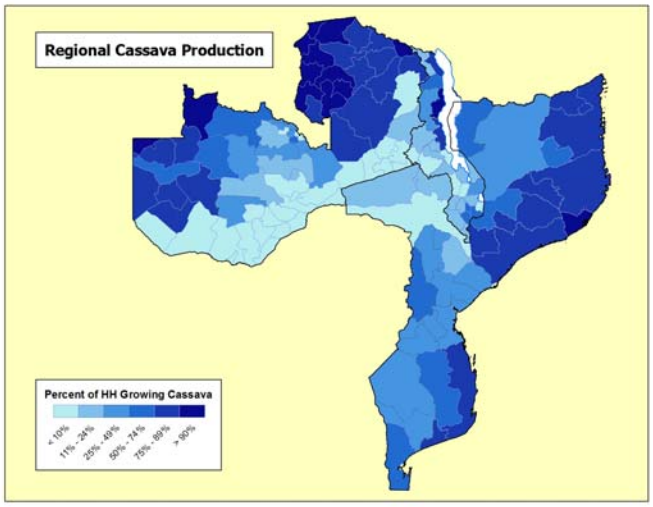
Zonal Mapping
of Food Staple Zones
in Zambia, Malawi and Mozambique



Cassava Transformation in Southern Africa (CATISA) Startup
Task 1. Report

by Steven Haggblade and Hunter Nielson
Michigan State University

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Tables

Figures

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OBJECTIVES

This paper aims to define major food staples zones in the two CATISA start-up countries of Zambia and Malawi. Given the regular importance of Mozambique as a surplus supplier of maize to Malawi during drought years, and given the likely importance of cassava production there in enabling that intermittent release of maize for export, this spatial analysis also includes Mozambique (Figure 1).

These three countries constitute the core of a regional food staples market-shed whose further development may offer critical opportunities for spurring agricultural production, commercial growth and improved food security in the region. Together, the CATISA startup tasks – of zonal mapping, production, value chain, and processing technology assessments – aim to help stimulate the potential for both accelerated commercial development of cassava and improved regional food security.

Figure 1. The three-country study region

The CATISA efforts stem from the observation that cassava production has grown rapidly in Zambia, Malawi and Mozambique over the past decade and a half (Figure 2).[1] This production surge, in turn, translates into significant commercial potential. Given the very high productivity of newly released cassava varieties, its high carbohydrate content and consequently low unit cost of energy supplied, cassava potentially offers a range of highly profitable commercial opportunities in the production of processed foods, livestock feeds, commercial starches, glues and sweeteners[2].

Zonal mapping of key food staple zones provides a spatial foundation for the CATISA work. Because cassava production, marketed volumes and prices differ significantly across food staple zones, commercial opportunities and processing potential will likewise differ spatially. Therefore, the farm production, value chain, processing technology and policy components will all need to incorporate these spatial differences in their analysis. The maps that follow, thus, serve as inputs into all other components of the CATISA work.

Farm production cannot continue to grow indefinitely without growing markets. Therefore, the CATISA project aims to facilitate and accelerate cassava commercialization in the region through an integrated program of applied research, policy analysis and technological exchange.

DEFINING FOOD STAPLE ZONES

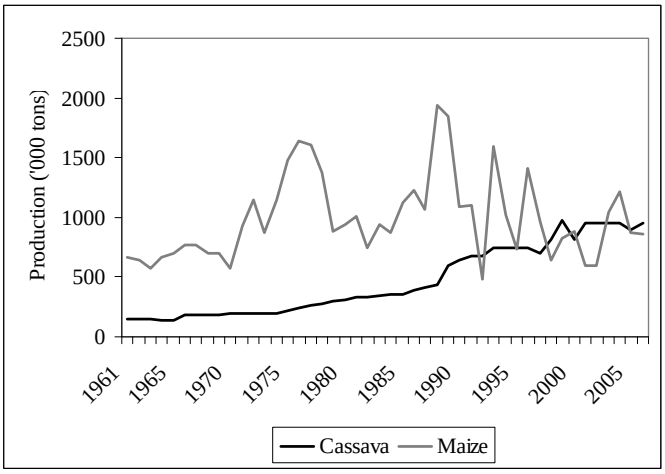
Key food staples

This analysis focuses on cassava and maize, the two most important food staples in sub-Saharan Africa as well as in these three countries. At a continental level, maize provides the largest single source of calories in Sub-Sharan Africa, about 600 kcal per person per day, while cassava follows closely behind as the continent's number two food staples, supplying 500 kcal per person per day (FAO Food Balance Sheets).

