Socioeconomics
Discussion Paper Series

Series Paper Number 35

Consumer demand for sorghum and millets in eastern and southern Africa: Priorities for the CGIAR Research Programme for Dryland Cereals

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9/21/2015

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This work has been undertaken as part of the CGIAR RESEARCH PROGRAM ON Dryland Cereals

Acknowledgments

The authors wish to thank ICRISAT's socio-economists in Nairobi for their valuable contributions and suggestions. Special thanks go to Christin Schipmann-Schwarze, formerly with ICRISAT in Nairobi, and our national partners in Kenya, Uganda and Tanzania who conducted a series of baseline surveys of processors, and consumers during the first phase of the HOPE project. Thanks are also due to the three consultants who prepared the preliminary tables from the four national household expenditure surveys on which Section 4 of this report is based: Ibrahim Macharia (Kenya and Tanzania), Michael Kidoido (Uganda) and Kibrom Tafere Hirfrfot (Ethiopia).

Executive Summary and Recommendations for Priority Setting

This report was prepared to help the CGIAR Research Program on Dryland Cereals set research priorities for ESA. A clearer understanding of consumer demand for sorghum and millets is required so that the priorities for crop improvement and value chain development are based on market demand.

This report summarizes current information on consumer demand for sorghum and millets in ESA, with particular reference to Kenya, Tanzania, Uganda and Ethiopia. The analysis is based primarily on data from nationally representative household expenditure surveys for these four countries conducted between 2005 and 2012. The original data was obtained and re-analysed to determine the drivers of consumer demand for sorghum and millets. Results showed that the consumption estimates from these surveys were inconsistent with the data on the production and availability of sorghum and millets reported in national statistics. Consequently, we adjusted the results from the household expenditure surveys to match the production and population estimates for each country to allow comparisons across the four countries for 2013. Information on price and income elasticities was obtained from secondary literature, while information on prices were gathered from the World Bank and FAO data sets on commodity markets and prices

Consumer demand for sorghum and millets in ESA is driven by population growth, urbanisation, income and price. Below, we summarise the findings for cereals in general, then separately for sorghum and millets.

Cereals

Consumer demand for cereals is driven primarily by population growth. Between 2000 and 2013, the combined population in the four ESA countries rose by 70 million, from 156 to 225 million. The rate of population growth averaged 2.9% per annum. Ethiopia had the largest population (94 million in 2013), which was three times the size of Tanzania or Uganda, and more four times the size of Kenya.

Rapid population growth combined with low average income means that a high share of the household budget is spent on food. Ethiopia had the highest share of total expenditure on cereals (49 %), while Tanzania (38 %), Uganda (26 %), and Kenya (21 %) all spent a lower share. Since Ethiopia has the biggest population, trends in the consumer demand for sorghum and millets in ESA are driven primarily by what happens there. Despite high population growth, regional cereal consumption per head for sorghum increased from 15 kg in 2000 to 23 kg per head in 2013. However, consumption of millets stayed constant at 6 kg per head. Consumption of maize, the main staple, rose from 55 kg in 2000 to 62 kg in 2013. At the regional level, therefore, consumer demand for millets held its own against maize, while consumer demand for sorghum has outstripped maize, with consumption per head rising by over 50%.

Urbanisation increases the market demand for cereals, although average levels of consumption are lower than in rural areas. Urbanisation in ESA is growing, but from a low base, and only 22 % of the total population was urban in 2013 up from 17 % in 2000. The most heavily urbanised countries were Tanzania (30 %) and Kenya (25 %), while Ethiopia was the least urbanised (16 %). In absolute terms, the urban population for the four ESA countries in 2013 was 50 million, which offers a sizeable market for growers of sorghum and

millets. Because of its bigger population size Ethiopia has the biggest urban market, with 15 million.

Sorghum

Consumption per head: Rising consumer demand for sorghum at the regional level conceals important differences between the four countries. In Ethiopia, consumption rose from 22 kg/head in 2000 to 43 kg/head in 2013. By contrast, in Kenya consumption remained constant at 2.4 kg/head. Uganda experienced the most dramatic changes in cereal consumption. Political instability in northern Uganda starting in 2007 led to a rapid decline in the production of both sorghum and millets. Currently consumption of sorghum is at all-time low of 6.5 kg/head. Consumers responded by doubling the consumption of maize from 30 kg/head in 2007 to 60 kg/head in 2013.

Urbanisation: Sorghum consumption had the biggest rural bias, with 30 kg/head in rural areas but only 7 kg/capita/year in urban areas. The gap between rural and urban consumption was highest in Ethiopia, where urban consumption in 2013 averaged 14 kg/head compared to 57 kg/head in rural areas. The gap was also large in Tanzania: only 8 kg/head in urban areas but 18 kg/head in rural areas. Thanks to relatively low rates of urbanisation and lower levels of urban consumption, consumer demand for sorghum was overwhelmingly rural. At the ESA level, 94 % of total demand for sorghum was rural and only 6 % came from urban consumers. Nevertheless, urban demand for sorghum was significant in absolute terms, reaching 175,000 t in Ethiopia, 86,000 t in Tanzania, and 38,000 t in Uganda. In Kenya, urban consumption of sorghum was too low to derive a meaningful estimate of consumer demand.

Markets: Sorghum consumption was concentrated in areas of sorghum production. In Ethiopia, consumption in rural areas where sorghum was widely grown averaged 78 kg/head compared to 16 kg/head in rural areas far from the centres of production. The corresponding figures were 31 and 3 kg/head in Tanzania and 18 kg and 5 kg/head in Uganda, Sorghum consumption was also higher in urban areas that were closer to areas of sorghum production. In Ethiopia, this difference was substantial, with urban areas close to producing areas averaging 30 kg/head compared to just 3.1 kg/head in urban areas that were far away. These results suggest that consumer demand for sorghum is concentrated in rural producing areas, and that urban demand is concentrated in areas close to sorghum production By contrast, consumer demand for maize is more evenly spread. This suggests that sorghum is concentrated in semi-arid areas and not widely traded while maize is grown across a spectrum of agro-ecologies that are closer to markets.

Income: Income drove consumption of sorghum in two opposite ways. In Tanzania and Uganda, sorghum consumption dropped by 60 – 80 % as income rose from ‘low’ to ‘high’ income households. In Kenya, sorghum consumption was minimal at the national level. By contrast, sorghum consumption in Ethiopia increased with income, from 36 kg/capita/year in low income households to 53 kg/capita/year in high income households. Consumption rises with income because Ethiopia has a large ‘sorghum belt’ where sorghum is a staple food crop and is preferred to maize.

Prices: Between 2000 and 2010, sorghum sold at a 20% premium over maize, but 20% below the price of millets. However, price differentials for sorghum varied between countries, with the smallest differentials in Ethiopia and the largest in Kenya. Consumer demand for

sorghum is price-inelastic, in other words a 1 % rise in the price of sorghum resulted in a 0.7 % drop rather than an equivalent 1 % drop in demand. This is normal for necessities like cereals. The income elasticity of demand for sorghum is low, and a 1 % rise in income increases consumer demand by 0.3 %, implying that sorghum is an 'inferior good'.

Millets

Consumption per head: Static demand at the ESA level concealed important differences between the four countries. In Kenya and Tanzania, consumption per head between 2000 and 2013 did not change. In Ethiopia, however, consumption rose from 4.5 kg/head in 2000 to 8.0 kg/head in 2013, while in Uganda consumption per head fell from 29 to 5 kg/head in just over a decade.

Urbanisation: Millet consumption was biased towards rural areas. At regional level consumption averaged 7.2 kg/head in rural areas compared to 3.7 kg/head in urban areas. This rural bias was strongest in Ethiopia, where rural consumption averaged 10.6 kg/head compared to 3.3 kg/head in urban areas. Elsewhere, however, millets showed a lower rural bias than sorghum. In Kenya, 33 % of consumer demand for millet was urban, and urban demand was also high in Uganda (24 %) and Tanzania (17%). Because of lower average consumption per head, the total urban demand for millets (153,000 t) was lower than for sorghum (300,000 t). Urban demand for millets was highest in Tanzania (46,000 t) followed by Uganda (43,000 t), Ethiopia (42,000 t), and Kenya (21,000 t).

Markets: At the regional level the consumption of millets, like sorghum, was concentrated in the rural areas where millets were grown. Consumption in rural producing areas averaged 10 kg/head compared to 2 kg/head in rural areas far from the main centres of millet production. This difference was strongest in Ethiopia, where the corresponding figures were 9 and 2 kg/head. However, these differences were less strong in Kenya and Tanzania. Consumer demand for millets in Kenya was higher in urban areas (averaging 2.2 and 3.2 kg/head in urban areas far from and close to centres of millet production) than in the rural areas where millets were grown (2 kg/head). Similarly, in Tanzania consumption in urban areas both far from and close to the centres of millet production averaged 4 and 5 kg/head, close to the level of consumption found in the rural areas where millets were grown (6 kg/head). In Uganda, consumer demand was concentrated in rural areas and urban areas close to the centres of production, but consumption in urban areas far from the producing areas was extremely low (0.5 kg/head). In Kenya and Tanzania, therefore, millets were widely traded with high levels of urban consumption.

Income: Unlike sorghum, consumer demand for millets rose with income in all four countries. Prized for its taste and nutritional value, millets are not an inferior good. Millets are used as a weaning food and for ceremonial occasions. This difference was strongest in Tanzania, where millet consumption averaged 10 kg/head in the high income group compared to 3.2 kg/head in the low income group. In Kenya, the difference in consumption between the high and low income groups was small (1.7 and 1.6 kg/head).

Prices: Between 2000 and 2010, millets sold at a 20% premium over sorghum and a 40 % premium over maize. The price differential was greatest in Kenya, suggesting that demand for millets far exceeds supply. Price differentials were lowest in Ethiopia. Consumer demand for millets was price inelastic, with a 1 % increase in price resulting in a 0.7 % drop in

demand. The income elasticity of demand for millets is only available for sorghum combined with millets (0.7 %). This is lower than the income elasticity of demand for maize (0.9%).

Recommendations for priority setting

Sorghum: crop improvement

1. Crop improvement to meet consumer demand should focus primarily on Ethiopia, where the number of sorghum consuming households and per capita consumption are highest, and where demand is growing thanks to high population growth, the high share of household income spent on cereals, and sorghum's competitive advantage over maize in the sorghum belt.
2. Crop improvement to meet consumer demand in Uganda should focus on northern Uganda where sorghum production fell steeply after 2007 because of civil unrest. Peace now gives the opportunity to increase sorghum production in this region but will face strong competition from maize which has replaced sorghum in the diet.
3. Crop improvement to meet consumer demand in Kenya and Tanzania should focus on increasing sorghum's competitive advantage over maize as a source of household food security in the semi–arid regions where sorghum is currently grown. Consumer demand for sorghum outside these regions is static.

Sorghum: market development

4. Market opportunities to increase consumer demand are limited because (1) sorghum is consumed primarily in the areas where it is grown, with limited consumption in other rural areas and in urban areas (2) sorghum consumption declines as incomes rise (3) prices are generally 20 % higher than maize, making sorghum uncompetitive as a staple food crop in urban areas and in rural areas where maize can be grown.
5. Market development for sorghum should therefore focus not on consumer demand but on alternative uses for sorghum grain through value-chain development rather than on meeting demand from urban consumers.
6. Market development to meet urban demand should focus on Ethiopia, where urban demand averaged 175,000 t in 2013. Opportunities for market development to meet urban demand in Tanzania, Kenya, and Uganda are more limited in scale.

Millets: crop improvement

7. Unlike sorghum, there is consumer demand for millets outside production areas. Crop improvement should therefore focus on improving market potential for millets.
8. To meet consumer demand, crop improvement should focus on traits that reinforce millets' reputation among consumers as a healthier alternative to maize, principally high concentrations of iron and zinc.
9. To facilitate commercialisation, crop improvement should focus on developing technology packages that reduce unit costs for farmers and increase profitability. Technology packages should include not just improved varieties that give higher yields, but improved crop management practices that increase the return to family labour.

Millets: market development

10. Millets show high potential for market development because (1) there is consumer demand outside the semi-arid regions where millet is grown (2) consumer demand for millets rises with income (3) millets' reputation as a health food for adults and for weaning children ensures a price premium of 40 % over maize, making it an attractive cash crop for growers.
11. Market development should focus on urban consumers, principally middle- and high-income households, who can afford to buy millets and are receptive to health benefits.
12. Market development for urban consumers should focus on Kenya, Tanzania and Uganda where urban demand is already high (33 %, 24 % and 17 % of domestic consumption, respectively).
13. Despite high demand among urban consumers in Kenya, where 33 % goes to urban markets, average levels of millet consumption in urban Kenya are much lower than in neighbouring Tanzania and Uganda. This suggests there is unmet market demand for millets among urban consumers. Market development in Kenya should therefore focus on increasing supply, either through imports or raising production in western Kenya.

Keywords: Sorghum, millets, consumer demand, Kenya, Ethiopia, Tanzania, Uganda, Eastern Africa

JEL classification: Q11, Q21

Content

List of Tables

List of Figures

List of Maps

List of Tables in Annex

Acronyms

CGIAR	Consultative Group for International Agricultural Research
CPI	Consumer Price Index
CRP	Collaborative Research Program
CSA	Central Statistical Agency of the Federal Democratic Republic of Ethiopia
EIAR	Ethiopian Institute of Agricultural Research
ERHS	Ethiopia Rural Household Survey
ESA	Eastern and Southern Africa
FAO	Food and Agriculture Organisation of the United Nations
GDP	Gross domestic Product
GIS	Geographic Information System
HBS	Household Budget Survey (Tanzania)
HICES	Household Income Consumption Expenditure Survey
HOPE	Harnessing Opportunities for Productivity Enhancement for Sorghum and Millets
ICRISAT	International Crops Research Institute for the Semi-arid Tropics
IFPRI	International Food Policy Research Institute Wash. DC
KIHBS	Kenya Integrated Household Budget Survey
KNBS	Kenya National Bureau of Statistics
LLDC	Least Developed Country
NBS	National Bureau of Statistics (Tanzania)
NMS	National Master Sample (Tanzania)
OECD	Organisation for Economic Co-operation and Development
RATIN	Regional Agricultural Trade Intelligence Network
THRS	Tanzania Human Resource Survey
UBOS	Uganda Bureau of Statistics
UNAP	Uganda Nutrient Action Plan
UNHS	Uganda National Household Survey
UNPS	Uganda National Panel Survey
WCA	Western and Central Africa
WDI	World Development Indicators (World Bank)
WFP	World Food Programme (of the United Nations)

Units

ADI	African Development Indicators (World Bank)
AE	Adult Equivalent
BIRR	Local currency in Ethiopia
Ha	Hectare
Kg	Kilogram
LCU	Local currency unit
Mt	Metric ton
WDI	World Development Indicators (World Bank)

1. Introduction

Eastern Africa has a diversity of foods reflecting its biodiversity and range of agro-ecologies. However, cereals dominate both crop production and food consumption. On average, they contribute over 40 % of total direct human dietary calorie intake, ranging from 68 % of calorie intake in Ethiopia to 12 % in Rwanda. This report analyses patterns of cereal consumption in Kenya, Uganda, Tanzania and Ethiopia. Although maize is the dominant cereal crop, the primary focus is on sorghum and millets.[1] ICRISAT has the international mandate for research on these crops, and information on consumer demand is required to set research priorities and justify research investments. .

The general objective of this report is to determine current levels of consumer demand for cereals in eastern Africa, with particular reference to sorghum and millets. The specific objectives are to determine:

1. The share of cereals in household food expenditure;
2. Variations in cereal consumption by urbanisation, income, and production; and
3. Price and income elasticities.

The report synthesises information from several sources, including FAO data on production and consumption, and secondary literature on elasticities. In addition, the report uses evidence from ICRISAT processor and consumer surveys, and from national household expenditure surveys conducted by national statistical organisations in these four countries.

The report is divided into five sections. Following this introduction, Section 2 describes the data and methods used to measure consumer demand. Section 3 analyses household food expenditures, and the composition of expenditure. Section 4 analyses the results from household expenditure surveys, while Section 5 presents results on price trends and elasticities. Finally, we summarise our conclusions and identify future research needs.

2. Data Sets and Sources

All four countries conduct national household expenditure surveys on a regular basis from which expenditure patterns on food and non-food items can be derived.. However, the quality and coverage of the food sub-system from those national household expenditure surveys is not standardised and somewhat under-represented compared to non-food sub-systems. Furthermore, the food sub-system is often regarded from a purely physical and nutritional, rather than an economic, point of view. Household surveys in all four countries report total expenditures, usually on a monthly basis, with further subdivisions into food and non-food use, and in some cases subdivided by rural-urban and income. Further decomposition of food expenditures into food components is available for all four countries, although grouping of food components is done in different ways. Expenditure for individual cereals is not covered in the official survey report published by National Statistical Offices, but only in third-party publications.

[1] No distinction is made between finger millet (*Eleusine coracana*) and pearl millet (*Pennisetum glaucum*, *P. typhoides*, and *P. tyhpideum*) as crop statistics do not differentiate between them.

This report uses several publicly available data sets. First, it uses four National Household Expenditure Surveys conducted in Kenya, Uganda, Ethiopia, and Tanzania between 2004 and 2009. These data sets are available on the 'World Wide Web', posted either on webpages specialized in households surveys or directly by the respective National Statistical Offices. ICRISAT used these data sets to develop a series of tables showing consumption of sorghum and millets, together with other cereals, for these four countries. These studies were made by three consultants between 2010 and 2012, following a common template developed by ICRISAT. Table 1 summarises the data sets used in the report.

Table 1: National household expenditure surveys and ICRISAT surveys used in this report

Survey name	Country	Sample size (no. of households)					
		total	rural	urban	sorghum	millets	maize
KIHBS 2005/06	Kenya	13,430	8,610	4,820	660	7,134	10,701
ICRISAT consumer survey for Kenya and Tanzania 2012	Kenya	454	164	290			
Household Income & Consumption Expenditure Survey (HICE) (2004/05)	Ethiopia	21,595	9,434	12,101	2,160	11,315	13,547
Tanzania Household Budget Survey (HBS) 2007	Tanzania	10,463	3,343	7,120	792	924	11758
ICRISAT consumer survey for Kenya and Tanzania 2012	Tanzania	439	59	380			
Uganda National Household Survey (UNHS) 2009/2010	Uganda	6,775	5,555	1,220	1,226	962	3,751

For Kenya, Macharia et al., (2012) used data collected by the Central Bureau of Statistics through the Kenya Integrated Household Budget Survey (KIHBS) for 2005/06. The KIHBS survey was conducted in 1,343 randomly selected clusters across all districts in Kenya and comprised 861 rural and 482 urban clusters. The total sample size was 13,430 households, of which 8,610 were rural and 4,820 were urban. ICRISAT also conducted a consumer survey for sorghum and millets in Kenya to provide an overview of consumption patterns and explore consumer preferences (Schipmann-Schwarze, 2013). The sample size for the ICRISAT survey for Kenya was 454 individual respondents from two urban centres (Nairobi and Kisii) and two rural locations (villages nearby the two urban locations). A valuable secondary source used in this study was the 'The Basic Report on Well-being in Kenya' which provides a comprehensive overview of household expenditure patterns across rural and urban locations based on the Kenya Integrated Household Budget Survey 2005/06 2 as the primary data source (Ministry of Planning and National Development, 2007).

[2] According to the KNBS, household consumption expenditures refer to goods and services intended for consumption, plus the value of goods and services received as income in kind and consumed by the household or individual members thereof. Household consumption expenditure excludes income tax and other direct taxes, pension and social security contributions and assimilated insurance premiums, remittances, gifts and similar transfers by the household as a whole and its individual members.

For Ethiopia, ICRISAT used data from the Household Income Consumption Expenditure Survey' (HICES) (2004/05), conducted by the Ethiopian Central Statistical Agency (CSA) (ICRISAT 2012a). The 2004/05 HICES dataset covered a representative sample of 21,595 households – 12,101 from urban and 9434 from rural areas. The survey covered the entire country except the zones of Gambella Region, and the non-sedentary, pastoral population of three zones of Afar and six zones of Somali regions.

For Tanzania, the main information source on household expenditures was the Household Budget Survey (HBS) which is conducted on a fairly regular basis every six-seven years. . The last three HBS rounds were in 2001, 2007 and the most recent in 2011/12. The Tanzanian HBS has a strong focus on consumption expenditure levels by region (rural versus urban), income levels, and temporal changes and decomposition of food items. For ICRISAT's consumer analysis in Tanzania, Macharia et. al. (2014) used the 2007 Tanzania Household Budget Survey (HBS). The HBS 2007 survey has a total sample size of 10,463, 7,120 urban households and 3,343 rural households. Additional information on agricultural production was extracted from the Agriculture Sample Census, 2007/08 preliminary report and National Bureau of Statistics (NBS) – Tanzania.

Uganda has a long tradition with large scale household surveys dating back to the 1990s. The primary source to which most publications in this field refer is the Uganda National Household Survey (UNHS). The UNHS III covered 7,421 households from May 2005, the UNHS IV covered 6,775 households from May 2009 to April 2010, and the UNHS V covered 6,810 households with consumption data from July 2012 to June 2013. Most relevant parameters for household expenditure analysis are covered in all three UNHS survey rounds.

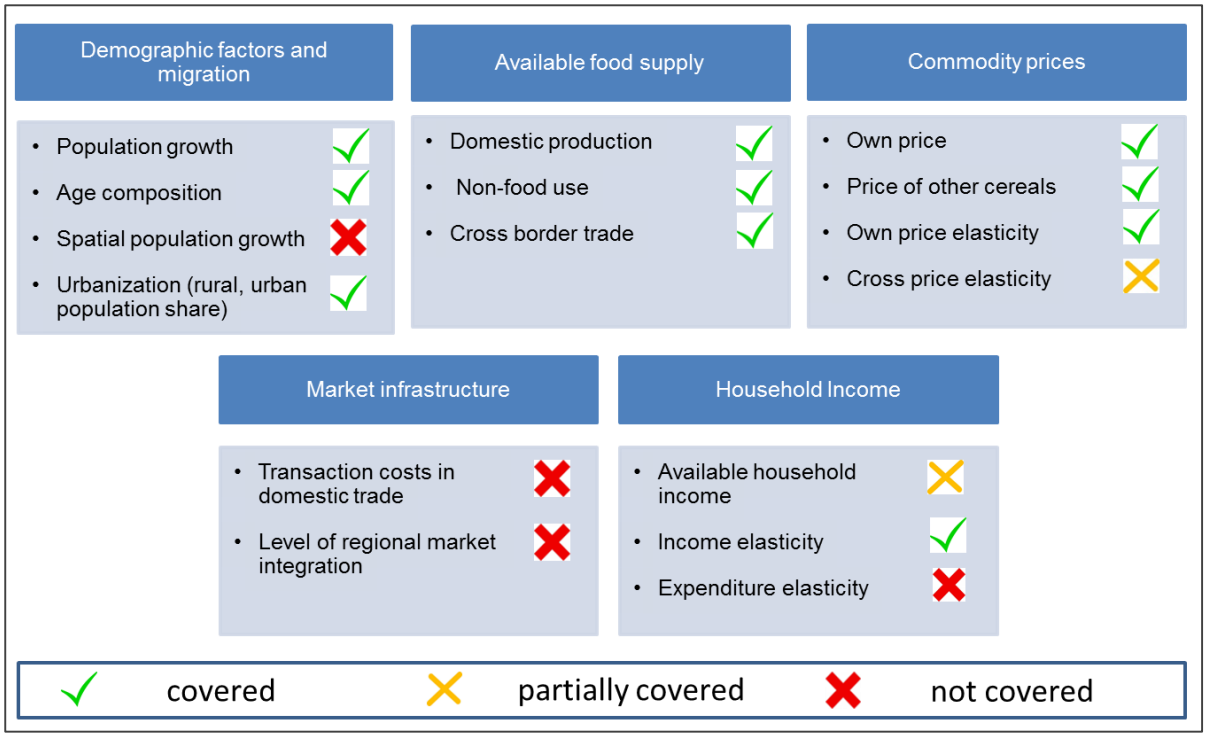
For Uganda, Kidoido et. al. (2012) used the Uganda National Household Survey (UNHS) for 2009/2010 as the basis for ICRISAT's consumer analysis. However, additional variables were extracted from the National Panel Survey (UNPS) 2009/2010. The UNHS 2009/10 covered 80 formally recognized districts in Uganda as of 2009. Specifically, this analysis concentrated on the socioeconomic module of the UNHS 2009/10. The socioeconomic module focused on household characteristics, household housing conditions, household expenditure, welfare, and cultural participation of households. The UNHS was designed to cover the whole nation, the rural-urban categorization, and 10 sub regions of Uganda.

3. Methodology

This study synthesises available data from ICRISAT's studies on consumer demand of sorghum and millets using descriptive statistics. Using a common template, the report presents cross-country tables that compare cereal consumption according to proximity to markets (distance from centre of production), location (rural-urban), and level of household income (high-medium-low). Figure 1 shows the determinants of consumption covered by this study.

Urban migration is another important factor in cereal consumption, since rural and urban food preferences and composition differ considerably. Another section of this report looks at how prices and price relations have developed between sorghum, millets and maize over the last ten years and how sensitive consumption reacted with regard to price changes (elasticity question). Similarly, household income is another important determinant. Disposable income in conjunction with location specific food availability and food retail systems in place has a strong bearing on the level and composition of cereal consumption as well as types of cereals products and place of buying. Issues concerning market infrastructure such as road and rail network, transportation costs, food retail systems and level of regional market integration have not been explored, although these affect how well and at what price regions are supplied with cereals as well as consumer choices. Some of these issues have been addressed in previous ICRISAT reports (Gierend et al. 2014a, 2014b, 2014c).

