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STUDY ON CASSAVA FLOUR PROCESSING AND MARKETING IN INDONESIA [1)]

Djoko S. Damardjati [2)], S. Widowati [2)],
T. Bottema [3)] and G. Henry [4)]

S U M M A R Y

Cassava is the fourth important food crop after rice, maize and soybean in Indonesia. Annually on average of 16 million tons of cassava is produced. This is mainly utilised mainly as food, but also as raw material for starch extraction, and export commodities as pellet and chips. Markets, however, are unstable and farmers have low incentives to produce more cassava.

The development of cassava flour production was initiated in 1990. It represents an alternative for diversification of cassava products. The cassava flour agro-industry through plasma-nucleous system is still on an initial stage in Indonesia. The system consists of local production systems including Model 1 at farm level, and Model 2 for farmers' groups. Model 3 represents the milling factory as the nucleus of the system. It absorbs dried chips from local production to produce cassava flour. The production capacities for Model 1, 2 and 3 are around 75, 500 and 10,000 kg fresh cassava per day during harvest season. The yield recovery for dried chips and cassava flour were 25 to 30% and 24 to 29%. The farmer and farmer groups get better added value in producing cassava chiplets (sawut) as compare to ***gaplek*** (dried cassava pieces chips) Marketing is, however, still major constraint on expansion of cassava flour agro-industry.

A consumer acceptance study conducted in the Purwakarta region and Ponorogo district showed that around 80% of industries manufacturing wheat based products accepted this cassava flour. For home consumption, the flour can be accepted by 84.4% of consumers. Need are estimated at 4-7 kg per month. Since cassava flour can substitute wheat based products up to 30%, therefore the entire production can potentially be absorbed especially by the food industries. PT Mariza, a private company, initiated the cassava flour industry and develops a marketing system.

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INTRODUCTION

Agriculture is an important component for the Indonesian economy since it provides 49% of the total employment, and about 18% of the gross domestic product (GDP). Food crops are the main contributor to agricultural GDP and represent, 62% of the GDP from agriculture sector, or 12% of the total GDP in 1991.

Rice is the most important food crop. Among secondary food crops (non-rice crops), high priority is given to soybeans followed by corn and cassava. Other secondary crops are peanuts, mungbean and sweet potatoes. There are a number of cereals and legumes, root and tuber crops with a minor role nowadays, but there may have a good potential for future food production.

Cassava is grown on around 1.4 million hectares of land distributed all over the country and is well known by the farmers. An average of 16.3 million tons is produced yearly, in 1992 (CBS, 1992), that is used for food, raw material for starch extraction, and for export as feed (Damardjati *et al.* 1991). The situation of cassava market is unstable and does not provide attractive incentives for farmers to produce cassava.

More recently, the goverment decided to promote the use of cassava for industrial purpose and for food. After an executive team visited Brazil in 1988, special efforts are underway to promote the production of cassava flour from high quality chips and the use of this flour, as a substitute for wheat flour in the production of cake, cookies, bread and pasta. This way one increases the participation of cassava in the menus of middle and high income segments of consumers.

A preliminary economic analysis indicates that the production and use of cassava flour in processed food would be feasible. In view of this, Research Institutes under Central Research Institute for Food Crops (CRIFC)

initiated a series of research on cassava flour production and utilization. In a second step and collaboration with private companies, CRIFC has successfully developed a model of cassava flour agro-industry system at village level at several location in Indonesia (Damardjati *et al.*,1992).

This paper presents the results of our study in development of cassava flour production system, consumer acceptance and marketing of cassava flour.

CASSAVA PRODUCTION, CONSUMPTION AND UTILIZATION

Production

At present, cassava is cultivated by farmers almost in all areas of Indonesia, from lowland to higher altitude land with dry or wet climate and variable soil fertility. Cassava is grown on about 1.3 million hectares, where production is variable from year to year. However, it has generally been stagnant during the last decade. During this period, the harvest area has decreased while productivity has increased. About 65% of total production comes from Java, which has been decreasing over this interval, while the contribution from other islands has increased (Dimyati and Manwan, 1992). The factors causing the reduction in the harvested area of cassava are quite complicated. It seems incentives and sharp price fluctuations have induced farmers to grow cassava. Other factors, such as switching between land with irrigation facilities and the reforestion program, also seem to have influenced this trend.

The average yield per hectare of cassava is still quite low at 12 ton/ha. However, the trend has been towards a constant increase in yields. A much higher yield can be obtained through farmer advancements. In the

cassava estate of a tapioca factory in Lampung, a yield of 25-30 tons of cassava per hectare has been continuously attained (Rusastra 1988). The observed increase in yield was due mainly to the cassava intensification (namely BIMAS) program started by government in 1975 (Dimyati and Manwan, 1992). Moreover, research findings suggest that yields can reach levels of 75 ton/ha. Therefore, it appears that cassava yields obtained by farmers is still far below its potential.

During the five year period between 1978-1992, cassava production fluctuated, and reached its peak at 17.1 million tons in 1989. However, only about 16 million tons were produced in 1992 (Fig. 1). Furthermore, an increase in cassava production is not difficult to achieve. The problem of over-production recurs every year during the peak harvest season with different levels of severity. These are due to a limited cassava market, which in turn is due to a limited variety of uses for cassava, as well as a limit in quantity.

Domestic Demand and Consumption

Annual per capita consumption of cassava tends to decrease gradually. Cassava consumption for food decreased from 57.41 kg/capita in 1983 to 51.0 kg/capita in 1988 (Damardjati *et al.* 1990). During the five year period between 1988 and 1992, it was shown that consumption of cassava and other secondary crops fluctuated and showed correlation with rice consumption. Peak rice consumption of 150 kg per capita in Indonesia was reached between 1988-1990. The subsequent decrease in rice consumption was followed by an increase in secondary crops consumption, including that of cassava (Table 1).

Cassava also became an important export commodity. Since 1982, Indonesia has exported "gaplek" (cassava chip)

and pellet to the European Community, based on a yearly quota, as well as to other countries. Since 1989, Indonesia has also regularly exported tapioca starch (Table 2). Availability of cassava for food consumption was also related to total export of cassava products, such as chips, pellet and starch. The domestic consumption of cassava in 1990 was lower than when compared with that of 1992, due to higher exports in 1990.

The consumption of cassava as a foodstuff is concentrated in Java, thus making demand more stable and more easily estimated. Outside Java, in areas such as Lampung, the international market and industrial activities which use cassava as a raw material will greatly influence the demand for cassava.

Processing and Utilization

Based upon the Indonesian Food Balance Sheet 1991 (C.B.S. 1992), total cassava production in that year was 15.95 million tons and 56.7% was consumed as food in both fresh and processed form. 20.9% of cassava production was processed into chips (gaplek) and pellet for export (41.2%) and industry (48,8%) uses. Tapioca starch was produced from 7.7% of harvested cassava, mostly for export purposes. For domestic purposes, most of the tapioca starch is used in the "krupuk" industry. The rest is used in other food, textile, paper, glucose and pharmaceutical industries. Post harvest losses are still relatively high at 13.0% (Table 3.).

