PRESENT SITUATION AND FUTURE POTENTIAL OF CASSAVA IN INDONESIA

Nasir Saleh[1], Koes Hartojo[1] and Suyamto[2]

ABSTRACT

Cassava (*Manihot esculenta* Crantz.) in Indonesia can be considered as a controversial crop. This crop has a tremendous yield potential of almost 100 t of fresh roots/ha, but official data show that its actual productivity is only 10-20% of its biological potential. It is considered to have multiple end uses, such as food, feed, raw material for industry and export. Very often, however, cassava farmers complain about the low and unstable price they receive for their product. A longer list can be developed concerning the contradictory nature of cassava. This in turn should be perceived as a special challenge to those who are more concerned about the improvement of people's living standards rather than the crop itself.

Starting from 1973, the cassava production system in Indonesia has shown a declining annual growth rate for the harvested area (-0.41%), but an increasing rate for both production (1.53%) and yield (1.93%). Since the standard deviation of the rate is much greater than its average, values of the rate and its sign (positive and negative) should be considered as a trend indicator only, and they can not be used for prediction purposes. At present, cassava in Indonesia is harvested from around 1.2 million ha, producing around 15-17 million tonnes of fresh roots, as the yield is only about 12-13 t/ha.

Most cassava is produced by small farmers that are weak in resources endowment, either in economic or social terms. Little purchased inputs, especially chemical or inorganic fertilizers, are applied, and as a result cassava production is frequently blamed as the cause of soil degradation. The crop is mostly grown in upland areas with undulating topography. Since its planting time should be compatible with the distribution of rainfall, the flexibility in planting and harvesting time is limited. As a consequence, the existence of a peak in planting and harvesting time is difficult to avoid. Abundance of cassava roots during the peak harvesting time results in low prices.

From an individual farmer's point of view, his income is determined by his productivity level. Logically, any improvement in productivity should increase farmer's income. However, this rarely happens, because the price is governed by the total amount of roots produced. As price fluctuation is the result of supply and demand imbalance, any decrease in price can be perceived as an indicator of limited demand. There is a belief that cassava farmers, especially the low-income groups, are trapped in a vicious cycle: changes in yield-planted area-production, are countered by changes in prices which go up and down. This condition in turn prevents farmers from improving their income.

If the opinion that demand is the most important limiting factor for production growth is true, the best solution should be a demand-led strategy. Demand for cassava in Indonesia is mainly in the areas of food, industry (mainly processing of starch and starch-based products), export and feed. Future prospects for using cassava as food will depend mainly on: (1) rice availability, since rice is the most preferred staple food for Indonesian people; and (2) cassava product development activities, as the social bias against cassava as being a food for the poor is strong and real. The existence of starch processing and starch-based industries, especially on a large scale, have been present for some time, but their role in improving farmers' welfare should be questioned. The growth in cassava exports will face two barriers: first, strong competition from Thailand, and secondly, the domestic price. Demand for cassava as a raw material for production of feed will depend on its price in relation to that of maize.

---

1 Research Institute for Legumes and Tuber Crops (RILET), Jl. Raya Kendalpayak, P.O. Box 66, Malang 65101, East Java, Indonesia.

2 Karangploso Assessment Institute for Agricultural Technology. Jl. Raya Karangploso km 4, P.O. Box 188, Malang 65101, East Java, Indonesia.

It can be concluded that from the grower's view point cassava is a cash crop rather than a subsistence crop, and therefore the crop is a source of income rather than a source of food. As a consequence, every effort to improve the crop's performance should strife to ensure an increase in the grower's welfare. In addition, there has to be a significant increase in net income for individual farmers, due to a correct balance between production and demand. In fact, economic and social issues are the principal constraints. Unfortunately, these two issues are beyond the farmer's control. Concerted efforts among farmers, government and non-government organizations, research and development agencies, and others are urgently needed. While technical expertise should continuously be improved, much is known already to help increase the present productivity level towards its full yield potential.

INTRODUCTION

In Indonesia, cassava is classified officially as a food crop, so its development should be under the responsibility of the Department of Agriculture. Almost all cassava roots and their derivative products (e.g. chips, pellets, starch, food, feed and chemicals) are traded or processed in other sectors, outside the jurisdiction of the Ministry of Agriculture. As trading and/or processing activities affect the cassava grower, directly or indirectly, any attempt to resolve cassava production problems by only focusing on its cultural practices will fail. A holistic view and approach through integrating all related parties concerned (cassava growers, traders, processors, and consumers) as a continuum is unavoidable.

Cassava is grown mainly by small farmers who use labor-intensive methods. Due to its wide adaptability, cassava can be grown over a wide range of soil and climatic conditions as well as levels of management. However, most areas allocated to cassava are uplands, characterized by marginal soil fertility, with sloping or undulating topography, under-developed infrastructure (especially transportation), and a number of other relatively unfavorable circumstances. There are cassava plantations owned by private companies, as well as "illegal" farmers on the other end of the scale; however, their existence does not necessarily have a positive effect on the legitimate small farmers.

