

Evans School Policy Analysis and Research (EPAR)

Cassava Integrated Value Chain: Global Analysis

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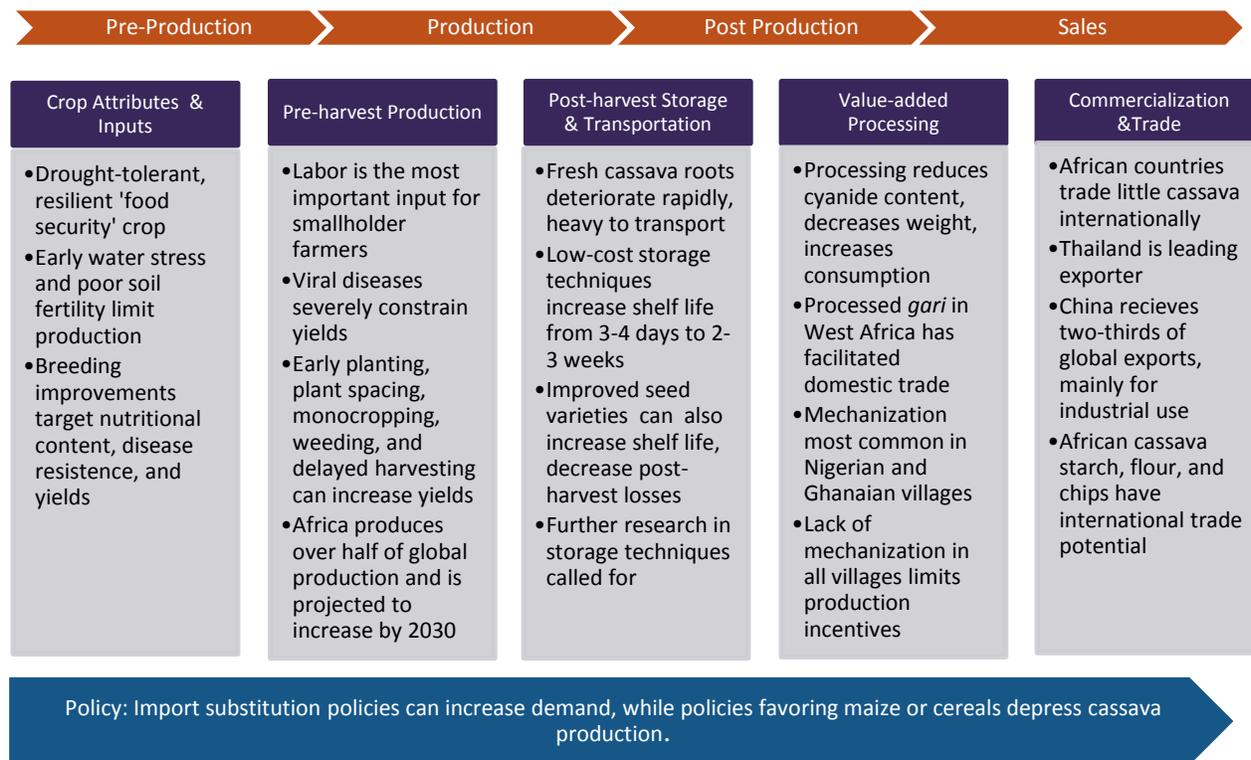
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Cassava is a tuber crop originating in South America and grown in tropical and subtropical areas throughout the world. Cassava use varies significantly by region. In Africa, cassava is primarily grown for food. In Asia, production is typically for industrial purposes, including ethanol, while in Latin America and the Caribbean it is commonly used in animal feed. Both roots and leaves are consumed, though most information on production focuses on roots. There are bitter and sweet varieties; bitter cassava has a high cyanide content and must be processed prior to consumption, while sweet varieties can be eaten directly.

This report presents information about current production, constraints, and future potential of cassava. We discuss cassava’s importance in Africa, current worldwide production, projections for supply and demand, production constraints, and current policies affecting cassava production and trade. We include global information but focus on Africa, particularly Nigeria, Ghana, Uganda, and Tanzania. *Figure 1* highlights some of our cassava integrated value chain findings.

Figure 1: Highlights of the cassava value chain



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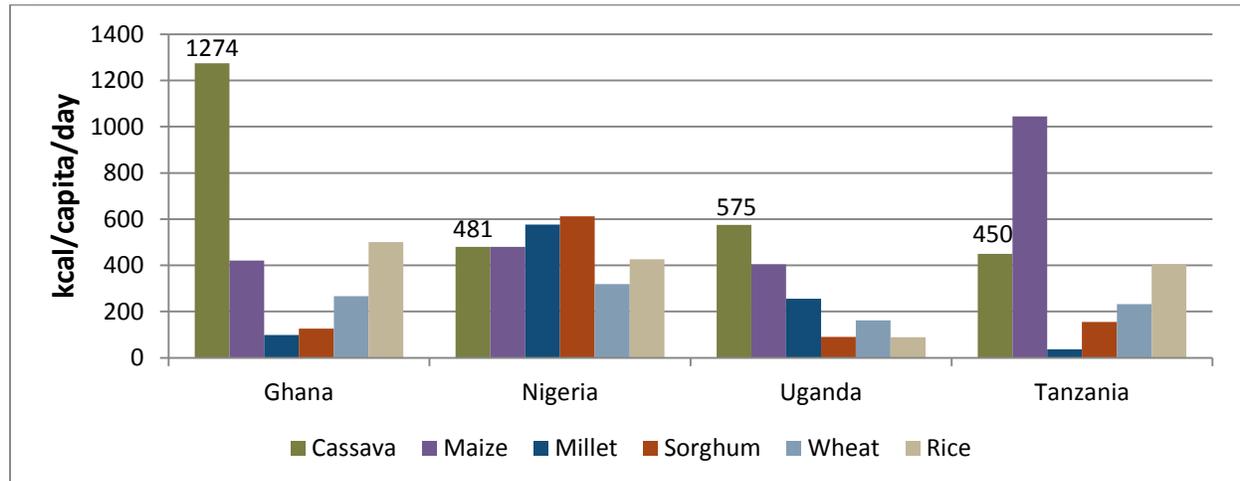
Data note: Assessment of cassava production in Africa is challenging because it is primarily grown under subsistence conditions, has an irregular harvesting pattern, and estimates on yield and production vary (FAO, 2012; Minot, 2010). Yield estimates obtained from a sample of major cassava producing areas (COSCA) were consistently higher than FAO estimates based on the national agricultural census (Nweke et al., 2004). Production estimates from FAOSTAT and FAO Trade and Markets Division differ slightly for the years they both report (2009, 2010).

