FOOD SECURITY RESEARCH PROJECT

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WORKING PAPER No. 32
FOOD SECURITY RESEARCH PROJECT
LUSAKA, ZAMBIA
AUGUST 2008
(Downloadable at: http://www.aec.msu.edu/agecon/fs2/zambia/index.htm)

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*This paper has been produced at the request of Zambia's Acceleration of Cassava Utilization Task Force. The authors presented an earlier draft of this paper to the Acceleration of Cassava Utilization (ACU) Task Force workshop in February 2007. The paper has likewise been circulated regionally under the Cassava Transformation in Southern Africa (CATISA) Startup Task 3. Report on Zambia's Cassava Value Chain.

ACKNOWLEDGMENTS

This paper builds on a preliminary draft prepared by the same authors for the Acceleration of Cassava Utilisation (ACU) Task Force's Round 1 Review and Planning Workshop held at the Agricultural Consultative Forum in Lusaka on February 1, 2007. The authors are grateful for the many helpful comments and suggestions contributed by the stakeholders participating in that workshop.

EXECUTIVE SUMMARY

Cassava production has grown rapidly in Zambia since the early 1990's. Available evidence suggests that volumes of traded cassava have been increasing roughly twice as fast as production.

Yet this cassava production boom could stall unless commercial markets for it develop. To help accelerate commercial development of cassava and cassava-based products at the national level, Zambia's Agricultural Consultative Forum (ACF) initiated an Acceleration of Cassava Utilization (ACU) Task Force, beginning in August 2005. At a regional level, efforts such as the Cassava Transformation in Southern Africa (CATISA) project aim to complement national efforts and help facilitate regional spillovers, so that new products, new technologies or new lessons can help to accelerate cassava-based commercial growth throughout the region.

This paper aims to provide empirical content in support of both the ACU Task Force and CATISA activities. Farm household surveys, together with market monitoring data, suggest that only about 8% to 10% of Zambia's cassava crop is currently marketed. However, the potential for market growth remains considerable. Our estimates suggest that commercial market potential could accommodate an approximate doubling of national cassava production, a growth that represents a six-fold increase marketed volumes. In the cassava belt, the largest markets will likely be for cassava-based convenience foods such as gari and cassava-based maheu and potentially for cassava-based ethanol production. In the maize belt, the largest potential markets include the livestock feed industry, the fresh market for human consumption (which is particularly attractive during the lean season when no other food staples can be harvested), the market for composite flours, and industrial uses as food sweetener.

Low price will be key to the viability of cassava as a carbohydrate source in prepared food, livestock feeds, and industrial sweeteners and starches. As a general rule of thumb, cassava substitution for maize becomes commercially attractive where the price of dried cassava lies about 60% to 70% of the price of maize. A low cassava price, in turn, requires high on-farm productivity, low marketing costs and therefore, in most cases, cassava production in close proximity to new processing facilities. Thus, accelerated expansion of improved cassava varieties, improved agronomic practices and establishment of processing facilities near major production centers – or the establishment of cassava farming near major consumption centers – will all contribute to improved incentives for cassava commercialization.

Likewise, regional cross-fertilization holds considerable promise for accelerating cassava commercialization. While Malawi has advanced furthest in cassava-based starch production, the Mozambican market features the broadest array of cassava-based food prepared foods, and Zambia appears to have advanced faster than its neighbors in its efforts to incorporate cassava into livestock feeds. Thus, prospects for regional technology sharing hold considerable promise as a vehicle for stimulating new product development and accelerating cassava commercialization in the region.

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ACRONYMS

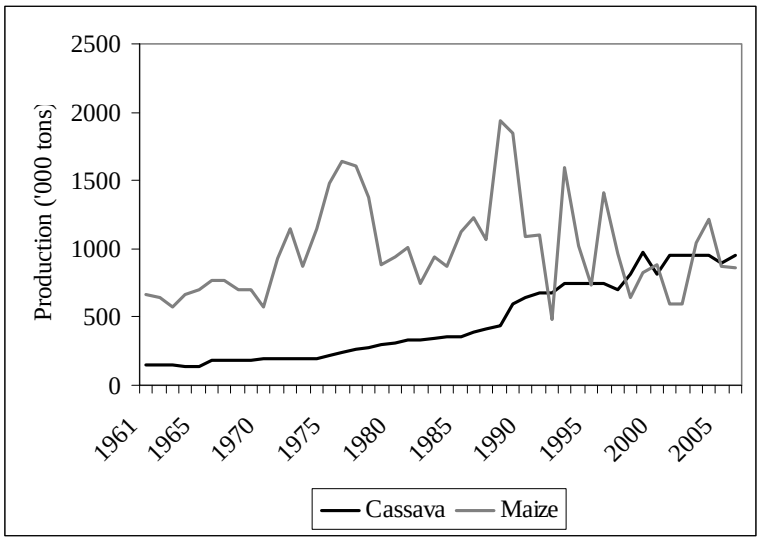
ACF	Zambia's Agricultural Consultative Forum
ACU	Acceleration of Cassava Utilization
AEZ	agro-ecological zones
CATISA	Cassava Transformation in Southern Africa
COMESA	Common Market for Eastern and Southern Africa
CSO	Central Statistical Office
DRC	Democratic Republic of Congo
FAOSTAT	Food and Agricultural Organization Online Statistical Database
FRA	Food Reserve Agency
FSRP	Food Security Research Project
LDT	Livestock Development Trust
MACO	Ministry of Agriculture and Cooperatives, Zambia
PHS	Zambia's Post Harvest Survey
RTIP	Zambia's Root and Tuber Improvement Programme
SARRNET	Southern Africa Rootcrops Research Network

1. INTRODUCTION

Cassava production has grown rapidly in Zambia since the early 1990's (Figure 1). While maize production has trended downward, amid wide variation, the more drought-tolerant cassava crop has grown steadily. Two forces have motivated farmers to diversify their food staple production out of maize and into cassava. The removal of heavy subsidies for maize production and marketing coupled with the government withdrawal of a guaranteed maize market, from the early 1990s onward, clearly reduced farmer incentives to grow maize (Howard and Mungoma 1996). Hence, farm families sought out more profitable crops. Among food staples, cassava and sweet potatoes have proven most popular (Zulu et al. 2000). At the same time, in the early 1990's, Zambia's Root and Tuber Improvement Programme (RTIP) released the first of two waves of new cassava varieties (Table 1). Disease resistant and early maturing, the new varieties outyield conventional cassava varieties by roughly a factor of three. The combination of significant productivity gains in cassava, combined with a significant increase in the farmers' cost of maize production, has propelled growth in cassava production at roughly 3.4% per year for the past decade and a half.

Yet this cassava production boom could stall unless commercial markets for it develop. While prospective new sources of demand – from food processing industries, livestock feeds or industrial starch users – could provide growing markets for these increased cassava supplies, without them it seems likely that Zambia's production boom could falter. Rapid productivity gains in cassava production hold the promise of significantly lower production costs and falling cassava prices. Lower costs, in turn, will make new commercial opportunities increasingly viable.

Figure 1. Trends in Food Staple Production in Zambia



Source: FAOSTAT.

To help accelerate commercial development of cassava and cassava-based products at the national level, Zambia's Agricultural Consultative Forum (ACF) initiated an Acceleration of Cassava Utilization (ACU) Task Force, beginning in August 2005 (see Chitundu, Droppelmann, and Haggblade Forthcoming). By encouraging and facilitating private sector development of these emerging commercial opportunities in the cassava market, the ACU Task force hopes not only to increase cassava-based farm and food processing income but also to improve national food security by increasing availability of drought-tolerant cassava and thereby reducing national dependence on highly variable rain-fed maize production.

At a regional level, the Cassava Transformation in Southern Africa (CATISA) project aims to achieve these same goals by building on a series of cassava production surges to help facilitate cassava-based commercial development. By comparing cassava production and commercialization pathways, CATISA aims to help cross-fertilize and facilitate commercial development of cassava-based products through technology exchanges, food safety analysis and training, and comparative policy analysis. Working in concert with the Common Market for Eastern and Southern Africa (COMESA) regional food staples initiative, CATISA aims to complement national efforts such as the ACU task force and to help facilitate regional spillovers, where new products, new technologies or new lessons can help to accelerate cassava-based commercial growth throughout the region.

This paper aims to provide empirical content in support of both CATISA and ACU Task Force activities. In doing so, the report draws on data from a variety of sources, including a series of national farm household surveys, interviews with a broad range of cassava traders and processors in northern Zambia, the Copperbelt and Lusaka, as well as weekly market monitoring of the dried cassava trade in Lusaka and in Kitwe over the past eighteen months. From this foundation, the paper builds a portrait of the structure and dynamics currently underway in Zambia's cassava value chain. The paper attempts to quantify the size of existing markets for cassava and derived products as well as the growth potential for each of these various final markets. Following a review of the current commercial system, market structure and coordination methods, the paper outlines key opportunities and potential constraints to cassava-based commercial growth.