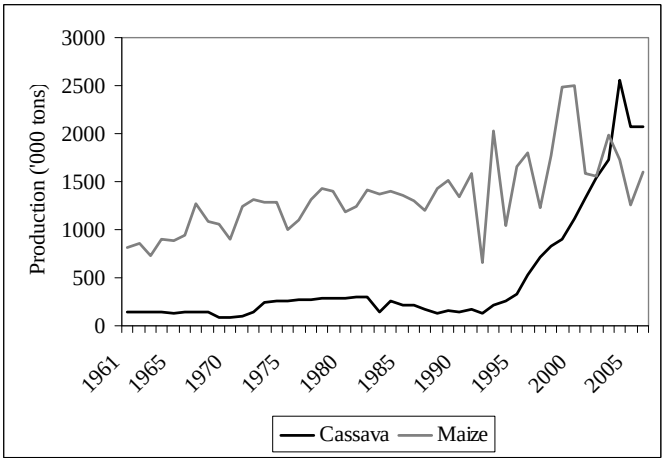
In Zambia and Malawi, maize dominates aggregate national food basket, providing half of all calories consumed, while cassava provides roughly 10%. In the cassava zones of northern Zambia and the lakeshore region of Malawi, however, cassava predominates. Likewise in Mozambique, cassava serves as the number one food staple, supplying about one-third of total calories, while maize, the number two staple, furnishes about one-fourth (Table 1).

[1] See also Haggblade and Zulu (2003).
[2] See Tembo and Chitundu (2000), Austral Consultia (2006), Barratt et al. (2006), Chitundu, Droppelmann and Haggblade (2008).

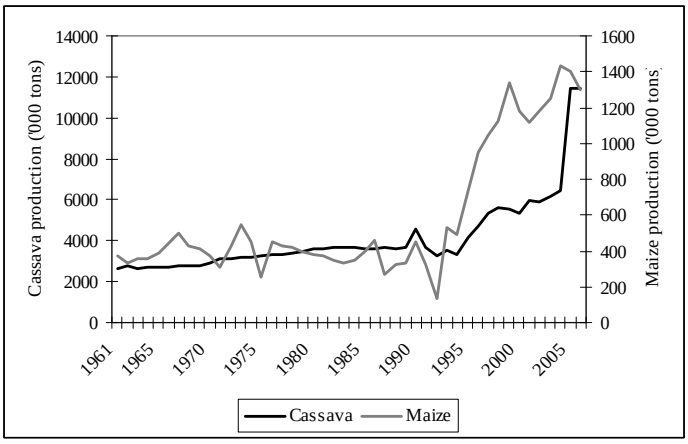
Figure 2. Trends in cassava and maize production in Zambia, Malawi and Mozambique



a. Production trends in Zambia



b. Production trends in Malawi



c. Production trends in Mozambique

Source: FAOSTAT.

Table 1. Average National Production and Consumption of Cassava and Maize, 2001-2003

	Cassava, fresh weight	Maize
Production (kg/capita)		
Malawi	138	158
Mozambique	314	64
Zambia	86	94
Consumption (g/person/day)		
Malawi	225	358
Mozambique	644	171
Zambia	231	351
Consumption (% kcal)		
Malawi	9%	53%
Mozambique	34%	24%
Zambia	13%	56%

Source: FAOSTAT.

Data and classification methods

To map food staple zones, we considered two alternative classification criteria. The first involved developing crop suitability maps using agro-climatic variables such as rainfall, temperature and soil type. The second alternative revolved around mapping actual production patterns using farm-household production data.

In assessing the first option, our review of available agro-ecological data and crop suitability maps suggested differences between the crop-suitability projections and observed patterns of farm production.[3] Cassava production specialists counseled us that these differences emerge for a variety of reasons, including a broad patchwork of micro-climates that are difficult to capture from available meteorological data, as well as differences in input availability, extension support and market access. Given sufficiently detailed micro-data, the agro-climatic crop suitability maps could indeed prove valuable in guiding future agricultural development priorities. However, for short- to medium-term purposes of accelerating cassava commercialization, it is more critical to understand where cassava production currently takes place.

Therefore, we opted to classify food staple zones based on actual current production practices. For this purpose, we obtained nationally representative farm household survey data for each of the three countries for what representative recent years. For Zambia, we have used the latest supplemental survey to the Central Statistical Office's Post-Harvest survey, the 2004 supplemental survey covering the crop year

[3] See, for example, the differences in northwest and southeast Mozambique between Austral Consultia (2006) and Figure 5.

2002/03. For Malawi, we have used the integrated rural household survey of 2004/05 and in Mozambique we have use the 2005/06 Ministry of Agriculture national household survey files.

These comprehensive household data sets permit a choice of measurement variables, including household numbers growing each crop, area planted and quantity harvested. After comparing these three measures, we ultimately adopted the simplest measure of cropping prevalence, the percentage of farm households growing each crop. Production data, particularly for cassava, are subject to large measurement error because farm households typically harvest cassava year-round and over a period of several years. Aggregating up to annual production from daily small baskets produces wide variation in estimated cassava output. Area data prove more reliable than production, although even here confusion arises since some surveys and some farmers report only area under mature cassava (those fields with plants over one year old and hence potentially available for harvest) while others report total area planted in cassava, including freshly planted first-year plots. Because all three measures are tightly correlated, and because the percentage of households growing each crop can be measured most reliably, we have elected to map food staple zones using this criterion. Looking forward, this definition offers the additional advantage of enabling our team to map neighboring areas of interest (in southern Tanzania and in southern DRC, for example) using simple rapid reconnaissance techniques.