Cassava’s Importance in Africa

According to FAOSTAT data, cassava is the most important crop in Africa by both production weight and value, and it provides a similar source of calories as rice. Its drought-tolerance, resilience on marginal agricultural land, and ability to be stored in the ground up to three years make it an important food security crop for smallholder farmers (FAO, 2000; Sayre, 2011). Cassava is a staple and also a famine reserve crop and can be an important food source when drought and conflict prevent production of other food crops (Burns et al., 2010).

An estimated 40% of Africans rely on the crop as a significant source of calories (Nweke et al., 2004). *Figure 2* compares kilocalories per capita of major staple crops in four countries.

Figure 2: Major Food Crops kcals per capita 2007-2009



Source: FAOSTAT Crops Primary Equivalent

Nweke (IFAD & FAO 2005, 2002) identified cassava’s changing role in Africa. Traditionally, smallholder farmers produced cassava largely for home consumption. Over the past 30 to 50 years, particularly in Nigeria and Ghana, cassava cultivation as a cash crop has increased. High-yielding varieties and labor-saving technologies have reduced the cost of producing and processing cassava products, making them competitive with other grain products. Further gains in these areas can facilitate increased growth in the cassava sector, especially as processed and exported products.

Cassava is a source of income for many cassava-producing households in Africa. The 1992 Collaborative Study on Cassava in Africa (COSCA), a comprehensive study of cassava production and utilization in Africa, found that cash income from cassava production accounted for 13% of cassava-producing household income in Ghana; 12% in Nigeria; 6% in Uganda, and 4% in Tanzania (Nweke, 2002).

Specific studies have also quantified the economic importance of cassava to smallholder farmers. Fermont et al. (2010) identified cassava as the most important staple food in 67% of the poorer households surveyed in western Kenya, with food self-sufficiency directly related to the amount of cassava cultivated. Cassava also contributed more than any other single crop to household income, with 63% of households in central and eastern Uganda and

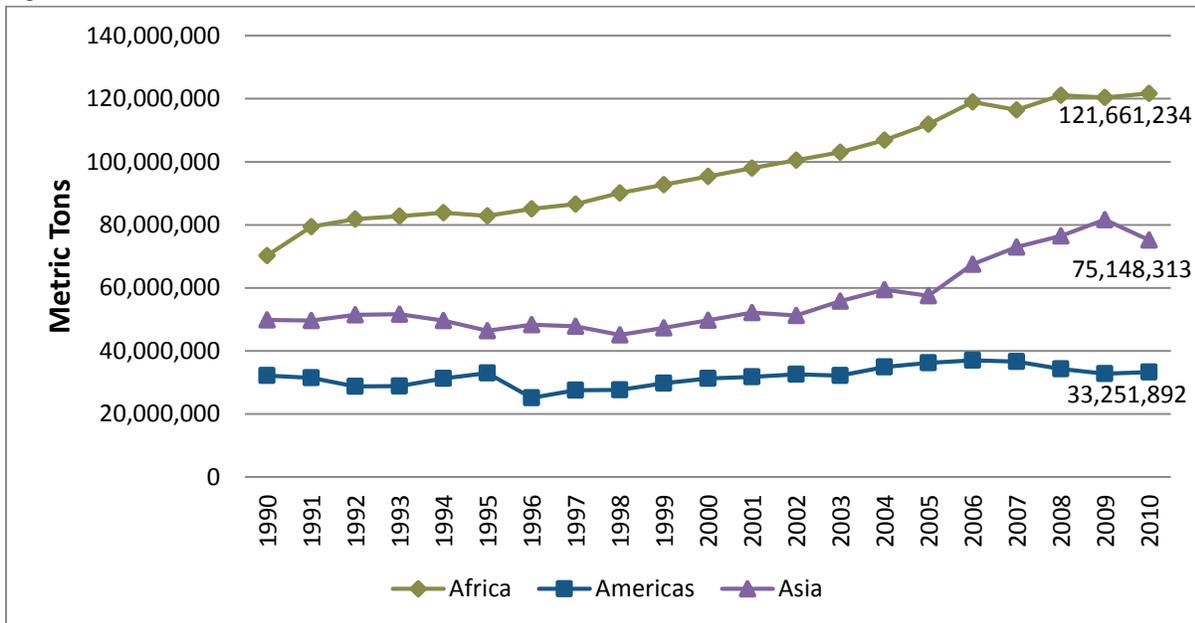
western Kenya selling cassava products to generate an average income of \$84 per household per year (Fermont et al., 2010).

Cassava Supply and Demand

Historical Global and African Production and Short Term Forecasts

Figure 3 shows the quantity of cassava produced over the last two decades. Africa produced 121.7 million metric tons (MT) in 2010, accounting for 52.9% of global production, followed by Asia at 32.6% and the Americas at 14.5% (FAOSTAT).

