700 tons, which was much higher than the export quantity (271 tons). This is possible because the import parity prices of maize in particular months (April-June and November-December) were lower than the domestic maize price, while no trade barriers were imposed on maize imports. The average CIF price of imported maize for the particular months in 2004 was US$ 124 per ton; and the average import parity price of maize was Rp 1,253 per kilogram. As a result of the supply shortage, the average domestic price of maize at the wholesale level in the months mentioned was Rp 1,400 per kilogram (Figure 6.1).

Figure 6.1 Monthly prices of maize at farm gate and wholesale in Lampung, 2004



Source: Office of Food Crops and Food Security.

Animal feed processing industries have great potential considering the high growth rate at which the poultry industry is developing. Recently, the growth rates of broiler and layer meats in Indonesia, as a whole, were respectively 9 per cent and 18 per cent per year, while the growth rate of eggs was 14 per cent per year (Agricultural Statistics, 2003). In 2003 in Lampung, the production of broiler meat, layer meat and eggs, were respectively 13,464, 229 and 22,154 tons. This can be considered relatively low and the growth rate of each type of poultry production was also low (less than 1 per cent per year). Nonetheless, animal feed produced in Lampung is also marketed in neighbouring provinces such as Bengkulu, South Sumatra and West Java. Lampung also exports animal feed, and the quantity has tended to increase (Table 6.2).

Table 6.2 Exports of maize, maize flour and animal feed from Lampung

	Quantity (tons)				Value (thousand of US dollars)			
	2001	2002	2003	2004	2001	2002	2003	2004
Maize	2 785	0	0	271	283	0	0	52
Maize flour	22	0	0	59	2	0	0	11
Animal feed	270	702	9 276	7 241	26	88	2 701	2 064

Source: Laporan Realisasi Perdagangan Luar Negeri Propinsi Lampung, December 2004. Office of Co-operatives, Industry and Trade, Lampung province. In 2003 and 2004, Lampung imported 3,700 tons of maize (US$ 458,800) per year.

In the animal feed processing industry, the proportion of maize in processed animal feed for layers and broilers is 54 per cent. This proportion is relatively high because maize is cheap, easy to produce high in calories, its protein content consists of complete amino acids, and chicken and livestock like its taste. Therefore, attempts to substitute other crops for maize in the feed industry have not succeeded so far.

An animal feed processing unit that produces 600 tons of animal feed per month, turns a profit of around Rp 135 million per month (Table 6.3). This requires 57 workers. The value added generated from feed milling is Rp 333 million per month. Generally, it operates the whole year (on average 310 days per year) unless there is a shortage of raw materials other than maize.

Table 6.3 Costs structure, value added and profit per month in producing animal feed for broilers in Lampung, 2005

Item	Unit	Quantity	Price/unit (Rp 000)	Values (Rp 000)	Percentage
1. Output (feed)	Ton	600	2 100	1260 000	100
2. Raw material:				0	
Maize	Ton	324	1 070	346 680	27.5
Rice bran	Ton	62	760	46 968	3.7
Soybean cake (*bungkil*)	Ton	124	1 900	236094	18.7
Other current inputs	Month	1	n.a.	25 100	2.0
3. Diesel fuel	Litre	78 500	2.2	172 700	13.7
4. Fixed costs	Month	1	n.a.	96 470	7.7
4. Other costs	Month	1	n.a.	2 514	0.2
5. Labour:					
Administration	Mm[a]	14	6 700	93 800	7.4
Technicians, etc.	Mm[a]	42	2 500	105 000	8.3
6. Profit: (1)-(2)-(3)-(4)	Month	1	n.a.	134 674	10.7
7. Value added: (4)+(5)	Month	1	n.a.	333 474	26.5

Source: Field survey.
Note: [a] Mm = man-months.

The high profits of the animal feed industry are probably the result of the industry's oligopsonistic power in acquiring maize as the major material input. In addition, the industry profits from economies of scale. High profits and the benefits of economies of scale should have stimulated the development of new firms into the industry but the high capital investment requirement seems to be the major constraint for new firms to enter this industry.

The animal feed industry has the capacity to encourage farmers to expand maize production by developing a partnership scheme between the industry and farmers using agreed farm gate prices of maize. The government had proposed such a partnership through its *Gema Palagung* programme, however it was not implemented properly.

Some recommendations to make partnerships between farmers and private companies more effective include: Firstly, the government could identify measures that may enforce companies to comply with agreements made between farmers and companies. Cancellation of the business licence might be the last alternative of enforcement for compliance. Secondly, maize imports should be strictly regulated in the sense that importation is only allowed when there is a serious shortage of domestically produced maize.

6.3 Tapioca processing industry

Although cassava in Lampung is used by both the tapioca processing industry and the *gaplek*/chip/pellet processing industry, most farmers in the area sell their cassava to the tapioca processors. Therefore, this section is only focused on the tapioca processing industry. Three important aspects of industrial prospects are discussed: (i) demand side of tapioca; (ii) supply side of cassava as the raw material for tapioca production; and (iii) the profitability of the tapioca processing industry.

From the demand side, tapioca processors enjoy good prospects because tapioca is used in many industries such as food, textiles, chemicals and pharmaceuticals. A by-product of the industry called *onggok* is used for animal feed. To meet the domestic and export demand for tapioca, tapioca production in Indonesia increased from 536.7 thousand tons in 2001 to 629.3 thousand tons in 2002, an increase of 17 per cent (Statistic of Medium and Large Industries, 2002). Most of the cassava produced in Lampung is used for domestic food industries; only 2.3 per cent is exported. Table 6.4 indicates that export demand for tapioca fluctuated but tended to increase in the period of 2001-2004.

Table 6.4 Exports of cassava products from Lampung province

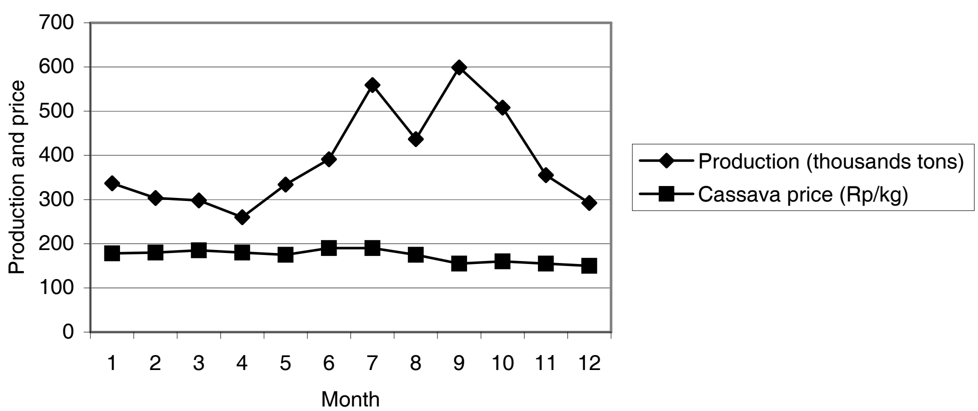
	Quantity (tons)				Value (000US$)			
	2001	2002	2003	2004	2001	2002	2003	2004
Dried cassava chips	9 697	9 936	6 686	24 764	582	638	451	3 489
Tapioca	12 809	14 595	13 116	170 541	1 991	2 544	810	30 399
O*ngggok* flour[a]	19 128	12 874	641	64	871	580	65	8

Source: Laporan Realisasi Perdagangan Luar Negeri Propinsi Lampung. December, 2004. Office of Co-operatives, Industry and Trade, Lampung province.
Note: [a]*Onggok* is a by-product of tapioca processing.

To describe the supply side of cassava in the tapioca processing industry, it is useful to look at the relationship between monthly production and prices of cassava in Lampung. There is no clear and consistent relationship between these two variables (Figure 6). This is also indicated by the weak correlation between monthly production and prices with a correlation coefficient of -0.1397. Fluctuating production and prices affect both farming and processing units. Low cassava prices, which often occur during harvest time, discourage farmers from using more fertilizers and new high-yielding varieties with high starch content as it entails higher costs. Consequently, productivity levels of cassava remain low and far below its potential, which is more than 30 tons per hectare. For tapioca processing units, fluctuating cassava production creates uncertainties in the supply of raw materials.

The tapioca processing industry in Lampung faces problems of excess capacity as locally produced cassava is not only used by the tapioca processing industry but also by the *gaplek*/chip/pellet processing industry. There are 49 tapioca processing units and 12 *gaplek/*chip/pellet processing units in Lampung. The capacity of the tapioca processing units varies from 1,000 to 90,000 tons of tapioca per year, while the capacity of *gaplek*/chip/pellet-processing units ranges from 10,000 to 150,000 tons per year. The total capacity of tapioca processing units is 1.2 million tons of tapioca per year, thereby requiring around 6 million tons of cassava per year. The total capacity of *gaplek*/chip/pellet-processing units is 1.5 millions or equivalent to 4.5 million tons of cassava per year. Hence, the total amount of cassava needed by the two types of processing industry is around 10.5 million tons of cassava per year (Office of Food Crops and Food Security, 2004). Total production of cassava is around 5 million tons per year. The two types of industry jointly face access capacity of 5.5 million tons of cassava per year. However, depending on the location of the tapioca processing units, quite a few may face excess capacity during particular months but excess supply in other months.

Figure 6.2 Monthly production and prices of cassava in Lampung, 2004



Source: Office of Food Crops and Food Security.

The aforementioned phenomenon of excess supply indicates that prices created by the market mechanisms are unable to optimally co-ordinate the marketing process from cassava farmers to processing units. Pakpahan *et al*. (1992) found that large processing units may take great advantage from cassava transactions because they have strong networks. This implies that, without increasing the price of cassava to encourage farmers to grow this crop, particularly in wet season, large processing units still benefit from the prevailing market circumstances without raising cassava prices in order to encourage farmers to grow more cassava. Zakaria (2000) added that middlemen and truckers benefit more than farmers because middlemen and truckers have more information. A truck driver may behave according to 'opportunism' by not transporting cassava to a particular processing unit but instead to another unit that gives more benefits. Such behaviour results in high transaction costs. This asymmetry of information could perhaps partly explain the relatively low cassava production in comparison to its demand from the processing units. Since the problem of short supply of cassava takes place both monthly and yearly, the production of dried cassava and tapioca is therefore only around 20-50 per cent of the export quota (Zakaria, 2000).

Zakaria (2000) proposed three policy actions to solve the problem of excess capacity in Lampung. First, it is necessary to relocate the processing units that have excess capacity to areas with excess supply to balance supply and demand. Secondly, each processing unit should operate in a particular area based on its processing capacity. Thirdly, it is essential that each processing unit in its sourcing area collaborates with farmers in deciding how much and when to produce cassava.

In order to solve the problems associated with low and fluctuating cassava prices and to boost cassava production, the Governor of Lampung chaired a committee on price agreement in 1987. The members of the committee were representatives of farmers, Associations of Indonesian Feed Exporters (ASPEMTI) and the Association of Tapioca Processing (ATTI). It was agreed upon that the cassava price paid by tapioca processing units or by *gaplek* processing units should be 13.6 per cent of the tapioca price or 70 per cent of the *gaplek* f.o.b. price. Although the agreement brought about consistent prices at the processing units, the price level at the farm gate remains below the agreed price level (Asnawi, 2002).

Table 4.6 shows that a large tapioca processing unit on average requires 4,500 tons of cassava to produce 1,125 tons of tapioca, while a small tapioca processing unit requires 375 tons of cassava to produce 86 tons of tapioca. This implies that conversion factors from cassava to tapioca in large and small tapioca processing units are 0.25 and 0.22 respectively. To produce one ton of tapioca, large and small tapioca processing units require 1.37 and 11.6 man-days respectively. In other words, the employment opportunity per unit of tapioca at the small tapioca processing units is around 8.5 times as much as that at large the tapioca processing units.