Cassava utilization in Indonesia differs throughout the country. In Java, where 60.0% of the population resides, cassava is consumed primarily as a human food. Unnevehr (1982) reported that the rural inhabitants, the producers and major consumers of cassava, utilize approximately 62% of the fresh cassava and 49% of the

dried cassava (gaplek) they produce for their family's needs.

If there are no further breakthroughs for new markets of cassava and its products, the demand for cassava in Indonesia seems to have reached a plateau. Nevertheless, some experts anticipate an increase in the internal demand for food during the next decade and the expansion of the industrial sector will further increase this demand.

DEVELOPMENT OF APPROPRIATE TECHNOLOGY FOR CASSAVA FLOUR

The development of diversification on cassava utility and technology will extend the market and strengthen the bargaining power of the farmers. They will have other buyers to choose from with better prices for their product. The development of alternatives for cassava utilization, should be simple, easy, and able to give added value directly to the farmers.

Based on the results of some investigation from AARD (Agency for Agricultural research and Development), the Ministry of Industry and Universities, as well as recommendation of the collaborative team of the Ministry of Agriculture and Industry after visit to Brazil. The government has decided that the development of cassava flour has good prospects to be developed as a food commodity for domestic consumption, as a raw material for both of home consumption as well as food industry, where it can be used as to complement wheat or as a substitute material.

Concerning that programme, the government recommended that the agricultural and industrial sectors should make special efforts in promoting cassava business. These recomendations include the diversitication of cassava processed products, to improve their quality, and to promote the use of cassava products for food among the

different strata of the Indonesian population. Several research institutes, the public sector and private companies have developed prototypes of machines for cassava processing and new recipes for preparing food using cassava products, and have promoted the use of composite cassava-wheat flour in the preparation of breads, pasta, cookies, etc.

The real efforts to develop the cassava flour industry has been made by Decree of the Minister of Industry numbers 331 and 332/MMP-X/1989 that assigned the following task to 5 Governmental Companies under the Ministry of Industry: to develop and act as foster-parent of cassava flour production plants in 5 selected provinces. In 1990, under Presidential Aid to KUD (Village Cooperative Unit), there have been 25 cassava flour production units distributed to KUD in 7 provinces.

The development of an agro-industry model on the cassava flour production system is expected to support the effort to transfer technology from researchers to farm level on a commercial scale. It is also supported by continuous distribution and marketing.

Development of Process Operation

To produce cassava flour, roots are peeled, washed, chipped, pressed, dried, ground or milled and the sieved (Damardjati *et al.*,1992). Based on the distribution and processing system which has been commonly used for agricultural product handling at village level, there are 3 types of processor groups : 1) individual farmers, 2) farmers' groups and 3) KUD/Processor/miller/cassava flour producers. The role of each group in this marketing system of cassava can be seen in Fig. 2. This figure shows 3 types of cassava products based on processing steps from

harvesting to marketing of flour, i.e. 1) fresh cassava roots; 2) dried cassava chips and 3) cassava flour.

The KUD (Cooperative) or other entrepreneur groups will be appointed to be the nucleus processor which will be responsible for the processing and marketing of cassava flour. From the distribution/marketing pattern and its transaction products three levels of basic models for cassava flour production, from home to small-scale industrial production, may be derived. They are: Model 1 for individual farmers; Model 2 for farmer groups and Model 3 for flour factories as the nucleus (Damardjati *et al.*,1992).

DEVELOPMENT OF THE AGRO-INDUSTRY FOR CASSAVA FLOUR PROCESSING

Under financing from the SURIF-Projectual Budget, ARM-AARD Project and Government Corporation (PT Petro Kimia Gresik), SURIF undertook to develop and establish this program. It was, then, embarking on a technological transfer program for farmers at the village level, with the assistance of PT Petro Kimia Gresik as the foster parent or nucleus company.

Project Site Selection

The macro-techno-economic approach was used for the selection of the development project sites. Determination of development project sites was based upon the following criteria :

1. Desire and participation of farmer/farmer group and KUD (village level cooperative)/private company as processor in dried chips and cassava flour production.

2. Village/subdistrict selected is a production center of cassava at a district/provincial level.

3. Development area selected has KUD/processor as cassava flour producer which is ready to collect dried chips from farmer/farmer groups.

4. Location selected has sufficient infrastructure such as a transportation system, marketing, etc.

Based on the above criteria, some locations have been chosen to develop the nucleus-plasma system of cassava flour, i.e.: Tanjung-Bintang, Gunung Sugih and Natar Subdistricts-under Lampung district; Wanaraja, Garut, Badegan, Siman and Sarwoo subdistricts under Ponorogo district.

Infrastructure Requirements for Project Implementation

The implementation of the project brought together all aspects of production, processing,and marketing of cassava chips and flour. In this project, the most appropriate available technology was tested in a real-life situation. Problems were encountered in a wide range of areas and levels. Troubles occurred with product quality when processing a large quantity of chips at the farmer level, the quality control system for both chips and flour, transaction systems between farmers and processors, handling systems for poor quality of chips, and the social organization of the processes involved in ending up with a marketable product. Operation research directed toward resolving problems was an essensial component in this project.

Since the project site was selected, project implementation was intiated by identification for

infrastructure requirements. Space and installation required for a village level processing operation at farmer and processor level are indicated in Table 4.

Supply and sorting area. Fresh cassava supply is placed in this area, where that which is of higher quality is separated for processing. This area is not really necessary for the farmer/farmers' group level. The farmers usually processes their own cassava directly after harvesting it from the field. There is no need for a special place to store the material. At the processor level, this place is actually part of the working area. Preparation of raw material, such as weighing, grading and grouping are conducted here. Fresh cassava will be sequentially processed based on its harvesting time. Ideally, all fresh cassava should be processed not more than 24 hours after harvest.

Work area for processing. In Models 1 and 2, this is the area where peeling, washing, soaking, chipping and pressing are conducted. In Model 3, milling and packing are added to the area. It must have a brick or plastered platform with sufficient slope to provide good drainage and easy cleaning. The size of the work area for processing in Model 3 in East Java is roughly 4m x 10m. There is not usually a special place for processing in Model 1. It can be done in the back yard or inside the kitchen. Some Model 2's have a special place, usually in the leader of a group's house or "office".

Drying area. Sun drying is appropriate and has the cheapest cost for drying chips in all models. The area is expected to be completely exposed to the sun. There should be a small shaded area where workers can spead wet chips on the tray before moving them in to the sun. The area is completed with a wooden or bamboo rack to put in the tray

during drying. Ideally, the size of tray is 0.8 x 2 m and usually can be used for 7-10 kg wet chips, depending on the weather. The developed Model 3 has a drying area capacity of 6.000 kg.