Table 1. Release of New Cassava Varieties in Zambia

Variety	Type	Released	Yield (tons/ha)	Taste
1. Bangweulu	cleaned local variety	1993	31	bitter
2. Kapumba	cleaned local variety	1993	22	sweet
3. Nalumino	cleaned local variety	1993	29	bitter
4. Mweru	bred by RTIP	2000	41	sweet
5. Chila	bred by RTIP	2000	35	bitter
6. Tanganyika	bred by RTIP	2000	36	sweet
7. Kampolombo	bred by RTIP	2000	39	sweet
Traditional	local variety		7	bitter

* All yields refer to research station observations using no purchased inputs but following recommended agronomic practices. Yields were measured 16 months after planting.

Source: Chitundu and Soenarjo (1997); Simwambana et al. (2004).

2. FARM PRODUCTION

2.1. Food Security Production Zones

Zambia spans a broad range of agro-ecological zones (AEZ), from the very arid AEZ1 in the south, where rainfall averages under 800 mm per year, to the much wetter and warmer AEZ3 in the north (Figure 2). The longer rainy season and warmer temperatures in the north lead to a growing season in AEZ3 roughly 20 to 30 days longer than in AEZ1.

Comparison of these agro-ecological zones with the prevalence of food staple production, by zone, reveals a tight correspondence (Figure 3). Zambia's heavy cassava production zones straddle the northern and northwestern parts of the country. These are the warmer, higher rainfall regions of AEZ 3 where cassava serves as the primary food staple and over 75% of farm households grow cassava. In contrast, the maize belt occupies the bulk of southern and eastern Zambia (AEZ 1 and 2a), the low temperature zones where a tropical crop such as cassava does not perform well. In these areas, over 75% of households cultivate maize, while less than 10% of households grow cassava (Table 2). An intermediate, dual staple zone forms a buffer between Zambia's cassava and maize belts, providing a transition zone that runs from central western Zambia and rising north east like a giant sash. Katanga Province of the Democratic Republic of Congo cuts across Zambia's cassava belt and into the transition zone. This dual-staple zone includes western Zambia (AEZ 2b), where sandy soils favor cassava production, as well as the southern perimeter of AEZ 3.

In order to make this study useful, simultaneously, for national efforts by the ACU Task Force and for the regional cassava promotion efforts by CATISA, Southern Africa Rootcrops Research Network (SARRNET) and COMESA, the following analysis defines food staples zones according to criteria adopted by both. Because of the tight correspondence between food staple zones as defined by CATISA (see Haggblade and Nielson 2007) and Zambia's agro-ecological zones (see Figure 2), it has proven possible to map one into the other by using the following breakdown. The maize belt, as defined by CATISA, includes AEZ 1 and 2a, where over 75% of households growth maize and less than 25% (in fact less than 10%) grow cassava. Agro-ecological zones 2b and 3 constitute Zambia's dual-staple zones, where over 50% of households grow cassava and maize. Because ongoing market monitoring by the Food Security Research Project (FSRP) reveals clear distinctions within AEZ3, we have opted to partition this agro-ecological zone into two parts. AEZ 3a, the southerly portion of AEZ3, constitutes a classic dual-staple zone with roughly equal shares of households growing cassava and maize. But in the northern and northwest corners of AEZ3, where over 90% of households grow cassava, cassava commercialization is most highly developed and cassava prices are lowest. To distinguish this high-intensity cassava belt, we refer to this high-intensity cassava zone (AEZ3b) as Zambia's cassava belt, or as its cassava-based dual staple zone.

Figure 2. Zambia's Agro-ecological Zones

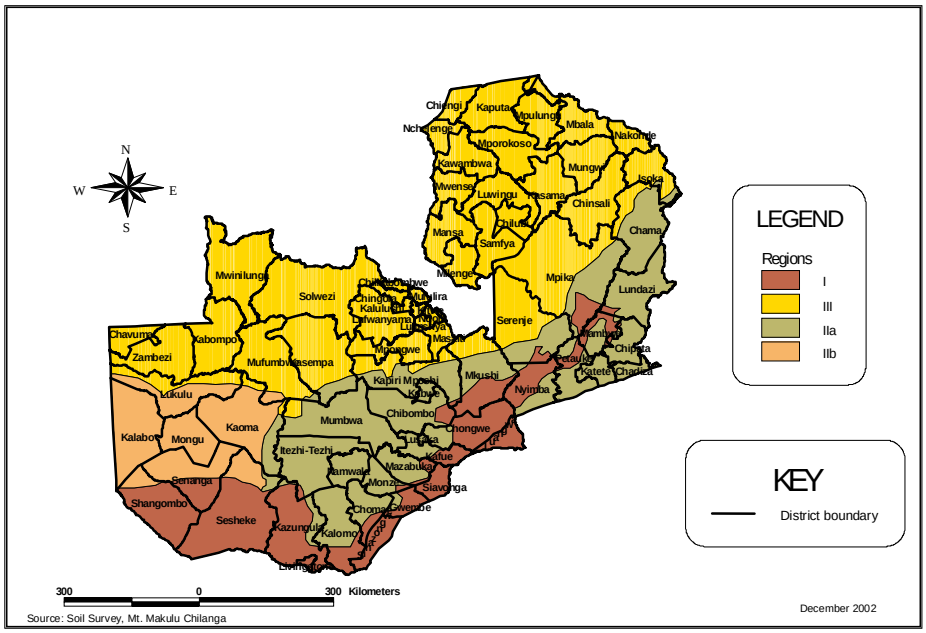
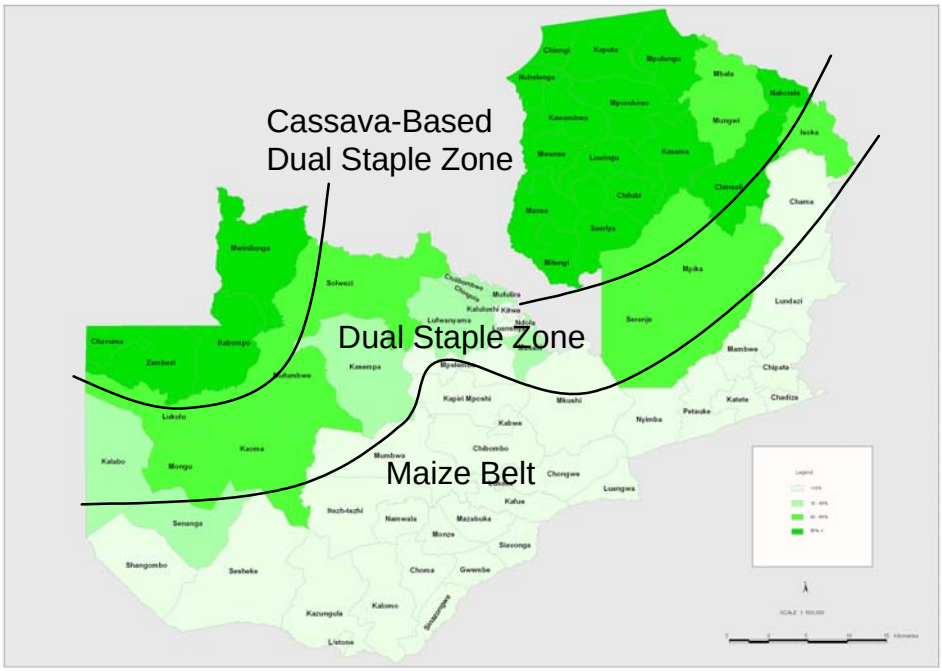


Figure 3. Zambia's Food Staple Production Zones



Source: CSO Post-Harvest Survey averages, 1999/2000 through 2004/05

Table 2. A Profile of Farm Households by Food Staple Zone (average 2000's)

	Agro-Ecological Zone					All
	1	2a	2b	3a*	3b*	Zambia
Households growing principal food staples						
cassava	2%	5%	65%	45%	92%	42%
maize	91%	79%	85%	85%	54%	81%
Area planted by households who grow these staple crops (ha/hh)						
cassava	0.53	0.38	0.66	0.56	0.86	0.76
maize	0.91	1.09	0.62	0.72	0.42	0.85
Production per producing household (kg/hh)						
cassava	222	363	374	856	1,434	1,142
maize	715	1,455	415	1,078	648	1,098
Yield (kg/ha)**						
cassava	922	1,126	756	1,700	2,488	2,122
maize	944	1,393	768	1,500	1,593	1,359
Commercialization (% of producing households who sell some of their production)						
cassava	24%	21%	21%	18%	25%	23%
maize	13%	22%	20%	41%	43%	28%
Quantity sold (kg per producing household)						
cassava	17	92	54	78	131	109
maize	100	310	54	333	207	258
Sales as share of total production						
cassava	7%	12%	9%	7%	7%	8%
maize	5%	7%	7%	15%	20%	10%

* Note that this demarcation splits AEZ3 into two zones. 3b is the core of the cassava belt, defined as all districts where over 90% of households grow cassava, while 3a covers the remaining districts in AEZ3.