Table 6.5 Cost structure, profit and income generation of large and small tapioca production for one month in Central Lampung

Item	Unit	Non-ITTARA (Large processing unit)			ITTARA (Small processing unit)		
		Quantity	Price/unit (Rp 000)	Value (Rp million)	Quantity	Price/unit (Rp 000)	Value (Rp million)
1. Output: Tapioca	ton	1 125	2 150	2 418 750	86	2 000	172 500
By product (*onggok*)	ton	358	325	116 250	27	340	9 324
Total returns	month	1	n.a.	2 535 000	n.a.	n.a.	181 824
2. Raw material (cassava)	ton	4 500	265	1 192 500	375	250	93 750
3. Other current inputs:							0
Diesel fuel	litre	162 800	2.3	374 440	3 750	2.4	9 000
Kerosene	litre	33 100	1.2	39 720	0	0	0
Others	month	1	n.a.	113 350	1	n.a.	3 120
4. Fixed costs	month	1	n.a.	45 340	1	n.a.	2 930
5. Labour:							
a. Permanent labourers	mm[a]	15	6 630	99 450	6	851	5 106
b. Contract labourers	mm[a]	47	2 500	117 500	34	400	13 600
6. Profit:(1)-{(2) to (5)}	month	1	n.a.	552 700	1	n.a.	54 318
7. B/C ratio: (1)/{(1)-(6)}	month	1	n.a.	1.28	1	n.a.	1.43
7. Income generation: (5)+(6)	month	1	n.a.	769 650	1	n.a.	73 024

Source: Field survey.
Note: [a] Mm = man-months; n.a. = not applicable.

Although the average wage at Non-ITTARA processing units are higher than the ITTARA processing units (Table 6.5), the share of labour in total returns for ITTARA units is higher than that for non-ITTARA. This is because the labour coefficient at ITTARA units (0.0212 man-day per kilogram of tapioca) is much higher than that at non-ITTARA units (0.0003 man-day per kilogram of tapioca). The shares of profit and income generation at ITTARA units are also higher.

Considering environmental aspects of tapioca processing units, Pakpahan and Nasution (1992) found that the industry generated 539,909 tons of solid waste and 11 million cubic metres of liquid waste per year, which are dumped into rivers. The waste affects the water quality of the rivers, of which many already are above legal limits.

Summarized from Table 6.5, Table 6.6 indicates that the share of cassava in total returns is the highest. Since large tapioca processing units use ovens to dry tapioca, the share of other inputs (23 per cent) is slightly higher than the share of profit (22 per cent). Conversely, since small tapioca processing units use solar heat to dry tapioca, the share of other inputs (8 per cent) is much lower than the share of profit (30 per cent).

Table 6.6 Factor shares of each input and profit in total returns for non-ITTARA and ITTARA tapioca processing units per kilogram of cassava

Item	Non-ITTARA (Large processing unit)		ITTARA (Small processing unit)	
	Rp/kg	%[a]	Rp/kg	%[a]
1. Total returns	563	100	485	100
2. Raw material (cassava)	265	47	250	52
3. Other inputs	127	23	40	8
4. Labour	48	9	50	10
5. Profit:(1)-(2)-(3)-(4)	123	22	145	30
6. Generated income:(4)+(5)	171	30	195	40

Source: This table is simplified from Table 4.6.
Note: [a] Percentage of total returns.

6.4 Potentials and constraints

Both feed and tapioca processing industries have the potential to develop further. Crucial problems facing feed and tapioca processing units are the continuity and quality of raw materials. Supply continuity of maize or cassava as the raw material is affected by cropping season. The quality of maize relates to moisture content whereas the quality of cassava relates to starch and moisture, all of which are affected by harvesting time, crop varieties and the use of fertilizers.

In terms of the environment, tapioca processing units, especially the large scale ones, create a problem of waste and waste disposal. Solid and liquid waste affect water quality, that was already bad.

6.5 Concluding summary

Processing industries using maize and cassava as raw materials have high potential since the industries are profitable and the demand for their outputs is rising. The most imminent constraining to large processing businesses is the continual supply of raw materials, especially cassava. Cassava is frequently in short supply during the wet season but in over supply in the dry season.

The over supply of cassava in the dry season can be explained by looking at the reasons why farmers prefer to grow cassava in the dry season. Firstly, unlike other food crops, cassava is relatively resistant to drought and requires relatively low costs such that the risk of growing cassava in the dry season is relatively low. Secondly, farmers are not sure about the way processing units determine moisture/starch content, which is more critical in the wet season. Note that middlemen and truck drivers, who act as marketing agents, provide limited information from farmers to processing unit or vice-versa. Thirdly, compared to maize in particular, cassava has weak competitive advantage in the wet season.

In other words, processing units are not able to stimulate farmers to grow more cassava in the wet season by further raising cassava prices that are already high. From the side of large processing units, these units still benefit from prevailing market circumstances without raising cassava prices in the wet seasons to encourage farmers to grow more cassava.

Since market mechanisms are unable to solve this problem, it is necessary that the provincial government facilitate co-ordination between tapioca processing units and farmer groups to balance the supply of cassava and the capacity of processing unit in a given locality and in determining the price of cassava. Problems of short maize supply for feed processing firms are not as severe as that of cassava for tapioca processing firms because the firms may substitute imported maize for locally produced maize.

7. Employment Creation and Income Generation

7.1 Employment creation by commodity system

Parts of Chapters 4, 5, and 6 discussed the impact of each commodity system (farming, marketing and processing) on employment and income. Employment and income in farming, marketing and processing were calculated on a per hectare basis.

Farming is more labour intensive than marketing and processing. Furthermore, rice production is significantly more labour intensive than maize or cassava production, as has been discussed earlier in Chapter 4. Consequently, total employment in the rice commodity system as a whole (production, marketing and processing) is the highest with 151 man-days per hectare amongst the three crops. Total employment in the rice commodity system and cassava commodity system are respectively 106 and 103 man-days per hectare.

Table 7.1 Employment generation in dry land production, marketing and processing of crops per hectare by season at the sample sites

Stage	Siswa Bangun			Restu Baru		
	Rice (WS) [a]	Cassava (DS) [a]	Total (1 year)	Maize (WS) [a]	Maize+ Cassava (DS) [a]	Total (1 year)
Farming	142	82	224	82	90	172
	(94)	(78)	(88)	(66)	(64)	(65)
Marketing	6	15	21	12	21	33
	(4)	(14)	(8)	(10)	(15)	(12)
Processing	3	8	11	30	30	60
	(2)	(7)	(4)	(24)	(21)	(23)
Total	151	105	256	124	141	265
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Primary data.
Notes: [a] WS = wet season; DS = dry season; Figures in parentheses are percentages of the total.

Farming employment per commodity system in relation to total employment is 94 per cent for rice, 78 per cent for maize and 80 per cent for cassava. Marketing cassava and maize is more labour intensive than rice. In processing, maize requires more labour than rice or cassava. Sometimes labour shortages occur in farming, especially during peak season.

7.2 Income generation by commodity system

In terms of income generation (defined as value added), Table 7.2 shows that, in the case of rice, income generation in farming is higher than in processing. Conversely, in the case of maize and cassava, income generation in processing is higher than in marketing (Table 7.2). With all three commodities, income generation in marketing is the lowest.

Table 7.2 Income generation in dry land production, marketing and processing per hectare by season at the sample sites (thousands rupiah)

Stage	Siswa Bangun			Restu Baru		
	Rice (WS) [a]	Cassava (DS) [a]	Total (1 year)	Maize (WS) [a]	Maize+ Cassava (DS) [a]	Total (1 year)
Farming	1 814	2 882	4 696	4 287	6 932	11 219
	(57)	(38)	(44)	(35)	(41)	(39)
Marketing	270	677	947	694	1 091	1 785
	(9)	(9)	(9)	(6)	(6)	(6)
Processing	1 083	3 978	5 061	7 145	8 898	16 043
	(34)	(53)	(47)	(59)	(53)	(55)
Total	3 167	7 537	10 704	12 126	16 921	29 047
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Primary data.
Notes: [a] WS = wet season; DS = dry season; Figures in parentheses are percentages of total production.

The maize commodity system per unit of land generates the highest total income (Rp 12,126 thousand per hectare): generated from farming (Rp 4.3 million per hectare), marketing (694,000 per hectare) and processing (Rp 7.1 million per hectare) (Table 7.2). Table 7.2 also shows that income generation in the cassava commodity system is higher than rice. Total income generation (from farming, marketing and processing) in the case of intercropping is Rp 16,921 thousand per hectare, which is 25 per cent higher than in the case of maize monocropping. This indicates that horizontal crop diversification tends to significantly generate more income.

7.3 Concluding summary

Output per hectare of any crop generates both employment and income not only in farming itself but also in marketing and processing. For the three commodity systems analysed here: rice, maize and cassava; employment in farming is higher than in processing. In the case of rice, income generation in farming is also higher than in processing. For maize and cassava, however, income generation in processing is higher than in farming. For all three commodities, both employment and income generation in marketing are lower than either in farming or processing.

Sometimes due to the extensive employment opportunities available in farming, especially during the peak season, the supply of labour cannot be satisfied. Most probably, this is because many young villagers are not interested in working as farm labourers even though non-farming employment opportunities are limited.

Total employment generation in the rice commodity system is significantly higher than for both maize or cassava. Total income generation in the maize commodity system is higher than cassava, which in turn, is higher than in the rice commodity system. Total income generation in the case of intercropping (maize + cassava) is even 25 per cent higher than in the case of monocropping maize. This indicates that horizontal crop diversification tends to significantly generate more income.

8. Analysis of Institutional Support

8.1 Economic policies

8.1.1 Price support programme

The main objectives of price support and marketing policies for particular food commodities in the past were (i) to maintain farm gate prices to prevent them from falling below floor prices set by the government, hence, giving the farmers an incentive to produce; and (ii) to meet the demand by interfering in domestic marketing and importation. In the past, this policy was implemented for rice while price support for soybean and maize, CGPRT crops, was minor.

After the country achieved rice self-sufficiency in 1984, rice imports were no longer permitted. BULOG was initially only allowed to purchase domestic rice in order to stabilize rice prices through maintaining a buffer stock. This import restriction policy was costly for two reasons: (i) international rice prices were declining but domestic prices were higher than the world market prices. Meaning that it would have been cheaper for BULOG to import rice; (ii) high costs were associated with domestic procurement and storage to maintain a buffer stock. Since BULOG's operational costs were subsidized through soft credit, the price stabilization policy has been successful in stimulating domestic rice production (Simatupang, 1989).

Price support policies for CGPRT crops were implemented for maize in 1978-1992 and for soybean in 1980-1992 (Erwidodo and Hadi, 1999). No floor price policy has ever been set up for the other CGPRT crops such as cassava, potato, sweet potato and groundnut. The main objective of the price support policy for maize and soybean was to increase domestic production in order to reduce the country's dependency on imports. However, in the period of 1996-2002 for example, the import growth rates of maize and soybean were 34 per cent and 38 per cent per year respectively as domestic production could not keep pace with domestic demands (Siregar and Suryadi, 2006).

Similar to the rice floor price, floor prices for maize and soybean were also set on the basis of production costs and returns (including expected net returns to farmers) and previous market prices. Thus, the floor prices were adjusted annually based on these variables. Erwidodo and Hadi (1999) found that the floor price of maize was inflated by 10.9 per cent per year, which was higher than that of rice (10.4 per cent per year) and soybean (6.4 per cent per year).

In the case of maize, BULOG bought maize from farmers through village co-operatives (KUD) for the period of 1978-1988 (Erwidodo and Hadi, 1999). Initially, the procurement was considerable because inter-island and inter-provincial marketing of maize were entirely controlled by BULOG in order to balance supply and demand, but the procurement then drastically declined. Since 1988, however, BULOG no longer intervened in maize marketing as such intervention resulted in (i) a substantial financial burden to the government budget; and (ii) most of the time the floor price for maize was much lower than farm gate prices because of excess domestic demand, particularly from the feed industry. In other words, price support for maize was not effective. A similar situation was true for soybean. Since then, the only floor price policy applied has been that for rice (Erwidodo and Hadi, 1999).