Even though well-known as a subsistence crop, most cassava is sold or traded outside the farm where it is produced. Cassava is sometimes considered as an undesirable food because it contains mostly carbohydrate. While it is considered to be of low value or a cheap commodity, cassava is the only food crop which contributes towards the net foreign exchange through export. Growing cassava is frequently considered a poverty indicator, but its produce and products create wealth for the wealthy.

The livelihood of millions of people depends on cassava, directly or indirectly, with great gaps either in social or economic status, beginning from the grower up to the exporter. It is becoming clear that the merits of cassava are not only limited by its physical or economic values, but go beyond that. Cassava can be a means of fulfilling our social obligations.

CHARACTERISTICS OF CASSAVA PRODUCTION IN INDONESIA

Three performance indicators of the production system are harvested area, production, and yield. **Figure 1** and **Table 1** show the trend in the cassava production system in Indonesia from 1961 to 2000, while **Figure 2** shows the trend in area for the four major cassava producing provinces.

Harvested area is directly related to the number of growers, because the average farm size for upland areas is approximately one hectare. Based on the assumption that family size is about

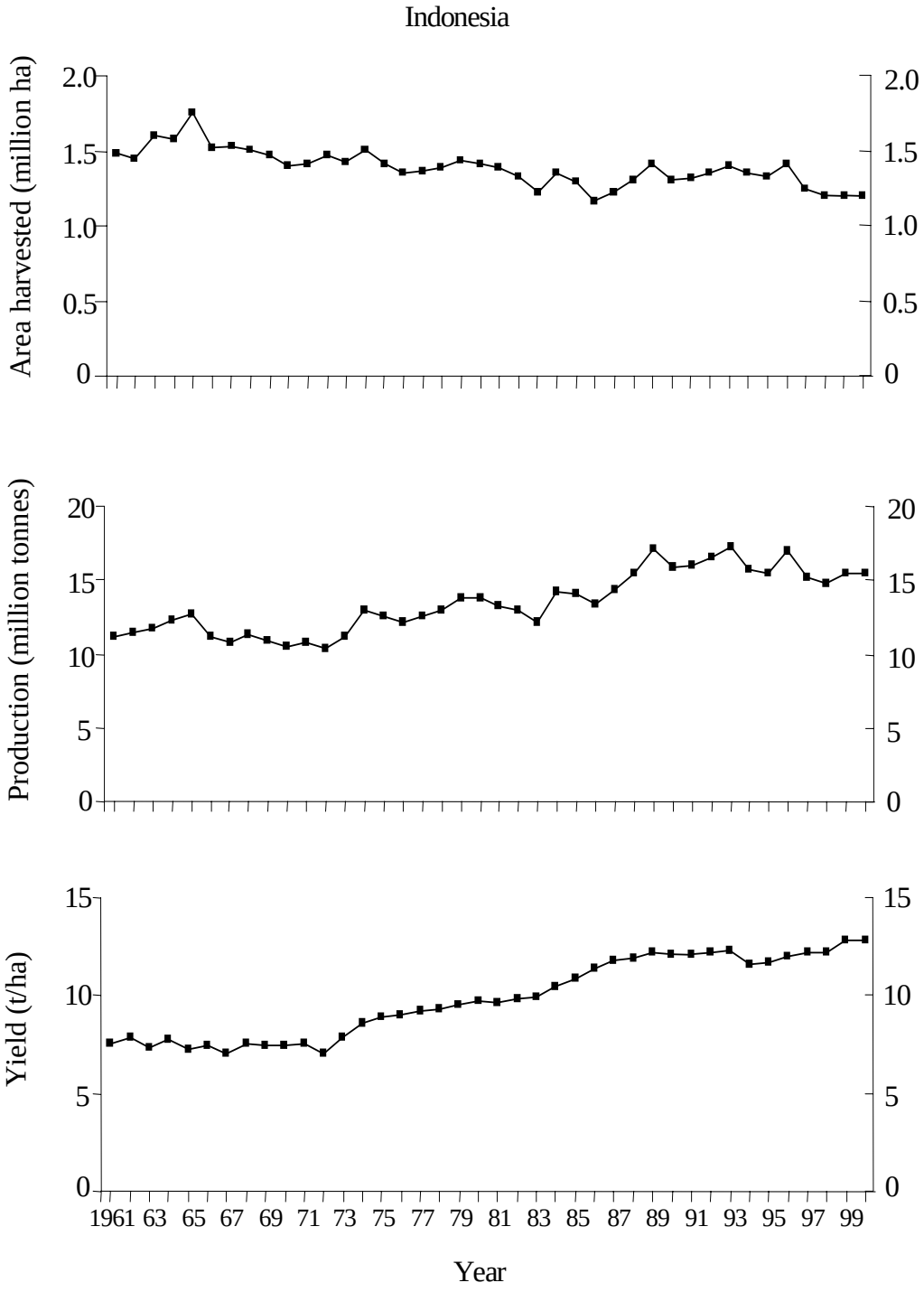

Figure 1. Cassava harvested area, production and yield in Indonesia from 1961 to 2000.
Source: *FAOSTAT, 2001.*

four, then the livelihood of not less than 4 million people will be influenced by either good or bad
crop performance. Productivity or yield is a quantitative measure of the farmers' welfare, depending on its financial value or root price. The farm-gate price for roots is also highly dependent on the distance between the farm and the market place.