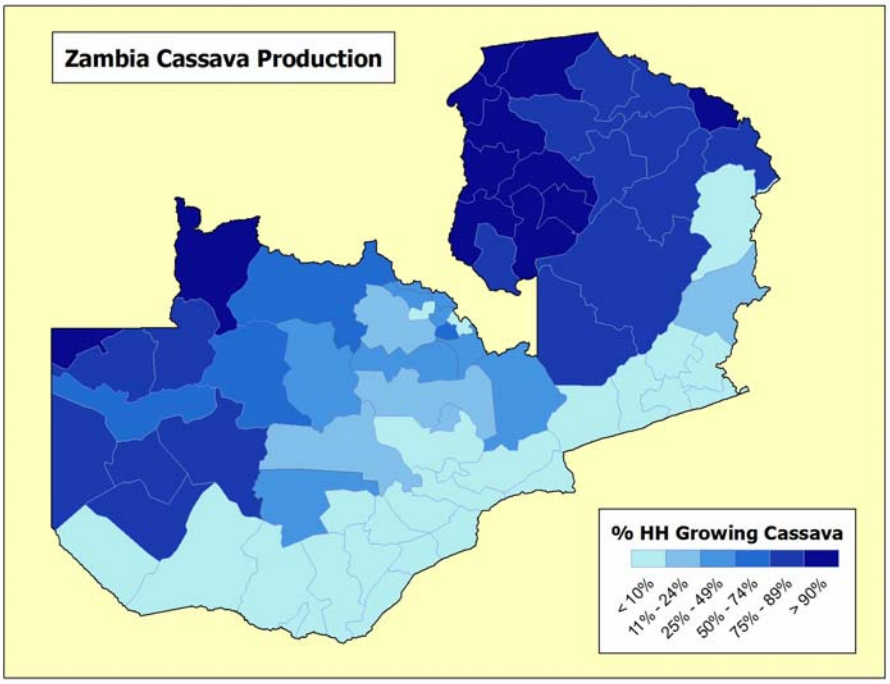
Results

At the country level, the following maps distinguish six levels of intensity for both cassava and maize production. Using progressively darker shades of yellow (for maize) and blue (for cassava) these maps classify districts in which under 10%, 11-24%, 25-49%, 50-74%, 75-89% and over 90% of households grow each of these two staple food crops. Figures 3 through 5 display the results of the country-level cropping prevalence mapping. At the regional level, we have aggregated as described in Table 2.

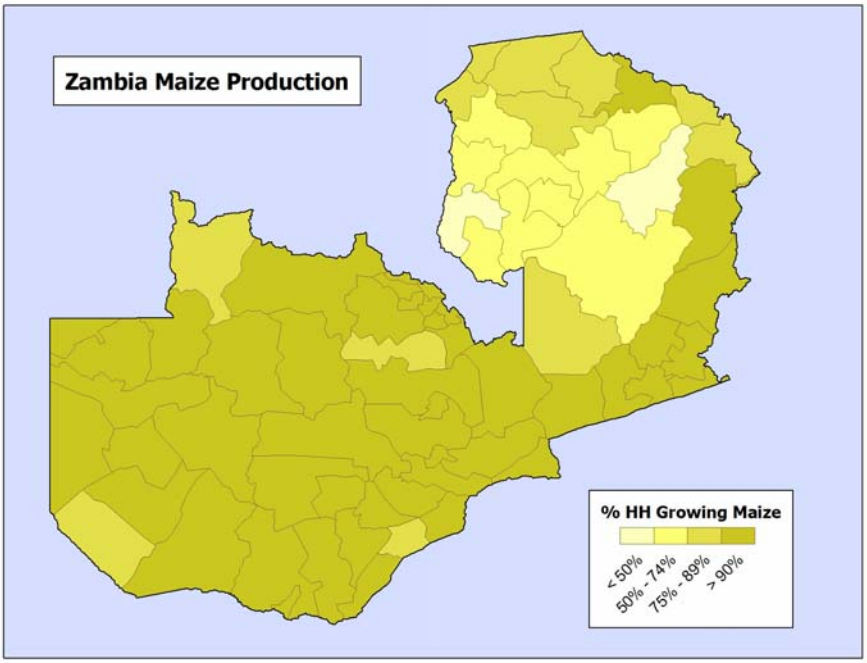
Table 2. Defining Food Staple Zones

Food Staple Zones	Percent of Households Growing	
	Cassava	Maize
Cassava Belt	> 75%	< 25%
Cassava Mixed	> 75%	25-50%
Dual-Staple	> 50%	> 50%
Maize Mixed	25-50%	> 75%
Maize Belt	< 25%	> 75%

