Profitability Assessment of Transmigration Land Use System in Dryland Peneplain Zone of Lampung: Continuous Annual Food Crop Farming System, Degrated to *Imperata cylindrica* Grassland

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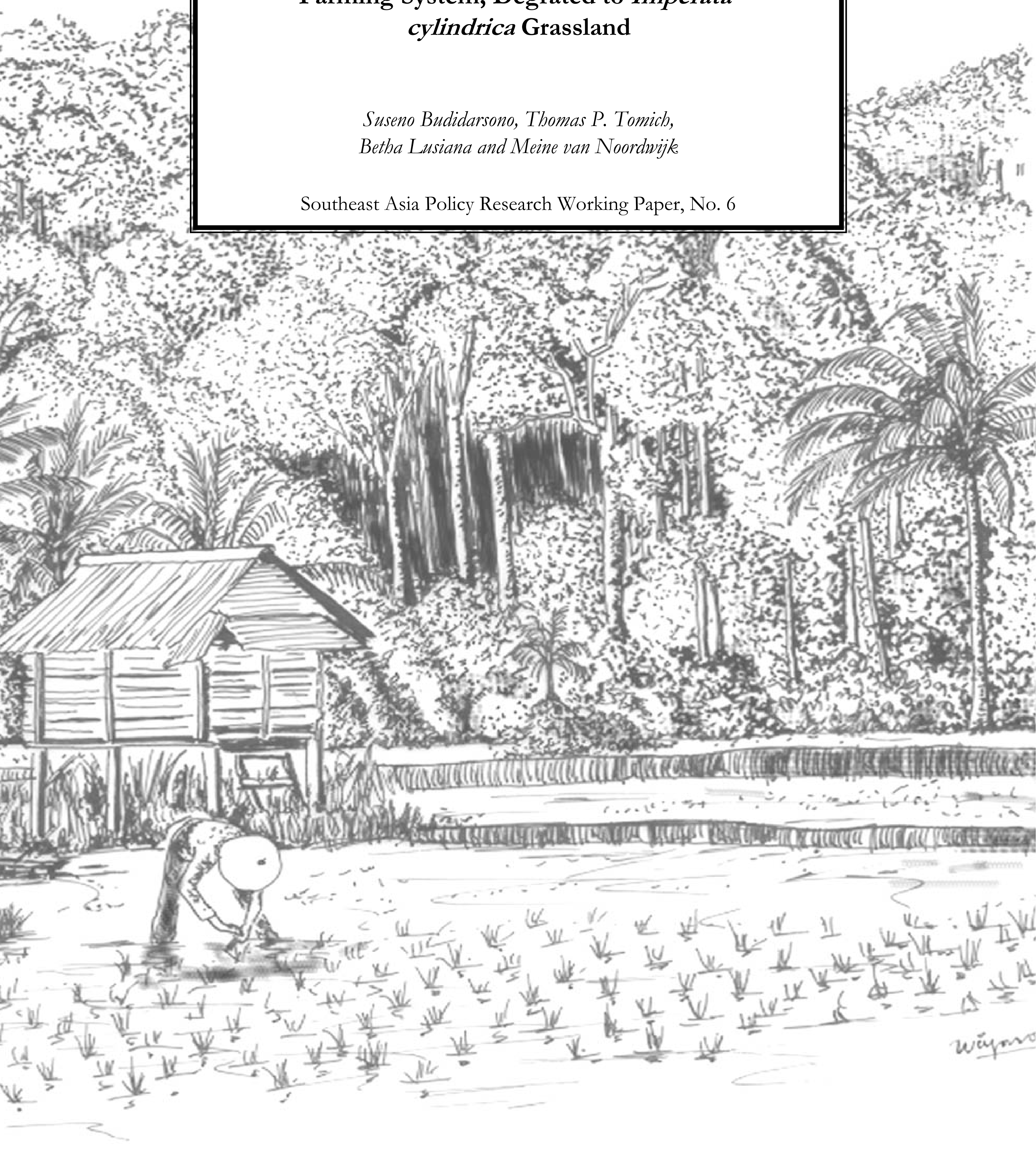

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Profitability Assessment of Transmigration Land use System in Dry-land Peneplain Zone of Lampung: Continuous Annual Food Crop Farming System degraded to *Imperata cylindrica* grassland

Case of Negara Jaya and Tegal Mukti, two transmigrants villages in the peneplain zone of Lampung

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This report is part of the ASB Project in Indonesia. The Asian Development Bank, under RETA 5711, financially supports this specific work. In estimating continuous cassava production overtime, authors benefited from the existence WaNuLCAS model developed by Meine van Nordwijk and Betha Lusiana.

Abstract

Sustainable forms of continuous foodcrop production may be *technically* feasible in Sumatra's peneplains, but often are not financially attractive because they require too much labor and too many purchased inputs. The study has focused on cassava, which may be among the most profitable of the continuous foodcrop alternatives for the peneplains. The most profitable cassava system studied was an extensive fallow system without any fertilizer applications. Profitability at private prices was estimated at over Rp 545,000 per ha. However, these systems mine nutrients, exhausting the soil and reducing the range of future land use options. Two cassava systems that use fertilizer are included in the study; one with fertilizer applications from the first year and one with fertilizer beginning in the seventh year after forest clearing. Application of fertilizer from the first year after clearing (30 kg N; 60 kg P; and 60 kg K per year) is not profitable privately (negative Rp 71,000 per ha) or socially (negative Rp 315,000 per ha). These treatments and the agronomic results are taken from experiments conducted at the Biological Maintenance of Soil Fertility (BMSF) research project at the ASB benchmark area in Lampung. However, an intermediate approach with fertilizer applications beginning in year seven (50 kg N; 50 kg P) does produce relatively attractive returns at both private prices (Rp 360,000 per ha) and social prices (Rp 224,000 per ha). However, the longer-run sustainability of this system requires further study. Note that, because of chemical fertilizer price subsidies that were still in effect in mid-1997, cassava is one of the few cases where estimated 'divergences' are positive, indicating that policy increases private profitability.

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I. INTRODUCTION

1.1. Transmigration Program in the Peneplain Zone of Lampung

Peneplain zone of Sumatra[1], on which this paper is concerned, begins in the very south of the island (Lampung province) and stretches right through the center of Sumatra up to the North Sumatra border in the north (Figure 1). Physically, peneplain zone of Sumatra constitutes flat land with Tertiary sediments, deposited in the sea; the altitude is less than 100 m above sea level, consist of 10% river levees and floodplain with more fertile alluvial soil, and 90% of uplands with a gently undulating landscape, mostly red-yellow podzolic soils that are roughly corresponding with Ultisol and Oxisols in the Soil Taxonomy (Scholz, 1983: pp. 141-144, van der Heide *et al* 1992: pp.1-2). The soil fertility constraints, such as problem of Al toxicity, P deficiency and rapid depletion of soil organic matter, are the most obvious on the peneplain sites, meaning that continuous food crop production is not possible without substantial input of fertilizer (Van Noordwijk *et al*. 1995: p.59). The practice of permanent cultivation of annual dry land the peneplain zone of Sumatra on a two hectare piece of land, as the transmigrants did, has turned out to be not optimal choice under given natural condition (Scholz, 1983: p. 215)

Within Lampung Province, this type of physical environment covers mostly northern part area of the province. At the end of 1970s, after more than six decades of the history of resettlement program was begun in Lampung province, this peneplain area that was initially not favorable site for transmigration destination, became the target area of transmigration program. Mougeot and Levang (1990) noted that the majority of transmigration centers installed in North Lampung since 1980 were located in the large eastern peneplain. Most of new settlers came from densely populated region within the province under *Translok* program, a locally resettlement scheme. This operation was partly linked to the preservation of the mountain regions and the protection of natural

[1] Scholz (1993) distinguishes the natural region of Sumatra into five major agro-ecological zones, with boundaries running from northwest to southeast approximately parallel to the coast: (1) a narrow western coastal zone, (2) a mountain zone, (3) a narrow piedmont zone, (4) a broad peneplain zone, and (5) a coastal swamp zone.

reserves in *Gunung* Balak (Benoit, *et al*., 1989:133). Most of those farmers were resettled under RCFC (*r*ain-fed *c*ultivation of *f*ood *c*rops) model[2], in which the new settlers was encouraged to cultivate dry land food crop for their livelihood.

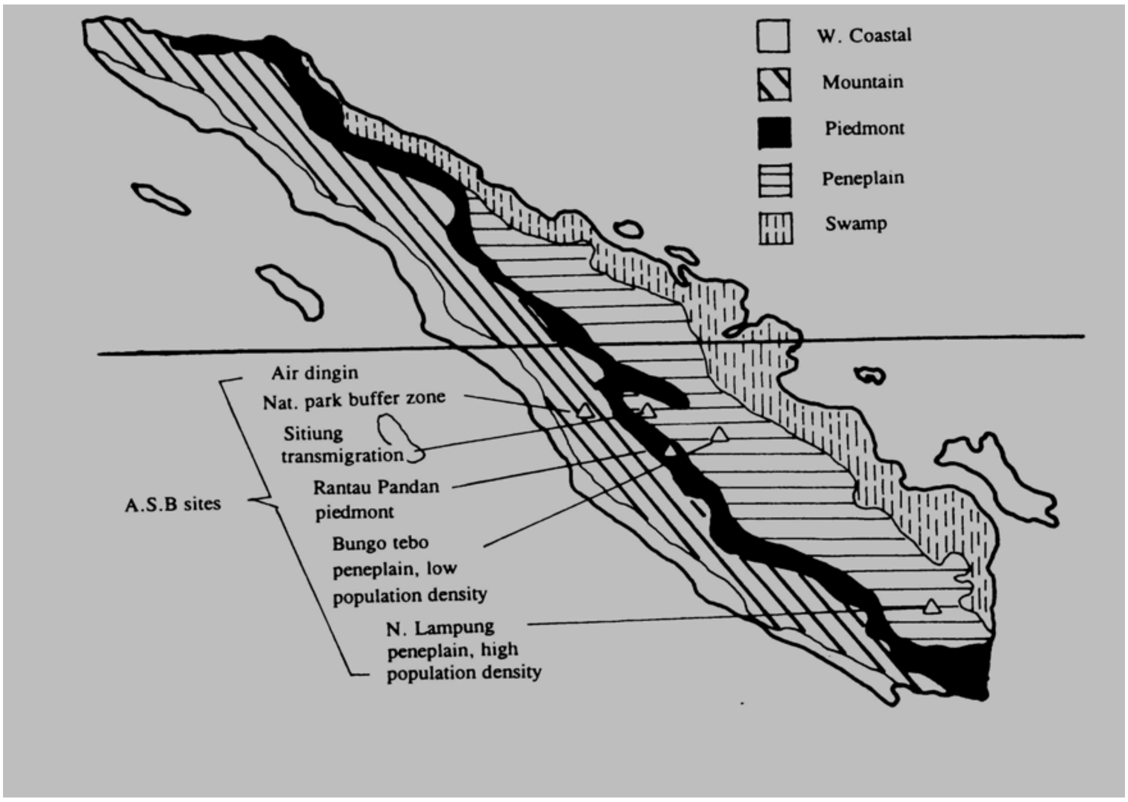

Figure 1: Agroecological zone of Sumatra (after Scholz, 1983) and ASB Research site (AARD, 1997 : Figure 3)

1.2. Transmigrant's agriculture practices in the peneplain zone

It is widely known that the transmigrant settlements under RCFC model were totally based on dry land farming. In the early years new settlers would be facing difficulties to maintain their livelihood. Scholz (1983: 166), based on 1973 and 1982 surveys, describes how the settler struggling to sustain their livelihood and finally they could not rely mainly on dry land food crop cultivation, as the following :

[2] There were three models in transmigration program : Irrigated Rice-farming by Tidal Flow (IRTF) model, Rain-fed Cultivation of Food Crop (RCFC) and Small Plantation / Nucleus Estate (SP/NES) model. There were 80% out of 366,000 families were resettled based on RCFC during REPELITA III (Mougeot and Levang , 1990 : 78-80)

> … Each of the transmigration families was given 2 ha of land (including 0.25 ha garden plot), which in this area consisted mainly of undulating alang-alang grass plains. The house garden was continuously cultivated with annual dry crop, primarily cassava. Of the remaining 1.75 ha of dry land, a single farm could usually not handle more than 50%, i.e., 0.8 – 0.9 ha, due to lack of labor. During the first two years the transmigrants applied a cropping system of dry land rice mixed with maize (at the ratio 4:1) in the rainy season, followed by cassava in dry season. In the third year only cassava could be grown in the same fields. In the fourth year the farmers switched over to his second half of land, leaving the former half under grass fallow for three years. After six years he could try the whole rotation from the beginning. Yet, in the long run the whole system proved to be too intensive to be performed continuously on the prevailing poor red-yellow podsolic soils, because most farmers could not afford fertilizer at that time. In many years the system finally ended up with two or three years of monocrop cassava, followed by the same period of fallow. In the mean time yields had often dropped to hardly tolerable level. For example both dry land rice and maize to less than 0.5 t/ha, and cassava 5.0 – 7.0 t/ha. The transmigrants had to search for alternative sources of income as wage laborers, often as coffee or clove pickers in the <u>kebun</u> of indigenous Sumatra farmers.

Ten years later,

> ….. the situation had changed in favor to farmers. Most of the transmigrants possessed full-grown perennials in their house gardens, mainly coconut but also some fruit and cloves tree, providing additional cash. About one farmer in two owned a draft animal, which besides providing meat, cash and manure, is used for ploughing and thus make it possible to enlarge their area under cultivation. The shortened fallow period was obviously more than fully compensated by application of fertilizer, which has meanwhile become a common feature in the area. This had helped to stabilize yields at tolerable level. However, the rotation pattern had remained basically unchanged during the last ten years. Most of dry land plots exclusively for cassava cropping. Other crops such as soybean, vegetables, peanut, sweet potato, and mungbean, were still minor importances. This may be still far from what theoretically can be achieved, and the living standard of the pure dry land farmers is still at very modest level.

The story quoted above suggests that the area is unsuitable to be intensively cultivated for continuous annual food crop farming system without any substantial external input. A long-term soil fertility experiments had been carried out in North Lampung transmigration site started in 1984 to verify that issues (van Heide et al, 1992, Van Noordwijk et al., 1992, Sitompul, S. et al, 1992). The question whether sustainable cropping system could be obtained with the present food crop and current fertilizer used (that is reasonable low), was among the concerns of the project. Experiments of cassava-based cropping systems on an Ultisol in Lampung to assess possibilities for sustained cassava production using low external input technology, confirms the rapid decline in land productivity after clearing forest vegetation (Sitompul, 1992). This experiment revealed:

(a) after five years of continuous cropping the production (tuber yield) of cassava declined gradually in all treatments;

(b) maize yield could not be maintained in the fifth year;

(c) although intercropping systems were much more productive in the long run than the monoculture cassava, the experiment concludes that the cassava production can be sustained in the long run if intercropped with upland rice and soybean;

(d) because cassava takes quite long time to form a closed crop canopy, cassava grown as monoculture provides ample opportunity for infestation by *Imperata cylindrica*, and many cassava field gradually become dominated by this weed; and

(e) the use of high input technology will sustain the cassava production, but this is often not feasible due to the low of income of small farmer.

1.3. The question of profitability

The last conclusion of the experiment needs to be assessed carefully. Even if farmers could afford the fertilizer they need, the issue is not merely related to the quantity of external inputs per unit of land needed to sustain its productivity. From private-farm point of view, it is conceivably that there is no farmer would maintain the productivity of land if the efforts always bring negative return over time. An important question to be addressed in this regard is whether the farming system with high external input is profitable for farmers and is more sustainable for their livelihood. Hence, is continuous cassava farming system financially and economically profitable? This assessment will focus on the profitability of cassava farming systems that is practiced by most transmigrant farmers in dry land peneplain zone in Lampung.

1.4. Methodology

1.4.1. Policy Analysis Matrix: approach of the assessment

Policy analysis matrix (PAM) is a matrix of information about agricultural and natural resources policies and factor market imperfection, that is created by comparing multi years land use system budget calculated at financial prices – reflecting actual market – and economics-shadow prices – reflecting efficiency (Monke and Pearson, 1995 ,is the basic reference). It composed of two set of identities – one set defining ***profitability***, and other defining the difference between private price and social values, measuring the

effect of divergence; as the difference between observed parameters and parameters that would exist if the divergence were removed (Monke and Pearson, 1995, pp.: 16 –19).

Profitability as the first identity of accounting matrix, is measured horizontally, across the columns of the matrix as demonstrated in Table 1. Profits, shown in the right hand column, are found by subtraction of cost, given in two middle columns, from revenue, indicated in the left-hand column. This column constitutes *profitability identities.* There are two profitability calculations: private profitability and social profitability.

Table 1. Policy Analysis Matrix

		Costs		
	Revenues	**Tradable Inputs**	**Domestic Factors**	**Profits**
Private prices	A	B	C	D[1]
Social prices	E	F	G	H[2]
Effect of divergence and Efficiency policy	I[3]	J[4]	K[5]	L[6]

[1] Private profit, D, equal A minus B minus C
[2] Social profit, H, equal E minus F minus G
[3] Output transfer, I, equal A minus E
[4] Input transfer, J, equal B minus F
[5] Factor transfer, K, equal C minus G
[6] Net transfer, L, equal D minus H, they also equal I minus J minus K

Source: taken from Monke and Pearson (1995, p.19)

Private profitability calculation is provided in the first row. The term of *private* refers to observe revenues and costs reflecting market prices received or paid by farmers, merchant, or processors in the agricultural system. Private profitability calculations show the competitiveness of agricultural systems at given current technologies, output values, import costs and policy transfers. Private profits are the difference between revenues (A) and cost of input (tradable input B, and domestic factors C); all measured in actual market price: D = A-B-C. ***Social profitability*** calculations, as indicated in the second row, is the accounting matrix utilized social prices using economic-shadow prices. These valuations measure comparative advantages or efficiency in the agricultural commodity system. Social profits H, are efficiency measures, because output E (revenue) and input (E+F) are valued in prices that reflect scarcity or social opportunity cost. Social valuation of output (E) and input (F) that internationally tradable, are given by world price: c.i.f. prices for good and services that are imported or f.o.b. export prices for exportable. Social valuation for domestic factor (G) are found by estimation of net income forgone because the factor is not employed its best alternative use or its opportunity cost (Monke and Person, 1996 p.21). In practice the valuation begins with a distinction between mobile (capital, labor and services that can move from agriculture to other sector of economy) and fixed factors (mostly land). For mobile factors, aggregate supply and demand forces determine prices. For fixed or immobile factors of production, such as land, are determined within particular sector of the economy. The value of agricultural land, for example, is usually determined only by land's worth in growing alternative crops.