** Cassava "yields", defined as production divided by total area in production, are understated because farmers harevest only about one-third of their total cassava area each season.

Source: CSO Post Harvest Surveys, averages of the five seasons from 2000/2001 through 2004/05.

While over 90% of households in the cassava belt (AEZ 3b) grow cassava, less than 10% in the maize belt (AEZ 1 and 2a) do (Table 2). In the dual staple zones (AEZ 2b and 3a), over 50% of households grow at least some cassava as well as some maize.

Though the prevalence of cassava production varies widely across zones, area planted in cassava, by cassava-growing households, varies less drastically. In the maize belt (AEZ 1 and 2a), cassava-growing households cultivate between 0.4 to 0.5 hectares of cassava per household. In the dual staple zones (AEZ 2b and 3a), households growing cassava cultivate between .6 and .7 hectares of cassava. And in the core of the cassava belt (AEZ 3b), households average over 0.8 hectares of cassava (Table 2).

At any one time, most cassava-growing household farm three plots of cassava. In a typical planting profile, households stagger maturities, with freshly planted, one-year-old and two-

year-old stands planted at any one time. Because cassava yields peak between 18 months and 3 years after planting, depending on the variety (Chitundu and Solanaro 1997; Barratt et al. 2006), this staggered planting calendar enables households to harvest their mature stands each season over a three-year cycle.

Cassava production per household varies considerably across zones. Given larger plot sizes and higher yields in AEZ 3b, cassava production there appears to be more than double that in the dual-staple zones (Table 2).[1] Not surprisingly, given higher rainfall and a longer growing season, yields of both cassava[2] and maize are highest in the cassava belt (AEZ 3b).

2.2. Commercialization

About one-fourth of cassava-growing farmers sell some of their crop. That share remains roughly constant across zones. Though very few farmers grow cassava in the maize belt (AEZ 1 and 2a), those who do consider it not only a food staple but also a cash crop. They sell about 10% of their cassava production, virtually all of it in the fresh market according to our market surveys. This represents a higher marketed share than for maize. In comparison, households in the heaviest cassava-producing zone sell only about 7% of their cassava production, on average, three-quarters of it in dried form and the remainder in the local fresh market. Cassava belt farmers market 15% to 20% of their maize crop, more than double the proportion marketed by smallholders in the maize belt.

Over the past decade, cassava production has grown most rapidly in the dual staple zones and in the cassava belt, where the percentage of households growing cassava has increased between 10% and 15% while annual production per household has grown by over 50% (Table 3). This has fueled increased cassava sales as well. The share of households selling some cassava has roughly doubled. Absolute quantities marketed per producing household have more than tripled (Table 3). Currently, Zambian farmers market about 8% of total cassava production, or roughly 80,000 of cassava per year, 35,000 as fresh cassava with the remaining 45,000 tons dried into approximately 15,000 tons of cassava chips which transit long distances to supply markets as far a field as DRC and Angola.

[1] Note that cassava production is notoriously difficult to measure accurately from farmer recall surveys such as Zambia's Post Harvest Survey (PHS). Households harvest cassava year-round as they require food, and they leave it stored – and growing – in the ground until then. They harvest intermittently using irregular baskets and receptacles. Consequently, scaling up recall data to annual production is fraught with difficulties. The production and yield data are most useful in comparing relative production levels across zones.

[2] The reported cassava yields in Table 2 are far below the 7 tons per hectare generally considered to be the Zambian national average. This underestimate arises because these figures take estimated production divided by total area under cassava, even though farmers harvest only about one-third of their plots in any one year. Therefore, the cassava yield reported in Table 2 should be roughly tripled to estimate productivity in terms of kilograms produced from each hectare harvested.

Table 3. Commercial Dynamics Among Cassava-growing Farm Households

	1990's	2000's	difference
Cassava production			
a. households growing cassava (%)			
Cassava-based dual staple (3b)	84%	92%	7%
Dual staple zone (3a)	37%	45%	8%
Dual staple zone (2b)	48%	65%	17%
Maize belt (1 and 2a)	2%	5%	3%
All Zambia	36%	42%	6%
b. quantity harvested (kg/hh)			
Cassava-based dual staple (3b)	803	1,434	631
Dual staple zone (3a)	433	856	423
Dual staple zone (2b)	244	374	130
Maize belt (1 and 2a)	243	340	97
All Zambia	575	1,142	567
Cassava commercialization			
a. percent of cassava-growing households who sell some production			
Cassava-based dual staple (3b)	11%	25%	14%
Dual staple zone (3a)	10%	18%	8%
Dual staple zone (2b)	9%	21%	11%
Maize belt (1 and 2a)	25%	21%	-3%
All Zambia	11%	23%	12%
b. quantity sold (kg/hh)			
Cassava-based dual staple (3b)	40	131	91
Dual staple zone (3a)	30	78	48
Dual staple zone (2b)	32	54	21
Maize belt (1 and 2a)	98	80	-18
All Zambia	38	109	70

Source: CSO Post Harvest Surveys. The figure for 1990's average data for the four Seasons from 1990/91 to 1993/94, while the data for the 2000s average the latest five Available PHS years 2000/2001 through 2004/05.

3. FINAL MARKETS FOR CASSAVA AND CASSAVA-BASED PRODUCTS

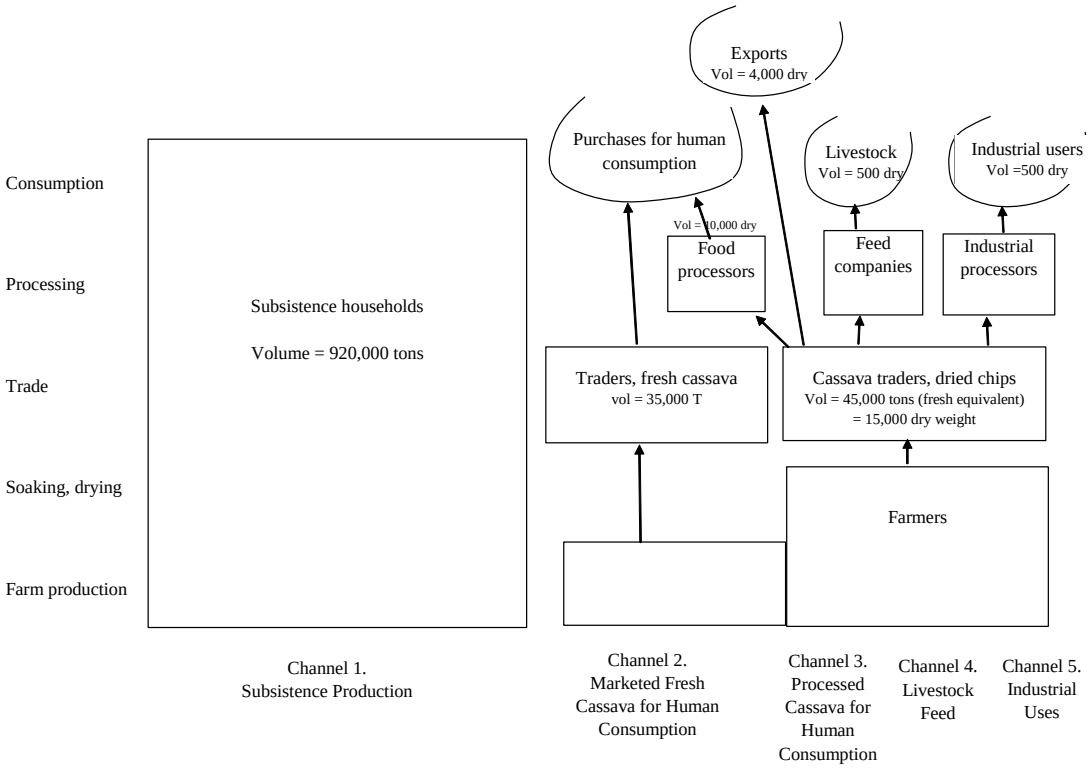
Though from a very small initial base, marketed volumes of cassava have increased rapidly in the decade and a half since liberalization of Zambia's maize markets. Where have these increased sales emerged? What final markets have absorbed the bulk of this growing production and commercialization? The following discussion addresses these questions, summarizing current market shares in the value chain diagram in Figure 4.

3.1. Farm Household Consumption (Supply Channel 1)

Farm households who grow cassava consume the bulk of their own production. Though shares vary across food staple zones, in aggregate, farm households consume about 92% of national cassava production and sell the remainder.