Storage room for chips. Dried chips are packed and stored in a storage room. The area is completed with wooden or bamboo in the floor to facilitate material for indirect subject to the cement or brick platform floor. The storage room for chips in Model 3 is also used for keeping the products collected from farmers/farmer groups. The chips are stored in this place until milled or sold. In Models 1 and 2 there is no special area for storing chips. They store the chips together with other things from their fields, i.e. in the central house.

Storage room for flour. The area for storage of cassava flour is more or less the same with the storage room for chips. Cassava flour is more compact than chips, therefore requires less storage space, and cassava flour is only prepared for short storage before it is sold.

Processing Procedure

The processing procedure of cassava flour required for a village-level processing plant encompasses the following steps: fresh cassava handling; peeling; wasking and soaking; chipping; pressing; drying; milling and packing.

Fresh cassava handling. Fresh cassava handling activities at farmer level are affected by the characteristics and quality of cassava product. Fresh cassava handling is encompassed by harvesting time and methods, transportation from the field and fresh cassava storage. In order to get

a good quality, fresh cassava should be processed not more than 24 hours after being harvested.

Peeling. Simple peeling of fresh cassava can be done manually with a knife or traditional peeler. Peeled cassava yield is around 70-80%. This step is preferably done by women, and the capacity of manual peeling is 15-20 kg/h/person.

Washing and soaking. Peeled cassava is washed properly, then is sorted over night for bitter cassava, or for just a few minutes while waiting for chipping steps. Soaking should be done in excess water to inhibit browning and to reduce HCN content.

Chipping and pressing. Peeled-soaked cassava is directly chipped with chipping equipment. The chips size is 0.2-0.5 cm in width, 1-5 cm in length and 1-3 mm in thickness. Wet chips are placed in a tray and then pressed with press equipment, either screw or hydraulic. The aims of pressing chips are reducing moisture to reduce drying time and reducing HCN content, especially for bitter cassava. This is an optional step for sweet cassava.

Drying. Pressed chips are placed in a tray made from bamboo or alumunium. It is spread and put on the rack. Drying is done in open sunlight. It takes from a minimum 14 hours to a maximum of 2 days. Unpressed chips take 2-3 days to dry. Faster drying time resulted in better quality chips.

Packing and milling. Dried chips can be packed in double plastic bags and sealed properly. They can be stored for about 6 months. These chips from Model 1 and Model 2, are then brought to the processor, while in Model 3 the chips are milled to flour with 60-80 mesh of partical size.

Usually the flour is packed into thick plastic bags (0.5-1.0 kg) or into double sacks (25 kg).

Implementation Agroindustrial Model on cassava flour production

Processing Operation System. The agroindustrial model follows a foster-parent system. In this system, the big national government owned corporations were appointed as foster-parents such as PT Petro Aneka Usaha in East Java, PT. Krakatau Steel in Lampung and PT Pupuk Kujang in West Java. The foster-parent Company was supporting some equipment and technical skills through Research and Development Institute Collaboration. For example, there is established collaboration between SURIF/CRIFC and PT Petro Aneka Usaha in founding an agroindustry system of cassava flour in Ponorogo district.

At village level, an agroindustrial model has been developed through the nucleous-plasma system, where the subjects of plasma are farmers or farmer groups. They produced dried chips as intermediate product. The subject of the nucleus or foster parent is milling factory with a final product of cassava flour. In this system, plasma produced dried chips 2-3 times a week, dependant on their capacity and the weather. The chips are collected by the nucleus. The farmers/farmer groups collected their dried chips product together, then sent it to the cassava flour factory (nucleous).

The nucleus factory is advised to produce approximately 40% of total dried chips and 60% collected from plasma. Those mixed chips are stored in a suitable room or milled to distribute or sent to the distributor.

This system has advantages for both the plasma and the nucleus. The nucleous guarantees that all chips produced by the plasma will be accepted and bought. On the

other hand, the nucleous has some advantages, such as operating the equipment (especially the milling unit) in an optimum capacity, indirectly getting drying area from the plasma, labor effeciency and longer operational time of the industry. The last factor mentioned means that during the cassava off season industry still has a stock of dried chips to be milled.

Material, energy and production cost analysis.. Material conversion value in cassava flour processing is influenced by size and skin, variety and equipment used. Bigger size of cassava and easy peeling result in higher yield recovery. Table 5 indicated material conversion in each processing step (Damardjati, *et al.* 1991). The average yield of dried chips and flour are 34% and 32%, respectively. Press equipment with a screw system results in a yield which is a little bit higher than pressed chips. The variety group of cassava based on cyanide content is highly influenced by yield recovery of dried starch. Normally, a bitter cassava variety contains higher starch than when compared with sweet cassava.

At the same time, labor wages were Rp 2.500,-/day. Based on the yield recovery of flour (i.e. 32%), the total cost of production of cassava flour was Rp 187.25,-/kg.

Economic Analysis

Price determination. Standard price is one of the important factors in the agroindustry system of cassava flour, which is basically improved for sliced "gaplek" product. The price of gaplek is unstable and depends on the middle man. Farmers have no bargaining power. The price of "gaplek" is always decreased, especially during peak season. Dried chips farmer face the same problem as gaplek farmers, i.e. price. One nucleus has a system to

give the price of cassava chips from the farmer, i.e. Rp 50,- per kg higher than the highest price of "gaplek". At the same time other nucleus use a table which is based on the price of fresh cassava.

Those methods to determine the price are still not accepted by the farmer. Through a collaboration of SURIF and Foster-parent as the nucleous factory, the standard price of dried chips is determined and agreed upon by both nucleous and plasma. In 1992 the standard price was Rp 270,-/kg chips.

Added value for farmer. Formerly the dried cassava farmer in Ponorogo district was a "gaplek" farmer, not a fresh cassava farmer. Traditionally all harvested cassava was converted to gaplek. Therefore, the economic analysis is calculated based on gaplek product. The added value of dried chips production by farmer compared to gaplek is presented in Table 3.4. The yield of "gaplek" and dried chips are 45% and 30%, respectively. The price of "gaplek" and dried chips at that time were Rp 125/kg and Rp 270/kg and the rent for chipping equipment was Rp 10/kg of dried chips. Average raw material (fresh cassava) processed by the farmer is 100 kg; thus, the added value is Rp 2.175/100 kg of fresh cassava (Table 6).

CONSUMER ACCEPTANCE AND MARKETING

Survey On Consumer Acceptance

Consumer acceptance and market assessment studies were conducted in two locations with different consumer characterictics, i.e. Purwakarta region and Ponorogo, East Java. Purwakarta and Karawang districts in Purwakarta region province are not cassava production areas, and cassava is not a major part of the diet in the menu of the

people. While Ponorogo district is a major cassava production area, cassava is the second diet, after rice, in the menu of the people. The first area mentioned is neither a production non consumer area of cassava. The second area mentioned is a production and consumer area. This study used based line survey method, which included 115 respondent families in Purwakarta and 124 respondents in Ponorogo. The study encompassed the following: recognition of cassava flour, utilization and consumer preference.