Figure 3. Staple food production zones in Zambia

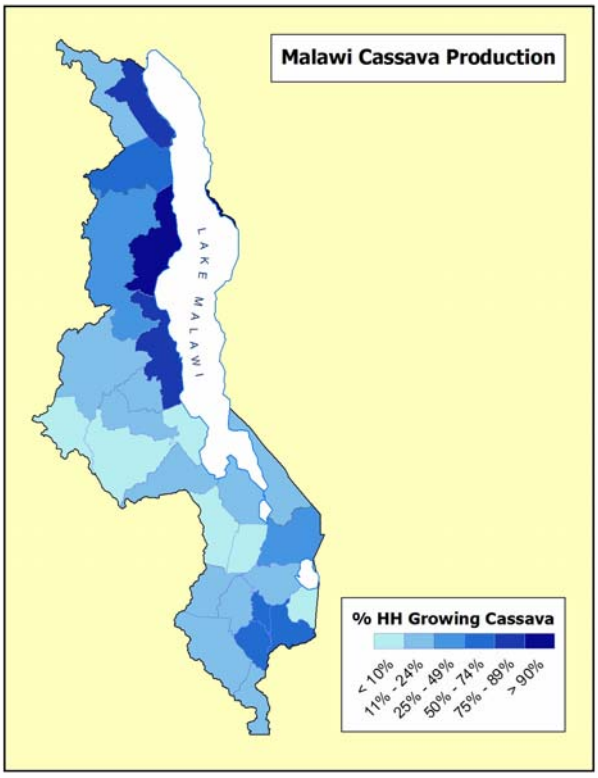


a. Cassava production zones

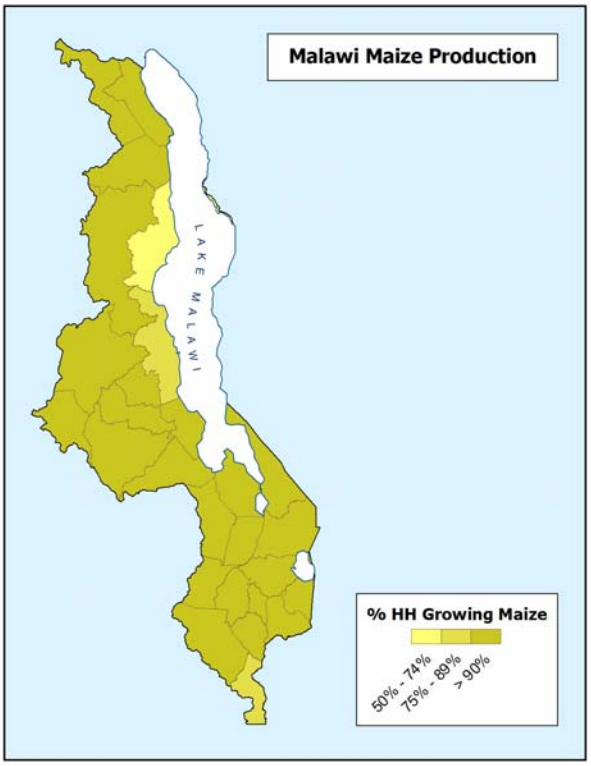


b. Maize production zones

Figure 4. Staple food production zones in Malawi

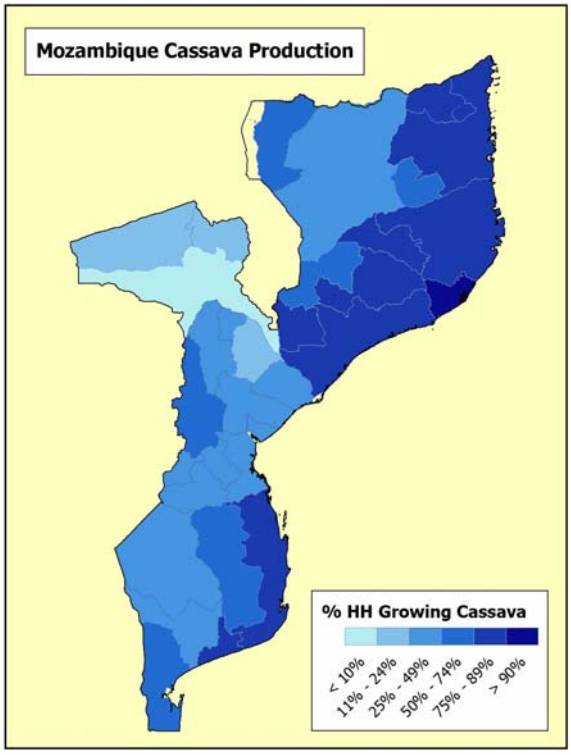


a. Cassava production zones

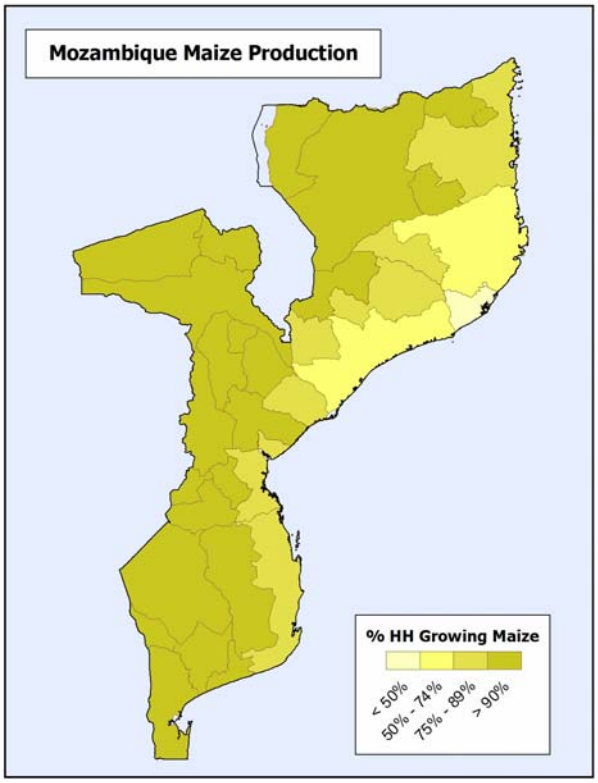


b. Maize production zones

Figure 5. Staple food production zones in Mozambique



a. Cassava production zones



b. Maize production zones

SPATIAL IMPLICATIONS FOR CASSAVA COMMERCIALIZATION

The spatial distribution of cassava production affects commercial potential in three major ways. First, because food consumption patterns vary across zones, the market prospects for cassava-based foods will prove most promising where consumers have already developed a taste for cassava and derived food products. Hence cassava flours and processed cassava-based foods are most likely to find ready markets in the zones of heavy cassava production. Most promising initially are the towns and cities within the cassava belt and the dual-staple zones. Thus towns such as Mansa and Kasama in Zambia, and Nampula and Mokuba in Mozambique emerge as likely centers of interest for local cassava-based food processing industries.

Secondly, relative food prices vary significantly across food staple zones. Data from Zambia suggest that cassava flour sells for 50% to 60% of the price of maize meal in the cassava zones of northern Zambia. Conversely, in the maize belt, cassava flour costs 10 to 15% more than maize meal (Table 3). This suggests that most processing activities, particularly the early stages of processing which result in rapid weight reduction (through water loss) and value added will prove most profitable in the heavy cassava production zones. Here again, the towns within the heavy cassava production zones zones emerge as promising locations, at least for first-stage cassava processing.

Finally, these maps offer important guides for future growth in food staple trade. Cassava production zones that lie in close proximity to industrial centers or food-deficit cross-border zones offer significant potential for simultaneous promotion of cassava and maize, cassava to enhance local food security and maize as a cash crop to service neighboring deficit areas. On these grounds, northern Zambia holds clear potential as a supply zones for southern DRC as well as the Zambian Copperbelt. Likewise, the central part of northern Mozambique (and probably southern Tanzania) house significant potential for servicing cross-border maize deficits in Malawi and Zimbabwe.