Over the past decade, subsistence production has probably grown most rapidly of all the supply channels in absolute size, although not in percentage terms. As maize production faltered in the dual staple zones, farm households have substituted cassava for maize in their production mix. National production data suggest that per capita maize production has fallen from about 110 kg per capita in the early 1990s to roughly 95 kg currently, while consumption of own cassava has largely filled the gap, growing from 65 kg per capita to 95 in fresh weight for a gain of about 10 kg per capita in maize-equivalent dry weight.

Figure 4. Alternative Supply Channels in Zambia's Cassava Value Chain



Source: FSRP market surveys and Post Harvest Survey (PHS) surveys.

In the future, however, growth prospects in this channel remain limited. Once households assure their food security, they will only increase cassava production if a commercial market exists. This suggests that future growth in cassava production will depend largely on growth prospects in the commercial channels of Zambia's cassava value chain.

3.2. Fresh Marketed Cassava for Human Consumption (Supply Channel 2)

The second supply channel, derived from the first, involves farm households selling surplus production in fresh form to nearby markets for human consumption. Historically, these fresh sales have accounted for no more than about 5% of total production (van Otterdijk 1996; and Tembo and Chitundu 2000; Langmead and Baker 2003). Market monitoring in 2006 and 2007 suggests that dried cassava accounts for the majority of marketed cassava volumes, or about 5% of total production, with fresh sales accounting for roughly 3% of national production.

Because cassava roots contain about 70% water, and because root quality deteriorates within 48 hours after harvesting, most fresh sales travel no more than about 50 kilometers from field to final market. For this reason, Channel 2 is well established in northern Zambia. It is also growing steadily in the maize belt, where farm production data suggest that virtually all marketed cassava is sold in fresh form.

Marketeers in Mansa report that the fresh cassava market is highly seasonal. Sales peak during the rainy season, when maize prices are high and when dried cassava is difficult to prepare because of the high humidity. So in the cassava belt, fresh cassava serves primarily as a lean-season food supplement. It could likewise play a similar role in the dual staple zones and in the maize belt. Currently, it is sold there only in small volumes, and primarily as a snack food.

In the future, however, the fresh cassava market offers considerable growth potential. The emergence of three regular fresh cassava sales depots in Lusaka's Soweto market in the past four years suggests that this market has indeed established a foothold in the urban Lusaka market. Cassava marketed in Zambia's maize belt largely targets this fresh market. Likewise, in maize-consuming central Malawi, the fresh cassava market has grown very rapidly, with fresh marketings constituting the bulk of marketed cassava sales there (Haggblade and Zulu 2003; Kambewa and Nyembe 2007).

Indeed, fresh sales of sweet cassava have grown rapidly in the Lusaka market over the past five years. Developed by private farmers and traders, this growing fresh cassava market has drawn both inspiration and planting material from Malawi. Two farmers from the village of Rafuntsa, about 50 km east of Lusaka, visited relatives in Malawi during the mid-1990s and returned impressed with the growing market for fresh cassava there. They likewise returned with cuttings from the preferred Malawian cassava variety, Manyokola. From these initial cuttings, they expanded production gradually in Rafuntsa. Widespread local appreciation of this sweet variety of cassava led local farmers to produce surpluses for sale in Lusaka. A network of half a dozen private traders has grown up over the past five years to assure daily deliveries into Lusaka. As a result, the area around Rafuntsa has become the primary supplier of fresh cassava to the Lusaka market. This market growth underscores the important potential for regional cross-fertilization in accelerating cassava commercialization.

The availability of four new sweet varieties of cassava improves prospects for developing this market further. Given that Zambia's Root and Tuber Improvement Programme released their latest three sweet varieties of cassava only in 2003, these new varieties are not yet widely available among farmers, either in the cassava belt or outside. If the private sector introduction of the popular Malawian sweet variety of cassava, Manyokola, is indicative, then the introduction of this broader menu of sweet varieties could play an important role in expanding the urban fresh cassava market further, even in Zambia's maize belt.

3.3. Dried Cassava for Human Consumption (Channel 3)

Because dried cassava provide a cheap source of calories, it offers an attractive substitute for the wheat- and maize-based products that currently predominate among Zambia's food, feed and industrial processors. Of these, the market for human consumption currently account for the majority of the dried cassava market, which in turn accounts for about 5% of total production. Farmers, traders and processors prepare dried cassava, then mill it to produce cassava flour for use in a variety of human foods, including toasted snacks, composite flour biscuits, blended nshima and convenience foods such as gari.

Cassava-based processed foods (Channel 3) hold significant long-term potential for market growth, though marketing and product development would likely be slower than with livestock feeds. Blended flour products, such as biscuits, breads, fritters and nshima offer the advantages of access to a large existing milling infrastructure and hence potentially rapid uptake, although they would require some product development and marketing efforts to gain consumer acceptance. Given current wheat consumption and estimating potential substitution at 10%, the rate officially targeted in Nigeria, would yield a market for blended flours requiring about 40,000 tons of fresh cassava per year. Blended maize flour, at a 10% substitution rate, could potentially absorb as much as 200,000 additional tons of fresh cassava. For gari and other cassava-based convenience foods, past efforts by private entrepreneurs suggest that market development will require time as well as resources sufficient to finance investments in marketing, packaging and processing technology. In the medium run, if Zambia were to reach cassava consumption patterns similar to those achieved in West Africa, then gari and other cassava-based convenience foods could ultimately account for as much as 50% of total cassava consumption, or roughly 500,000 tons of fresh cassava per year.

3.4. Cassava-based Animal Feeds (Supply Channel 4)

In Zambia, an array of innovative farmers and feed companies are experimenting with cassava-based feed rations as a means of lowering feed costs, the major cash expenditure in livestock production. Private sector participants in the ACU Task Force collaborated with the Livestock Development Trust in conducting a series of feeding trials with cassava-based feeds (see Chitundu, Droppelmann, and Haggblade Forthcoming). These trials suggests that cassava-based feeds produced comparable weight gains comparable to those achieved with maize-based feeds . in poultry, pigs and in dairy cattle. The associated economic analysis indicated that cassava-based feeds would be profitable where cassava prices were 60% of the price of maize (Simbaya 2007). Following these tests, one of Zambia's major feed companies has begun to buy cassava for use in its feed rations. The company has announced its intention to purchase up to 2,000 tons of cassava. They, and others, believe that significant potential exists to expand this market and to insulate the feed industry from

fluctuating availability and prices of maize, particularly given government import controls imposed during drought years.

Current annual maize use in the livestock feed industry, together with common international feed formulations, suggest that Zambia's feed industry could absorb on the order of 90,000 to 150,000 tons of fresh cassava per year. The upper end of this range would represent a 15% increase in national production and a doubling of currently marketed volumes. Given low barriers to entry, any number of existing feed companies, millers, food processing firms or even individual livestock producers could potentially produce cassava-based livestock feeds. Thus, prospects for broad-based growth appear strong.

3.5. Industrial Starches and Sweeteners (Supply Channel 5)

Industrial uses of cassava derivatives in the manufacture of paper products, wood processing, artificial sweeteners, ethanol and other manufactured goods offer a third potential market for Zambian cassava. Industrial starch production, in Channel 5, has atrophied with the demise of a parastatal cassava starch company in the town of Ndola, on the Zambian Copperbelt, though a variety of private firms have been exploring prospects for cassava-based flour and starch as an input in a range of industrial applications (Mwasi, Chisamanga, and Mapulanga 2004). Currently, a handful of industrial enterprises, primarily on the Copperbelt, use cassava flour in their packaging, paper products and wood processing activities, although volumes currently do not exceed 300 tons of cassava flour, or 1,000 tons of fresh roots, per year.

In land-locked Zambia, where petroleum-based fuels cost in the range of $1.50 per liter, ethanol production from cassava could potentially absorb on the order of 100,000 tons of fresh cassava per year, given current volumes of fuel consumption and assuming a 10% substitution between ethanol and petroleum-based fuels without modification of vehicle carburetion systems (Earth Trends 2003). Cassava-based sweeteners could likewise absorb significant volumes, possibly in the range of 40,000 tons of fresh cassava per year.

Taken together, the ACU Task Forces estimates that commercial potential in channels 2 through 5, could easily sustain a 50% increase in national cassava production in Zambia. Achieving that potential would involve a six-fold increase in marketed volumes. The following section reviews the existing structure of Zambia's cassava markets.