Figure 1: Determinants of consumption in the ESA region covered in this report



Source: own figure

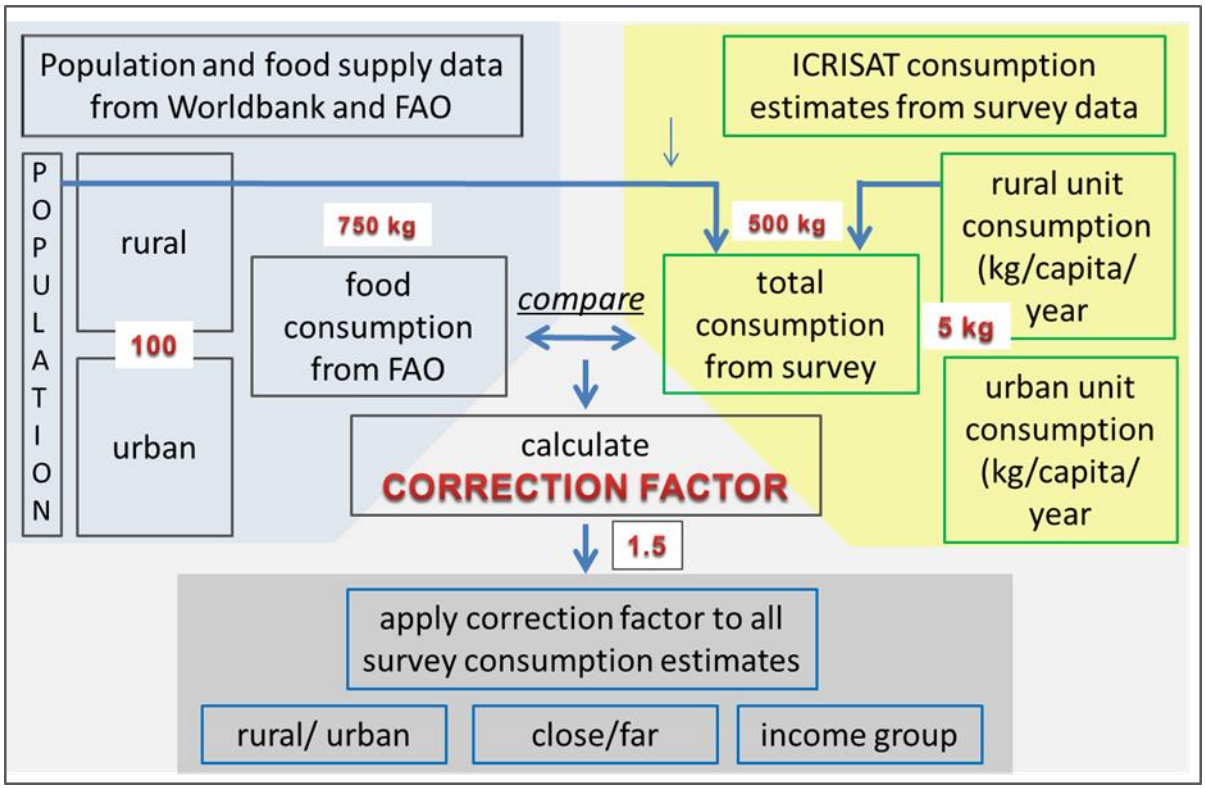
3.1. Adjusting ICRISAT consumption estimates

The national household expenditure surveys used by ICRISAT were made between 2004 and 2009. Since then, there has been significant population growth, and the production and domestic supply of cereals show a strong upward trend compared to the previous decade.

Special emphasis was therefore placed on updating the consumption estimates by using the most recent demographic data, in order to match the food supply situation in 2013.

Figure 2 explains the process of correcting consumption estimates by taking account of demographic and supply changes over the years, as reported by the World Bank and the FAO. The main consumption estimates from ICRISAT's consumption analysis based on national household expenditure surveys s are expressed in per-units (per capita and per adult equivalent) consumption per year at a country level or further disaggregated by rural and urban areas. If those figures are combined with the most recent population estimates (total, rural and urban) population then it is possible to calculate aggregate consumption.

Figure 2: Correction and update of consumption estimates to the year 2013



Source: own figure

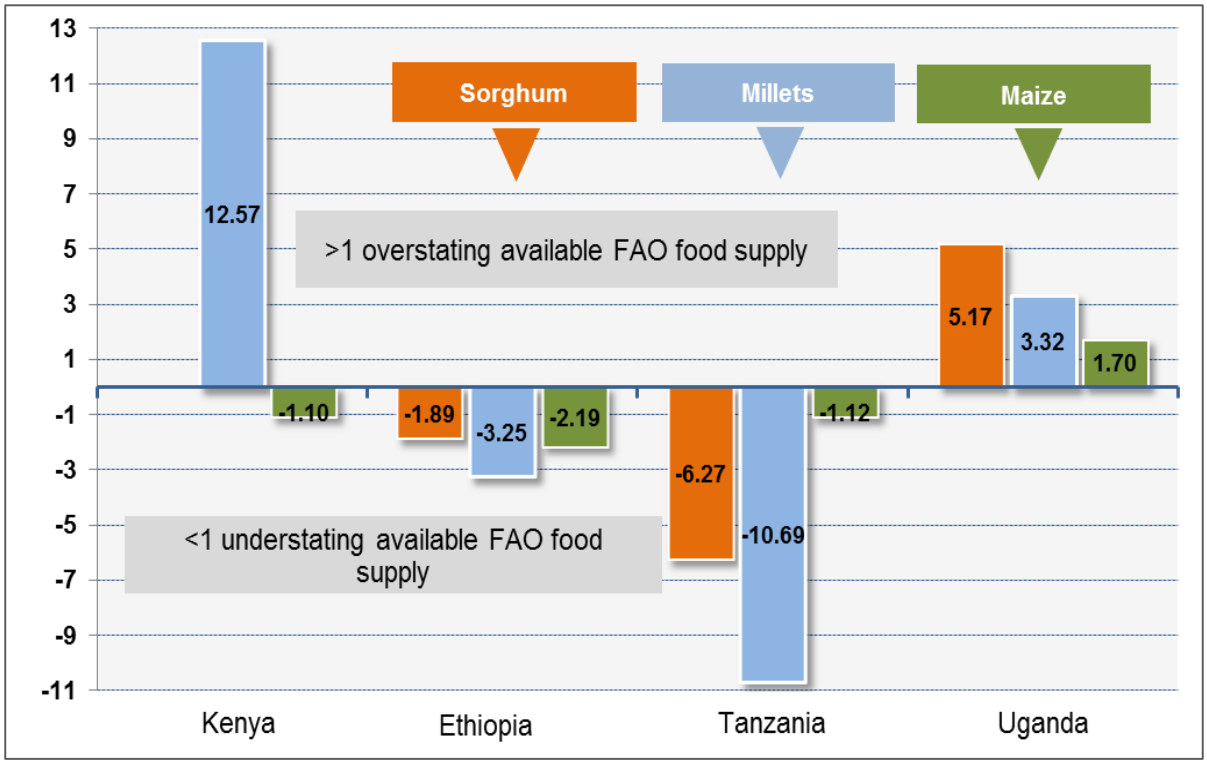
Comparing aggregate consumption levels derived from national household expenditure surveys with the actual supply situation in 2013 according to the FAO commodity balance sheets allows us to set a correction factor by which consumption estimates need to be adjusted in order to balance consumption levels reported in the surveys with FAO data. In making this adjustment, the structure of consumption by different categories (rural, urban, proximity to production areas, income level) was held constant, with only the level of per unit consumption being adjusted. Figure 2 contains a simple numerical example. With a population of 100 and 5 kg cereal consumption per capita and year from the national household expenditure surveys, total consumption accounts for 500 kg. If on the other hand total domestic consumption in 2013 is reported by FAO as 750 kg, then we have to apply a common correction factor of 1.5 to all the national household survey consumption estimates.

A comparison of the unadjusted consumption estimates per capita from the national household expenditure surveys with those derived from FAO data and population census data shows an astonishing mismatch. Figure 3 shows this mismatch for each country and

crop. For sorghum in Uganda, the value of 5.17 means that, if multiplied by the population in 2013, per capita consumption of sorghum given by the household expenditure survey in 2009-2010 overstates the actual food supply from the FAO commodity balance by a factor of 5.17. Another example: for millets in Ethiopia, the value of 3.25 means that, if multiplied by the population in 2013, the per capita consumption of millets given by the household expenditure survey in 2004-2005 understates the actual food supply in millets in 2013 by a factor of 3.25.

Figure 3 shows that the mismatch is highest for millets but lowest for maize. The large mismatch for sorghum and millets across the four countries points to a general sampling problem embedded in the national household expenditure surveys. Sorghum and millet consuming households are far fewer in numbers than maize consuming households and are largely found in remote areas. As a result, the sampling design and spatial coverage of these surveys may not have provided a representative coverage of households consuming sorghum and millets. Hence, these surveys generated unreliable consumption estimates for these crops. Country-wise, the quality of the estimates from the national expenditure surveys was better for Ethiopia while consumption estimates for Tanzania and Uganda were grossly out of range.

Figure 3: Mismatch between consumption estimates from national household expenditure surveys and FAO food supply estimates in 2013[3]



Source: own calculations

[3] All countries and crops under consideration are covered, except sorghum for Kenya. The number of sorghum consuming households in the Kenyan survey was not sufficient enough to derive meaningful consumption estimates

3.2. Conversion of 'per capita' into 'adult equivalent'

Adult Equivalent (AE) is the unit used measure annual consumption. Adult equivalent is a concept that distinguishes and weighs a person according to a person's need in terms of food, electricity, and other services. Equivalent scales allow comparisons of households of different sizes and age composition. There are several methods for measuring AE.[4] (see Table 2). We used the 'OECD-modified scale' which is widely accepted. The modified OECD uses 1.0 for the first adult, 0.5 for the second and subsequent adult and 0.3 for each child. Table 2 illustrates how needs are assumed to change as household size increases, for the three equivalence scales. The choice of a particular equivalence scale depends on technical assumptions about economies of scale in consumption as well as on value judgements about the priority assigned to the needs of different individuals such as children or the elderly. These judgements will affect results.

Table 2: Most common concepts of equivalence scale in demand analyses

	Equivalent scale				
Household size and age composition	Per capita income	'Oxford' scale (Old OECD Scale')	'OECD modified scale'	Square root scale	Household income
1 adult	1	1	1	1	1
2 adults	2	1.7	1.5	1.4	1
2 adults, 1 child	3	2.2	1.8	1.7	1
2 adults, 2 children	4	2.7	2.1	2.0	1
2 adults, 3 adults	5	3.2	2.4	2.2	1
Elasticity	1	0.73	0.53	0.5	0

Source: OECD 2014

Using household size as the determinant, equivalence scales can be expressed through an "equivalence elasticity", i.e. the power by which economic needs change with household size. The equivalence elasticity can range from 0 (when unadjusted household income is

[4] According to OECD (2014) the rationale for equivalence scales such as AE is that household types in a sample population need to be assigned a value in proportion to its member needs. The factors commonly taken into account to assign these values are the size of the household and the age of its members (whether they are adults or children). The needs of a household grow with each additional member but – due to economies of scale in consumption– not in a proportional way. Needs for housing space, electricity, etc. will not be three times as high for a household with three members than for a single person. A wide range of equivalence scales exist, some of the most commonly used scales include:

-OECD equivalence scale". This assigns a value of 1 to the first household member, of 0.7 to each additional adult and of 0.5 to each child. This scale (also called "Oxford scale") was mentioned by OECD (1982) for possible use in "countries which have not established their own equivalence scale". For this reason, this scale is sometimes labelled "(old) OECD scale".

-"OECD-modified scale". After having used the "old OECD scale" in the 1980s and the earlier 1990s, the Statistical Office of the European Union (EUROSTAT) adopted in the late 1990s the so-called "OECD-modified equivalence scale". This scale, first proposed by Haagenars et al. (1994), assigns a value of 1 to the household head, of 0.5 to each additional adult member and of 0.3 to each child.

-Square root scale. Recent OECD publications (e.g. OECD 2011, OECD 2008) comparing income inequality and poverty across countries use a scale which divides household income by the square root of household size. This implies that, for instance, a household of four persons has needs twice as large as one composed of a single person. However, some OECD country reviews, especially for Non-Member Economies, apply equivalence scales which are in use in each country.

taken as the income measure) to 1 (when per capita household income is used). The smaller the value of the equivalence elasticity the higher the economies of scale in consumption.

3.3. Market Prices and Elasticities

Price monitoring of agricultural products in ESA countries is fragmented. As a result, long term price series of dryland cereals need to be collected and blended from different sources leaving the problem of comparability, matching time periods and types of prices. The most suitable and comprehensive source of price data for cereals is the World Bank's Africa Development Indicators which provides producer prices for major agricultural products from 1991 until 2010. Unfortunately, price data are not available for Uganda. The second largest data set is the FAO Food Price Monitoring and Analysis Tool which includes monthly price data at wholesale and retail level. With regard to ESA countries, Ethiopia has the best coverage including all cereals except for millets. For Kenya, Tanzania and Uganda price data is only available for maize. The third comprehensive source of price data is the Regional Agricultural Trade Intelligence Network (RATIN) managed by the East African Grain Council. RATIN monitors daily and weekly prices of major staple crops (incl. sorghum and millets) for market places in five east African countries, but does not include Ethiopia. Long-term price series are not available.

The concept of 'elasticity' is a standard quantitative measurement in demand analyses which provides key information about the extend and direction of changes in demand under the influence of population growth, market prices, income as driving factors of demand and/or policy interventions into markets.

The Concept of Demand Elasticity (Ramskov and Munksgaard (2001))

In the theory of demand, elasticities are used to examine how sensitive the demand for a good is to changes in the price of the good itself, to changes in the price of related goods, and to changes in income. As the demand for a good depends on more factors than the price of the good itself we have to introduce various types of elasticities.

Income elasticity shows the percentage increase in the demand for a given good as a result of a percentage increase in income. Generally, the income elasticity for necessities is smaller than for luxury goods. So a reduction in income will not reduce the consumption of electricity, for example, to the same degree as the consumption of staple foods. In agriculture we see often expenditure elasticity instead of income elasticity as income is frequently approximated by household expenditure.

Own-price elasticity – or simply price elasticity as the concept is also known, , shows the percentage rise in the demand for a given percentage rise in the price of the good itself. As the demand curves generally have a negative slope the own-price elasticity turns negative too, which corresponds to a decline in the demand when the price increases. If for instance $|\in_P|$ =1, it means that a price increase of 1% will cause a reduction in the demand for a good of 1%.

Type of elasticity	Formula*	Values	Examples
Income elasticity	$\in_I = \frac{\frac{\partial C_i}{C_i}}{\frac{\partial M}{M}} = \frac{\partial C_i}{\partial M} \times \frac{M}{C_i}$	$\in_I$ =1 unit elastic $\in_I$ >1 luxury good $\in_I$ <1 inferior good	luxury goods: meat, fruits inferior goods: maize, sorghum, some roots & tubers
Own price elasticity	$\in_P = \frac{\frac{\partial C_i}{C_i}}{\frac{\partial P_i}{P_i}} = \frac{\partial C_i}{\partial P_i} \times \frac{P_i}{C_i}$	usually negative sign (except Giffen good) $\|\in_P\|$ =1 unit elastic	elastic: many luxury goods inelastic: basic needs staple foods

		$\|\epsilon_P\| > 1$ elastic $\|\epsilon_P\| < 1$ inelastic	
Cross-price elasticity	$\epsilon_{i,j} = \frac{\frac{\partial C_i}{C_i}}{\frac{\partial P_j}{P_j}} = \frac{\partial C_i}{\partial P_j} \times \frac{P_j}{C_i}$	$\epsilon_{i,j} < 0$ complementary goods $\epsilon_{i,j} > 0$ substitutive goods	complementary: maize vs beans substitutive: maize vs sorghum

*C= demand, M = income, P = price, i = good i, j = good j

Cross-price elasticity shows the percentage increase in demand for good *i* as a result of a percentage increase in the price of good *j*. Cross-price elasticity for products that complement each other or are close substitutes would have relative large numerical valyes. If there is a close substitution the cross-price elasticities will be positive as a price increase of good *i* will make the consumers substitute towards demanding good *j*. If *i* and *j* are complementary goods the cross-price elasticity will be negative. A reduction in the demand for good *i* as a result of a price increase of the good will also lead to a decreasing demand for good *j*. For goods that are neither close substitutes nor complementary goods the cross-price elasticity will be insignificant.

3.4. GIS Consumption Maps

This report incorporates two types of GIS maps that were produced from ICRISAT consumption figures for sorghum, finger millets and maize. The first shows 'per capita consumption' and the second absolute consumption. Generating GIS maps from cereal consumption figures faces several challenges in gathering additional information that allows accurate geospatial attribution of consumption estimates into GIS maps. The most detailed consumption analysis by ICRISAT differentiates consumption by 1) broader regions within a country, 2) further subdivision of the broader regions into rural and urban and 3) into proximity to production areas. The first division into broader regions is straightforward. The other two spatial criteria 'rural-urban' and 'proximity' require a sufficient data base and criteria to operationalize and arrive at a meaningful spatial allocation of consumption across GIS maps. In view of the underlying subjective assumptions in creating these GIS maps, they should be understood as merely indicative of the geographic patterns of consumption rather than showing the exact absolute and per capita levels in each of the administrative units. For a better understanding of the administrative structure and names within the GIS maps Table 3 depicts the different administrative levels and number of units for each country based on which the administrative divisions and consumption allocations in the maps are derived from.

Table 3: Administrative levels in ESA countries

	Kenya	units	Ethiopia	Units	Tanzania	Units	Uganda	Units
Admin level 0	country		county		country		country	
Admin level 1	province (prior to 2013)	8	region (kilil)	9	region	30	region	4
Admin level 2	county	47	zone (zone)	68	district	169	district	111
Admin level 3	sub-county	290	district (woreda)	770	division	n.a	county city council municipality	146 1 13
Admin level 4	ward	1450	ward (kebele)	approx. 10,000	ward	approx. 2,700	sub-county	n.a

Source: Wikipedia

As administrative boundaries changed frequently in ESA countries, especially in Uganda, most information were extracted from WIKIPEDIA. In some cases the exact numbers of lower-level units are unknown and were not found in WIKIPEDIA or official country documents.

In terms of data requirements for consumption maps the following types of primary and derived data are necessary:

- crop production;
- population;
- indicators/ratio of crop intensity (production per capita) and/or relative production shares among cereals (e.g. ratio of sorghum/maize production);
- appropriate indicator for 'proximity'; and
- consumption estimates, classified either rural/urban or 'proximity' to spatial GIS units

Production data for the GIS maps were retrieved from national crop statistics or from the 'MapSpam' crop data set that allowed acreage and production figures to be translated from the GIS master file into lower administration levels. Usually, national crop statistics were available at administration level 2 (districts) which sometimes lack sufficient spatial depth where the number of districts (alternatively county) are small, e.g. in Uganda.. Population data were available for ESA countries from population censuses and other sources that offer public access to data sets.

The major problem in population data with regard to GIS mapping for consumption is unavailability of disaggregated data on admininstration level 3 (sub-district, sub-county level) and the lack of further differentiation by rural and urban population. Where rural-urban population share is known at district level but not on sub-district level, all sub-districts are assigned the same rural-urban proportion as the district level. Doing so creates a small consumption bias within sub-districts of the same district[5] but remains fairly accurate at district level.

Once population and consumption for each GIS unit is known, it is possible to create consumption maps in the simplest form that differentiates consumption (absolute and per capita) by broader region and rural-urban cluster. More accurate GIS maps can be obtained by further subdividing rural and urban clusters using 'proximity' as the criterion. 'Proximity' to production areas as such can be defined in different ways, though all are subjective and have their own pros and cons. [6] This study applies crop production per capita as the criterion for 'proximity' (Table 4). One of the main advantages of this criterion is comparability between production per capita and consumption per capita which helps setting the benchmark for 'proximity' in comparison with consumption levels, which is not t possible with other types of criteria. Table 4 summarizes the benchmark levels which were chosen based

[5] As rural and urban sub-districts are assigned the same rural-urban percentage share in population, calculating consumption for rural sub-districts shows a downward bias as a consequence of the overestimating the urban share in population and higher consumption of sorghum, millets and maize in rural areas compared to urban areas.

6 Other possible criteria include absolute production by district or sub-district, and the ratio of production between sorghum, millets and maize.

on 1) relation to the per capita consumption levels and 2) adjusted downwards or upwards if aggregate consumption did not match national consumption levels.

Table 4: Setting consumption level benchmarks to define 'proximity' to production areas

	Sorghum		Millets		Maize	
	Consumption levels for 'proximity	National average	Consumption level for 'proximity	National average	Consumption level for 'proximity	National average
	kg/capita/year					
Kenya	not covered	2.7	> 0.4	1.6	> 50	94.3
Ethiopia	> 30	49.9	> 2	9.4	> 40	66.8
Tanzania	> 5	15.7	> 2.5	6.0	> 30	70.3
Uganda	> 4	7.2	> 2	5.4	> 30	53.1

Source: based on own estimates

4. Demographic Trends and Cereal Consumption

Domestic demand for food is driven by population growth. Distinguishing growth between rural and urban populations is important because of differences in food availability and preferences.

Population in the four ESA countries grew from 150 million in 2000 to over 225 in 2013 (Figure 4). The most populous country in 2013 was Ethiopia, with 94 million inhabitants. The annual rate of population growth was highest in Uganda (3.5 %), making it one of the 10 fastest growing populations in the world. Ethiopia reduced its population growth from 2.9% to 2.6% in the same period while in Tanzania the growth rate rose from 2.6% in 2000 to 3.1% in 2013.

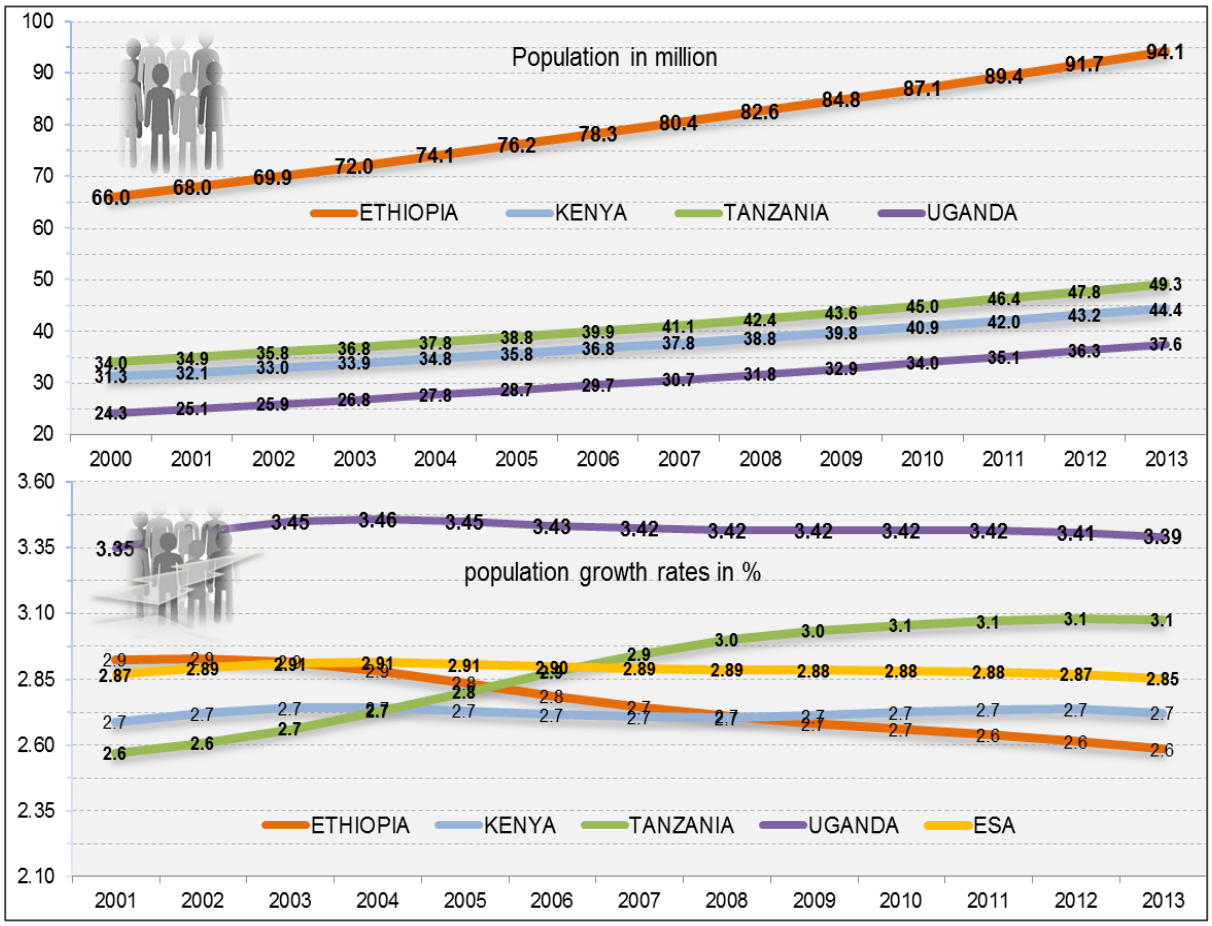
Urbanisation in ESA is growing rapidly, although the share of the rural population remains one of the highest in the world (Figure 5). For ESA as a whole, around 22% of the population lived in urban areas in 2013 compared to 17% in 2000. Growing urbanisation is a common trend with similar developments in all four countries. It seems urbanisation is gaining momentum especially in Tanzania where the rate of decline in the share of the rural population is still increasing.

The age composition of the population is also changing. The share of young people in the 0-14 year age bracket is declining in all countries except Tanzania, and is declining fastest in Ethiopia (Figure 5). This implies that the ESA region is experiencing an aging process, at least in the 0-14 year age bracket.

Urbanisation in conjunction with a declining share of minors may lead to a shrinking family size and number of children in the family. The long term trend in per capita food consumption can be measured by combining the figures for population from the World Bank indicators with the figures for food supply from the FAO commodity balance sheet. Since food supply is net of cross border trade and non-food uses, food supply in the FAO commodity balance is labelled as ‘supply for food consumption’. For convenience, we use this definition as equivalent to food consumption. Figure 6 shows that in most years food supply in the four ESA countries outpaced population growth. Consequently, food availability and food consumption per capita has improved. Figure 6 breaks down per capita consumption by type of cereal and by country. For the four ESA countries as a whole, per capita sorghum consumption increased over time from 14.9 kg/year to over 22.5 kg/year while maize consumption increased from 55 kg/year to 62 kg/year. By contrast, millets experienced a decline in availability and consumption over time. Consumption declined from 6 kg/year in 2000 to 5.7 kg/kg in 2013. The most likely reason for this was the dramatic decline in finger millet cultivation in Uganda after civil unrest in 2007.

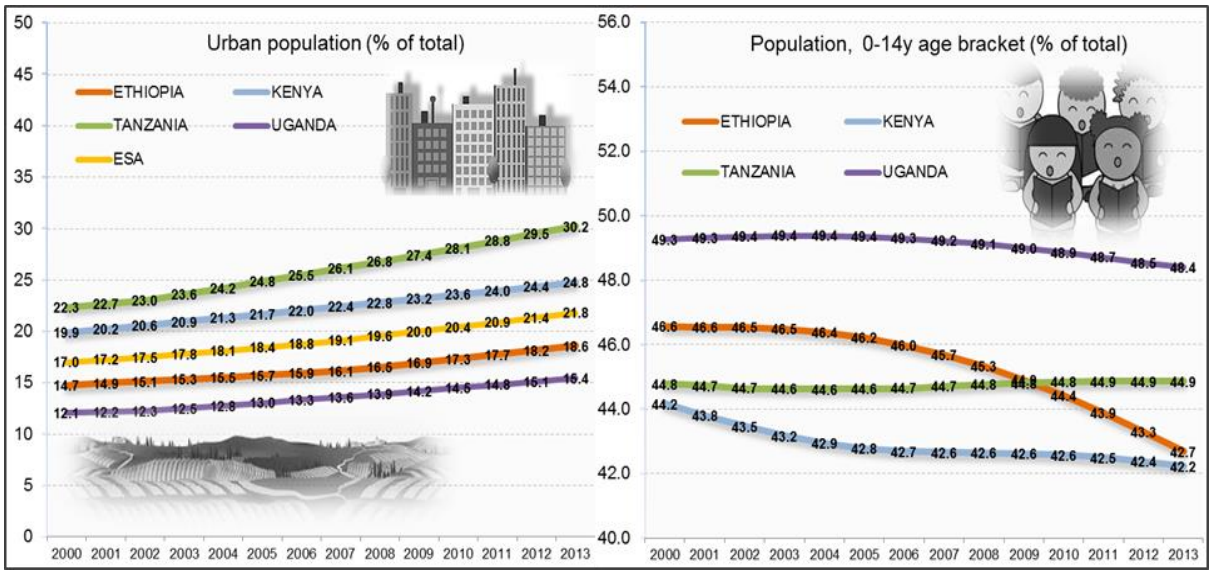
Kenya experienced large swings in food consumption during the past decade as a result of supply shortages, mainly due to drought. Swings can be observed for all three cereals but were most pronounced for sorghum, followed by maize. Kenya’s food consumption has not improved for the past 13 years. Maize consumption remained at 82 kg/capita/year, sorghum at 2.4 kg/capita/year and finger millets at 1.4 kg/capita/year. Interestingly, Kenya’s maize consumption is the highest and sorghum and millet consumption the lowest among the four countries.