Figure 3: Cassava Production 1990-2010



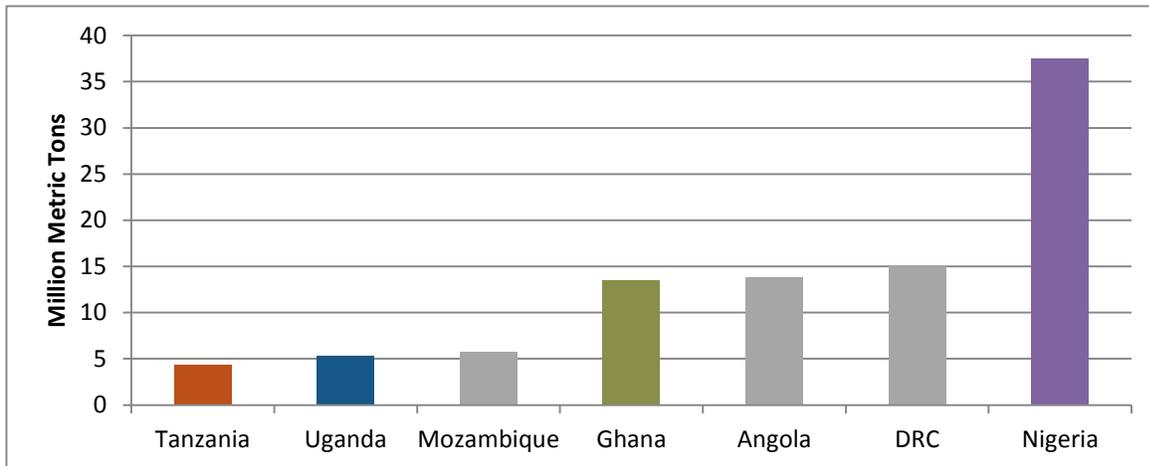
Source: FAOSTAT

Between 2008 and 2010, annual worldwide production averaged 232 million MT per year (FAOSTAT). As shown in

Figure 3, production has flattened in Latin America but continues to grow in Africa and Asia. FAO’s Trade and Market Division estimates continued growth with 2012 worldwide production forecast to increase 7% from 2011 to 281.7 million MT (FAO, 2012).

Nigeria is Africa’s largest producer of cassava harvesting an average of 40 million MT annually between 2008 and 2010, followed by the Democratic Republic of Congo, Angola, and Ghana (see Figure 4).

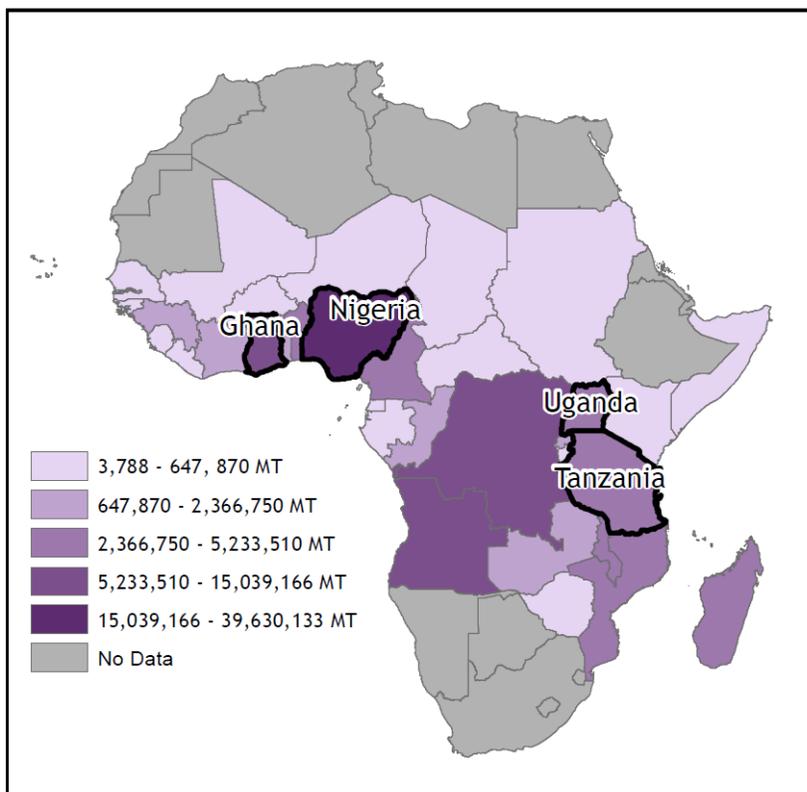
Figure 4: Production for Major African Cassava-producing Nations, 2010



Source: FAOSTAT

However, Cassava production is spread throughout the continent, with thirty-seven African countries producing substantial quantities of cassava (see Figure 5) (FAOSTAT).

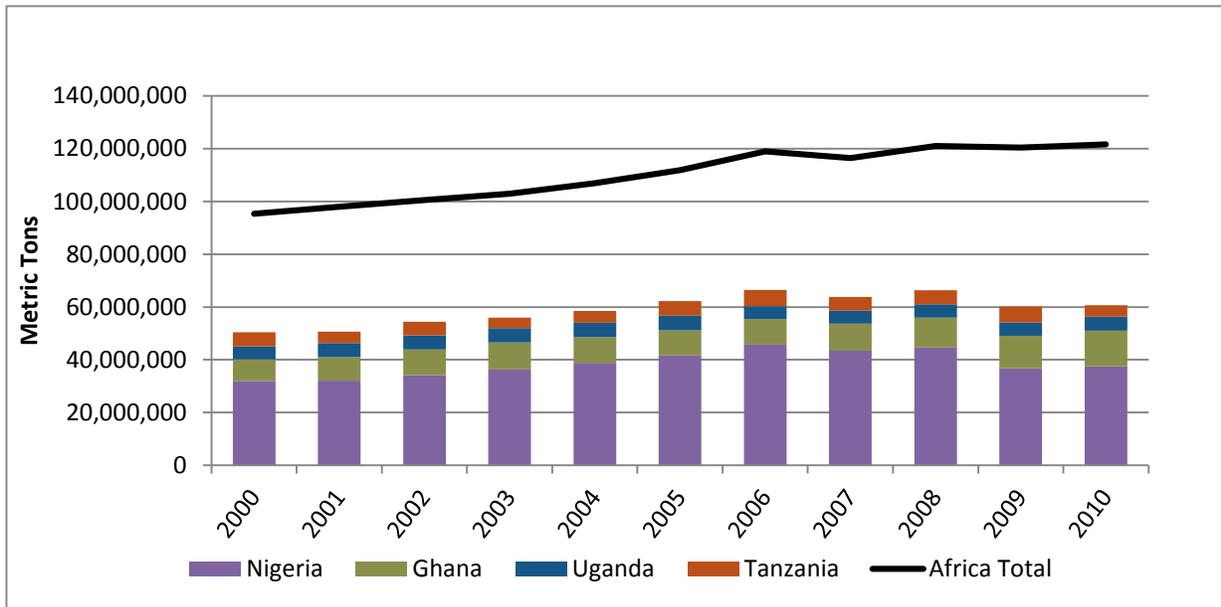
Figure 5: Cassava production (average annual production 2008-2010)



Source: FAOSTAT

Figure 6 shows production in Nigeria, Ghana, Uganda, and Tanzania relative to the total for Africa from 2000 to 2010.

