IFC SADI Agri Sectors

Value Chain Analysis for

Commercial Cassava Growing in NTT

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Executive Summary

Summary of NTT Cassava Industry Potential, Issues and IFC TA Recommendations

The interest shown by the major Chinese importer and the heads of agreement drawn up with the local government in West Manggarai to produce cassava chips for transportation by ship from Labuan Bajo to China (Guang Zi Port) would indicate that there is potential for increased commercial production of cassava in NTT. This agreement was established 2005.

The project proposes is to grow cassava for chip production for later processing into bio-ethanol on an area of over 100,000 hectares in West Manggarai. A small pilot project of 1,000 ha has begun at Vol village, Lembor, West Manggarai. This site is in close proximity to the port at Labuan Bajo (one hour by road). Seed is currently being sourced from Surabaya and field research verifies that the region is well suited to growing cassava with large areas of unused arable land. The unused area of arable land at Lembor could potentially be developed into an area of over 50,000 hectares under the management of smallholders in the district.

West Manggarai is a suitable district for developing such a project due to an existing supply base and traditional knowledge of basic cassava growing plus large areas of unused arable land suitable for cassava growing. The area may also be suitable for mechanization such as tractors for cultivation and harvest, although the economics of this need further investigation.

Developing an area of cassava production in Flores is of particular interest to the IFC due to the potential smallholder benefits of developing integrated farming systems where cassava is used as a source of cash income and as a valuable feed source for cattle fattening. This approach to developing cassava production in Flores, and potentially other parts of NTT, also allows smallholders to diversify risk away from only one or two agricultural products.

Industry Issues

- The potential for smallholder cassava production and NTT and the feasibility of a large-scale cassava growing project for bio ethanol production in Flores is still in an early stage of development. Field research and interviews with the local government and West Manggarai suggest that a full feasibility study on the district and market potential is required to manage the risk that exists for smallholders in growing large areas of cassava for bio-ethanol production.

- Initial field research indicates that cassava yields in NTT are comparable with other regions of Indonesia. However, further work is required to understand whether NTT has comparative advantage in cassava production over other regions of Indonesia and whether there is a risk that the major buyer could reduce future buying operations.

- Like other agricultural commodities, smallholders producing cassava in NTT will require adequate access to seasonal finance for basic agri-inputs. Such access does not currently exist and smallholders rely on informal forms of finance supplied by traders and intermediaries for other products.

- The proposed project will rely on Cassava chip purchases from a single large buyer for processing in China. This buying situation creates considerable risk for smallholders and farmer groups investing in cassava production for chip production.

- Cassava chip production is not a traditional post harvest practice for smallholders in NTT and will require extension to ensure that smallholders produce a quality product.

Recommendations for IFC TA

The following points summarize the key recommendations made in the value chain analysis. The recommendations are made with a potential TA program to support the proposed cassava production project.

- Conduct research on the minimum average level of cash needed per household per year so that an integrated farming system to meet household cash requirements can be developed.

- Collaborate with ACIAR to undertake further research and trial improved high starch varieties for specialist cassava production, including soil testing, best practice cultivation, weed and pest control, best practice harvest, drying and processing into chips.

- Collaborate with the local government DINAS, ACIAR and farmer groups to establish a demonstration plot to encourage farmers to use best practice cassava growing techniques.

- A demonstration farm should also investigate the potential for farmers to increase their overall cash income by utilizing cassava as a home consumption crop, cash crop from cassava chips production and also as a livestock feed for an integrated cattle farming/cropping system. The goal for a demonstration farm should be to achieve a minimum level of cash income per year from a range of crops from an average smallholding.

- Work with the ACIAR program and the major cassava chip processor to understand cassava chip quality requirements and on-farm practices to meet these standards.

- Investigate other uses and markets for cassava chips once production has reached a critical mass to manage farmers' marketing risks.

- Work with the local DINAS, farmer groups and village leaders to improve smallholder access to on-farm research and information from other parts of Indonesia and incorporate this practice into the integrated cassava demonstration farm.

An Overview of Agribusiness in NTT

East Nusa Tenggara (Nusa Tenggara Timur / NTT)

NTT province consists of 566 islands with a land area of 47.3 thousand km2. the provincial population is around 4.1 million (2004), spread over 42 islands. The main islands in NTT include Flores, Sumba, Timor, and Alor. The West Timor region, which is directly adjacent to the Democratic Republic of Timor Leste, constitutes 32 percent of the total area and is inhabited by around 38 percent of the total population of NTT.

There is no single common "culture" to be found in NTT with the populations on the different islands of the province making up at least 40 different ethno-linguistic groups. The cultural traditions of Sumba are different from those of Timor, Alor, or Flores. Compared with most other Indonesian provinces, NTT is notable for its diversity.

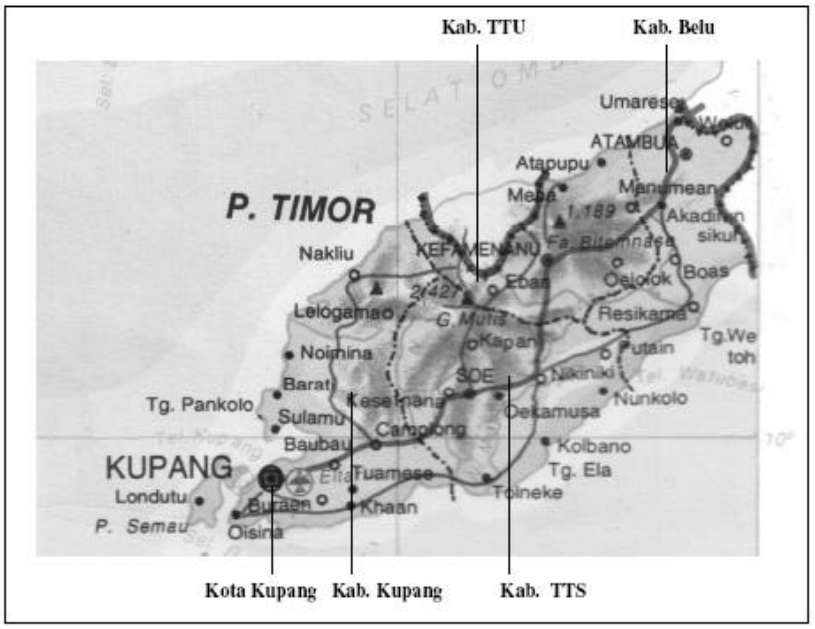
Administratively, the NTT province is divided into 15 *kabupaten* and one *kota*. Out of them, four *kabupaten* and one *kota* are located in West Timor. They are Kab. Kupang, Kab. TTS, Kab. TTU, Kab. Belu, and Kota Kupang. The demographics and map of the West Timor region is shown below.