Figure 4: Demographic development in four ESA countries (2000 – 2013)



Source: World Bank indicators, at http://data.worldbank.org/indicator/

Figure 5: Urbanisation and age composition in four ESA countries (2000-2013)

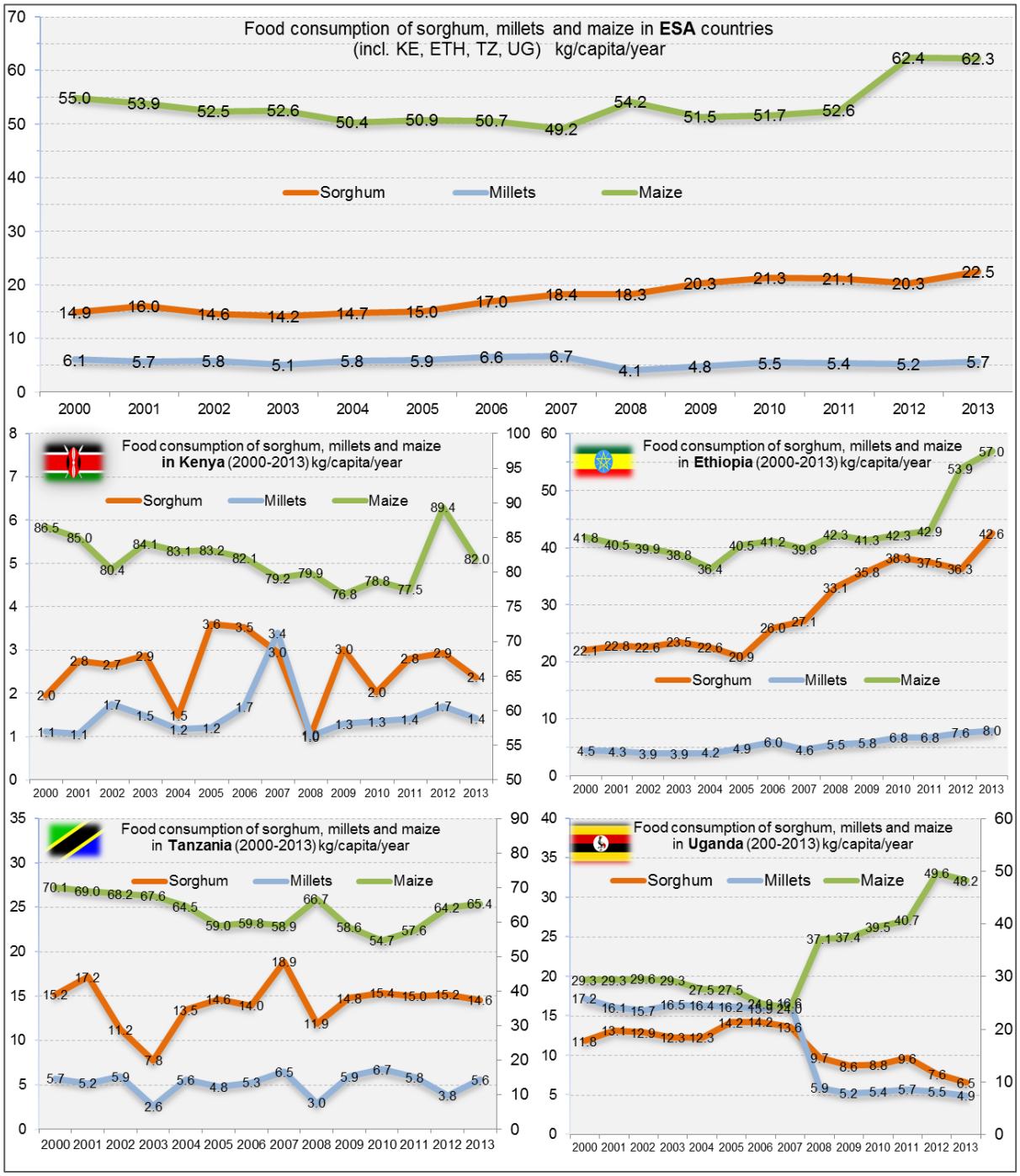


Source: World Bank database: http://data.worldbank.org/indicator/

Ethiopia is the only country where consumption has increased for all cereals. Sorghum consumption doubled from 22 to 43 kg/capita/year in 2013. Although finger millet has not been a prominent cereal in the past, the same increase is reported for finger millet, from 4.5 kg to 8 kg/capita/year in 2013. Maize increased from 42 kg/capita/year in 2000 to 57

kg/capita/year in 2012/13. Ethiopia has managed to escape the famines which affected the country in the past two decades by boosting cereal production, giving it the highest level of per capita consumption of sorghum and millets among the four countries under review.

Figure 6: Consumption of sorghum, millets and maize per capita/year (2000 – 2013)



Source: Own calculation, based on World Bank African Development Indicators and FAO commodity balance.

Tanzania's trend in food consumption is similar to Kenya's, despite its greater agricultural potential and larger arable land frontier. The consumption of maize, sorghum and millets in 2013 was the same as in 2000, with similar swings due to shortages in supply. Food availability and consumption level have stabilised over the past five years and show a slight

upward trend. Consumption levels are second to Ethiopia with regard to sorghum and millets and second to Kenya with regard to maize.

Food consumption in Uganda between 2000 and 2013 followed a different trend, experiencing a dramatic slump in production and the substitution of sorghum and millets by maize and other cereals. Political unrest in the North and Northeast region in 2007 led growers to suspend cultivation of sorghum and finger millet, resulting in a 50 % drop in production. From having the highest consumption of finger millet in the four countries (17 kg/capita/year), Uganda became the lowest consumer of these cereals. Consumers substituted maize for sorghum and millets. The consumption of maize rose from 25 kg/capita/year in 2007 to 50 kg/capita/year in 2012.

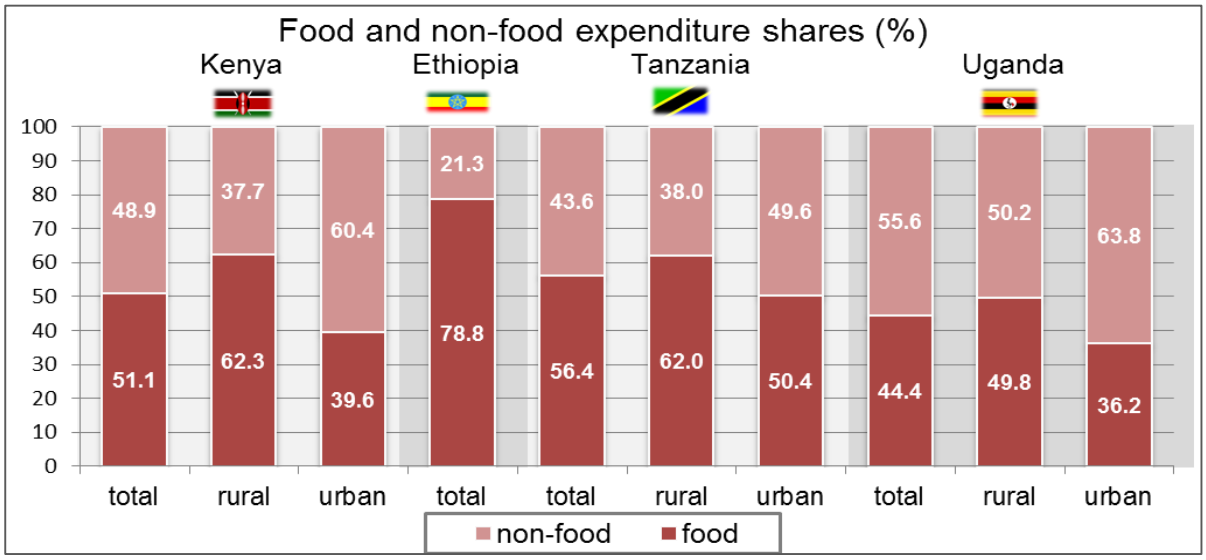
5. Household Food Expenditure and Composition

Food expenditure per household is a powerful indicator that reflects the state of development, private wealth, the nature of the agricultural sector, domestic trade in food and the structure of the agro-food and retail sector. Similarly, the share of food expenditure in total household income tells us much about poverty status, vulnerability to changes in food prices, and the affordability of non-food goods and services such as health, education and transportation. On the other hand, the composition of food consumption indicates a household's income level (staple foods vs processed and high-value foods), of the characteristics of agricultural production (subsistence vs market orientation), as well as the state of development of food markets, domestic trade and food retail systems. This section puts consumer demand for sorghum and millets into context, by analysing the overall pattern of food expenditure and composition. The section is structured around three food expenditure indicators:

1. Food versus non-food expenditures;
2. Decomposition of food expenditure into different food groups; and
3. Decomposition of cereal expenditures by type of cereal.

Figures 7-9 provide a cross-country comparison for all three indicators. Despite similar levels of income (GDP per capita ranges between 600 – 800 USD/year) the results show significant differences in the level and composition of food consumption between countries. Ethiopian households spend 79 % of their income on food compared to just 44% in Uganda. Rural households spend an average of 10 % more on food compared to urban households; this is mainly due to differences in rural-urban income levels. Similar differences exist in food composition. In terms of expenditures, cereals are the predominant food group in Ethiopia (49 %) but much less so in Kenya (21 %) and Uganda (26 %). In terms of expenditure on different cereals, maize dominates by a large margin in Tanzania (71 %), Uganda (69 %) and Kenya (53 %), but not in Ethiopia (23 %) where expenditure on cereals is more diverse. Expenditure on sorghum and millets is a relatively small proportion of total expenditure on cereals.

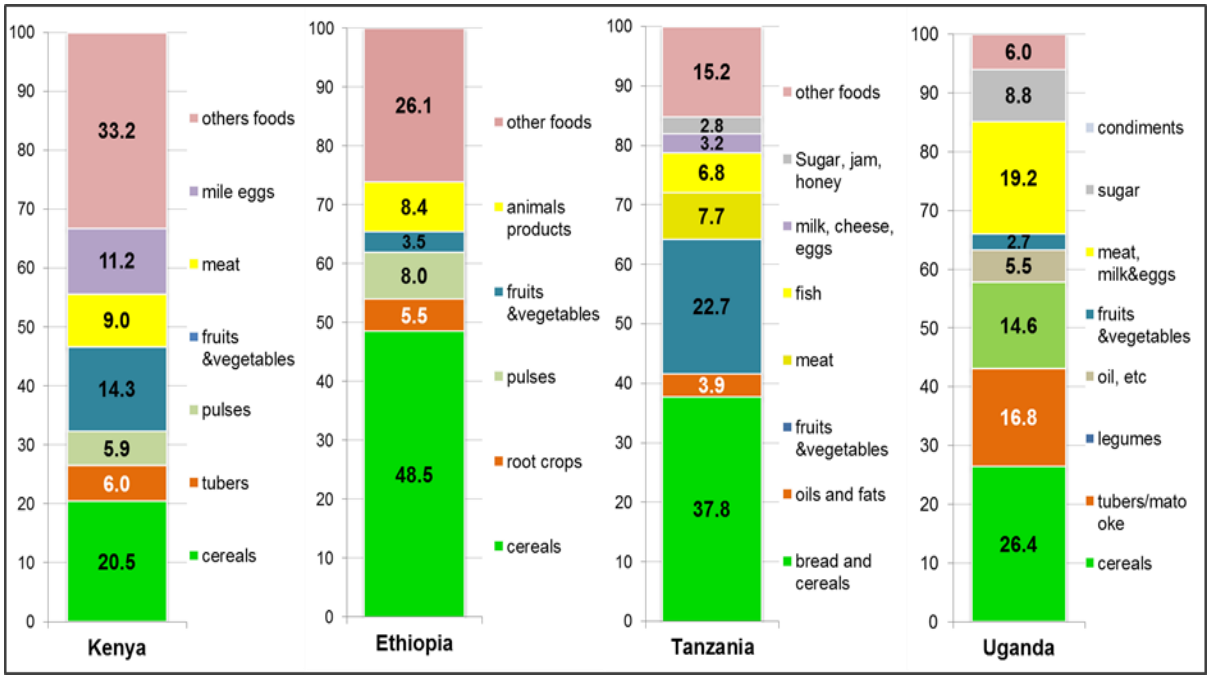
Figure 7: Food and non-food expenditure shares in ESA (%)



Source: own figure

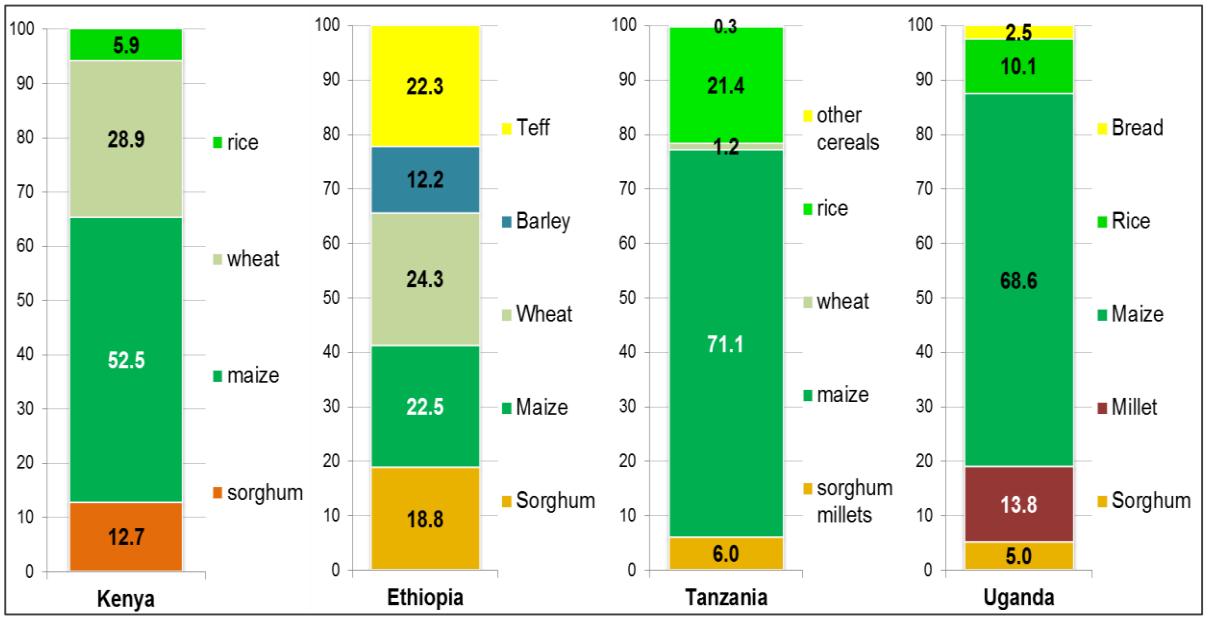
As a share of total expenditure on cereals, expenditure is highest for sorghum in Ethiopia (19 %), followed by Kenya (12 %). Expenditure on millets is highest in Uganda where it forms 13 % of total expenditure on cereals.

Figure 8: Composition of food expenditure shares in ESA (%)



Source: own figure

Figure 9: Composition of cereal expenditure shares in ESA (%)



Source: own figure

5.1. Kenya

The *Basic Report on Well-being in Kenya* provides a comprehensive overview of household expenditure patterns based on the Kenya Integrated Household Budget Survey for 2005/06 [7] (Ministry of Planning and National Development, 2007). The *Basic Report* classifies consumer items into two broad categories: food and non-food. Mean food expenditure per month and per adult equivalent was KSh 1,453 in rural areas and KSh 2,642 in urban areas (Table 5). Interestingly, average total household expenditure in rural areas (Ksh. 2,331) is less than half the average total expenditure of urban households (Ksh. 6,673), which underlines the rural-urban disparity in poverty and income in Kenya.

Table 5: Mean monthly food and non-food expenditures per adult equivalent (KSh/household)

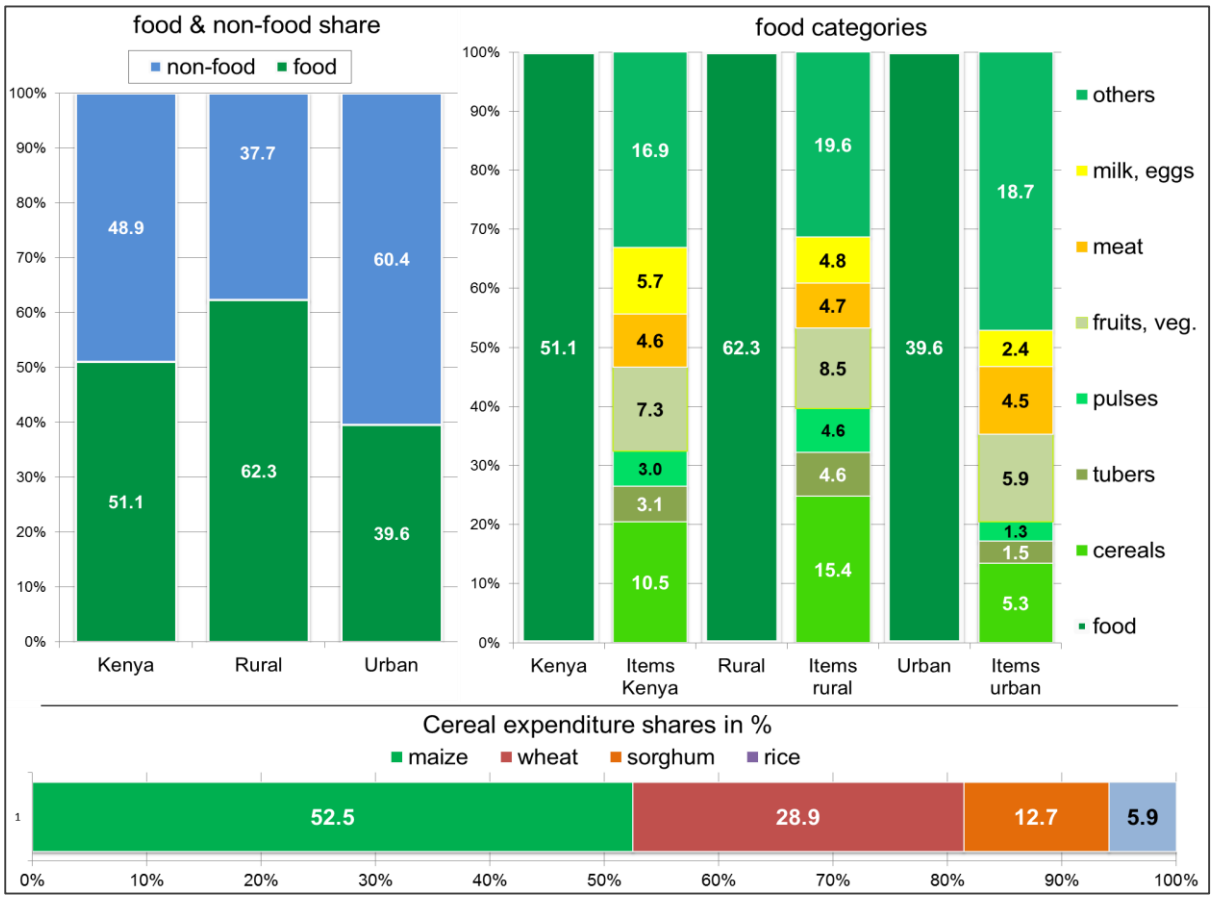
	food	non-food	total
Kenya	1,754	1,678	3,432
total rural	1,453	878	2,331
total urban	2,642	4,032	6,673

Source: Ministry of Planning and National Development 2007

At the national level, overall food expenditure accounts for 51 % of total household expenditure (Figure 10). Expenditures is higher in rural areas (62 %) compared to urban areas (40 %). The right-hand side of Figure 10 disaggregates expenditures by food items. In rural areas, expenditure on staples (cereals, tubers and pulses) is higher (25 %) than in urban areas (13 %) where consumers spend proportionately more on higher value items like fruits, vegetables, meat, and poultry.

[7] According to the KNBS, household consumption expenditures refer to goods and services intended for consumption, plus the value of goods and services received as income in kind and consumed by the household or individual members thereof. Household consumption expenditure excludes income tax and other direct taxes, pension and social security contributions and assimilated insurance premiums, remittances, gifts and similar transfers by the household as a whole and its individual members.

Figure 10: Food and non-food expenditure shares in Kenya (%)



Source: own Figure, based on Ministry of Planning and National Development (2007), Nzuma, JM, and Sarker, R (2008)

The household expenditure survey collected data on four sources of consumption: purchases, own production, own stock, and gifts. Overall, 54 % of food consumed in rural areas came from purchases, with a high of 59 % for North Eastern province. The share of own produce was 27 %, with the lowest in the North Eastern (10 %) and Coast provinces (22 %). In the urban areas, the share of purchases was 80 %. Compared to larger urban centres (Nairobi, Mombasa, and Kisumu), Nakuru and the 'other urban' category had a higher proportion of food consumption from own produce, because they contained peri-urban clusters where some farming took place. Expenditures can be disaggregated further according to the type of cereal (Nzuma and Sarkar, 2008). Maize had the highest share, accounting for 53 % of total expenditure on cereals (lower part of Figure 10). The budget shares for wheat and sorghum were 29 % and 12 %, respectively, while the budget share for rice was only 6 % of total expenditure on cereals. These budget shares closely track the actual pattern of cereal consumption in Kenya.

The effect of income on food expenditure has been studied for urban households in Nairobi (Kamau et al., 2011). Between 2003 and 2009, monthly household expenditure increased from Ksh. 27,301 to Ksh. 37,830 in nominal terms, an increase of 40 % (Table 6). This increase was biased towards the rich, however. For the highest income quintile, household food expenditure more than doubled, while for the lowest income quartile it rose by only 9 %. Another change was the growing expenditure wedge between the rich and poor. In 2003, the top income quintile spent five times more than the bottom quintile. By 2009, the top income quintile spent ten times more than the bottom quintile (Ksh. 140,828 per month and KSh.

13,979, respectively). Adjusted for inflation, total expenditure declined for all income quintiles between 2003 and 2009. The results show a modest 3 to 6 % decline for the second, third and fourth quintiles, but a massive 55% decline for poorest households in the bottom quintile. However, Kamau et al. (2011) suggest that the large decline in the lowest quintile may be partly attributed to an error in the earlier (2003) survey in which households belonging to a higher income group were mistakenly included in the lowest income group.

Table 6: Monthly total and food expenditure in Nairobi , 2003 and 2009 (KSh/household).

Total and food expenditures (nominal in 2003 and 2009)								
	Total expenditures			Food expenditures			Food expenditure share (%)	
income quintile	2003	2009	change (%)	2003	2009	change (%)	2003	2009
lowest	12,841	13,979	9	3,208	6,876	114	25.0	49.2
2	11,859	19,117	61	3,900	8,467	117	32.9	44.3
3	15,852	25,231	59	5,766	10,256	78	36.4	40.6
4	24,799	40,712	64	7,396	13,964	89	29.8	34.3
highest	70,114	140,828	101	17,793	21,934	23	25.4	15.6
sample average	27,301	37,830	39	7,536	11,155	48	27.6	29.5
inflation adjusted total and food expenditures (base = February 2009)								
lowest	21,728	13,979	-55	5,428	6,876	21	25.0	49.2
2	20,066	19,117	-5	6,599	8,467	22	32.9	44.3
3	26,822	25,231	-6	9,756	10,256	5	36.4	40.6
4	41,961	40,712	-3	12,514	13,964	10	29.8	34.3
highest	118,636	140,828	16	30,107	21,934	-37	25.4	15.6
sample average	46,195	37,830	-22	12,751	11,155	-14	27.6	29.5

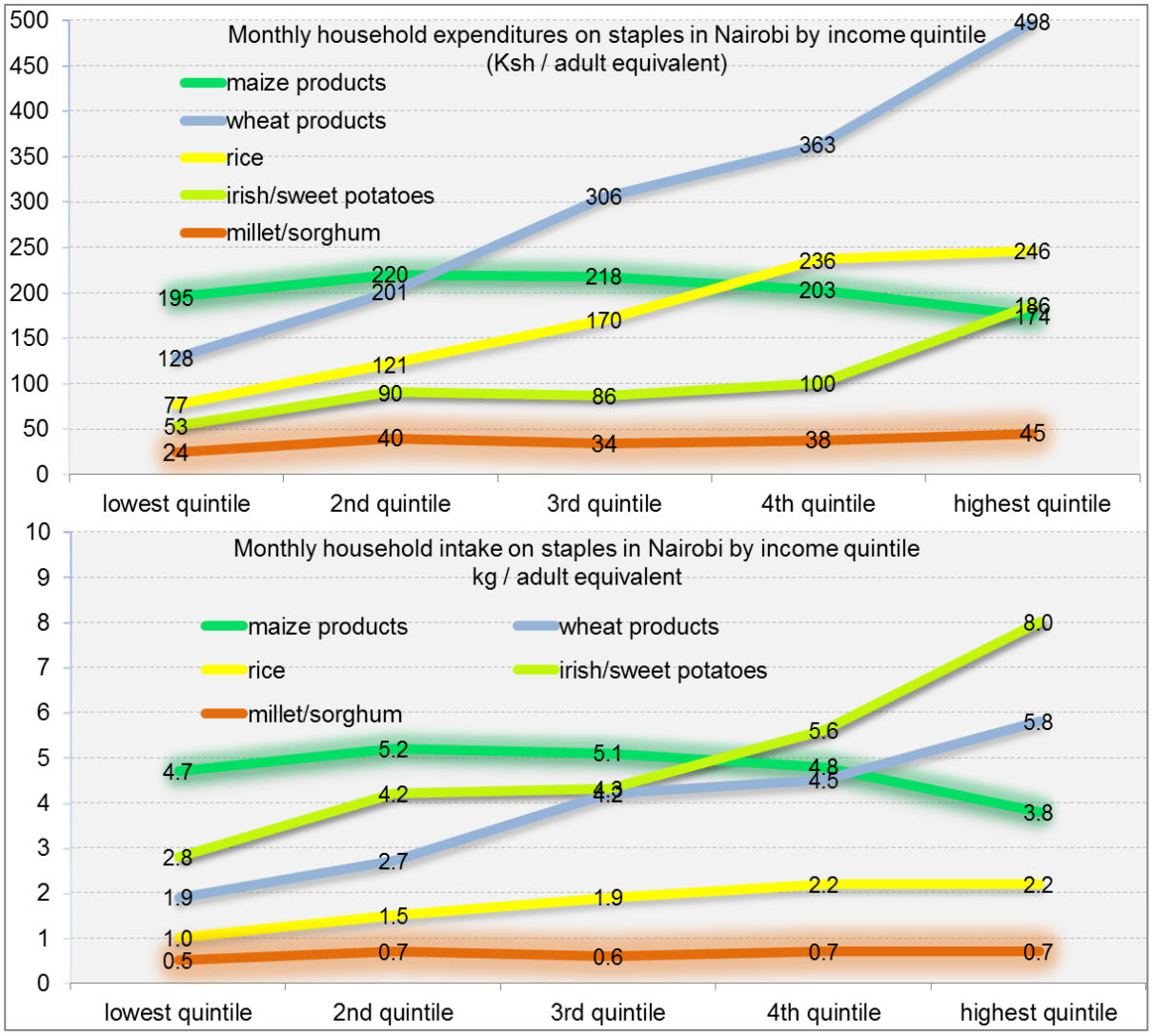
Source: Kamau et al. (2011)

On the food expenditure side, we observe two distinct patterns. In 2003, the share of food expenditure grew with increasing income for the lowest three income classes while in 2009, they moved in the opposite direction to income. On average, 28% was spent on food in 2003 which increased slightly to 30% in 2009. An alarming development was the rise in share of food expenditure for the lowest income quintile, which doubled from 25% to 49%. This indicates severe food price inflation in Nairobi, which increased the burden on poor households to feed their families. Household expenditures on food in real terms have increased for all but the top quintile. Food expenditure increased by 21% and 22% for the first and second quintiles, respectively, and by 5% and 10% for the third and fourth quintiles, respectively. Since total expenditure declined while expenditure on food increased, this suggests that, except for the top quintile, households in Nairobi were worse off in 2009 than in 2003.