Table 1. Cassava production in Indonesia from 1973 to 1998.

Year	Harvested area (ha)	Production (tonnes fresh roots)	Yield (t/ha)	Annual growth rate[1)] (%)		
				Area	Production	Yield
1973	1,428,913	11,185,592	7.829	-2.7	7.7	10.7
1974	1,509,440	13,030,674	8.633	5.6	16.5	10.3
1975	1,410,025	12,545,544	8.897	-6.6	-3.7	3.1
1976	1,351,289	12,190,728	9.022	-4.2	-2.8	1.4
1977	1,367,535	2,487,664	9.132	1.2	2.4	1.2
1978	1,386,246	12,902,011	9.307	1.4	3.3	1.9
1979	1,441,748	13,750,767	9.538	4.0	6.6	2.5
1980	1,413,328	13,773,778	9.746	-2.0	0.2	2.2
1981	1,390,461	13,300,911	9.566	-1.6	-3.4	-1.8
1982	1,322,305	12,987,891	9.833	-4.9	-2.4	2.7
1983	1,219,066	12,102,733	9.928	-7.8	-6.8	1.1
1984	1,350,448	14,167,090	10.491	10.8	17.1	5.7
1985	1,291,835	14,057,027	10.881	-4.3	-0.8	3.7
1986	1,169,886	13,312,119	11.379	-9.4	-5.3	4.6
1987	1,222,151	14,356.336	11.747	4.5	7.8	3.2
1988	1,302,581	15,471,111	11.877	6.6	7.8	1.1
1989	1,407,880	17,117,249	12.158	8.1	10.6	2.4
1990	1,386,482	15,829,635	11.417	-1.5	-7.5	-6.1
1991	1,319,093	15,954,467	12.095	-4.9	0.8	5.9
1992	1,351,324	16,515,855	12.222	2.4	3.5	1.0
1993	1,401,640	17,285,385	12.332	3.7	4.7	0.9
1994	1,356,580	15,729,232	11.595	-3.2	-9.0	-6.0
1995	1,319,627	15,321,062	11.610	-2.7	-2.6	0.1
1996	1,415,101	17,002,455	12.015	7.2	11.0	3.5
1997	1,243,366	15,134,021	12.172	-12.1	-11.0	1.3
1998	1,211,871	14,888,793	12.286	-2.5	-1.6	0.9

[1)] growth rates calculated in comparison with previous year.
Source: *Statistical Yearbook of Indonesia (various issues).*