Figure 6: Africa Cassava Production 2000-2010



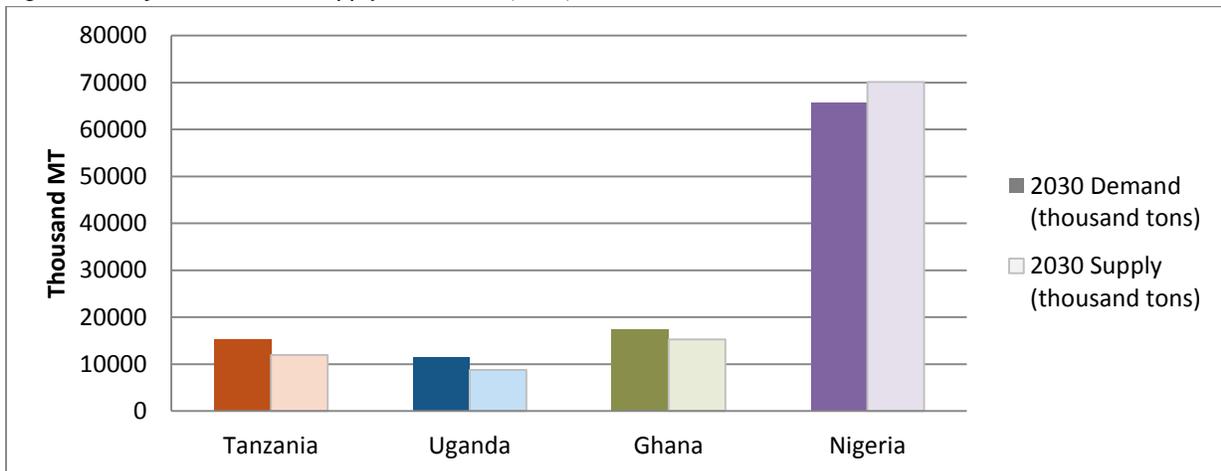
Source: FAOSTAT

While cassava production declined in some countries in 2009 and 2010, FAO Trade and Markets Division predicts increases in production in 2012 in Ghana, Nigeria, and Tanzania, with a possible decline in production in Uganda due to cassava mosaic virus. From 2009 to 2012, Africa is forecast to increase production by an average of 7.6% annually (FAO, 2012).

Longer Term Projections Estimate Growth in Supply and Demand

As shown in *Figure 7*, the Harvest Choice model generally predicts excess demand in 2030.

Figure 7: Projected Cassava Supply & Demand (2030)



Source: FAOSTAT

IFPRI identified cassava as one of the most important crop sub-sectors whose incremental growth will result in the greatest gains in GDP in East and Central Africa by 2015 (Omamo et al., 2006). Omamo et al. (2006) estimated the cassava supply and demand in 2015 in East and Central Africa using a model that accounted for increased

investment in R&D and spillover effects. According to their model, regional supply will still fall short of demand by 72,000 MT.

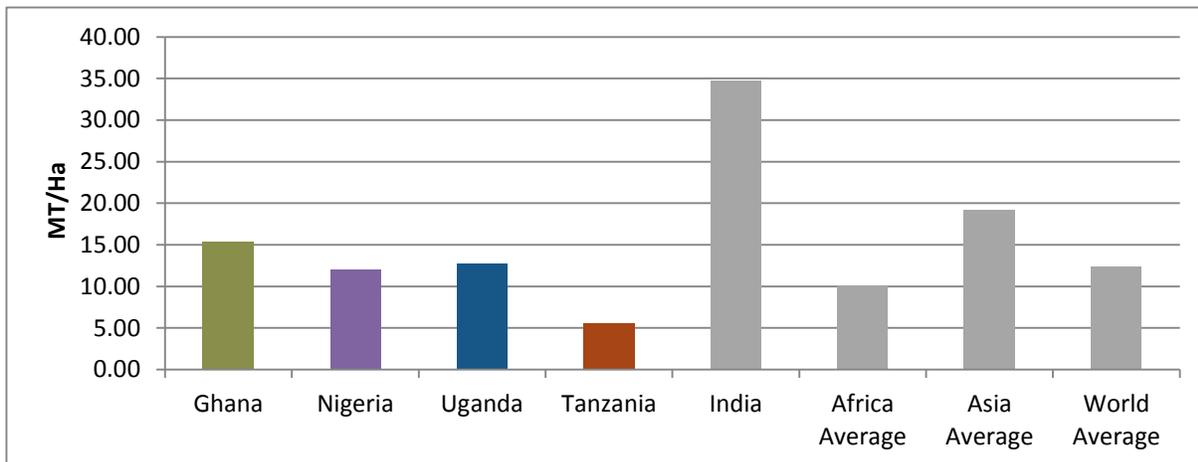
Johnson et al. (2006) estimated the spillover benefits to smallholder farmers in Ghana and Ivory Coast from new cassava varieties in Nigeria. Revenue gains from increased production of improved varieties range from 18% in the humid region of Ghana to 48% in the humid region of the Ivory Coast. With freely available mechanized graters, these gains increase in these humid regions to 48% in Ghana and 85% in the Ivory Coast.

Future growth in global demand is expected to be driven by non-perishable, value-added food and industrial products. As evidenced recently in China, demand for biofuels could also be a future growth market for cassava (Prakash, n.d.; FAO, 2012). Growing industrial demand in Asia could raise prices and lead to an increase in supply.