The second identity of the accounting matrix is ***effect of divergences***, indicated in the third row. Although this row mainly concerns the difference between private and social valuation of revenues, costs and profits, and is measured vertically. This row constitutes the main point of the PAM approach. Any divergence between the observed private prices and the estimated social prices must be explained by the effect of policy or by the existence of market failure. *Output transfer* (I=A-E) and *input transfer* (J=B-F), arise from two kind of policies that cause divergence between observed market prices and world product prices. Those two kind of policies are commodity-specific policies include a wide range of taxes and subsidies and trade policies, and exchanged rate policy. *Factor transfer* (K = C-G) shows how policies on factors of production and the factor market imperfection had been taking place that create a divergence between private cost (C) and social cost (G). Finally the *net transfer* (L) caused by policy and market failure is the sum of the separate effect from product and factor market (L = I-J-K). Positive entries in two cost categories J and K represent negative transfer because they reduce private profit, whereas negative entries in J and K represent positive transfer.

1.4.2. Data needed for the Analysis

The determination of profit that actually received by farmers is straightforward and important initial result of the analysis. It shows which farmers are currently competitive and how their profit might change if price policies were changed. Therefore farm budget components of the principal agriculture systems, such as farm output or revenues and input cost, are the main necessary data and information. All of these are measured in actual market price. Regarding the second row of the matrix that measures comparative advantages or efficiency in the agricultural commodity system, the valuation is given in world price. Therefore f.o.b. prices data of exportable items and c.i.f. prices of importable items in farm budget are the necessary data that should be collected.

1.5. Site Selection and Data Collection

The assessment selected two villages (Negara Jaya and Tegal Mukti) that was formerly settlement unit for transmigrants within ASB benchmark site in North Lampung. The two villages were selected to represent transmigration area within dry land peneplain zone in which farmers practice continuous annual cropping system.

Information regarding farming practice of farmers was gathered from the field using rapid rural appraisal (RRA) method. RRA consist of short, intensive and informal field surveys that focuses on peoples' own views of their problem (Khon Kaen University 1985; Chambers et al, 1989). Generally, the method involves open-ended exploration of key issues and more focused understanding on key themes from key informants' perspectives. Two data collection techniques were applied i.e., field observation and in-depth interview with key informants using semi structured interview guide.

Other information that needs to be collected that is not necessarily from the field is secondary data, such as c.i.f. prices of importable farm input, f.o.b. prices of exportable and farm input, marketing cost and processing cost of farm product that was collected form related agro-processing companies. This assessment also relies on statistics derived from the reliable statistic publication.

1.6. *Data sources and assumptions*

Information of farming practices and all related data, that are used to construct farm budget - to fill the two rows of PAM matrix, are collected from different level of data sources. Input and output data of farming system are collected from key informants in the field (mostly farmers), related district agencies, and traders. Market prices of farm input and out put and resources used are collected from the same sources and agro-processing companies (CV Bumi Waras). Borders prices of exportable and importable farm input and output used in the assessment were calculated based on statistical data form BPS, commodity prices – "pink sheet" of the World Bank, and International Financial Statistics Yearbook.

Since the assessment of continuous annual food crop system is set to 25 years, a scenario of farming practice including farm inputs used and its yields, need to be constructed. At this point the assessment could not rely mainly on information from farmers or field observation. None of farmer and key informants were able to recall what was the yield from time to time. This was the first data problem to be encountered. This assessment uses data from BMSF project[3] to bridge the data gap. The second problem is the use of farm input and the level technologies of farming system (seed variety and the use of external input) generally used by transmigrant farmers from time to time.

In estimating the production of fresh of cassava from time to time during given period for each scenario (as there are relationship among soil condition, input level and output level), the assessment apply WaNulCAS model[4]. This model helped the assessment to simulate the succession of continuous-cassava farming from the first year of operation including the years when fallow period is occurred during 25 years. Three cassava forming scenarios were set up within two patterns of external farm input use;

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[3] BMSF (Biological Management of Soil Fertility) Project conducted long term soil fertility experiment in North Lampung (that are facilitated by PTP Nusantara VII, PG Bunga Mayang) from 1984 to 1994. BMSF project conducted experiment in North Lampung (belong to Lampung peneplain zone) to test whether sustainable cropping system could be obtained with the present food crop and the current levels of fertilizer use (van der Heide, 1992). The assessment made use the data available in the project (a continuous data of tuber yield of cassava and maize, which are the main food crop species cultivated by transmigrant farmers) to construct a 25 years yield-scenario of the farming system.

[4] WaNulCAS (Water, Nutrient and Light Capture in Agroforestry System) is a general model of tree soil and crop interactions in agroforestry developed by International Centre for Research in Agroforestry (ICRAF). The model is formulated in STELLA Research modeling environment (van Nordwijk and Lusiana ,1998). Appendix A explains on how the model is applied to construct 25 years production scenarios of cassava farming in the two villages.

with and without external input application. Those three scenarios were differed in its rate of fertilizer application. Those are : (1) continuous cassava farming with fertilizers application right from the first year, (2) continuous cassava farming with fertilizer application after yield of cassava reached untellable level of production (9 ton/hectare), (3) continuous cassava without fertilizer application.

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II. CONTINUOUS ANNUAL FOOD CROP FARMING SYSTEM IN DRY LAND PENEPLAIN OF LAMPUNG

2.1. Two selected transmigrants' villages : the research sites

The assessment selected two villages within Lampung ASB benchmark site, from which the data of continuous annual food crop farming system in a transmigration area within peneplain zone of Lampung were collected. The two villages, Negara Jaya and Tegal Mukti, administratively are situated within Pakuon Ratu sub-district administration, North Lampung District, northern part of Lampung Province. Both are located about 65 km away from the district capital city of Kotabumi in the south (Figure 2 and 3). It is also about the same distance to the sub district administrative center of Pakuon Ratu in the west. Pakuon Ratu sub-district covers an area of about 1,291 km^2, and at present has 41 villages. Nearly two third of the villages (24 villages) were formerly settlement units of transmigrants which were established during the last two decades.

The two villages were established in 1982 in line with resettlement program within Lampung Province, so called *translok* (*transmigrasi lokal* / locally resettlement scheme) that was done in early 1980s. All the transmigration areas in Pakuon Ratu Sub-district, were previously logged-over secondary forests that were then converted into transmigration area. Physically, the landscape is gently undulating/dissected peneplain; the altitude approximately 50 – 60 meter above see level, with some river valleys and small in-lands swamps, containing acid tuffs and coarse felsic sedimentary rocks, with slopes of 3 to 15%.

The population in the two villages in early 1997 was about 1200 households with 6100 people; 458 families with 2312 people are living in Tegal Mukti. The population of Pakuon Ratu sub-district has increased dramatically in the last two decades. Annual population growth in Pakuon Ratu during the 1980s was very much higher, reaching 57%, than in the1970s, that was 1.3% (Elmhirst, 1997: p128). Population density of Pakuon Ratu was growing nearly three times during 12 years; in 1983 it was 24/km^2 (Van Noordwijk et al 1995, p.26) has been increased to 62/km^2 in 1995 (BPS, 1995).

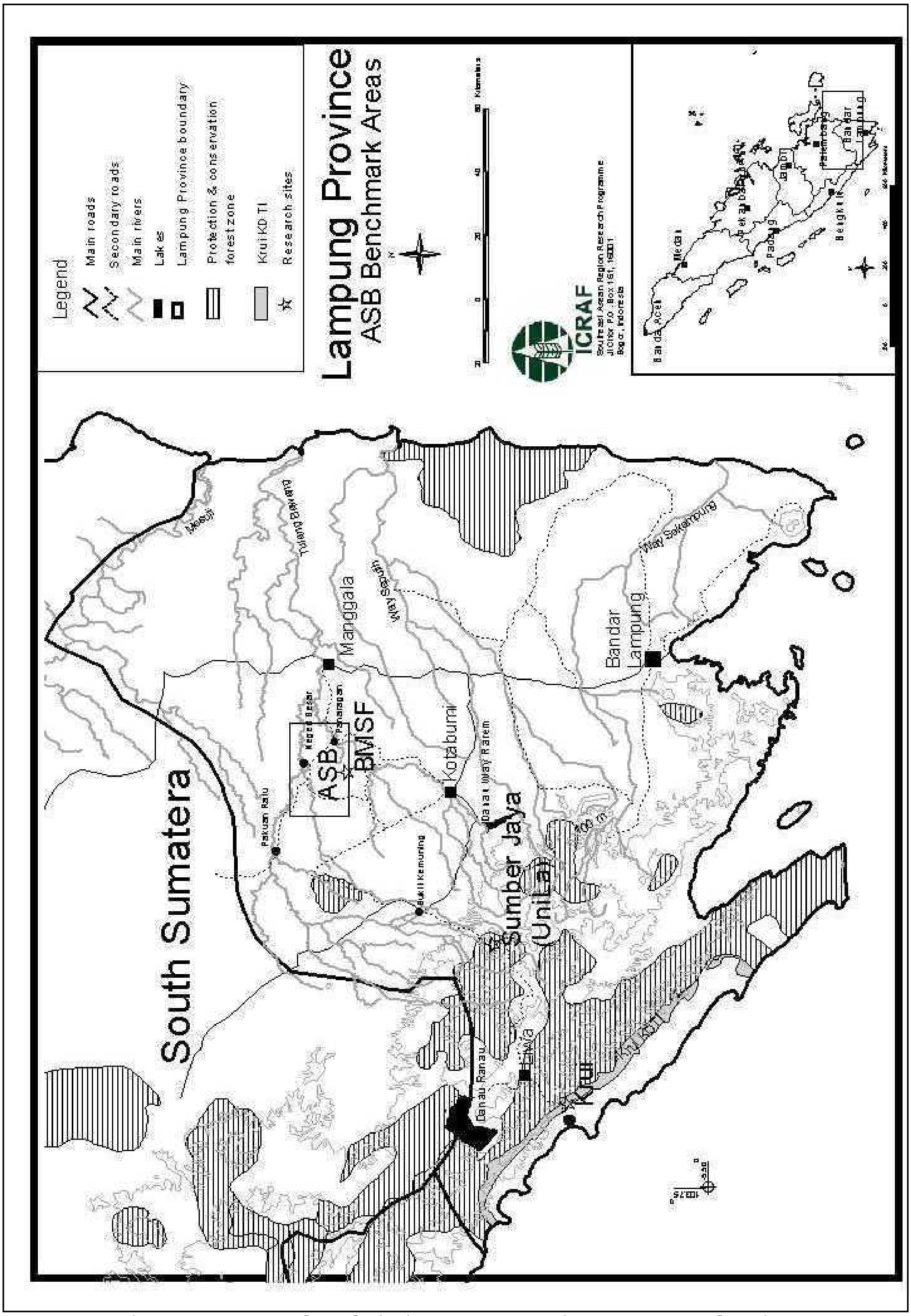


Figure 2. ASB Benchmark site in Lampung province, Sumatra,Indonesia

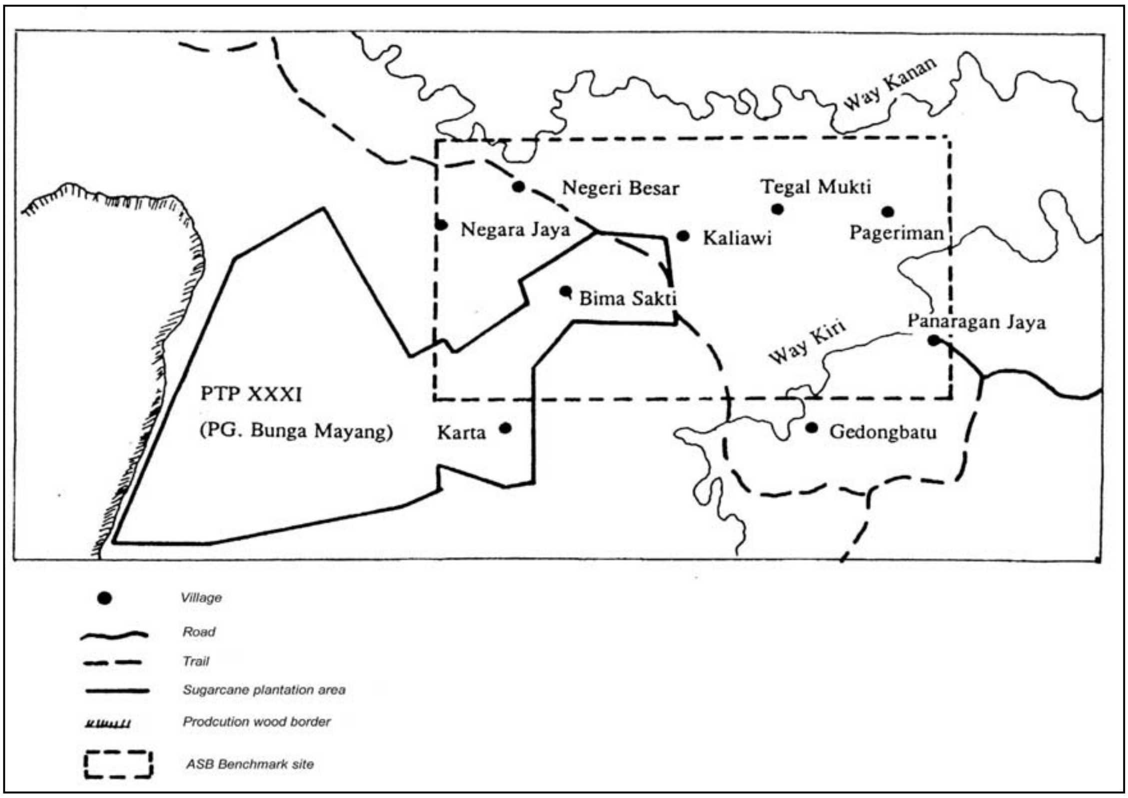


Figure 3. Sketch map : location of two villages under study within North Lampung benchmark site

Most people in the villages engage in dry land farming. Only few farmers cultivate wet land paddy fields, mainly in depressed area in the riverbanks or swampy area; most of them live in Negara Jaya. About 10% out of the population engage in non-farm employment. Very few were found, however, people rely solely on non-farm employment. Seasonal off-farm employment available in the area is laborer in PT Bunga Mayang sugar cane plantation during harvesting period (July – November). The occurrences of seasonal migration among the young people to Jakarta, Palembang and Bandar Lampung contribute to the problem of farm labor shortage in the area.

2.1.1. Land uses and the existing farming practice

At present, the two villages and its surroundings characterized with upland food crops farming (mostly cassava and maize) and sugar cane plantation of state owned plantation (PT. Perkebunan Nusantara VII - Bunga Mayang). During the visit in

August and October 1997, it was easily seen abandoned agricultural land, infested with alang-alang / Imparata cylindrica. There were also few plots of oil palm plantation and tree plantation with Sengon (Paraserianthes falcataria) as the main tree species.

In general, each household of transmigrant entitle to and had been allotted two hectares of land, consisting 0.25ha of land for housing and pekarangan (home-yard), and two plots of agricultural land : lahan usaha I (0.75 ha) and lahan usaha II (1 ha). The first two plots of land (i.e. pakarangan and lahan usaha I) were allotted during the first year. Lahan usaha II allotted after they had completely cultivated lahan usaha I. Approximately, only 50 to 60% of their agricultural land were cultivated for annual food crops. The rest comprises of alang-alang grassland, bush and shrub, abandoned agriculture land, few plots of timber tree crop and oil palm tree plantation, sugar cane field that was cultivated under technical assistance (Tebu Rakyat Intensifikasi) from PT. Bunga Mayang and nard grass/citronella grass (Cymbopogon nardus) in Tegal Mukti.

The Constraints

The occurrences of abandon and underutilized farmland in the two villages, that was easily found during the field visit, is very much related to the constrains in food crop farming that is practiced by transmigrant- farmers. Three main constraints can be identified. Firstly, soil fertility constraints as it is underlined in the previous chapter. It leads to the situation where continuous annual food crop farming in dry land is not possible to be practiced. Farmers in the two villages have been experiencing with the decline of food crops' yield reaching intolerable limit to cover the cost. Whenever the yield does not cover its cost of production, farmers will leave their land idle for 2 to 4 years. Secondly, capital and labor constraints impede farmers-transmigrant to cultivate all agricultural land they have. Farmers have not been able to cultivate all land they have in one cropping year all together due to the lack of capital (personally owned and credit) and labor shortage. For those who had been allotted *lahan usaha* II located relatively far away from house lot, tends to abandon the land. Controlling the crops in the *lahan usaha* II from pest (mammalian pest) was big problem in cultivating this land. The cases of selling the *lahan usaha* II in these two villages in some extents were related to that matter. Some farmers already sold their agricultural land to Lampung native people or other transmigrant, even they never cultivate the land, to buy a new plot of wet land closed to the river to grow rice or other agricultural land that is closer to their houses. In many cases the acreage of the new plots was less then they sold. The others make use of the idle-depressed area (such as waterways, creeks, and river's bank) belong to PT. Bunga Mayang to cultivate rice. Thirdly, related to the issue of land right that has not been resolved until recently. The issue has been the problem between Lampung native people and the new settlers. Some farmers never cultivate their *lahan usaha*, because of this problem.