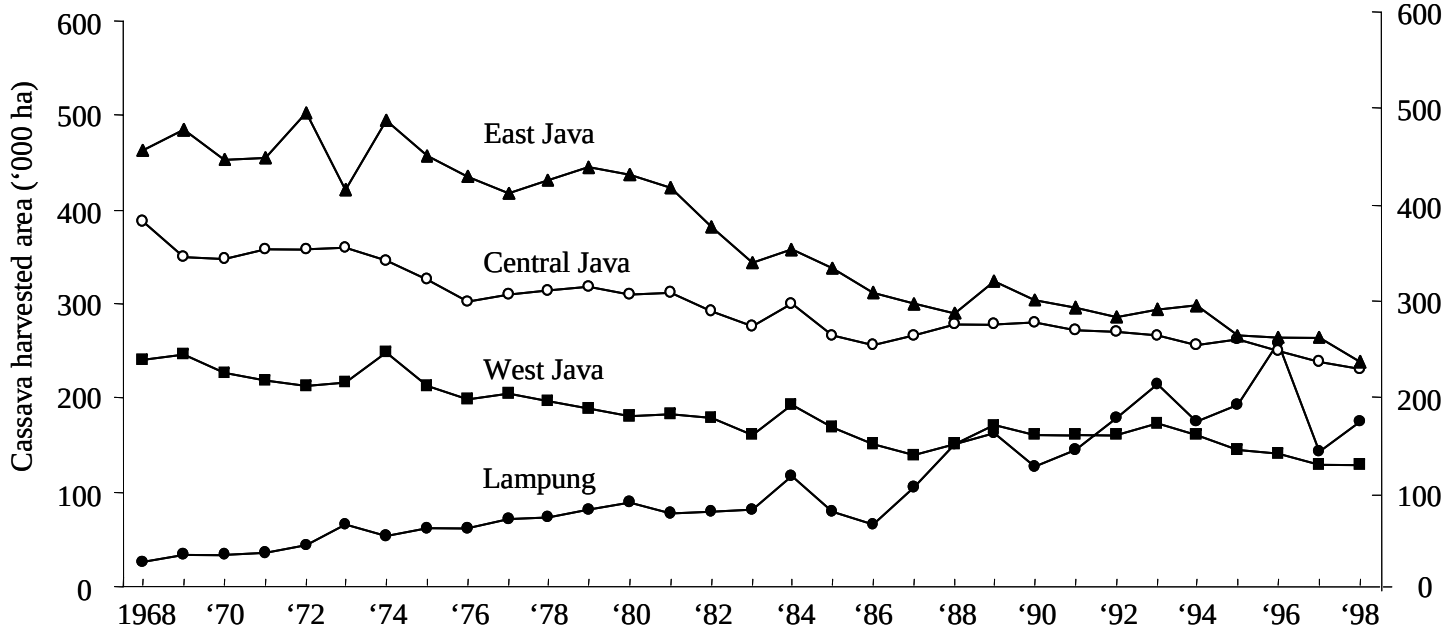

Figure 2. Trend in cassava harvested area in the four major cassava producing provinces of Indonesia from 1968 to 1998.
Source: CBS, 1999.

Due to its wide adaptability, cassava is grown in all the 26 Indonesian provinces, but the spatial distribution of cassava varies widely. Java island, with about seven percent of the country's agricultural area, accounts for about 50% of the national cassava harvested area and more than 50% of national production, because the yield level there is slightly higher than in the other islands. The wide-ranging archipelago of Indonesia creates specific problems, such as transportation systems and costs.

Fluctuations in harvested area over time suggest that there were changes in the number of farmers who grow cassava, or there was a change in the planted area per farmer. The former is a more likely explanation. There is no data on the actual number of cassava farmers at any one time. Since fluctuations in harvested area are much less than those of production volume or yield, it may be deduced that the farmers who start growing cassava and those who quit are more responsive to price changes, while those who continuously grow cassava are totally dependent on price fluctuations.

Trends among the three performance indicators can be seen clearly in **Figure 1**. Production appears to be mainly a function of yield. This conclusion is statistically valid, but the graph tells nothing about farmer characteristics. Koes Hartojo (1999), using national data over a shorter period from 1986 up to 1996, and Koes Hartojo and Wargiono (1999), using certain provincial data over a much shorter period from 1995 up to 1997, came to contradictory conclusions. Production was a function of harvested area, whereas yield was not related to production at all. It was suggested that for the purpose of prediction or developing programs for the future, the use of shorter period data (e.g. over the last three years) as well as long-term trends may provide more accurate results.

It is hoped that in the future cassava production will be a function of yield, but with very strict prerequisites. Productivity should be distributed normally with a very narrow base and a very sharp peak. This means that yield variability among farmers should be as small as possible. Since the natural conditions of cassava-growing areas vary widely, there is a need for a wide range of environment-specific technologies to be developed. That is the challenge to be faced by cassava researchers.

Even though the level of yield might be the most important key factor, the role of the other two indicators cannot be overlooked. This is because they are essentially linked to the grower's welfare. All three indicators are mutually related, but not necessarily in the same direction. What frequently happens is that any factor's increase or decrease is at the expense of the others. For example, an increase in yield (leading to higher production) should not go beyond the market capacity; otherwise, it will result in a price decline. For bulky and perishable products like cassava, the rate of price decline is much faster than the rate of productivity increase under over-supply conditions. Therefore, the hope of getting more money by selling more roots is unlikely to be fulfilled.

Price is determined by total production, which is the level of supply, and this is not possible to be predicted by the individual farmer. Thus, the existence of an early warning system, which can provide signals or information on both the planted area or the yield, would be very useful in order to match supply with demand. Such a system is totally absent at present. Without this system, farmers' response to price fluctuations is often too late.

It can be concluded that cassava is still a crop in demand, and that the number of people who depend on this crop for their livelihood is relatively stable, but unlikely to increase.

Productivity will continue to increase, but whether this also results in an increase in the grower's income is still uncertain. The agricultural sector has been growing at a higher rate than before the economic crisis of 1997. Even at the height of the economic crisis, the agricultural sector grew at a rate of more than 2% per year. Production will therefore always increase, which means that cassava growers will be providing more raw materials, jobs, or wealth to others.