Table 3. Relative food prices across food staple zones in Zambia

	Product	Prices (Kw/kg)		Relative prices
		cassava	maize	cassava/maize
Cassava belt/dual staple zone				
Mansa	flour/mugaiwa	444	889	0.50
Kawambwa	flour/mugaiwa	444	778	0.57
Mixed 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: Haggblade and Nyembe (2007).

CASSAVA AS A REGIONAL FOOD SECURITY BUFFER

Improving regional food security

Increased cassava production, in addition to generating direct income gains for farmers and food processors, promises to improve food security in several additional ways. First, because it is a perennial root crop, cassava withstands drought more easily than maize or other cereals. The energy stored in cassava roots enables the plant to survive even severe droughts. Cassava's well-deserved reputation for drought-resistance translates into much lower production volatility for cassava than maize (Figure 1). As a result, increasing cassava production provides a growing buffer against drought-induced volatility in rainfed maize production.

Growth in cassava production can improve regional food security in a second important way. Because households in some locations consume both cassava and maize (Table 4), and because they can harvest cassava over several years, households can choose to consume more cassava and sell more maize during drought years, thus releasing maize for sale to deficit maize-belt households. In bad years, when nearby maize belt households face acute deficits, farmers from neighboring cassava and dual staple zones are able to harvest more of their perennial cassava crop and in turn free up more maize for export to deficit zones. Because cassava can be harvested over a 2-3 year period, because these zones are highly productive maize producers, and because local consumers prefer cassava, these dual staple zones can adjust cassava production very rapidly (upwards or downwards), adjust internal maize consumption accordingly, and release large quantities of maize (and also cassava) to other regions. These mixed and dual-staple zones, thus, serve as food security shock absorbers, enabling the release of maize to deficit areas in times of short supply, thereby moderating regional food shortages.