Cassava Yield Gap Analysis

Various factors are believed to contribute to the yield gap for cassava in Africa. Threatening viral diseases, significant post-harvest losses, and lack of widespread mechanization all impact the cassava integrated value chain. As seen in *Figure 8*, yield estimates in Ghana, Nigeria, and Uganda are above average on the African continent. However, these four countries are lagging behind the average yield in Asia, and are less than half the yield estimated for India, the highest performer in 2010. Yields in Tanzania are less than half those in the other three countries and have declined from 13.2 MT/ha in 1990 to 5.8 MT/ha in 2010 (FAOSTAT).

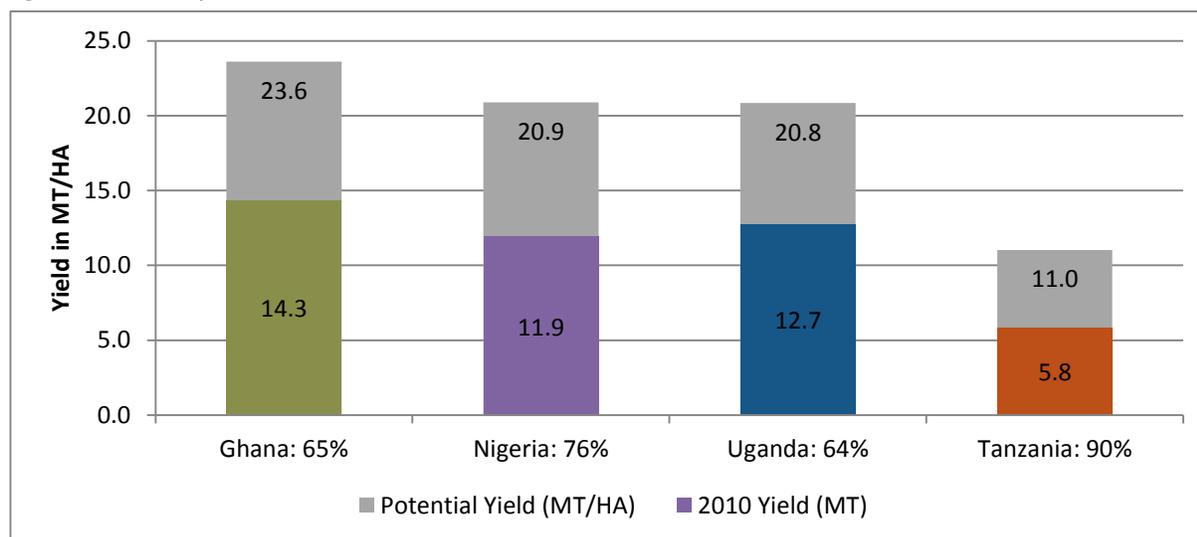
Figure 8: Yield Estimate Comparison, 2010



Source: FAOSTAT

Fermont (2009) estimates yields in East Africa can reach 20 MT/ha with existing technologies and improved farm management. Yield potential in a well-controlled research or commercial setting with irrigation and fertilization is 45 MT/ha or higher (Joseph et al., 1990; Tian et al., 2009). *Figure 9* below shows the yield gap in 2010 for Ghana, Nigeria, and Uganda.

Figure 9: Yield Gap 2010



Source: FAOSTAT and Chris Gingrich¹

Production

While cassava grows well on marginal land and is generally considered a resilient, low-input crop, various biotic and abiotic constraints can impede its optimal production. Viral disease, lack of access to improved seed and inputs, weed competition, and high labor requirements all constrain production and impact yield. Fermont et al. (2009) found that cassava plots produced higher yields in central and eastern Uganda and western Kenya if farmers planted with improved genotypes, hired more labor, weeded more often, and harvested their plots later in the season, perhaps suggesting increased yield potential with continued improvements in germplasm and cropping practices.

Viral diseases are the most severe biotic factor limiting cassava production

Viral diseases are estimated to represent the single most severe biotic limitation to cassava production in Sub-Saharan Africa, particularly in East Africa, among which cassava brown streak disease (CBSD) and cassava mosaic disease (CMD) are the most important (Patil & Fauquet, 2009). Both diseases are transmitted by whitefly vectors (Fargette et al., 1993; Maruthi et al., 2004; Mware et al., 2009).

In East Africa, CMD is caused primarily by single or dual infections of the single stranded DNA (ssDNA) geminiviruses, African cassava mosaic virus (ACMV) and East African cassava mosaic virus (EACMV). CMD has been a major constraint to cassava production in Africa since the 1930s (Legg and Thresh, 2000). In the 1990s, a devastating pandemic occurred in the region, originating in Uganda, and progressed through East and Central Africa (Legg & Fauquet, 2004). CMD continues to threaten cassava production in the Lake Victoria region, reducing yields up to 80-90% (Vurro et al., 2010). Each year it is estimated that at least 30% of the cassava harvest in Sub-Saharan Africa is lost to CMD, an amount equal to \$1.25 billion worth of production (Legg et al., 2006). In the February 12, 2010 issue of *Science* magazine article entitled 'Armed and Dangerous', CBSD was listed as one of the seven most dangerous plant diseases in the world for the impact it can have on food and economic security throughout Africa (Pennisi, 2010).

¹ Calculations were provided in strategy template emailed to EPAR by Lawrence Kent on 11-19-12. According to FAOSTAT, Tanzania had yields higher than 11MT/ha in the past.

The damage caused by these and other diseases is further exacerbated by the logistical challenge of large-scale production and distribution of clean planting material, the lack of institutional systems to ensure that only clean planting material is disseminated, and the difficulty of changing farmer attitudes and practices (Legg et al, 2011; Thresh & Cooter, 2005).

West African countries are making efforts to prevent the entrance of CMD and CBSD into their national cropping systems. Nweke (2009) pointed to Nigeria as an example of using collaborative and aggressive research, especially through the International Institute for Tropical Agriculture (IITA), to develop and promote the use of CMD-resistant varieties to prevent the entrance of CMD into the country.