Table 1 Profile of NTT and the Five Kabupaten/Kota in West Timor, 2004

Description	NTT Province	Kabupaten				Kota Kupang
		Kupang	TTS	TTU	Belu	
Area (Km²)	17,349.9	5,898.3	3,947	2669.7	2,445.6	160.3
Population	4,188,774	337,406	405,993	197,174	352,176	258,104
Population Density/ Km²	88	57	103	74	144	1,610
# of Kabupaten /Kota	16	-	-	-	-	-
#of Kecamatan	203	28	21	9	17	4
# Villages & Kelurahan	2,569	186	212	159	166	45

Source: SMERU Research Institute (October 2006)

Figure 1. Map of West Timor region



Agriculture is an important part of the regional economy in East Nusa Tenggara making up more than 40 percent of Gross Regional Domestic Product (GRDP) (Ministry of Agriculture 2006). However due to stronger growth (relative to agriculture) in other sectors, agriculture's share of GDRP declined form 51 to 42 percent from 1990-2003. The livestock sub-sector makes the largest contribution to agriculture in NTT at around 42 – 45 percent and or around 13 – 14 percent of GRDP . Agriculture is also important for regional employment where smallholder farming, transport, trading and downstream services account for around 80 percent of total employment. The major agricultural products of NTT include cattle, corn, tamarind, candlenut, tubers, nuts, betel nut and coconut. Kabupaten Kupang is the main producer of cattle in NTT; almost 25 percent of the total cattle in NTT come from this *kabupaten.*

The Dutch are identified NTT has "minus-area" of limited development potential 300 years before the Indonesian government officially classified the province as a "daerah-minus". NTT has the poorest soils and lowest rainfall in all of Indonesia and the mountainous terrain on many of its islands limits the possibilities for extensive agriculture. The province also experiences pronounced El-Nino weather patterns ensuring that once every few years (on average, one year in three) there is likely to be a drought. A number of droughts have had a significant impact on the province over the past century with the 1997 98 drought being one of the worst on record. Under these conditions farmers must strive to minimise risk rather than maximise production and with low investment in the province there are few alternative forms of employment. Most of NTT's population (86 percent during the 1990s) is involved in agriculture and engaged in some of the least productive forms of agriculture in Indonesia Fox, J, 2007)[1].

[1] SMERU newsletter article- James, J. Fox, professor at the Research School of Pacific and Asian Studies, the Australian National University.

The limited economic activities in NTT are reflected from the low GRDP per capita figures of only Rp2.2 million (2003), while on West Timor the GRDP per capita ranged between Rp1.7-1.9 million. NTT has a high rate of poverty and the number and proportion of the poor are shown in the table below.

Table 2
The number and proportion of poor people in West Timor, 2004

Kabupaten	# of poor in Kab. (000s)	% of Kab. pop'n
Kupang	109	33%
TTS	149.5	37%
TTU	62.7	31%
Belu	70.4	21%
Kota Kupang	27.8	11%
NTT Province	1,152.10	28%
National		17%

Source: SMERU Research Institute (October 2006)

NTT has only a small manufacturing industry (3.2 percent of GRDP, 2003) with limited scope for generating employment opportunities and the region has a heavy reliance on imported manufactured goods from Java. With agriculture forming the basis for such a large share of economic activity in NTT, improving this sectors' performance will have a relatively large impact on poverty alleviation.

The climate in this region is semi-arid climate, with the relatively low rainfall and the low indigenous vegetation. The main agricultural activities are livestock and estate crops. Local authorities estimate that there is around 740,000 hectares of dry meadow areas that have potential for development into cattle grazing, however anecdotal evidence from field research suggests that the area available for grazing is decreasing and being used for other uses such as horticultural crops. NTT is a major livestock producing region and is the second largest producer of beef cattle producer in Eastern Indonesia, behind South Sulawesi (DGLS, 2006). Cattle fattening is a traditional farming enterprise and a major source of cash income for farmers, especially on West Timor Island. The dry climate and steep terrain on West Timor Island lends itself to livestock production and the region has a history of producing high quality Bali cattle for export to Java. A major industry issue has been the decline in cattle populations in NTT due to high demand for beef and unsustainable slaughter rates.

Estate crops such as coffee and cocoa grow well in NTT. The province has recently been identified by major coffee buyers as a producer of high grade Arabica coffee and various donor funded programs are seeking to catalyse development of the coffee sector on Flores. The historical lack of smallholder access to fertiliser and agrichemicals and the pristine mountain environment may provide significant marketing opportunities for Arabica coffee if the industry is able to organise reliable supply.

Aquaculture and fisheries, in various forms (open water, brackish water pond, fresh water pond, paddy field and seaweed culture) is also a major primary industry and mainly located on Flores.

With the province spread over 566 islands the cost of transport for NTT between the districts and with other parts of Indonesia is high and is a barrier to trade and further economic development The role of sea transportation is important for the province. A major problem is the poor condition of roads during periods of high rainfall. Official state data indicates that only 20 percent of the region's regency and village roading are in good condition while other roads can be prone to slips and closure during heavy rain (BPS NTT, 2003).

The limited size of local markets for the sale of agricultural products (due to very low levels of local consumer disposable income) highlights the importance of the region's infrastructure for trade. In general, smallholders can capture the best returns by supplying export (including inter-regional export) markets. With high transportation costs and a lack of investment in NTT processing capabilities agricultural products for interregional and export market have been limited to traditional products e.g., cattle, cashew nut, sea weed and coffee. Other products such as banana, orange and avocado struggle to compete in Java markets due to the high cost of transportation.

The fieldwork conducted for the VCA of priority commodities covered the areas of Kupang, and TTS Sub District for Beef Cattle, Ruteng, and Bajawa (Manggarai Sub District) for Coffee and West Manggarai Sub District for Cassava.

Business Operating Environment in NTT

The business operating environment in NTT, with respect to the level of informal and formal charges and taxes that farmers, middlemen and traders are required to pay was found to be a significant frustration of local business people although not necessarily a significant barrier to business. Further field research in this area is required to identify the impact that local charges have on the beef cattle industry.

A recent study on the NTT business operating environment by the SMERU Institute found that the NTT cattle industry has been the subject of various regulations and excessive charges, starting at the village level. Most regulations include charges, such as: the certification of calves and a permit to export, *retribusi* to cover the administration cost, a quota limit on the number of cattle exported, and the SPK charge for issuing a permit for import and export, the services of slaughtering houses, the services of livestock markets, the services of livestock health checks, and quarantine.

Other findings include that the presence of many middlemen and traders at the village and sub-district (*kecamantan)* levels has very limited impact on price information, since product prices are mostly determined by a small number of inter-island or large traders that form a monopsony market structure. The recent increase in the number of traders and exporters coming to Kupang, has not fully benefited farmers, due to the limited information on product location and excessive inspections that give rise to informal charges and uncertainty.

The study found that the regional governments in NTT persist with imposing charges and regulations to agricultural products although the contribution of these charges to regional government revenues is very small. Some progress has been made on reducing regulations and charges for agricultural food crops, however less progress has been made in the beef cattle industry. The regulations and licensing have drawn out informal charges applied at various levels that distort the marketing of cattle (amongst other agricultural products) and in turn limit the opportunity of farmers to receive better prices and incomes.

Cassava in NTT: Sector Profile and Value Chain Analysis

1. Indonesia in the Global Cassava Industry

Cassava (Manihot esculenta) was recognised by early European traders in Asia and Africa as an important staple crop as early as the 16th century. Cassava is now grown in most tropical countries, between 30° north and 30° south of the equator, with a wide range of adaptability (FAO, 2002).

Some of the key characteristics of the crop are its efficiency in producing carbohydrates, its tolerance to drought and poor soils. Despite its reputation as a hardy root crop, it thrives in more fertile conditions and offers farmers a wide range of timing for planting and harvesting.

Indonesia is a major cassava producer

Major world cassava producing regions tend to be drought prone areas of Africa and Asia. Indonesia is the third largest producer of cassava in the world behind Nigeria and Brazil. Africa (Nigeria in particular) produces over half the world cassava production although Brazil is a world leader in the processing of cassava for an added-value products.