SPATIAL AND TIME DISTRIBUTIONS OF CASSAVA PRODUCTION PARAMETERS

Cassava is grown in all the provinces of Indonesia, and is characterized by wide variations in both harvested area and production, and slightly less variability in yield. As previously stated, harvested area is indicative of the number of people who grow cassava; thus, a larger area will mean more farmers. However, this is not always true when comparing Java with the other islands, because average farm size in Java is smaller than in the other islands. It can be expected that for the same harvested area, the number of farmers growing cassava in Java will be greater than in Sumatra. The number of cassava growers is a yardstick for measuring the number of beneficiaries of any program or activity in production development.

The largest harvested area and production during the last five years were achieved in 1996, i.e., more than 1.4 million hectares, producing more than 17 million tonnes of fresh roots. About 88% of the harvested area and production were distributed within ten provinces only, which are considered as the main cassava production areas (**Table 2**). Nevertheless, among the main cassava-producing provinces, the variability in both harvested area and production is very large. Harvested area and production in East Java province, is about 7-8 times higher than the harvested area and production in North or South Sumatra.

Table 2. Cassava production in the main cassava growing provinces of Indonesia in 1996.

Rank	Province	Area (ha)	Yield (t/ha)	Production (t)
1.	East Java	263,799	13.4	3,546,260
2.	Lampung	257,417	11.3	2,898,667
3.	Central Java	250,841	13.3	3,344,715
4.	West Java	141,637	12.8	1,816,487
5.	East Nusa Tenggara	93,720	9.1	849,606
6.	South Sulawesi	62,473	10.9	681,256
7.	Yogyakarta	58,430	11.9	695,488
8.	Maluku	46,493	11.9	554,909
9.	South Sumatra	35,506	11.9	403,063
10.	North Sumatra	35,246	12.0	421,460

Source: *Statistical Yearbook of Indonesia, 1997.*

The geographical conditions as well as the distance among the provinces determine whether or not one province is dependent or independent of another. Even though East Nusa Tenggara and Maluku provinces are main producers, since these two provinces consist of many separated islands their production will not significantly affect those of other provinces. By contrast, there is a strong dependency between Lampung and East Java. Many industries located in East Java utilize starch produced in Lampung. Any increase or decrease in starch processing in East Java will affect the level of starch demand from Lampung, which in turn will affect the cassava price and production in Lampung.

Spatial distribution of cassava availability also determines the required policy for development and its effectiveness. Fresh roots have two components. First, the dry matter content which consists of starch and non-starchy materials. Second, the moisture content, which, from an economic stand-point, can be considered the undesirable part because of its effect on perishability and costs. Since the weight of the undesirable part is twice as large as the weight of the desirable part, then the further the distance of transportation the lower will be the price of the desirable part. Consequently, fresh roots should be processed near the place where cassava is grown. Based on these features, it is suggested that there should be specifications on what products should be produced (starch, chips or pellets) as well as the scale of the processing enterprise (household, small, medium or large) in accordance with natural, economic and social circumstances. Furthermore, the development of spatial distribution should be based on the principles of competitiveness and comparative advantage.

Most likely, certain provinces will be centers of starch production, while other provinces will be centers of other cassava products. Ideally, there should be a balanced demand for the various products. Otherwise, competition among the products will happen, leading to a reduction in total potential. Besides spatial distribution, the development of an enterprise will be based on time distribution.

Cassava is available all the time, but the supply is unevenly distributed (**Table 3**). In general, cassava is available more evenly in Sumatra (North and South Sumatra, Lampung) and the western part of Java (West Java) compared with the availability in Central Java, Yogyakarta and East Java. Since this fluctuation in cassava supply is caused by natural conditions, especially rainfall, a change towards a steady supply situation is not likely to occur. Consequently, the type and the scale of the enterprise, which is expected to create a demand for fresh roots, should be planned in accordance with the supply capabilities of the region.

Ideally, any enterprise, especially a big one, should operate for as long as possible. To be secure in its investments, it is very likely that the demand level will be fixed below the average or even at the lowest availability level. Consequently, there will be certain periods or months when supply is larger than demand. Such a condition will result in two possibilities. First, the root price will automatically decline. Second, by prolonging the transaction time the price will also decrease due to an increase in cost as well as a decline in quality. In the case of starch processing, the trucker who has to queue longer will charge more (Erwidodo and Hadi, 1999). That is one of the defects of big enterprises. A big enterprise with large investments, especially fixed costs, may have high-tech infrastructure but will not necessarily offer a high root price. In fact, the opposite may be true. Household or small-scale starch processors usually offer higher prices than big factories; however, their capacity is very limited.

Table 3. Monthly proportions of cassava harvested area in several selected provinces of Indonesia in 1996.