Recognition of cassava flour. Cassava flour produced with chips as an intermediate product is an improvement of the well known "gaplek" flour. This is a relatively new product, therefore, a recognition has been conducted to give information to consumer. The information source can be extended through undergrade students who did the final task at university (Villages development services), neighbours, mass media, such as newspapers, magazines, television, etc. Results indicated that most of respondents, i.e. 86% from Purwakarta region and 80% from Ponorogo did not know this product. Generally, the respondent or consumer accepted the flour (84,4%).

Consumer preference. Kind of product and consumer preference were evaluated during the second visit. Table 5 indicated that most respondents use cassava flour to make traditional food, i.e. 57% from Purwakarta region and 59.7% from Ponorogo. Cake products were also prefered by respondents from North West Java and only slightly preferred by respondents from Ponorogo. Cookies and cake products were preferred by respondents from Purwakarta region rather than those of Ponorogo. One of the reasons, probably, is the location. The first location mentioned is a bigger town and most respondents are more educated and skilled in food products.

Cassava Flour Utilization by Consumers. Based on the characteristics of cassava flour, it can be used as a substitute flour in production of wheat-based products. In the utilization of cassava flour for home consumption, most respondents preferred to process cassava flour into four kinds of proceesed food products: (1) traditional food, (2) cakes, (3) cookies and (4) "kerupuk" or cracker like product, respectively. The basic ingredients and processing are shown in Table 8.

Generally, the respondents processed cassava flour into traditional food (more than 50%). The consumers gave the reasons that traditional foods were simple in preparation, and that there was familiarity of the products and availability of the supplement materials. The different income level of respondents gave different preferences on types of food prepared from cassava flour. In high income levels of consumer, there were a higher number of respondents (43%) who preferred to process cassava flour into cake compared to medium (21%) and low income level (29%), where preference for traditional food tended to decrease.

(1) *Traditional Foods.* Several kinds of traditional food prepared by respondents which are usually made from wheat, rice flour or maize starch, can be substituted partially or replaced totally with cassava flour. The kinds of traditional foods were *Bala-bala, nagasari, cimplung and bika ambon* (Table 10).

(2) *Cakes.* The basic procedures of cake praparation were mixing flour with sugar, eggs, leavening agent and melted margarine thoroughly into dough. Then, the dough is poured into the pan which has already been coated with margarine, and then it is baked. There are many types of cakes such as coconut cake, palm sugar cake, pineapple cake, etc. It also can be served as rollcake and layer-cake. Several

respondents made the cakes from 100% cassava flour and the others made them from 50% cassava flour and 50% wheat flour.

(3) *Cookies*. In the survey, There were three kinds of cookies made by respondents, there were cheesestick, aster cookies and nastar. Each of them was made from 100% cassava flour. Chessestick can be made by mixing the cassava flour, egg yolk, salt, coconut milk and a certain margarine. The homogenized dough was sheeted, cut and then deep fried. Aster cookies can be made by mixing the refined sugar and margarine, and then eggs were added one by one until desired expansion. Vanilla, baking powder and roasted cassava flour were added and mixed thoroughly. The dough is moulded and then baked. The basic procedure for nastar making is similar to aster cookies.

(4) *Kerupuk*. Kerupuk is processed by mixing eggs, sugar, salt, ground garlic, cool water and composite flour. It is wrapped in a roll shape with a banana leaf and then steamed. Then the steamed dough is cooled and sliced, dried and deep fried. The composite flour consists of 50% cassava flour and 50% cassava starch.

Consumer Acceptability for Longterm Consumption. In the third visit of surveyors, there were evaluation of the acceptability of the consumer and kind of food products that were consumed in the longterm in the utilization of cassava flour. Table 11 shows the consumer acceptability level of cassava flour products based on the group of food products.

Most of the respondents utilized cassava flour up to 50% mixed with ordinary flour such as wheat flour, tapioca flour or rice flour for traditional food ("bala-bala", fried banana, "putu ayu", etc) and cakes. For cookies and

"kerupuk", relatively little was utilized (Damardjati, et. al. 1992). It was reported that substitution of cassava flour up to 60% resulted in good quality of various cookies (Damardjati et. al., 1992). Cassava flour and tapioca (cassava starch) mixture with a ratio of 1:3 can be used in "kerupuk", and the product was accepted by the panelists (Suismono and Whetley, 1991).

For the second cooking trial by 115 respondents, cassava flour was accepted by 84.4% of respondents and rejected by 15.6% of respondents. The average demand of respondents on cassava flour is about 5 to 7 kgs per month. The highest purchaser group was that with a medium income level. Most consumers would process cassava flour into traditional food product (41.7%) and cakes (21.7%).

Marketing Problem. During the several years in initiation and development of the cassava flour agro-industry, marketing was the first problem faced. Cassava flour was unknown and the market had to be developed. Farmers and farmer groups highly depend on a milling factory as the nucleus in collecting and buying chips. The cassava flour factory sold the flour mostly to food industries. However, it seems there is a lack of marketing for cassava processed products. Therefore, the overstock of chips and flour occured in the processor (nucleous). Besides marketing, operational management is also a problem.

MARKETING: SPECIAL CASE OF PT. MARIZA

When other cooperatives and companies are still in difficulties for continuous operation due to management and market problem, one private company is still expanding their cassava flour industry-the PT Mariza Company.

In Indonesia, the biggest company who have been involved, directly, in the cassava chips and flour

business is PT. Mariza. They produced and marketed the cassava flour of around 200 tons which fluctuated from 100 to 400 tons per month in 1992. It has been shown that the selling of cassava flour in 1992 was increased more than 200% compared to that of 1991, which was only about 100 tons per month (Fig 3). Recently, PT Mariza developed the newest and biggest cassava flour plant in Jakarta, with a capacity of around 1000 ton per month (PT Mariza, Personal Communication).

The factory did not produce cassava chips under its own process in the plant. They bought, under contract, cassava chips from certain cooperatives and small companies. This system was also similar to the foster-parent system, in which the PT. Mariza acted as foster-parent of some chips processors in Lampung-Sumatera. The quality of chips affected the price by the discount system. The major components of quality were moisture content and whiteness.

Fig. 3 showed the fluctuations of purchasing chips and sale of cassava flour during 1991 in PT Mariza. It seems that peak purchasing occurs in July and August, because that time is also the peak of the harvest season of cassava. The selling trend was reverse; March and February were the highest selling months.