Consumption of staple foods in Nairobi varied according to income (Kamau et. al. 2011). Monthly consumption of staples ranged from 14 to 30 kg per capita, averaging 21 kg (Figure 11). Among low income households (the first three quintiles) the most popular staple was maize, with monthly consumption of 4.7 to 5.1 kg of maize per adult equivalent. Potatoes and wheat ranked second and third. By contrast, among higher income households (fourth and fifth quintiles) the most popular staples were potatoes (8.0 kg) and wheat (5.8 kg). Among higher income households, wheat has overtaken maize in terms of quantity

consumed and expenditure. Consumption of sorghum/millet was the lowest among staples. However, consumption rose with income from 24 kg in the bottom quintile to 46 kg per adult equivalent in the top income quartile. This suggests that sorghum/millet is not an inferior good, although the rise in consumption with higher incomes was less pronounced than for potatoes and maize.

Figure 11: Household intake and expenditure on staples in Nairobi by income quintiles



Source: data from Kamau et al. (2011).

As well as eating more wheat, higher income urban households are also changing where they shop. The majority of households (64%) in the poorest income quintile purchase food in open markets and small retail shops or *dukas* (Muyanga et al.,2009). By contrast, the top income quintile buy food in supermarkets. Thirty seven percent of food expenditure among the top income quartile takes place in large supermarkets and 11% in smaller supermarkets (Muyanga et al. (2009). The emergence of supermarkets in Nairobi and regional cities is associated with increased consumption of processed foods and reduced dietary diversity (Rischke et. al., 2014).

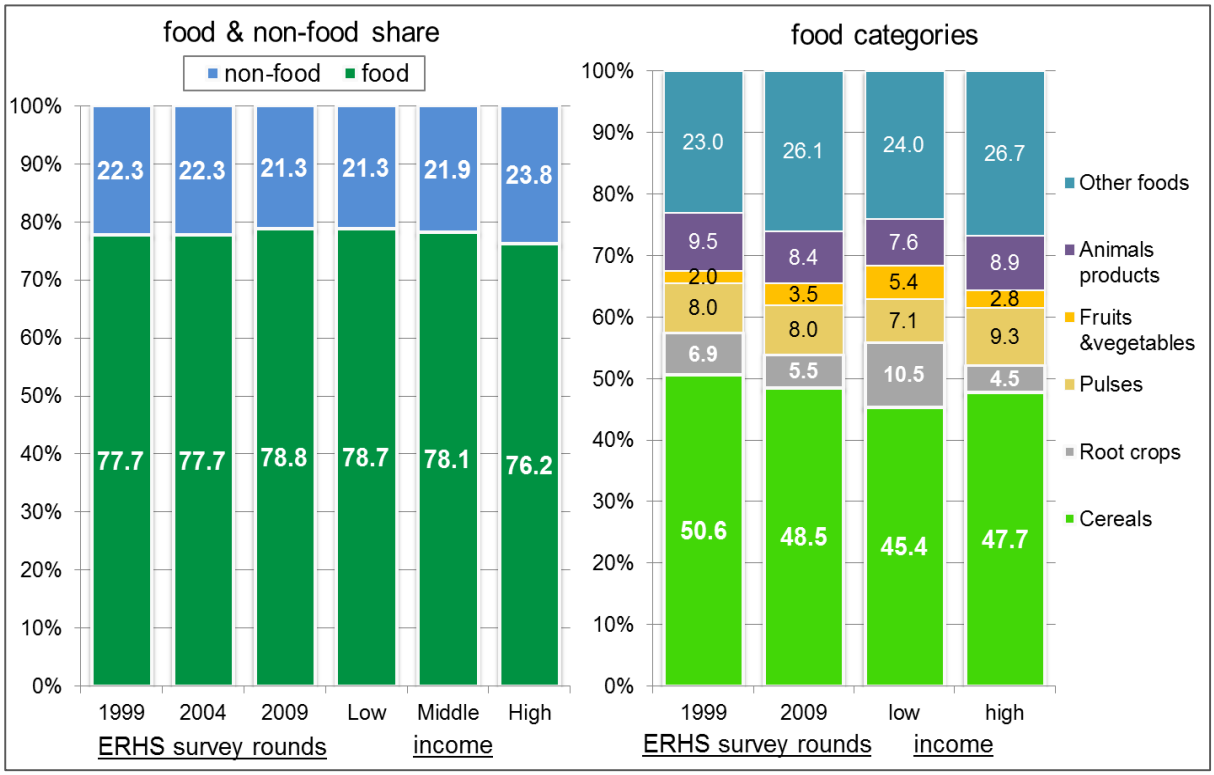
5.2. Ethiopia

Despite rising incomes over the past few decades, food still accounts for 78 % of household expenditure. There is little difference between the low income (79 %) and the top income group (76 %). This is typical for the 'least developed' developing countries (LLDC), where household food expenditure increases with income until a nutritional threshold is reached. Between 1994 and 2004, the share of food consumption in food expenditure rose by 1 % and at a similar rate between 2004 and 2009. Clothing accounted for 7% while housing, health, education and transport as well as household consumables accounted for 2-4 %.

Compared to other countries in eastern Africa, food consumption patterns in Ethiopia are more diverse, and no one crop dominates the national food basket. However, the level of consumption and the mix of staple grains vary seasonally and between regions. Traditionally, rural Ethiopians eat what they themselves produce, reflecting poor market linkages and the need to be self-sufficient. The diversity in consumption patterns across Ethiopia is explained by variations in rural and urban livelihoods and patterns tend to be stable over time (Berhane et al., 2011).

Figure 12 presents budget shares for different food categories and for different income groups. Cereals (*tef*, barley, wheat, maize and sorghum) are the major staples and account for 45-50 % of the household's food budget. Across income groups, cereal consumption between high and low-income groups differs by only 2 %. Maize consumption dominates (13 %), followed by wheat (9 %) and *tef* (8 %) (Table 7). With rising income, the composition of food expenditure has changed over time. The budget share of cereals as a group stayed constant but the consumption of *tef* and to a lesser extent wheat and barley expanded while all other cereals remained constant or experienced a slight decline.

Figure 12: Food and non-food expenditure shares in Ethiopia, 1999-2009 (%)



Source: Tefera et al. (2012), computation from ERHS panel data

Cereal consumption was higher in Ethiopia than in the other three countries studied. The average Ethiopian consumes about 150 kg of cereals per year (Table 7). Consumption levels are slightly higher in rural than in urban areas (152 and 137 kg, respectively). Maize is the most important cereal (38 kg per head) followed by sorghum (32 kg), wheat (30 kg), and *tef* (26 kg). Barley is the least important of the five cereals consumed (13 kg).

Consumption patterns were determined more by location than by income. First, processed cereals were more popular in urban areas (32 kg per capita) compared to rural areas (8 kg). Second, in urban areas, *tef* (61 kg) and wheat (20 kg) were more popular than maize (10 kg) and sorghum (9 kg) (Table 7). Urban consumers ate three times as much *tef* as their rural counterparts. In terms of expenditure share, *tef* remains prominent in urban diets (25 %) followed by wheat (10 %), maize (6 %) and sorghum (5 %). Maize and sorghum consumption was largely confined to rural areas. Third, the share of expenditure on different cereals did not differ much between the bottom 40% and top 60%, except for consumption of *tef* among the urban rich. On average, cereals accounted for half (46 %) of all food expenditures, with the share of expenditure higher among the bottom 40 % than among the top 60 %. As elsewhere, rich urban consumers shift consumption from cereals to higher-value food products, including meat, dairy products, fruits and vegetables, as well as to other non-food consumption items.

Table 7: Consumption and expenditures of cereals in Ethiopia

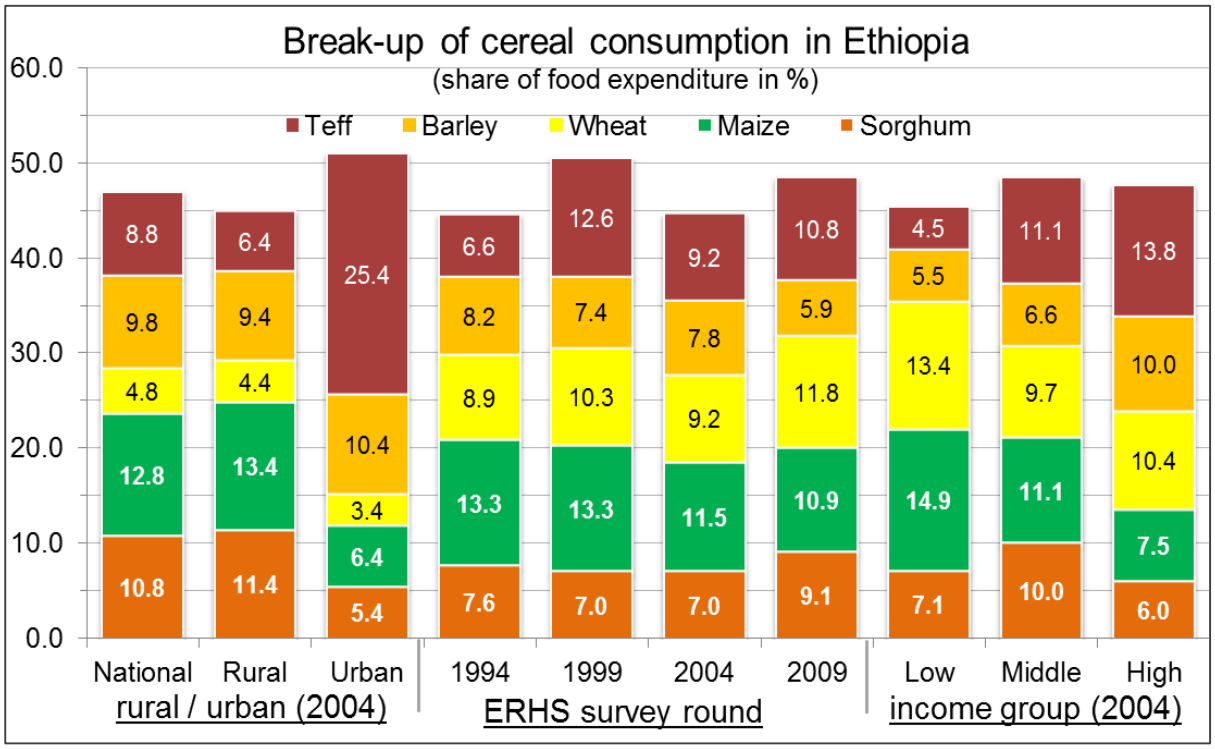
	Per capita consumption (kg)			Share in food consumption expenditures (%)						
				All			Bottom 40%		Top 60%	
	National	Rural	Urban	National	Rural	Urban	Rural	Urban	Rural	Urban
Teff	25.9	20.1	61.4	8.0	6.0	23.0	7.9	17.3	7.3	16.4
Wheat	29.6	31.2	20.2	9.0	9.0	8.0	9.8	6.0	9.5	4.3
Barley	12.8	14.3	3.8	4.0	4.0	1.0	5.5	1.3	4.7	0.9
Maize	37.7	42.2	10.4	12.0	13.0	4.0	11.1	3.2	9.1	1.2
Sorghum	**32.2**	**35.9**	**9.3**	**10.0**	**11.0**	**3.0**	**9.9**	**2.7**	**8.9**	**1.3**
Other cereals	11.4	8.1	32.2	4.0	2.0	12.0	1.7	1.2	1.7	0.7
Processed cereals							1.3	14.3	1.6	11.6
Total cereals	**149.6**	**151.7**	**137.2**	**46.0**	**46.0**	**51.0**	**47.0**	**46.0**	**43.0**	**36.0**

Source: Berhane et al. (2011), based on HICES of 2004/2005

Compared with the HICES 2004/05 data as used by Berhane et al. (2011) in Table 7, the Ethiopian Rural Household Survey (ERHS) for 2004 reports similar expenditures on different cereals (see Figure 13). At the regional level, consumption levels varied according to income. Real per capita consumption levels are highest in Addis Ababa, followed by Harari and Dire-Dawa, with Amhara, Oromia, Benshangul-Gumuz, and Somale regions having the lowest consumption levels between 1995/96 and 2004/05 (Table 8). There were substantial interregional variations in the share of major cereals. Tigray allocated more than half of its food budget to the five major cereals, while Amhara, Dire-Dawa and Oromia allocated 50%, 45% and 45%, respectively. The correlation between poverty and cereal expenditures seems to be weak. The main production areas of cereals (Oromiya, Amhara and Tigray) have similar poverty rates in terms of head counts (between 28.7% and 31.8%) which are coupled with similar shares in cereal expenditures, between 45% and 50%.

Cereal expenditures are lowest in the poorest regions of Ethiopia, namely Afar and Somale in nominal and relative terms (between 35.8% and 37.4%. This does not imply a general conclusion that cereals are less important for poor rural households, which would be counter-intuitive to previous findings in this report, but rather refers to the particular nature of Afar and Somale being dominated by pastoralist societies. Given poor market integration, the high proportion of own consumption and inefficiency in the mobility of goods, regional consumption variations reflected regional specialisation in cereals.

Figure 13: Cereal expenditure pattern in Ethiopia according to ERHS, 2004 (%)



Source: Tefera et al. (2012), computation from ERHS panel data

In general, there are two main groups of regions in Ethiopia where sorghum consumption and expenditures are either high or very low. Consistent with its production per capita, the Benishangul Gumuz region was the largest consumer of sorghum in terms of expenditure shares (21.9%), followed by Tigray (13.7%) and Amhara (9.6%). However, sorghum never becomes the prime cereal (except for Benishangul Gumuz) but is always surpassed by *tef*, wheat or maize. The regions with low expenditures on sorghum are the capital Addis Ababa, Afar and SNNP (Table 11). There are exceptions to the rule of high production coupled with high consumption and expenditure shares. This is not the case for all grains, especially *tef*. Berhane et al. (2011) report that in 2003/04 Oromia was the highest tef producer after the Amhara region, both in terms of total and per capita production (EEA 2004, 56). However, Oromia's share of consumption expenditure on tef (8 %) is only a little less than the share for maize (11 %) and wheat (10 %), and not comparable to its contribution in tef production compared to Amhara, which is 13 %. Tef had the highest share of regional food expenditure in Addis Ababa, followed by Amhara and Tigray. *Tef* was therefore more widely traded than any other cereal.

Table 8: Share of major cereals in total food expenditures by region, 2004/05

Region	Per capita. expenditure in Birr	Poverty level % P0[1)]	Share in total food expenditures (%)						
			Tef	Wheat	Barley	Maize	Sorghum	Other cereals	Total Cereals
Tigray	1,771	31.8	10.2	13.1	7.0	2.7	**13.7**	3.7	50.4
Afar	1,923	36.1	9.6	10.0	0.2	6.3	**1.4**	8.3	35.8
Amhara	1,548	30.5	12.8	10.4	6.7	5.3	**9.6**	4.5	49.3
Oromiya	1,737	28.7	8.2	9.6	4.7	10.8	**7.9**	3.8	45.0
Somale	1,651	32.8	1.0	9.7	0.8	7.0	**8.1**	10.8	37.4
Benishangul Gumuz	1,822	28.9	5.2	0.9	0.2	8.4	**21.9**	7.5	44.1
SNNP	1,594	29.6	4.0	5.5	1.5	11.9	**5.7**	4.5	33.1
Harari	2,532	11.1	6.0	7.0	0.4	1.9	**9.4**	12.9	37.6
Addis Ababa	2,577	28.1	19.6	3.4	0.5	0.5	**0.1**	17.1	41.2
Dire-Dawa	2,128	28.3	5.8	7.4	0.7	0.7	**9.2**	21.5	45.3

Source: Berhane et al. (2011), based on HICES of 2004/2005, [1)] Federal Democratic Republic of Ethiopia (2012), based on HICE survey of 2010/11

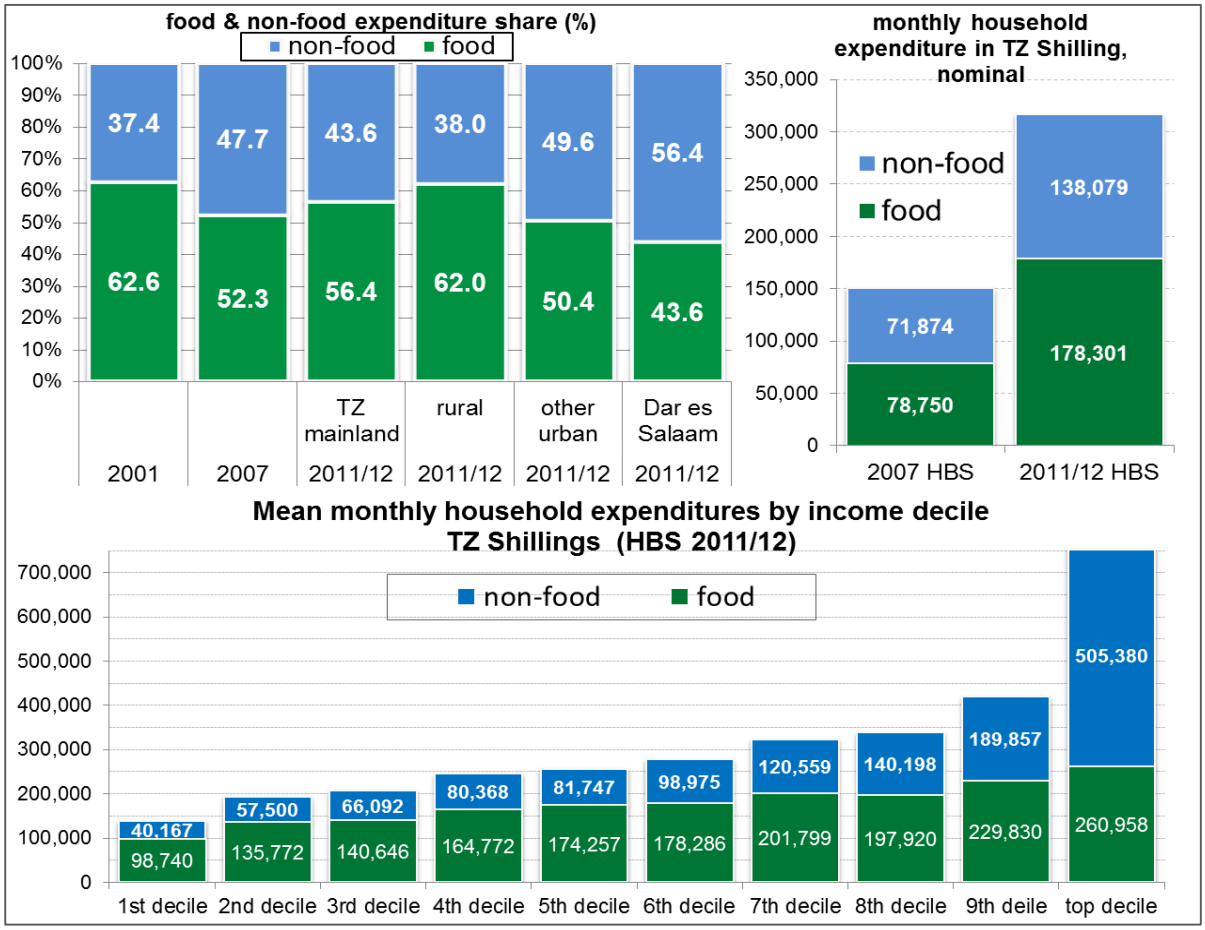
Wheat accounts for more than 10% of the food budget in many regions, including Tigray, Amhara, Oromia, Somale, and Afar. In line with earlier findings, the expenditure share of processed cereals (and other cereals) is highest in the urban regions of Dire-Dawa, Addis Ababa, and Harari. Overall, contrary to the urban regions, the lowland, pastoral regions of Afar, Somale, Harari, and especially the SNNPR, are among the lowest consumers of cereals in Ethiopia.

5.3. Tanzania

Food dominates household expenditure, accounting for 56 % of total expenditure in 2012 and 52.3 % in 2007 (Figure 14). Food expenditure was higher in rural areas (62 %) than in Dar-es-Salaam (44 %), indicating a large gap in income between the capital and rural Tanzania. In other urban areas the share of food (51 %) and non-food (50 %) expenditure was almost equal. The share of expenditure on food increased over time, possibly because of slow income growth and/or rising food prices. Price trends show a strong spike in cereal prices starting in 2007. However, household expenditures almost doubled in nominal terms from 72,000 Tsh/month in 2007 to 130,000 Tsh/month in 2011/12.

Figure 17 shows variations in the share of food and non-food expenditure according to income (results for 2007 are included in the Appendix). Income levels are shown in deciles. Among the richest decile, expenditure was seven times higher (TSh 700,000) than for the poorest decile (TSh 110,000). The poorest spent 70% of their income on food, while the richest spent only 30 %. The income gap has widened since 2007, when it stood at 63% for the poorest and 37% for the richest. The expenditure pattern in the food group confirms the statement of sluggish growth between 2007 and 2011/12. Relative consumption of staple foods (cereals, roots and tubers, pulses) increased while that of more expensive items such as meat, oil seed, fruits and vegetables decreased. Cereals made up 35% of the food bill in 2011/12 but only 32% in 2007.

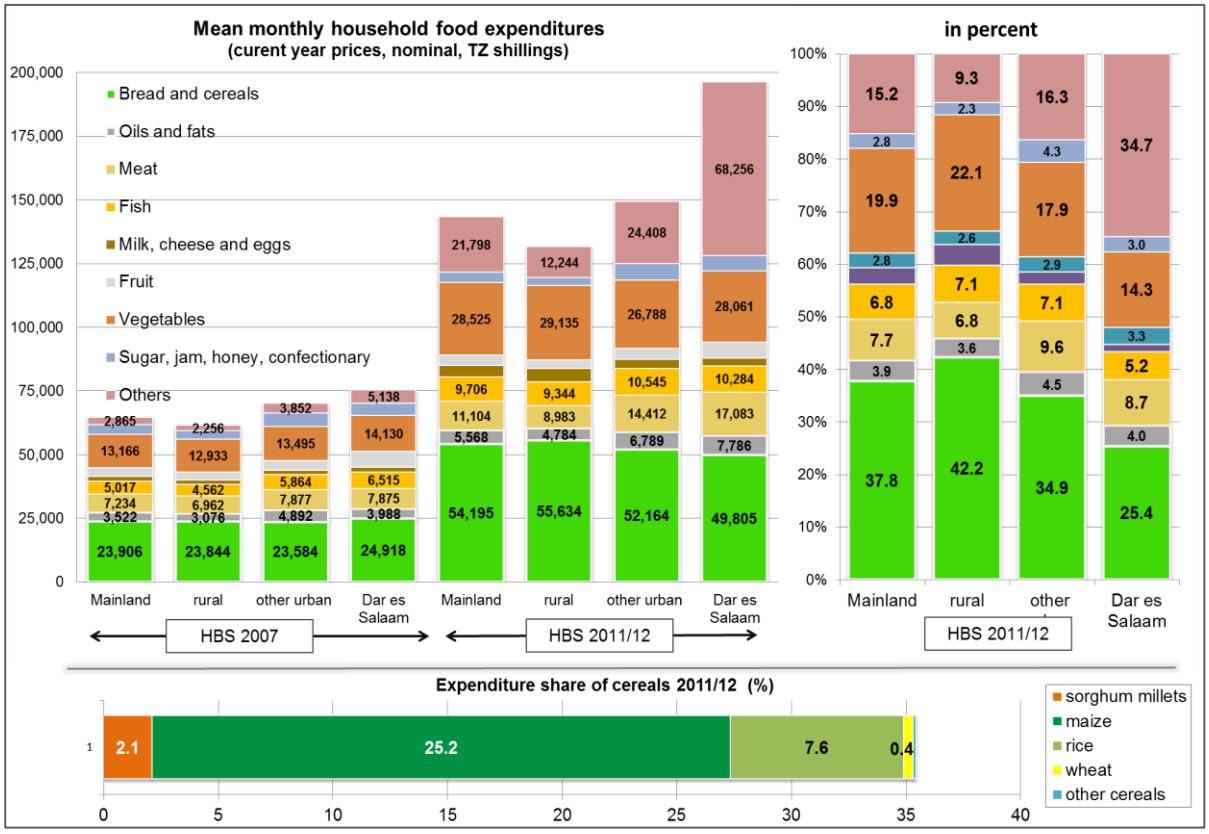
Figure 14: Food and non-food expenditure share in Tanzania (2001-2011/12)



Source: National Bureau of Statistics 2014b

Rural and urban food consumption was very different, a finding confirmed by analysis in Section 6. Figure 15 shows that cereals and cereal products are the most important food group in Tanzania, with an expenditure share of 38%, but cereals are twice as important in rural areas (42%) than in urban areas (25%). The breakdown of expenditures by type of cereal shows that the share of sorghum and millets is low (2 %), contradicting the high level of domestic supply during this period. Maize takes a 25% share in total food expenditure, or over 70% of total expenditure on cereals. Rice has gained momentum in production and consumption, with a budget share of 8 %, or 20% of total expenditure on cereals. In contrast to other countries in the region where cereal consumption is more diverse, consumption in Tanzania is ruled by maize.