Province	Proportions of harvested area by month (%)												Total (ha)
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	
1. East Java	2.66	2.46	1.91	1.76	3.27	6.08	**16.41**	**29.20**	**18.36**	11.23	4.29	2.30	263,799
2. Lampung	8.05	8.73	7.76	8.55	6.16	6.10	6.87	**11.26**	**13.24**	**10.46**	7.73	4.92	257,417
3. Central Java	3.22	2.81	3.25	3.37	5.29	6.24	**13.27**	**32.23**	**13.76**	9.29	3.71	3.56	250,841
4. West Java	6.16	5.15	5.20	5.38	7.88	10.88	**13.67**	**15.50**	**11.94**	8.53	5.36	6.31	141,637
5. East Nusa Tenggara	2.25	2.14	2.15	2.59	2.68	4.91	11.64	**16.60**	**19.19**	**24.79**	8.54	2.51	93,720
6.South Sulawesi	1.96	3.30	2.31	2.41	3.26	5.74	**11.11**	**24.44**	**28.96**	9.08	3.28	4.16	62,437
7.Yogyakarta	0.39	0.51	0.75	0.43	1.04	**4.78**	**49.05**	**36.11**	4.44	1.24	0.96	0.32	58,430
8.Maluku	9.27	8.80	**11.44**	9.12	10.30	10.12	**11.84**	**12.55**	7.68	1.12	7.39	0.37	46,439
9.South Sumatra	**10.55**	7.44	5.66	6.60	8.25	**11.89**	**13.89**	8.87	5.82	9.36	6.03	5.64	35,506
10.North Sumatra	**12.50**	**13.34**	6.44	5.14	5.95	8.08	**14.52**	4.90	7.46	9.07	4.75	7.84	35,246
TOTAL	4.86	4.74	4.34	4.44	5.13	6.87	**14.10**	**21.79**	**14.52**	10.32	5.25	3.54	1,245,472

Source: *Calculated from Statistical Yearbook of Indonesia 1997 (three highest months shown in bold print).*

Big enterprises are not only suspected of causing lower prices, but are also frequently believed to pollute the environment significantly. Big enterprises may buy roots at low prices because they have monopolistic power when buying fresh roots, while they are also monopolistic when selling their products (Gunawan, 1997). However, there are arguments against this suspicion which come mainly from the big factory owners. They usually claim that their factory operates much below the designed capacity. Regardless of which argument is true, there is something wrong which needs to be corrected. In the case of environmental pollution, starch processing has the potential of producing serious pollution regardless of the scale of operation (Howeler *et al*., 2000). As the awareness of the need for environmental conservation is growing, waste treatment, either solid wastes or waste water generated by the starch processor, should be improved.

Based on the above explanations, it is clear that both the spatial and time distributions of cassava availability are uneven. Spatial distribution will characterize what are the most appropriate products to be produced from cassava, whereas the time distribution will determine the scales of the processing enterprises. Nevertheless, alternatives in processing can be many, as long as they are complementary to each other. At present, coordination between cassava growers and consumers is almost absent. The processors (as consumers) are not usually concerned with the farmers' problems. Despite farmers being the first link in the chain of cassava-based economic activities, they struggle by themselves. Without cassava farmers it is unlikely that the cassava processing industry as well as its trade will be as big as it is at present.

CHARACTERISTICS OF CASSAVA FARMERS

The existence of millions of people involved, directly or indirectly, in cassava growing is an undisputable fact. However, Lynam (1987) noted that they are an invisible group especially to policy-makers. Lynam's statement was based on the fact that there was an inbalance between the farmer's role and government support. Possibly, that inbalance still exists even today.

Most of the 1.4 million hectares of cassava area is cultivated by small farmers characterized by either small capital or low technical capabilities. Unfortunately, they face considerable constraints and uncertainties for a better life. Limited capital and technical capabilities frequently force them to practice "inappropriate" cultivation techniques, even though from their point of view these are the best choice they can make. For example, on sloping land most farmers grow their cassava along up-and-down ridges rather than on contour ridges. The reason is they believe that yield is higher with the former practice, even though they are aware that such practices will cause severe soil erosion. Most poor farmers are faced with a dilemma; either to maximize productivity in order to sustain their present life style or to conserve their land for the future. Limited capital coupled with low marketing capabilities make matters worse. Sales of standing crops are commonplace, indicative of the weak bargaining position of cassava farmers. As a result, their farm-gate price is about 50% of the factory or consumer price. Consequently, only a small part of their income will be used to conserve their natural resource, especially to maintain land quality. It is believed that many farmers are trapped in a "vicious cycle" (**Figure 3**).

Most farmers respond to price signals, either an increase or a decrease, through their subsequent planting schedule. Such a response is due to the absence of coordination among farmers, and more importantly, there is no advance communication between farmers and consumers. A decline in harvested area in response to a price decline is usually accompanied

by a lower level of technology, whereas a price increase will result in the use of better technology as well as an increase in planted area. Indeed, the vicious cycle cannot be broken by the individual farmer, as the possibility of a price increase depends on the conditions that demand is larger than supply. Better communication between farmers and consumers is urgently needed.