Improved breeding and seed systems could improve yields

Because cassava planting material is bulky, farmers are less likely to purchase it from a formal-sector seed company than they are to purchase other crop seeds. The transportation costs involved in moving cassava planting material from a central producer to distributors are high relative to its base cost, hence, cassava planting material is multiplied more often at the farm level rather than in the formal sector (Minot et al., 2007).

Genetic diversity is typically low within a given region because smallholder farmers cultivate cassava through plant cuttings, making crops vulnerable to pests and disease (Nassar & Ortiz, 2010). Improved varieties of cassava can increase the crop's resistance to disease, pests and environmental constraints. Crop yields have increased by up to 40% as a result of breeding high-yield varieties (Nassar & Ortiz, 2006). CIAT released improved in Asia that are believed to be the main drivers of Asia's cassava yield increases over the past 30 years (Kawano, 2011). Breeding for traits such as ratio of root weight to total plant weight, drought tolerance, adaptation to poor, acidic soil, and disease resistance achieved yield improvement.

Varietal selection can also be used to select for low cyanide content. Mariscal et al. (2000) discuss that, in the Philippines, farmers who use cassava as a staple food may select low cyanide content varieties, whereas starch millers prefer higher cyanide content varieties because they tend to produce higher yields, have higher starch content, and discourage crop theft.

While improved varieties offer multiple benefits, they also create the potential for faster spread of disease if the central distribution systems inadvertently distribute infected stems (FAO, 2012).

While drought-tolerant, cassava yields and quality are affected by water stress

Cassava is known as a drought-tolerant crop; it can survive under water stress conditions. Still, root development is affected by water stress (Sriroth et al., 2001). Starch content is correlated with the amount of rainfall in the four weeks prior to planting and the soil water content during growth. Mature plants are more capable of adapting to water stress than new plants. When mature plants recover from water stress they utilize reserve starch, which results in a net effect of lower starch quantity and quality. This suggests that cassava's potential as a value-add product in drought-prone areas may be limited. Furthermore, roots harvested during periods of drought contain a higher concentration of cyanide than roots harvested after normal rainfall (Sriroth et al., 2001).

Weed competition constrains production

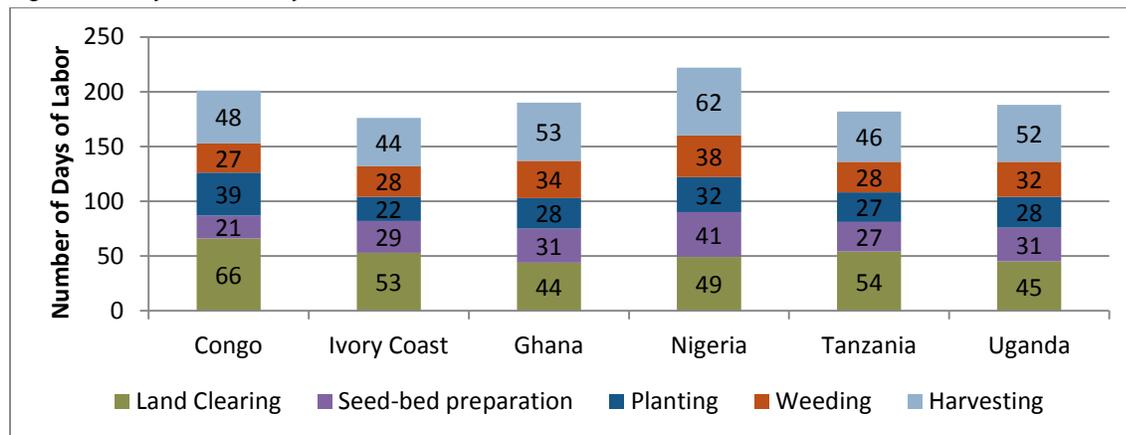
Weeding is a major labor requirements for cassava production and weed competition is a major constraint to yields (Fermont et al, 2010). Uncontrolled weed growth can result in almost total yield loss (Chew et al., 2012). Herbicides can be a cost effective alternative to hand weeding cassava (Chew et al., 2012). However, Ginanessi & Williams (2011) found only 5% of smallholder farmers in Africa use herbicide on any crop. Larger farms and smallholder farmers in West Africa report more herbicide use than smallholder farmers in East Africa (Chew et al., 2012).

Labor constraints affect productivity, yields

Labor is a key constraint to production, particularly for harvesting and processing (Anderson et al, 2009). In their study of the cassava value chain in the Niger Delta, Daniels et al. (2011) found labor to be the most expensive input, accounting for 70% of total production costs. The COSCA study found that 77% of Nigerian cassava fields used hired labor from outside the household, compared to 71% in Ghana, 63% in Uganda, and 22% in Tanzania (Nweke et al., 2002). Fermont et al. (2010) also found labor to be a costly input in their study of cassava production in Uganda and Kenya, debunking the common conception of cassava as a low-input crop.

Figure 10 illustrates the days of labor of each task involved in cassava production for six African countries. On large-scale farms, harvesting labor is limited due to labor requirements for harvesting higher yielding varieties. Harvesting labor is less of a constraint on smallholder farms where harvest can be delayed until labor is available. Weeding is a more important constraint on smallholder farms, as delaying this activity can result in significant yield losses (Chew et al., 2012).