From subsistence food crop farming to oil palm plantation

Food crop farming was began at homeyard lots right after transmigrants were resettled, and then gradually moved to their *lahan usaha*. In the early years (1983-1985) subsistence foods crops, such as cassava and maize widely grown and often intercrop with other legume crops such as soybean and groundnuts. In Negara Jaya, those who hold land that is located in depressed area and close to river or creek practice wet land paddy. If there was a chance to grow paddy, they preferred to cultivate this food crop. During the same period they planted perennials crop, such as *belinjo* (*Gnetum gnemon*), HYV coconut, banana, clove, and *nangka* (*Arthocarpus heterophillus* - jack fruit) in their respective home-yard, as part of resettlement programme. However, only few of farmers could keep it grow.

In 1985 agricultural extension services introduced soybean farming to farmers-transmigrants. For about four years most farmers grew soybean as the first crop, and became a favorite crop. This profitable crop, however, could not be sustained until, and had no longer existed after 1989; the yield declined to nearly zero after three years cultivation.

In 1989 PT. Bunga Mayang began to provide five years credit schemes for small holder to grow sugar cane in their *lahan usaha*. It had encouraged farmer to join the small holder sugar cane scheme. Elmhirst (1997: pp. 362-363) on her survey in two neighboring villages (Negara Anyar and Tiuh Indah), mentions around 44% of total area owned by sample household were use for sugar cane. Half of the sample, joining small holder sugar cane scheme meant bringing uncultivated land into use for the first time since arrival at the settlement. But by 1994/1995 many farmers were disappointed with the scheme. Logistical problem of fertilizer delivery, problems with transport of the harvested cane to factory, and poor crop growth due to drought in 1994 led to financial disappointment. Many farmers could not repay they credit (Van Noordwijk et al 1995, p.58).

At the other hand, roads network improvement to link the villages within Pakuon Ratu sub-district and from the villages to the main road, connecting the villages to bigger market centers within the province, had changed farming practices and marketing of the main agricultural commodities. The improvement of this infrastructure also attracted traders from provincial capital city and other bigger market centers to operate in the area. Previously, fresh cassava was always processed and sold in the form of *gaplek* (dry cassava). After road construction, farmers prefer to sell fresh cassava and the traders from Kotabumi and other market center operated their activities to the villages collecting marketable agricultural product.. Besides, the tendencies to grow other tree crop such as fast growing tree (*sengon*), rubber, oil palm, and nard grass/citronella grass (*Cymbopogon nardus*) had increased afterward.

In the second half of 1997, an oil palm investor promoting credit scheme to small holder farmer to grow oil palm tree on their agricultural land. The amount of credit is approximately Rp. 6.8 million/ha. Installment will begin in year six. Those who "release" their land for oil palm plantation would not have any access in farm management, but they can be working as laborers on this oil palm plantation. This scheme has attracted farmers to join. Many of them are farmers who disappointed with credit scheme in sugarcane plantation. The measures towards the establishment of oil palm plantations in this area so far consists of the establishment of oil palm nursery plant in the sub-district center of Pakuon Ratu, information dissemination to farmers, and farmers registration.

The dynamics of farming practices in the two villages, as briefly mentioned above, indicates that the settlers have been seeking the tracks for the best use of their land (more productive land use) to make a better livelihood. Along with that efforts, for the sake of their livelihood, most of the transmigrant farmers always reserve a parcel of land, even in small plots in their home garden or between fast track of sugar cane, for food crop cultivation.

2.1.2. The Occurrence of Imparata grass land

The occurrence of *Imparata* in many patches of farmland, as a result of cropping pattern that does not provide permanent cover of the soil surface (van Noordwijk et al, 1997), have been basically part of the problem in which farmers have to resolve every year prior land preparation since arrival. Slashing and/or burning the weed is the first activity need to be carried out regardless tillage system would be applied in land preparation. Labor requirement for this initial stage of land preparation is 7 ps-d/ha for manual *Imperata* clearence, and it will be 10 ps-d/ha if herbicide is applied.

Although this kind of weed is considered by most farmers as a troublesome and noxious perennial rhizomatous grass, few farmers in Tegal Mukti have been using *Imparata* leave to make thatch for they own purposed and for local demand. At least 3 households in Tegal Mukti have side income from making thatch made of *Imparata* leave that is abundant in the villages. Because the market for thatch is limited within village and the neighboring villages, they only produce thatch on order. However, annual income from making thatch is ranging from Rp 200,000 to Rp. 2,400,000.- depends on the demand. It was mentioned that the price of thatch per sheet varies from Rp200,- to Rp400,-

2.2. Continuous Annual Food Crop : Cassava and Maize

Most farmers grow drought-resistant and / or short duration crop species in their dry land. Cassava and maize are the most important commodities that are continuously cultivated since the early years of arrival of the transmigrants until recently. These two crops have changed its role from subsistence food crop to become cash crops that are cultivated in more extensive way.

Continuous annual food crop farming system, as it was practiced by most farmers during the first ten years, has not been existed at present. They have been practicing fallow rotation farming for food crop cultivation. Hence, farmers would leave their land fallow for 2 to 4 years whenever the yield of cassava or maize declining reaching 9 ton fresh cassava per hectare and 0.8 ton grain of maize per hectare. These figures seems to be the limits where farmers to leave the land idle in the subsequent year. There was also the case that farmers would not harvest cassava at all, just because the price of cassava was very low. They left the land idle until they decide to cultivate it again sometime in the following years. By the time they will cultivate another plot of land or seeking temporary off-farm job.

2.2.1. Cropping Pattern and Cropping Calendar

There are three cropping patterns (of maize and cassava farming) that are broadly practiced by farmers in Negara Jaya and Tegal Mukti:

(a) Monocrop cassava (CASSAVA → FALLOW). This cropping pattern will have three months fallow period after harvesting cassava; by the time *Imparata* weed grows and will cover the field before it is cultivated again.

(b) Maize - cassava relay intercropping (MAIZE → CASSAVA → FALLOW). Cassava as the second crop is planted right after maize is harvested. Cultivating the land in the subsequent year is possible.

(c) Maize - cassava intercropping (MAIZE + CASSAVA → FALLOW). Cassava and maize are planted in the same time. Fallow period will be less then three months.

Land preparation, which is preceded by *Imparata* clearance, begins in October. The planting time coincides with the beginning of rainy season; from late October till the first two weeks of November. Planting time for the second crop is done during February to March in the following year. Figure 4 shows cropping calendar in the two villages.

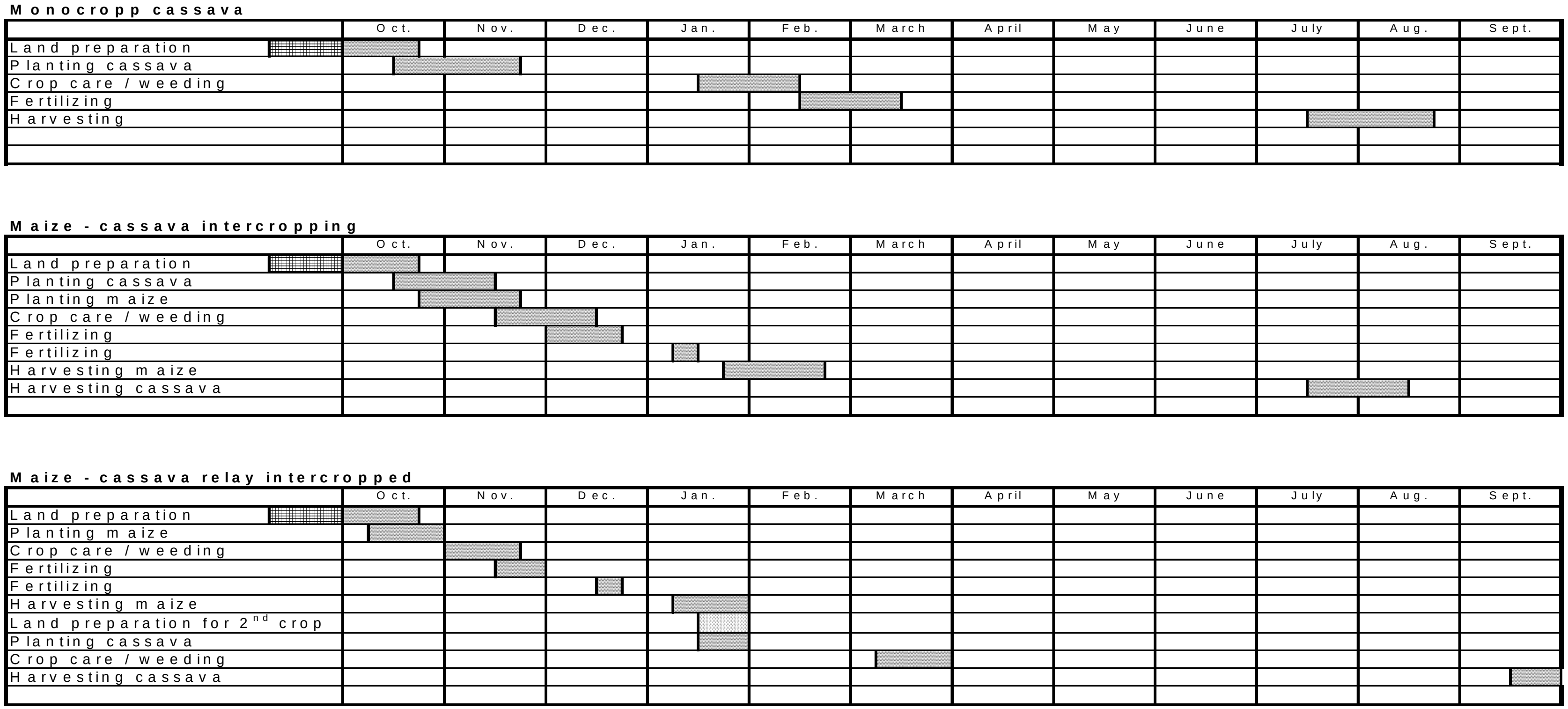


Figure 4. Cropping calendar: cassava and maize farming system in Tegal Mukti and Negara Jaya

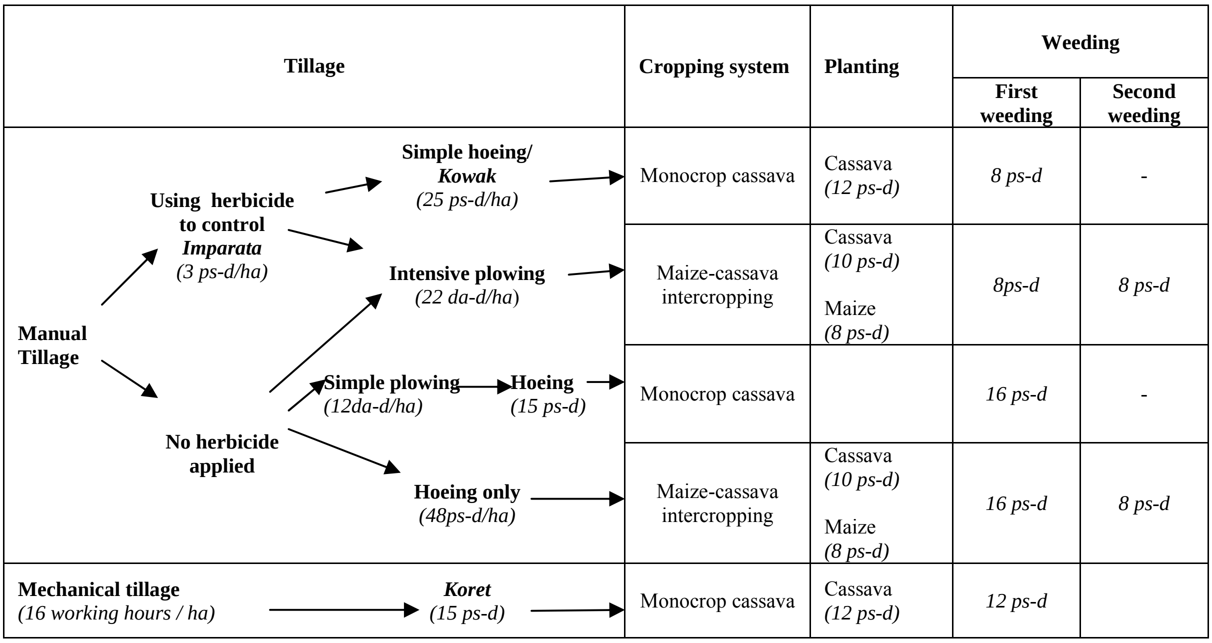
2.2.2. Farming practices and labor inputs

Human labor and draft animals are the main power sources for maize and cassava farming in the two villages. Although there is hired-tractor services available in the neighboring villages of Tegal Mukti and Menggala, only few farmers with large areas of land use hired-tractor to cultivate their land, and mostly for monocrop cassava farming[5].

Imparata clearance (slashing and burning) that is done by farmers prior soil cultivation, needs 7 to 10 ps-days per ha. There are two common techniques applied by farmers in the two villages for soil cultivation: (1) manual cultivation using human labor and drafts animal power, and (2) mechanical cultivation using tractor. It is interesting to note that each technique that farmers are choosing, is always related to the crop they want to plant and the resources they have (capital and land). Those who decide to grow maize would never use tractor and for those who cultivate larger areas of land and intend to grow cassava prefer to apply mechanical cultivation using tractor. Each technique also implies *Imparata* clearings activity priors land preparation, and has consequences on the weeding activities during one cropping cycle. Figure 5 shows various soil cultivation techniques applied by farmers for cassava and maize farming and its relationship to the weeding activities. Once farmers decide to use tractor, they would never apply herbicide in *Imparata* clearance. In monocrop cassava system very few are found farmer who applies herbicide in *Imparata* clearance. In maize-cassava intercropping system, most farmers would apply herbicide and followed by intensive plowing. In most cases where herbicide can not be incurred, farmers would be doing labor intensive for hoeing. However, manual tillage without herbicide (for *Imparata* clearance) is the tillage system applied by most farmers in the two village for cassava farming. Mechanical cultivation using tractor always applied by few-rich farmers for large scale cassava farming.

[5] During the field visit in October 1997, there was a farmer in Tegal Mukti, a close relative of the *Kepala desa* of Tegal Mukti, cultivated 2.5 ha of land for cassava farming. He spent Rp. 400,000 for tractor services or Rp. 160,000/ha. In Negara Jaya, rich farmers used to hire tractor services to cultivate their land. But, since the last two years this service has no longer been available. The tractor has been broken down.

Figure 5. Schematic diagram of soil cultivation techniques in relation to cropping system, weeding and its labor requirement.



Note :
1. ps-d : persons day, da-d : draft animal

Wit regard to harvesting activities, family labors are commonly employed for maize farming; about 18 to 20 person-days per ha for harvesting corn. While in cassava farming it is done on a contractual basis by a group of 10 to 20 persons. The cost is ranging Rp 10 to Rp 15 per kg depending the field condition. The harder the field the more expensive the cost will be. In many cases, harvesting cassava is organized by village traders, who are also working for cassava processing industry. Labor requirement for harvesting cassava depends on the yield of cassava per unit of land; approximately ranging from 28 to 94 person-days per ha. Monoculture cassava farming system requires less labor compare to maize farming system and maize-cassava intercrop and system

2.2.3. Inputs use

In general farmers have been adopting high yielding varieties of cassava and maize since their arrival. Two varieties of maize they grow are C3 and Arjuna, and for cassava there are Adira 4 and Sembung. Arjuna gives better yield than C3 (Arjuna: 2.4

ton/ha/harvest and C3: 2 ton/ha/harvest). There are no difference yields between the two varieties of cassava. At present the maximum yield of relatively well manage cassava crops is 22 ton/ha of fresh tuber a year.

Most farmers apply fertilizer from low to moderate level for cassava farming. But for maize cultivation they apply fertilizer as recommended. A farm survey that was conducted in conjunction with BMSF project in 1994, figured out that farmers used a fertilizer rate of 61 kg N/ha, 22 kg P/ha and 4 kg K/ha. (van der Heide et al, 1992). In the initial years of their arrival, no fertilizers were applied for cassava farming. But at present fertilizer constitutes an important farm input to sustain and even to increase cassava yield. Farmers interviewed during field visit in July and October 1997 mentioned, without fertilizer they will not get a good yield. As an example they mentioned, high yielding cassava would yield 18 to 20 ton per ha if fertilizer were applied. The fertilizer rate they apply Without fertilizer the yield might lower than 9 ton. For maize cultivation, most farmers using standard fertilization of 440 kg/ha consist of 1/3 urea and 2/3 TSP.

Other kinds of external input are insecticide and pesticide (mainly for maize, soybean, rice and groundnut) and herbicide to control *Imparata*. Few farmers apply herbicide for cassava farming. These kinds of chemical farm input can be incurred in the adjacent market centers in Panaragan and Negara Jaya. Depending on the type of herbicide, the price of herbicide is ranging from Rp. 8,000/ltr (for contact type of herbicide) and Rp21,000/ltr (for systemic type of herbicide).

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III. PROFITABILITY ASSESSMENT OF CONTINUOUS CASSAVA FARMING SYSTEMS

This chapter examines cassava farming profitability in the two villages under study, both financially and economically. Prior to the assessment, some points need to be noted regarding cassava farming in the two villages.

Continuous cassava farming has been practiced by transmigrants since their arrival. Due to the inherent characteristics of soil fertility, the rate of productivity declined from time to time. Under this circumstances fallow rotation techniques are applied by most transmigrants in dry land farming. Hence, when ever the tuber yield of cassava reach the level of nine tons per hectare, farmers would abandon their land or leave their plot idle for two or three years. By the time they cultivate another plot. They believe that soil fertility will recover after they leave the land idle for two or three years.