Simatupang (1989) stated that the floor price policy for rice resulted in relatively high and stable rice prices. Thereby making the production of rice more profitable than that of secondary food crops.

The government has continued implementing a price support policy for rice through the Procurement Price Policy (HPP) since 2002. The effectiveness of this policy, however, has been declining since the policy is no longer supported by soft loans and the Food Logistic Agency (BULOG) has been reformed. In this reform, BULOG is no longer assigned to deal with food crops other than rice. Suryana and Hermanto (2004) found that the ratio of procurement price to farm gate price (GKP) was around 99 per cent in 2002-2003. Although the price support policy has been less effective and the input subsidy, other than fertilizer subsidy, has been phased-out, the effects of the policies on rice prices and stability at farm gate still continue. This does not encourage crop diversification.

In conclusion, price support policies as an instrument to encourage the production of rice should be terminated as its implementation is too costly and its funding limited. Therefore, the government should not apply price support policies to encourage production for import substitution of maize or soybean as it is too costly and its effectiveness is questionable. Note that price support policies can only be effective if the government can procure and store a large amount of the commodity during peak harvest and sell it when its market price is relatively high. For maize and soybean, it would be more realistic for the government to implement import tariffs rather than price support policies. For net-exported CGPRT crops such as cassava, the provincial government may find it necessary that processing companies buy cassava at a given ratio of cassava price to tapioca price (for example 10 per cent).

8.1.2 Credit support and input subsidy for farming

Since the beginning of the green revolution in Indonesia, the government provided cheap credit for subsidized material inputs to encourage rice production. The credit scheme has been modified several times since 1968. After the country achieved rice self-sufficiently in 1984, the government introduced the Farm Credit Programme (KUT) in 1985. This scheme was implemented not only for the production of rice but also for CGPRT crops and horticulture, but most of the credit was used for rice production (Erwidodo and Hadi, 1999).

The provision of the credit never reached 10 per cent of national rice area, except in 1999 when it reached 20 per cent, but its default rate in that year was also the highest (Erwidodo and Hadi, 1999). Since 2000, the government has replaced the KUT programme for the Food Security Credit (KKP) programme. This programme is a commercial credit programme in which the executing banks bear the entire credit fund and risks. Most of this credit has also been for rice production (Suryana and Hermanto, 2004).

Input subsidies formed part of the credit programme aimed at helping farmers to meet the high input requirements for high yielding varieties. These subsidies were removed in 1998 as part of a reform proposed by the IMF in dealing with the Indonesian economic crisis. The removal of fertilizer subsidies increased the prices of Urea, ZA, SP-36 and KCL to Rp 1,115, Rp 1,000, Rp 1,600, and Rp 1,650 per kilogram respectively. Put differently they increased by 147, 53, 146, and 94 per cent respectively (Erwidodo and Hadi, 1999).

As the removal of fertilizer subsidies resulted in reduced fertilizer use, the government began in 2002 providing subsidies to fertilizer producers to buy natural gas. The producers of fertilizers are responsible for distributing fertilizers close to farmers such that the prices are not higher than ceiling retail prices. Table 8.1 presents the allocation of fertilizer subsidy to fertilizer producers. The total value of subsidy up to August 2005 was Rp 1.3 trillion. An additional Rp 533 billion is needed to December 2005. It is estimated that the fertilizer subsidy for 2006 will be Rp 2 trillion (Sinar Tani, 18-24 May, 2005). Although the government provides subsidies to fertilizer producers, fertilizer shortages often occur in many parts of Indonesia due to distribution problems.

Thus far, credit programmes for cassava and maize have been very limited because the government still accords high priority to boosting rice production. In the future, credit programmes should be given not only for rice but also for CGPRT crops such that credit programme will not adversely effect food crop diversification.

Table 8.1 Budget allocation of fertilizer subsidy, 2005

Type of fertilizer	Quantity (thousand tons)	Ceiling retail price (Rp/kg)	Subsidy (Rp billion)
Urea	4 037	1 050	1 158.2
ZA	600	950	219.8
SP-36	750	1 400	212.5
NPK	230	1 600	141.7
Total fertilizer subsidy	n.a.	n.a.	1 732.2
Transport costs to remote areas	n.a.	n.a.	81.7
Supervising	n.a.	n.a.	20.0

Source: Sinar Tani (18-24 May, 2005).
Note: n.a. = not applicable.

8.1.3 Food diversification policies

Since long ago the Indonesian government realized that the country should reduce its dependency on rice as a staple food. Therefore, food consumption diversification has been promoted. As a response to the food crisis before 1960, for example, the government launched a campaign of ‘rice-maize’ staple food. This was done by promoting people to: (i) mix rice and maize at every meal; or (ii) substitute rice with maize for breakfast, lunch or dinner (Hasan, 1994).

At the end of the first five-year development plan (PELITA-I), the government announced a Presidential Decree (INPRES no. 14, 1974) regarding ‘food quality improvement’ (UPMMR) which was then superseded by INPRES no. 20, 1979 (Hasan, 1994). Although food quality improvement was translated as staple food diversification, the implementation of this policy was not clear.

Since 1991/92, the Ministry of Agriculture has been campaigning for Diversified Food and Nutrition (DPG) with two objectives: (i) to strengthen food security at the household level; and (ii) to improve the awareness of rural people to consume diversified foods giving nutritional balance through the cultivation of home gardens to grow various crops. Since 1998/99, the programme has included the development of local food alternatives (Ariani and Ashari, 2003). However, to what extent this programme has significantly reduced per capita consumption of rice is not clear.

That the government has not been so serious in promoting food diversification can be seen from rice and wheat related policies. In relation to rice, the government actually has been prioritizing the intensification of rice production since the first Five-Year Development Plan (PELITA I). As a result, the country achieved rice self-sufficiency in 1984. After that, however, rice imports have continuously increased. In 1996-2003, for example, the amount of imported rice was around 2 million tons per year (Siregar and Suryadi, 2006). Rice self-sufficiency could not be maintained, after which the government shifted the orientation of its food policy from: (i) rice sufficiency to food sufficiency; (iii) food quantity oriented to quality oriented; (iii) production oriented to market demand oriented; and (iv) single favoured commodity to diversified food commodities (Hasan, 1994). However, the implementation of this food diversification policy has not been very clear.

Wheat-related policies significantly affect food diversification in Indonesia. Government subsidies for wheat imports and distribution; and subsidies for the establishment of wheat flour processing have significantly increased the consumption of wheat products. In the second half of the 1960s when the country was facing a foreign currency shortage, the government intensively introduced wheat flour to avoid being dependent on rice imports. During that period, the international price of rice was unstable and the international market was thin. To stabilize food prices and the economy, the government believed that it was better to import wheat instead of rice. The international price of wheat was relatively stable, the international wheat market was relatively large, and the substitutability of wheat for rice was predicted to be high.

Magiera (1981) and Sawit (2003) reported that the USA facilitated a concession loan with a low interest rate to purchase wheat from USA at the end of 1960s. In the period between 1968 and 1973, total imports totalled 3.3 million metric tons of wheat (grain equivalent); 61 percent of which was imported from the USA and 89 percent of the import budget was the concession loan. After the construction of three wheat flour mill plants early in the 1970s, wheat imports drastically increased up to 4.6 million tons in the period of 1973-1978, but the proportion of concession loan for wheat imports declined to 24 per cent (Sawit, 2003).

Recently, Indonesia became the sixth largest wheat importer in the world after Brazil, Egypt, Iran, Japan and Algeria. Imports of wheat grain increased from 3.7 million tons in 1997/98 to 4.1 million tons in 2000/01 (Sawit, 2003). The government subsidy for wheat imports and distribution can partly explain this development. The real subsidy increased from Rp 3 billion in 1976/77 to Rp 17 billion in 1978/79. The instant noodle industry was extremely subsidized. Based on data in 1994, the industry was subsidized Rp 760 billion per year. In line with the ability to increase rice production, wheat imports were curbed in the 1980s, but wheat imports drastically increased after the government liberalized the markets of wheat and wheat flour in 1998. Noodle consumption, therefore, increased from 1.1 kg/cap/year in 1993 to about 2.3 kg/cap/year in 2002 (Martianto and Ariani, 2004).

Recently, Indonesia became the second country after China in consuming instant noodles. It seems that income elasticity of demand for wheat products is relative high because the consumption level of wheat products by the high-income group is 40 to 60 times that of the low-income group. The share of large companies in producing instant noodle is enormous, while the share of the largest company alone is 85-90 per cent. In 2000, domestic production of instant noodle was 8.2 billion packs. The rapid shift of consumption to wheat products by low and middle-income classes has significantly reduced the consumption of domestic food crops such as cassava, sweet potato, sago and maize (Sawit, 2003).

An increase in import tariffs for rice, when effective, would raise the domestic price of rice. Since rice and wheat have high substitutability to each other, any increase in import tariff for rice would increase the import of wheat and wheat flour significantly. Therefore, Sawit (2003) suggested that wheat imports should be levied at least 50 per cent of the import tariff for rice. Such a policy would diversify consumption and, in turn, diversify the production of food crops including CGPRT crops.

To some extent, wheat related policies have reduced per capita consumption of rice. In 1993-2003, for example, annual per capita rice consumption declined from 116 kilograms to 100 kilograms (Siregar and Suryadi, 2006). However, the total consumption of rice only declined by -1.6 per cent per year because of the increase in population and more people in several parts of the country changed their staple food from maize, cassava, sago or tubers to rice.

It can be seen that Indonesia has become not only highly dependent on rice, but also on the importation of wheat. Maintaining this situation in the future will be dangerous for food security. Indonesia is unique in the sense that the country has a wide range of soil fertility, different potentials of local food crops, and different socio-cultural backgrounds of the people (Hasan, 1994). The country has great cropping potential. Staple foods in Indonesia, such as CGPRT crops with maize and cassava in particular have comparative advantage. Indonesia would be better off producing staple foods at home rather than importing them. It is recommended that the government provides sufficient support for the production of CGPRT crops to promote food diversification.

8.1.4 International trade policies

Before 1989, the government heavily protected the rice market in Indonesia, especially by using non-tariff barriers to raise the level of rice self-sufficiency. In spite of the heavy import restrictions, rice imports increased substantially because domestic production could not meet the growing demand for rice. Imports have made Indonesia one of the largest rice importers in the world. Since the government declared the concept of 'rice self-sufficiency on trend', the import restriction has been flexibly adjusted to the level of domestic production but the rice self-sufficiency level is expected to improve from one period to another (Suryana and Hermanto, 2004).

In the case of maize, Indonesia imports and exports maize to balance domestic production and uses. However, mostly on an annual basis imports have been exceeding exports. For the period of 1996-2002, for example, the average trade balance of maize was highly negative since the average import quantity was seven times the average export quantity (Siregar and Suryadi, 2006).

To protect maize farmers from the severe effects of price drops, the government imposed import tariff policies for maize, but these tariffs were reduced from 15 per cent in 1990 to 10 per cent in 1995, and to 5 per cent since 1996 (Erwidodo and Hadi, 1999). Although the import tariff for maize was reduced and totally eliminated in 1998, the domestic price of maize grain increased by 19 per cent per year in 1991-2001 because domestic prices of maize were not only affected by import tariffs but also by the global maize price (Siregar and Suryadi, 2006). This implies that the tariff policy for maize did not predominantly affect the farm gate price as an incentive for maize farmers.