Figure 10: Days of Labor by Task



Source: COSCA

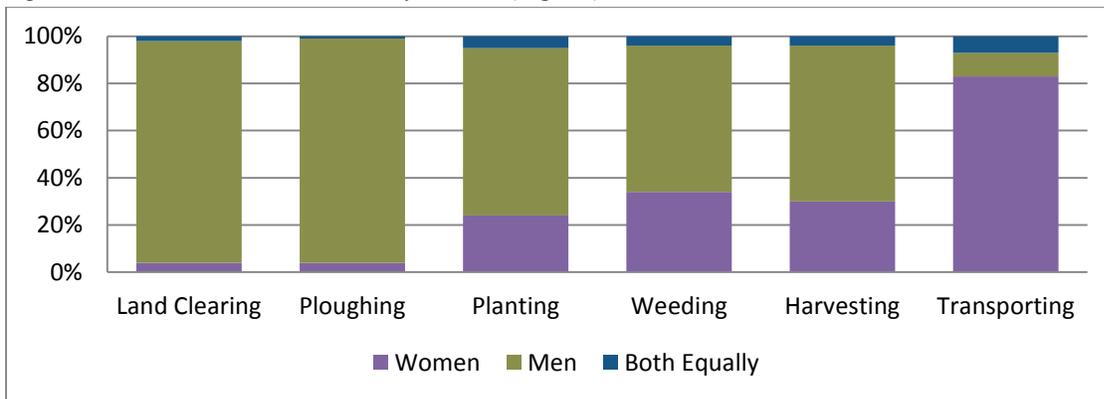
Access to and use of inputs is limited

The COSCA study found less than 10% of cassava fields used inorganic fertilizer, and those that did were primarily in Nigeria and Ghana (Nweke, 1996). Non-labor inputs were undersupplied to cassava farmers in a study in the Niger Delta (Daniels et al., 2011). Reasons for the undersupply included uncoordinated improved variety distribution networks, limited private sector involvement in fertilizer supply, and high distribution costs to remote farmers. When inputs were available, their high cost was a barrier for smallholder farmers. Little research has documented cassava’s response to fertilizer (Fermont et al., 2008).

Labor for cassava production is frequently divided along gender lines

The COSCA studies suggest that the common conception of cassava as a women’s crop is not entirely true (Nweke et al., 2001). Female cassava plot ownership ranged from 4% in the Congo to 24% in Ivory Coast. Men and women made important and specialized contributions in the cassava production process. Men often specialized in land clearing, ploughing, and planting, and women performed the weeding, harvesting, transporting, and processing. Mechanization and increased processing altered these gender roles; women shifted their labor to production tasks like weeding, while men took over the processing aspects. Labor-reducing technologies were generally male owned and men accrued most of the economic benefits (Anderson et al., 2009). Similarly, as cassava transforms into a cash crop, men’s labor increased in proportion to women’s. Figure 11 demonstrates the gendered division of labor for cassava production in Nigeria. In Uganda and Tanzania, tasks are more often shared equally by men and women than in Ghana and Nigeria (Nweke et al., 2002).

Figure 11: Bulk of Labor Performed by Gender (Nigeria)



Source: COSCA

Post-Harvest

Cassava's nutritional drawbacks can be mitigated by post-harvest processing

While cassava is a major source of calories, a cassava based diet is low in protein, iron, zinc, and vitamin A. Cassava roots and leaves also contain high levels of cyanogenic glycosides, which can be harmful to human health if cassava is improperly processed (Sayre, et al., 2011). Traditional processing techniques, namely soaking, pounding, and grating and squeezing the root, are effective ways to remove the cyanide content and make the root safe for human consumption (IFAD, 2005). Similarly, cassava leaves may be boiled, pounded, and cooked to bring cyanide content down to safe levels.

Post-harvest losses are significant and increase market risk

The rapid post-harvest physiological deterioration (PPD) of cassava within 3-4 days causes substantial quantitative and qualitative post-harvest losses (Wenham, 1995). Significant amounts of the roots are damaged or rot in transportation to markets or to processing facilities, which prevents utilization and marketing of the fresh roots and value-added products. Post-harvest management techniques such as packing in moist media, freezing, waxing, and canning exist, but many techniques have not been commercially viable or desired by consumers (Wenham, 1995).

A study in Ghana found that early application of fungicide treatment to the roots in plastic bag storage can increase shelf life from 3-5 days to 2-3 weeks, and that water treatment alone in storage bags can increase storage potential to seven days (Bancroft and Crentsil, 1995). A study on the commercialization of the value-added cassava product, *fufu*, suggests that addressing the perishability of cassava through improved storage techniques is a key obstacle to the successful commercialization of this cassava product in Nigeria and calls for greater research toward this aim (Sanni et al., 1999).

Value-added processing increases commercial potential

Post-harvest processing of cassava into value-added products can greatly impact its commercial viability. Processing removes naturally-occurring toxins, reduces the product's weight for transport, decreases post-harvest losses resulting from root breakage, and extends shelf life (FAO & IFAD, 2000). In West Africa, it is estimated that over half of all cassava is consumed in a fermented and roasted form called *gari*, which is popular in both rural and urban households (Phillips et al., 2004). The extended shelf-life of *gari* has allowed significant domestic trade in this product in Nigeria and Ghana, making cassava a 'cash crop' for many West African farmers. Cassava is also consumed as fermented dough (*fufu* and *akpu*) when simply boiled and pounded, though these products have a much shorter shelf life than *gari* (Phillips et al., 2004). High quality cassava flour (HQCF) has high potential as a cassava product and is used as a replacement for wheat flour (Adebayo et al., 2010). In East Africa, cassava

remains largely a subsistence crop, consumed as fermented dough or boiled (intact or pounded). *Gari* is not popular in East Africa, limiting the extent of domestic trade.

In Thailand, the development and improvement of cassava 'flour' or 'starch' processing for industrial purposes greatly increased their cassava exports (Sriroth et al., 2000). According to the FAO, value-added cassava products such as cassava flour, cassava starch, and cassava chips have unmet potential in the forms of wheat import substitutions, adhesive ingredients, and animal feed, respectively. In addition, cassava producing countries import many starch-based products that in many cases could be produced from cassava starch (FAO, 2005).

Other uses include ethanol production, which is increasing, particularly in Asia. An estimated 780 million liters of cassava ethanol could be produced in China in 2012, requiring about 6 million MT of dried cassava (FAO, 2012). Though Latin American countries, particularly Brazil, use cassava in animal feed, demand for cassava animal feed elsewhere is weak and the international market for cassava pellets has collapsed (FAO, 2012).

Lack of widespread post-harvest mechanization limits incentives for increased production

Particularly in Nigeria and Ghana where cassava is predominantly sold in the market as processed *gari* and *fufu*, cost-saving advantages of high yielding varieties are off-set by the lack of cost-saving technologies for cassava processing (Nweke et al., 1997). The COSCA study found that in Ghanaian and Nigerian villages where farmers had access to mechanized cassava graters, farmers reported an increase in the area planted to cassava. Without adequate post-harvest processing technologies, farmers have fewer incentives to invest in high-yielding seed varieties.