The fluctuation of fresh cassava price was relatively higher (Rp 55,to Rp 95 per kg) then when compared with the cassava flour price (Rp. 300 to Rp. 400 per kg) (Fig 4). The price of "good quality" cassava chips for flour were ranging from Rp. 180 to 220.- per kg. For comparison, the price of dried cassava ("gaplek") with poor quality were Rp. 80 to 150,- per kg, while yield recovery from fresh cassava for was 40% for "gaplek" compared to 30% for white chips. PT Mariza was a food products industry, which produced various products such as cookies, cakes and snack food (extrusion food). Formerly, the main ingredient of their products was wheat flour. Now, they mostly use

cassava flour. The special famous product from this industry is layer cake. Therefore, cassava flour is absorbed by their own food industry as raw material.

PT Mariza, in conjunction with other companies, has planned to expand the factory to a capacity of up to 2000-3000 tons/month. Usually, the flour sales are in big packs i.e. 25 and 50 kg. They plan to sell cassava flour in retail market with a small plastic package 0,5 and 1 kg.

CONSIDERATION FOR FUTURE DEVELOPMENT OF THE CASSAVA FLOUR AGRO-INDUSTRY

Inter-relationships among determinant factors in the development of Agro-industry

There are some determinant factors to support the development of the agroindustry of cassava flour (Table 11), where the matrix shows that the subjects in the agroindustry are (1) farmers/farmer groups; (2) KUD/processor; (3) Industry and distributors and (4) Consumers. Four determinant factors encompass the following: (1) policy; (2) supporting facilities; (3) participation and (4) technology.

Farmer/farmer groups. Basic policy is needed at farmer level such as: determination of a suitable basic price of chips, therefore farmers will gain interest in processing such chips. Small farmers have the possibility to get credit from banks if its procedure is quite simple with a flexible garantee. More extension and training to increase their knowledge and skills are important in the development of the agro-industry of cassava flour as well as its processed products.

KUD/processor. Simple procedures and flexible guarantees to get credit from banks are also expected by KUD/processor. In order to ensure continuity in agro-industry at village level, the sharing production of small industries should be protected. In addition, chips price should be competitive enough.

It is accepted that KUD/processor at village level has relatively low management capability, therefore it is necessary to guide its operation management. The view of equipment, simple and easily installed with available spare parts at the market is prefered. The purpose is to give an opportunity for local workshops to produce the equipment needed in cassava flour agro-industry.

Industry/Distributor. Determination of market share of cassava flour at distribution level through BULOG intervention will speed up the flour distribution to consumers. A ten percent share from the total distributed by BULOG will be sufficient to warrant cassava flour marketing. In addition, bigger industry can speed up the development of cassava flour through the foster-parent system. Bigger industries are expected to actively promote the cassava flour processed products. On the other hand, quality standards highly determine the price.

Consumer. Intervention of BULOG in distribution of cassava flour is up to distributers and retailer to make it easy for the consumer to find the flour. A cheaper price when compare to other flour is also one method of promoting the flour so that consumers will have interest to use it.

Promotion through mass media and increasing the role of the food industry/catering industry are expected to increase the quantity and frequency of utilization of cassava flour as raw material in processed food production.

SUPPORTING ACTIVITIES

To support the attempts in the development of the technological approach, supporting governmental policies are urgently needed. The objectives of the policies are to create a production environment and quality improvement that are advantageous to industries in the trading environment, distributors, and farmers, and to change consumer mental behavior on cassava.

Price and distribution policies, The price and distribution policies for cassava products (cassava flour and chips) for particular quality can act as incentives for the production increase and the improvement of product quality. The assurance of supplies of cassava as raw material requires an established distribution mechanism.

The continuous distribution of cassava flour during the full year will give assurance for the farmer to increase the production of cassava and give assurance for continuous supply to the industrial/processing companies. National Food Authority (BULOG) is expected to play an important role in this distribution system. Then it is expected to be developed by the self supporting mechanism of the existing market.

Support for industries and export diversification. The development of cassava flour processing industries is the major component to support the development of cassava industries in general. The consistent demand for raw material for cassava flour production is important to ensure the production increase at farmer level. The development of these industries needs support in conductive environment for capital investors to develop these industries.

The increasing of the traditional export of dried cassava, chip and pellet is very difficult due to quota

limitation. The support, however, can be given to non-traditional commodities, such as fructose candies, sorbitol and modified starch, to increase their export volumes. Various food products with cassava flour as raw material have been formulated, with good prospects as export commodities.

Extension. Extension should be aimed at the various levels of the community, from farmers, farmers' families, processor and other social groups. The extension materials selected depend on the level of the respective community.

Campaigns and promotion. Governmental attemps to change the appreciation of cassava by the community must be made through promotion, extension, exposition, cooking festivals, etc.

The participation of the community. The catering and bakery industries play an important role in absorption of cassava flour, especially in substitution of wheat flour into their products. The other participations are Governmental and semi governmental organizations, such as *KORPRI, Dharma Wanita, Dharma Pertiwi,* NGO, social institutions, profesional organizations and mass media, that can facilitate the campaign activities widely.

CONCLUSSION

1. The development of agro-industry of cassava flour production in Indonesia, represents an alternative for diversification of cassava products. It has a potential to increase the farmers' incomes, to extend marketing, to support food diversification, to minimize the import of wheat and to add to the development of various chemical and food industries.

2. Cassava flour processing involves the development of technologies and equipment for chipping, pressing, and milling, besides techniques for peeling, washing, soaking and drying.

3. The cassava flour agro-industry system is designed as nucleus plasma models. The system can be grouped into three models based on the capital, capability, level of knowledge and the distribution systems of the raw material. Those plasma system are included Model 1 for farmer level and Model 2 for farmers group. Model 3 represent a milling unit/factory of private companies or cooperative (KUD) as the nucleus of the system. The milling units act as processor of intermediate product i.e., dried chips from Model 1 and Model 2 to be processed into cassava flour as final products.

4. Economical feasibility analysis showed that the three models are feasible as the system in development of an agro-industry for cassava flour production at village level.

5. Cassava flour can be processed to four groups of food products, i.e. traditional food, cookies, cakes and "kerupuk". The higher the levels of income and education level of the household mother, the more traditional food and cakes can be processed with substitution of cassava flour of up to either or more than 50%. Cassava flour can be accepted by 84.4% of consumers and most of them have the capability to purchase of 4 to 7 flour kgs/month. Consumers preferred to process the flour into traditional food, as well as cakes for high income and educated consumers. Therefore, cassava flour has high potential to develop with better promotion and continuous supply into a

market segment for the supplementation of other cereal flour in Indonesia, especially in urban areas.

6. Marketing is still a major constraint on the expansion of cassava flour agro-industry. The successful expansion of PT Mariza in the cassava flour industry is due to support from their ability on the diversification of products and marketing system. There is still a need for government support and policy to create a favorable production environment and quality improvement in every step of the production system to match market demands.