Import tariffs were also imposed on maize products such as maize seeds, maize flours, maize starch for baking, sweet corn, crude maize oil, corn flakes and maize bran. To support research centres and breeding companies to generate new improved varieties, import tariffs have never been imposed on imported maize seeds. The tariff for maize flours or maize starch has been 5 per cent since 1989. The tariff for crude maize oil was levied at 20 per cent in the period of 1989-1994 but it became 0 per cent after 1994. Imports of sweet corn were levied at 30 per cent in 1989-1994, 25 per cent in 1995-1996, 20 per cent in 1997 and 5 per cent since 1998. Import tariffs for corn flakes reduced from 60 per cent in 1989 to 40 per cent in 1990-1993, 35 per cent in 1994, 30 per cent in 1995-1996 and 5 per cent since 1998. The tariff for maize bran was cut from 19 per cent in 1989-1994 to 5 per cent since 1995. Based on the General Agreement on Tariffs and Trade, GATT, 1995 was regarded as the base year for GATT ratification (Erwidodo and Hadi, 1999).

As a net exporter of cassava, Indonesia imposes an export quota despite the small share of Indonesia's cassava in the global market (8 per cent). The quota is to prevent cassava prices from falling and has only been applied for exports to Europe. The quota increased from 500,000 tons in 1982 to 700,000 tons in 1983-1984, and finally to 825,000 tons afterwards. In 1988-1993, Indonesia's exports of cassava exceeded the quota (Erwidodo and Hadi, 1999), but after 1993 cassava exports have been drastically decreasing to 389,000 tons in 1996 and just 7,000 tons in 2002 (Siregar and Suryadi, 2006). Domestic uses of cassava increased as cassava exports declined and domestic production increased by 1 per cent per year. Since domestic uses for direct consumption decreased, domestic use for industrial uses should be rising. Unfortunately, information on the use of cassava by different types of industry was not available.

Import tariffs were also imposed on various cassava products. The highest tariff (30 per cent) was imposed on such primary products as dried-sliced cassava and pellets, while the lowest tariff (5 per cent) was imposed on manioc starch. All tariffs remained unchanged until 1998, but eventually all tariffs were reduced to 5 per cent (Erwidodo and Hadi, 1999).

When the Indonesian economy was hit by the crisis, the government suddenly deregulated the domestic rice market, including the removal of BULOG's monopoly on rice imports and import tariffs. Recently, there has been growing concern about the potential adverse effects of this deregulation. The absence of import tariffs for rice and decreasing world market rice prices, lead to more rice imports that reduce domestic rice production and farm income. To encourage farmers to grow rice and sugarcane, the government still imposed tariffs for rice (34 per cent) and sugar (25 per cent) in May 2002, which became specific tariffs in July 2002. These tariff policies reduced farmers' flexibility in the use of land as such policies do not bring about real competition among crops. Therefore, gradual tariff reduction followed by improvements in infrastructure at the farm and marketing levels and agro-industrial development would foster farm diversification.

8.1.5 Investment policies

For a long period of time, the government of Indonesia has been encouraging private investment, both domestic and foreign, showing awareness of the strategic role of investments in economic development. In the first year of the first Five-Year Development Plan (PELITA-I), the government opened opportunities for foreign investment by issuing Law No. 6, 1968. In June 1983, the government carried out a Banking Regulation Policy in order to attract and mobilize funds from the people for various investments. After that, the government consecutively implemented various deregulation policies creating a conducively situation for private investment. There are six points offered to stimulate private investments (Irawan *et al*., 2002): (i) To ease the procedures when applying for investment permits; (ii) To facilitate the transportation of investment goods and the use of domestic capital goods; (iii) To enable private ownership of national companies' stocks; (iv) To expand private investment in various economic sectors; (v) To protect infant industries through import tariffs, and rescheduling of value-added tax payments on imported capital goods until the industries begin operating commercially; and (vi) To provide facilities for exported production.

The impacts of these policies began to show in 1987 when total investment reached Rp 117.2 trillion, but only small proportion of the total investment was in the agricultural sector (Irawan *et al.*, 2002). This implies that agriculture was not an attractive sector for investments. Only 15 per cent of domestic investment (PMDN) and 4 per cent of foreign investment (PMA) were allocated to the agricultural sector. In 1999-2003, the approved investment in agriculture, including forestry and fishery, was only 2.19 per cent of the total approved investment (Appendix 16).

Factors that make agricultural investment less attractive than investments in other sectors may be its higher risk of production due to natural factors and its longer capital recovery. Even though the number of proposed private agricultural investments increased, the implementation ratio was small both for domestic and foreign investments. From the first to the sixth five-year development plan (1969-1996), the ratios were 25 per cent for domestic investments and 26 per cent for foreign investments. This implies that the private investors, both domestic and foreign investors, were facing many unavoidable constraints. Table 8.2 indicates that in the fourth and fifth five-year development plans, investment constraints for food crops and horticulture increased while investment constraints in livestock and fishery subsided.

Table 8.2 Composition and proportion of implemented to approved investments by source and sector in Indonesia (percentage)

I t e m	PELITA I&II	PELITA III&IV	PELITA V&VI	PELITA I toVI
Domestic investments (PMDN) in billions of rupiah:	(56)	(2 342)	(8 477)	(10 875)
Food crops and horticulture	8.0	6.4	7.4	7.2
Estate crops	82.6	83.8	75.0	76.9
Livestock	4.3	2.7	8.6	7.3
Fishery	5.1	7.1	9.0	8.5
Total	100	100	100	100
Foreign investments (PMA) in billions of rupiah:	(71)	(204)	(1 564)	(1 839)
Food crops and horticulture	0.0	3.6	4.6	4.3
Estate crops	76.3	44.2	36.8	39.1
Livestock	2.4	12.9	10.5	10.5
Fishery	21.3	39.3	48.1	46.1
Total	100	100	100	100
Ratio of implemented to approved investments:				
Food crops and horticulture	61.6	60.0	21.8	24.8
Estate crops	50.4	30.5	24.1	25.5
Livestock	32.5	16.7	49.3	41.9
Fishery	42.8	14.4	23.2	21.5
Total	48.6	27.6	24.9	25.5

Source: Irawan *et al.*, 2002.
Note: PELITA = five-year development plan.

In the first and second five-year development plan the role of foreign investment (PMA) was slightly dominant with Rp 71 billion (56 per cent). Most of this was invested in the development of estate crops as raw materials of the processing industries for both domestic and export markets. Table 8.2 indicates that investors did not show much interest in food crop investments and livestock. Most livestock and food crop commodities are for domestic markets. This shows that most private investors focus their investments on export commodities (estate crops) that have comparative advantage in international markets.

8.2 Infrastructure provisions

8.2.1 Irrigation

Development of irrigation systems was initiated during the colonial era in Indonesia. Now many irrigation systems have been neglected. Entering the first Five-Year Development plan (PELITA *I*), the government decided four irrigation development strategies: (i) development of new irrigation systems; (ii) rehabilitation of old irrigation systems; (iii) river and flood controls; and (iv) development of wetland and tidal swamp areas. Public investment in irrigation increased from Rp 20.7 billion in 1969/70 to Rp 1,556.4 billion in 1993/94 (Rosegrant and Pasandaran, 1995). In PELITA I and II (1969-1979), the priority was put on the rehabilitation of damaged irrigation systems. Since then, the priority has been put on the development of new irrigation systems. In the period of 2001-2004, government expenditure for irrigation was the same as expenditure for agriculture; 7.1 per cent of total government expenditure (Table 8.3).

Table 8.3 Government development expenditure by sector in Indonesia, 2001-2004

(billions rupiah)

Sector	2001	2002	2003	2004	Average/year	Percentage
Agriculture	3 114	3 709	4 731	4 919	4 118	7.1
Irrigation	3 123	3 712	4 764	4 798	4 099	7.1
Industry	1 533	1 813	1 068	1 063	1 369	2.4
Natural resources	696	653	511	778	660	1.1
Mining and energy	2 467	3 778	3 184	2 852	3 070	5.3
Transportation	4 787	7 810	9 052	9 923	7 893	13.6
Other sectors	28 267	30 824	41 820	46 538	36 862	63.5
Total	43 987	52 299	65 130	70 871	58 072	100.0

Source: Statistical Yearbook of Indonesia, 2003.

The government continuously develops more irrigation infrastructure. Areas with technical irrigation, semi-technical irrigation, simple irrigation, rainfed and tidal swamps, which can be used at least to grow rice twice a year, increased by 2.68 per cent, 0.60 per cent 0.58 per cent, 5.61 per cent and 3.03 per cent per year respectively. This also indicates that the government has spent more on technical irrigation and rainfed lowlands than for the other type of lowland.

Total area of lowland that can be used to grow rice twice a year expanded annually by 9.26 per cent, whereas the total area on which rice can be grown once a year decreased by 12.65 per cent per year. A part of this improvement must be in the form of converting areas from once-a-year rice to twice-a-year rice. In line with population growth and increased food demand, the supply and use of irrigation water is challenged by four unavoidable facts: (i) land conversion to non-agricultural uses; (ii) increasing competition in the use of water; (iii) increasing investment costs of irrigation; and (iv) phenomenon of global climate change. Land conversion is not merely the conversion of agricultural land to non-agricultural land, it also involves the destruction of expensive irrigation systems. Irawan (2001) found that one-hectare of irrigated land converted to housing development requires a compensation of pump-irrigation for 3.5-7.0 hectares to maintain the prevailing food supply and agricultural employment.

As a consequence of economic development and population growth, the use of water for irrigation tightly competes with the use of water for households, electricity, industry and fishponds, in terms of both water debits and the priority in water allocation during water shortages. Meanwhile, the source of water has been constricted by the degradation of catchment areas.

The extent of water scarcity in agriculture is negatively correlated to the investment in irrigation development and rehabilitation. The condition of irrigation systems tends to deteriorate as the cost of irrigation investment increases and government budgets for irrigation are limited. The efficiency of irrigation water use is low. The situation is exacerbated by the El Nino phenomenon that has been causing frequent droughts in recent years.

The Operation and Maintenance (O&M) costs of irrigation facilities have been the responsibility of local province, district and city authorities since the decentralization policy. However, regional governments have not been able to properly implement O&M due to institutional, staffing and budget problems, while Water User Associations (P3A) have insufficient resources to carry out proper irrigation management. This leads to malfunctioning of irrigation facilities and water cannot be equally distributed at tertiary blocks. This raises the cost of irrigation rehabilitation (FAO, 2003).

Before the government intervened in the development and management of irrigation, rural communities managed their irrigation systems. They used fairness and trust to design rules that enabled harmonious relationships among individuals in a community and among communities in the same and in different irrigation systems.

When the government intervened, a standard design, management and new Water User Association (P3A) were introduced. Existing local institutions were subsequently neglected. In addition, the government's intervention made farmers highly dependent on government assistance in managing irrigation systems.

The present autonomy era is the right time for revitalization of social capital in irrigation and natural resource management. However, many bureaucrats keep questioning the effectiveness of such an approach because it will create additional burdens for farmers. This argument is used to justify government intervention in irrigation management in an attempt to maintain the status quo. Pasandaran (2003) concluded that a fair mechanism that can improve the role of farmers in irrigation rehabilitation and management is necessary.

The impact of irrigation development on CGPRT crops is dependent on the production technology of each crop. Kasryno *et al*. (2004) found that, in several major maize-producing regions, hybrid maize tends to displace rice on irrigated land, particularly in the dry season because the productivity growth rate of hybrid maize is higher than that of rice. Since the productivity growth rates of the other CGPRT crops are still lower than that of rice, the impacts of irrigation development on the production of CGPRT crops other than maize are minor. This also implies that food crop based farming will be more diversified if the productivity of CGPRT crops can be increased because the higher the productivity the greater the competitive advantage. This has been shown by the case of maize.

8.2.2 Transportation and marketing infrastructure

The government has put high priority on the development of transportation (Table 8.3). In the period of 2001-2004, the government spent 63.5 per cent of the total development expenditure on transport including land, sea and air. However, land transportation, particularly in relation to agricultural development is still far from sufficient. For example, Lampung Statistics indicates that in 1996 the ratio of road length to total area excluding forestland in Lampung is only 5.2 kilometres per 1,000 hectares.