4. COMMERCIAL FLOWS

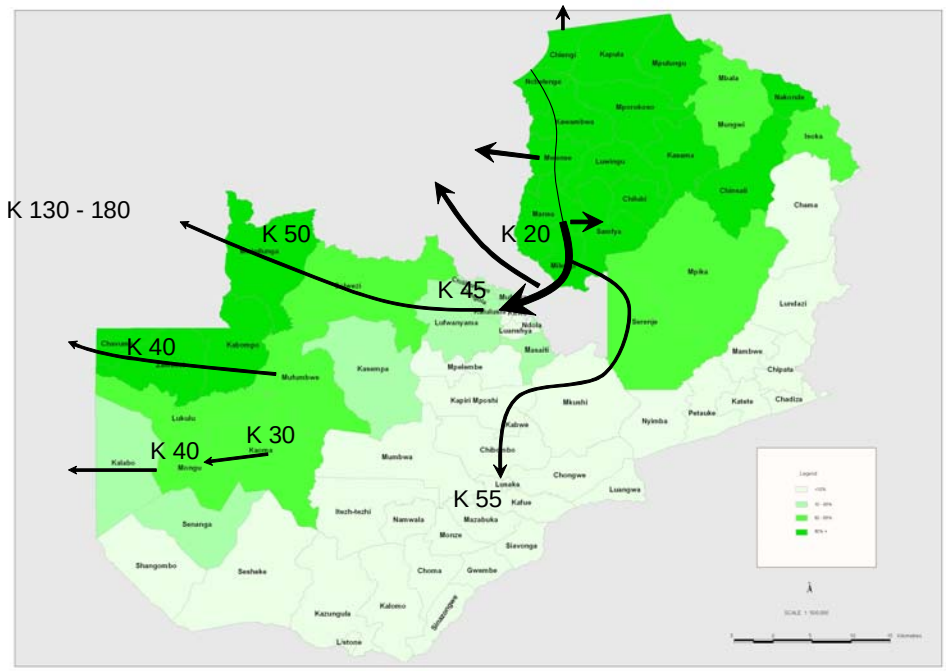
4.1. Structure

4.1.1. Geographic Flows

Trade in dried cassava, which accounts for about 60% of marketed volumes, originates predominantly in the core of Zambia's cassava belt, in Luapula Province. Surpluses there regularly find their way into the Copperbelt, the Democratic of Congo and to a lesser extent south into Lusaka (Figure 5). Significant intra-regional trade also exists given that the fishing communities along the lakes of Luapula and Northern Provinces depend on regular purchases of dried cassava.

Angola has likewise begun importing small volumes of Zambian cassava, primarily via Northwest Province but generally sourced from Luapula. During the early post-conflict years, when this export trade first opened up, Angolan traders purchased most of their supplies in the Copperbelt markets, particularly the Nakadole Market in Kitwe (Figure 6). However, since about 2006, they have begun buying primarily from the Mansa area where prices are far lower. During one market visit in November 2006, we interviewed a trader assembling cassava chips half way between Mansa and Chembe. He had already loaded a 30-ton truck with dried cassava destined for Angola. Under tarpaulins on the ground, easily another 30 tons awaited arrival of a second truck. Despite poor roads on the Angolan side, wide price differentials motivate this spatial arbitrage.

Figure 5. Dried Cassava Trade Flows and Wholesale Market Prices*



* Wholesale market prices listed in '000 Kwacha per 50kg bag.
Source: FSRP market monitoring.

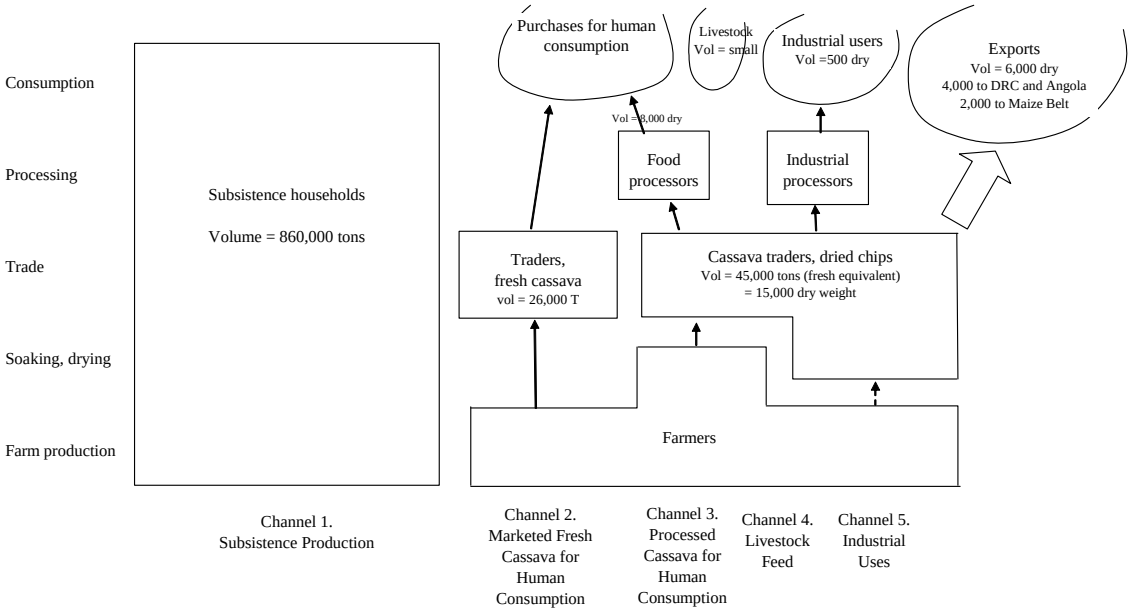
Figure 6. Cassava Wholesale Market, Nakadole Market, Kitwe

4.1.2. Key Actors in the Dried Cassava Supply Channels

The trade in dried cassava originates primarily in Luapula Province, the core of Zambia's cassava belt, where the intensity of cassava production is highest and where prices are consequently lowest (Figure 5). While the overall structure of the cassava marketing channels in this zone resembles the overall national picture, dried cassava production and the export trade assume a larger role here than elsewhere (Figure 7).

Several sets of intermediaries operating in Zambia's cassava zones process cassava and deliver it to final markets. Most important are a network of itinerant traders who purchase cassava directly from farmers. They typically go into a specific village and purchase cassava in the ground directly from farmers. Sometimes they pay cash. They then contract with village labor to harvest, soak, peel and dry the cassava which they then carry to the nearest roadside. Other times, they barter for cassava, paying with used clothing, blankets, bicycles or other household durables. Along the major arteries in the cassava belt, the roadside is dotted with temporary shelters displaying the 50 kg bags ready for sale (Figure 8). The trader then negotiates with truck owners to transport the dried cassava to market, either in the Copperbelt, the Chembe border for sale to Congolese traders, or via Serenje to the Lusaka market. We estimate that these itinerant traders account for about 60% of marketed volumes of dried cassava.

Figure 7. Supply Channels in Zambia's Cassava Belt and Dual Staple Zone



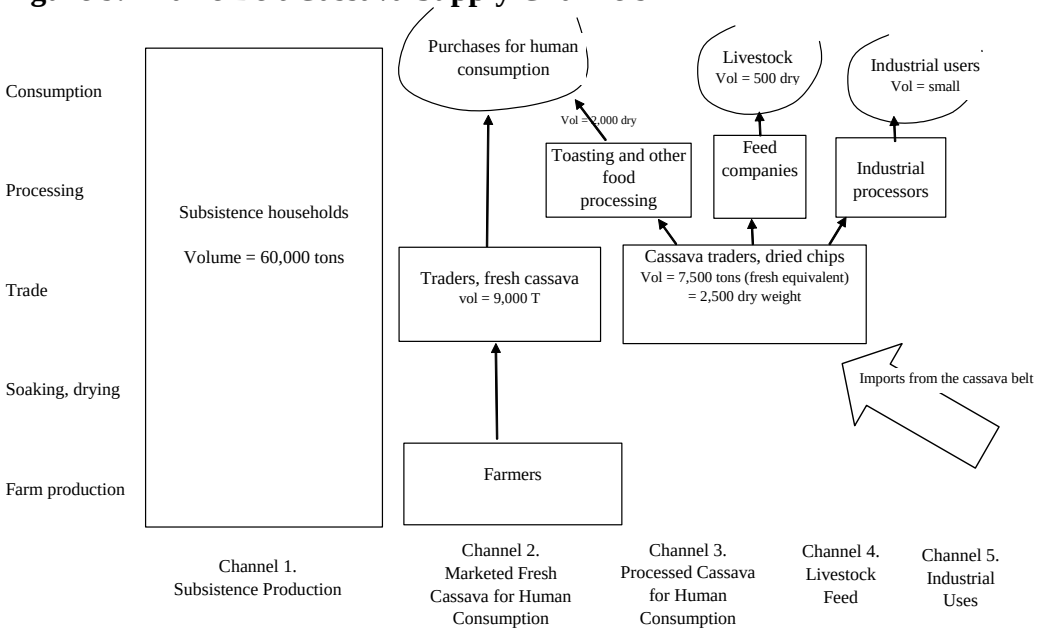
Source: FSRP market surveys and Post Harvest Survey (PHS) surveys.

Some farmers become cassava traders in their own right during the dry season. They prepare cassava for sale by soaking, peeling and drying. Then, they carry it to the roadside where they negotiate with passing transporters for delivery to their intended market (Figure 8). In many cases, the farmer him- or herself will take the cassava to market. In other instances, they will sell it to itinerant traders or commodity traders who pass by looking to fill up a load. Based on our discussions with marketers and traders, we estimate that these cassava farmer-traders account for roughly 30% of the volume of dried cassava traded.