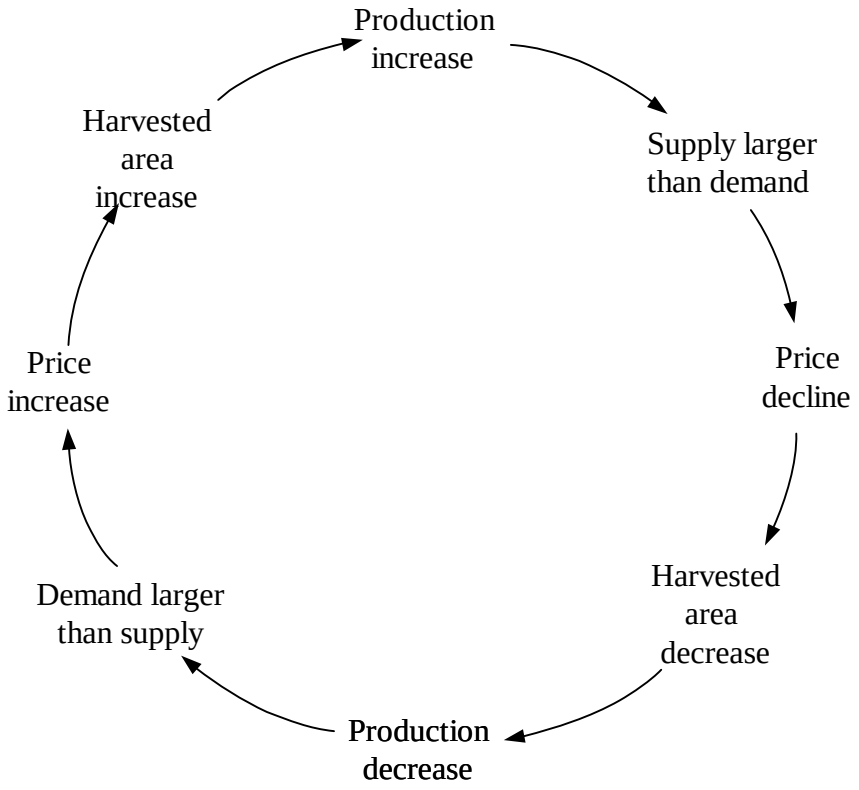

Figure 3. Hypothetical vicious price cycle which prevents farmers from reaping benefits from increased production.

FUTURE NEEDS AND POTENTIAL

What the cassava growers really need is an improvement in their living standard. If a better life can be accomplished by higher incomes, the higher income can be realized through sustainable farming practices. Sustainable farming practices can increase yield, while a yield increase can fulfill consumer demand. This consumer demand should drive a balanced production, which will benefit the farmers; but a better life is not so easily achieved.

Economic incentives to cassava farmers are low. Gunawan (1997) stated that the income of cassava farmers per unit time was the lowest among food crops farmers. For a long time it was believed that low farmer income stemmed from low productivity; hence, increasing

productivity was considered the best strategy. Furthermore, the prospect of increasing yield is very promising since the gap between actual and potential yields is very wide. Unfortunately, this option has not always been successful.

The wide gap between actual and potential yields is true but increasing yield will raise income only on the condition that demand is larger than supply. Theoretically, price is a result not a cause: a price decline is indicative that supply is larger than demand. Limited demand itself can be expressed in terms of limitations in financial capability or capacity to process or to consume cassava. Since increasing farmer income is the main objective, expanding demand is urgently needed.

Cassava is in demand either for domestic use (food, feed or industry) or export. Cassava is consumed both as fresh roots and in dried forms. There is a marked regional variation in consumption patterns of both fresh and dried forms. Fresh and dried cassava consumption, at least in rural areas, increases markedly with increasing income at low income levels; consumption levels off at medium income levels, and declines at high income levels. In general, total cassava consumption tends to decline when income increases. As cassava is considered as an inferior food commodity, the prospect of expanding demand through direct consumption depends highly on the number of the poorer income groups who substitute cassava for rice (more highly preferred). Furthermore, rice prices have a very marked effect on cassava consumption.

Based on the overall tendency that cassava for direct human consumption will decline with an increase in income, the prospect of using direct consumption as a means to expand demand is dubious. As trends in direct consumption are related to the type of products as well as to the preparation methods for cassava, the future hope rests upon product development activities. Availability of more cassava-based products will make more people willing to accept cassava, and not only as an alternative food when rice is in short supply. Integrating cassava into the overall food policy through government support is essential.

Two main cassava-demanding industries are starch processing and the manufacture of starch-based products. The structure of the cassava industry is characterized by great diversity. Starch factories are scattered throughout Java and Sumatra, with a significant range in plant size as well as processing techniques and scale. The future potential of this demand locus is expected not only to absorb more cassava but also to generate social benefits such as employment. The local government of Lampung province launched a special program “called the Community-owned Cassava Starch Industry “since 1998. It is expected that the demand for cassava will increase with this program, stabilizing cassava prices as well as farmers’ income. However, there are still many constraints, mainly in marketing the starch and in capital availability. The prospect of industry being a focus of demand expansion is promising. However, it should be based on mutual benefits for farmers and processors. A good example has already been implemented by one of the private enterprises located in Lampung province.