Figure 15: Food expenditure pattern in Tanzania (2007-2011/12)



Source: National Bureau of Statistics 2014b

Table 9 shows cereal consumption across Tanzania's regions in 2004, based on the analysis by Smith and Subandoro (2007), while Table 10 shows consumption by level of income. At national level, sorghum consumption was estimated at 14.5 kg/capita/year. Sorghum consumption was highest in rural regions (18 kg/capita/year) and over ten times higher than consumption in urban areas. This confirms the perception of sorghum as an inferior 'poor man's crop'.

Rural consumption was uneven, with the highest consumption levels found in the three biggest producing districts of Dodoma, Singida and Shinyanga, where consumption reached 50 – 70 kg/capita/year. In regions where sorghum production was less important, less important, consumption ranged from 10 – 30 kg/capita/year. In other rural regions and in urban areas, sorghum was almost entirely absent from the diet. The food basket in rural areas was strongly influenced by the predominant staple crops, suggesting limited trade in staple food between regions. Sorghum consumption is unique compared to all other food staples in its sensitivity to household income and it is the only crop that has negative income elasticity. Consumption in the lowest income quintile averaged 18 kg/capita/year compared to just 10 kg in the highest income quintile (Table 10). By contrast, even staples that would be considered inferior goods in many countries, like plantain and maize, showed increasing consumption among higher income groups.

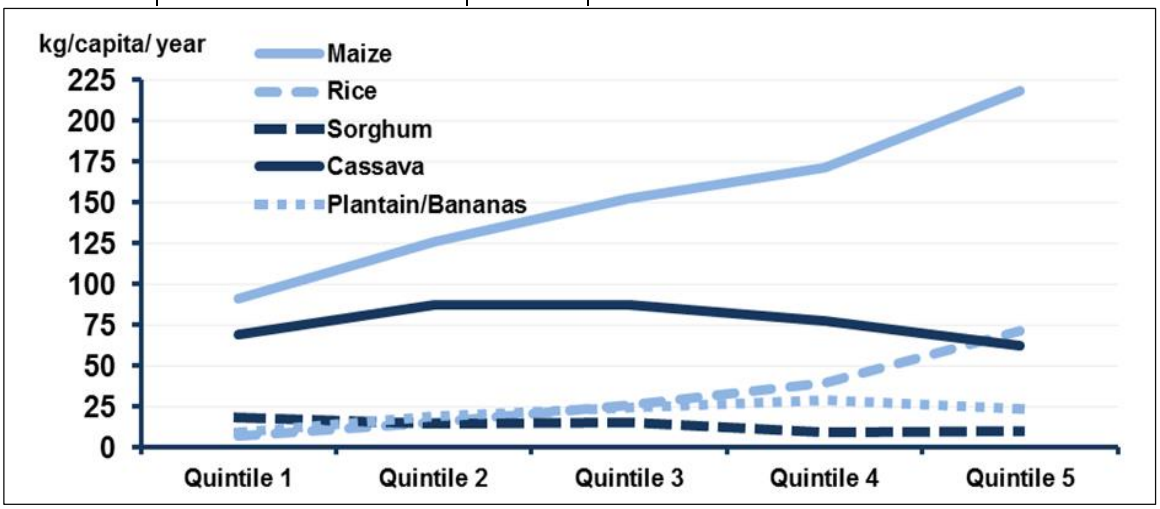
Table 9: Cereal consumption in Tanzania by region (kg/capita/year), 2004

	Maize	Wheat	Rice	Sorghum	Millet	Cassava	Sweet potatoes	Plantain/ Bananas	English potatoes
National	137.4	5.8	24.7	14.5	1.4	77.2	12.1	19.0	4.7
Rural areas	145.8	4.0	20.7	18.1	1.5	92.0	13.1	21.6	4.1
Urban areas	106.9	12.4	39.6	1.5	1.1	23.4	8.7	9.7	6.7
Dodoma	161.2	3.0	10.3	71.4	1.4	4.0	6.5	0.8	3.0
Arusha	143.0	8.9	15.8	1.0	1.8	3.6	5.5	16.3	8.4
Kilimanjaro	76.8	4.4	26.7	0.1	1.9	34.2	1.9	75.5	6.0
Tanga	136.3	8.7	16.5	0.4	0.2	90.8	7.7	20.1	8.2
Morogoro	130.1	5.3	51.3	1.7	0.4	23.2	6.8	20.7	2.4
Pwani	140.6	9.0	43.8	0.6	0.4	73.1	5.2	7.3	1.5
Dar es Salaam	65.9	15.5	45.4	0.1	0.5	7.5	3.5	5.1	5.4
Lindi	106.5	5.4	40.9	21.2	0.5	177.6	4.8	10.9	0.7
Mtwara	121.3	5.5	30.7	9.2	1.5	193.1	3.8	6.5	1.1
Ruvuma	151.9	3.3	28.4	3.9	2.8	206.8	18.1	5.6	1.5
Iringa	197.8	9.1	19.0	1.6	3.1	10.6	10.1	3.0	20.6
Mbeya	155.6	6.7	28.8	0.7	2.0	18.4	15.9	27.6	9.5
Singida	94.1	8.8	13.3	78.8	2.8	2.6	5.7	1.0	2.1
Tabora	233.0	4.4	29.3	5.1	1.1	37.0	14.9	2.1	0.6
Rukwa	210.5	1.9	8.2	3.2	2.3	110.7	7.1	1.9	3.2
Kigoma	122.9	2.5	14.7	2.9	2.1	145.5	23.3	15.8	2.4
Shinyanga	202.1	3.3	26.6	49.6	0.5	18.6	26.9	0.7	0.5
Kagera	64.4	1.6	9.4	4.5	1.6	109.5	20.9	115.9	5.8
Mwanza	144.0	3.6	24.0	6.8	0.9	195.6	20.9	1.4	0.7
Mara	71.1	3.5	12.2	28.0	2.1	284.8	20.4	5.1	1.0

Source: Smith and Subandoro (2007)

Table 10: Consumption of food staples in Tanzania by income group (kg/capita/year)

Increasing income level	Maize	Wheat	Rice	Sorghum	Millet	Cassava	Sweet potatoes	Plantain/ Bananas	English potatoes
Quintile 1	91.116	0.864	7.2	18.432	0.72	68.94	10.692	9.288	1.872
Quintile 2	125.82	2.232	15.084	14.508	1.152	86.976	11.808	19.332	3.528
Quintile 3	152.35	5.184	25.776	15.156	1.296	87.588	14.328	24.228	4.86
Quintile 4	171.72	9.288	39.78	9.36	2.304	77.076	14.364	28.98	6.732
Quintile 5	218.88	23.22	70.992	10.116	3.24	62.46	10.692	23.688	11.664

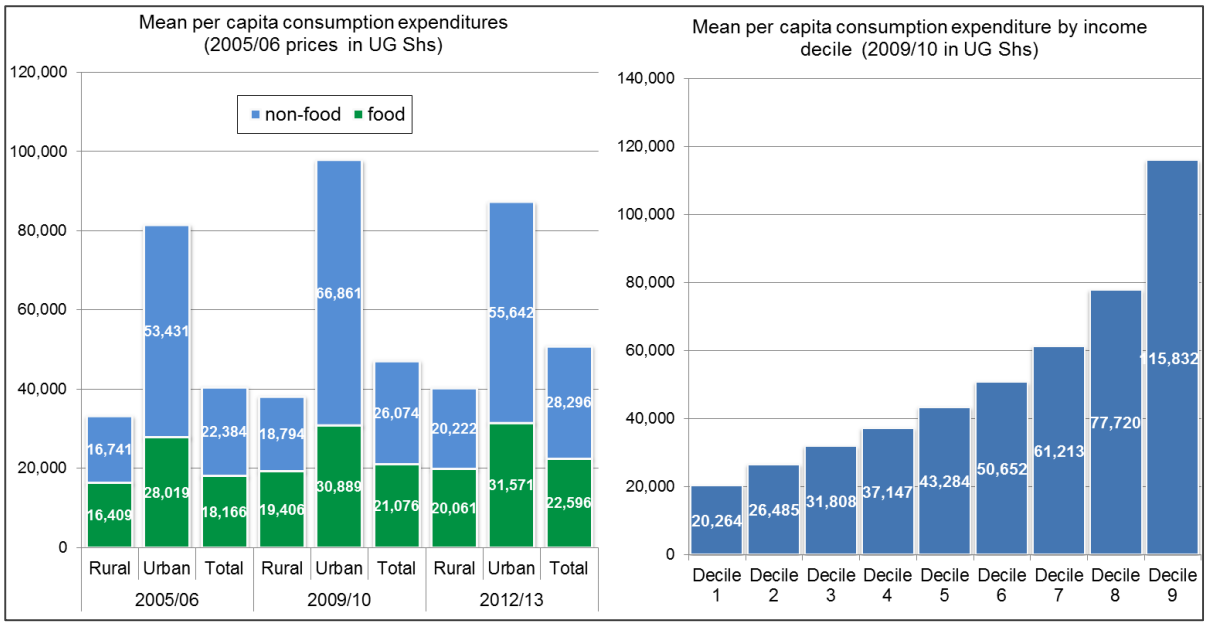


Source: Smith and Subandoro (2007).

5.4. Uganda

Figure 16 compares food and non-food expenditure patterns for 2005/06, 2009/10, and 2012/13, together with expenditure by level of household income. Between 2005 and 2013 total household expenditures increased from 23,000 to 28,000 UG Shs, an increase of just 22 %. By contrast, in Tanzania household expenditures more than doubled between 2007 and 2012. Another distinctive feature in Uganda is the wide gap in expenditure between rural and urban households. In 2012/13, urban expenditures were double that in rural areas, and in 2005/06 and 2009/10 the gap was even bigger, with expenditure nearly three times higher in urban areas. Over the last decade, therefore, income growth has become more balanced between rural and urban areas. Income and expenditure levels are strongly correlated. The poorest 10% spent an average of 20,000 and the richest 10% an average of 116,000 UG Shs/month in 2009/10, a similar difference to 2002/03 and 2005/06.

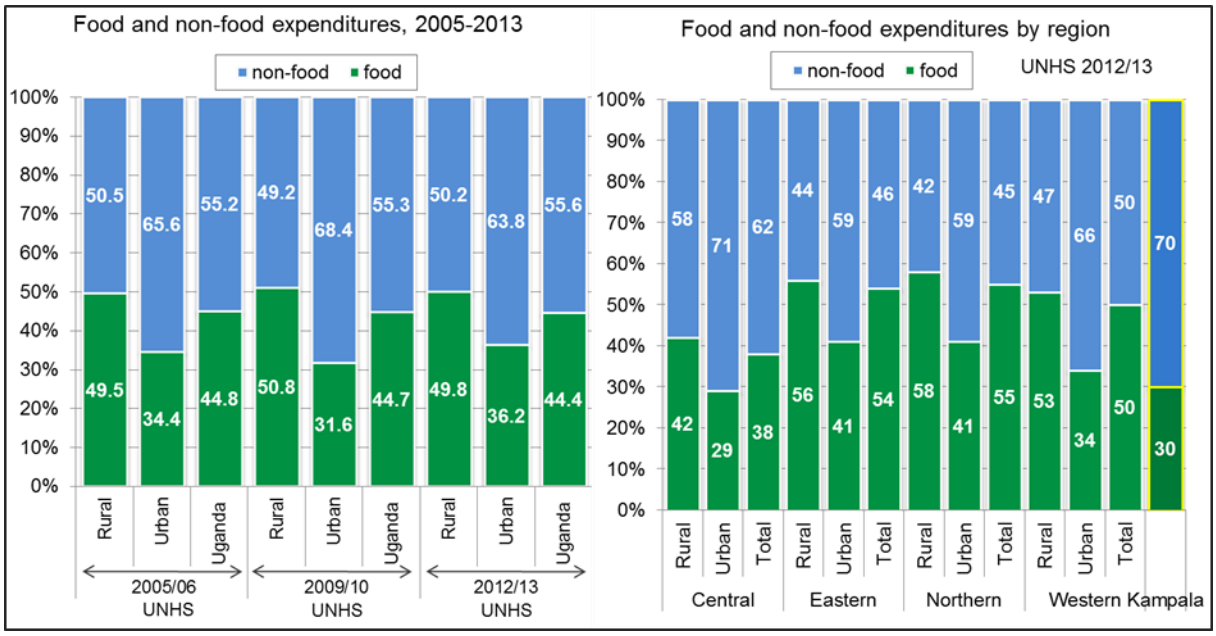
Figure 16: Food and non-food expenditures (UG Shs/capita/month)



Source: Uganda Bureau of Statistics 2013a, Uganda Bureau of Statistics 2010

Trends in the share of food expenditures in Uganda are presented in Figure 17. Food expenditure includes drinks and tobacco, giving a slight upward bias. Overall, the share of food, drinks and tobacco in total household expenditure remained stable over time while preserving rural and urban differences. At the national level, food accounted for 44% of household expenditure in 2012/13. This was a lower share than in Kenya (51%, 2009, Ethiopia (79%, 2009) and Tanzania (56%, 2011/12). In rural areas, food accounted for 50% of household expenditure compared to 36% in urban areas. Rural-urban variations slightly narrowed in comparison with 2009/10 and 2005/06. The right-hand side of Figure 17 presents the share of food expenditure by region. In 2012/13, the Central region, the wealthiest region in Uganda, had the lowest share of food expenditure (38%), compared to 56 % in the Eastern and Northern regions. Kampala, together with other urban centres in the Central region, has the lowest share of household expenditure on food (30%).

Figure 17: Food and non-food expenditure shares in Uganda, 2005-13



Source: Uganda Bureau of Statistics 2010, Uganda Bureau of Statistics 2013b

Other sources give estimates for food expenditure well above these official statistics. The World Food Programme WFP (McKinney, 2009) and IFPRI (Benson et al., 2008) studied household demand using the same 2005/06 data set. Figure 18 summaries the results. The WFP analysis compared food expenditure by livelihood activity groups (jobs, sources of income), wealth and asset classes. Food expenditures shares in livelihood groups ranged from 50% to 60%. The study by Benson et al. (2008) reported food expenditure shares of 60-67 % and 54-58 % using broad and narrow definitions of food expenditure, respectively [8].

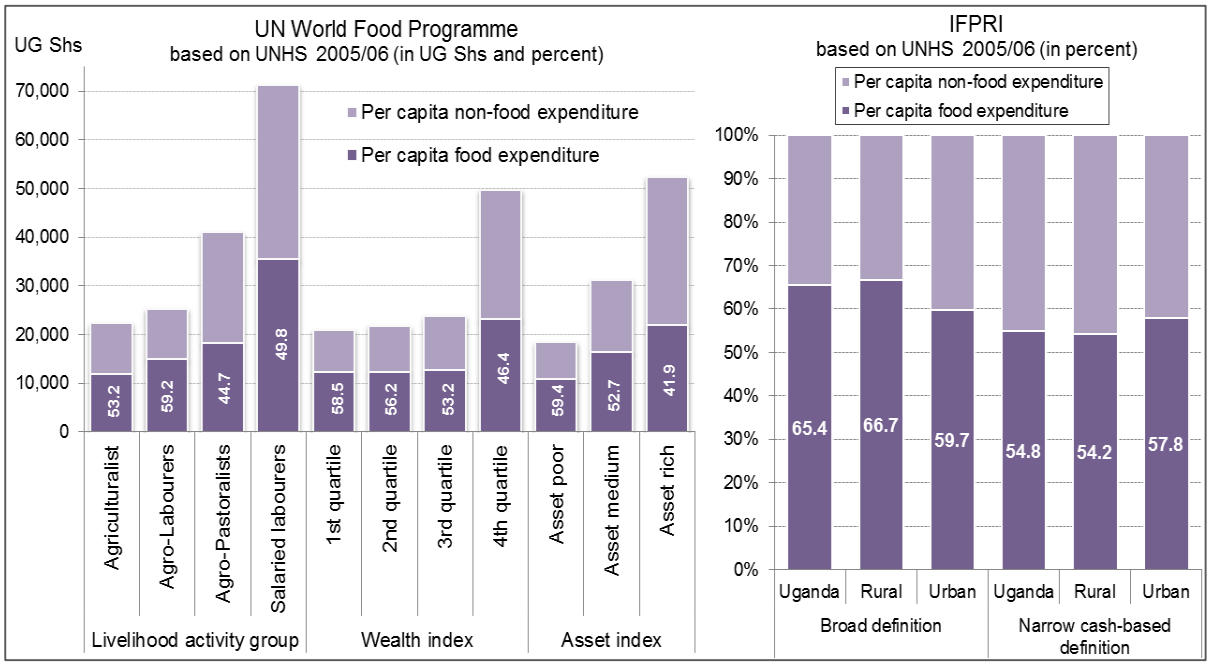
Two sources disaggregate household expenditure according to the type of food consumed (Boysen, 2012; McKinney, 2009).[9] Boysen's (2012) analysis (left-hand side of Figure 19) differentiates expenditure by location (rural-urban) and by income.. Regardless of income levels, in rural areas the most important food group were not cereals but roots and tubers. By contrast, cereals were the dominant food group in urban areas. *Matooke* (cooking banana) was a major part of the diet, particularly for middle- and high-income households. The WFP study indicates a slightly higher cereal expenditure share of 26% compared to Boysen (2012). The share of cereals in household expenditure varied from 13 - 20% in rural 13 - 21% in urban areas. This was the second-lowest share after Kenya. In Tanzania and Ethiopia, expenditure on cereals accounted for 40 - 50% of the food budget. In Uganda, therefore, the consumption of staple foods was more diverse. The 'Other' expenditure

[8] The broader definition of food consumption includes the value of own-produced food that is consumed by the household in both the cost (value) of food consumed and in the total income of the household. A more narrow definition is presented in the second column of the table where the value of the own produced food consumed by the household is excluded from both food consumption and income. While the second definition focuses more tightly on cash income and food expenditures, it may provide a false impression of increased vulnerability for those households who are more subsistence oriented, since much of their income is in-kind rather than cash.

9 The UBOS provides information on the composition of household diets by calorie source and frequency in consumption of food types on a weekly basis, but not in terms of household expenditures.

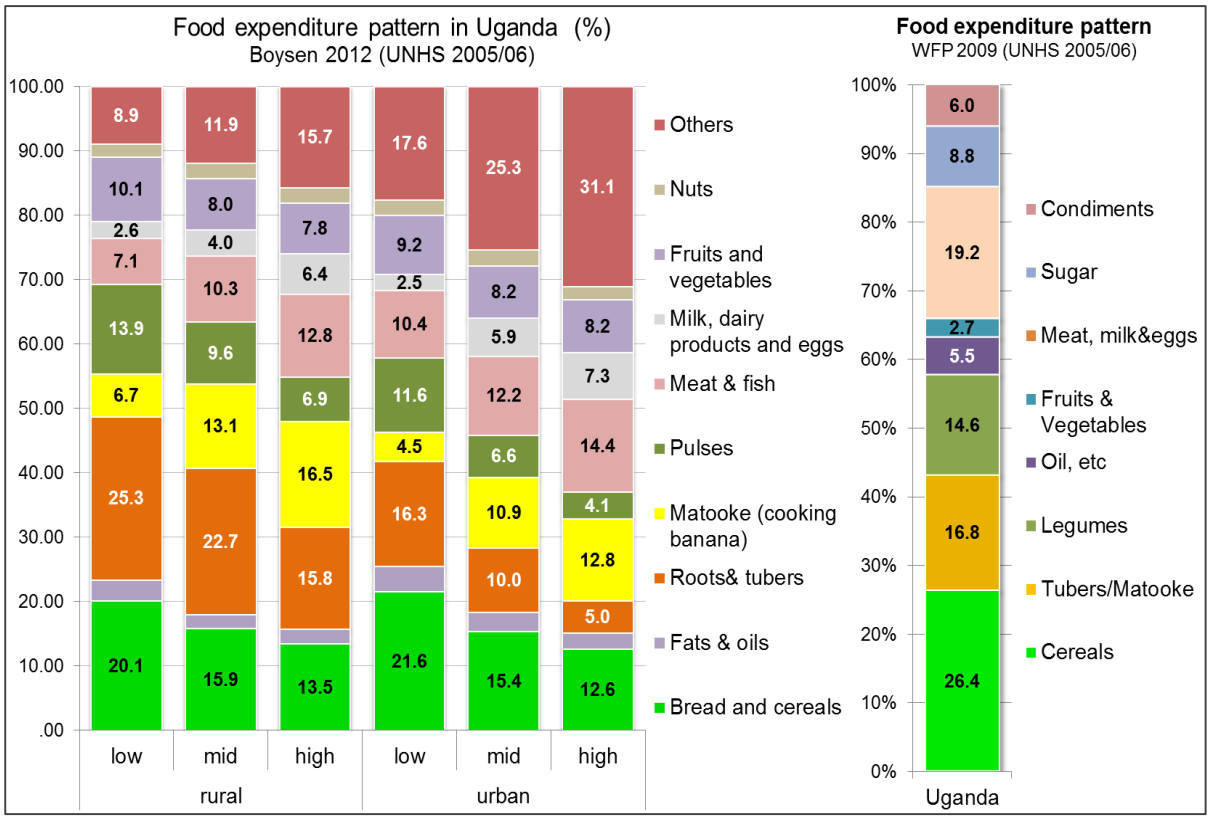
category includes foods associated with modern life-styles and dining-out plays an increasingly important role for affluent urban households.

Figure 18: WFP and IFPRI estimates of food expenditure shares in Uganda



Source: Benson et al. (2008), , McKinney (2009).

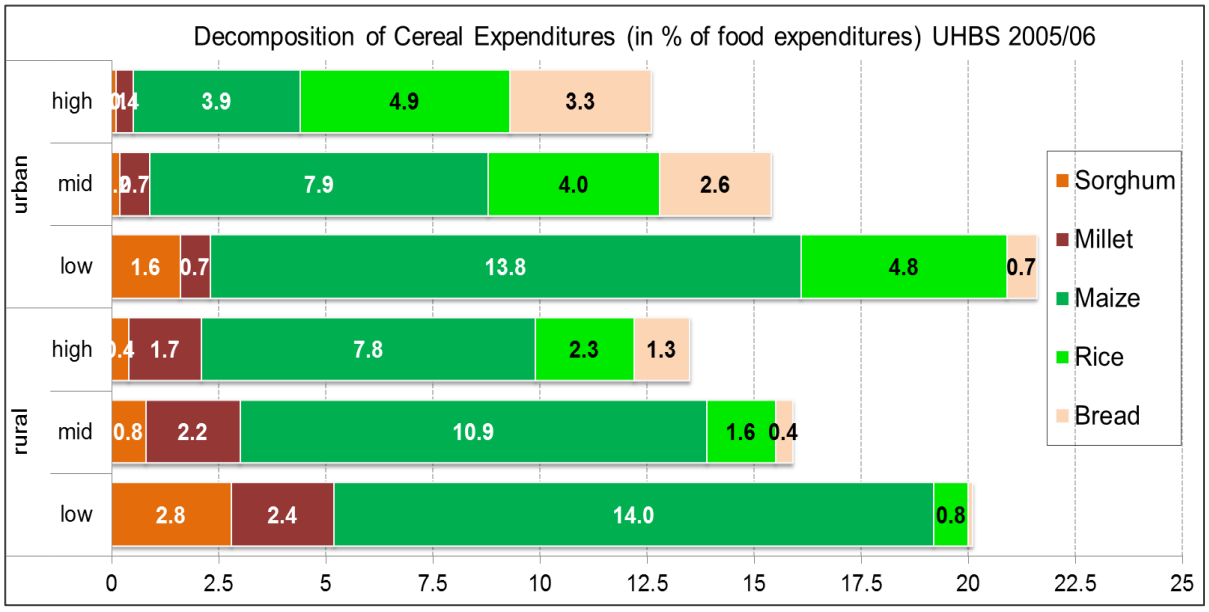
Figure 19: Food expenditure pattern in Uganda (rural vs urban; by income group)



Source: Boysen, O (2012), McKinney (2009)

Sorghum and millets were an insignificant share of household expenditure (< 3 %), except among middle and low income rural households, reaching 5.2 % among low-income households (Figure 20) and below 1% for high income urban households. Relative expenditure shares for sorghum and millets were more influenced by level of income than by rural and urban location.. Expenditures for millet appear more stable than for sorghum with regard to income and rural-urban. Maize was by far the most important cereal, accounting for more than 50% of cereal expenditure. Rice and bread consumption were a higher share of cereal consumption in urban areas. The pattern of expenditure pattern in Figure 20 closely matches the figures for capita consumption in Section 6.

Figure 20: Cereal expenditure pattern in Uganda (based on UHNS 2005/06 data)



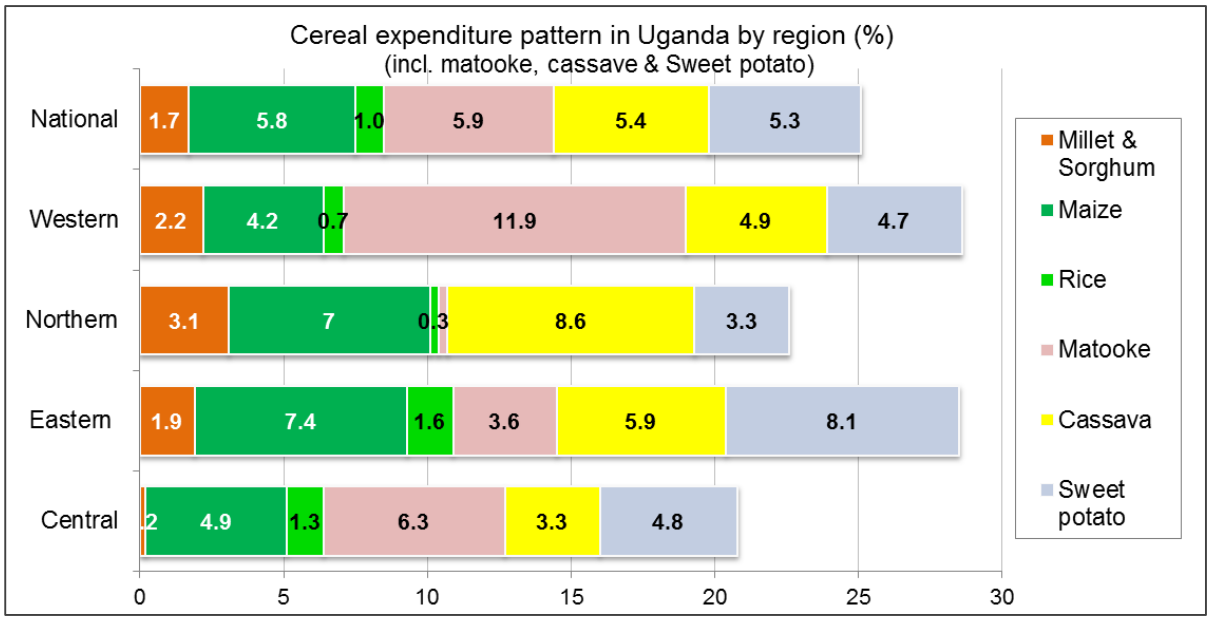
Source: Boysen, O (2012)

Figure 21 shows household food expenditure by region (Simler, 2010). Sorghum and millets are not shown individually but are grouped. Variation in the share of cereal expenditures lies between 20% and 30%. Regions with a high proportion of cereal production in terms of area and per capita production have higher expenditure shares than other regions. Across all major cereals, therefore, cereal consumption and expenditures are driven by the regional pattern of production.. The expenditure share for sorghum and millets expenditure at the national level is 2 % and was highest in the Northern region (3%) where sorghum and finger millet are major cereal crops. There is almost no consumption of sorghum and millet in the densely populated central regions. By contrast, *matooke*, cassava and sweet potato are staple foods. Sorghum and millets are concentrated in the Western, Northern and Eastern parts of Uganda. Maize is dominant in all regions.