The table below shows how Indonesia's production compares to other major cassava producers in terms of total tonnes produced and yields per hectare. Total Indonesian production has increased at approximately three percent per year between 2000 and 2005 and this growth is similar to the other major producers.

Table 3 World Cassava Production

Cassava Production ('000 tonnes)

	2000	2001	2002	2003	2004	2005
Nigeria	32,010	32,068	34,120	36,304	38,845	41,565
Brazil	23,336	22,577	23,066	21,961	23,927	25,725
Indonesia	16,089	17,055	16,913	18,524	19,425	19,459
Thailand	19,064	18,396	16,868	23,849	20,209	15,794
Congo, Dem Rep of	15,959	15,436	14,930	14,945	1,495	14,974
Mozambique	5,362	5,975	5,925	6,150	6,413	11,458
Ghana	8,107	8,966	9,731	10,239	9,739	9,739
Angola	4,433	5,394	6,523	6,892	8,587	8,606
Tanzania, United Rep of	7,120	6,884	6,888	5,284	6,152	7,000
India	6,014	6,768	6,516	7,000	6,700	6,700
Viet Nam	1,986	3,509	4,438	5,309	5,821	6,646
Uganda	4,966	5,265	5,373	5,450	5,500	5,031
Paraguay	2,719	3,568	4,430	4,669	5,500	4,785
China	3,822	3,873	3,925	4,015	4,216	4,216
Benin	2,350	2,703	2,452	3,055	2,955	2,861

Source: FAO Statistical Website April 2007

Recent forecasts from FAO suggested that cassava production is increasing rapidly in Asia and world cassava production is likely to reach over 208 million tonnes in 2007 mainly driven by an expected 12 percent production increase in Thailand. Rising demand for bio-fuels in Thailand has also increased domestic prices for ethanol and starch in Asia and is expected to stimulate growth in Indonesia and Vietnam[2].

Strong demand from China is driving forecasted increases in the global trade of cassava and cassava products (FAO food Outlook, 2006). China is the world's third largest ethanol producer behind Brazil and the US, and is the largest exporter of ethanol.[3] The EU was once a major destination for cassava chips and pellets for animal feed, but price rises have resulted in feed producers switching back to locally produced grains.[4]

Indonesian cassava production is also likely to be stimulated by government initiatives such as the government's intention to reduce the country's dependence on rice imports through encouraging cassava production. Governments in Africa are also implementing policies to stimulate cassava production for bio-fuel.

While Indonesia is the third largest producer, the average yield per hectare (15,903 kg) is well below most other major producers. The table below provides a comparison of cassava yields per hectare of the major producing countries.

Table 4 Yields per hectare of Major Producing Countries

Cassava Yield (Kg/Ha)

	2000	2001	2002	2003	2004	2005
India	26,909	26,700	27,275	29,167	27,917	27,917
Cook Islands	17,647	33,333	32,000	25,000	25,000	25,000
Barbados	17,241	17,200	16,542	17,167	31,700	20,833
Niger	23,217	21,027	20,000	20,000	20,000	20,000
Réunion	17,500	22,727	20,417	20,000	20,000	20,000
Jamaica	18,105	18,857	18,858	18,414	18,293	18,293
French Polynesia	18,000	17,826	18,000	17,917	17,500	17,917
Cambodia	9,607	10,468	6,327	13,205	16,086	17,869
China	15,974	16,056	16,272	16,016	16,811	16,809
Solomon Islands	16,429	16,429	16,667	16,667	16,667	16,667
Malawi	15,253	16,693	14,964	16,845	16,338	16,600
Paraguay	13,476	14,679	17,161	16,417	17,974	16,500
Suriname	15,839	19,758	18,724	21,170	16,226	16,226
Thailand	16,858	17,537	17,069	23,336	19,119	16,018
Indonesia	12,530	12,941	13,249	14,884	15,468	15,903

Source: FAO Statistical Website April 2007

[2] FAO Food Outlook, No. 1 June 2006 www.fao.org/docrep/009/J7927e/j7927e05.htm
[3] The Standard. China turns large ethanol exporter. September 2006 www.thestandard.com.hk
[4] FAO Food Outlook No.1 June 2006 www.fao.org

Uses for cassava

Cassava roots and leaves are suitable for human consumption although the consumption is mainly restricted to developing countries as a cheap source of carbohydrate (FAO, 2002). A typical cassava root is made up of moisture (70%), starch (24%), fibre (2%), protein (1%) and other nutrients (3%), while the cassava leaves contain protein and minerals. Some cassava roots contain large amounts of cyanohydrin (containing cyanide) and giving the root a bitter taste. Cultivars are classified as sweet or bitter depending on their cyanide contents, with the bitter variety unsuitable for human consumption unless properly treated. Bitter varieties are especially suitable for industrial and feed purposes, because of their higher starch content, while sweet varieties are generally preferred for consumption[5].

As a source of carbohydrate, cassava competes with grains such as corn and maize for stockfeed, rice and wheat flour for food staples, and sugarcane and corn for ethanol production. One main weakness with cassava for livestock feed is that products can be of variable nutritional quality compared to grain products.[6]

In 1994 about one fourth of world cassava production was estimated to be used as a feed ingredient for pork, poultry, cattle and fish farming (FAO, 2002) fed directly or indirectly through their incorporation into compound feeds. In Africa and Asia, only six percent of cassava production is fed to livestock, while in Latin America and the Caribbean (Brazil and Paraguay) the figure is closer to 50 percent. Cassava is also an important livestock feed ingredient in the European Union with the largest markets for cassava feed products being the Netherlands, Belgium, Germany, Spain and Portugal.

Starch is the main product of cassava and can be used as a raw material for a wide range of food products and industrial goods, including paper, cardboard, textile, plywood, glue, alcohol pharmaceuticals and rubber. Globally, cassava is the fourth leading source of starch, after maize, wheat and potato. Four to five tonnes of roots are normally required to produce one tonne of cassava starch although this ratio can vary depending on the cassava quality.

Cassava for bio-fuel production

Global ethanol production more than doubled between 2000 and 2005 and there is now more interest in cassava as a source of starch for ethanol production.[7] In Brazil, sugar cane is a major bio-energy crop and has made the country a world leader in bio-ethanol production, while cassava based ethanol is widely used to replace additives in petrol. Cassava has the potential to become a substitute for sugarcane and maize because of its high yields of starch with an overall starch efficiency rate of 32 percent.

[5] FAO. The World Cassava Economy. 2000. www.fao.org
[6] The Global Cassava Strategy www.fao.org/docrep/006/y0169e/y0169e04.htm
[7] Bio-fuels for Transportation: Selected Trends and Facts. June 7, 2006. Worldwatch Institute

Further research is required to develop cultivars with different starch compositions (Univ. Helsingiensis, 2007) and several projects are underway in Brazil, Thailand, China and Indonesia to develop cassava production capacity and ethanol processing plants. Some governments are also introducing policies to increase the use of bio-fuel to reduce greenhouse gas emissions.

Indonesia is one of these countries investing in bio-fuel production capacity. In January 2007, 59 energy firms and institutions made preliminary commitments to invest US $12.4 billion in the renewable energy sector (Jakarta Post, 2007). The largest investment will come from China's energy firm CNOOC, which will partner with Sinar Mas Agro Resources and Technology and Hong Kong Energy to invest a total of US$5.5 billion. These investments are focused on the use of palm oil as a bio-fuel, however the Sugar Group would start producing ethanol from sugarcane in March and Medco Bioethanol will build an ethanol industry in Lampung based on cassava with a total investment of US$40million, and with a production capacity of 60 million litres of ethanol per year (Kompas, 2007).