Roads to fields where CGPRT crops are grown are generally dirt roads in bad condition. Rehabilitation of these roads would greatly aid the marketing of CGPRT crops. Table 8.4 shows that households in general have relatively good access to marketplaces. In Lampung, for example, each market unit serves 1,472 households. On Java, each market unit serves a higher number of households because this island is the most densely populated island in Indonesia. Most of these marketplaces retail agricultural inputs, agricultural products and consumer goods. Marketing CGPRT crops usually bypasses the marketplaces, except for retailing. To facilitate the marketing of agricultural produce including CGPRT commodities, the government has initiated the development agribusiness terminals in many places.

The government has established formal credit units at least at the sub-district level in the form of rural banks such as BRI and BPR under the supervision of the Central Bank (Bank Indonesia). The access of farmers and traders to the formal credit units, however, is still limited because many of them cannot meet the terms determined by the banks. Usually land certificates are required as collateral in applying for formal credit. Therefore, to improve access to credit, it is recommended that the government continues the national programme *(Pronas*) for land certification.

Table 8.4 Ratio of households to market units and credit service units in Lampung and other selected provinces, 2001

Province	Number of households per market unit	Number of households per formal credit service unit
North Sumatra	1 761	20 107
Lampung	1 472	29 934
West Java	3 828	10 850
East Java	2 590	5 188
West Kalimantan	1 639	59 719
East Kalimantan	1 447	77 993
North Sulawesi	1 726	13 358
South Sulawesi	1 395	15 348

Source: Anonymous (2001).

8.2.3 Potentials and constraints in infrastructure development

The development of infrastructure such as irrigation, farm roads and marketplaces is the domain of the government but both the central and district governments have limited budgets to develop such public services. The only thing that the central and district government can do is to prioritize the ranking of infrastructure development.

Road development that can significantly improve agricultural marketing should have priority. Any farm road improvement would reduce transportation costs and therefore improve marketing efficiency considerably.

Rehabilitation and maintenance of existing irrigation systems should be prioritized by stimulating participation of the water user association in all stages of rehabilitation, from planning to implementation and evaluation. Since the development of new irrigation systems is extremely costly, it should be of low priority to implement.

8.3 Research and development

8.3.1 Research on maize and cassava [2]

So far, the Indonesian Centre for Food Crops Research and Development (ICFORD) has introduced 17 composite maize varieties and 11 hybrid maize varieties. Four of the composite varieties, Arjuna, Wisanggeni, Lagaligo and Kresna dominated maize cropping area until early 1990s. These composite maize varieties have competitive advantage on marginal lands. However, the use of new maize varieties combined with integrated management of production may boost yields by 25-30 per cent. For hybrid varieties, however, farmers adopt only a few because multinational companies release better hybrids. In Restu Baru Village, farmers grow hybrid maize varieties released by multinational companies in the wet season, namely P-12 (60 per cent), NK-77 (20 per cent), Bisi-II (15 per cent) and others (5 per cent).

In the period of 2000-2003, ICFORD introduced three maize varieties: Bisma, Lamuru and Semar-10. These varieties may yield 6 tons per hectare. In 2001, CIMMYT in Mexico introduced QPM (quality protein maize). Verification of these varieties in 16 locations of Indonesia indicated that they might produce 6 tons of maize per hectare as well. Introducing and expanding QPMs requires demonstration plots on farmers' land and subsequently up-scaling.

The rising demand for animal feed in the form of forage has expanded maize area. For example, Indonesian Cereals Research Institute (ICRI) in collaboration with a private company recently prepared a sample of dried chopped maize. Dried chopped maize is a type of cow feed and an export commodity. Ideally, maize used for this type of animal feed should be digestible with a moisture content that is not too high. For this, the crop is best harvested after 75-85 days. To expand the production of this type of animal feed, it is recommended that the government informs maize farmers about how to produce it and provide them with a particular rural credit scheme for the purchase of choppers and drying boxes.

The development of agricultural technology since 1970 has significantly raised food crop production. In the period of 1988-1994, farmers adopted several new food crop varieties. Eight varieties of tidal swamp rice, five varieties of sorghum, 11 varieties of soybean, three varieties of mung bean, seven varieties of groundnut, four varieties of string bean (*kacang tunggak)*, two varieties of dry-land rice, two varieties of potato, and two

[2] This section is heavily drawn from Anonymous (2005).

varieties of cassava have been adopted by farmers. In the study areas, cassava grown in the dry season is Adira (20 per cent) and Kasetsart (80 per cent). Kasetsart was originally imported from Thailand (Siregar, 2005).

Since the late 1960s, there have been 130 modern rice varieties released in Indonesia. ICFORD produced about 73 per cent of them, while the International Rice Research Institute (IRRI) released the remaining 27 per cent. The varieties include 57 varieties for wetland areas, 12 varieties for tidal swamps and 25 varieties for dry land. Six of the wetland varieties have good adaptation in dry land ecosystems as well (Anonymous, 2005). The history of adoption of modern rice varieties can be described as follows: PB5/PB8 (1968-1975), PELITA-1/1 and PELITA-1/2 (1972-1978), IR26 and IR36 (1978-1985), and finally IR42 and IR64 (1986-present). Since 1990s, ICFORD has been developing rice varieties resistant to brown plant hopers, *tungro* and leaf bacteria (Anonymous, 2005).

About 90 per cent of the 9.2 million hectares cropped with rice in 12 provinces are planted with various modern rice varieties. The use of these modern rice varieties has resulted in increased yields. The increase in rice production between 1971 and 2000 was 56 per cent, whereas the area cropped with rice over the same period of time only expanded by 26 per cent. New varieties, irrigation systems and fertilizers may contribute 75 per cent to the increase in rice production.

Rice productivity, which has been levelling-off during the last 15 years, urges for a new technological breakthrough. Challenged by the situation, ICFORD introduced hybrid varieties such as Maro and Rokan in 2001 and a new type of modern variety (Fatmawati) in 2003. These varieties may increase yields by 10-20 per cent. Multinational and private companies also participate in the development of hybrid rice. PT BISI and PT Kondo released two and three hybrid varieties respectively. In the future, the productivity of new rice varieties should increase by 15-25 per cent above the existing varieties.

New rice varieties produced by ICFORD contribute to quality improvement and agribusiness development. For example: (i) IR64, *Lusi, Jangkok* and *Kapuas* are good for infant food; (ii) *Cisokan* and *Mahakam* are suitable for canned rice; (iii) *Cisokan*, IR36, IR42, *Jatiluhur* and *Progo* are good for rice noodles; (iv) *Gilirang*, *Batang Gadis*, *Situ Bagendid* and *Sintanur* are aromatic rice; and (v) *Membramo* is good for instant rice.

To develop agricultural mechanization, the Indonesian Agricultural Mechanization Research Institute (IAMRI) has developed new agricultural equipment. In 1992, the institute produced a prototype to simultaneously plant and fertilize soybean and maize. The objective of producing such tools is to increase the efficiency of using seeds, fertilizers and labour. However, the use of this equipment in the field is still limited. The institute is developing other equipment for weeding, groundnut threshing, groundnut peeling and rice milling.

Established in January 2002, the Indonesian Agricultural Post-harvest Research Institute (IAPOSTRI) carries out research on post-harvest technologies for all agricultural commodities. In relation to food crops, IAPOSTRI has conducted research on (i) reducing post-harvest losses and the use of circular drying silos for rice grains; (ii) technology to produce instant rice; (iii) technology to produce rice flour and instant glutinous rice flour; and (iv) technology to produce instant porridge of glutinous rice.

IAPOSTRI also develops technology to produce flour as a source of carbohydrates. Its objective is to reduce the country's dependency on rice. In this field, the institute has developed demonstration units of cassava flour in East Java and Lampung. The technology has several merits such as a high conversion factor (27-39 per cent), longer expiry dates, and low HCN content (less that 40 ppm). The institute has recommended the substitution of the flour for wheat flour (20-80 per cent) in various foods.

Balanced fertilizing based on soil nutrients introduced by the Indonesian Centre for Soil and Agro-climate Research and Development has had large impact on crop production. The centre has prepared maps of phosphor and potassium status for 18 provinces in Indonesia. Using these maps accurately and considering the needs of crops for nutrients, the country may save huge foreign currency. Indonesian Institute for Fertilizer (LPI) and the government-owned fertilizer producing companies use these maps to prepare recommendations on effective and efficient fertilizers for wetland rice. The centre significantly contributes to the national fertilizer policy; they recommend the conditions and procedures of registering inorganic fertilizers. The centre has published the 'Atlas of Soil Resources', 'Atlas of Agricultural Spacing Management', 'Atlas of Favoured Commodities by Regions', "Atlas of Indonesian Climate', and 'Atlas of Wetland Rice Fields'.

The Indonesian Centre for Socio-Economic Research and Development (ICASERD) also plays a role in directing the policies on food crops in Indonesia. To implement effective floor prices for rice (HDPP), the centre recommended that the floor price policy be accompanied by a tariff policy, which is compatible to the floor price policy, and relate the programme of rice for the poor (*Raskin*) to the floor price. For the present floor price of rice, which is Rp 1,725 per kilogram, the government needs to raise the prevailing specific import tariff of Rp 430 to Rp 710 per kilogram. In addition, the government should relate the programme of rice for the poor to domestic rice procurement based on the floor price such that rice for the programme is not from imports. These recommendations are however still under consideration by the government.

For the year 2005, parliament (DPR) suggested that the government provide fertilizer subsidies, on which the government has to spend Rp 1.3 trillion. ICASERD actively participated in the discussion on whether the subsidy would be given directly to farmers or indirectly through fertilizer producers. The minister of agriculture seemed to prefer the latter to avoid any misconduct in channelling the subsidy.

Indonesian delegates in the Uruguay Round proposed the concept of 'strategic agricultural products' that can be excluded from trade liberalization. ICASERD significantly contributes to the discussion on justifying and quantifying indicators determining these strategic products. The concept is important to help farmers prepare for global competition. If the proposed strategic products are accepted, Indonesia has to increase farm efficiency and develop products for larger markets. The centre is also successful in developing a model of price projections for major food crops and estate crops. Presently, ICASERD is developing Self Help Credit (*Kredit Usaha Mandiri*) that is a credit scheme of the Bangladeshi Grammen Bank, and synthesizes policies for each agricultural sub-sector (food crops, horticulture, estate crops and animal husbandry).

It is obvious from the above discussion that research and development on food crops in Indonesia has put high priority on rice and low priority on CGPRT crops. Consequently, such a bias policy will not significantly boost the productivity of CGPRT crops. If the productivity of CGPRT crops increased, diversification of food crops would have improved. Diversification of food crops is required to strengthen food security and alleviate poverty.

8.3.2 Development of extension services networks[3]

The government has been developing extension service networks in Indonesia since the early 1970's. In particular the green revolution, characterized by the introduction of modern rice varieties and chemical inputs, was expanded. The government then expanded networks for non-rice crops. However, technological development in rice stagnated after Indonesia achieved self-sufficiency in rice. This has reduced the effectiveness of extension services for farmers. The situation has become worse after 1999 when the country initiated the decentralization of government at district level.

In the present milieu of autonomous government, each district has to manage overall development in its own district including its budget. In such situations, district governments

[3] This section is heavily drawn from Anonymous, 2001.

are usually not interested in managing agricultural extension programmes, as they cannot directly provide returns to district government. Consequently, the performance of agricultural extension has been falling. A number of extension workers are assigned to do non-extension work; when they are still working on extension services, they are often neglected.

Looking at the average number of farm households per extension worker, one may conclude that farmers in general have relatively good access to extension services, except in some provinces (Table 8.5). In Lampung, agricultural land area per extension worker is 714 hectares and the number of farm households per extension worker is 922. Agricultural land area per extension worker tends to be high in less populated area such as in West and East Kalimantan. Conversely, the number of farm households per extension worker tends to be high in highly populated area such as Java.