Under those particular characteristics of cassava farming in the two villages, profitability assessment of cassava farming based on a single year of operation, would not give a reliable result to measure cassava farming profitability. Therefore cassava farming profitability assessment was carried out within 25 years scenarios of continuous cassava farming, starting from the year of arrival of the settler. In examining cassava farming profitability within 25 years cycle using PAM methodology, net present value (NPV) PAM is established.

The assessment assumes that real interest rate (interest rate net of inflation) used in NPV calculation is 20% for private real interest rate and 15% for social real interest rate[4]. It will be the main cause of divergences between calculation at private and social prices. Besides, the exchange rate used in the assessment was Rp. 2,400/US dollar and the agricultural labor wage rate is Rp. 4000/ person-day.

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[4] PAM Research Teams in a meeting held in October 1997 decided to use these real interest rate for NPV Calculation. It was thought about that in July 1997, formal sector lending rates were almost 30% pa and inflation was under 10%. Thus private interest rate of 20% used in this study is lower bound for the actual cost of capital for smallholder. The real social interest rate is less than private price, and is somewhat arbitrarily; a rate of 15% has been used for real cost of capital, which is both the interest rate and discount rate for calculating NPV at social prices

3.1. Continuous cassava farming system within 25 years production scenario

Continuous cassava farming scenarios are developed to "reconstruct" farming activities, focusing on farm input used and output (fresh tuber yield of cassava) during given time frame (25 years), from which farm budget (constitute key components of an assessment applying PAM approach) of continuous cassava farming will be calculated. To make the scenarios as close as possible to the real situation in the two villages, continuous cassava farming here was simulated to start its cultivation at the year of arrival on logged-over secondary forest, where *Translok* of Lampung Province took place.

In setting up the cassava farming scenarios, two inter-related factors are considered: farm inputs used (both tradable inputs and domestic factors) and farm output (tuber yield of cassava). There are three scenarios of cassava farming were constructed. Regarding farm input used, based on data and information derived from field observation and other sources which is related to the study area, such as BMSF experiment, the three scenarios were set up within two patterns of external farm input use; with and without external input application. Scenario 1 is set to be a continuous cassava farming with low fertilizer application from the first year cultivation (30 kg N, 60 kg P and 60 kg K per hectare per year). Secondly, scenario 2 is set to represent a continuous cassava farming with fertilizer application beginning in year 7 (50 kg N and 50 kg P per hectare per year). Lastly, scenario 3 is a continuous cassava farming without fertilizer application.

In estimating the production of fresh of cassava from time to time during the given period for each scenario, as briefly mentioned in Chapter I, the assessment applied WaNulCAS model (van Nordwijk and Lusiana ,1998). Since there are relationship among soil condition, input level and output level, the model helped the assessment in three ways : to simulate the succession of continuous-cassava farming from the first year of operation, to estimate tuber yields of fresh cassava every year, and to figure out the years when fallow periods are occurred during 25 years. Appendix A explains on how the model is applied to construct 25 years production scenarios of cassava farming in the two villages.

Table 3.1. summarizes cassava farming practices under the three scenarios. Under **scenario 1** farmers will begin to abandon their land in year 12 and fallow period will recur every two years. Under **scenario 2**, representing the situation where farmer begins to apply fertilizer in year 7 (when the yield of cassava has reached the level close to 9 ton/ha in year 6), WaNulCAS model simulates that fallow period will never been occurred. Because the yield of fresh cassava never fall below 10 ton /ha in the following years. While under **scenario 3**, representing continuous-cassava farming without fertilizer application, farmer will begin to leave their land fallow at year 7. It is interesting result simulated from WaNulCAS : tuber yield of cassava remains low after three years and four years fallow. In this case farmer would insist to cultivate cassava without fertilizer application after three or four years fallow period. The yields never reach the threshold of 9 ton/ha. The detail cassava productions from time to time of continuous cassava farming under the three scenarios are presented in Appendix A.

Paying attention at labor requirements, the largest proportion are employed in harvesting activities, and mostly done by non-family member. Most of labor employed in cassava farming allocated for harvesting that is paid under contractual basis (ranging form Rp 10 to Rp. 15 per kg). Comparing those three scenarios, total labor employed during 25 years under scenario 3 seems to be the lowest. Under scenario 3, there is no labor employed for fertilization and the number of harvester is also the least among the three. This relates to the yield level gain in this scenario, which is also the lowest.

Table 3.1. Continuous cassava farming scenarios : external farm input used, tillage and imperata control, yield, fallow period and occurrences, and labor employed.

ITEMS	Scenario 1	Scenario 2	Scenario 3
External farm inputs use	Fertilizers application begins in the first year of operation. The fertilization rate is 30 kg N, 60 kg P_2O_5 (as TSP) and 60 kg K_2O (as KCl). No herbicide is applied	Fertilizers application begin at year seventh of operation; when the tuber yield of cassava fall under the threshold of 9 ton/ ha. The fertilization rate is 50 kg N, 50 kg P_2O_5 (as TSP). No herbicide is applied.	No external farm input application.
Soil cultivation and Imperata control	Manual, using human labor and draft animal power.	Manual, using human labor and draft animal power.	Manual, using human labor and draft animal power.
Fallow period : the occurrence, year to start and length of the period	Under this scenario farmers will abandon the land at year 12. Fallow period is three years long and will recur every two years till the end of year 25.	Fallow period never occurred, because the tuber yields of cassava never fall below 10 ton/ha, means that the yield levels always above the threshold of 9 ton/ha.	Under this system, farmers will start to leave their land fallow for three years at year 7. Without any fertilizer input, the tuber yield of cassava never reach the level of 9 ton/ha after year 7.
Cultivation years during 25 years	16 years	25 years	16 years
Total tuber yield of cassava harvested	256,173 kg	348,095 kg	176,683 kg
Average yield (kg/ha/year)	16,011kg	13,924 kg	11,043 kg
Total labor employed Total in person-days ***Person-days/ha/year***	1,538 ***98***	2,596 ***104***	1,190 ***81***
Labors employed for *Imperata* clearance : Total in ps-days, ***Person-days/ha/year***	112 ***7***	175 ***7***	112 ***7***
Labors employed for land preparation : Total in ps-days, ***Person-days/ha/year***	432 ***27***	675 ***27***	432 ***27***
Labors employed in planting and crop care Total (person-days) ***Person-days/ha/year***	384 ***12***	576 ***11***	220 ***8***
Labor employed for harvesting Total (person-days) ***Person-days/ha/year***	640 ***40***	870 ***35***	426 ***27***

*3.2. **Profitability Assessments***

As it is summarized in Chapter I, there are two profitability calculations involved in PAM approach : private (financial) profitability and social (economic) profitability (Monke and Person, 1996). ***Private profitability*** calculation shows the competitiveness of agricultural systems at given current technologies, output values, import cost and policy transfer that valued at observed – market prices received and paid by farmers, merchant, or processors in agricultural system. ***Social profitability*** calculation is an accounting matrix utilized economics – shadow prices or social prices. This valuation measures comparative advantages or efficiency in the agricultural commodity system. Social profits are efficiency measures, because outputs (revenues) and inputs are valued in prices that reflect scarcity or social opportunity cost. Social valuation of output and input that are internationally tradable, are given by world c.i.f. prices for good and services that are imported or f.o.b. export prices for exportable. Social valuation for domestic factors are found by estimation of net income forgone because the factor is not employed its best alternative use or its opportunity cost (Monke and Person, 1996 p.21).

The prices of farm inputs and output for farm budget calculation in this assessment is presented in Table 3.2. Market-private prices of fertilizers, which are the only tradable input used in cassava farming, are annual average of fertilizers retail prices (in real term) in Indonesia during 1987 to 1997. Fertilizer retail price in Indonesia was very much influenced by government policy through subsidy, especially for Urea, ZA and TSP (Suyanto and Quizon, 1996). So that fertilizers retail price would be the same across the country, except for KCl. In 1994 government withdrew official subsidy on KCl, allowing KCl prices henceforth to be determined in the free market. With regard to social prices of fertilizers, this assessment uses ten years average of import parity prices of fertilizers at farm gate in real term during 1987-1997. For fresh cassava price, the assessment assumes that there is no price difference between private price and social price. Hence, the assessment uses annual average producer price of fresh cassava in Tanjung Karang 1993-1997 in real term (constant price 1997).

Table 3.2. Farm inputs and output prices of cassava farming

Farm Input and Output	Unit	Private Prices *(Rp)*	Social prices *(Rp)*
Tradable input			
Urea	Rp/kg	329 [1)]	555 [2)]
TSP	Rp/kg	446 [1)]	621 [2)]
KCl	Rp/kg	385 [1)]	378 [2)]
Labor	Rp/person-day	4,000 [3)]	4,000 [3)]
Fresh cassava	Rp/kg	45 [4)]	45 [4)]

Sources
1) Calculated from Suyanto and Quizon, Fertilizer Policy in Indonesia : a historical account, In CPIS, *Fertilizer Policy in Indonesia*, Monografi Kajian, serial No. 1/1996, and field observation
2) Calculated from Iternational Financial Statistics Yearbook, 1997
3) Field observation
4) Calculated from BPS, *Statistik harga produsen sektor pertanian di Jawa 1983-1985 dan di luar Jawa* 1987-1985, Jakarta, 1996; and field observation for 1997 price

Note :
1) Average fertilizer retail price in Indonesia 1987-1997 in real term (constant price 1997).
2) Import parity price at farm gate : ten years average 1987-1997 in real term (constant price 1997)
3) Wage rate in Sumatra
4) Average producer price of fresh cassava in Tanjung Karang 1993-1997 in real term (constant price 1997)

*3.2.1. **Private Profitability***

The term of private here refers to observe revenues and cost reflecting market prices received or paid by farmers in the agricultural system. Tables 3.3. summarizes the results of profitability calculation at private prices of continuous cassava farming in the two villages.

It is interesting that continuous cassava farming without fertilizer application (Scenario 3) is the most profitable among the three systems. Cassava farming that begins to apply fertilizer at year 7 (Scenario 2) is also profitable but lower than the previous one. But, continuous cassava farming with fertilizer application from the first year of cassava cultivation (Scenario 1) comes out with negative sign. Looking at total revenues, the third scenario is the lowest among the three techniques; about 15 to 16 % lower than the first two scenarios. But, looking at the farm input use, the third scenario is also the lowest cost among the three; no fertilizer expenditure, labor cost is about 18% lower than the two scenario and capital expenditure (including working capital) is also 17% to 19% lower than the on the two systems.

Table 3.3. NPV PAM at Private Price : 25 years continuous cassava farming (Rp)

ITEMS	Scenario 1	Scenario 2	Scenario 3
Total Revenues	4,848,005	4,803,008	4,061,491
Cost			
Tradable input	595,371	138,351	0
Labors	1,901,957	1,920,343	1,558,747
Capitals	2,422,002	2,384,695	1,957,690
Profit (Loss)	(71,324)	359,619	545,054
Return to Labor - the wage rate that sets NPV equal to zero - (Rp/person-day)	3,895	4,515	4,966

Source : Authors' calculation

Paying attention at cost of labor during 25 years cassava farming, total discounted cost of labor is ranging from Rp 1.56 to Rp 1.92 million. More than 75% of cost of labor are allocated for harvesting that is paid under contractual basis (Rp 10,- /kg), and in most cases is done by non family members. Cost of labor for harvesting is ranging from Rp 899 thousand to Rp 1.073 million. In this regard, Scenario 3 is again the lowest among the three scenarios. In total, number of labor employed, this scenario is the lowest among the three during 25 years. It is because, besides there is no labor employed for fertilization, the number of harvester is also the least among the three, due to the yield gained is also relatively low (See Table 3.1). Under the systems in which labor for harvesting is paid on a contractual basis, seem that the lower the yield the lower expenditure for harvesting will be.

Regarding return to labor (wage rate that sets NPV to zero) -- represents total return for family labor, land and management, and also an indicators smallholders' production incentives -- continuous cassava farming without fertilizer has the highest return, means more attractive for farmer to apply. Return to labor at private price for

Scenario 2 and Scenario 3 are respectively 13% and 24% higher than the wage rate of Rp 4,000, per person day.

From the production sustainability point of view, Scenario 2 is the most sustainable among the three scenarios. Under this scenario, fallow period never occurred, because the tuber yields of cassava never fall below 10 ton/ha. The yield level after year 7 always above the threshold of 9 ton/ha. As seen in Table 3.1, under Scenario 2 continuous cassava farming yielded 348 ton with annual production average nearly 14 ton per year in 25 years of cultivation. Scenario 3 which is the most profitable system, has the lowest yield its annual yield (as presented in Appendix A,) is not sustainable. After year 6, when the yield is lower than the threshold of 9 ton/ha, annual yield never reach the threshold.

Further assessment based on farm budget to trace back to the threshold of 9 ton per ha -- the yield level where farmers will leave the land fallow for t three years -- found that the three cassava-farming scenarios are not profitable at that level of yield (See Table 3.4.). It is consistent with information from farmers interviewed saying that 9 ton tuber yield of cassava per ha is the threshold for farmers to abandon their land. Answering question in what level of yield of cassava farming reach its break even points, a deeper assessment based on farm budgets calculation, found that under Scenario1, positive return will be reached if the yield is more than 17.79 ton per ha. While the other two scenarios, positive return will be reached if the yields are 10.9 ton and 11.4 ton per ha respectively.

The figures in Table 3.4. explains the reasons why farmers tend to avoid to apply fertilizer for cassava farming as much as they could. Although high-rate of fertilizer application is recommended to sustain cassava production (Sitompul et al, 1995), as it is simulated under Scenario 2, this farming practice would is not widely adopted by smallholder-farmer. Continuous cassava farming without any fertilizer applied is more widely adopted by cassava farmers than the other systems in the two villages. Lack of capital to afford fertilizer and household labor scarcity are the main reasons.

Table 3.4. Profitability at the threshold of 9 ton /ha and break even point of cassava farming

		Scenario 1	Scenario 2	Scenario 3
Profitability at 9 ton/ha of fresh tuber yield of cassava	Rp 000/ha	(204)	(64)	(55)
Yield level at Break even point (profit = 0)	kg/ha	17,786	10,918	11,392

Source : Authors' calculation

3.2.2. Social Profitability

As mentioned above, social profitability is an accounting matrix valued at social prices. Given social prices presented in Table 3.3. above, social profitability valuations result figures which give similar portrays of continuous cassava farming in degraded land as described under private profitability. NPV valued at social prices results positive sign for Scenario 2 and Scenario 3. While Scenario 1 stands as being unprofitable. Regarding return to labor at social price, the last two scenarios also above wage rate of Rp 4000,- per day (See Table 3.5).

Table 3.5. NPV PAM at Social Price : 25 years continuous cassava farming (Rp)

ITEMS	Scenario 1	Scenario 2	Scenario 3
Total Revenues	5,632,473	5,764,916	4,569,727
Cost			
Tradable input	950,100	346,512	0
Labors	2,278,692	2,404,975	1,829,010
Capitals	2,718,365	2,788,983	2,137,514
Profit (Loss)	(314,684)	224,446	603,203
Return to labor (the wage rate that set NPV equal to zero)	3,605	4,263	4,930

Source : Authors' calculation

3.2.3. Effect of Divergences

The following section concerns in the differences between private and social valuations of revenues, costs and profits. Effect of divergences, under PAM methodology, refer to the policy effect and market failures in all components of production processes. Any divergence between the observed private (actual market) price and the estimated social (efficiency) price must be explained by the effect of policy or by the existence of market failure (Monke and Pearson, 1995, pp. 226-236).

Table 3.6 presents the divergences of all components of PAM of the three scenarios. Since there is an indication that market failure does not existed in cassava market in Lampung, the following analysis refers to four policy transfers of PAM approach, i.e., output transfer, tradable-input transfer, factor transfer and net transfer [5].

Total revenues, tradable inputs (except under Scenario 3) and domestics factors are found as being negative for all scenarios. It means that those components of continuous cassava farming at private prices are lower than its comparable social prices. Tradable input under Scenario 3, which is found as no divergence, the reason is clear that this scenario was simulated as continuous cassava farming without fertilizer application.

Looking at the negative output transfers (total revenues), one might conclude that there is tax effect for cassava farming. But it is not really true. Because, as clearly stated above, in calculating farm budget for the three scenarios of continuous cassava farming, there is no difference between private and social price of fresh of cassava. So that the divergences appear in total revenues are mainly caused by the difference between private and social interest rates. Assuming that private real interest rate is resulted from monetary policies that influence agricultural system indirectly, using nominal protection

[5] *Output transfers* is defined as the difference between the actual market price and social price valuation of commodity produced by an agricultural system). *Tradable-input transfers* are defined as the difference between the total cost of tradable inputs valued in private prices and total cost of the same input measured in social prices. *Factor transfers* are defined as the difference between the cost of all factors of production (unskilled and skilled labor and capital) valued in actual market prices and the social cost of that factors. *Net transfers* are defined as all output transfers minus tradable-input transfers minus factor transfers. (Monke and Pearson, 1995, pp. 226-236)

coefficient (NPC) one might measure the impact of policy that cause a divergence between the two prices (Monke and Pearson, 1995 : 260). The divergences appear in total revenues indicate that distorting monetary policy contributes in losses of potential revenues of cassava farmers by 11% to 17% (See NPC on tradable output in Table 3.6)

Table 3.6. Divergences (in Rp), Nominal Protection Coefficients, Profitability Coefficients, and Subsidy Ratio to Producers (SRP) for Continuous Cassava Farming System

ITEMS	Scenario 1	Scenario 2	Scenario 3
Total Revenues	- 784,468	- 961,908	- 508,236
Cost			
Tradable input	- 354,730	- 208,160	0
Labors	- 376,735	- 484,632	- 270,263
Capitals	- 296,363	- 404,288	- 179,824
Profit	243,360	135,173	- 58,149
Nominal protection Coefficients on tradable output(NPC/O)	0.86	0.83	0.89
Nominal protection Coefficients on tradable Input(NPC/I)	0.63	0.40	0
Profitability Coefficient	0.23	1.60	0.90
Subsidy ratio to Producers (SRP)	0.043	0.023	- 0.013

Source : Authors' calculation

Note :

- Scenario 1 : continuous cassava farming with fertilizer application from the first year of cultivation; the rate of fertilizer application is : 30 kg N/ha, , 60 kg P_2O_5 (as TSP) and 60 kg K_2O (as KCl).
- Scenario 2 : continuous cassava farming with fertilizers application starts form the year seventh of operation; when the tuber yield of cassava fall under the threshold of 9 ton/ ha. The rate of fertilizer applied is 50 kg N/ha, 50 kg P_2O_5/ha (as TSP).
- Scenario 3 : continuous cassava farming without fertilizer application

Positive input transfers (tradable input's row), as it is appeared under Scenario 1 (Rp. 354,730) and Scenario 2 (Rp. 208,160), indicates that these two systems had enjoyed the subsidy. The subsidy policy on fertilizer retail price had reduced cost of tradable input by 37% to 60% from the comparable world price. These percentages derived from the degree of input transfers (NPC/I) that are found as 0.40 for Scenario 2 and 0.63 for Scenario 1. Depending on the rate of fertilizer application, the higher the rate of this tradable input used, the higher the farmers enjoy the subsidy.