Fixed-establishment traders account for the remaining 10% of the dried cassava traded. Shop owners, commodity traders, and truck owners assemble cassava until they have a full truck load, and then they transport it to market. Unlike the itinerant cassava traders and the farmer-traders, these fixed-establishment traders typically own their own transport. They also are most likely to negotiate sales with large industrial purchasers of cassava flour such as the printing, packaging and plywood factories in the Copperbelt.

Figure 8. Roadside Cassava Awaiting Transport to Market

Figure 9. Maize Belt Cassava Supply Channels



Source: FSRP market surveys and Post Harvest Survey (PHS) surveys.

On the receiving end, maize belt consumers eat a growing volume of dried cassava, primarily toasted and sold as a snack food by marketers and vendors in urban areas. Half a dozen hammer mills have begun milling cassava chips into packaged flour which they sell in outdoor markets and even in large supermarkets, though in small quantities. Alongside these dried cassava products, a growing share of maize belt cassava production has focused on sweet varieties for consumption as a snack food and as a food supplement during the rainy season when both dried cassava and maize become scarce. The result is a maize belt supply chain that presently relies heavily on imported dried cassava from the cassava belt where cassava prices are much lower (Figure 9).

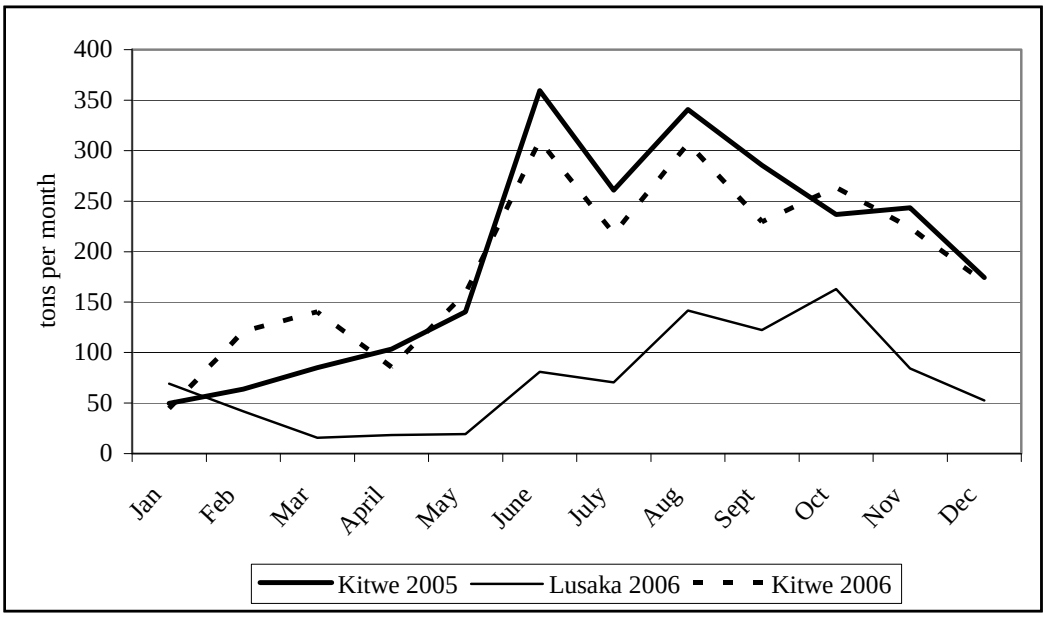
4.2. Seasonality

4.2.1. Seasonality of Quantities Traded

Cassava trade in Zambia is highly seasonal. Although cassava can be harvested year round, the trade follows distinct seasonal patterns. Because farmers and processors depend primarily on sun drying, the dried cassava trade flourishes during the dry season. Two years of data from the cassava wholesale market in Kitwe indicate that seasonal volumes traded more than triple, from 50 to 100 tons per month in the rainy season to about 300 tons per month during the dry season. In the Lusaka market, where dried cassava must transit far longer distances, the same seasonality occurs, although rainy season volumes drop to as low as 20 tons per month during the rainy season while peaking at about 150 tons between August and October (Figure 10).

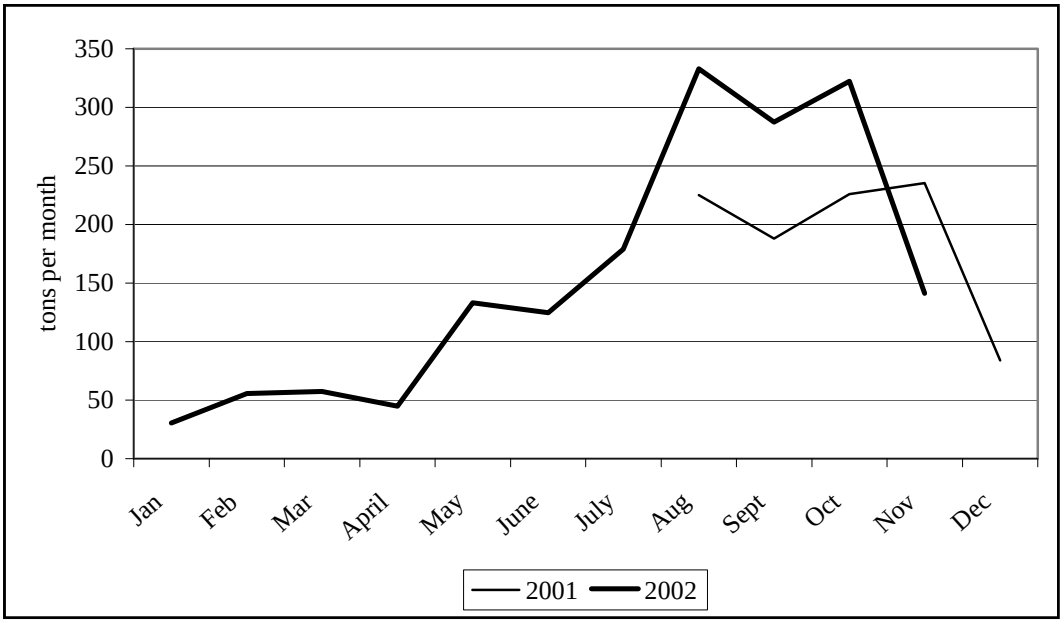
Export data from the hub of the Zambian cassava belt, in Luapula Province, suggest similar seasonal fluctuations. From the main export corridor, along the Mansa-Chembe road, monitoring data suggest a roughly six-fold variation between rainy and dry season volumes of dried cassava chips passing through Chembe, en route for the Copperbelt and the DRC (Figure 11).

Figure 10. Seasonality of Dried Cassava Chips Sold in Urban Markets



Source: FSRP market monitoring.

Figure 11. Export of Cassava Chips via the Chembe Border Station



Source: Root and Tuber Improvement Programme (RTIP) border monitoring.

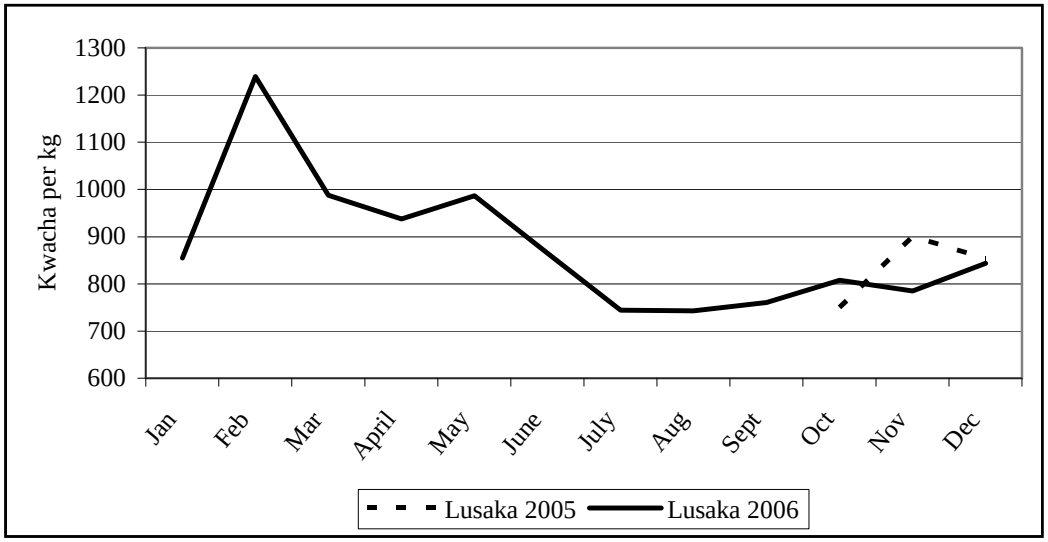
The fresh market also fluctuates seasonally, although unlike the dried market, fresh sales peak in the rainy season and fall off during the dry season. Though quantitative data are not available tracking seasonal quantities of fresh cassava traded in major markets, interviews with market traders suggest that volumes roughly double during the rainy season. This lean season surge in fresh cassava sales occurs because of increasing scarcity of maize, dried cassava and other food staples, which trigger corresponding rise in seasonal prices (Figure 12). Because fresh cassava is the only food staple available for harvest early in the lean season, it plays a critical food security role in buffering consumption shortfalls until green maize, cowpeas and sweet potatoes become available later in the rainy season.