2. Size and Structure of the NTT Cassava Industry

Cassava in Indonesia tends to be grown in rain fed, intercropped farming systems. This is the main cropping pattern found in NTT. As noted cassava can adapt to poor soils, is resistant to drought, is an easy care crop to grow and is an important source of carbohydrate for smallholder producers in the NTT. These favourable characteristics have encouraged small holder farmers to plant cassava. Cassava is usually intercropped with grain and legumes (such as peanuts) rather than grown in pure stands.

The NTT cassava industry is made up of a large number of smallholder farmers
Data from local DINAS offices indicate that there were approximately 390,000 smallholders (farming households) growing cassava in the NTT district (Agriculture Census) in 2003 and predominantly in an intercropped system with other staple foods such as corn, beans, sweet potato, and livestock feed and horticulture crops. Cassava is predominantly consumed as fresh roots although mature cassava can be dried and used for cattle feed.

NTT cassava industry requires low inputs
When farmed in an intercropped system cassava is a low input crop for smallholders, only requiring cassava stems for replanting. Cassava is usually grown without any forms of fertiliser (apart from cattle manure) and smallholders are able to harvest cassava over a wide period depending on needs and intended uses.

Commercial cassava growing in NTT is undertaken in a very limited way and the main purpose of the IFC SADI field research was to investigate the potential for commercial cassava (for use in bio-ethanol production) in the West Manggarai district. This potential is based on a heads of agreement drawn up in 2005 between the local

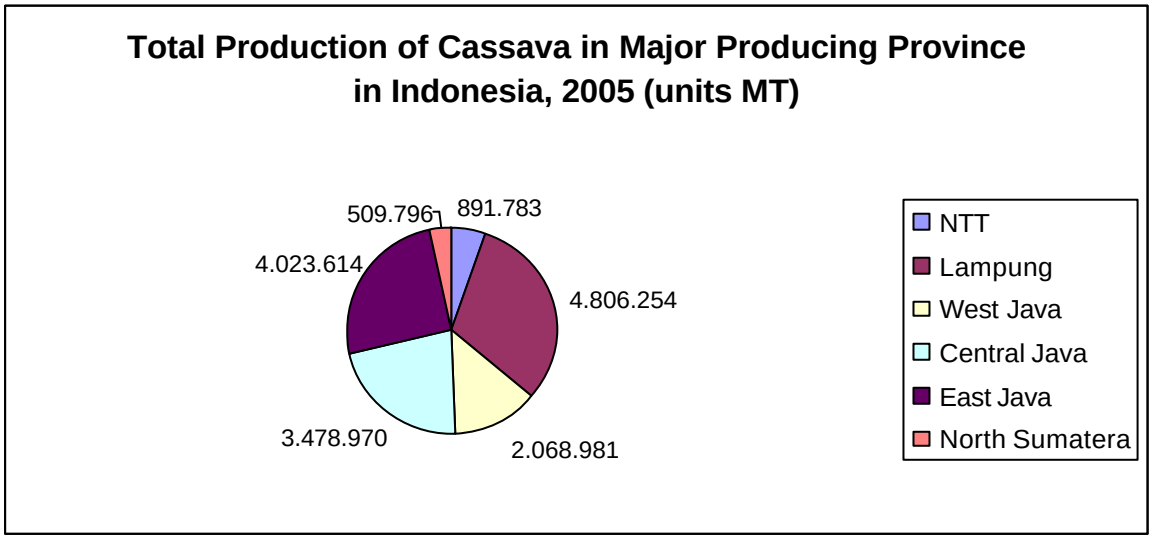
government of West Manggarai and a Chinese importer of cassava chips for the purpose of bio ethanol production. Further details of this project are outlined in the *Summary of Industry Potential* section.

Should this project proceed the structure of the industry would be similar to other agricultural commodities in Indonesia with a large number of smallholders (growing cassava on over 100,000 ha) supplying a small number of cassava chip buyers. In addition to cassava chip production for bio-ethanol, other uses for cassava may develop. Cassava as a feed source for beef and other livestock would be an important alternate use for cassava and important for the development of integrated farming systems in the district.

3. NTT Cassava Production and Sector Performance

NTT is a relatively small producer of cassava compared to other regions in Indonesia. However, the crop has potential to improve smallholder returns in NTT by offering an additional source of cash income to existing crops and an integrated use with beef cattle.

Figure 2 Major cassava producing regions of Indonesia, 2005



Source: Crops Division of the Indonesian Ministry of Agriculture

Cassava main producer area in NTT

The main growing areas are in NTT are Manggarai and Ngada (Flores), Timor Tengah Selatan Timor Tengah Utara, Belu and Kupang in Timor Island, and Sumba Barat. A well-known local cassava variety comes from the Ende district "Nuobosi". This variety is favoured by locals for household consumption. In Manggarai, Ende and Ngada smallholders grow both yellow and white varieties mostly for consumption. In West Sumba, cassava is used for chips or "gaplek", which is the process of peeling the skin,

shredding the root into chips and drying. Gaplek or dried cassava chips are used as a staple food during drought season. Dried cassava chip or gaplek can be stored for two to three years. In Maumere and Lembata, cassava is a major staple food and in these locations there is a traditional ceremony "Lamaholot", where cassava is served with corn chips, fish and tuak (local alcoholic drinks).

The taste of cassava in NTT varies between regions and islands. In Flores islands and Sumba where the soil type is volcanic, cassava is soft and sweet. In Timor islands, the taste of cassava is bitter and sometimes used more often as a feed for cattle.

The table below shows an indicative breakdown of cassava growing areas across NTT. The district that is targeted for a cassava growing and chip production project is located in Manggarai (shown in the table below as the largest producing area in NTT). Manggarai currently has 22 percent of the total planted area and has roughly twice the area as other producing regions such as TTS, Belu, Sumba Barat, Kupang and Sikka. The table below indicates that most of the increased production over the past six years has come from the Manggarai district.

Table 5 Cassava Production in Major Districts in NTT, 1999 - 2004 (Metric Tonnes)

Districts	1999	2000	2001	2002	2003	2004
Manggarai	137.442	133.105	122.704	137.603	126.701	263.766
Manggarai Barat						10.016
Sumba Barat	114.261	121.215	110.487	75.827	92.887	109.223
Sumba Timur	25.298	33.542	27.048	25.989	32.469	24.881
Ngada	40.482	48.041	40.323	31.541	45.485	26.268
Timor Tengah Selatan	153.285	67.11	148.373	115.079	83.163	96.681
Timor Tengah Utara	98.64	89.681	80.855	82.115	81.002	69.028
Belu	99.729	89.096	92.723	115.085	95.323	107.401
Kupang	44.536	51.989	48.132	17.782	67.868	101.74
NTT	**822,326**	**836,056**	**778,423**	**807,315**	**861,620**	**1,041,270**

Source : Provincial Food Crops Office, 2006

Cassava is mainly used for household consumption and intercropped with other crops

In NTT cassava is mainly used for local consumption. With the development of a potential cassava growing project for bio-fuel production, smallholders in this district are growing specifically to meet new demand under the guidance and support of the local government Food Crops Office. Field research also indicates that in the past six months the Chinese and Indonesian national governments have established an MOU to supply cassava chips for export to Guang Xi – China.