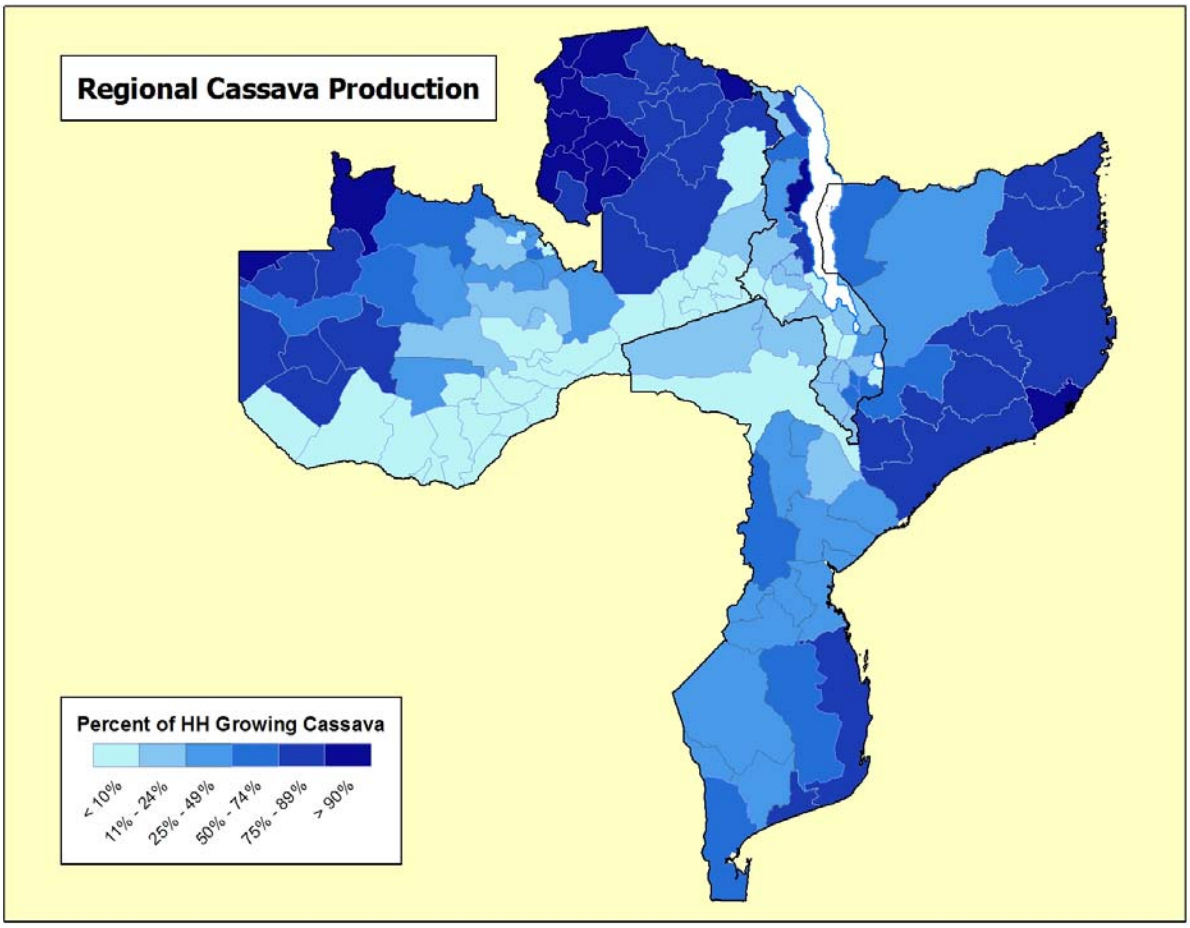
Table 4. Food staple production across food staple zones

	Food Staple Zones				
	Cassava Belt	Cassava Mixed	Dual Staple	Maize Mixed	Maize Belt
% hh growing cassava	> 75%	> 75%	> 50%	25 - 49%	< 25%
% hh growing maize	< 25%	25 - 49%	> 50%	> 75%	> 75%
Cassava production (kg/hh/year)					
Malawi	n.a.	n.a.	313	57	21
Mozambique	n.a.	1,415	1,651	394	108
Zambia	n.a.	1,823	1,336	109	20
Maize production (kg/hh/year)					
Malawi	n.a.	n.a.	306	381	499
Mozambique	n.a.	13	390	607	931
Zambia	n.a.	235	516	1,386	1,443

n.a. is not applicable, no districts fall into this category.

Source: computed from national farm household surveys.