Despite this evidence of dietary diversity, Uganda is often blamed for a monotonous diet, causing micronutrient deficiencies (Republic of Uganda, 2011). The Uganda Nutrient Action Plan (UNAP) set a target of “75 percent of the dietary energy consumption provided from foods other than cereals and starchy foods by 2016”. Uganda is still far from reaching this goal. The World Food Programme (WFP) analysed dietary diversity by categorising households according to the number of food groups consumed in the weeks preceding the WFP survey (McKinney, 2009). A low dietary diversity is indicated if less than five groups out of the seven main food groups (cereals/tubers, pulses/nuts, vegetables, fruits, milk, m

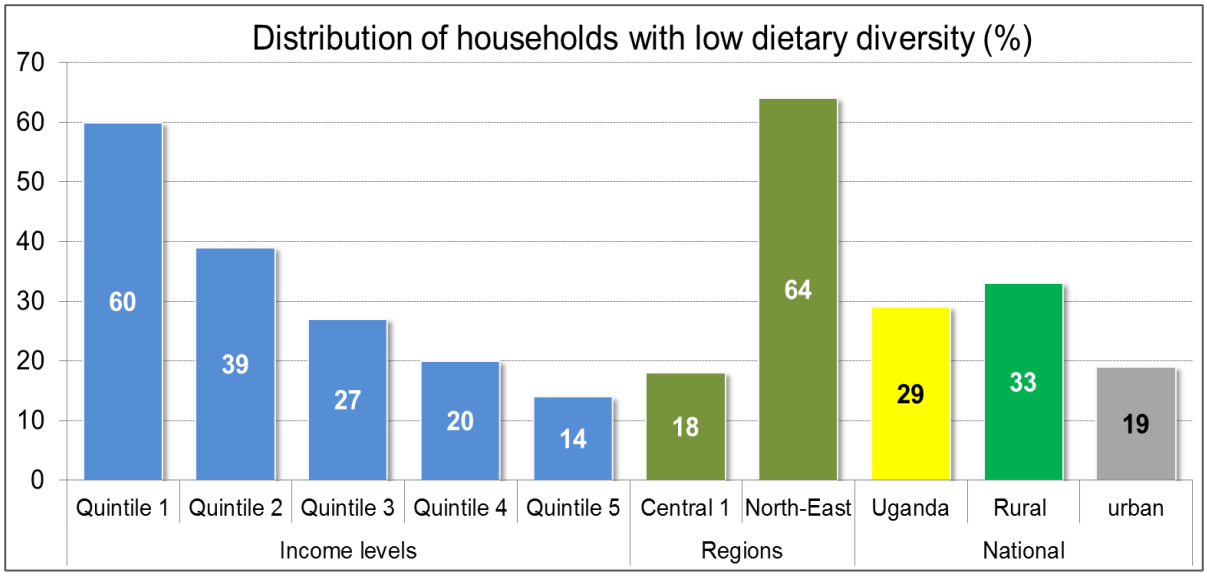
eat/fish/eggs, and oil) were observed. Figure 22 shows that nationally, 29 % of households had low dietary diversity, with the lowest diversity in the Central region (18%) and the highest in the North-Eastern region (64 %), which is also the region with the highest incidence of poverty. Dietary diversity is therefore a matter of household income. Sixty percent of the poorest 20% of households in Uganda have a monotonous diet deficient in nutrients.

Figure 21: Cereal expenditure pattern in Uganda by region (in %)



Source: Simler 2010, based on UNHS 2005/06

Figure 22: Distribution of households with low dietary diversity (%), UNHS 2005/06



Source: McKinney (2009), based on UNHS 2005/06

A high share of expenditure on food makes households vulnerable to sudden price rises. The implications of higher food prices for household welfare in Uganda were studied by the World Bank, using data from the UNHS 2005/06 round (Simler, 2010). The short-run impact of higher food prices on the poverty headcount ratio (i.e., the percentage of the population below the poverty line) is shown in Table 11. The figures in the base column are the actual

estimates from the UNHS 2005/06, which is the most recent source of poverty estimates for Uganda. The second column, labelled “All 5 foods,” shows the combined impact of higher prices for all five food items in the table, and the remaining columns show the impact of higher prices for each of the five individual food commodities.

At the national level, food price spikes in 2008 are estimated to increase the poverty headcount ratio by 2.6 %, which increases the number of Ugandans below the poverty line by 700,000. The increase in the ratio is higher for urban areas (3.6%) than rural areas (2.4 %). Most of the increase in poverty, in both urban and rural areas, is due to a rise in the price of maize, followed by cassava and sweet potato.

Table 11: Estimated impact of food price increases on poverty headcount ratio

	poverty headcount (%)	Impact of observed price increases (percentage point change in poverty headcount ratio)					
	base (2005/06)	All 5 foods	Maize	Matooke	Cassava	Sweet potato	Rice
National	31.1	2.6	1.7	0.1	0.9	-0.7	-0.1
Urban	13.7	3.6	2.5	-0.1	0.9	0	0.4
Rural	34.2	2.4	1.6	0.1	0.9	-0.8	0.2
Central	16.4	3.2	3.1	-0.1	-0.4	-0.9	0.1
Eastern	35.9	1	1.4	-0.2	-0.1	-1.7	-0.2
Northern	60.7	5.9	0.5	0	5.2	0.7	0
Western	20.5	0.9	1.4	0.7	0.1	-0.6	-0.2

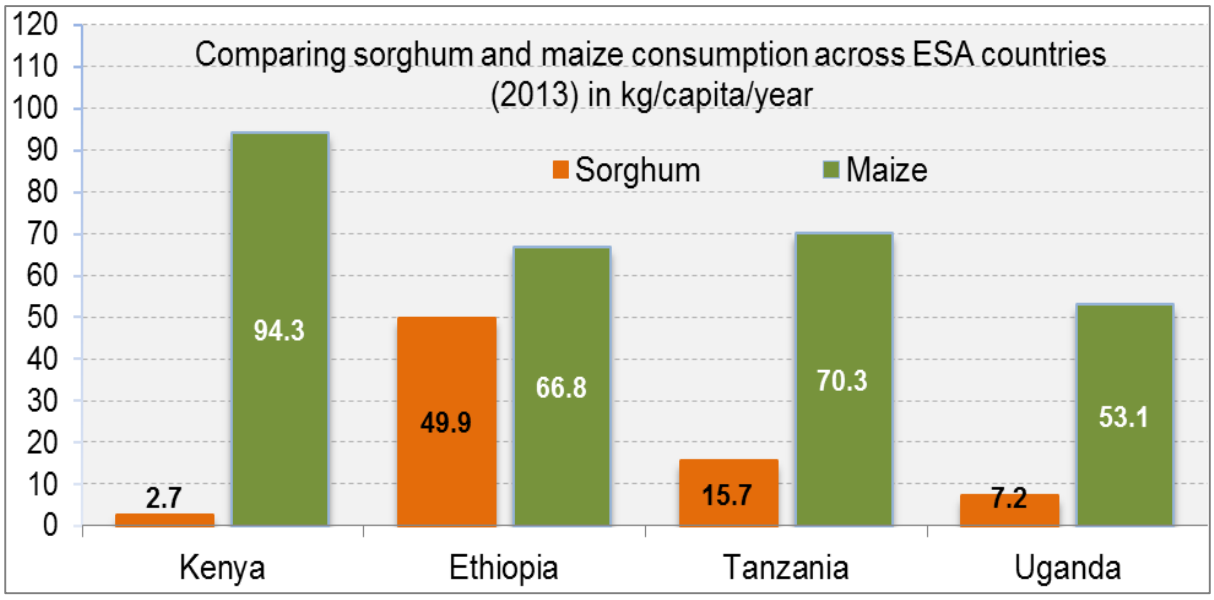
Source: Simler (2010), based on UNHS 2005/06

6. Consumer Demand: Synthesis from ICRISAT's Study Findings

This chapter synthesises results from four national household expenditure surveys, based on analyses made by ICRISAT between 2012 and 2014. In addition, it summarises information from consumer surveys by ICRISAT in Kenya and Tanzania in 2013. Sorghum consumption together with millets and maize consumption are highlighted at national level, by rural-urban clusters, by proximity to the major production areas, and finally by household income levels.

At a first glance, ESA countries differ widely in their consumption of sorghum versus maize. Figure 23 shows that the relative importance of cereals grown and consumed varied between the four countries. Kenya, Tanzania and Uganda are traditional 'maize' countries: Kenyans for example consume 95 kg/capita/year of maize per year and only 2.7 kg of sorghum. In Tanzania and Uganda, maize consumption dominates over sorghum consumption by a factor or five (Tanzania) and seven (Uganda). The reasons are that sorghum is more widely grown and more deeply embedded in the dietary tradition than in Kenya. Only in Ethiopia does the consumption of sorghum (50 kg/capita/year) almost reach the same level as maize (67 kg/capita/year).

Figure 23: Traditional 'maize' countries in the ESA region (2013)



Source: own figure, based on ICRISAT analysis of national household expenditure surveys

Table 12 compares the consumption of sorghum, millet and maize consumption between rural and urban areas. Food consumption figures at the beginning of each section have been obtained from FAO commodity balances. National consumption levels per capita and per adult equivalent (AE) are derived from national food consumption and most recent population census data. As explained in Section 3.1, , differences between rural and urban consumption were estimated derived in two stages: 1) deriving the proportion of rural and urban consumption from ICRISAT's consumption tables, and 2) adjusting to the national level while maintaining the initial rural and urban consumption proportions per capita or per AE.

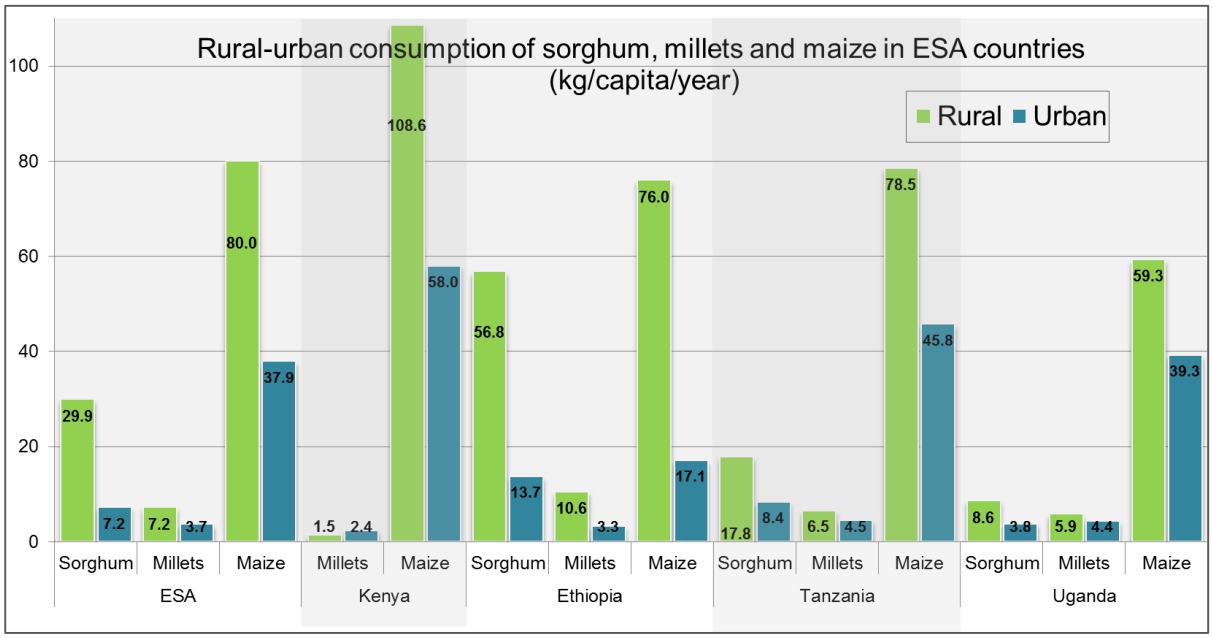
Table 12: Baseline results: consumption of sorghum, millets and maize in ESA countries

	Units	Kenya	Ethiopia		Tanzania	Uganda	Total ESA
		2013	2004/05	2012/13	2013	2013	2013
DEMOGRAPHY							
Population	million	38.6	*73.3*	83.7	45.8	34.1	202.3
Total AE		24.1	*43.6*	50.1	28.6	21.3	124.2
Rural AE		18.1	*36.6*	42.1	22.2	15.1	97.5
Urban AE		5.3	*7.0*	8.0	6.5	6.2	25.9
SORGHUM							
Production	tons/year	138,533	*1,742,454*	4,338,262	832,084	299,000	5,607,879
TOTAL							
Food consumption	tons/year	105,303	*1,590,093*	4,004,805	718,215	246,129	5,074,452
		100%	*100%*	100%	100%	100%	100%
per Capita	kg/capita/year	**2.7**	***22.8***	**49.9**	**15.7**	**7.2**	**25.5**
per Adult equivalent	kg/AE/year	4.4	*36.5*	79.9	25.1	11.5	40.9
Rural							
Food consumption	tons/year		*1,511,757*	3,829,634	631,554	208,287	4,669,475
			98%	96%	88%	85%	92%
per Capita	kg/AE/year	Na.	***25.8***	**56.8**	**17.8**	**8.6**	**29.9**
per Adult equivalent	kg/capita/year	Na.	*41.3*	90.9	28.5	13.8	47.9
Urban							
Food consumption	tons/year		*78,336*	175,172	86,661	37,842	299,674
			2%	4%	12%	15%	6%
per Capita	kg/capita/year	Na.	***7.0***	**13.7**	**8.4**	**3.8**	**7.2**
per Adult equivalent	kg/AE/year	Na.	*11.2*	21.9	13.4	6.1	11.5
MILLETS							
Production	tons/year	64,102	*397,390*	807,056	322,731	228,000	1,421,889
Total							
Food consumption	tons/year	62,896	*369,695*	754,415	275,471	185,631	1,278,412
		100%	*100%*	100%	100%	100%	100%
per capita	kg/capita/year	**1.6**	***5.3***	**9.4**	**6.0**	**5.4**	**6.4**
per Adult equivalent	kg/AE/year	2.6	*8.5*	15.1	9.6	8.7	10.3
Rural							
Food consumption	tons/year	42,336	*347,513*	711,936	229,195	141,736	1,125,202
		67%	*94%*	94%	83%	76%	88%
per capita	kg/AE/year	**1.5**	***5.9***	**10.6**	**6.5**	**5.9**	**7.2**
per Adult equivalent	kg/capita/year	2.3	*9.5*	16.9	10.3	9.4	11.5
Urban							
Food consumption	tons/year	20,560	*22,182*	42,479	46,276	43,895	153,210
		33%	*6%*	6%	17%	24%	12%
per capita	kg/capita/year	**2.4**	***2.0***	**3.3**	**4.5**	**4.4**	**3.7**
per AE	kg/AE/year	3.9	*3.2*	5.3	7.1	7.1	5.9
MAIZE							
Production	tons/year	3,890,941	*3,911,869*	6,674,048	5,356,350	2,748,000	18,169,339
Total							
Food consumption	tons/year	3,635,701	*3,084,987*	5,359,395	3,221,578	1,811,587	14,028,261
		100%	*100%*	100%	100%	100%	100%
per capita	kg/capita/year	**94.3**	***44.2***	**66.8**	**70.3**	**53.1**	**70.6**
per Adult equivalent	kg/AE/year	150.9	*70.7*	106.9	112.5	84.9	113.0
Rural							
Food consumption	tons/year	3,144,585	*2,955,549*	5,122,467	2,783,450	1,436,073	12,486,575
		86%	*94%*	94%	86%	79%	89%
per capita	kg/AE/year	**108.6**	***50.5***	**76.0**	**78.5**	**59.3**	**80.0**
per Adult equivalent	kg/capita/year	173.7	*80.7*	121.6	125.6	94.9	128.0
Urban							
Food consumption	tons/year	491,115	*126,792*	218,934	474,189	390,029	1,574,268
		14%	*4%*	4%	15%	22%	11%
per capita	kg/capita/year	**58.0**	***11.3***	**17.1**	**45.8**	**39.3**	**37.9**
per Adult equivalent	kg/AE/year	92.8	*18.1*	27.4	73.2	62.8	60.7

Source: ICRISAT analysis of expenditure surveys, FAO commodity balance , World Bank population figures

Figure 24 shows differences in rural-urban consumption and explains the figures in Table 12. At regional ESA level, consumption levels for sorghum, millets and maize were much higher in rural than in urban areas. Sorghum had the highest rural bias in consumption, with 30 kg/capita/year in rural areas but only 7 kg/capita/year in urban areas. The figures for millets show a similar pattern, though at a lower consumption level of 7.2 kg/capita/year in rural areas versus 3.7 kg/capita/year in urban areas. For maize, people in rural areas consumed 80 kg/capita/year but less than half this amount (38 kg) in urban areas.

Figure 24: Rural-Urban consumption pattern by crop and country (2013)



Source: own calculation, updated figures derived from ICRISAT analyses of national household expenditure surveys

Consumption patterns differed to some extent between the four countries. Ethiopia had the lowest consumption of maize in absolute terms, and the largest consumption gap between rural and urban areas. A likely reason for this is the predominance of *injera* as the traditional local bread which keeps maize consumption in cities low. *Injera* is made from pure *tef* or blended with sorghum and millets but not with maize. For millets, three distinct patterns can be observed. In Kenya, urban consumption exceeds rural consumption indicating that millet is a cash crop sold to urban processors. In Tanzania and Uganda, consumption of millet in urban areas is fairly high in comparison with rural areas. In Ethiopia, by contrast, millet consumption is three times higher (10.6 kg/capita/year) in rural than in urban areas (3.3 kg/capita/year), suggesting that millets are widely used for *injera* in rural areas, with little sold to urban areas.

Based on this evidence, we can suggest three factors that help explain the differences between rural and urban consumption:

1. **Subsistence nature of the staple food sector**: The majority of sorghum, millet and sorghum growers are small-scale farmers who use cereals to feed their family. Little production is sold unless cash requirements urge them to sell some stock on local markets.
2. **Limited domestic trade**. ICRISAT impact studies on sorghum and millets (Gierend et al., 2013) estimated that only a small share of sorghum and millet production is

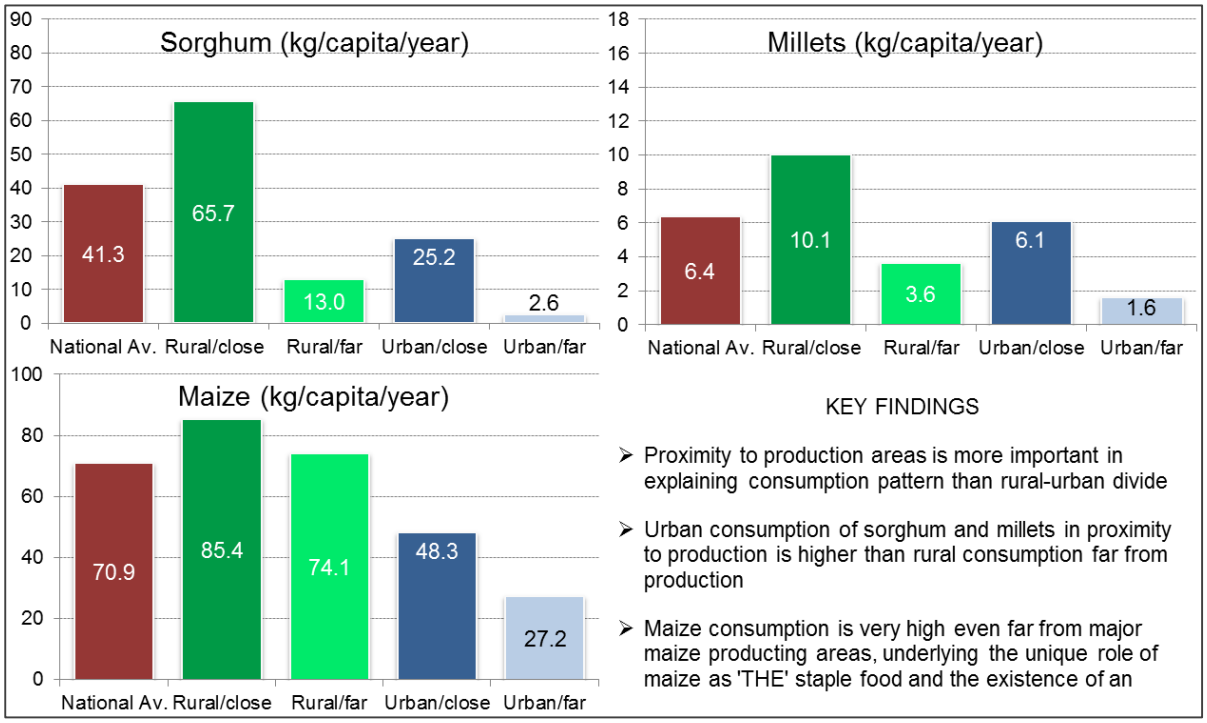
traded across administrative boundaries and to the major cities. Poor infrastructure, high transport costs, and an underdeveloped food processing industry reduce urban demand.

3. **Changing food retail systems**: consumer habits in urban areas are changing with the establishment of retail discounters, shopping malls, international food chains, and a growing urban middle class. In Kenya, consumption of wheat and wheat products recently superseded in volume and expenditures terms the consumption of maize based products (Figure 11) alongside the emergence of new retail systems, availability of western style food products and restaurant chains, and growing middle and high income urban class (Kamau et al. 2011).

6.5. Cereal Demand by Proximity to Production

Besides comparing rural and urban, the ICRISAT consumer studies compared consumption of sorghum and millets by their proximity to the major areas of production. This reflects the fact that domestic trade in staple foods is often limited, thus preserving locally specific food consumption patterns particularly in more remote rural areas. In total, there are four spatial clusters: two clusters for rural areas (close to and far from major production areas) and another two clusters for urban areas (close to and far from major production areas). Figure 25 shows per capita consumption for each of the four consumption clusters at ESA level, together with the average for the four countries, weighted by the average share of production for each country. As expected, the highest levels of consumption were found in rural areas close to the centres of production. The next highest levels of consumption were found in urban areas close to the centres of production. This holds true for both sorghum and millets. By contrast, maize consumption was highest in rural areas both close to, and far from, the major centres of production, while close to centres of maize production, rural consumption of maize exceeded urban consumption..

Figure 25: Consumption levels in 'proximity' clusters: results at ESA level (2013)



Source: Own Figure, calculation based on ICRISAT analysis of national household expenditure surveys

The level of maize consumption was more evenly spread than the level of consumption for sorghum and millets. 'Proximity to production' as a consumption factor seems more important for sorghum and millets than the simple rural-urban divide. Traditionally, sorghum and millet are confined to the dry and semi-dry clusters, particularity in Kenya, Uganda and Tanzania, with limited production outside those areas. In contrast, maize is grown over a wide spectrum of agro-ecologies and production is therefore less concentrated. Furthermore, maize has better marketing and distribution channels, resulting in a high level of maize consumption throughout the country. Table 13 presents the same cluster results but at the country level and not averaged over the ESA region.

Table 13: Clustering consumption according to proximity to production (2013)

Consumer clusters	Kenya		Ethiopia		Tanzania		Uganda	
	kg/capita/ year	Cluster dispersion	kg/capita/ year	Cluster dispersion	kg/capita/ year	Cluster dispersion	kg/capita/ year	Cluster dispersion
	Sorghum							
National average			49.9		15.7		7.2	
Rural close to production			77.9		30.6		17.5	
Rural far from production			15.9	*SD= 32.7 MAD= 23.1	2.9	SD= 13.5 MAD= 9.9	4.5	SD= 7.3 MAD= 5.1
Urban close to production			29.6		13.2		6.6	
Urban far from production			3.1		1.2		0.5	
	Millets							
National average	1.6		9.4		6		5.4	
Rural close to production	2		13.2		6.1		6.6	
Rural far from production	1.4	SD= 0.7 MAD= 0.5	1.8	SD= 5.7 MAD= 4.3	7.7	SD= 1.5 MAD= 1.1	5	SD= 3.1 MAD= 2.2
Urban close to production	3.2		6.5		5		7.3	
Urban far from production	2.2		0.7		4.3		0.5	
	Maize							
National average	94.3		66.8		70.3		53.1	
Rural close to production	116.3		85.4		79.6		58.4	
Rural far from production	96.7	SD= 30.2 MAD= 22.4	67	SD= 34.7 MAD= 28.5	75.1	SD= 19.6 MAD= 15.7	61.6	SD= 14.8 MAD= 11.2
Urban close to production	78.1		29		54.7		46.2	
Urban far from production	45.2		9.3		37.1		28.9	

Source: own table, calculation based on ICRISAT consumer studies
* SD is the standard deviation; MAD is the mean absolute deviation around the mean

Ethiopia stands out as the country with the highest cluster differences in consumption. This holds true for all three cereal crops if compared with Kenya, Tanzania and Uganda. Consumption levels of sorghum and millets in areas far and close to major production areas differ by a large margin. Sorghum consumption amounts to 78 kg/capita/year in areas close to the major centres of production versus 16 kg/capita/year in areas that are far away. Similar differences can be observed for finger millet: 13 kg/capita/year close and only 2 kg/capita/year far from production. One obvious explanation for this difference is the size

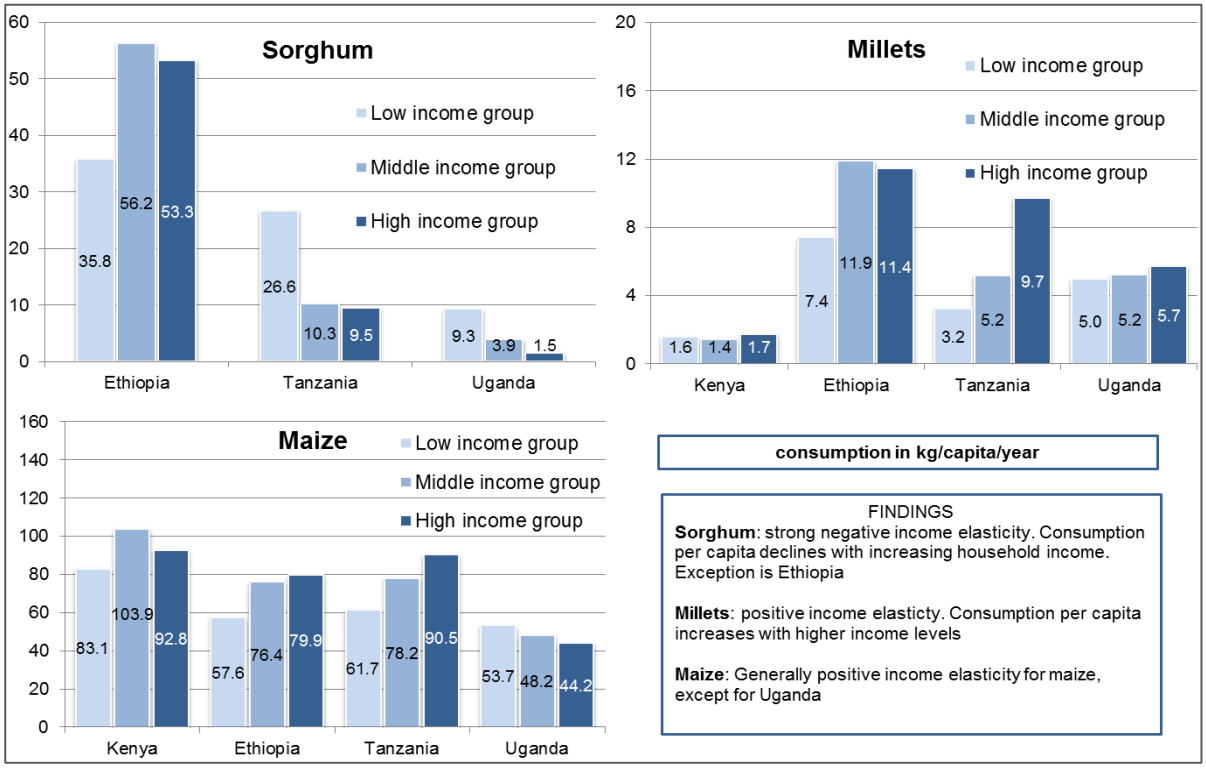
and challenging topography of Ethiopia that constrains domestic trade of sorghum and millets over large distances..