Table 8.5 Agricultural land area, number of farm households and number of farmer groups per extension worker in selected provinces

Province	Agricultural land area (ha) per extension service unit (BPP)	Agricultural land area (ha) per extension worker	Number of farm households per extension worker	Number of farmer groups per extension worker
North Sumatra	5 186	743	702	9.54
Jambi	15 350	585	321	4.95
Lampung	11 194	714	922	10.00
West Java	4 640	575	1 262	0.30
East Java	5 383	519	1 100	0.24
West Kalimantan	20 553	1 110	545	0.15
East Kalimantan	14 656	1 020	580	0.19
North Sulawesi	5 418	382	349	5.15
South Sulawesi	7 128	666	524	0.30

Source: Anonymous, 2001.

From the present number of extension workers in Indonesia (25,380), 98 per cent are in extension services units (BPP) of districts or municipalities, 0.8 per cent in various agricultural offices at the provincial level, 1 per cent in Assessment Institute of Agricultural Technology Assessment (BPTP) and 0.2 per cent in units of Department of Agriculture in Jakarta. There are 3,892 extension service units (BPP) at the sub-district level, but the units do not function well since the district or municipal governments do not pay much attention to the units (Sinar Tani, 2-8 March 2005).

Many extension workers feel frustrated because their present assignments are not clear. To improve the situation, the president and the Ministry of Agriculture have announced that the central government will re-centralize agricultural extension including salaries and assignments. However, it is not clear yet when the central government might implement the centralized policy of agricultural extension because it is dependent on availability within the government budget.

In 2005, the Agency of Human Resource Development in Agriculture strengthened agricultural extension from district and municipality levels to sub-district, village, and community levels. The sequence of the programme consisted of (i) training of trainers (TOT); (ii) training of extension workers; (iii) forum between extension workers and farmers; (iv) guidance for farmer groups; (v) weekly meetings; and (vi) farmer action research. The agenda of the weekly meetings is leadership development, problem solving and topics of training for extension workers at the extension services units (BPP). In farmer action research, farmers identify and develop existing or new location-specific technologies (Sinar Tani, 1-7 June, 2005).

8.3.3 Potentials and constraints in the development of technology and extension service network

The Agency of Agricultural Research and Development (AARD) in general and the Indonesian Centre for Food Crops Research and Development (ICFORD) in particular have great potential in terms of human resources to conduct agricultural research and development. In 2004, the total number of research workers in all research fields was: 273 PhDs, 871 masters and 1,916 undergraduates (Anonymous, 2004). In relation to rice and CGPRT crops, AARD has released and recommended many varieties, mechanized equipment, farming practices, post-harvest technologies and agriculture-related policies.

The accountability of AARD is dependent on the professionalism of the researchers. To improve their professionalism in future, it is essential to motivate the researchers.

Financing is also another strategic factor influencing the performance of AARD. Table 8.6 indicates that AARD budgets are highly dependent on loans from the World Bank and Asian Development Bank through the projects of Agricultural Research Management II (ARM-II) and Participatory Development of Agricultural Technology (PAATP). The proportion of loans has been decreasing since 2001. To reduce the dependency on loans in the future, AARD will develop domestic and international collaborations such as collaborations with private companies, regional governments, small and medium companies, NGOs, government-owned enterprises, farmers and bilateral collaborations in the form of science and technology transfers.

Table 8.6 AARD budget, 1999-2004 (millions of rupiah)

Year	Routine budget	Development budgets			
		Government	Loans	Collaboration	Total
1999	80 670	78 984	131 170	0	290 824
2000	85 211	49 125	108 250	0	242 586
2001	113 608	82 264	135 422	0	331 294
2002	127 566	117 660	128 781	3 290	377 237
2003	147 943	166 056	82 367	12 583	408 949
2004	192 594	182 258	86 195	31 762	492 809

Source: Anonymous, 2004.

Based on the number of extension workers, the Ministry of Agriculture could intensify agricultural extension services in the future as long as the extension workers are sure about their status and the stepladders of their careers, and the Ministry of Agriculture trains them periodically about innovations. The question is: “Which innovations are farmers willing to adopt?” This depends on how far each AIAT (Assessment Institute of Agricultural Technology) in each province can assess and assemble all innovations from all AARD’s research institutes for location-specific situations by applying a participatory approach. The participatory approach should cautiously take into consideration the existing farmers’ resources, input markets and market demand for outputs.

Evaluation of the performance of AIAT carried out by AARD every year should be based on the achievements of the approach. The achievements become the inputs for extension workers to expand in the field through the processes of adoption and diffusion of innovations. This implies that the participatory approach applied by AIAT in assessing and assembling all innovations should include the participation of extension workers.

8.4 Concluding summary

Most food crop related policies, such as price supports, farm credit, input subsidy, trade, irrigation development as well as research and development policies have been bias toward the development of rice production to achieve the highest possible level of rice self-sufficiency. Consequently, the diversification index of food crops (rice and CGPRT crops) has declined. Rice has become the only specialized crop in almost all provinces of Indonesia.

In relation to the development of food crops (rice and CGPRT crops), the AARD has released and introduced many varieties, farming practices, agricultural machinery and post-harvest technologies. However, the agency accorded low priority to research and development for CGPRT crops because they are not major staple foods and the government perpetuates its tendency to strive for rice self-sufficiency. To reduce the country's dependence on rice, research on creating alternative foods based on the processing of CGPRT crops is essential. Besides, research on developing varieties of maize, cassava and other CGPRT crops for direct human consumption is also necessary. To raise the demand for CGPRT crops in general, research on developing non-food products such as bio-fuel should be intensively undertaken.

AARD has great potential in terms of human resources. As a public institution, however, it might not be sufficiently conducive to motivate researchers. Hence, it is necessary for the agency to seek ways of motivating the researchers in carrying out agricultural research and development. In terms of financing, AARD could reduce its dependence on loans by developing domestic and international partnerships. In the future, AARD should pay more attention to research and development of CGPRT crops to foster food crop diversification. This is a prerequisite for poverty alleviation because most poor farmers grow CGPRT crops.

The Ministry of Agriculture has neglected agricultural extension since even before the decentralization of government. In terms of human resources, however, agricultural extension still has potential. To what extent the ministry can improve agricultural extension depends on two things: (i) Assurance regarding the status and career stepladders for extension workers; and (ii) breakthroughs developed by AARD in general, and technological and institutional assessment by AIAT in particular. To expand the diversification of food crops, agricultural extension in the future should prioritize the development of CGPRT crops.

9. Prospects for Enhancing the Sustainable Development of Diverse Agriculture

9.1 Overall assessment of potential

Farming, marketing and processing maize and cassava in Lampung are promising because the three types of activity are profitable and the demand for feed and tapioca is increasing. Recently, the demand for animal feed and tapioca products has risen by 8 per cent and 5 per cent per year respectively. In addition, export prospects for dried cassava still show promise because export quotas to the European market are not filled yet.

In general, farming is more vulnerable than marketing and processing because farming often deals with unfavourable weather situations, high fluctuations in output prices, and increasing prices of material inputs. Regardless of the vulnerability of farming, farmers are rational in the sense that they tend to choose crops or crop rotations based on available resources, technology and the market situation. This implies that to develop sustainable diverse agriculture, farmers have to have more access to farm credit, new technologies, and relatively stable prices of inputs and outputs.

9.2 Overall assessment of constraints

Although capital for purchasing farm inputs is not a serious problem in the area, farmers feel that the prices of recommended seeds (maize and rice) and fertilizers are too expensive while output prices are too low. This perception actually stems from the fact that they frequently face fluctuating and sometimes low output prices, while the prices of inputs tend to increase continuously. Other classic input problems that farmers face are the shortages of fertilizers and labourers. Labourers may be in short supply, particularly at peak harvest time when many farmers need them.

In marketing, the classic constraints are price fluctuations caused by seasonal harvests, and high transportation costs caused by bad road conditions. In addition, the market structure at the processing level is oligopsonistic. No clear and consistent relationship exists between monthly production and prices. This situation is exacerbated by imperfect information for the farmers regarding the way the processing firms determine weight and moisture content of the commodities.

Crucial constraints faced by feed and tapioca processing industries are the continuity and quality of raw material. Supply continuity of maize and cassava as raw materials for feed processing and tapioca processing is affected by the cropping season. The quality of maize in terms of moisture content and the quality of cassava in terms of both starch and moisture content are affected by the time of harvest, crop variety and the use of fertilizers. Starch content of cassava harvested 7-9 months after planting is lower than the starch content of cassava harvested 9-11 months after planting. When farmers are in need of immediate cash they sometimes harvest cassava before the 9-month threshold.

The problems of supply continuity faced by feed and tapioca processing industries and the problems of price volatility faced by farmers could be resolved by the two parties working together. With such co-operation, each processing unit could ask farmer groups in a particular area to use a specific cropping pattern that meets the capacity of the processing unit. To encourage farmers to use these cropping patterns, the processing unit should offer farmers fair and stable maize and cassava prices.

To develop the agriculture sector, infrastructure must be developed. The development of irrigation systems, roads and marketplaces should be the domain of the government, but both the central and district governments have limited budget capacity to accelerate the development of such public services. Pump irrigation is suitable for the production of maize or cassava as well as other CGPRT crops.

The Agency of Agricultural Research and Development (AARD) in general, and the Indonesian Centre for Food Crops Research and Development (ICFORD) in particular, have great potential in terms of human resources to conduct agricultural research and development. AARD has released and recommended many varieties, mechanized equipment, farming practices, post-harvest technologies and agriculture-related policies. In the future, AARD should pay more attention to research and development of CGPRT crops to reduce poverty because most CGPRT crops are grown by poor farmers in relatively harsh environments. AIAT (Assessment Institute of Agricultural Technology) in Lampung can use the results of research and development to develop location-specific diversification based on CGPRT crops, including maize and cassava.

The accountability of AARD is dependent on the professionalism of the researchers. To improve professionalism in the future, it is essential to design a system to motivate their researchers because AARD is a public institution where all innovations so far have become public goods.

Financing is another factor influencing AARD's performance. Thus far, AARD budgets were highly dependent on loans from the World Bank and Asian Development Bank, but the proportion of loans has been decreasing since 2001**.** To further reduce the dependency on loans in the future, AARD will develop domestic and international collaborations with private companies, regional governments, small and medium enterprises, NGOs and government-owned enterprises.

Based on the number of extension workers, the Ministry of Agriculture can intensify agricultural extension services in the future as long as the extension workers are trained periodically about both technical and institutional innovations. The question is which innovations farmers are willing to adopt. The answer is dependent on how far each AIAT (Assessment Institute of Agricultural Technology) in each province can assess and adapt the innovations from AARD's research institutes to local conditions, particularly by applying a participatory approach. Extension workers would play a significant role in the diffusion of location-specific diversification based on CGPRT crops, including maize and cassava.

9.3 Strategies and policies to enhance sustainable development of diverse agriculture

It is indicated in Chapter 4, farmers are rational in a sense that, given their limited resources, available technology, input markets and prevailing market demands for agricultural outputs, they choose the best alternative taking all possible risks into account. If the factors are unchanged, the farmers will maintain their existing cropping patterns. Phase I of this study, however, found that the diversification index of food crops (rice and CGPRT crops) has been declining, while rice proves to be the only specialized crop in almost all provinces of Indonesia. The declining diversification index of food crops is the result of government policies affecting irrigation development, floor prices, farm credits, input subsidies, and technological development which were all biased towards expanding rice production to achieve rice self-sufficiency.

CGPRT crops are commonly grown by poor farmers in harsh environments. To reduce rural poverty in this group, it is necessary that diversification is based on CGPRT crops. To encourage CGPRT crop based diversification, Phase I of this study recommended several policy measures (see justification for each recommendation in the introduction of this report):

1. Removal of import tariffs and price support for rice;
2. Imposition of import tariffs on wheat and wheat products;

3. Imposition of import tariffs on net-imported CGPRT commodities;
4. Partnerships between farmer groups and processing units to raise the prices of net-exported and non-traded CGPRT commodities;
5. High research priority on CGPRT crops;
6. Improve marketing efficiency of CGPRT crops; and
7. Improve institutions to support agricultural diversification.