A pilot project of 1,000 ha has been established under an agreement between the local government and a Chinese cassava chip processor to meet the growing demand for bio-fuel raw materials in China. Agreements have also been established between the local government and national exporters.

A lack of knowledge on best practice cassava chip processing presents a risk to the proposed project

The local government has limited resources to support farmers with on-farm production and post harvest drying and processing into cassava chips. There is a lack of local experience and on post harvest practices and the selling process to international buyers. Field research indicates that despite a pilot project of 1,000 hectares already under way in the district of West Manggarai, smallholders may not have access to the optimum varieties and growing practices to produce high quality cassava chips for bio-ethanol production. Access to the required agri-inputs such as fertilizer and agrichemicals is also likely to be limited due to a lack of smallholder capital for such purchases and for industry services.

4. Market Conditions

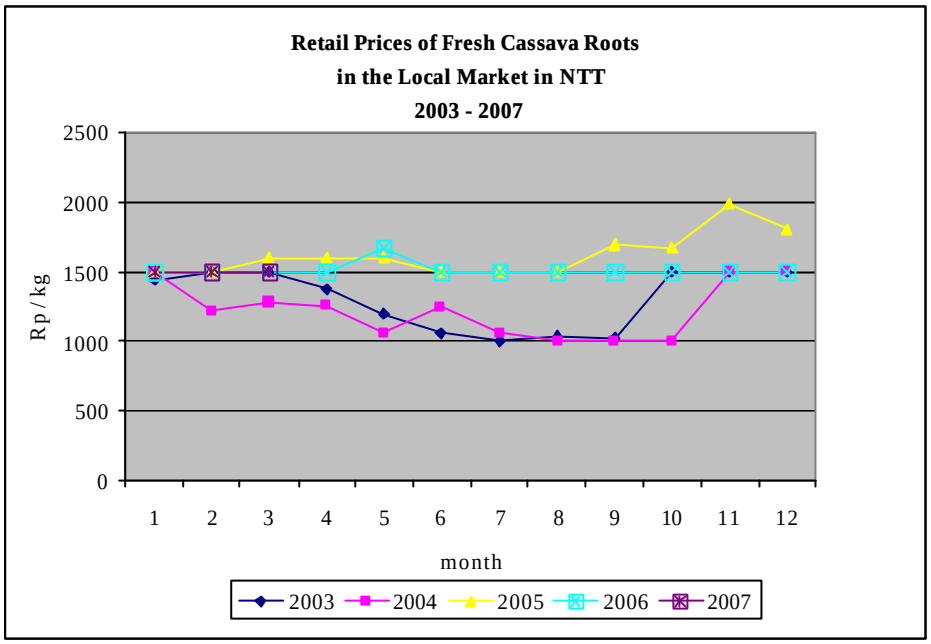
Cassava is a cheap form of starch (compared with rice and corn)

Smallholders in NTT sell cassava in fresh root form in local markets, as a major staple food. The crop is also commonly used for "in-kind trading" or barter amongst households. Cassava for household consumption is mostly used as a food reserve during the dry season when corn and rice are no longer available. Without a critical harvest age (i.e. for ripeness), cassava offers smallholders flexibility in consumption. Besides cassava flour (known as "tepung sagu"), field research indicates that there are few other marketing options (e.g., cassava chips for snacks) for cassava as a cash crop. Retail prices of cassava flour in local markets are around 5,800 – 6,000 rupiah per kg. Further research is required to understand the returns for cassava growing and processing into flour.

The graph below shows the retail prices for fresh cassava roots in local NTT markets. Prices in the local NTT markets (Naikoten, Oebobo, Oeba and Kuanino market), for fresh cassava are usually around 1,500 to 1,600 rupiah per kg, and can fluctuate between 1,500 to 2,500 rupiah per kg. A price for cassava chips (for bio-ethanol purposes) has yet to be been established in NTT. Given its single use for bio-ethanol production (and limitations for home consumption due to a more bitter taste) the prices for cassava chip varieties are likely to be lower than traditional varieties.

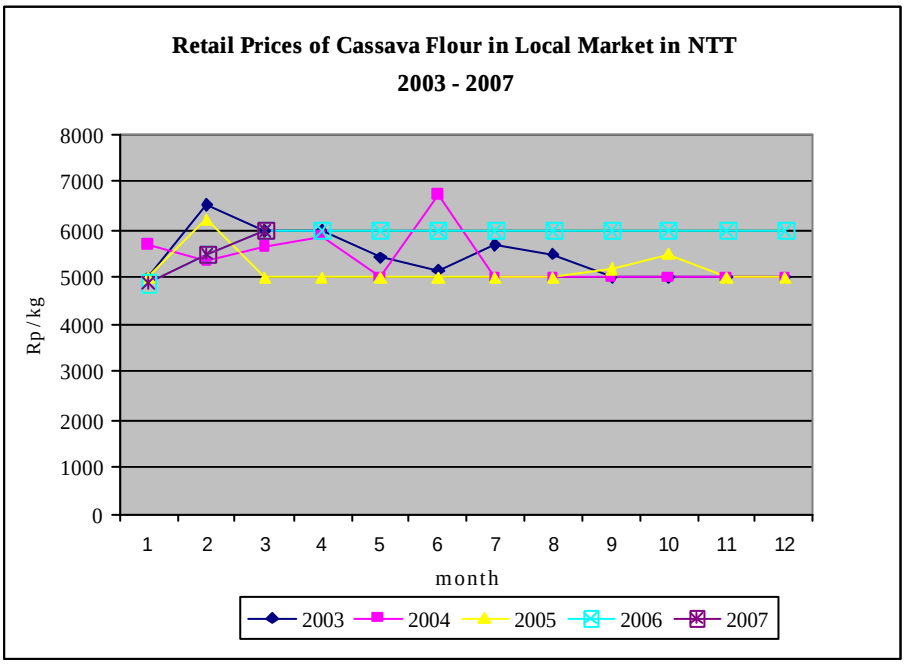
The graph shows that prices in local markets have been relatively stable over the past five years with the main driver of price being seasonal variations in supply. Peak production occurs from July to September. Anecdotal evidence suggests that NTT prices for fresh cassava are similar to other regions of Indonesia.