6.6. Cereal Demand by Income Groups

Household income plays an important part in the composition of food expenditure. As disposable income grows, the food bill becomes a smaller share of household expenditure. Cereals are an inferior food in economic terms since absolute and relative consumption decline as income rises. This section provides a descriptive overview of cereal consumption for high, middle, and low income groups, defined as terciles from the income range in the national household expenditure surveys. Because income levels differ in the four ESA countries, the absolute value of the income for each tercile also differs by country.

Figure 26 compares differences in the consumption of sorghum, millets and maize by level of household income. In the case of sorghum, income affects consumption in two opposite ways. In Tanzania and Uganda, sorghum consumption drops sharply by 60-80% as income rises from the 'low' to the 'high' income group. By contrast, in Ethiopia sorghum consumption increases as income rises from the low to the high income group, from 36 to 53 kg/capita/year. There is no empirical evidence in the literature that explains this difference. Sorghum in Ethiopia may have a higher status and be treated equally with maize and *tef*. This is supported by the fact that the level of consumption and production of sorghum, maize and teff have not changed much over the past two decades. In Uganda, Tanzania and Kenya, however, sorghum is perceived as a minor cereal, with production levels five-ten times lower than maize. In addition, sorghum is known as a 'poor man's crop' grown by resource-poor farmers.

Figure 26: Decomposition of sorghum, millets and maize consumption by income group



Source: own Figure, calculation based on ICRISAT analysis of national household expenditure surveys

In the case of millet, per capita consumption increases with rising income. Prized for its taste and nutritional value, millet is not an inferior good but a higher-priced cereal.. Consumption in urban areas and among richer households is high, and millet is in demand as a valuable weaning food for children and for ceremonial occasions. This income effect on millet consumption is weaker in Uganda, reflecting the relatively high consumption in rural areas, particularly as raw material for traditional alcoholic brews.

Maize consumption is less affected by income. Differences across consumption levels by income category are far lower for maize than for sorghum and millets, hardly exceeding 20% between the 'low' and 'high' income groups. In Kenya, Ethiopia and Tanzania maize consumption rises with income. By contrast, in Uganda, maize consumption falls with income. This suggests that households in Uganda have reached a threshold of food security at which maize has become an inferior good. If true, then rising maize consumption with higher income in Kenya, Ethiopia and Tanzania may indicate significant food deficits caused by a lack of purchasing power, and increased expenditure on maize by 'middle' and 'high' income households reflect efforts to reduce this deficit.

Table 14 presents the entire set of consumption figures, showing the difference between rural and urban areas. Consumption trends by income group are very similar between rural and urban areas, although there are differences in the absolute level of consumption.

Table 14: Consumption of sorghum, millets and maize by income group (kg/capita/year)

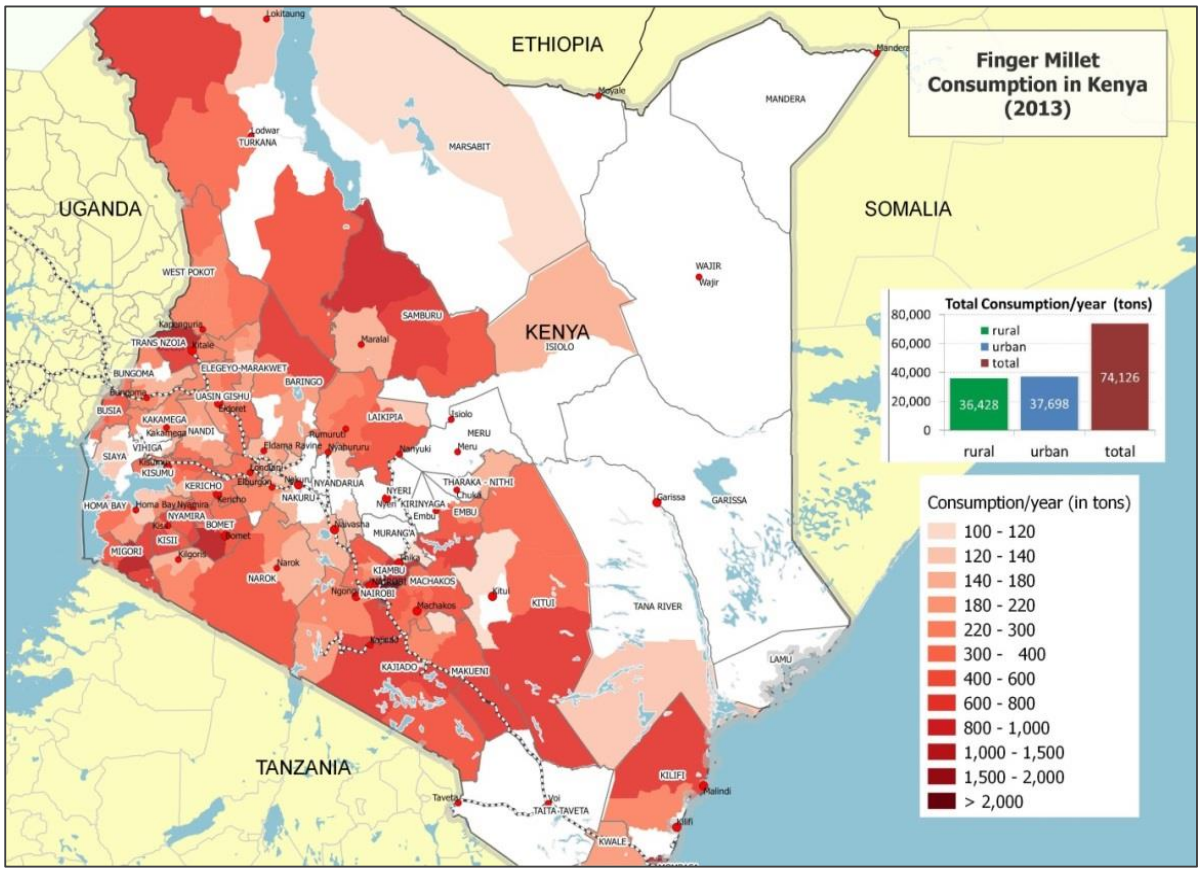
	Sorghum				Finger Millet			
	Kenya	Ethiopia	Tanzania	Uganda	Kenya	Ethiopia	Tanzania	Uganda
Unit	kg/capita/year				kg/capita/year			
	Total							
Low income		35.8	26.6	9.3	1.6	7.4	3.2	5.0
Middle income		56.2	10.3	3.9	1.4	11.9	5.2	5.2
High income		53.3	9.5	1.5	1.7	11.4	9.7	5.7
	Rural							
Low income		38.8	22.8	13.8	1.3	7.0	5.2	5.1
Middle income		60.7	12.9	6.2	1.3	11.3	8.4	5.6
High income		67.6	12.0	3.0	1.6	12.8	20.0	6.6
	Urban							
Low income		14.1	10.1	4.4	2.5	3.2	1.9	4.3
Middle income		15.4	3.2	1.2	2.2	3.7	3.9	2.3
High income		12.0	7.4	0.7	2.4	2.2	7.1	5.7
	Maize							
Unit	kg/capita/year							
	Total							
Low income	83.1	57.6	61.7	53.7				
Middle income	103.9	76.4	78.2	48.2				
High income	92.8	79.9	90.5	44.2				
	Rural							
Low income	101.9	57.0	66.6	59.6				
Middle income	109.9	74.6	103.9	53.8				
High income	110.2	93.2	142.0	57.5				
	Urban							
Low income	51.5	16.5	39.0	39.5				
Middle income	75.1	17.8	47.6	37.3				
High income	60.4	10.9	58.3	26.4				

Source: own table, calculation based on ICRISAT analysis of national household expenditure surveys

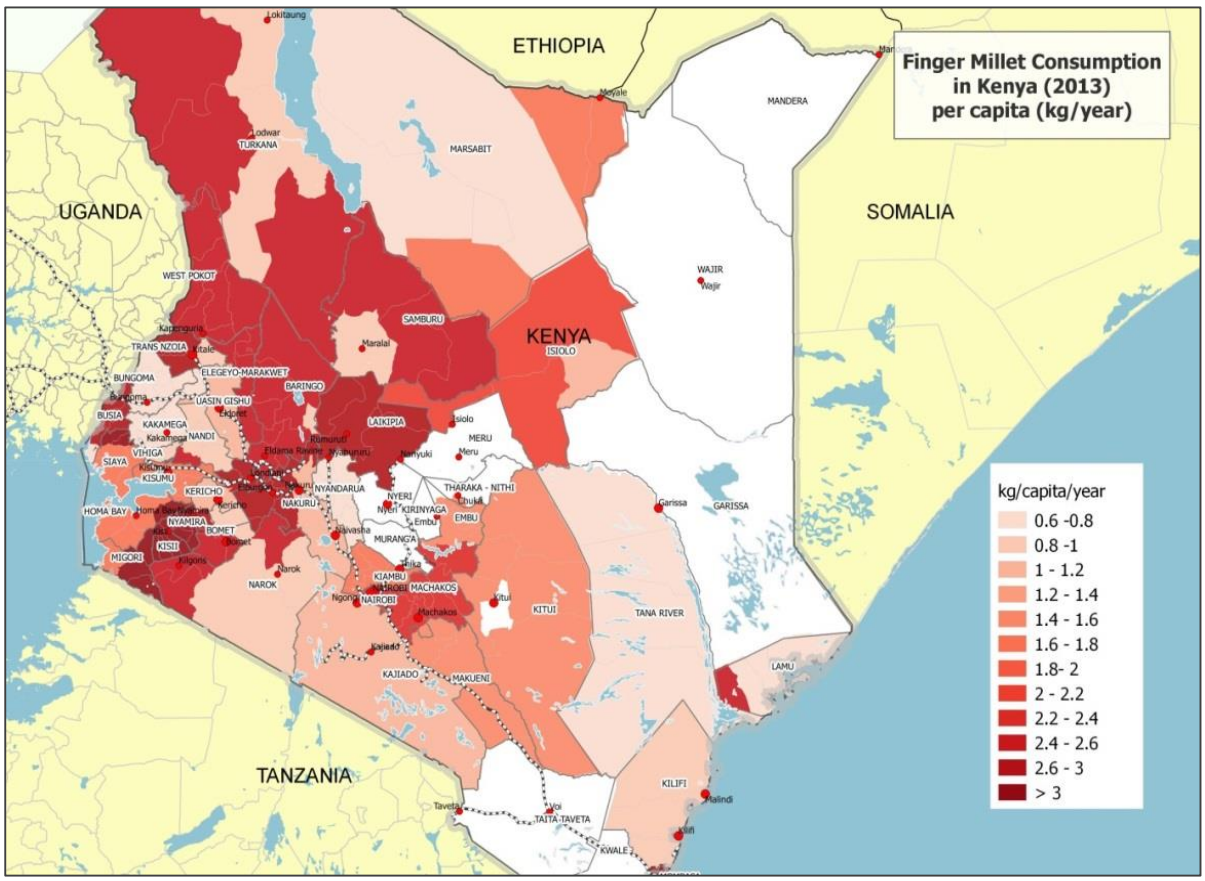
6.7. Cereal Consumption Maps

This section presents a series of GIS maps that highlight the spatial pattern of cereal consumption across Kenya, Ethiopia, Tanzania and Uganda. One set of maps shows total consumption per year in metric tons, while the second set shows the per capita consumption per year in kg. As mentioned in Chapter 3.4, some of the underlying regional consumption estimates taken from ICRISAT's research are based on a small sample size, so these maps are only indicative.

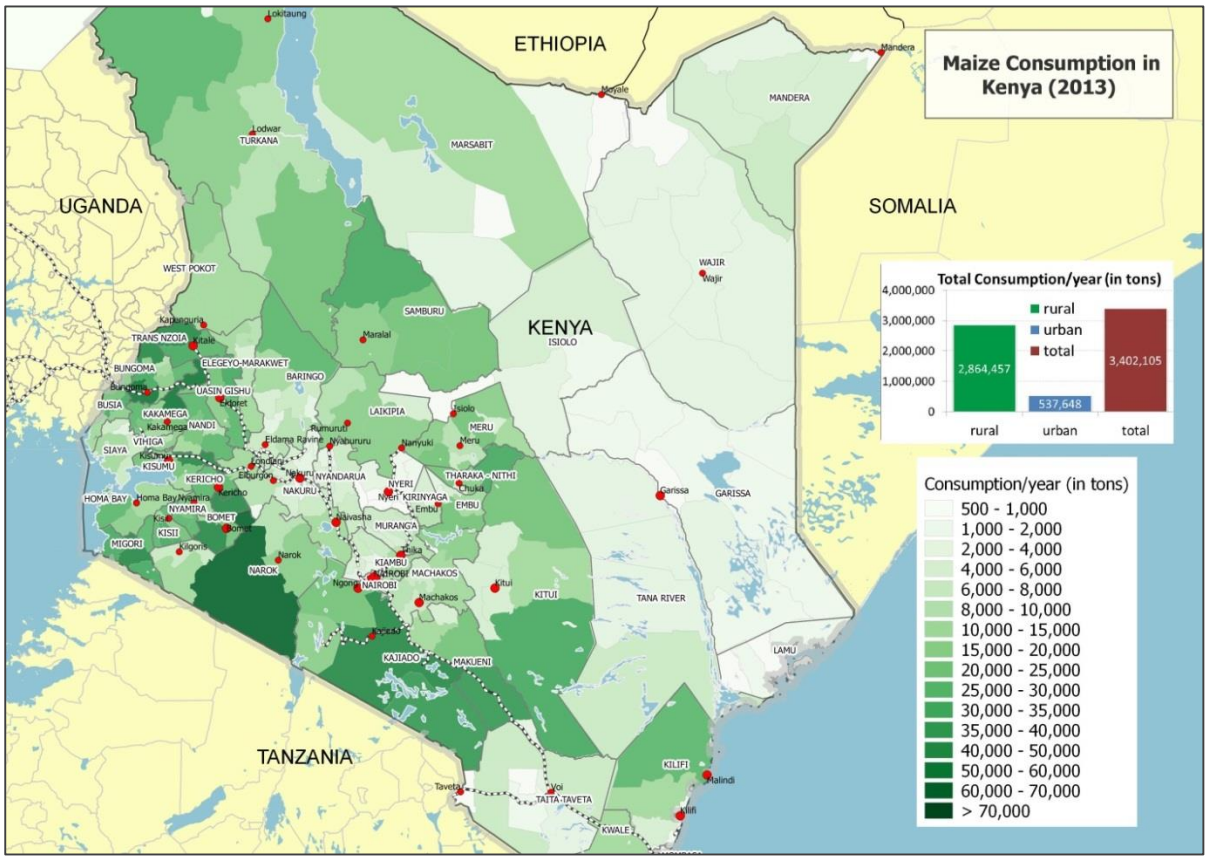
Map 1: Millet consumption in Kenya (2013)



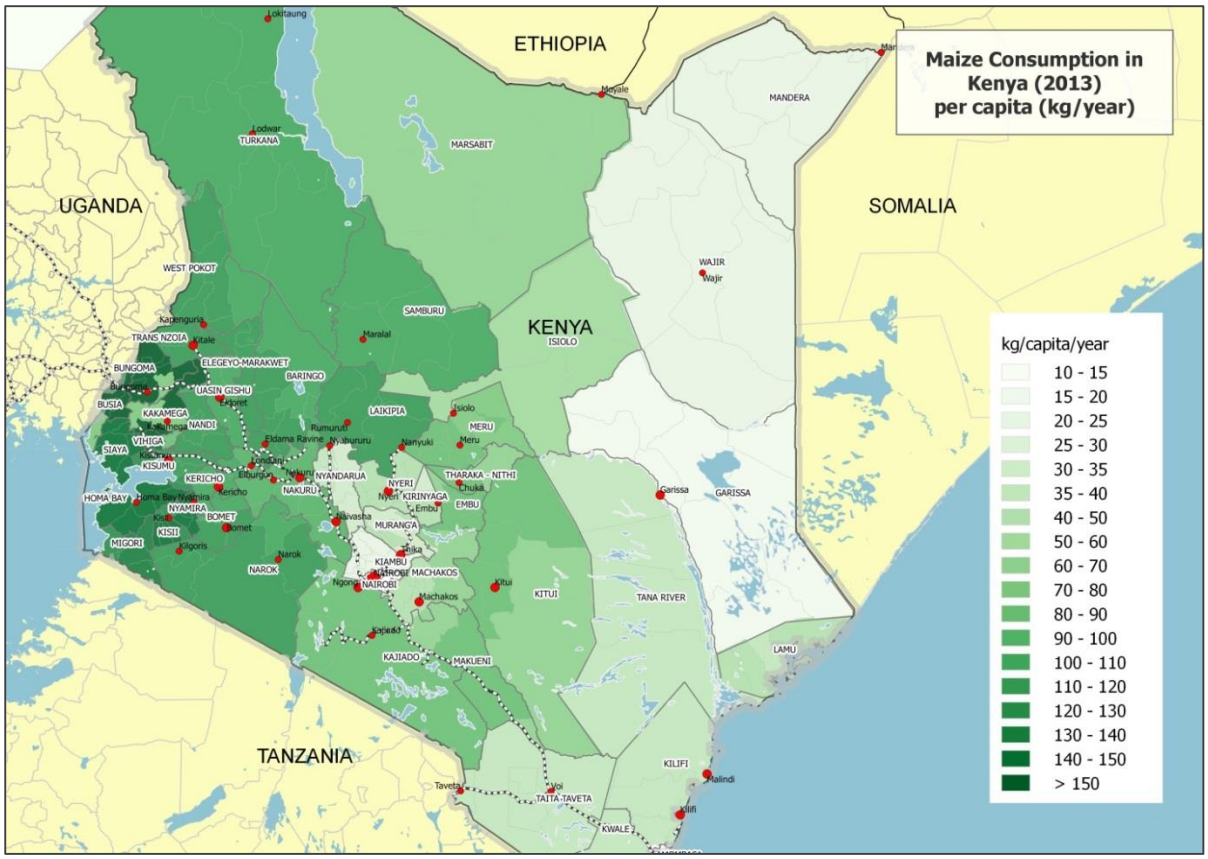
Map 2: Per capita millet consumption in Kenya (2013)



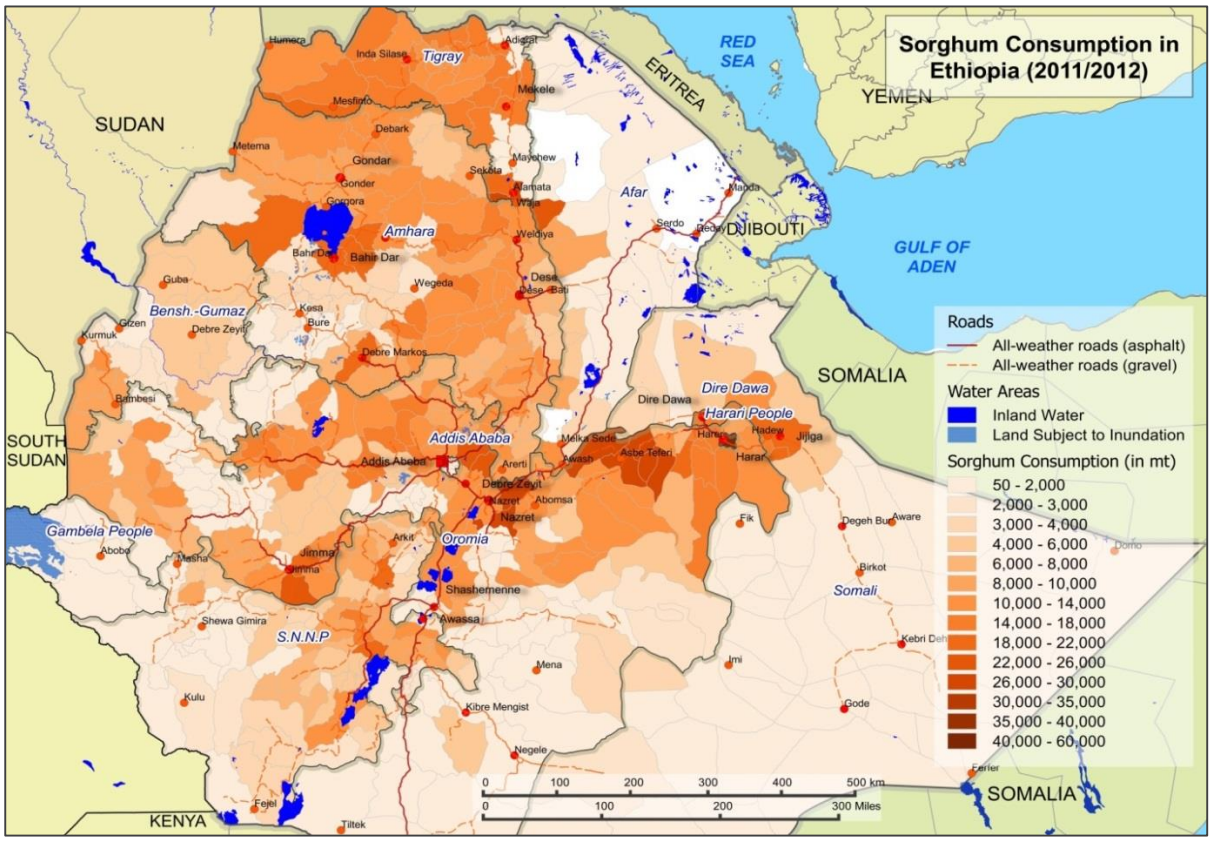
Map 3: Maize consumption in Kenya (2013)



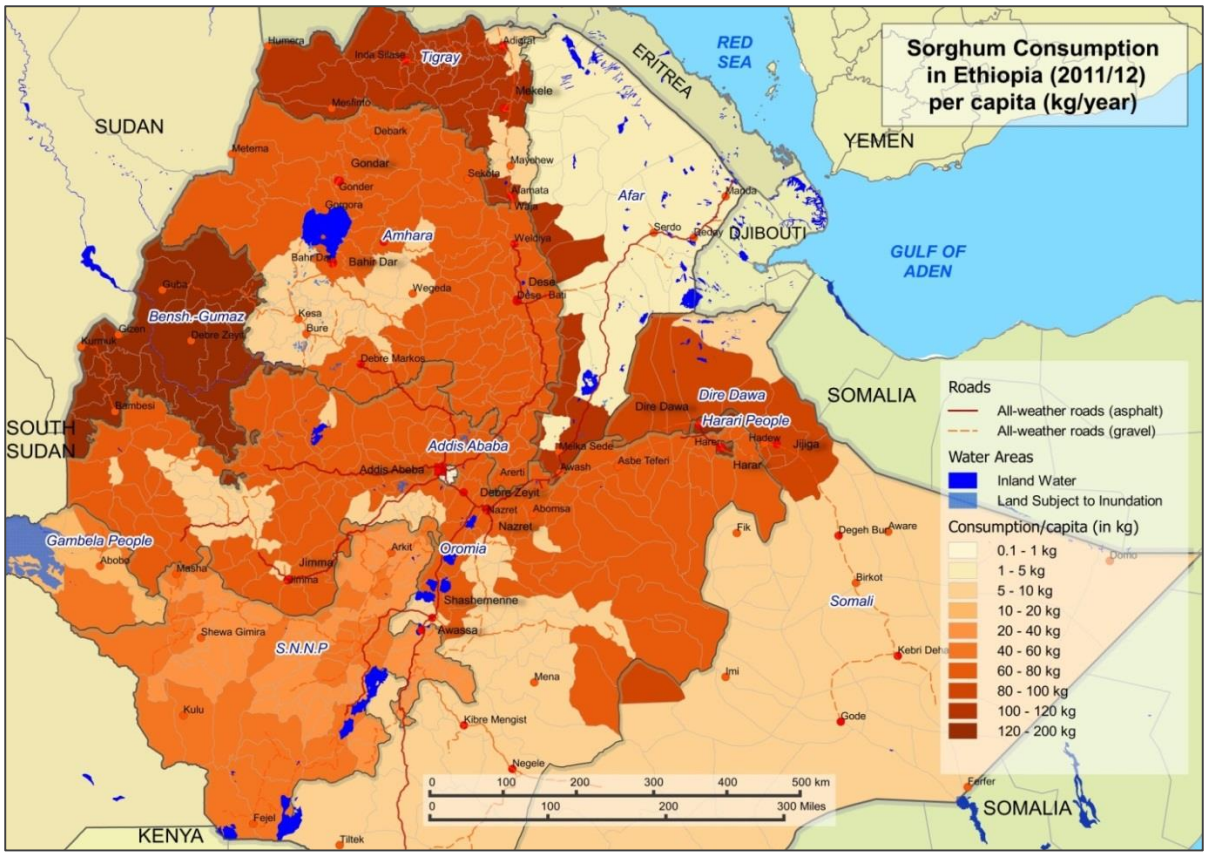
Map 4: Per capita maize consumption in Kenya (2013)