The divergences between private and social prices of domestics factors are also caused by the difference in interest rates used in NPV calculation and not from the price differences. Factors transfers (both for labors and capitals) appear in the three scenarios are indicating positive factors transfer. In total positive factors transfer are found ranging from 450 thousands to 870 thousands per hectare. In percentage the private cost of domestics factors is 82.9 % to 88.7 % of their full social value.

Lastly the divergence between private and social profit. Negative transfer is found under Scenarios 3 of cassava farming, while Scenario 1 and Scenario 2 stand as being positive. It means that under Scenario 1 and Scenario 2, profits at private prices are higher than the comparable social prices. While under Scenario 3, profit at private price is lower than it's valued at social price. Taking into account the subsidy policy for fertilizer, the subsidy ratio to producers (SRP)[6] of the three systems show that the proportions of net transfer to total revenues are very little, hence, 4.3% (Scenario 1) and 2.3% (Scenario 2), while for Scenario 3 the results is -1.3%. Those results indicate that the divergences caused by fertilizer subsidy had increased the gross revenues for those who practice cassava farming with fertilizer application.

Looking at their profitability coefficient (PC : ratio between private profit and its comparable social profit), policy transfer has permitted private profit of cassava farming under Scenario 2, is 1.6 times greater than social profit. The other two scenarios, their private profit are respectively 23% and 90% of their full social profit.

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[6] Subsidy ratio to producers (SRP) is the ratio of the net transfer to social revenues, serve as indicator to show the level of transfer from divergences as proportion of undistorted value of the system revenues. If market failure are not an important component of the divergences, the SRP shows the extent to which the system's revenues have been increased or decreased because of policy (Monke and Pearson, 1995 : 235)

One may conclude that in the prevailing monetary policy (under real private interest rate of 20%), subsidy on fertilizer could help farmers to increase gross revenues if fertilizer application is adopted in a proper way. Cassava farming without fertilizer application (Scenario 3) has tremendous profit in the early years after land clearings. But, due to the land productivity is decreasing over time, as seen in the result of WaNulCAS simulation, the gross revenue per ha will also be decreasing, and even could not reach its break even point. It also loses the opportunity to get benefit from fertilizer subsidy. Continuous cassava farming with fertilizer application from the first year of operation (Scenario 1), although it is benefited from subsidy policy on fertilizer (NPC/I = 0.63 and SRP = 4.3%), its profitability coefficient is very much below its full social valued, hence, 23% of its social profit. Continuous cassava farming with fertilizer application when it is needed, as it is simulated in Scenario 2, besides enjoyed subsidy policy on fertilizers (NPC/I = 0.40), this policy transfer permitted its private profit 1.6 times greater then comparable social profit.

3.3. ***Chance in the prevailing monetary crisis***

Real exchange rate depreciation occurring in the country along with monetary crisis since August 1997 provides the opportunity to assess how this change affects cassava farmers profitability. Sensitivity analysis in PAM approach provides a way of assessing changed assumptions and errors in estimating profitability. The estimation of world price of output, the cost of labor, and the cost of capital are usually the most uncertain and hence receive the most attention (Monke and Pearson, 1995 : 220-221).

Real exchange rate depreciation apparently revised macroeconomic parameter used in this assessment. It also affects price of tradable out put and input. As noted above real exchange rate used in this assessment is the rate of July 1997 (Rp 2,400/ US dollar). The real exchange rate changed to approximately Rp 7,700 in July 1998 (calculated by deflating nominal exchange rate of Rp 11,550 / US dollar that prevailed in June 1998 by 50% inflation since July 1997). The rupiah depreciation had changed the prices of fresh cassava and fertilizers, and apparently has changed the profitability of cassava farming under study (see Table 3.7)

Table 3.7. Sensitivity Analysis of PAM Studies on Continuous Cassava Farming in dry land peneplain of Lampung to the change of exchange rate

Items		Unit	July 1997	June 1998
Changes in Output and Input Prices				
Price of fresh cassava at farm gate (ten years average)		Rp/kg	45	74
Prices of fertilizers at farm gate (ten years average)				
	Urea	Rp/kg	555	636
	TSP	Rp/kg	621	727
	KCl	Rp/kg	378	437
Profitability assessments at social price *(rounded)*				
Scenario 1				
Total revenues		Rp/ha	5,632,500	9,240,500
Tradable input cost		Rp/ha	950,100	1,102,800
Domestic factors				
	Labor	Rp/ha	2,278,700	2,278,700
	Capitals	Rp/ha	2,718,400	2,738,200
Profit		Rp/ha	(314,700)	3,120,800
Scenario 2				
Total revenues		Rp/ha	5,764,900	9,457,800
Tradable input cost		Rp/ha	346,500	401,700
Domestic factors				
	Labor	Rp/ha	2,405,000	2,405,000
	Capitals	Rp/ha	2,789,000	2,796,100
Profit		Rp/ha	224,400	3,855,000
Scenario 3				
Total revenues		Rp/ha	4,569,700	7,828,100
Tradable input cost		Rp/ha		
Domestic factors			0	0
	Labor	Rp/ha	1,829,000	2,166,100
	Capitals	Rp/ha	2,137,500	2,447,900
Profit		Rp/ha	603,200	3,214,100

By adjusting the prices of tradable output and tradable inputs, the profitability of continuous cassava farming under three scenarios appear to have increased many times greater than the situation in July 1997. Continuous cassava farming with fertilizer application beginning at the first year that was not profitable has changed to have positive profit.

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IV. CONCLUDING REMARKS

4.1. ***Locally transmigration program in dry land peneplain and inherent low soil fertility***

After more than six decades of the history of resettlement program was begun in Lampung province, the peneplain area that was previously not favorable site for transmigration destination, in the end of 1970s it became the target area of transmigration program. Majorities of transmigration centers installed in North Lampung since 1980 were located in the large eastern peneplain. Most of new settlers came from densely populated region within the province under *translok (transmigrasi lokal)* program that was implemented under RCFC (*r*ain-fed *c*ultivation of *f*ood *c*rops) model. Under this model of resettlement, new settlers (transmigrants) were encouraged to cultivate dry land food crop for their livelihood. This operation was partly linked to the preservation of the mountain regions and the protection of natural reserves within Lampung province.

Resettlement program under RCFC model in dry-land peneplain for the sake of natural reserves in other areas within Lampung province has many consequences for the target population. Land suitability of an area for such resettlement programs and sustainability of food crop farming system in dry-land peneplain of Lampung are some other issues to which the questions can be addressed. Several studies that were carried out in this dry land peneplain, especially in ASB benchmark site, conclude that the food crop cultivation done by farmers can not be sustained unless high intermediate external input is applied in their farming system. Continuous annual food crops may not be sustainable in such area that has low inherent fertility. Through a long term trial on cassava-based farming system in five years continuous cropping, BMSF revealed the yields declined gradually in all treatment.

The occurrences of abandon and underutilized farmland in the two villages, that was easily found during the field visit, is very much related to the constrains in food crop farming that is practiced by transmigrant-farmers. Three main constraints can be identified. Firstly, soil fertility constraints that led to the circumstances where continuous annual food crop farming in dry land was not possible to be practiced without substantial external input used. Secondly, capital and labor constraints impede farmers-transmigrant to cultivate all agricultural land they have. And thirdly, problem related to land right issue that has not been resolved until recently; some farmers never cultivates *their lahan usaha*, because of this problem. This also implies to the occurrence's of land transfer in the two village. Some farmers already sold their agricultural land to Lampung native people or other transmigrant, before they had ever cultivated, and bought a new plot of wet land closed to the river to grow rice or other agricultural land that is closer to their houses. In many cases the acreage of the new plots was less then they had sold.

*4.2. **Dry-land farming practices***

The dynamics of farming practice in the two villages from the years of arrival until recently, indicates that the settlers have been seeking the tracks for the best use of their land (more productive land use) to make a better livelihood. Many efforts to improve the settlers' livelihood have been implemented, from the introduction of soybean farming and the provision of credit scheme for smallholder to grow sugar cane. The result was not like what it was expected in its objectives. The profitable-soybean crop, however, could not be sustained until, and had no longer existed after 1989; the yield declined to nearly zero after three years cultivation. While for the scheme from sugarcane plantation, although the scheme had brought most of uncultivated land into use for the first time since arrival at the settlement, in the due time of credit repayment many farmers were disappointed. Logistical problem of fertilizer delivery, problems with transport of the harvested cane to factory, and poor crop growth due to drought in 1994 led to financial disappointment. Many farmers could not repay they credit (Van Noordwijk et al 1995, p.58).

In some patches farmers grew tree-commercial crops (*sengon* and oil palm) since the last seven to ten years ago. However, field observation and in-depth interview with key persons in two transmigrants' villages have given features that farmers, in such way, keep practicing continuous annual food crop farming system, mostly cassava and maize.

Continuous annual food crop farming system that was practiced in the first decade of their arrival, has not existed at present. Most farmers, to some extent have been practicing fallow rotation for dry-land food crop. The yield level of 9 ton/ha of fresh cassava or 0.8 ton/ha of grain of maize are the threshold when farmers would leave the land idle in the subsequent year for two to three years. Profitability analysis on continuous cassava farming found that farmers would get negative return at that level of yields.

The occurrence of *Imperata* grassland in many patches of farmland in those two villages have been basically part of the problem in which farmers have to resolve every year prior land preparation since arrival. Slashing and/or burning the weed is the first activity need to be carried out regardless tillage system would be applied in land preparation. Labor requirement for this initial stage of land preparation is 7 ps-d/ha and it will be 10 ps-d/ha if herbicide is applied. However, this kind of weed that is considered by most farmers as a troublesome and noxious perennial rhizomatous grass, few farmers in Tegal Mukti have been using *Imperata* leave to make additional income by making thatch for they own purposed and for local demand. At least three households in Tegal Mukti have side income from *Imperata* leave that is abundant in the villages. Because the market for thatch is limited within village and the neighboring villages, they only produce thatch on order. However, annual income from making thatch is ranging from Rp 200,000 to Rp. 2,400,000.- depends on the demand. It was mentioned that the price of thatch per sheet varies from Rp200,- to Rp 400,-

4.3. **Profitability of continuous cassava farming**

Sustainable forms of continuous food crop production may be *technically* feasible in Lampung's dry-land peneplains, but often are not financially attractive because they require too much labor and too much purchased input.

The assessment revealed that the most profitable cassava system studied was an extensive fallow system without any fertilizer applications. Profitability at private prices was estimated at over Rp 545,000 per ha (see Appendix D). Two cassava systems that use fertilizer are included in the study , one with fertilizer applications from the first year

(30 kg N; 60 kg P; and 60 kg K per year) and one with fertilizer beginning in the seventh year after forest clearing. (50 kg N; 50 kg P). Application of fertilizer from the first year after clearing is not profitable privately (negative Rp 71,000 per ha) or socially (negative Rp 315,000 per ha). These treatments and the agronomic results are taken from experiments conducted at the Biological Maintenance of Soil Fertility (BMSF) research project at the ASB benchmark area in Lampung. However, an intermediate approach with fertilizer applications beginning in year seven (50 kg N; 50 kg P) does produce relatively attractive returns at both private prices (Rp 360,000 per ha) and social prices (Rp 224,000 per ha). However, the longer-run sustainability of this system requires further study. Note that, because of chemical fertilizer price subsidies that were still in effect in mid-1997, cassava is one of the few cases where estimated ‘divergences’ are positive, indicating that policy increases private profitability.

Considering cost of labor as part of family income, this component of expenditure does not contribute much to family income. About three quarter of this expenditure are spent out to non family members, i.e., harvesters which are paid on a contractual basis. Conceivably that most harvesters are not family members. In many cases, harvesters are part of marketing channels for cassava that are brought to the farm by cassava traders. It is estimated that from total cost of labor (Rp 1.56 to Rp 1.92 million per hectare), cost of labor for harvesting is ranging from Rp 0.89 to Rp 1.07 million per hectare.

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APPENDIX A.

Estimating tuber yields of cassava s in dry land peneplain of Lampung using WaNuLCAS modeling : 25 years continuous cassava farming systems

As it is known that dry land peneplains zone has soil fertility problems, such as problem of Al toxicity, P deficiency and rapid depletion of soil organic matter means continuous food crop production is not possible without substantial input of fertilizer. The gradual decline of fresh cassava yielded from continuous monocrop cassava cultivation is a fact that every farmer could explains regarding their cassava farming. But it is hard to get the exact figures from farmers regarding the yield of fresh cassava from the first year of arrival; no single farmer was able to recall what were the yields. This was the main constraint in the profitability assessment of 25 years-continuous cassava farming in a dry land peneplain.

To handle this problem, i.e. estimating the yield of continuous cassava farming from time to time, the assessment made use of WaNuLCAS modeling that was developed by van Nordwijk and Lusiana (1998), to estimate the annual yield of fresh cassava produced from continuous cassava farming within 25 years period. This appendix intends to describe how the model was applied to estimate the yield of fresh cassava under three scenarios developed in the study.

The WaNuLCAS Modeling

The model that is formulated in the STELLA Research Modeling environment, emphasizes on belowground interaction, where competition for water and nutrient (nitrogen) is based on the effective root length densities of both plant and current demand by tree and crop. A key feature of the model is the description of uptake of water and nutrients (N) on the basis of root length densities of both the tree and the crop, plant demand factors and the effective supply by diffusion at given soil water contents. The model represents a four-layer soil profile, with four spatial zones, a water and nitrogen balance and the uptake by a crop and a tree. The model can be used both for simultaneous and sequential agroforestry system, and may help to understand the continuum of options ranging from 'improved fallow via relay planting of tree fallow to rotational and simultaneous forms of 'hedgerow intercropping'.   Figure A.1 presents components of WaNuLCAS model.

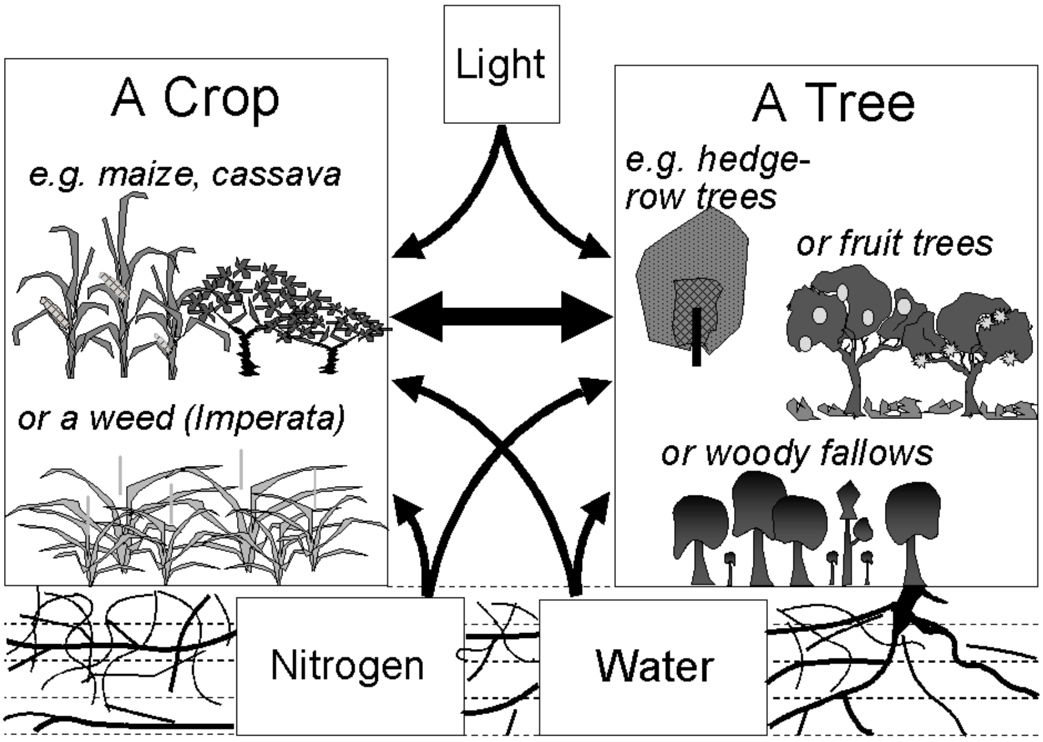

Figure A.1.   Components of the WaNuLCAS model

The *climate* effects are mainly included via daily rainfall data, which can be read from spreadsheet or generated on the basis of daily probability and division between 'heavy' and 'light' rain. *Soil* is represented in four layers. the depth of which can be chosen, with specified soil physical properties and initial water and nitrogen contents. The *water balance* of the system includes rainfall, with option of exchange between the three zones by run-on and run-off, surface evaporation, uptake by the crop and three leaching. Only vertical transport of water is included; an option is provided to incorporate (nighttime) 'hydraulic equilibration' via the three root systems, between all cells in the model. The *nitrogen balance* of the system includes inputs from fertilizer (up to four applications, specified by amount and time of application), atmospheric N fixation and mineralization of soil organic matter and fresh residues. Uptake by crop and tree is allocated over yield (exported from the field/patch) and recycled residues. Leaching of mineral N (nitrate) is driven by water balance, the N concentration and apparent adsorption constant for nitrate in each layer, thus allowing for chemical safety net by subsoil nitrate adsorption). *Growth* of both plant (crop and tree) is calculated on daily basis by multiplying potential growth (which depend on climate) with minimum of three 'stress' factors : shading, water limitation and nitrogen. *Root growth* is represented for the crop by logistic increase of root length density in each layer up till flowering time and gradual decline of roots after that time. A maximum root length density per layer is given as input. The model also incorporates a 'functional equilibrium' response in shoot/root allocation of growth, and a 'local response' to shift root growth to favourable zone. For the root length density in all zones and layers can be assumed to be constant, thus representing an established three system with equilibrium of root growth and root decayor can follow dynamic rule roots similar to those for crop. *Light capture* is treated on the basis of the leaf area index (LAI) of both components and their relative heights. in each zone.