Figure 6. Cassava production zones in the three-country region

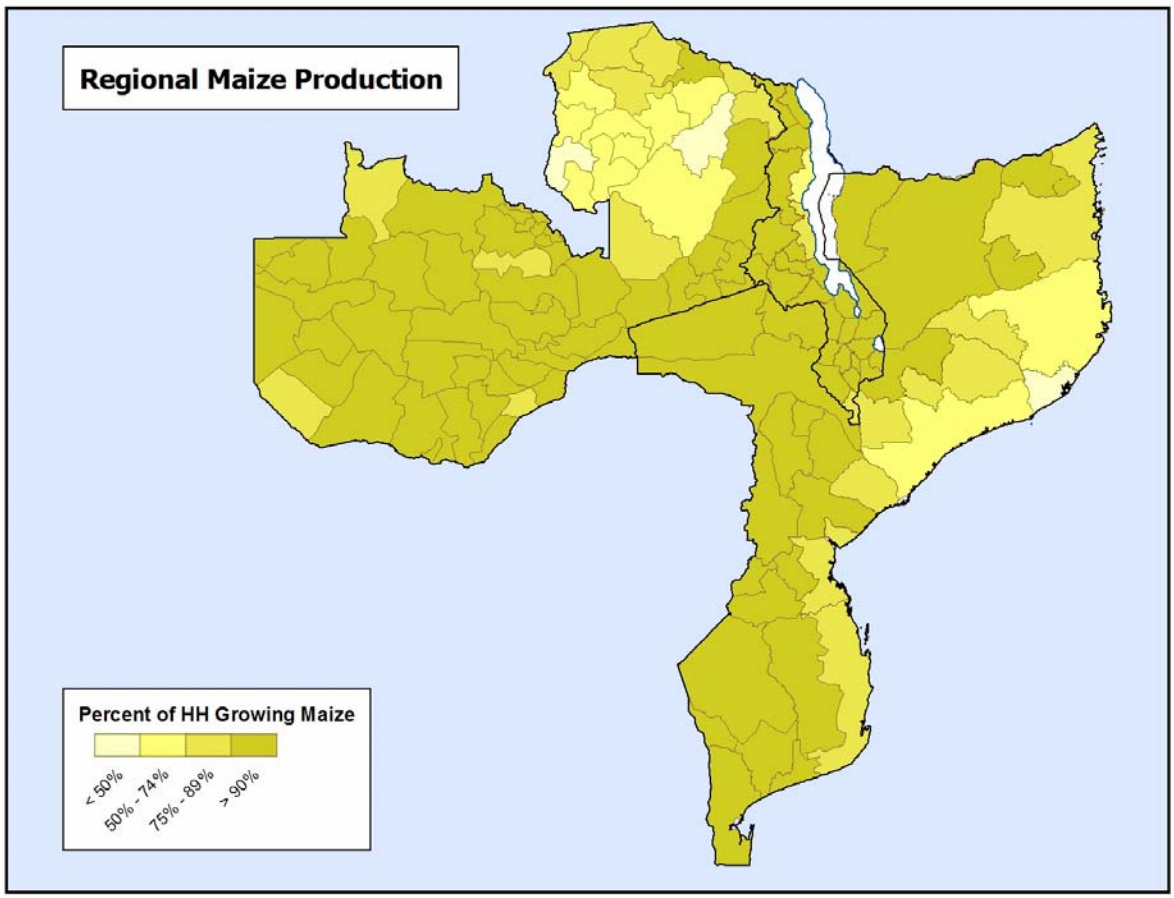


Mapping dual-staple staple zones

The CATISA efforts at mapping the regional cassava belt, maize belt and dual-staple zones provide a launching pad for related work on regional trade in food staples. Within the three-country region under review, cassava production predominates in a broad arc around the periphery, from northwest Zambia, through northern Zambia, the lakeshore zone of Malawi and along the north-eastern coast of Mozambique (Figures 6). Maize, in contrast, dominates in the cooler, more arid interior zones (Figure 7). Still, most households in the region grow at least some maize. Even in the heaviest cassava-producing zones, at least 25% of households also grow maize.

Combining these two individual commodity maps enables us to identify the maize belt, the cassava belt as well as various gradations of mixed and dual-staple zones. By overlaying the cassava zones, colored in blue, with the maize production zones, colored in various shades of yellow, the areas of greatest overlap become colored in green. Darker shades of green represent dual staple zones, while yellow-green represents the mixed-but-maize-dominated zones and the blue-green shades indicate the cassava-dominant mixed-staple zones.