Gari processing is carried out largely at the village level using artisanal equipment. The COSCA study found that attempts by private firms to scale up large-scale cassava processing at the factory level have failed, largely due to lack of sustained public or private investment and a fragmented market for cassava products (FAO & IFAD, 2005). Mechanized graters, pressers, and mills are common in villages in Ghana, Nigeria, and Uganda while in Tanzania, Congo, and the Ivory Coast only a small percentage of villages have access to mills. Due to the lack of electricity and petroleum in many villages, the study recommends that increased mechanization at the village level should use small processing machines that are easily fabricated and repaired using local scrap metals (FAO & IFAD, 2005).

In addition to existing research, studies recommend further research, development, and diffusion of labor-saving technologies, industrial uses for cassava, and market pulls for cassava by improving roads in order to address these post-harvest constraints and increase market access (FAO & IFAD, 2005).

Trade

Cassava is generally traded in the form of dried chips and hard pellets. There is very little trade in fresh roots, given cassava's low value per unit of weight and short shelf life without post-harvest intervention. In Africa, mechanization of post-harvest processing varies by country and is more common in Nigeria and Ghana (FAO & IFAD, 2000).

Nine percent of cassava production was traded internationally in 2010, mainly in Asia (FAO, 2012). Trade has increased considerably in recent years; 2012 trade estimates are 31.7% higher than 2011. Trade activity measured in imports and exports is concentrated between South East Asia and East Asia (FAO, 2012). Two-thirds of global exports go to China, mainly for industrial purposes. Thailand exported 4.2 million MT of dried cassava and 1.7 million MT of cassava starch in 2010 and is the world's largest exporter (FAOSTAT)². According to FAOSTAT, the entire continent of Africa exported only 12,048 MT of dried cassava and 1,081 MT of cassava starch. However, FAOSTAT's data for cassava exports does not include several countries, including Nigeria and Ghana.

Nigeria exports very limited amounts of cassava to neighboring countries in the form of *gari* (Babatunde, 2012). Nigeria will also begin exporting bread with 20% cassava content in the ECOWAS region in December 2012 (Elazeh,

² According to an IFAD report, 2.25 kg fresh roots converts to 1 kg dried chip (IFAD, 2010).

2012). In 2012, Nigeria agreed to supply China with 1 million MT of cassava chips and entered an agreement with Australia to supply 500,000 MT per year (FAO, 2012). The Nigerian minister of Agriculture and Rural Development reported 2012 exports to China of 2.2 million MT (Elazeh, 2012).

Policy

Import substitution policies in Nigeria

Policies to promote the direct use or blending of cassava flour with imported cereals are believed to be an important determinant in boosting cassava food consumption (FAO, 2012). Nigeria enacted a blending ratio of 10% cassava flour in 2005, though only 5% was enacted. In July 2012, the Nigerian government imposed a levy on wheat imports to increase the blending ratio and eliminated import duties on cassava enhancing enzymes (FAO, 2012; Elazeh, 2012). The government is currently drafting a proposal to utilize the tariff funds for a cassava bread development fund. Policies to promote cassava flour blending have the added benefit of foreign exchange savings as cassava displaces imported wheat (FAO, 2012).

Lessons from Thailand

Tijaja (2009) outlined lessons for the cassava value chain in African countries based on policy responses undertaken by the Thai government. The Thai cassava sector is believed to have grown largely as a result of government policies on trade and processing and government support of domestic research and development. Thailand actively supports export commodity-specific trade associations and research institutions. These organizations promote new varieties and farmer trainings and participate in the policy dialogue. The organizations focus on increasing yield, and also increasing market access and attracting investors. Improved rural transportation networks also supported the cassava trade. Thailand also implemented policies to encourage agribusiness and implemented cassava-specific price supports. Finally, the Thai market grew as a result of strong linkages with a reliable export market: the EU and China. However, African countries are likely to face stiff competition in the cassava export market because of Thailand's large, established market share (Prakash, n.d.).

Lessons from Zambia

Public-private partnerships may also lead to increased cassava production and utilization. In Zambia, where cassava production increased dramatically after preferential maize policies ended, the Acceleration of Cassava Utilization Task Force was formed by a coalition of private feed companies, traders and processors, NGOs, and the public sector to increase the commercialization of cassava and increase its contribution to Zambian food security. The task force reviewed the cassava value chain, assessed previous cassava promotion efforts, and identified key market opportunities (Chitundu et al., 2009). The Task Force's study is suggested as a model for developing value chain interventions in other African countries (Simwambana, 2005).

Current policy environment

Figure 12 notes cassava policy in four countries as it relates to the cassava value chain.

Figure 12: Cassava Policy Environment

Priority Country	Current Policy Environment	Policy Implication
Nigeria	<ul style="list-style-type: none"> Import Substitution Pro-industrialization 	<ul style="list-style-type: none"> Promotes direct use or blending of cassava flour with imported wheat flour and other cereals to increase demand for cassava Scaling R&D to support increased industrial uses, implications for international trade
Ghana	<ul style="list-style-type: none"> Support for root and tuber crop research Increasing agricultural production for export 	<ul style="list-style-type: none"> Recognizes cassava importance as food security crop and increasingly as urban food staple Scaling R&D to support increased industrial uses, implications for international trade

Tanzania	<ul style="list-style-type: none"> Limited investment in infrastructure facilities, roads, storage 	<ul style="list-style-type: none"> Reduces market access for smallholder farmers
Uganda	<ul style="list-style-type: none"> Prioritization of road improvements Price and trade liberalization, promotion of non-traditional crops 	<ul style="list-style-type: none"> Increases road access to urban market centers Stimulates exports of cassava

Source: FAO & IFAD, 2005

Please direct comments or questions about this research to Leigh Anderson and Mary Kay Gugerty, at eparx@u.washington.edu.

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