Estimate the yield of continuous cassava farming using WaNuLCAS

Three production scenarios of continuous cassava farming were developed in the assessment : (1) continuous cassava farming with low fertilizer application from the first year cultivation -- 30 kg N, 60 kg P and 60 kg K per hectare per year -- ; (2) continuous cassava farming with fertilizer application beginning in year 7 – 50 kg N and 50 kg P per hectare per year -- ; and (3) continuous cassava farming without fertilizer application. Each scenario was then simulated using WaNuLCAS modeling to get the annual yield.

All scenarios used default values with relevant change related to planting time and fertilizer application. Specific changes were made to simulate *Imperata* growth during fallow period. Hence, *Imperata* was treated as crop component and use most of default values of rice for crop specific parameters except for : *length of vegetative stage* (Cq_TimeVeg) = 364 days and *length of generative stage* (Cq_TimeGen) = 2 days.

In estimating the occurrence of fallow period for each scenario, WaNuLCAS model helped the assessment to simulate when a fallow period might happened during 25 years continuous cassava farming. As it was mentioned that farmers would leave the land idle when the yield of fresh cassava falls below 9 ton per hectare, and fallow period would be three to four years. By looking at the yield resulted from the simulation, we would be able to decide, when the fallow should begin. The result of the simulations is presented in Table A.1.

Table A.1. Annual yield of monocrop cassava under three production scenarios

	SCENARIO 1	***SCENARIO 2***	***SCENARIO 3***	
			three years fallow	*four years fallow*
	(kg/ha)	*(kg/ha)*	*(kg/ha)*	*(kg/ha)*
year 1	37,743	37,735	37,750	37,750
year 2	34,676	34,138	34,142	34,142
year 3	30,273	27,431	27,394	27,394
year 4	22,033	17,736	17,624	17,624
year 5	17,019	11,682	11,615	11,615
year 6	13,843	8,644	8,609	8,609
year 7	11,903	12,308	*fallow*	*fallow*
year 8	10,607	12,743	*fallow*	*fallow*
year 9	9,772	12,414	*fallow*	*fallow*
year 10	9,184	12,049	6,619	*fallow*
year 11	8,757	11,754	4,428	6,484
year 12	*fallow*	11,523	3,964	4,334
year 13	*fallow*	11,334	*fallow*	3,898
year 14	*fallow*	11,175	*fallow*	*fallow*
year 15	11,907	11,035	*fallow*	*fallow*
year 16	8,619	10,907	4,602	*fallow*
year 17	*fallow*	10,791	3,604	*fallow*
year 18	*fallow*	10,683	3,357	4,639
year 19	*fallow*	10,577	*fallow*	3,569
year 20	11,205	10,447	*fallow*	3,294
year 21	8,097	10,381	*fallow*	*fallow*
year 22	*fallow*	10,287	3,930	*fallow*
year 23	*fallow*	10,196	3,203	*fallow*
year 24	*fallow*	10,108	2,982	*fallow*
year 25	10,534	10,021	2,860	3,908

Note

As seen in Table A.1, under ***Scenario 1*** (representing continuous cassava farming with fertilizer application right from the first year) farmers will start to abandon their land (for three years) in year 12 and fallow period will recur every two years. While in **Scenario 2,** which represents the situation where farmer starts to apply fertilizer in year 7 (when the yield of cassava has reached the level close to 9 ton/ha in year 6), WaNulCAS model simulated that fallow period will never been occurred. Because the yield of fresh cassava never fall below 10 ton /ha in the following years. Under ***Scenario 3,*** which is representing continuous-cassava farming without fertilizer application, farmer will start to leave their land fallow at year 7. It is interesting result simulated from WaNulCAS : tuber yield of cassava remains low after three years and four years fallow. The yields never reach the threshold of 9 ton/ha.

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APPENDIX B

Input and output tables of 25 years continuous cassava farming :

three scenarios cassava farming systems

SCENARIO 1
INPUT - OUTPUT TABLE
Monocrop cassava farming with fertilizer application from the first year of cultivation
(30 kg N, 60 kg P and 60 kg K per hectare per year)

25 years production scenario

I/O Item	Unit	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10	year11	year12	year13	year14	year15	year16
TRADABLE PURCHASED INPUT																	
Fertilizer																	
Urea	*kg/ha*	65	65	65	65	65	65	65	65	65	65	65	0	0	0	65	65
TSP	*kg/ha*	133	133	133	133	133	133	133	133	133	133	133	0	0	0	133	133
KCL	*kg/ha*	133	133	133	133	133	133	133	133	133	133	133	0	0	0	133	133
Seed and Planting Meterial		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
stump of cassava	*stumps/ha*	25	25	25	25	25	25	25	25	25	25	25	0	0	0	25	25
LABOR																	
Imperata Clearance																	
slash and/or burn	*ps-day/ha*	7	7	7	7	7	7	7	7	7	7	7	0	0	0	7	7
herbicide application	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land preparation																	
kowak (simple hoeing)	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hoeing	*ps-day/ha*	15	15	15	15	15	15	15	15	15	15	15	0	0	0	15	15
koret (to scrape away the mulch)	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planting																	
Cassava	*ps-day/ha*	12	12	12	12	12	12	12	12	12	12	12	0	0	0	12	12
Crop care																	
weeding	*ps-day/ha*	8	8	8	8	8	8	8	8	8	8	8	0	0	0	8	8
fertilization	*ps-day/ha*	4	4	4	4	4	4	4	4	4	4	4	0	0	0	4	4
Harvesting																	
Cassava)*	*ps-d/ha*	94	87	76	55	43	35	30	27	24	23	22	0	0	0	30	22
LAND	*ha*	1	1	1	1	1	1	1	1	1	1	1	0	0	0	1	1
CAPITAL																	
Draft animal use																	
Simple plowing	*da-d /ha*	12	12	12	12	12	12	12	12	12	12	12	0	0	0	12	12
Intensive plowing	*da-d /ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tractor use	*whr /ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp/kg*	12	12	12	12	12	12	12	12	12	12	12	0	0	0	12	12
Output																	
Tuber yield of Cassava	kg/ha	37,743	34,676	30,273	22,033	17,019	13,843	11,903	10,607	9,772	9,184	8,757	0	0	0	11,907	8,619

SCENARIO 1
INPUT - OUTPUT TABLE
Monocrop cassava farming with fertilizer application from the first year of cultivation
(30 kg N, 60 kg P and 60 kg K per hectare per year)

25 years production scenario

I/O Item	Unit	*year17*	*year18*	*year19*	*year20*	*year21*	*year22*	*year23*	*year24*	*year25*
TRADABLE PURCHASED INPUT										
Fertilizer										
Urea	*kg/ha*	0	0	0	65	65	0	0	0	65
TSP	*kg/ha*	0	0	0	133	133	0	0	0	133
KCL	*kg/ha*	0	0	0	133	133	0	0	0	133
Seed and Planting Meterial		0	0	0	0	0	0	0	0	0
stump of cassava	*stumps/ha*	0	0	0	25	25	0	0	0	25
LABOR										
Imperata Clearance										
slash and/or burn	*ps-day/ha*	0	0	0	7	7	0	0	0	7
herbicide application	*ps-day/ha*	0	0	0	0	0	0	0	0	0
Land preparation										
kowak (simple hoeing)	*ps-day/ha*	0	0	0	0	0	0	0	0	0
hoeing	*ps-day/ha*	0	0	0	15	15	0	0	0	15
koret (to scrape away the mulch)	*ps-day/ha*	0	0	0	0	0	0	0	0	0
Planting										
Cassava	*ps-day/ha*	0	0	0	12	12	0	0	0	12
Crop care										
weeding	*ps-day/ha*	0	0	0	8	8	0	0	0	8
fertilization	*ps-day/ha*	0	0	0	4	4	0	0	0	4
Harvesting										
Cassava)*	*ps-d/ha*	0	0	0	28	20	0	0	0	26
LAND	*ha*	0	0	0	1	1	0	0	0	1
CAPITAL										
Draft animal use										
Simple plowing	*da-d /ha*	0	0	0	12	12	0	0	0	12
Intensive plowing	*da-d /ha*	0	0	0	0	0	0	0	0	0
Tractor use	*whr /ha*	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp/kg*	0	0	0	12	12	0	0	0	12
Output										
Tuber yield of Cassava	kg/ha	0	0	0	11,205	8,097	0	0	0	10,534

SCENARIO 2
INPUT - OUTPUT TABLE
Monocrop cassava farming with fertilizer application beginning at year 7
(50 kg N and 50 kg P per hectare per year)

25 years production scenario

I/O Item	Unit	*year1*	*year2*	*year3*	*year4*	*year5*	*year6*	*year7*	*year8*	*year9*	*year10*	*year11*	*year12*	*year13*	*year14*	*year15*	*year16*
TRADABLE PURCHASED INPUT																	
Fertilizer																	
Urea	*kg/ha*	0	0	0	0	0	0	109	109	109	109	109	109	109	109	109	109
TSP	*kg/ha*	0	0	0	0	0	0	111	111	111	111	111	111	111	111	111	111
KCL	*kg/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial																	
stump of cassava	*stumps/ha*	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
LABOR																	
Imperata Clearance																	
slash and/or burn	*ps-day/ha*	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
herbicide application	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land preparation																	
kowak (simple hoeing)	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hoeing	*ps-day/ha*	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
koret (to scrape away the mulch)	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planting																	
Cassava	*ps-day/ha*	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Crop care																	
weeding	*ps-day/ha*	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
fertilization	*ps-day/ha*	0	0	0	0	0	0	4	4	4	4	4	4	4	4	4	4
Harvesting																	
Cassava)*	*ps-d/ha*	94	85	69	44	29	22	31	32	31	30	29	29	28	28	28	27
LAND	*ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPITAL																	
Draft animal use																	
Simple plowing	*da-d /ha*	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Intensive plowing	*da-d /ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tractor use	*whr /ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp/kg*	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
Output																	
Tuber yield of Cassava	kg/ha	37,735	34,138	27,431	17,736	11,682	8,644	12,308	12,743	12,414	12,049	11,754	11,523	11,334	11,175	11,035	10,907

SCENARIO 2
INPUT - OUTPUT TABLE
Monocrop cassava farming with fertilizer application beginning at year 7
(50 kg N and 50 kg P per hectare per year)

25 years production scenario

I/O Item	Unit	year17	year18	year19	year20	year21	year22	year23	year24	year25
TRADABLE PURCHASED INPUT										
Fertilizer										
Urea	*kg/ha*	109	109	109	109	109	109	109	109	109
TSP	*kg/ha*	111	111	111	111	111	111	111	111	111
KCL	*kg/ha*	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial										
stump of cassava	*stumps/ha*	25	25	25	25	25	25	25	25	25
LABOR										
Imperata Clearance										
slash and/or burn	*ps-day/ha*	7	7	7	7	7	7	7	7	7
herbicide application	*ps-day/ha*	0	0	0	0	0	0	0	0	0
Land preparation										
kowak (simple hoeing)	*ps-day/ha*	0	0	0	0	0	0	0	0	0
hoeing	*ps-day/ha*	15	15	15	15	15	15	15	15	15
koret (to scrape away the mulch)	*ps-day/ha*	0	0	0	0	0	0	0	0	0
Planting										
Cassava	*ps-day/ha*	12	12	12	12	12	12	12	12	12
Crop care										
weeding	*ps-day/ha*	8	8	8	8	8	8	8	8	8
fertilization	*ps-day/ha*	4	4	4	4	4	4	4	4	4
Harvesting										
Cassava)*	*ps-d/ha*	27	27	26	26	26	26	25	25	25
LAND	*ha*	0	0	0	0	0	0	0	0	0
CAPITAL										
Draft animal use										
Simple plowing	*da-d /ha*	12	12	12	12	12	12	12	12	12
Intensive plowing	*da-d /ha*	0	0	0	0	0	0	0	0	0
Tractor use	*whr /ha*	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp/kg*	12	12	12	12	12	12	12	12	12
Output										
Tuber yield of Cassava	kg/ha	10,791	10,683	10,577	10,447	10,381	10,287	10,196	10,108	10,021

SCENARIO 3
INPUT - OUTPUT TABLE
Monocrop cassava farming without fertilizer application

25 years scenario

I/O Item	Unit	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10	year11	year12	year13	year14	year15	year16
TRADABLE PURCHASED INPUT																	
Fertilizer																	
Urea	*kg/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSP	*kg/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KCL	*kg/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial																	
stump of cassava	*stumps/ha*	25	25	25	25	25	25	0	0	0	25	25	25	0	0	0	25
LABOR																	
Imperata Clearance																	
slash and/or burn	*ps-day/ha*	7	7	7	7	7	7	0	0	0	7	7	7	0	0	0	7
herbicide application	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land preparation																	
kowak (simple hoeing)	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hoeing	*ps-day/ha*	15	15	15	15	15	15	0	0	0	15	15	15	0	0	0	15
koret (to scrape away the mulch)	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planting																	
Cassava	*ps-day/ha*	12	12	12	12	12	12	0	0	0	12	12	12	0	0	0	12
Crop care																	
weeding	*ps-day/ha*	8	8	8	8	8	8	0	0	0	8	8	8	0	0	0	8
fertilization	*ps-day/ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harvesting																	
Cassava)*	*ps-d/ha*	94	85	68	44	29	22	0	0	0	17	11	10	0	0	0	12
LAND	*ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPITAL																	
Draft animal use																	
Simple plowing	*da-d /ha*	12	12	12	12	12	12	0	0	0	12	12	12	0	0	0	12
Intensive plowing	*da-d /ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tractor use	*whr /ha*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp/kg*	12	12	12	12	12	12	0	0	0	12	12	12	0	0	0	12
Output																	
Tuber yield of Cassava	kg/ha	37,750	34,142	27,394	17,624	11,615	8,609	0	0	0	6,619	4,428	3,964	0	0	0	4,602

SCENARIO 3
INPUT - OUTPUT TABLE
Monocrop cassava farming without fertilizer application

25 years scenario

I/O Item	Unit	year17	year18	year19	year20	year21	year22	year23	year24	year25
TRADABLE PURCHASED INPUT										
Fertilizer										
Urea	*kg/ha*	0	0	0	0	0	0	0	0	0
TSP	*kg/ha*	0	0	0	0	0	0	0	0	0
KCL	*kg/ha*	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial										
stump of cassava	*stumps/ha*	25	25	0	0	0	25	25	25	25
LABOR										
Imperata Clearance										
slash and/or burn	*ps-day/ha*	7	7	0	0	0	7	7	7	7
herbicide application	*ps-day/ha*	0	0	0	0	0	0	0	0	0
Land preparation										
kowak (simple hoeing)	*ps-day/ha*	0	0	0	0	0	0	0	0	0
hoeing	*ps-day/ha*	15	15	0	0	0	15	15	15	15
koret (to scrape away the mulch)	*ps-day/ha*	0	0	0	0	0	0	0	0	0
Planting										
Cassava	*ps-day/ha*	12	12	0	0	0	12	12	12	12
Crop care										
weeding	*ps-day/ha*	8	8	0	0	0	8	8	8	8
fertilization	*ps-day/ha*	0	0	0	0	0	0	0	0	0
Harvesting										
Cassava)*	*ps-d/ha*	9	8	0	0	0	10	8	7	7
LAND	*ha*	0	0	0	0	0	0	0	0	0
CAPITAL										
Draft animal use										
Simple plowing	*da-d /ha*	12	12	0	0	0	12	12	12	12
Intensive plowing	*da-d /ha*	0	0	0	0	0	0	0	0	0
Tractor use	*whr /ha*	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp/kg*	12	12	0	0	0	12	12	12	12
Output										
Tuber yield of Cassava	kg/ha	3,604	3,357	0	0	0	3,930	3,203	2,982	2,860

APPENDIX C

Farm budget tables of 25 years continuous cassava farming systems :

three scenarios cassava farming

SCENARIO 1
PRIVATE PRICE BUDGET TABLE
Monocrop cassava farming with fertilizer application from the first year after clearing
(30 kg N, 60 kg P and 60 kg K per hectare per year)