The demand for CGPRT crops can be increased through processing and product diversification, research on new processing techniques, as well as preserving and diversifying CGPRT products is important to enhance the sustainable diversification of CGPRT crops based farming systems. These represent the fields of research covered by the Indonesian Agricultural Post-harvest Research Institute (IAPOSTRI).

This study has shown that the major constraints facing maize and cassava farmers are high fluctuations in output prices and the unclear ways processing units determine the moisture content of maize and cassava and the starch content of cassava. On the other hand, supply continuity of cassava is the major problem faced by the processing units. These problems can be resolved through co-operation between the two parties. To this end, a processing unit may ask specific farmer groups to use specific cropping patterns that can meet the capacity of the processing unit. To encourage farmers to use the cropping pattern, the processing unit should provide the farmers with stable prices and disclose information regarding the ways of determining moisture and starch content. Such co-operation between farmer groups and a processing unit should be applied not only for maize and cassava but also for all CGPRT crops.

Most sample farmers use their own savings to cover the costs of farming. However, comparisons between the two study sites explicitly indicates that the availability of working capital is the major factor influencing farmers' decisions when choosing which crops to grow and what cropping pattern to use. This implies that expanding farmers' accessibility to formal credit at reasonable interest rates would enable farmers to diversify their farms with CGPRT and vegetable crops to boost household income.

10. General Conclusion and Policy Recommendations

10.1 General conclusion

The agricultural sector in Lampung has been growing at a relatively high rate. This sector plays a significant role in generating income and employment and alleviating poverty. As such, development of agro-industry seems to be a means to this end, because agro-industry creates demand for agricultural produce and, therefore, generates employment and value added, and ultimately reduces poverty. In this relation, CGPRT crop based agro-industry to produce food and non-food products should be prioritized. This would not only generate employment and value added but also develop sustainable diverse agriculture.

A comparison between the two survey sites indicates that the availability of working capital, which is affected by farm size and access to non-farm employment, is an important factor affecting farmers' decision-making. Farmers with smaller farm sizes and less access to non-farm employment grow rice instead of maize in the wet season though maize production may generate higher net returns per unit of land. This is because maize production requires higher input costs while rice as the major staple crop can be used directly for household food security. In the dry season, farmers at both sites grow cassava because they feel that it is a 'saving' crop in the sense that cassava production does not entail high costs but provides moderate returns to household resources. This indicate that farmers are rational and responsive to the markets, but they also take into account all possible risks.

The main problem in marketing maize and cassava in Lampung stems from the fact that processing units and middlemen tend to be price makers while farmers are price takers. In relation to maize, the number of large feed mills is small and, therefore, they tend to be oligarchic. Moreover, farmers and middlemen face the problem of poor transparency from feed mills regarding the way they weigh maize and determining its moisture content.

Similar problems are found in tapioca processing firms. There are many active tapioca processing companies in Lampung, but it does not mean that the market is competitive since sellers also do not know the real procedure to weigh cassava or determine the starch content. Note that when a seller is not satisfied with a price level offered by a buyer or tapioca processing firm, it is not easy to move to another buyer since this entails additional transport costs. Although the number of tapioca processing units is relatively high, there is a tendency for the small units to follow the decisions of the large ones, particularly in determining the buying price of cassava and selling price of tapioca.

It is unequivocal that the processing industries using maize or cassava as raw materials show high potential since the industries are profitable and the demand for their outputs is increasing. The most challenging constraint faced by the processing business is the continuation of raw materials, especially cassava. Cassava is frequently in short supply in the wet season but in over supply in the dry season. Problems of short maize supply for the feed processing firms is not as severe as that of cassava because imported maize can be substituted for local maize.

Output per unit of land of any crop generates both employment and income not only in the farming itself but also in marketing and processing. For the three commodity systems studied, employment in farming is much higher than in either marketing or processing. Sometimes the supply of labour cannot satisfy the high employment opportunities in farming, especially during peak season. Most likely, it is because many young villagers are not interested in working as farm labourers even though non-farming employment opportunities are limited.

In relation to the development of food crops, AARD has released and introduced many varieties, farming practices, agricultural machinery and post-harvest technologies. However, the agency put low priority on research and development of CGPRT crops, most probably because they are not major staple foods and the government has a tendency to focus on rice self-sufficiency.

Financing is another strategic factor influencing the performance of AARD. Thus far, AARD budgets have been highly dependent on loans from the World Bank and Asian Development Bank, but the proportion of loans has been decreasing since 2001. To reduce the dependency on loans in the future, AARD will develop domestic and international collaboration with private companies, regional governments, small and medium companies, NGOs and government-owned enterprises, among others.

The Ministry of Agriculture has neglected agricultural extension since before the decentralization of government. In terms of human resources, however, agricultural extension still has the potential to improve. To what extent the ministry may improve agricultural extension depends on at least two things: (i) Assurance regarding the status and career stepladders of extension workers; and (ii) innovations developed by AARD as well as technological and institutional assessments by AIAT.

10.2 Policy recommendations

1. It seems that the constraints farmers face at the study sites are low soil fertility, high input prices, low output prices and shortages of chemical fertilizer and labour. Besides, unusually low precipitation sometimes occurs in the dry season. To loosen some of these constraints, local governments could play a significant role by helping farmer groups to produce organic fertilizers, providing farmer groups with shallow tube-well pumps, and identifying and overcoming the causes of fertilizer shortages.
2. The availability of working capital is the main factor influencing farmers' decision-making on what to grow and which cropping pattern to use. In order to develop food crop diversification[4], it is therefore necessary that farm inputs be subsidized and farmers' access to cheap credit be improved. Government-owned banks should be obliged to improve individual farmer's access to cheap credits. Since a land certificate is required to apply for credit from the banks, the National Agency for Land Certification (BPN) could support this policy by accelerating a Low-Cost Land Certification Programme.
3. To make maize and cassava marketing efficient, local governments should provide farmers with information on how processing firms weigh and determine moisture or starch content when they buy maize or cassava. Such information may reduce transaction costs and result in more efficient markets.
4. On one hand, the major problem for cassava farmers in Lampung is low and fluctuating cassava prices. On the other hand, large tapioca processing companies have the problem of excess capacity. To solve the two problems simultaneously, local governments may encourage or necessitate co-operation between a processing company and cassava farmer groups in a given locality, particularly in relation to how much and when to produce, and more importantly the price at the processing gate. Similar co-operation can be applied between feed processing companies and maize farmers.
5. Development of small-scale tapioca processing units in line with the ITTARA Programme can improve marketing efficiency for cassava because the distance from farmers to tapioca processing units becomes shorter rendering the involvement of middlemen redundant. Therefore, it is necessary that local

[4] It is indicated in this study that crop diversification through intercropping creates more employment and generates significantly more income.

governments rehabilitate ITTARA units that have collapsed so that the market structure can become more competitive. Rehabilitation of each ITTARA unit, however, should be based on a comprehensive cost-benefit study. The rehabilitation would be more successful if it followed a participatory approach involving the local community.

6. Research and development carried out by AARD is another significant element in agricultural development in Indonesia. The accountability of AARD is dependent on the professionalism of the researchers. To improve their professionalism it is essential to motivate the researchers.
7. Thus far, AARD has accorded low priority to research and development of CGPRT crops, most probably because they are not the major staple foods and the government always has a tendency to increase rice self-sufficiency. To reduce the country's dependence on rice, research on creating alternative foods based on the processing of CGPRT crops is essential. Research on developing alternative industrial products of CGPRT crops, such as bio-fuel, is imperative for Indonesia.

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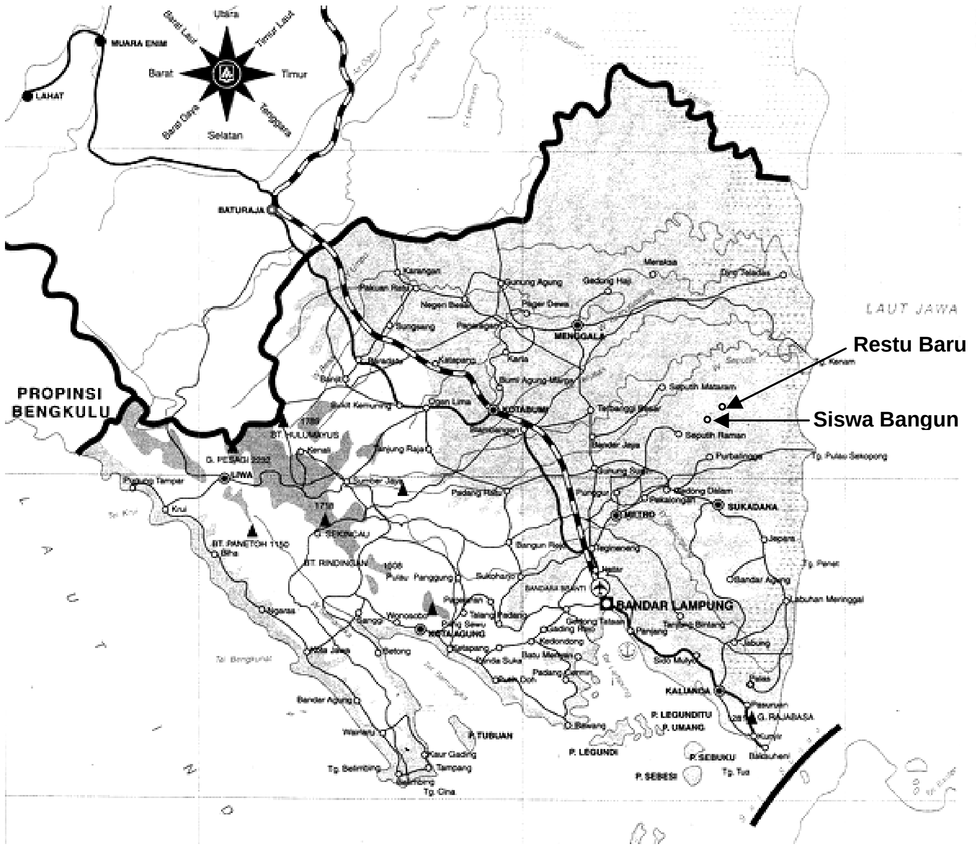
Appendix 1. Location of studies site



Source: Field survey.

Appendix 2. Changes in gross regional domestic product of Lampung province, 1993-2003 (at 1993 constant prices)

Sector	GDP (Rp billion)		Proportion (%)		GR (%/yr)
	1993	2003	1993	2003	
Agriculture [a]	1 954.2	2 911.7	36.8	35.2	4.9
Manufacturing	777.4	1 084.8	14.6	13.1	4.0
Construction	360.2	596.2	6.8	7.2	6.6
Trade, restaurants and hotels	853.8	1 221.4	16.1	14.8	4.3
Transport, storage and comm.	402.5	803.7	7.6	9.7	10.0
Banking and other financials	228.6	564.9	4.3	6.8	14.7
Public services	625.8	706.3	11.8	8.5	1.3
Mining, electricity, gas and water	105.6	374.8	2.0	4.5	50.3
Total	5 308.1	8 263.8	100	100	5.6

Source: Lampung Dalam Angka (Lampung in Figures), 1993 and 2003.
Note: [a] including livestock, forestry and fishery.