4.2.2. Price Seasonality

Cassava prices follow the same seasonal profile as maize price, peaking in the rainy season, when both dried cassava and maize become scarce, and reaching their lowest level during the dry season when supplies of both staples are abundant. Monitoring data from Lusaka's Soweto market indicate that prices of dried cassava during the 2006 calendar year bottomed out at about 750 Kwacha per kilogram between July and September and rose about 33%, to roughly 1,000 Kwacha per kilo during most of the rainy season, with a sharp spike to 1,200 Kwacha per kilogram in the month of February (Figure 12).

In the fresh cassava market, traders indicate that prices increase by 50% to 100% during the rainy season. Although marketed supplies of fresh cassava supply are most plentiful in this season, sharply diminished availability of other food staples, such as maize and dried cassava, drive prices of all alternative foods higher.

Figure 12. Seasonal Prices of Dried Cassava Chips in Lusaka's Soweto Market



Source: FSRP market monitoring.

4.3. Performance

4.3.1. Market Coordination

The terminal market brokers are the key coordinators of the cassava marketing system. They take delivery of truckloads of shipments brought in by itinerant traders and farmers. They advise on delivery timing and prices, usually by cell phone prior to shipment. Most try to schedule deliveries in order to avoid market shortages and gluts.

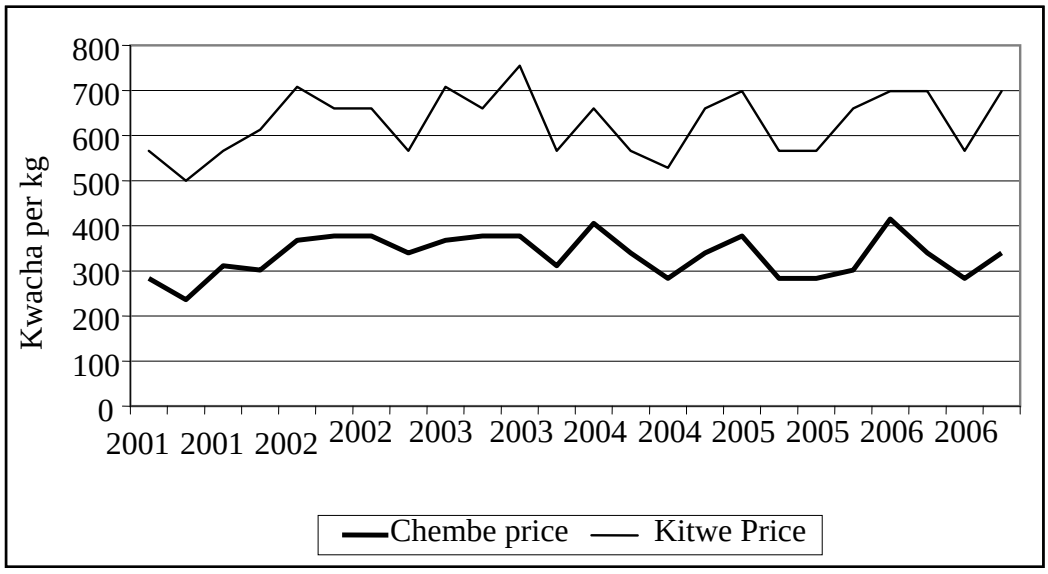
4.3.2. Financing

The wholesale market brokers likewise finance transport into the terminal markets. They charge an offloading and a storage fee to offset the costs of this lending to the farmers and itinerant traders.

4.3.3. Marketing Margins

Marketing margins for dried cassava are larger than for maize, primarily because cassava transits longer distances from the cassava belt to final markets. Figure 13 and Table 4 outline typical wholesale price spreads for a standard 50-kg bag of cassava chips.[3]

Figure 13. Export and Copperbelt Prices of Dried Cassava, 2001 to 2006



Source: MACO Department of Field Services, Mansa South.

[3] Although sold in bags that are 50 kg by volume, cassava chips typically weigh in the range of 53 kg per bag.

Table 4. Marketing Margins for Dried Cassava Chips

	Price for 50 kg bag of dried cassava chips (Kwacha)			
Location	Cassava belt	Dual staple zone	Maize belt	Export
Angola				120,000
Lusaka			55,000	
Kitwe		40,000		
Mansa	15,000 to 20,000			
Farmgate	10,000 to 15,000			

Source: FSRP market monitoring and field visits.

4.3.4. Relative Prices

Prices for dried cassava are lowest in the cassava belt and highest in the maize belt. Maize prices typically move in the opposite direction. As a result, the relative price of cassava to maize is range from 0.5 to 0.6 in the cassava belt to 0.7 in the transition zone to 1.1 or higher in the maize belt (Table 5). This means that substitution of cassava for maize – in composite flours or livestock feeds – is only commercially viable at present in the cassava belt and dual staple zone.

At the retail level, cassava and maize flour generally sell side-by-side in the dual staple zones (Figure 14). This permits price comparison as well as seasonal food substitution by consumers.

Table 5. Relative Cassava and Maize Prices by Food Staple Zone, November 2006

	Product	Prices (Kw/kg)		Relative prices
		cassava	maize	cassava/maize
Cassava-based dual staple zone				
Mansa	flour/mugaiwa	444	889	0.50
Kawambwa	flour/mugaiwa	444	778	0.57
Dual staple zone				
Kasama	chips/grain	469	778	0.60
Serenje	chips/grain	444	667	0.67
Maize belt				
Lusaka	chips/grain	800	700	1.14

Source: FSRP market visits.

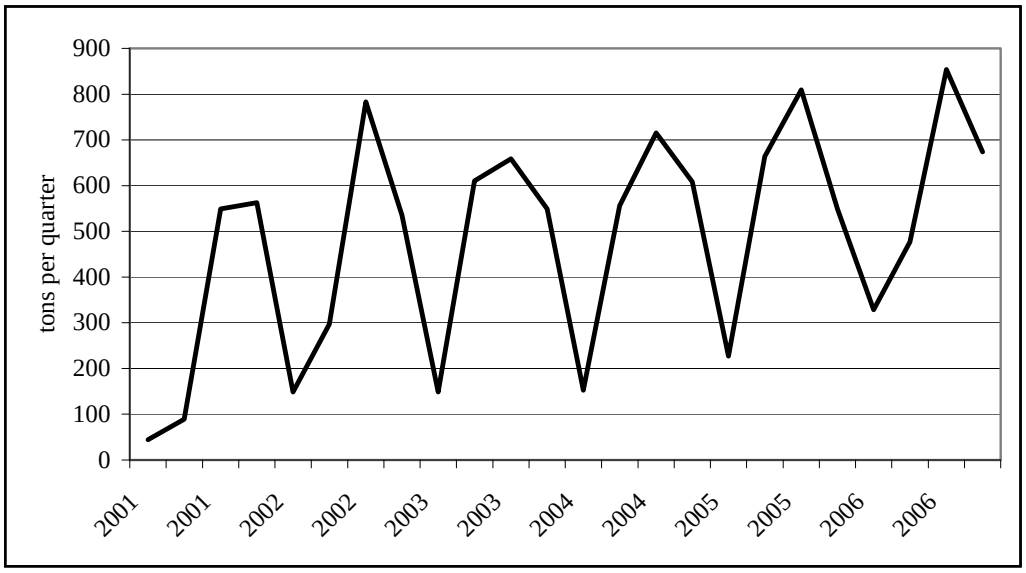
Figure 14. Mugaiwa and Cassava Flour Retailing Side-by-side in the Mansa Market

4.4. Dynamics

During surges in basic food production, marketed volumes typically grow much faster than output. For example, during the Asian green revolution of 1960s and 1970s, traded volumes of staple foods (rice and wheat) grew much faster than production. This rapid increase in marketed volumes occurs because as surplus farm households satisfy their own consumption needs the incremental production becomes available for sale.

Zambia's decade and a half-long surge in cassava production has generated similarly rapid growth in marketed volumes, though from an initial small base. Data tracking dried cassava trade at the Chembe border post indicate dried cassava trade has grown steadily since the Ministry of Agriculture and Cooperatives (MACO) began tracking it in 2001 (Figure 15). While national production has grown by about 25% between 2001 and 2006, at a 6% annual growth rate, dried cassava chips passing through the Chembe border post have increased by over 80%, at a compound annual rate of 13% per year (Table 6). If these data from the principal exporting zone are broadly representative of traded volumes throughout Zambia, then volumes of traded cassava have been increasing roughly twice as fast as production.