25 years scenario

I/O Item	unit	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10	year11	year12	year13	year14	year15	year16
TRADABLE PURCHASED INPUT																	
Fertilizer																	
Urea	Rp/ha	21,450	21,450	21,450	21,450	21,450	21,450	21,450	21,450	21,450	21,450	21,450	0	0	0	21,450	21,450
TSP	Rp/ha	59,451	59,451	59,451	59,451	59,451	59,451	59,451	59,451	59,451	59,451	59,451	0	0	0	59,451	59,451
KCL	Rp/ha	51,275	51,275	51,275	51,275	51,275	51,275	51,275	51,275	51,275	51,275	51,275	0	0	0	51,275	51,275
Seed and Planting Meterial																	
stump of cassava		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	0	0	0	28,000	28,000
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land preparation																	
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	0	0	0	60,000	60,000
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planting																	
Cassava	Rp/ha	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	0	0	0	48,000	48,000
Crop care																	
weeding		32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	0	0	0	32,000	32,000
fertilization	Rp/ha	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	0	0	0	16,000	16,000
Harvesting																	
Cassava)*	Rp/ha	377,428	346,759	302,730	220,334	170,188	138,430	119,029	106,075	97,724	91,845	87,570	0	0	0	119,069	86,193
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPITAL																	
Draft animal use																	
Simple plowing		96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	0	0	0	96,000	96,000
Intensive plowing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	452,914	416,111	363,276	264,401	204,226	166,116	142,835	127,290	117,268	110,214	105,084	0	0	0	142,883	103,431
Working Capital	*Rp*	1,242,518	(67,471)	(96,865)	(181,271)	(110,321)	(69,868)	(42,681)	(28,500)	(18,372)	(12,934)	(9,405)	(604,830)	0	0	674,129	(72,329)
OUTPUT- REVENUES																	
Tuber yield of Cassava	*Rp*	1,705,040	1,566,494	1,367,590	995,365	768,829	625,360	537,717	479,195	441,469	414,911	395,598	0	0	0	537,899	389,378
Total Revenue (Rp/ha)	Rp/ha	1,705,040	1,566,494	1,367,590	995,365	768,829	625,360	537,717	479,195	441,469	414,911	395,598	0	0	0	537,899	389,378
Tradable purchased inputs	Rp/ha	132,177	132,177	132,177	132,177	132,177	132,177	132,177	132,177	132,177	132,177	132,177	0	0	0	132,177	132,177
Domestic factors																	
Labors	Rp/ha	561,428	530,759	486,730	404,334	354,188	322,430	303,029	290,075	281,724	275,845	271,570	0	0	0	303,069	270,193
Capitals	Rp/ha	1,791,432	444,640	362,411	179,130	189,904	192,247	196,154	194,790	194,896	193,280	191,679	(604,830)	0	0	913,013	127,103
Land	Rp/ha																
Profits (loss) excluding land	Rp/ha	(779,996)	458,918	386,272	279,724	92,560	(21,494)	(93,642)	(137,846)	(167,327)	(186,391)	(199,827)	604,830	0	0	(810,360)	(140,094)

SCENARIO 1
PRIVATE PRICE BUDGET TABLE
Monocrop cassava farming with fertilizer application from the first year after clearing
(30 kg N, 60 kg P and 60 kg K per hectare per year)

25 years scenario

I/O Item	unit	year17	year18	year19	year20	year21	year22	year23	year24	year25	Total	NPV
TRADABLE PURCHASED INPUT												
Fertilizer												
Urea	Rp/ha	0	0	0	21,450	21,450	0	0	0	21,450	343,200	96,618
TSP	Rp/ha	0	0	0	59,451	59,451	0	0	0	59,451	951,221	267,790
KCL	Rp/ha	0	0	0	51,275	51,275	0	0	0	51,275	820,404	230,962
Seed and Planting Meterial												
stump of cassava		0	0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0	0		
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	0	0	0	28,000	28,000	0	0	0	28,000	448,000	126,122
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0	0
Land preparation												
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	0	0	0	60,000	60,000	0	0	0	60,000	960,000	270,261
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0	0
Planting												
Cassava	Rp/ha	0	0	0	48,000	48,000	0	0	0	48,000	768,000	216,209
Crop care												
weeding		0	0	0	32,000	32,000	0	0	0	32,000		
fertilization	Rp/ha	0	0	0	16,000	16,000	0	0	0	16,000	256,000	72,070
Harvesting											0	0
Cassava)*	Rp/ha	0	0	0	112,046	80,974	0	0	0	105,336	2,561,730	1,073,155
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0	0
CAPITAL											0	0
Draft animal use											0	0
Simple plowing		0	0	0	96,000	96,000	0	0	0	96,000	*1,536,000*	432,418
Intensive plowing		0	0	0	0	0	0	0	0	0		
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	0	0	0	134,455	97,169	0	0	0	126,404	3,074,076	1,287,786
Working Capital	*Rp*	(601,801)	0	0	658,678	(68,359)	(590,319)	0	0	0	0	701,797
OUTPUT- REVENUES												
Tuber yield of Cassava	*Rp*	0	0	0	506,171	365,801	0	0	0	475,860	11,572,677	
Total Revenue (Rp/ha)	Rp/ha	0	0	0	506,171	365,801	0	0	0	475,860	11,572,677	4,848,005
Tradable purchased inputs	Rp/ha	0	0	0	132,177	132,177	0	0	0	132,177	2,114,825	595,371
Domestic factors												
Labors	Rp/ha	0	0	0	296,046	264,974	0	0	0	289,336	5,505,730	1,901,957
Capitals	Rp/ha	(601,801)	0	0	889,133	124,810	(590,319)	0	0	222,404	4,610,076	2,422,002
Land	Rp/ha										0	0
Profits (loss) excluding land	Rp/ha	601,801	0	0	(811,185)	(156,159)	590,319	0	0	(168,057)	(657,954)	(71,324)

SCENARIO 1
SOCIAL PRICE BUDGET TABLE
Monocrop cassava farming with fertilizer application from the first year after clearing
(30 kg N, 60 kg P, and 60 kg K)

25 years scenario

I/O Item	unit	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10	year11	year12	year13	year14	year15	year16	year17
TRADABLE PURCHASED INPUT																		
Fertilizer																		
Urea	Rp/ha	36,195	36,195	36,195	36,195	36,195	36,195	36,195	36,195	36,195	36,195	36,195	0	0	0	36,195	36,195	0
TSP	Rp/ha	82,784	82,784	82,784	82,784	82,784	82,784	82,784	82,784	82,784	82,784	82,784	0	0	0	82,784	82,784	0
KCL	Rp/ha	50,438	50,438	50,438	50,438	50,438	50,438	50,438	50,438	50,438	50,438	50,438	0	0	0	50,438	50,438	0
Seed and Planting Meterial																		
stump of cassava		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LABOR																		
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	0	0	0	28,000	28,000	0
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land preparation																		
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	0	0	0	60,000	60,000	0
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planting																		
Cassava	Rp/ha	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	0	0	0	48,000	48,000	0
Crop care																		
weeding		32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	0	0	0	32,000	32,000	0
fertilization	Rp/ha	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	0	0	0	16,000	16,000	0
Harvesting																		
Cassava)*	Rp/ha	377,428	346,759	302,730	220,334	170,188	138,430	119,029	106,075	97,724	91,845	87,570	0	0	0	119,069	86,193	0
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPITAL																		
Draft animal use																		
Simple plowing		96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	0	0	0	96,000	96,000	0
Intensive plowing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	452,914	416,111	363,276	264,401	204,226	166,116	142,835	127,290	117,268	110,214	105,084	0	0	0	142,883	103,431	0
Working Capital	*Rp*	1,279,758	-67,471	-96,865	-181,271	-110,321	-69,868	-42,681	-28,500	-18,372	-12,934	-9,405	-642,070	0	0	711,369	-72,329	-639,040
OUTPUT- REVENUES																		
Tuber yield of Cassava	*Rp*	1,705,040	1,566,494	1,367,590	995,365	768,829	625,360	537,717	479,195	441,469	414,911	395,598	0	0	0	537,899	389,378	0
Total Revenue (Rp/ha)	Rp/ha	1,705,040	1,566,494	1,367,590	995,365	768,829	625,360	537,717	479,195	441,469	414,911	395,598	0	0	0	537,899	389,378	0
Tradable purchased inputs	Rp/ha	169,416	169,416	169,416	169,416	169,416	169,416	169,416	169,416	169,416	169,416	169,416	0	0	0	169,416	169,416	0
Domestic factors																		
Labors	Rp/ha	561,428	530,759	486,730	404,334	354,188	322,430	303,029	290,075	281,724	275,845	271,570	0	0	0	303,069	270,193	0
Capitals	Rp/ha	1,828,672	444,640	362,411	179,130	189,904	192,247	196,154	194,790	194,896	193,280	191,679	-642,070	0	0	950,252	127,103	-639,040
Land	Rp/ha																	
Profits (excluding land) (Rp/ha)	Rp/ha	-854,476	421,678	349,033	242,484	55,320	-58,734	-130,882	-175,086	-204,567	-223,630	-237,066	642,070	0	0	-884,839	-177,334	639,040

SCENARIO 1
SOCIAL PRICE BUDGET TABLE
Monocrop cassava farming with fertilizer application from the first year after clearing
(30 kg N, 60 kg P, and 60 kg K)

25 years scenario

I/O Item	unit	year18	year19	year20	year21	year22	year23	year24	year25	Total	NPV
TRADABLE PURCHASED INPUT											
Fertilizer											
Urea	Rp/ha	0	0	36,195	36,195	0	0	0	36,195	579,121	163,036
TSP	Rp/ha	0	0	82,784	82,784	0	0	0	82,784	1,324,537	372,887
KCL	Rp/ha	0	0	50,438	50,438	0	0	0	50,438	807,003	227,189
Seed and Planting Meterial											
stump of cassava		0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0		
LABOR										0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	0	0	28,000	28,000	0	0	0	28,000	448,000	126,122
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0
Land preparation											
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	0	0	60,000	60,000	0	0	0	60,000	960,000	270,261
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0
Planting											
Cassava	Rp/ha	0	0	48,000	48,000	0	0	0	48,000	768,000	216,209
Crop care											
weeding		0	0	32,000	32,000	0	0	0	32,000		
fertilization	Rp/ha	0	0	16,000	16,000	0	0	0	16,000	256,000	72,070
Harvesting										0	0
Cassava)*	Rp/ha	0	0	112,046	80,974	0	0	0	105,336	2,561,730	1,073,155
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0
CAPITAL										0	0
Draft animal use										0	0
Simple plowing		0	0	96,000	96,000	0	0	0	96,000	*1,536,000*	432,418
Intensive plowing		0	0	0	0	0	0	0	0		0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	0	0	134,455	97,169	0	0	0	126,404		1,287,786
Working Capital	*Rp*	0	0	695,918	-68,359	-627,559	0	0	0		729,689
											0
OUTPUT- REVENUES											0
Tuber yield of Cassava	*Rp*	0	0	506,171	365,801	0	0	0	475,860	11,572,677	4,848,005
Total Revenue (Rp/ha)	Rp/ha	0	0	506,171	365,801	0	0	0	475,860	11,572,677	4,848,005
Tradable purchased inputs	Rp/ha	0	0	169,416	169,416	0	0	0	169,416	2,710,661	763,112
Domestic factors											
Labors	Rp/ha	0	0	296,046	264,974	0	0	0	289,336	5,505,730	1,901,957
Capitals	Rp/ha	0	0	926,373	124,810	-627,559	0	0	222,404	4,610,076	2,449,893
Land	Rp/ha									0	0
Profits (excluding land) (Rp/ha)	Rp/ha	0	0	-885,665	-193,399	627,559	0	0	-205,297	-1,253,790	(266,957)

SCENARIO 2
PRIVATE PRICE BUDGET TABLE
Monocrop cassava farming with fertilizer application beginning in the year 7 after clearing
(50 kg N and 50 kg P per hectare per year)

25 years production scenario

I/O Item	unit	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10	year11	year12	year13	year14	year15	year16	year17
TRADABLE PURCHASED INPUT																		
Fertilizer																		
Urea	Rp/ha	0	0	0	0	0	0	35,750	35,750	35,750	35,750	35,750	35,750	35,750	35,750	35,750	35,750	35,750
TSP	Rp/ha	0	0	0	0	0	0	49,543	49,543	49,543	49,543	49,543	49,543	49,543	49,543	49,543	49,543	49,543
KCL	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial																		
stump of cassava		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land preparation																		
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planting																		
Cassava	Rp/ha	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
Crop care																		
weeding		32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000
fertilization	Rp/ha	0	0	0	0	0	0	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000
Harvesting		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cassava)*	Rp/ha	377,346	341,383	274,311	177,359	116,820	86,435	123,075	127,428	124,144	120,490	117,541	115,225	113,340	111,746	110,348	109,072	107,912
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPITAL																		
Draft animal use																		
Simple plowing		96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
Intensive plowing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	452,815	409,660	329,173	212,831	140,184	103,722	147,690	152,914	148,973	144,588	141,049	138,270	136,008	134,095	132,418	130,886	129,494
Working Capital	*Rp*	1,094,161	(79,119)	(147,558)	(213,294)	(133,186)	(66,847)	181,901	9,577	(7,225)	(8,039)	(6,488)	(5,095)	(4,147)	(3,507)	(3,076)	(2,807)	(2,552)
OUTPUT- REVENUES																		
Tuber yield of Cassava	*Rp*	1,704,670	1,542,206	1,239,207	801,224	527,737	390,472	555,994	575,659	560,824	544,316	530,994	520,532	512,016	504,815	498,500	492,735	487,495
Total Revenue (Rp/ha)	Rp/ha	1,704,670	1,542,206	1,239,207	801,224	527,737	390,472	555,994	575,659	560,824	544,316	530,994	520,532	512,016	504,815	498,500	492,735	487,495
Tradable purchased inputs	Rp/ha	0	0	0	0	0	0	85,293	85,293	85,293	85,293	85,293	85,293	85,293	85,293	85,293	85,293	85,293
Domestic factors																		
Labors	Rp/ha	545,346	509,383	442,311	345,359	284,820	254,435	307,075	311,428	308,144	304,490	301,541	299,225	297,340	295,746	294,348	293,072	291,912
Capitals	Rp/ha	1,642,976	426,541	277,615	95,536	102,998	132,875	425,591	258,490	237,748	232,549	230,561	229,175	227,861	226,588	225,342	224,079	222,942
Land	Rp/ha																	
Profits (excluding land) (Rp/ha)	Rp/ha	(483,653)	606,282	519,281	360,328	139,919	3,162	(261,964)	(79,552)	(70,361)	(78,015)	(86,401)	(93,161)	(98,478)	(102,812)	(106,483)	(109,709)	(112,652)

SCENARIO 2
PRIVATE PRICE BUDGET TABLE
Monocrop cassava farming with fertilizer application beginning in the year 7 after clearing
(50 kg N and 50 kg P per hectare per year)

25 years production scenario

I/O Item	unit	year18	year19	year20	year21	year22	year23	year24	year25	Total	NPV
TRADABLE PURCHASED INPUT											
Fertilizer											
Urea	Rp/ha	35,750	35,750	35,750	35,750	35,750	35,750	35,750	35,750	679,250	57,989
TSP	Rp/ha	49,543	49,543	49,543	49,543	49,543	49,543	49,543	49,543	941,313	80,362
KCL	Rp/ha	0	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial											
stump of cassava		0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0		
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	700,000	138,532
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0
Land preparation											
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	1,500,000	296,855
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0
Planting											
Cassava	Rp/ha	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	1,200,000	237,484
Crop care											
weeding		32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000		
fertilization	Rp/ha	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	304,000	25,953
Harvesting		0	0	0	0	0	0	0	0	0	0
Cassava)*	Rp/ha	106,827	105,765	104,470	103,806	102,865	101,957	101,076	100,211	3,480,952	1,063,195
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0
CAPITAL											
Draft animal use											
Simple plowing		96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	2,400,000	474,968
Intensive plowing		0	0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	128,192	126,918	125,364	124,567	123,438	122,348	121,291	120,253	4,177,142	1,275,834
Working Capital	*Rp*	(2,387)	(2,336)	(2,849)	(1,461)	(2,070)	(1,998)	(1,938)	(587,660)	0	633,893
OUTPUT- REVENUES											
Tuber yield of Cassava	*Rp*	482,594	477,796	471,946	468,946	464,695	460,593	456,613	452,706	15,725,285	4,803,008
Total Revenue (Rp/ha)	Rp/ha	482,594	477,796	471,946	468,946	464,695	460,593	456,613	452,706	15,725,285	4,803,008
Tradable purchased inputs	Rp/ha	85,293	85,293	85,293	85,293	85,293	85,293	85,293	85,293	1,620,563	138,351
Domestic factors											
Labors	Rp/ha	290,827	289,765	288,470	287,806	286,865	285,957	285,076	284,211	7,984,952	1,920,343
Capitals	Rp/ha	221,805	220,582	218,515	219,106	217,368	216,351	215,353	(371,407)	6,577,142	2,384,695
Land	Rp/ha									0	0
Profits (excluding land) (Rp/ha)	Rp/ha	(115,332)	(117,843)	(120,332)	(123,259)	(124,830)	(127,007)	(129,109)	454,609	(457,372)	359,619

SCENARIO 2
SOCIAL PRICE BUDGET TABLE
Monocrop cassava farming with fertilizer application beginning in the year 7 after clearing
(50 kg N and 50 ke P per hectare per year)