Appendix 3. Changes in employment by economic sector in Lampung, 1999 and 2003

Sector	Employment (thousand)		Proportion (%)		GR (%/yr)
	1999	2003	1999	2003	
Agriculture	1 807.1	2 049.8	59.4	67.9	3.4
Manufacturing	247.4	144.5	8.1	4.8	-10.4
Construction	86.8	90.3	2.9	3.0	1.0
Trade, restaurants and hotels	435.5	385.3	14.3	12.8	-2.9
Transport, storage and comm.	119.9	126.1	3.9	4.2	1.3
Banking and other financials	3.2	12.9	0.1	0.4	75.8
Public services	333.8	203.2	11.0	6.7	-9.8
Mining, electricity, gas and water	7.3	5.7	0.2	0.2	-5.5
Total	3 041.0	3 017.8	100.0	100.0	-0.2

Source: Statistical Yearbook of Indonesia, 1999 and 2003.

Appendix 4. Land uses in Lampung, 1995 and 2003 (hectare) [a]

Land use	1995		2002		GR [b] (%/yr)
	Thousands of hectares	%	Thousands of hectares	%	
Settlement (*pemukiman*)	238.1	11.2	256.1	11.7	1.08
Dry land (*lahan kering*)	795.0	37.4	832.4	37.9	0.67
Wetland (*sawah*)	285.2	13.4	310.8	14.1	1.28
Estate crops (*perkebunan)*	491.8	23.2	549.8	25.0	1.68
Wood land (*kayu-kayuan*)	107.9	5.1	122.6	5.6	1.94
Meadows (*padang rumput*)	10.5	0.5	10.2	0.5	-0.37
Dyke (*tambak*)	24.7	1.2	14.9	0.7	-5.63
Pond (*kolam*)	3.2	0.2	4.0	0.2	3.45
Temporary fallow (*lahan bera*)	167.1	7.9	97.21	4.4	-5.98
Total	2 123.7	100	2 198.1	100	0.50

Source: Statistical Yearbook of Indonesia, 1996 and 2003.
Note: [a] Forest area is excluded.
[b] GR = Growth rate.

Appendix 5. Exports of CGPRT products from Lampung province

Product	Quantity (tons)				Value (thousands of US$)			
	2001	2002	2003	2004	2001	2002	2003	2004
Dried cassava chips	9 697	9 936	6 686	24 764	582	638	451	3 489
Dried sweet potato	0	0	0	240	0	0	0	80
Maize	2 785	0	0	271	283	0	0	52
Maize flour	22	0	0	59	2	0	0	11
Tapioca	12 809	14 595	13 116	170 541	1 991	2 544	810	30 399
O*nggok* flour [a]	19 28	12 874	641	64	871	580	65	8
Feed	270	702	9 276	7 241	26	88	2 701	2 064

Source: Laporan Realisasi Perdagangan Luar Negeri Prop. Lampung. December, 2004. Office of Cooperatives, Industry and Trade, Lampung province.

Note: [a] *Onggok* is a by-product of tapioca processing. In 2003 and 2004, Lampung imported 3,700 tons of maize (US$ 458,800) per year.

Appendix 6. Changes in forest area by uses in Lampung (thousand of hectare)

Classification of forestland	1995	2002	GR (%/Yr)
1. Protected forest	336	318	-0.8
2. Park/Reservation forest	422	462	1.4
3. Limited production forest	44	33	-3.6
4. Production forest	281	192	-4.5
5. Non-convertible forest (1+2+3+4+5)	1 083	1 005	-1.0
6. Convertible forest	153	0	-14.3
Total forest area	1 236	1 005	-2.7

Source: Statistical Yearbook of Indonesia, 1996 and 2003.

Appendix 7. Estimated proportion of area by cropping pattern at the study sites

Cropping pattern	Siswa Bangun village (Seputih Banyak sub-district)	Restu Baru village (Restu Baru sub-district)
Rice-cassava	65	0
Cassava-cassava	15	0
Maize-maize-vegetables	0	5
Maize-cassava	15	40
Rice-maize	5	0
Maize-(maize+cassava)	0	55
Total	100	100

Source: Field extension workers' estimation.

Appendix 8. Labour use (man-days per hectare) in dry-land rice production in Siswa Bangun, wet season 2004/05

Activity	Hired labour				Family labour				Total value (Rp 000)
	Male	Female	Drought animal	Paid wages (Rp 000)	Male	Female	Drought animal	Imputed wages (Rp 000)	
1	2	3	4	5	6	7	8	9	10=(5+9)
Land preparation	0.0	0.0	1.9	48	3.2	0.6	7.5	239	287
Planting	4.4	9.0	0.0	156	8.3	9.2	0.0	217	373
Weeding	1.2	3.9	0.0	57	9.1	9.9	0.0	236	293
Fertilizing	0.0	1.1	0.0	11	7.2	5.8	0.0	166	177
Plant-protection	0.0	0.0	0.0	0.0	3.5	1.7	0.0	68	68
Harvesting	30.5	0.7	0.0	465	4.6	5.0	0.0	118	583
Drying storage	0.6	0.3	0.0	11	5.9	7.5	0.0	162	173
Total	36.7	14.9	1.9	748	41.6	39.6	7.5	1 206	1 954

Source: Primary data.

Appendix 9. Labour use (man-days per hectare) in dry-land cassava production in Siswa Bangun, dry season 2004/05

Activity	Hired labour				Family labour				Total value (Rp 000)
	Male	Female	Drought animal	Paid wages (Rp000)	Male	Female	Drought animal	Imputed wages (Rp 000)	
1	2	3	4	5	6	7	8	9	10=(5+9)
Land preparation	0.0	0.0	1.7	41	8.3	4.4	6.3	328	369
Planting	0.6	0.4	0	12	7.4	6.1	0	172	185
Weeding	0.0	0.0	0	0	4.8	3.4	0	107	107
Fertilizing	0.8	0.4	0	16	7.7	6.1	0	177	193
Plant- protection	0.0	0.0	0	0	0.9	0.0	0	13	13
Harvesting	30.0	8.0	0	530	0.0	0.0	0	0	530
Total	31.4	8.8	1.7	600	29.2	20.0	6.3	797	1 397

Source: Primary data.

Appendix 10. Labour use (man-days per hectare) in dry-land maize production in Restu Baru, wet season 2004/05

Activity	Hired labour				Family labour				Total value (Rp 000)
	Male	Female	Drought animal	Paid wages (Rp 000)	Male	Female	Drought animal	Imputed wages (Rp 000)	
1	2	3	4	5	6	7	8	9	10=(5+9)
Land preparation	0.1	0	5.9	154	0.2	0.1	0.6	19	173
Planting	7.3	4.0	0	144	0.9	0.4	0	16	160
Weeding	3.3	2.1	0	67	0.6	0.3	0	11	78
Fertilizing	6.1	3.3	0.8	130	6.1	0.1	0	77	207
Plant- protection	3.8	0.1	0	62	0.4	0	0	6	68
Harvesting	21.0	13.9	0	364	0.5	0.3	0	8.0	372
Total	41.5	23.4	6.7	921	8.7	1.2	0.6	138	1 059

Source: Primary data.

Appendix 11. Labour use (man-days per hectare) in dry-land maize+cassava production in Restu Baru, dry-season 2004

Activity	Hired labour				Family labour				Total value (Rp 000)
	Male	Female	Drought animal	Paid wages (Rp 000)	Male	Female	Drought animal	Imputed wages (Rp 000)	
1	2	3	4	5	6	7	8	9	(5)+(9)
Land- preparation	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0
Planting:									
Maize	7.3	4.0	0.0	144	0.9	0.4	0.0	16	160
Cassava	9.7	4.4	0.0	184	0.7	0.0	0.0	9	193
Weeding	3.3	2.1	0.0	67	0.6	0.3	0.0	11	78
Fertilizing	6.1	3.3	0.8	130	6.1	0.1	0.0	77	207
Plant protection	3.8	0.1	0.0	62	0.4	0.0	0.0	6	68
Harvesting	21.0	13.9	0.0	364	0.5	0.3	0.0	8	372
Total	51.2	27.8	0.8	951	9.2	1.1	0.0	127	1 078

Source: Primary data.

Appendix 12. Material input uses for dry-land rice production in Siswa Bangun, wet season 2004/05

Input	Unit	Quantity	Price (Rp/unit)	Total value (Rp)
Seeds	kg	60	2 303	138 207
Urea	kg	155	1 198	185 862
SP-36	kg	131	1 553	203 448
KCl	kg	42	1 773	74 483
Manure	pack	48	5 705	273 862
Pesticides	*	*	*	45 793
Herbicides	*	*	*	1 379
Others	*	*	*	24 667
Total	*	*	*	947 701

Source: Primary data.
Note: * Consisting of different kinds.

Appendix 13. Material input uses per hectare in dry-land cassava production in Siswa Bangun, dry season 2004/05

Input	Unit	Quantity	Price (Rp/unit)	Total value (Rp)
Plant materials	bunch	77.24	2 911	224 828
SP36	kg	13.79	1 550	21 379
Sugar-residue *(tetes)*	litre	4 000	91	363 448
Manure	packs	13.00	5 000	65 000
Herbicides	litre	0.62	37 111	23 034
Others	kg	2.00	10 000	20 000
Total	n.a.	n.a.	n.a.	717 690

Source: Primary data.
Note: n.a. = not applicable.

Appendix 14. Material input uses in dry-land maize production in Restu Baru, wet season 2004/05

Input	Unit	Quantity	Price (Rp/unit)	Total value (Rp)
Seeds	kg	18.27	26 443	483 096
Urea	kg	300.00	1 325	397 385
SP-36	kg	115.38	1 563	180 385
KCl	kg	87.50	2 543	222 500
Manure	pack	94.62	6 663	630 462
Herbicides	litre	3.46	37 567	130 038
Others	litre	0.12	66 667	7 692
Total	n.a.	n.a.	n.a.	2 051 558

Source: Primary data;
Note: n.a. = not applicable.

Appendix 15. Material input uses in intercropped maize+cassava production on dry land of Restu Baru, dry season 2004/05

Input	Unit	Quantity	Price (Rp/unit)	Total value (Rp)
Seeds (maize)	kg	18.27	26 443	483 096
Plant material (cassava)		70	4 500	315 000
Urea	kg	200	1 325	265 000
SP-36	kg	54	1 563	84 402
KCl	kg	95	2 543	241 585
Manure	pack	0	n.a.	0
Herbicides	litre	3.46	37 567	130 038
Total	n.a.	n.a.	n.a.	1 519 121

Source: Primary data
Note: n.a. = not applicable.

Appendix 16. Approved investments by sectors in Indonesia, 1999-2003

(billions of rupiah)

Economic sector	1999	2000	2001	2002	2003	Total	%
Agricultural sectors:	2 408	4 137	1 378	1 454	1 929	11 306	2.19
Agriculture	1 615	3 351	777	1 452	1 658	8 853	1.72
Forestry	749	16	446	0	177	1 388	0.27
Fishery	44	770	155	2	94	1 065	0.21
Mining	174	36	1 198	787	753	2 948	0.57
Industrial sectors:	46 746	83 061	43 968	15 853	40 445	225 554	43.78
Foodstuffs	12 728	9 221	11 109	4 968	4 247	42 273	8.21
Textiles	2 562	2 312	2 223	440	2 112	9 649	1.87
Wood	1 229	181	553	409	563	2 935	0.57
Paper	20 244	8 672	4 771	150	245	34 082	6.62
Chemical/pharmacy	2 481	56 409	22 337	1 953	30 205	113 385	22.01
Non metal mineral	70	3 523	597	217	933	5 340	1.04
Basic metal	6 354	275	375	7 179	0	14 183	2.75
Metal goods	1 071	2 445	0	0	1 003	4 519	0.88
Other	7	23	2 003	537	1 137	3 707	0.72
Construction	395	843	2 007	1 500	1 774	6 519	1.27
Hotels	1 380	186	2 459	683	930	5 638	1.09
Transportation	225	1 993	1 489	3 118	2 022	8 847	1.72
Housing and offices	996	226	4 541	255	1	6 019	1.17
Electrical, trading, others	1 226	1 846	1 635	1 613	633	6 953	1.35
Total	53 550	92 328	58 675	25 263	48 487	278 303	100.00

Source: Monthly Report (January 2005), Bank Indonesia.