Figure 15. Trends in Quarterly Cassava Quantities Exported from Chembe Border Station



Source: MACO Department of Field Services, Mansa South.

Cassava trade has grown most rapidly in the dual staple zone, particularly in Western Zambia. The proportion of households growing cassava has increased by 10% to 15% in these zones, while the proportion of those households who sell some production has doubled (Table 3).

Table 6. Trends in Annual Shipments of Dried Cassava through the Chembe Border Post, 2001 to 2006 (tons)

	2001	2002	2003	2004	2005	2006
Jan - Mar	44	148	148	152	227	329
Apr - June	89	297	610	557	664	477
July - Sept	549	783	658	716	809	854
Oct - Dec	563	535	549	608	549	674
Total	1245	1763	1965	2033	2249	2334

Source: MACO Department of Field Services, Mansa South,
Chembe Border Post monitoring.

5. POLICIES AFFECTING CASSAVA

5.1. Production

Government influences cassava production and marketing primarily through its long-term investments in research. A highly successful 15-year breeding programme by RTIP, from the mid-1980s to the late 1990s, has led to two waves varietal releases, the first in 1993 and the second in 2000 (Table 1). However, following, termination of donor funding for this breeding work, the RTIP has drastically drastically reduced its cassava breeding programme.

Seed multiplication programmes, also supported by donor resources, have atrophied as well. As a result, distribution of the four new varieties released in 2000 has been limited. Given the considerable productivity gains available in these new varieties, and given that three of the four are sweet varieties, whose adoption proves most rapid outside the cassava belt, this genetic pool represents a significant but currently underutilized resource.

Price intervention is a tool the Zambian government has historically used to promote maize production. Indeed, it was the dismantling of these maize price subsidies, in the early 1990s, that triggered the substantial crop diversification efforts by farmers seeking recourse in more profitable unsubsidized alternative crops. A recent surge of activity by the Food Reserve Agency (FRA), since 2005, has once again raised government's profile in maize markets. And in recent seasons, the FRA bought cassava, as well, at a price of 500 Kwacha per kilogram, well above the market price of 15,000 to 20,000 per 50 kg bag (equivalent to 283 to 377 Kwacha/kilogram). During the 2006 season, because the FRA offered a price 30% to 50% higher than the prevailing market price (Table 7), they were able to procure their entire 2,400 ton quota in less than two weeks.

Though beneficial to the farmers in the cassava belt who received this price subsidy, the above-market FRA cassava price risks stalling commercial market development of cassava. Indeed, potential users of cassava-based carbohydrates in the food, feed and starch processing industries indicate that commercial growth in cassava will depend on lower cassava prices, not higher ones. While productivity gains from new varieties and improved management practices promise to accelerate the commercial viability of cassava processing, the institution of above-market prices will tend to lower farmer incentives to raise production efficiency and, therefore, risks pricing cassava out of contention in the feed and industrial markets.

Table 7. Food Reserve Agency Cassava Purchases

	2004	2005	2006
Purchases (tons)	570	2550	2400
FRA price (Kw/kg)	700	500	500

Source: FRA.

5.2. Trade

Trade in cassava remains largely informal and private. Even with the recent FRA foray into cassava procurement, marketed volumes remain predominantly in private sector hands.

District levies on the movement of agricultural goods do, however, influence cassava prices. Though they vary by district, cassava levies in most cases are the same as for maize. Chembe district, for examples, imposes an export levy of 2,000 Kwacha per 50 kg bag, or about 40 Kwacha per kilogram, and they impose the same rate per bag of maize. Since maize is a higher-value crop, this amounts to a higher rate of taxation on cassava. Though this higher levy rate contributes to the higher margins observed in cassava marketing, the bulk of the higher cassava marketing costs stem from longer distances traveled and hence higher transport costs involved in getting cassava from the surplus zones in the cassava belt to the major markets in the Copperbelt, the DRC and Lusaka.

6. OPPORTUNITIES FOR CASSAVA-LED COMMERCIAL GROWTH

6.1. Opportunities

Cassava markets in Zambia hold significant potential for growth. In the cassava belt, the largest markets will likely be for cassava-based convenience foods such as gari and cassava-based maheu and potentially for cassava-based ethanol production. In the maize belt, the largest potential markets include the livestock feed industry, the fresh market for human consumption (which is particularly attractive during the lean season when no other food staples can be harvested), the market for composite flours, and industrial uses as food sweetener. All together, prospective markets could accommodate an approximate doubling of national cassava production, a growth that represents a six-fold increase marketed volumes (Chitundu, Droppelmann, and Haggblade Forthcoming).

6.2. Constraints

6.2.1. Price

Low cost will be key to the viability of cassava as a carbohydrate source in prepared food, livestock feeds and industrial sweeteners and starches. Hence, rapid growth in cassava commercialization will require a lower price, not a higher one. Feeding trials conducted by the Livestock Development Trust (LDT) suggest that the cassava price must fall to 60% of the price of maize in order for cassava to become a viable substitute for maize in production of livestock feed (Simbaya 2007). Similarly, the market for composite flour hinges on the cassava price being lower than that of maize or wheat. Otherwise, substitution of cassava for wheat and maize becomes unviable, raising consumer cost rather than lowering it. Indeed, the FRA's difficulty in disposing of its high-cost cassava stocks over the past three years suggests that high-priced cassava offers a sure means of preventing cassava commercialization.

Given the far higher onfarm productivity of cassava compared to maize, production cost and hence price of cassava can easily be brought lower than maize. In the cassava belt, cassava prices currently range between 50% to 60% of the price of maize. In the dual staple zone, cassava's relative cost lies closer to 70%. And in the maize belt, the cassava price is normally higher than maize price because of the long distances cassava must transit from the cassava belt to the feed and food industries of central and southern Zambia. Given the high cost of transport in Zambia, it seems that increased cassava production in the maize belt offers the best likelihood of making low-cost cassava available in that zone. Given the confirmed high productivity of cassava in central Zambia, it is clearly possible to produce low-cost cassava in this region (Barratt et al. 2006).

6.2.2. Product Development, Packaging, and Processing Technology

In the cassava belt, product development will be critical to the establishment of prepared foods that promise the greatest potential for cassava-based commercial development. In West Africa, where cassava commercialization began several decades earlier than in southern Africa, small-scale food processing industries transform over half of all cassava production into prepared consumer foods such as gari (a pre-cooked instant cereal) and atteki. But in Zambia, no systematic effort has yet been made by food technology specialists to develop

cassava-based food and industrial products for the local market. Given an acute shortage of bank lending for such experimentation, few entrepreneurs have been able to accumulate the funds necessary for this type of initial product development. Given that new product development by a single private enterprise risks widespread imitation by prospective competitors, few entrepreneurs have been willing to invest the necessary private funds to develop new cassava-based products. For this reason, new product development retains the character of a public good which may require short-term public support for product development and innovation. The full CATISA project aims to fill this important void by expanding its initial work on food safety and commercial processing.

6.2.3. Standards

The recent development of formal standards for cassava chips and flour by the Zambian Bureau of Standards together with the ACU Task Force offers food and feed industries legal protection from food and feed safety litigation. The advent of these new legal standards means that food safety concerns will no longer constrain commercial expansion of cassava-based products.

6.3. Prospects for Regional Cross-fertilization

Zambia has already benefited in an important way from cross-country sharing of cassava technology. Section 3.2. above has described how private sector farmers and traders brought in the preferred Malawian sweet cassava variety of Manyokola and together established the market for fresh cassava in Lusaka's Soweto market over the past five years. Other possibilities also exist for learning from private sector colleagues in the region.

Malawi, unlike Zambia, currently operates a cassava-based starch plant. Their baking industry has also, apparently, begun use of composite flours more rapidly and more extensively than in Zambia (Kawembwa and Nyembe 2007). In both instances, the regional private sector technology exchanges envisaged under CATISA could help to accelerate development of similar commercial markets in Zambia.

Mozambique, unlike Zambia, has established markets for several cassava-based products, including deep fried cassava chips and prepacked cassava cheese bread, using technology imported from Brazil. Here, too, Zambian business community would benefit from technical exchange with food processing plant managers from Mozambique.

Conversely, Zambia appears to have advanced furthest in developing cassava-based livestock feeds. On this score, Zambian processors can offer information of value to their colleagues elsewhere in the region.

Over fifty years ago, access to prototype cassava graters from Benin inspired tinkering and adaptation by Nigerian metal workers and ultimately launched the gari industry in Nigeria, which now processes roughly half of national cassava production (Nweke et al. 2002). In the same way that cassava-processing methods spread across West Africa, Zambia and its regional neighbors in southern Africa can likewise benefit from learning more about alternative cassava commercialization technologies in order to facilitate and accelerate cassava commercialization in the region.

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