Figure 3 Local Market Retail Prices of Fresh Cassava



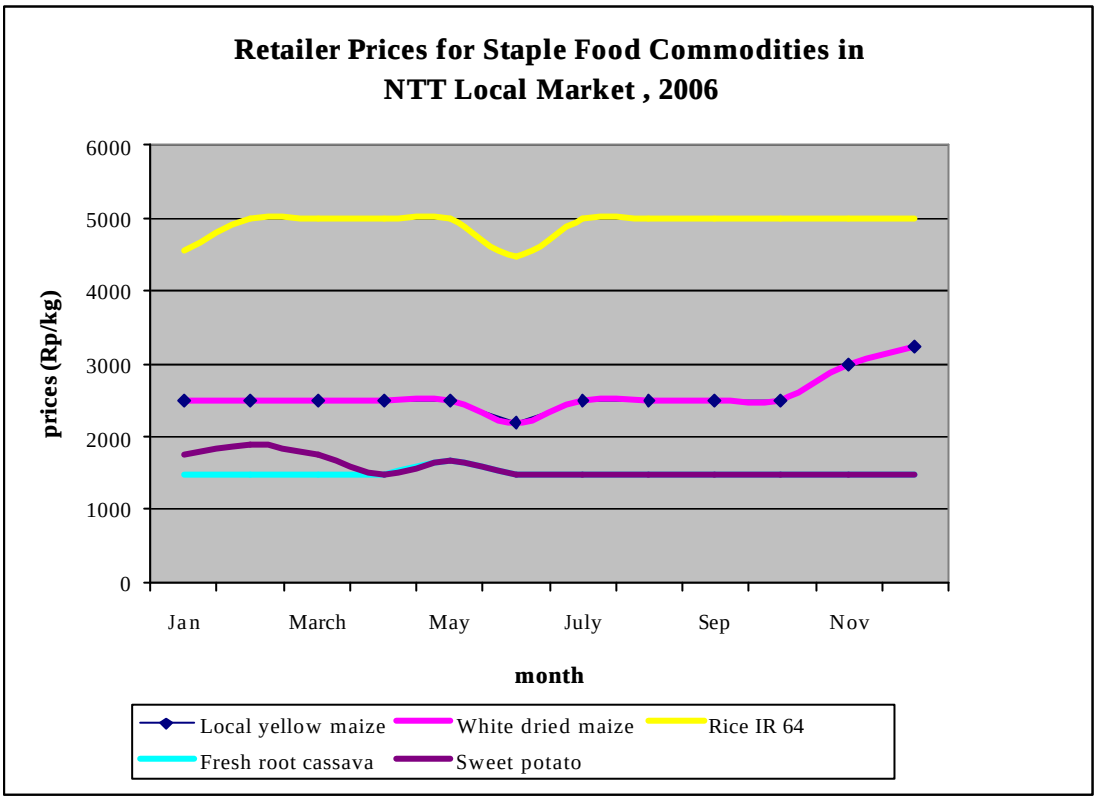
The graph below also shows that cassava flour prices in local NTT markets have been relatively stable over the past five years. With the expected increases in production from the proposed bio-ethanol cassava project, an increase in fresh cassava and processed product prices might be expected to decline over time.

Figure 4 Retail Prices for Cassava Flour in Local Markets



The graph below compares fresh root cassava prices at local NTT markets with other staple food crops. The graph shows that fresh cassava is considerably cheaper than maize and rice. Cassava is also considered to be a socially less acceptable food source than rice.

Figure 5 Retail Prices for Staple Food Crops in NTT



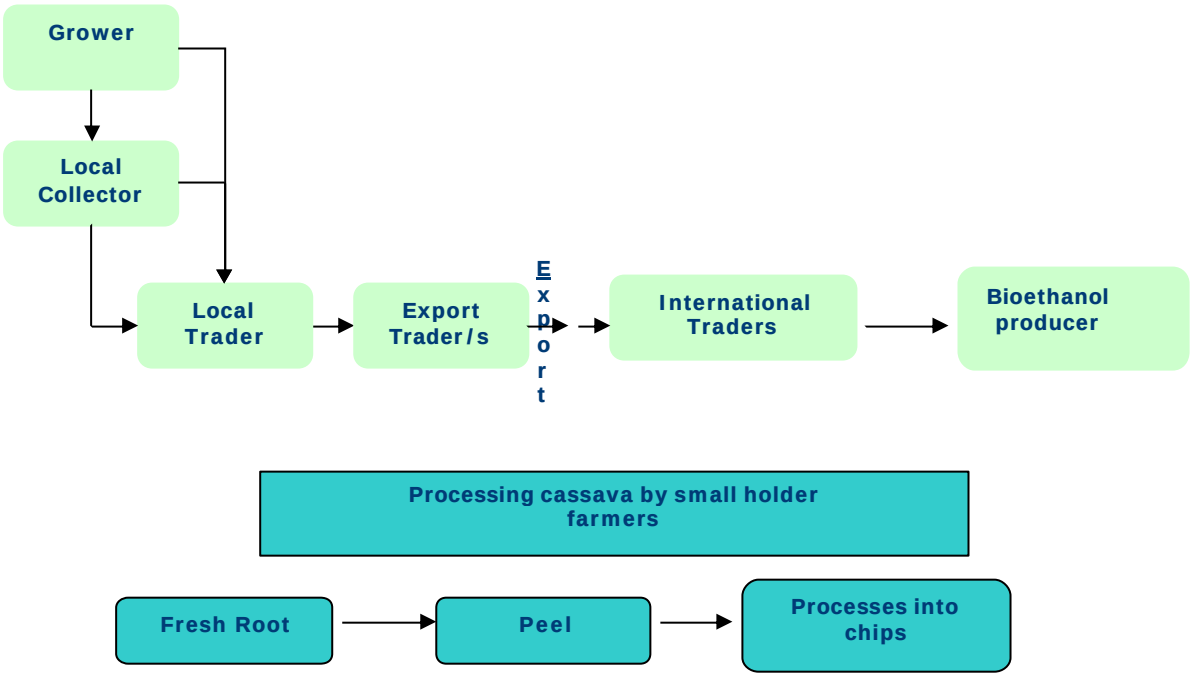
Source: NTT DINAS Crops Division

Cassava provides a valuable livestock feed as well as food staple

Cassava used for livestock feed is mainly roots that have grown past their best for human consumption and are fed to pigs or cattle. Finishing cattle are fed 5-7kg for 1-2 weeks and can achieve daily liveweight gains of 500 g per day (significantly more than weight gains expected by grazing native pastures). The practice of using cassava as a primary source of cattle feed however is not common in NTT, due to the valuable source of carbohydrate for human consumption that it provides.

Cassava Value Chain

The diagram below illustrates the supply chain for cassava from smallholder growers to potential bio-ethanol producers. Due to the early stages of the proposed project this supply chain is yet to be established.



5. Related Industries and Supporting Structures

Smallholder cassava producers are likely to face similar challenges to producing cassava as other agricultural commodities in NTT. The proposed project to develop large areas of unused land for cassava production is progressing without a full understanding of the following important factors:

- An understanding by the local government partner of the specified variety that the major Chinese buyer requires;
- Expected farm gate prices for smallholders growing bio-ethanol cassava;
- An understanding of the expected economic returns that farmers will earn from the proposed cassava growing project in comparison to existing crops;

Smallholders also lack access to finance for agri-inputs and this factor may impact on the sustainability of the proposed project once natural soil fertility is worked out. A sustainable cassava growing industry in the NTT will require improved research and extension support from local government and national research providers. This does not currently exist.

6. Value Chain Cost Analysis

The following tables allocate costs and returns for smallholder farmers. The estimates of value are based on a brief site visit to the proposed cassava growing project in West Manggarai.

The estimates of economic returns are shown below. Gross margins can be used as the first step involved in comparing the profitability of the different enterprises. The mathematics is simple- the direct or variable costs incurred in production are subtracted from the total income of the enterprise. They represent an indicative average, in reality weights and costs vary between regions and management. Gross margins are a simple means of comparing enterprises but care must be taken in interpreting the results, due to the following assumptions:

- That each enterprise is independent of all other related smallholder activities (in reality they're not);
- That each additional unit of production is worth as much, and costs as much, as the preceding unit.
- No account of interest or overhead expenses are accounted for.

6.1. Farming Returns

While most of the land targeted under the proposed project is unused, current returns from rice growing were researched as a comparison to projected cassava growing returns. The tables below show that, using production estimates made by smallholders for rice and cassava and using market price assumptions provided by the local government Crops Division, the expected returns from cassava growing are considerably higher than existing returns from rice.