In an attempt to get a sustainable supply of cassava, the private enterprise has implemented a joint venture scheme with farmers. The company provides technology and loans for working capital, while farmers provide their land and labor. By this scheme, more productive technologies can be implemented and a fair price can be paid. Since providing technology and loans for working capital is an investment, the company also actively supervises farmers’ cultural practices. Many advantages can be achieved by such a scheme.

Another source of industrial demand, which has potential but is not yet sufficiently tapped, is the animal feed industry. Constraints which handicap the use of cassava in the feed industry should be identified. Government support is required, since some feed components are still imported. The future prospect of this demand is expected to be high, because trends in demand for poultry, dairy and other animal products are increasing, while most of these products are still imported. Cassava chips and pellets can be used as one of the components in feed manufacture. In addition, exporting feeds which contain cassava as one of their components will be another good alternative. Again, government support is required, because large investments, either from domestic or foreign sources, are necessary. There are good possibilities of creating either unilateral or multilateral joint ventures.

The above discussion shows that demand is required to trigger an increase in farmer productivity within the farmer's capability. Without expanding demand, there is limited hope for an increase in farmer income. Farmers need support, not only in technological expertise but also in economic expertise. The simplest expression of their most basic need is: "please tell us how to sell cassava in order to get a reasonable price". Of course, the availability of more productive and efficient technology is undoubtedly required. However, availability of other necessary measures which enable farmers to employ more productive technologies should come first.

CONCLUSIONS

1. Cassava remains an important crop, involving the lives of millions of people either directly or indirectly. At least four million people, the growers, are directly affected by either high or low cassava production, which in turn affects price.
2. Most of the cassava growers cultivate their crop under relatively unfavorable circumstances. They are dependent on rainfall which is usually unpredictable. The topography of their land is mostly undulating, and is therefore susceptible to soil erosion and degradation.
3. Most of the cassava roots are traded outside the farm, and cassava is more likely to be a source of income rather than a source of food. Low price at harvest discourages farmers from using productive cultural practices. As a result of the relatively low income obtained from cassava farming, only a small fraction of the farmer's income is allocated to conserving his land.
4. Since the role of the crop is more likely to be a source of income, the best measure for the effectiveness of a development program should be a change in farmer income. The best way for farmers to increase their income is to increase their yield. While the potential for increasing farmer income through increased yield is high, it can only be realized if other determinants, such as demand and distribution, operate in a complementary fashion.
5. Increasing demand is crucial to absorb the greater production as a result of higher yields. Improving the efficiency in distribution is essential in order to reduce the marketing margin and allow a more equitable price for the farmers.
6. Demand can be expanded through product development which will lead to more people consuming cassava-based products as well as through higher consumption by each person. Product development should be supported by government policy which encourages the integration of cassava into the overall food policy. Industrial demand,

mainly starch and starch-based industries, is expected to grow. Demand for cassava by the feed industry, which is still insignificant at present, has a huge growth potential.

7. All these prerequisites are beyond the farmer's control. Without these preconditions in place, the farmer's future is unclear. Of course, farmers themselves will try to develop their own mechanism to adapt to the difficulties/problems they encounter.

REFERENCES

Central Agency of Statistics (CAS). 1998. Statistical Yearbook of Indonesia. Jakarta, Indonesia.

Erwidodo and P.U. Hadi. 1999. Effects of trade liberalization on agriculture in Indonesia: Commodity aspects. CGPRT Working Paper 48. CGPRT Center, Bogor, Indonesia.

Gunawan, M. 1997. Market prospects for upland crops in Indonesia. CGPRT Working Paper 25. CGPRT Center, Bogor, Indonesia.

Howeler, R.H., C.G. Oates and A.C. Allem. 2000. Strategic Environmental Assessment: an assessment of the impact of cassava production and processing on the environment and biodiversity. Paper presented at the Global Cassava Development Strategy Validation Forum, held in Rome, Italy. April 26-28, 2000. FAO/IFAD, Rome, Italy. 153 p.

Koes Hartojo. 1999. Prospects in the cassava agribusiness-agroindustry development. Agency for Agribusiness, Jakarta, Indonesia. (in Indonesian)

Koes Hartojo and J. Wargiono. 1999. Efforts to increase cassava productivity and efficiency in Lampung province. Natar Assessment Institute for Agricultural Technology, Bandar Lampung, Lampung, Indonesia. (in Indonesian)

Lynam, J. 1987. Global cassava research and development. *In:* The Cassava Economy of Asia: Adapting to Economic Change. IV. Indonesia. CIAT, Cali, Colombia.