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Table 1. Average consumption of major food crops in Indonesia. 1986-1992.

Commodity	Consumption							
	1986		1988		1990		1992	
	kg/year	Calorie (Cal/day)	kg/year	Calorie (Cal/day)	kg/year	Calorie (Cal/day)	kg/year	Calorie (Cal/day)
Rice	147.36	1453	150.18	1.481	150.05	1.480	147.91	1.459
Cassava	51.44	154	51.00	154	43.07	129	57.40	172
Sweet potato	11.05	32	10.93	32	9.74	28	10.34	30
Wheat	5.96	60	6.59	60	7.54	75	10.36	104
Maize	29.25	256	30.75	256	29.68	260	34.64	303
Soybean	8.80	80	9.45	80	10.72	97	12.57	114

Source : C.B.S. 1984, 1987, 1989.

Table 2. International trade of cassava in Indonesia, 1983-1992

Year	Export		Import	
	Chips	Starch	Chips	Starch
	--- ton ---			
1983	358,346	1,602	-	63,883
1984	365,161	183	-	3
1985	343,303	107,000	-	21
1986	424,600	-	165,000	20,500
1987	783,776	116,000	41,750	9,500
1988	825,000	-	250,000	23,000
1989	834,000	282,000	-	-
1990	697,000	487,000	-	-
1991	494,000	317,000	-	12,000
1992	372,000	135,000	79,000	34,000

Source : Pranadji, 1990 and CBS, 1991-1992

Table 3. Trend of production and utilization of cassava in Indonesia

Item of food	Fresh Cassava (or equivalent)				
	1986	1988	1989	1990	1991
	—— 000 ton ——				
Total Production	13,312	15,471	17,117	15,830	15,954
Waste (loss)	1,572	2,011	2,225	2,058	2,074
Feed (domestic)	242	309	342	317	319
Manioc			4,281	3.900	3,336
			(1,540)	(1,403)	(1,200)
Export	(424)	(825)	(834)	(697)	(494)
Tapioca starch	-	-	1,150	1,881	1,232
			(322)	(527)	(345)
Export	-	-	(282)	(487)	(357)
Food Industry			5,431	5,781	4,568
Food consumption	8,573	8,863	9,119	7,674	8,993

Source : CBS 1986 - 1992

Note : ( ) = indicate in dried form

Table 4. Infrastructure required in chips and cassava flour agro-industry.

Infrastructure	Model I (individual farmer)	Model II (farmers group)	Model III (processor/ nucleous)
1. Supply and sorting area (m^2)	4 - 8	10 - 16	20 - 30
2. Work area for processing (m^2)	10 - 15	30 - 40	300 - 500
3. Drying area (m^2)	20 - 30	80 - 100	800 - 1000
4. Storage area for cassava chip (m^2)	8 - 12	20 - 30	200 - 300
5. Storage area for cassava flour	-	-	1000 t

Table 5. Yield recovery in cassava flour processing from 500 kg of fresh cassava.

No.	Material form	n	Processing recovery Min - Max	Average Conversion value
		n	%	
1.	Fresh cassava	12	100	100
2.	Peeled cassava	15	73 - 83	80
3.	Soaked-peeled cassava	12	74 - 88	82
4.	Wet chips before pressed	15	70 - 88	80
5.	Pressed chips			
	Screw press	6	61 - 68	65
	Hydraulic press	6	61 - 66	62
6.	Dried chips			
	Screw press	6	29 - 37	34
	Hydraulic press	6	22 - 37	31
7.	Cassava flour	15	30 - 34	32
8.	Dried starch	9	2 - 5	3

Note: calculated from 500 kg of fresh cassava

Table 6. Added value of chips compared to "gaplek" at farmer level calculating based on 100 kg (Ponorogo, 1992).

Farmer/capacity 100 kg fresh cassava	Farmer (capacity 100 kg fresh cassava)	
	"Gaplek"	Dried chips
A. cost		
labor		
- peeling/100 kg	Rp 1.000,-	Rp 1.000,-
- Chipping,drying/100 kg		Rp 1.000,-
a) equipment hire (Rp 10/kg dried chips		Rp 300,-
Total (1)	Rp 1.000,-	Rp 2.300,-
Yield (%)	45,-	30,-
product	45,-	30,-
price	Rp 125,-	Rp 270,-
B. Income from product	Rp 5.625,-	Rp 8.100,-
C. Economic profit	Rp 4.625,-	Rp 5.000,-
D. Economical income + wage	Rp 5.625,-	Rp 7.800,-
E. Addition income in dried chips production compare to gaplek	Rp 0,-	Rp 2.175,-

Note : calculated based on 100 kg fresh cassava, gaplek yield 45%, chips yield 30%, price of gaplek and sawut were Rp 125/kg and Rp 270/kg for 1992, and equipment hire was Rp 10/kg dried chips.

Table 7. Consumer preference for cassava product in Purwakarta and Ponorogo district.

Product	Purwakarta (n=115)		Ponorogo (n=124)	
	like	dislike	like	dislike
	.....	% of respondents	.....	
Traditional food	57.0	3.3	59.7	12.1
Cookies/Crakers	13.1	0.9	8.9	0.8
Cakes	37.8	1.8	9.7	8.9

Source : Damardjati et al (1993) and Martini (1992), modified.

Table 8. Process and Material Composition of Product Which is Processed from Cassava

	Traditional Food	Cookies	Cakes	"Kerupuk"
Basic Ingredient	Wheat Flour Rice Flour	Wheat Flour	Wheat Flour	Tapioca Flour
Additional Ingredient	Margarine Egg Cane Sugar/ Vegetable Coconut Milk	Margarine Egg Cane Sugar	Margarine Egg Cane Sugar	Sugar
Other Ingredient	Salt/ Artificial Color	Leavening Flavoring	Leavening Artificial Flavoring	Salt Spices Flavoring
Process	Steamed/ Fried/ Roasted	Baked/ Oven	Baked/ Oven	Steamed prior to frying

Table 9. Preference of consumer in food preparation trial using cassava flour, samples given during the survey.