Smallholder- Rice (1 crops per year, non irrigated, cropping pattern paddy - fallow)

Return per crop	Unit	Volume	IDR/Unit	IDR	USD
Income (per hectare)					
Paddy (GKP)	tonne	5.98			
Rice in Husked (GKG)	tonne	5.08			
Rice	tonne	3.30	4,000,000	13,200,000	1,467
- 50% for own consumption	tonne	1.65			
- 50% selling to RM owner	tonne	1.65			
Total Income				**13,200,000**	**1,467**
Production Costs (per hectare)					
Bed Seedling preparation	days	6	45,000	270,000	30
Land Preparation 1:					
- animal (buffalo)	days	14	30,000	420,000	47
- operator	days	28	45,000	1,260,000	140
Rebuilding borders	days	16	45,000	720,000	80
Cultivation	days	16	45,000	720,000	80
Seeds	kg	40	2,000	80,000	9
Fertilizer :				395,000	44
- Urea	kg	200	1,200	240,000	27
- SP 36	kg	100	1,550	155,000	17
Pesticides (Killtop)	bottle	2	40,000	80,000	9
Labour	days	178	56,910	10,130,000	1,126
Transport (field to house)	sacks	52	2,000	104,000	12
Transport (house to mill)	sacks	44	2,000	88,000	10
Rent thresher	sacks	52	4,000	208,000	23
Milling	kg	3,300	200	660,000	73
Sacks	sacks	52	500	26,000	3
Total Production Costs				**10,601,000**	**1,178**
Gross Profit/Margin per hectare (% value added)				**2,599,000**	**289**

The following tables show expected cassava returns for the proposed project in the first year of development and then in subsequent steady state years.

Smallholder cassava in 1st year (seeds, pesticide, land provided by Dinas Office)

Return per crop	Unit	Volume	IDR/Unit	IDR	USD
Income (per hectare)					
Production	stek	12000			
Production per stek	kg	4			
Total Production	kg	48000			
Converted from cassava to chips					
		0.6			
Chips	kg	7200.00	600	4,320,000	
Total Income				**4,320,000**	**480**
Production Costs (per hectare)					
Bed Seedling preparation	days	6		-	-
Land Preparation 1:					
Manual grubbing	days	39	45,000		-
Tractor	unit	1	750,000	750,000	83
Composting	days	10	45,000		-
Labour- Planting	days	16	45,000	720,000	80
Male	days	6	45,000	270,000	30
Female	days	4	15,000	60,000	7
Seeds	stek	12,000	178	2,136,000	237
Fertilizer :					
- manure	kg	5,000	300	1,500,000	167
Labour - Processing	ton	25,000	48	1,200,000	133
(peel, slices, transport)					
Transportation to the port	ton	1.80	450,000	810,000	90
Total Production Costs				**7,446,000**	**827**
Gross Profit/Margin per hectare (% value added)				**- 3,126,000**	**- 347**

Smallholder - non irrigated cassava in (steady state production)

Return per crop	Unit	Volume	IDR/Unit	IDR	USD
Income (per hectare)					
Production	stek	12000			
Production per stek	kg	4			
Total Production	kg	48000			
Converted from cassava to chips					
		0.6			
Chips	kg	7200.00	1,600	11,520,000	
Total Income				**11,520,000**	**1,280**
Production Costs (per hectare)					
Bed Seedling preparation	days	6		-	-
Land Preparation 1:					
Manual grubbing	days	39	45,000		-
Tractor	unit	1	750,000	750,000	83
Composting	days	10	45,000		-
Labour- Planting	days	16	45,000	720,000	80
Male	days	6	45,000	270,000	30
Female	days	4	15,000	60,000	7
Seeds	stek	12,000		-	-
Fertilizer :					
- manure	kg	5,000	300	1,500,000	167
Labour - Processing (peel, slices, transport)	ton	25,000	48	1,200,000	133
Transportation to the port	ton	1.80	450,000	810,000	90
Total Production Costs				**5,310,000**	**590**
Gross Profit/Margin per hectare (% value added)				**6,210,000**	**690**

7. NTT Cassava Product Value Chain Table – From Smallholder Perspective

Note: The comments and observations made in the Cassava Value Chain Table below are based on observations of subsistence cassava grown for home consumption and as a supplementary feed crop for cattle fattening in some parts of West Timor and Flores. Comments made concerning a commercial supply chain for cassava are based on the expected returns and market linkages for the proposed Lembor cassava project (for bio-ethanol production) only.

INBOUND LOGISTICS		
Observations	**Issues**	**Recommended Strategies**
HUMAN RESOURCE MANAGEMENT		
Cassava for cattle feed and home consumption IS planted and grown by family labour with little or no technical from experts. Cassava for bio-ethanol program likely to be developed with limited extension advice provided by local DINAS.	Subsistence cassava grown using traditional varieties, knowledge and experience only. Best practice fertiliser and input requirements are largely not employed. Uncertainty over whether farmers will receive enough support on cultivation and establishment. Farmers are unlikely to have cash or knowledge on purchasing required inputs. We have to rely on buyer for agri-inputs.	Conduct farm budgeting and cash management training to assist farmers to purchase required inputs (analisa usaha tani).
TECHNOLOGY AND DEVELOPMENT		
Large areas of arable land are available for development into cassava growing fields in Manggarai and all cultivation will be	Current practices require a large amount of labour for land preparation and planting.	Investigate the economics of purchasing farm machinery for shared use among farmer groups.

undertaken by kerbau or hand grubbing.	Farmers lack knowledge on soil fertility, manure and composting requirements.	Work with ACIAR to trial the best varieties of cassava, conduct soil testing around Lembor and develop recommendations on cultivation and input use Establish demonstration plots to improve local knowledge on input use and variety selection.
PROCUREMENT		
Farmers lack capital for routine family and farm expenses Current rice and cattle enterprise do not provide farmers with adequate cashflow for input purchase. Half the rice crop is used for home consumption resulting in little cash sales.	Lack of capital to purchase inputs exposes farmers to informal credit arrangements with buyers and a lack of transparency on input prices and finance costs.	Conduct research on how a warehouse receipts program would operate for farmers supplying cassava chips to major buyer.

OPERATIONS (Production)		
Observations	**Issues**	**Recommended Strategies**
HUMAN RESOURCE MANAGEMENT		
Farmers lack an understanding of how to manage cassava as a feed crop for beef production. Cassava is predominantly a crop grown for household consumption and farmers lack an understanding of how to manage cassava for chip production to maxmise bio-ethanol yield.	Cassava production as a cash crop, raw material for bio-ethanol and as a feed crop is not fully utilised.	Work with ACIAR program and international cassava chip buyer to investigate and improve cassava production and quality.
TECHNOLOGY AND DEVELOPMENT		
Farmers use basic manual cultivation, planting, crop management and harvest practices. A lack of commercial production reduces the incentive for farmers to understand how on-farm practices affect yield and quality.	The potential yields and quality attributes for commercial cassava (for bio-fuel) in NTT are largely untested.	Collaborate with ACIAR to establish a demonstration farm with a farmer group to improve farmer access to best practice and trial new varieties.

PROCUREMENT		
Farmers lack capital for necessary agri-inputs	Soil fertility and pest and disease levels in newly developed areas of fallow land (Manggarai) for cassava production may deteriorate once natural fertility is "worked out" and disease builds up.	Demonstration farms and collaborative R&D initiatives should develop best practices for soil management, pest and disease control and crop rotation.