Figure 7. Maize production zones in the three-country region

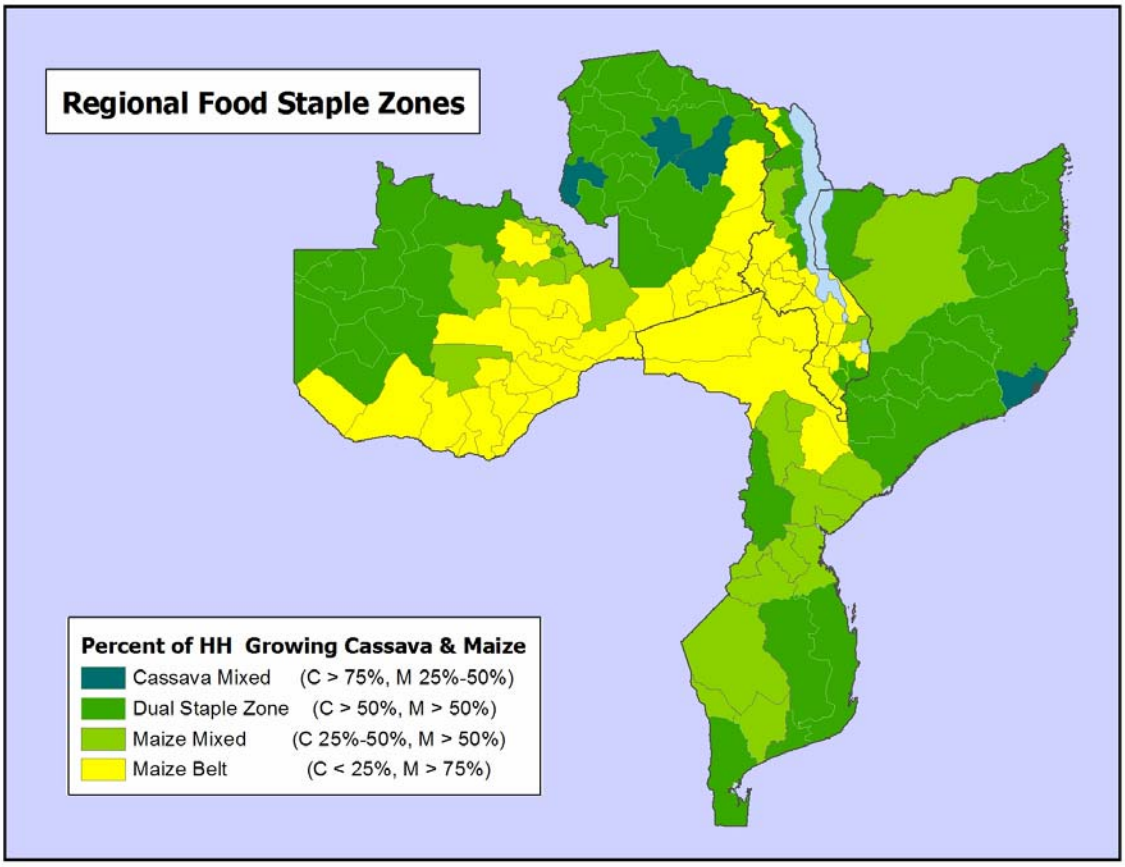


The resulting overlay map reveals two significant dual-staple zones, one in Northern Mozambique and the other in Northern Zambia (Figure 8). Anecdotal evidence and border monitoring efforts suggest that the dual-staples zones of Northern Mozambique have repeatedly proven able to export maize to deficit countries in the region, notably Malawi as well as Zimbabwe and sometimes even eastern Zambia (Figure 9).[4] Similarly, the dual-staple zones of Northern Zambia have regularly remained food secure, even during the serious drought years of 1992, 1998 and 2002 and appear able to release both maize and even small quantities of dried cassava to DRC and maize-dependent areas of Zambia (FAO, 2005).

The magnitude of food released regionally by these dual and mixed food staple zones during years of poor maize harvest, the directions of these flows, and the production and processing activities feeding into them have not yet been systematically analyzed. To do so will require monitoring of both cassava and maize markets over multiple years and mapping the volumes, prices and flows of these surpluses geographically in relation to the intermittently deficit zones within their natural regional market sheds.

[4] See Whiteside (2003), Tschirley et al. (2004), Fewsnet (2006) and Dradri (2007).

Figure 8. Food staple zones in the three-country region



NEXT STEPS

The CATISA team is anxious to move from its start-up phase to full implementation of the CATISA agenda. Spatially, this will mean filling in key missing pieces of the regional market-shed, particularly the food-surplus zones of southern Tanzania and the food deficit regions of southern DRC and Zimbabwe. On the production side, farm assessments are now positioned to link up with the spatial and value chain market assessments to identify sources of past and future production growth.

CATISA's early food processing and food safety assessments provide a solid foundation for further expansion, both within Zambian and Malawi and to other countries in the region. Given the prevalence of cassava consumption in Mozambique and the long history and variety of cassava-based foods consumed there (many brought in by the Portugese from Brazil), offers clear promise for cross-fertilizing product development and technology transfer to other cassava-consuming zones where production and urbanization are now growing rapidly.

Figure 9. Mozambican traders delivering maize to the Malawian border

Looking forward, the full CATISA agenda offers a solid platform for rapidly launching the cassava component of COMESA's upcoming regional food staples initiative. The dual staple zones identified by the CATISA team hold clear potential to become focal points for regional food security investments. To realize this potential, however, it will be necessary to measure the magnitude of in-ground cassava stocks, the scope for consumer food substitution and the scale of marketing responses and maize released by dual-staple zones during drought year deficits in the maize belt. This agenda will require regular monitoring of production, consumption, prices and trade flows for both cassava and maize during surplus, normal and deficit years. Together with the policy review planned under the full CATISA research program, these efforts will help identify practical ways of capitalizing on the highly productive new cassava germplasm available in the region and accelerating its translation into improved commercial opportunities as well as enhanced regional food security.

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