Respondents Group		Processed products			
		Traditional Food	Cookies	Cakes	Krupuk
		------ % respondent -----			
Purwakarta					
Low	(n=39)	67.6	16.2	29.7	2.7
Medium	(n=46)	75.6	12.2	21.9	2.4
High	(n=30)	53.3	13.3	43.3	-
Ponorogo					
Urban	(n=57)	66.7	17.5	15.8	-
Village	(n=67)	76.1	1.8	24.6	-

Table 10. Traditonal Food Product Made of Cassava Flour as Substituted flour

Local Name	Percentage of Cassava Flour	Other Flour	Brief Description
Bala-bala	50%	Wheat	- Mixture of flour, water, vegetables and spices - Fried
Cimplung	50%	Wheat	- Mixture of flour, water, sliced jackfruit, salt - Fried
Nagasari	70%	Maizena	- Mixture cassava flour with coocnout milk, sugar, salt vanili, maizena and cooked - Wrapped with banana leaf, fill in with banana sliced - Steamed
Jongkong	50%	Rice	- Dough of mixture of flour with coconut milk,salt and cooked - fill with slice palm sugar poured with thick coconut milk, wrapped in banana leaf - Steamed
Ongol-ongol	65%	Wheat	- Mixture the flour with water and sugar then cooked - Formed, cooled and sliced - Served with grated coconut
Dodongkal or Awug	100%	-	- Cooked cassava flour with water and salt - Fill in shredded palm sugar in the dough - Served with grated coconut
Biji salak	100%	-	- Mixture small ball from cassava flour dough - Cooked - Served with sweet coconut milk and sliced jackfruit
Bika Ambon	35%	Rice	- Mixture the flour with egg, fermipan and coconut water worked into dough (I) - Cook of sugar and coconut milk until oily (II) - Mixture of I and II - Baked

Table 11. Matrix correlation of determinant factors toward subject in agro-industry of cassava flour.

Determinant factor	Subject			
	Farmer/farmer group	KUD/processor	Industry	Consumer
Policy	- Basic price of chips - Simplicity to get a credit - Ensured to get a credit - Flexibility of assurance	- Ensured to get a credit - Flexibility of assurance - Protection of production share - Basic price of cassava flour	- Cassava flour marketing at distributor level will be controlled through BULOG - BULOG as foster-parent, but not monopoly of market.	- Good distribution through BULOG intervention - Ceiling price
Infrastructure	- Extension - Training - Credit for chips processor - Market implementation	- Guidance in operation management - Credit for equipment and operational cost - Market information	- Facilities for promotion of cassava processed product - Facilities for credit	- Promotion through mass media - Improvment role of service - Products from cassava flour
Participation	- Price expectation - Processing efficiency - Added value in processing	- Price expectation - Processing efficiency	- Continuities of chips and cassava flour product - Standard quality of chips and flour - Export promotion	- Competitiveness of taste and flour packaging - Attractive packaging - Can be mixed with other flour
Technology	- Simple and easily installed. Spareparts are available in the market - Relatively cheap	- Simple and easily installed. Spareparts are available in the market - Labour intensive	- Efficient	- Serving technique

Source: Adnyana, *et. al.* (1991)