25 years production scenario

I/O Item	unit	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10	year11	year12	year13	year14	year15	year16	year17	year18
TRADABLE PURCHASED INPUT																			
Fertilizer																			
Urea	Rp/ha	0	0	0	0	0	0	60,325	60,325	60,325	60,325	60,325	60,325	60,325	60,325	60,325	60,325	60,325	60,325
TSP	Rp/ha	0	0	0	0	0	0	68,986	68,986	68,986	68,986	68,986	68,986	68,986	68,986	68,986	68,986	68,986	68,986
KCL	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial																			
stump of cassava		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000	28,000
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land preparation																			
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planting																			
Cassava	Rp/ha	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000	48,000
Crop care																			
weeding		32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000	32,000
fertilization	Rp/ha	0	0	0	0	0	0	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000	16,000
Harvesting																			
Cassava)*	Rp/ha	377,346	341,383	274,311	177,359	116,820	86,435	123,075	127,428	124,144	120,490	117,541	115,225	113,340	111,746	110,348	109,072	107,912	106,827
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPITAL																			
Draft animal use																			
Simple plowing		96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000	96,000
Intensive plowing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	452,815	409,660	329,173	212,831	140,184	103,722	147,690	152,914	148,973	144,588	141,049	138,270	136,008	134,095	132,418	130,886	129,494	128,192
Working Capital	*Rp*	1,094,161	(79,119)	(147,558)	(213,294)	(133,186)	(66,847)	225,919	9,577	(7,225)	(8,039)	(6,488)	(5,095)	(4,147)	(3,507)	(3,076)	(2,807)	(2,552)	(2,387)
OUTPUT- REVENUES																			
Tuber yield of Cassava	*Rp*	1,704,670	1,542,206	1,239,207	801,224	527,737	390,472	555,994	575,659	560,824	544,316	530,994	520,532	512,016	504,815	498,500	492,735	487,495	482,594
Total Revenue (Rp/ha)	Rp/ha	1,704,670	1,542,206	1,239,207	801,224	527,737	390,472	555,994	575,659	560,824	544,316	530,994	520,532	512,016	504,815	498,500	492,735	487,495	482,594
Tradable purchased inputs	Rp/ha	0	0	0	0	0	0	129,311	129,311	129,311	129,311	129,311	129,311	129,311	129,311	129,311	129,311	129,311	129,311
Domestic factors																			
Labors	Rp/ha	545,346	509,383	442,311	345,359	284,820	254,435	307,075	311,428	308,144	304,490	301,541	299,225	297,340	295,746	294,348	293,072	291,912	290,827
Capitals	Rp/ha	1,642,976	426,541	277,615	95,536	102,998	132,875	469,609	258,490	237,748	232,549	230,561	229,175	227,861	226,588	225,342	224,079	222,942	221,805
Land	Rp/ha																		
Profits (excluding land) (Rp/ha)	Rp/ha	(483,653)	606,282	519,281	360,328	139,919	3,162	(350,002)	(123,571)	(114,380)	(122,034)	(130,420)	(137,180)	(142,496)	(146,831)	(150,502)	(153,727)	(156,671)	(159,350)

SCENARIO 2
SOCIAL PRICE BUDGET TABLE
Monocrop cassava farming with fertilizer application beginning in the year 7 after clearing
(50 kg N and 50 ke P per hectare per year)

25 years production scenario

I/O Item	unit	year19	year20	year21	year22	year23	year24	year25	Total	NPV
TRADABLE PURCHASED INPUT										
Fertilizer										
Urea	Rp/ha	60,325	60,325	60,325	60,325	60,325	60,325	60,325	1,146,177	97,852
TSP	Rp/ha	68,986	68,986	68,986	68,986	68,986	68,986	68,986	1,310,740	111,901
KCL	Rp/ha	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial										
stump of cassava		0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0		
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	28,000	28,000	28,000	28,000	28,000	28,000	700,000	138,532
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0
Land preparation										
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	60,000	60,000	60,000	60,000	60,000	60,000	1,500,000	296,855
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0
Planting										
Cassava	Rp/ha	48,000	48,000	48,000	48,000	48,000	48,000	48,000	1,200,000	237,484
Crop care										
weeding		32,000	32,000	32,000	32,000	32,000	32,000	32,000		
fertilization	Rp/ha	16,000	16,000	16,000	16,000	16,000	16,000	16,000	304,000	25,953
Harvesting									0	0
Cassava)*	Rp/ha	105,765	104,470	103,806	102,865	101,957	101,076	100,211	3,480,952	1,063,195
LAND	Rp/ha	0	0	0	0	0	0	0	0	0
CAPITAL										
Draft animal use										
Simple plowing		96,000	96,000	96,000	96,000	96,000	96,000	96,000	2,400,000	474,968
Intensive plowing		0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	126,918	125,364	124,567	123,438	122,348	121,291	120,253	4,177,142	1,275,834
Working Capital	*Rp*	(2,336)	(2,849)	(1,461)	(2,070)	(1,998)	(1,938)	(631,679)	0	645,716
OUTPUT- REVENUES										
Tuber yield of Cassava	*Rp*	477,796	471,946	468,946	464,695	460,593	456,613	452,706	15,725,285	4,803,008
Total Revenue (Rp/ha)	Rp/ha	477,796	471,946	468,946	464,695	460,593	456,613	452,706	15,725,285	4,803,008
Tradable purchased inputs	Rp/ha	129,311	129,311	129,311	129,311	129,311	129,311	129,311	2,456,917	209,753
Domestic factors										
Labors	Rp/ha	289,765	288,470	287,806	286,865	285,957	285,076	284,211	7,984,952	1,920,343
Capitals	Rp/ha	220,582	218,515	219,106	217,368	216,351	215,353	(415,425)	6,577,142	2,396,518
Land	Rp/ha								0	0
Profits (excluding land) (Rp/ha)	Rp/ha	(161,862)	(164,351)	(167,278)	(168,849)	(171,026)	(173,127)	454,609	(1,293,727)	276,394

SCENARIO 3
PRIVATE PRICE BUDGET TABLE
Monocrop cassava farming without fertilizer application

25 years production scenario

I/O Item	unit	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10	year11	year12	year13	year14	year15	year16	year17
TRADABLE PURCHASED INPUT																		
Fertilizer																		
Urea	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSP	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KCL	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial																		
stump of cassava		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	28,000	28,000	28,000	28,000	28,000	0	0	0	28,000	28,000	28,000	0	0	0	28,000	28,000
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land preparation																		
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	60,000	60,000	60,000	60,000	60,000	0	0	0	60,000	60,000	60,000	0	0	0	60,000	60,000
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planting																		
Cassava	Rp/ha	48,000	48,000	48,000	48,000	48,000	48,000	0	0	0	48,000	48,000	48,000	0	0	0	48,000	48,000
Crop care																		
weeding		32,000	32,000	32,000	32,000	32,000	32,000	0	0	0	32,000	32,000	32,000	0	0	0	32,000	32,000
fertilization	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harvesting		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cassava)*	Rp/ha	377,496	341,422	273,942	176,239	116,153	86,092	0	0	0	66,188	44,277	39,639	0	0	0	46,024	36,038
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPITAL																		
Draft animal use																		
Simple plowing		96,000	96,000	96,000	96,000	96,000	96,000	0	0	0	96,000	96,000	96,000	0	0	0	96,000	96,000
Intensive plowing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	452,995	409,706	328,731	211,487	139,383	103,310	0	0	0	79,425	53,133	47,567	0	0	0	55,229	43,246
Working Capital	*Rp*	1,094,491	(79,363)	(148,455)	(214,947)	(132,190)	(66,134)	(453,402)	0	0	409,613	(48,203)	(10,204)	(351,206)	0	0	365,253	(21,968)
OUTPUT- REVENUES																		
Tuber yield of Cassava	*Rp*	1,705,348	1,542,382	1,237,541	796,163	524,722	388,921	0	0	0	299,004	200,023	179,070	0	0	0	207,914	162,804
Total Revenue (Rp/ha)	Rp/ha	1,705,348	1,542,382	1,237,541	796,163	524,722	388,921	0	0	0	299,004	200,023	179,070	0	0	0	207,914	162,804
Tradable purchased inputs	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic factors																		
Labors	Rp/ha	545,496	509,422	441,942	344,239	284,153	254,092	0	0	0	234,188	212,277	207,639	0	0	0	214,024	204,038
Capitals	Rp/ha	1,643,487	426,343	276,275	92,539	103,193	133,176	(453,402)	0	0	585,038	100,930	133,362	(351,206)	0	0	516,481	117,278
Land	Rp/ha																	
Profits (excluding land) (Rp/ha)	Rp/ha	(483,635)	606,617	519,323	359,385	137,376	1,653	453,402	0	0	(520,221)	(113,184)	(161,932)	351,206	0	0	(522,591)	(158,512)

SCENARIO 3
PRIVATE PRICE BUDGET TABLE
Monocrop cassava farming without fertilizer application

25 years production scenario

I/O Item	unit	year18	year19	year20	year21	year22	year23	year24	year25	Total	NPV
TRADABLE PURCHASED INPUT											
Fertilizer											
Urea	Rp/ha	0	0	0	0	0	0	0	0	0	0
TSP	Rp/ha	0	0	0	0	0	0	0	0	0	0
KCL	Rp/ha	0	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial											
stump of cassava		0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0		
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	0	0	0	28,000	28,000	28,000	28,000	448,000	109,949
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0
Land preparation											
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	0	0	0	60,000	60,000	60,000	60,000	960,000	235,605
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0
Planting											
Cassava	Rp/ha	48,000	0	0	0	48,000	48,000	48,000	48,000	768,000	188,484
Crop care											
weeding		32,000	0	0	0	32,000	32,000	32,000	32,000		
fertilization	Rp/ha	0	0	0	0	0	0	0	0	0	0
Harvesting		0	0	0	0	0	0	0	0	0	0
Cassava)*	Rp/ha	33,574	0	0	0	39,297	32,025	29,822	28,602	1,766,829	899,052
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0
CAPITAL											
Draft animal use											
Simple plowing		96,000	0	0	0	96,000	96,000	96,000	96,000	1,536,000	376,968
Intensive plowing		0	0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	40,289	0	0	0	47,156	38,430	35,786	34,322	2,120,195	1,078,863
Working Capital	*Rp*	(5,422)	(337,863)	0	0	350,453	(15,998)	(4,847)	(329,608)	0	501,858
OUTPUT- REVENUES											
Tuber yield of Cassava	*Rp*	151,671	0	0	0	177,525	144,674	134,721	129,210	7,981,692	4,061,491
Total Revenue (Rp/ha)	Rp/ha	151,671	0	0	0	177,525	144,674	134,721	129,210	7,981,692	4,061,491
Tradable purchased inputs	Rp/ha	0	0	0	0	0	0	0	0	0	0
Domestic factors											
Labors	Rp/ha	201,574	0	0	0	207,297	200,025	197,822	196,602	4,454,829	1,558,747
Capitals	Rp/ha	130,867	(337,863)	0	0	493,610	118,432	126,940	(199,286)	3,656,195	1,957,690
Land	Rp/ha									0	0
Profits (excluding land) (Rp/ha)	Rp/ha	(180,770)	337,863	0	0	(523,382)	(173,783)	(190,040)	131,894	(129,331)	545,054

SCENARIO 3
SOCIAL PRICE BUDGET TABLE
Monocrop cassava farming without fertilizer

25 years production scenario

I/O Item	unit	year1	year2	year3	year4	year5	year6	year7	year8	year9	year10	year11	year12	year13	year14	year15	year16	year17
TRADABLE PURCHASED INPUT																		
Fertilizer																		
Urea	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TSP	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
KCL	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial																		
stump of cassava		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	28,000	28,000	28,000	28,000	28,000	0	0	0	28,000	28,000	28,000	0	0	0	28,000	28,000
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land preparation																		
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	60,000	60,000	60,000	60,000	60,000	0	0	0	60,000	60,000	60,000	0	0	0	60,000	60,000
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Planting																		
Cassava	Rp/ha	48,000	48,000	48,000	48,000	48,000	48,000	0	0	0	48,000	48,000	48,000	0	0	0	48,000	48,000
Crop care																		
weeding		32,000	32,000	32,000	32,000	32,000	32,000	0	0	0	32,000	32,000	32,000	0	0	0	32,000	32,000
fertilization	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harvesting																		
Cassava)*	Rp/ha	377,496	341,422	273,942	176,239	116,153	86,092	0	0	0	66,188	44,277	39,639	0	0	0	46,024	36,038
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CAPITAL																		
Draft animal use																		
Simple plowing		96,000	96,000	96,000	96,000	96,000	96,000	0	0	0	96,000	96,000	96,000	0	0	0	96,000	96,000
Intensive plowing		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	452,995	409,706	328,731	211,487	139,383	103,310	0	0	0	79,425	53,133	47,567	0	0	0	55,229	43,246
Working Capital	*Rp*	1,094,491	(79,363)	(148,455)	(214,947)	(132,190)	(66,134)	(453,402)	0	0	409,613	(48,203)	(10,204)	(351,206)	0	0	365,253	(21,968)
OUTPUT- REVENUES																		
Tuber yield of Cassava	*Rp*	1,705,348	1,542,382	1,237,541	796,163	524,722	388,921	0	0	0	299,004	200,023	179,070	0	0	0	207,914	162,804
Total Revenue (Rp/ha)	Rp/ha	1,705,348	1,542,382	1,237,541	796,163	524,722	388,921	0	0	0	299,004	200,023	179,070	0	0	0	207,914	162,804
Tradable purchased inputs	Rp/ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Domestic factors																		
Labors	Rp/ha	545,496	509,422	441,942	344,239	284,153	254,092	0	0	0	234,188	212,277	207,639	0	0	0	214,024	204,038
Capitals	Rp/ha	1,643,487	426,343	276,275	92,539	103,193	133,176	(453,402)	0	0	585,038	100,930	133,362	(351,206)	0	0	516,481	117,278
Land	Rp/ha																	
Profits (excluding land) (Rp/ha)	Rp/ha	(483,635)	606,617	519,323	359,385	137,376	1,653	453,402	0	0	(520,221)	(113,184)	(161,932)	351,206	0	0	(522,591)	(158,512)

SCENARIO 3
SOCIAL PRICE BUDGET TABLE
Monocrop cassava farming without fertilizer

25 years production scenario

I/O Item	unit	year18	year19	year20	year21	year22	year23	year24	year25	Total	NPV
TRADABLE PURCHASED INPUT											
Fertilizer											
Urea	Rp/ha	0	0	0	0	0	0	0	0	0	0
TSP	Rp/ha	0	0	0	0	0	0	0	0	0	0
KCL	Rp/ha	0	0	0	0	0	0	0	0	0	0
Seed and Planting Meterial											
stump of cassava		0	0	0	0	0	0	0	0	0	0
Seed of maize		0	0	0	0	0	0	0	0		
LABOR	Rp/ha	0	0	0	0	0	0	0	0	0	0
Imperata Clearance	Rp/ha	0	0	0	0	0	0	0	0	0	0
slash and/or burn	Rp/ha	28,000	0	0	0	28,000	28,000	28,000	28,000	448,000	109,949
herbicide application	Rp/ha	0	0	0	0	0	0	0	0	0	0
Land preparation											
kowak (simple hoeing)	Rp/ha	0	0	0	0	0	0	0	0	0	0
hoeing	Rp/ha	60,000	0	0	0	60,000	60,000	60,000	60,000	960,000	235,605
koret (to scrape away the mulch)	Rp/ha	0	0	0	0	0	0	0	0	0	0
	Rp/ha	0	0	0	0	0	0	0	0	0	0
Planting											
Cassava	Rp/ha	48,000	0	0	0	48,000	48,000	48,000	48,000	768,000	188,484
Crop care											
weeding		32,000	0	0	0	32,000	32,000	32,000	32,000		
fertilization	Rp/ha	0	0	0	0	0	0	0	0	0	0
Harvesting										0	0
Cassava)*	Rp/ha	33,574	0	0	0	39,297	32,025	29,822	28,602	1,766,829	899,052
LAND	Rp/ha	0	0	0	0	0	0	0	0	0	0
CAPITAL											
Draft animal use											
Simple plowing		96,000	0	0	0	96,000	96,000	96,000	96,000	1,536,000	376,968
Intensive plowing		0	0	0	0	0	0	0	0	0	0
Tractor use	Rp/ha	0	0	0	0	0	0	0	0	0	0
Trcuk services	*Rp*	40,289	0	0	0	47,156	38,430	35,786	34,322	2,120,195	1,078,863
Working Capital	*Rp*	(5,422)	(337,863)	0	0	350,453	(15,998)	(4,847)	(329,608)	0	501,858
OUTPUT- REVENUES											
Tuber yield of Cassava	*Rp*	151,671	0	0	0	177,525	144,674	134,721	129,210	7,981,692	4,061,491
Total Revenue (Rp/ha)	Rp/ha	151,671	0	0	0	177,525	144,674	134,721	129,210	7,981,692	4,061,491
Tradable purchased inputs	Rp/ha	0	0	0	0	0	0	0	0	0	0
Domestic factors											
Labors	Rp/ha	201,574	0	0	0	207,297	200,025	197,822	196,602	4,454,829	1,558,747
Capitals	Rp/ha	130,867	(337,863)	0	0	493,610	118,432	126,940	(199,286)	3,656,195	1,957,690
Land	Rp/ha									0	0
Profits (excluding land) (Rp/ha)	Rp/ha	(180,770)	337,863	0	0	(523,382)	(173,783)	(190,040)	131,894	(129,331)	545,054

APPENDIX D

NPV PAM
Continuous monocrop cassava
(rupiah per hectare)

SCENARIO 1: *Monocrop cassava farming with low external input application, beginning from the first year of cultivation*

	Revenues	Cost			Profits
		Tradable inputs	Domestic factors		
			Labors	Capitals	
Private prices	4,848,005	595,371	1,901,957	2,422,002	(71,324)
Social Prices	5,632,473	950,100	2,278,692	2,718,365	(314,684)
Effect of divergences	(784,468)	(354,730)	(376,735)	(296,363)	243,360

SCENARIO 2 : *Monocrop cassava farming with external input application, beginning in year 7 of cultivation*

	Revenues	Cost			Profits
		Tradable inputs	Domestic factors		
			Labors	Capitals	
Private prices	4,803,008	138,351	1,920,343	2,384,695	359,619
Social Prices	5,764,916	346,512	2,404,975	2,788,983	224,446
Effect of divergences	(961,908)	(208,160)	(484,632)	(404,288)	135,173

SCENARIO 3 : *Monocrop cassava farming without external input application*

	Revenues	Cost			Profits
		Tradable inputs	Domestic factors		
			Labors	Capitals	
Private prices	4,061,491	0	1,558,747	1,957,690	545,054
Social Prices	4,569,727	0	1,829,010	2,137,514	603,203
Effect of divergences	(508,236)	0	(270,263)	(179,824)	(58,149)

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