OUTBOUND LOGISTICS		
Observations	**Issues**	**Recommended Strategies**
HUMAN RESOURCE MANAGEMENT		
Cassava is often harvested early and immature due to consumption and cash requirements	Yields and quality are compromised by early harvests.	Involve collectors and buyers of cassava in the development of optimum harvest requirements so that all parties have a common understanding of product quality. Trial effect of harvest timing on nutrition levels for cattle feeding.
TECHNOLOGY AND DEVELOPMENT		
All cassava is harvested, chipped and dried manually.	Manual post harvest practices are likely to produce a range of cassava chip quality.	Collaborate with ACIAR to identify best practice technology for post harvest and on-farm processing to improve quality.
PROCUREMENT		
It is unclear what the buying arrangements and physical collection systems will be for the proposed bio-fuel plant.	Farmers in remote villages may have farm gate prices discounted due to the cost of transporting high bulk product.	Include the effect of on-farm storage of cassava chips in demonstration program. Investigate whether warehouse receipts program would be feasible for cassava chip destined for processing (quality requirements, shelf life, etc)

MARKETING AND SALES		
Observations	**Issues**	**Recommended Strategies**
HUMAN RESOURCE MANAGEMENT		
As a relatively new crop for bio-fuel production farmers lack knowledge on marketing options.	Farmers will have limited marketing options with only one major buyer for bio-fuel.	Investigate other uses and markets for cassava chips once production has reached a critical mass to manage farmers' marketing risks.
TECHNOLOGY AND DEVELOPMENT		
More than one use / market for cassava chips will be needed for a viable industry.	Other uses and cassava storage are not well known to farmers.	Include cattle fattening in the demonstration program to utilise low grade cassava and manage farmers' marketing risks for unsold cassava.
PROCUREMENT		
The supply of processing chips to a proposed bio-fuel plant is likely to be highly seasonal. Farmers will still be largely dependent on one or two crops for cash income.	The viability of processing plant may be compromised by seasonality of supply.	Assist farmer to access the market for other crops Trial complimentary crops to cassava for other income.

SERVICE		
Observations	**Issues**	**Recommended Strategies**
HUMAN RESOURCE MANAGEMENT		
The local government (e.g., DINAS and bappeda) will be involved in the development of cassava for bio-fuel program from the start. There is strong traditional social hierarchy in village and sub district level	The DINAS lack institutional capacity to provide farmers with guidance in a well coordinated way.	Work with local DINAS and village leaders to improve their access to on-farm R&D information from other parts of Indonesia and help disseminate the findings of the integrated cassava demonstration farm.
TECHNOLOGY AND DEVELOPMENT		
Farmers lack access to on-farm best practice for integrated cassava and beef production.	Cassava yields and quality is compromised due to poor service from R&D providers and local government.	Work with local DINAS and village leaders to improve their access to on-farm R&D information from other parts of Indonesia and help disseminate the findings of the integrated cassava demonstration farm.
PROCUREMENT		
Finance is typically unavailable or provided by collectors.	With a lack of finance farmers don't have the ability to purchase necessary agri-inputs.	Work with A2F component of IFC SADI to develop ways to improve farmers' access to finance. Investigate the role of a wharehouse receipts program in this regard.

8. Summary of Industry Potential, Issues and Recommendations.

8.1. Industry Potential

The interest shown by the major Chinese importer and the heads of agreement drawn up with the local government in West Manggarai (2005) to produce cassava chips for transportation by ship from Labuan Bajo to China (Guang Zi Port) would indicate that there is potential for increased commercial production of cassava in NTT.

The proposed project is to grow cassava for chip production on an area of over 100,000 hectares in West Manggarai, for further processing into bio-ethanol in China. A small pilot project of 1,000 ha has begun at Vol village, Lembor, West Manggarai. This site is in close proximity to the port at Labuan Bajo (one hour by road). Seed is currently being sourced from Surabaya and field research verifies that the region is well suited to growing cassava with large areas of unused arable land. The unused area of arable land at Lembor could potentially be developed into an area of over 50,000 hectares under the management of smallholders in the district.

West Manggarai is a suitable district for developing such a project due to an existing supply base and traditional knowledge of basic cassava growing plus large areas of unused arable land suitable for cassava growing. The area may also be suitable for mechanization such as tractors for cultivation and harvest, although the economics of this need further investigation.

The IFC is likely to have an interest in the proposed project due to the potential benefits for smallholders and the potential for further integrated farming systems where cassava is used as a source of cash income and as a valuable feed source for fattening cattle. This approach to developing cassava production in Flores, and potentially other parts of NTT, also allows smallholders to diversify risk away from only one or two agricultural products.

8.2. Industry Issues

- The potential for smallholder cassava production in NTT and the feasibility of a large-scale cassava growing project for bio-ethanol production in Flores is still in an early stage of development. Field research and interviews with the local government and West Manggarai suggest that a full feasibility study on the district and market potential is required to manage the risk that exists for smallholders in growing large areas of cassava for bio-ethanol production.

- Initial field research indicates that cassava yields in NTT are comparable with other regions of Indonesia. However, further work is required to understand whether NTT has comparative advantage in cassava production over other regions of Indonesia and whether there is a risk that the major buyer could downsize future buying operations.

- Like other agricultural commodities, smallholders producing cassava in NTT will require adequate access to seasonal finance for basic agri-inputs. Such access does not currently exist and smallholders rely on informal forms of finance supplied by traders and intermediaries for other products.

- The proposed project will rely on Cassava chip purchases from a single large buyer for processing in China. This buying situation is a risk that will have to be managed by the smallholders and farmer groups intending to become involved in cassava growing and chip production.

- Cassava chip production is not a traditional post harvest practice for smallholders in NTT and will require extension to ensure that smallholders produce a quality product.

8.3. Recommendations for IFC TA

The following points summarize the key recommendations made in the value chain analysis. The recommendations are made with a potential TA program to support the proposed cassava production project.

- Conduct research on the minimum average level of cash needed per household per year so that an integrated farming system to meet household cash requirements can be developed.

- Work with the IFC A2F program to investigate whether a linkage can be established with the major cassava chip buyer to establish a wharehouse receipts program and provide farmers with improved access to finance. A tri-partite finance agreement between buyers, local banks and farmer groups may should also be investigated to improve access to finance.

- Collaborate with ACIAR to undertake further research and trial improved high starch varieties for specialist cassava production, including soil testing, best practice cultivation, weed and pest control, best practice harvest, drying and processing into chips.

- Collaborate with the local government DINAS, ACIAR and farmer groups to establish a demonstration plot to encourage farmers to use best practice cassava growing techniques.

- A demonstration farm should also investigate the potential for farmers to increase their overall cash income by selling fresh roots for household consumption, as a cash crop for cassava chip production and also as a livestock feed for an integrated cattle farming/cropping system. The goal for a demonstration farm should be to achieve a minimum level of cash income per year from a range of crops from an average smallholding.

- Work with the ACIAR program and the major cassava chip processor to understand cassava chip quality requirements and on-farm practices to meet these standards.

- Investigate other uses and markets for cassava chips once production has reached a critical mass to manage farmers' marketing risks.

- Work with the local DINAS, farmer groups and village leaders to improve smallholder access to on-farm research and information from other parts of Indonesia and incorporate this practice into the integrated cassava demonstration farm.

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