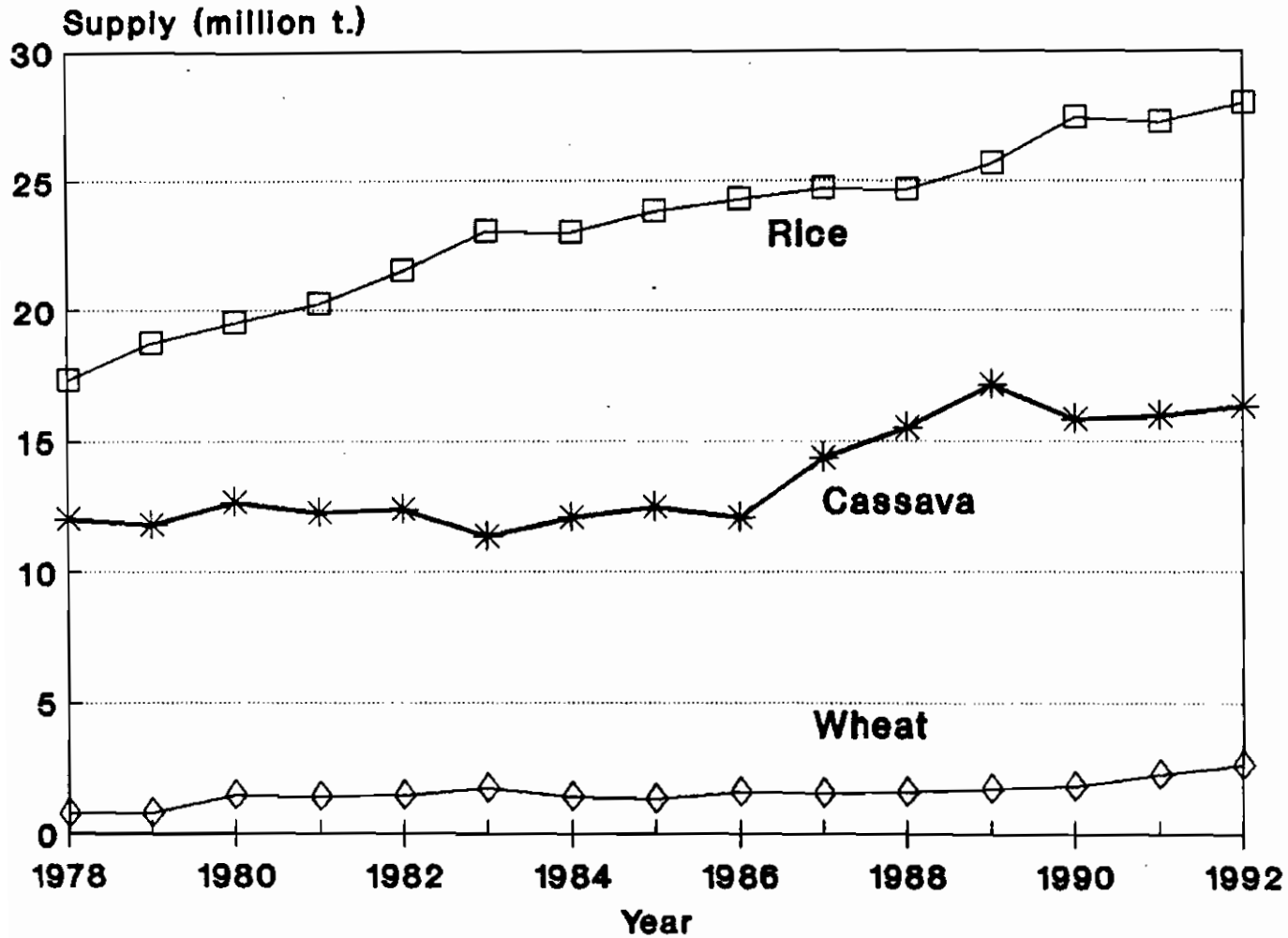

Fig. 1. Domestic supply of rice, cassava and wheat in Indonesia, 1978 - 1992

Source : C.B.S. 1978-1992

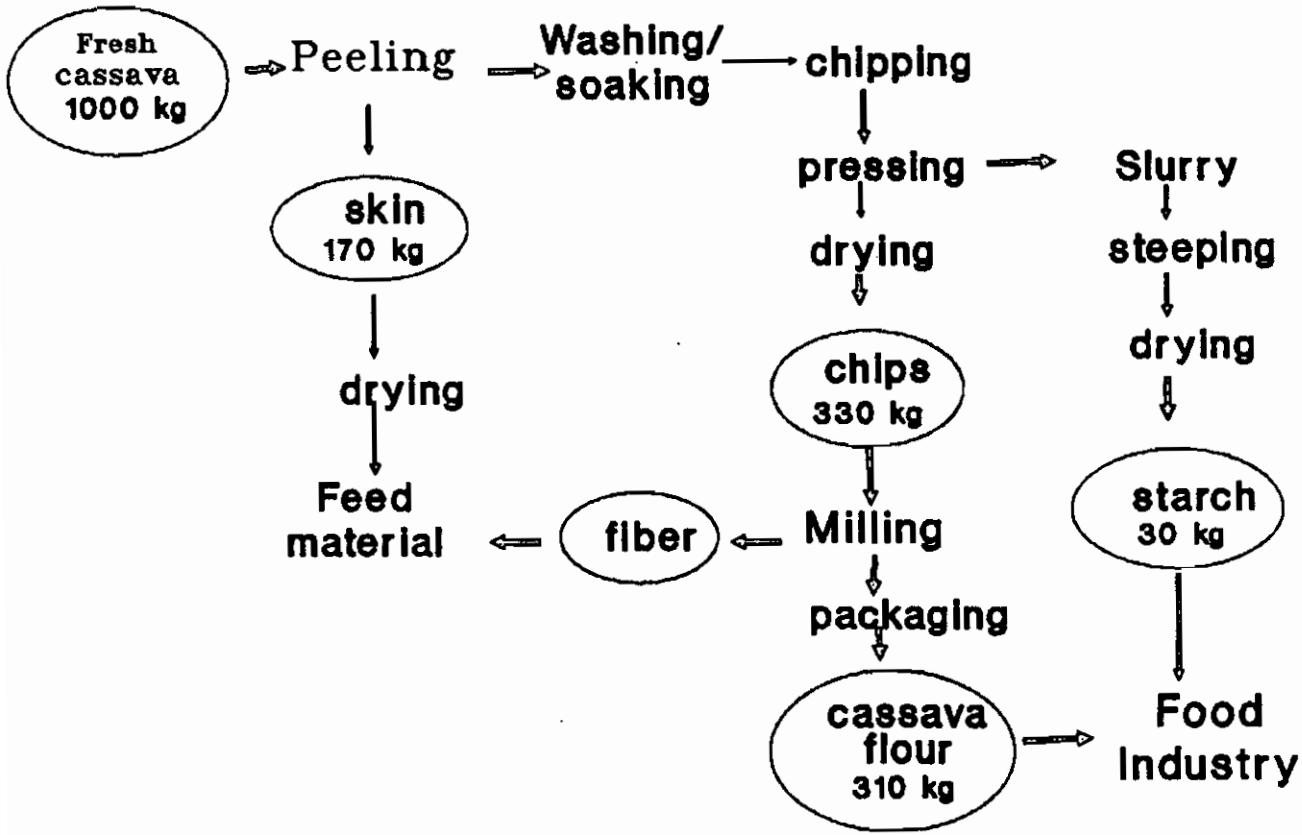

Figure 2. Processing system of cassava flour production in Indonesia

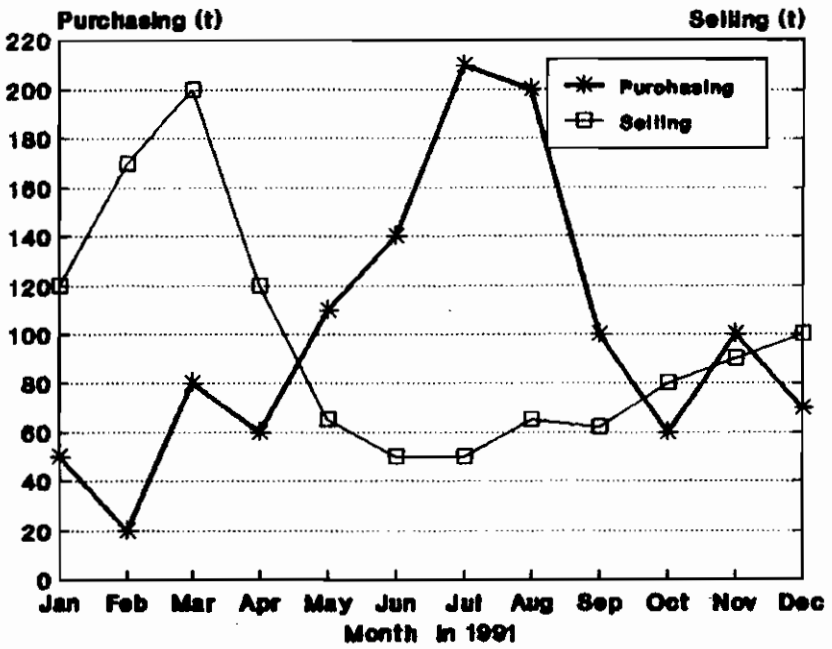

Fig. 3. The trend of purchasing of chips and selling of cassava flour by PT Mariza in 1991

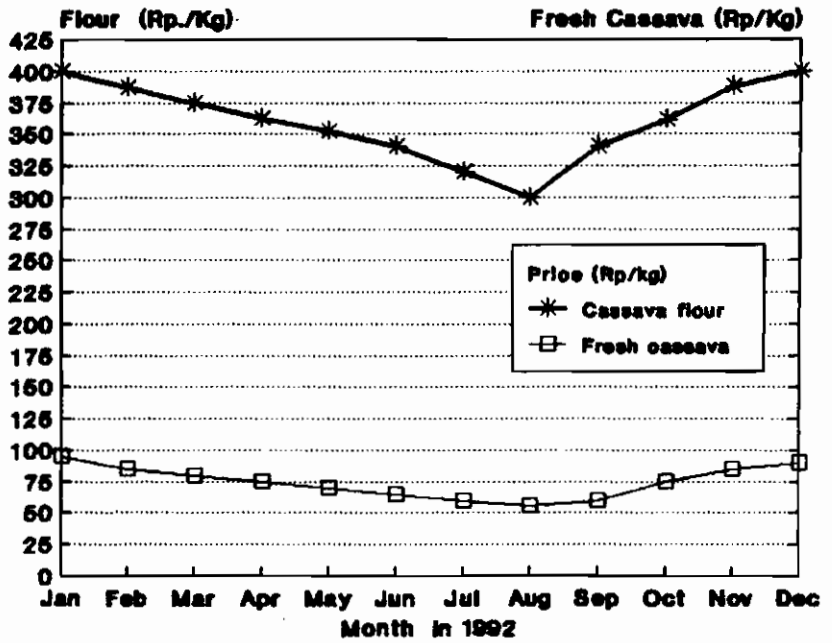

Fig. 4. The trend of price of fresh cassava and cassava flour under transaction by PT Mariza in 1992