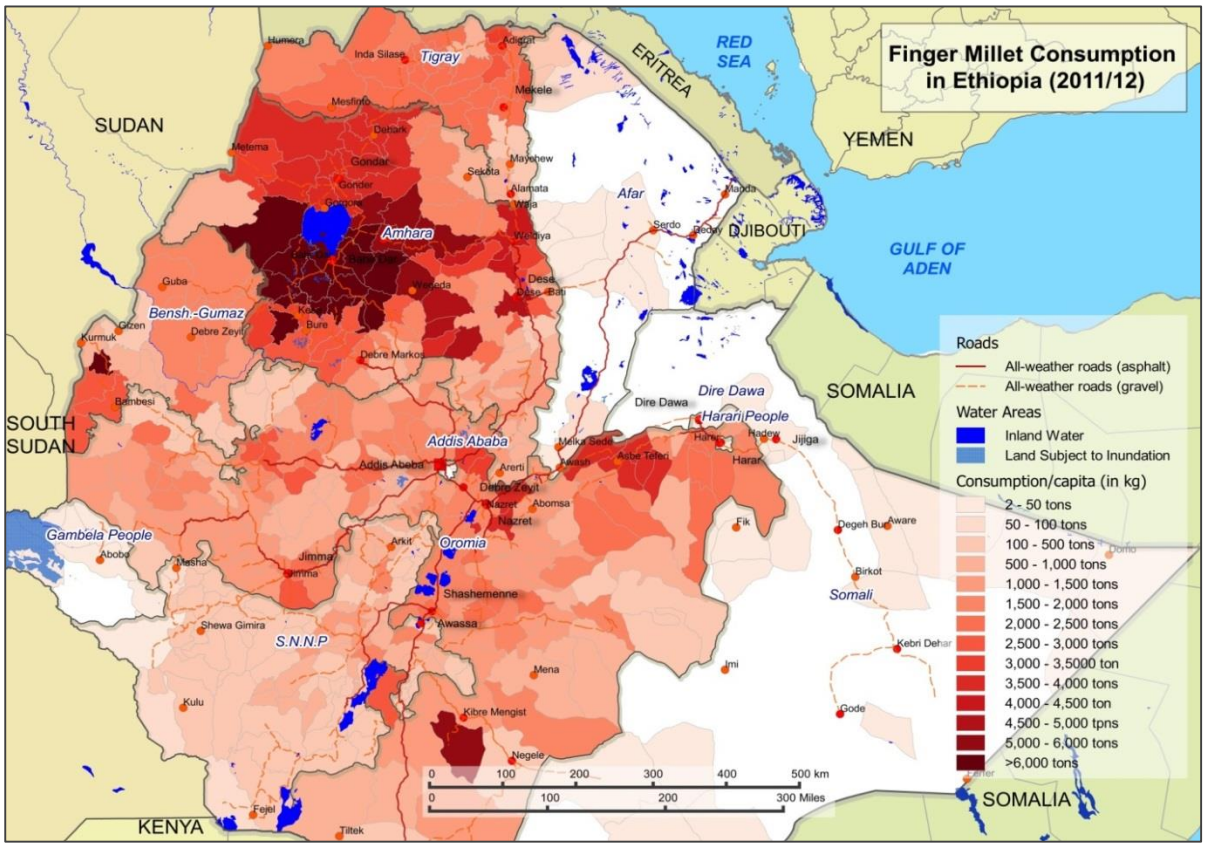
Map 5: Sorghum consumption in Ethiopia (2013)



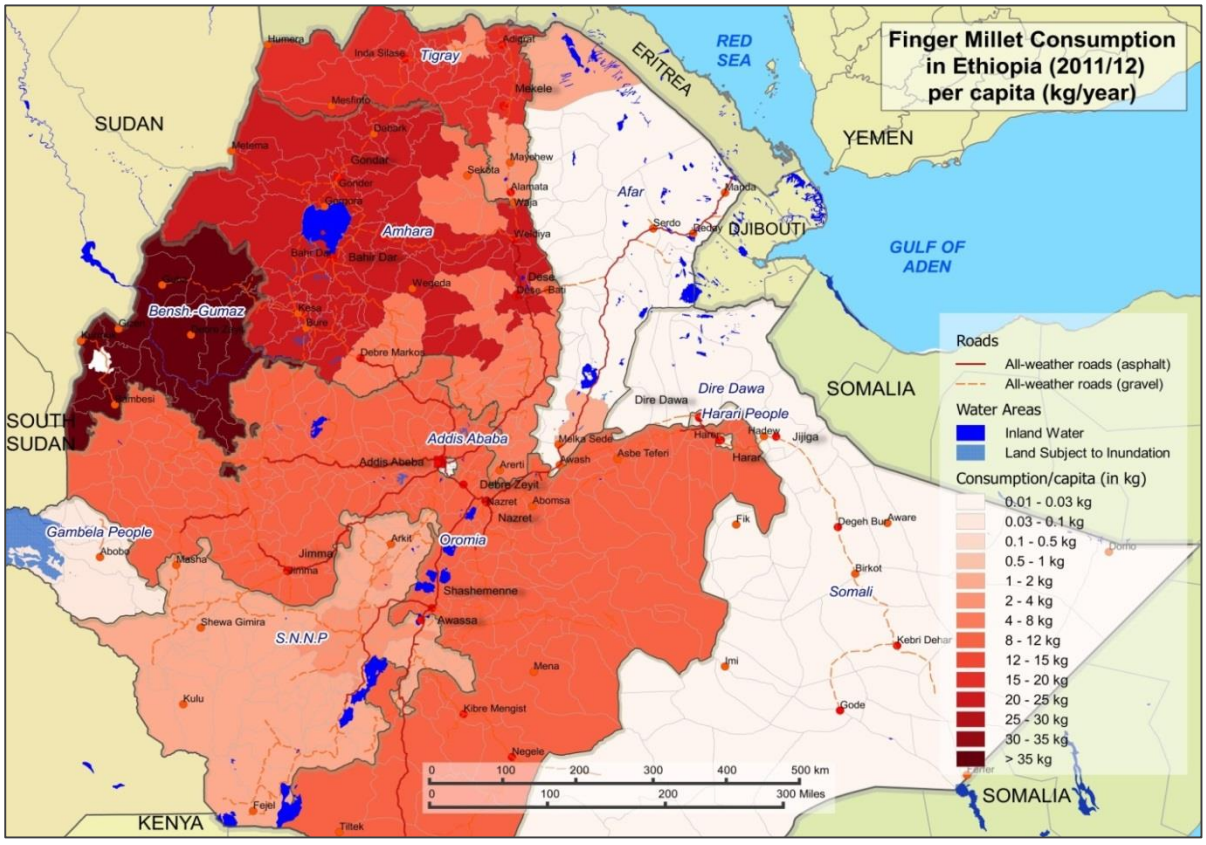
Map 6: Per capita sorghum consumption in Ethiopia (2013)



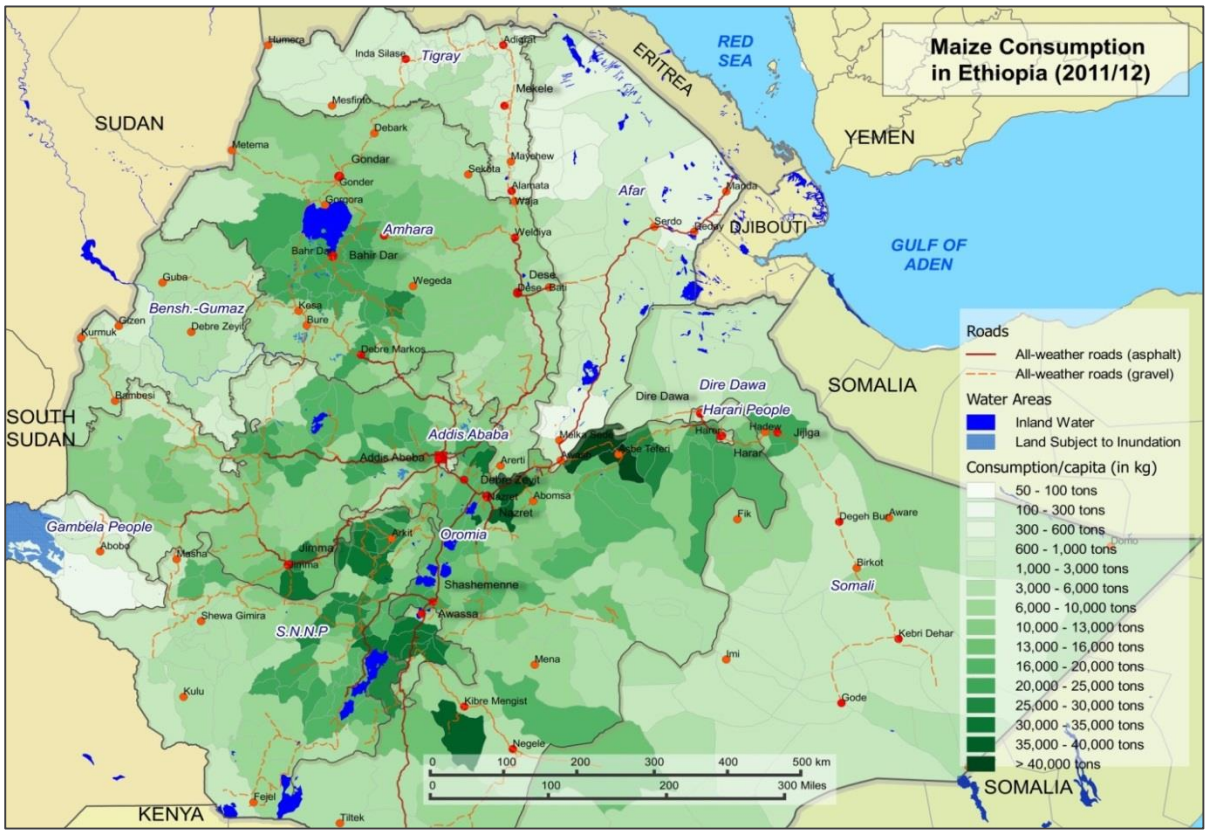
Map 7: Millet consumption in Ethiopia (2013)



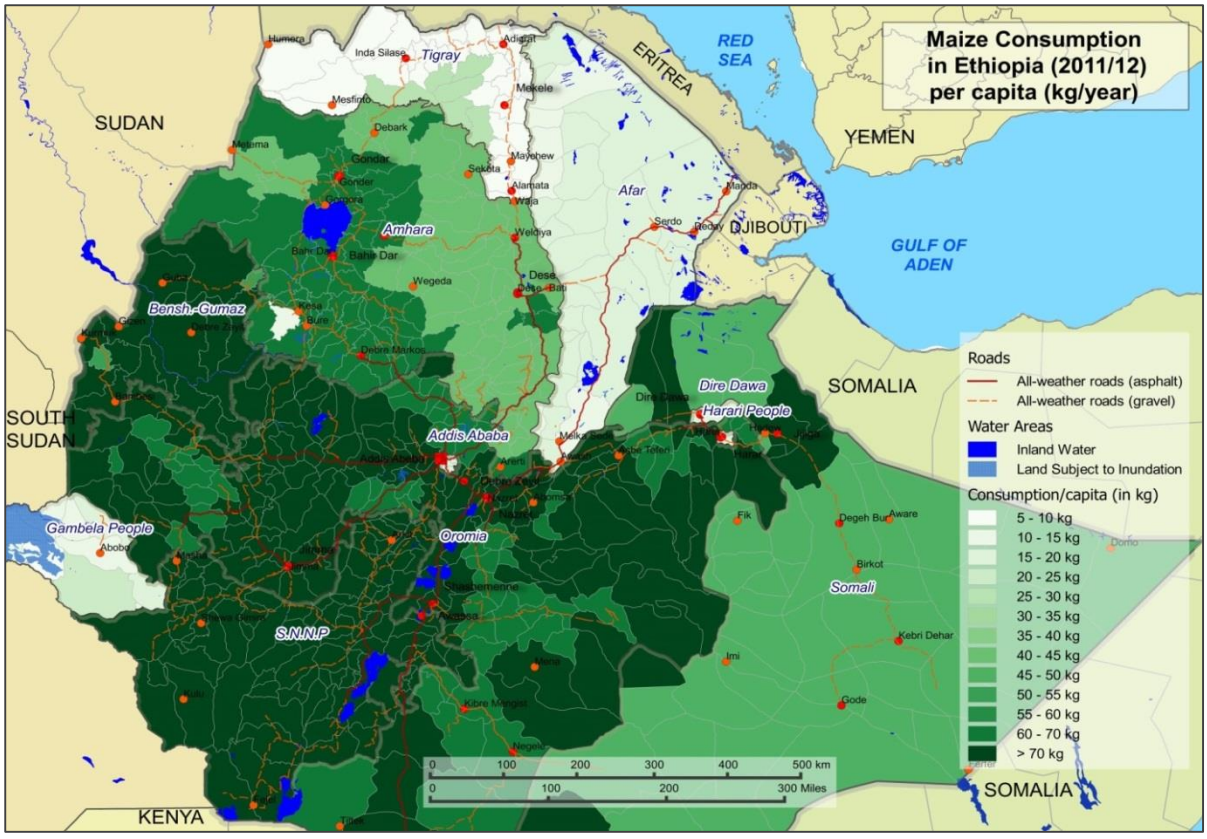
Map 8: Per capita millet consumption in Ethiopia (2013)



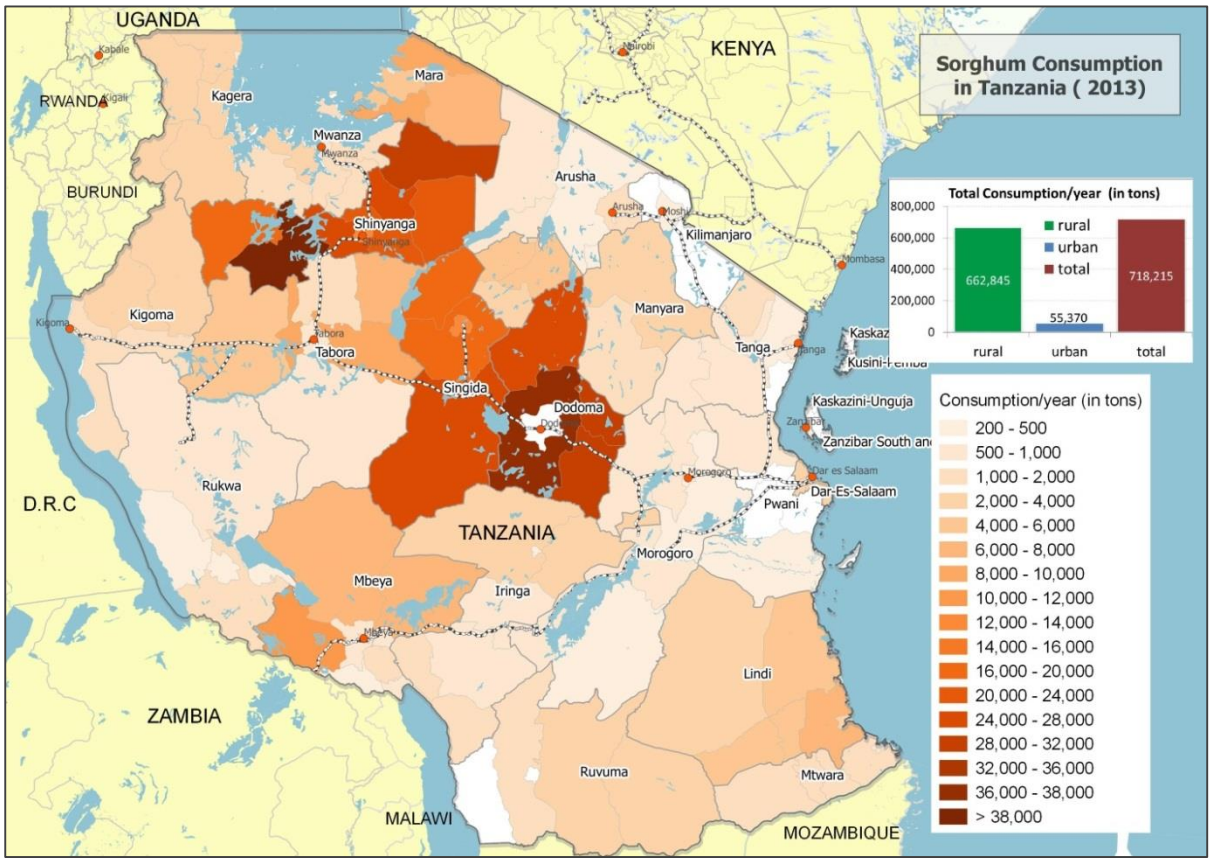
Map 9: Maize consumption in Ethiopia (2013)



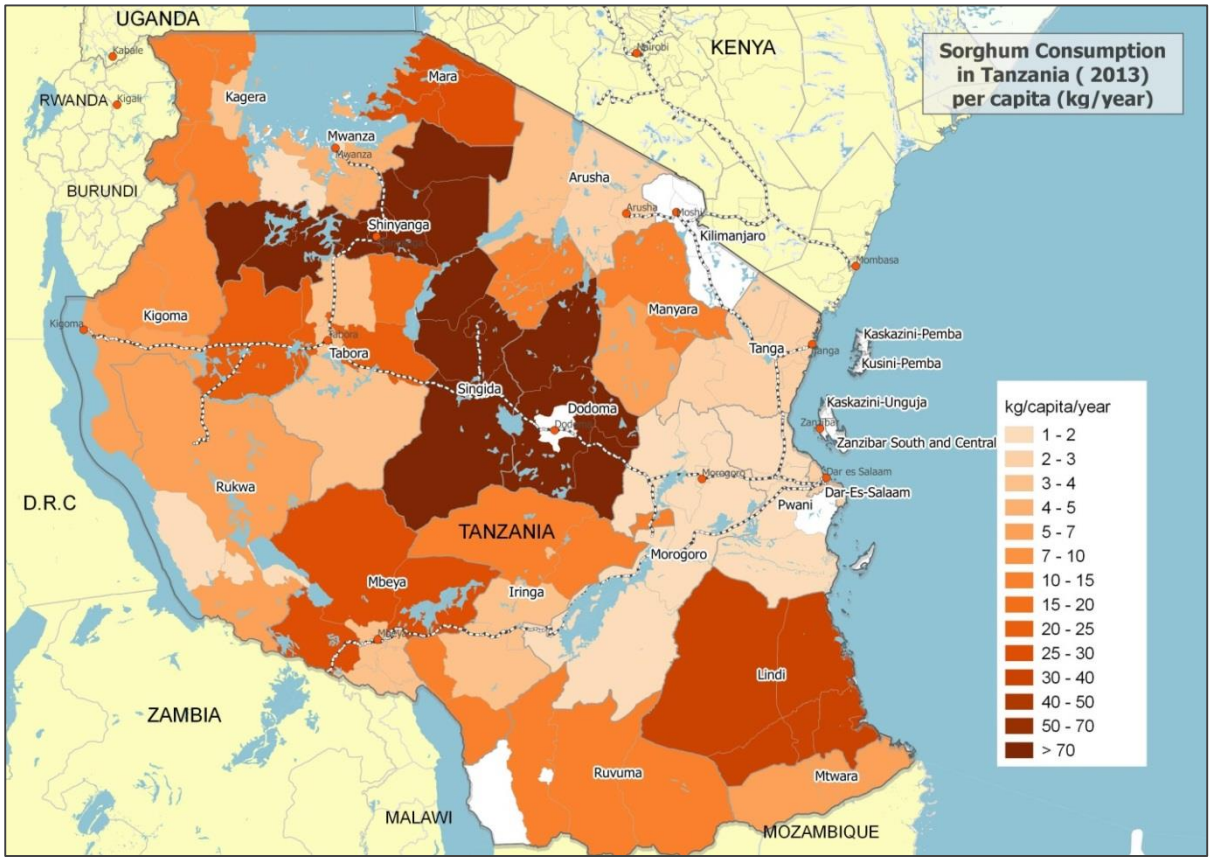
Map 10: Per capita maize consumption in Ethiopia (2013)



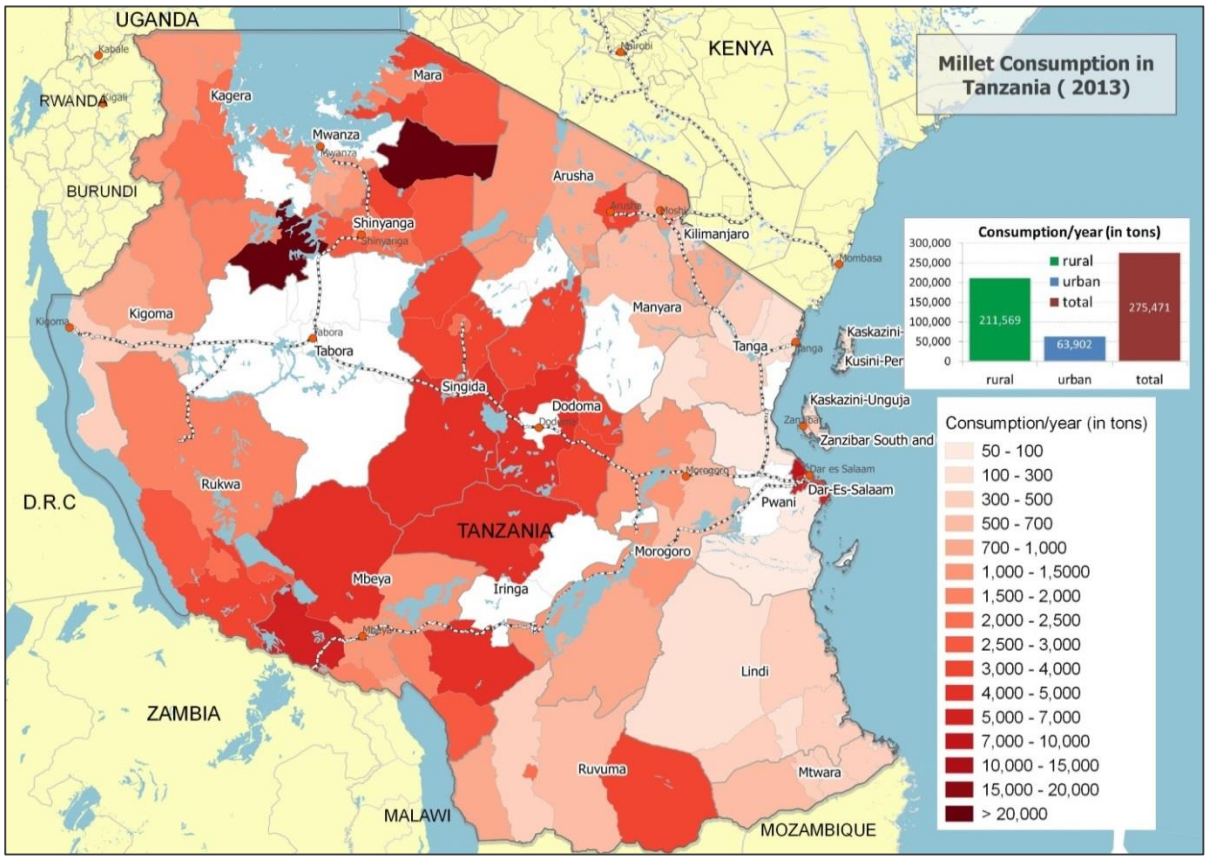
Map 11: Sorghum consumption in Tanzania (2013)



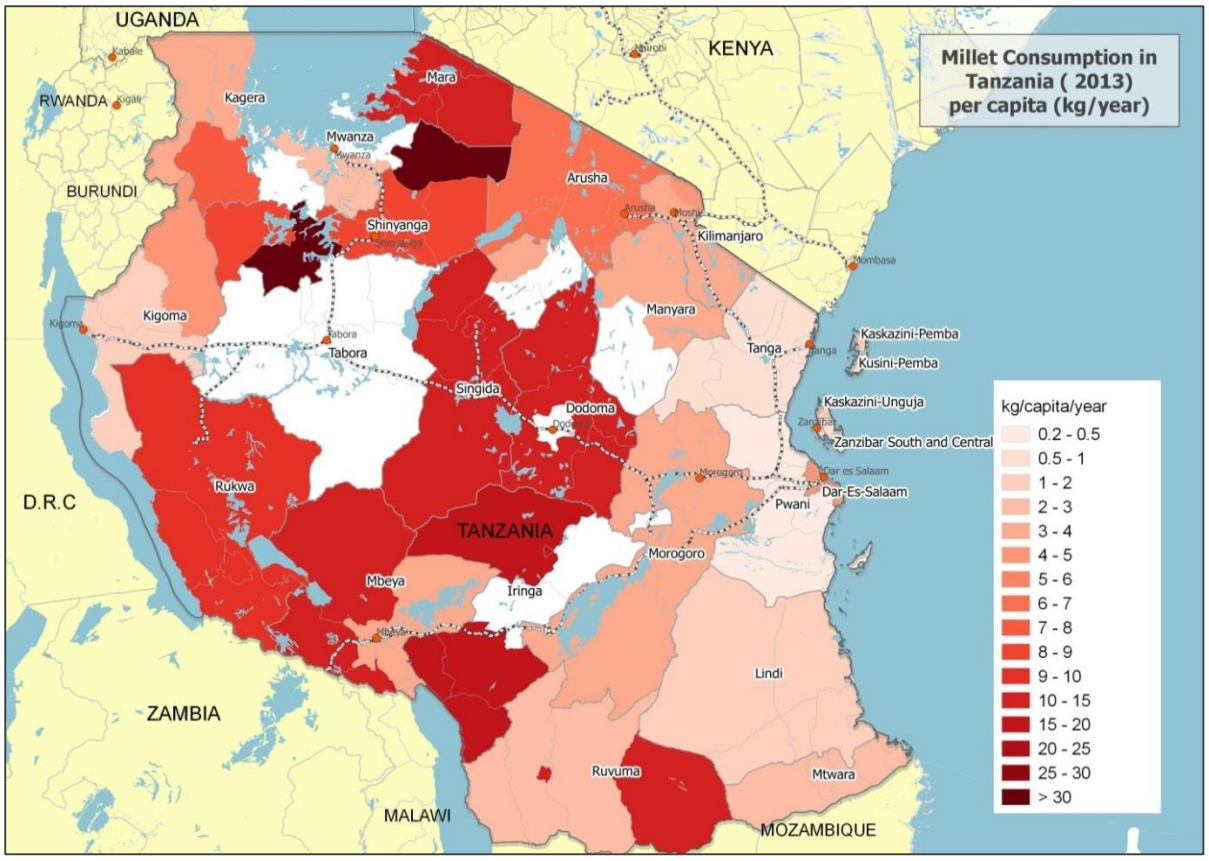
Map 12: Per capita sorghum consumption in Tanzania (2013)



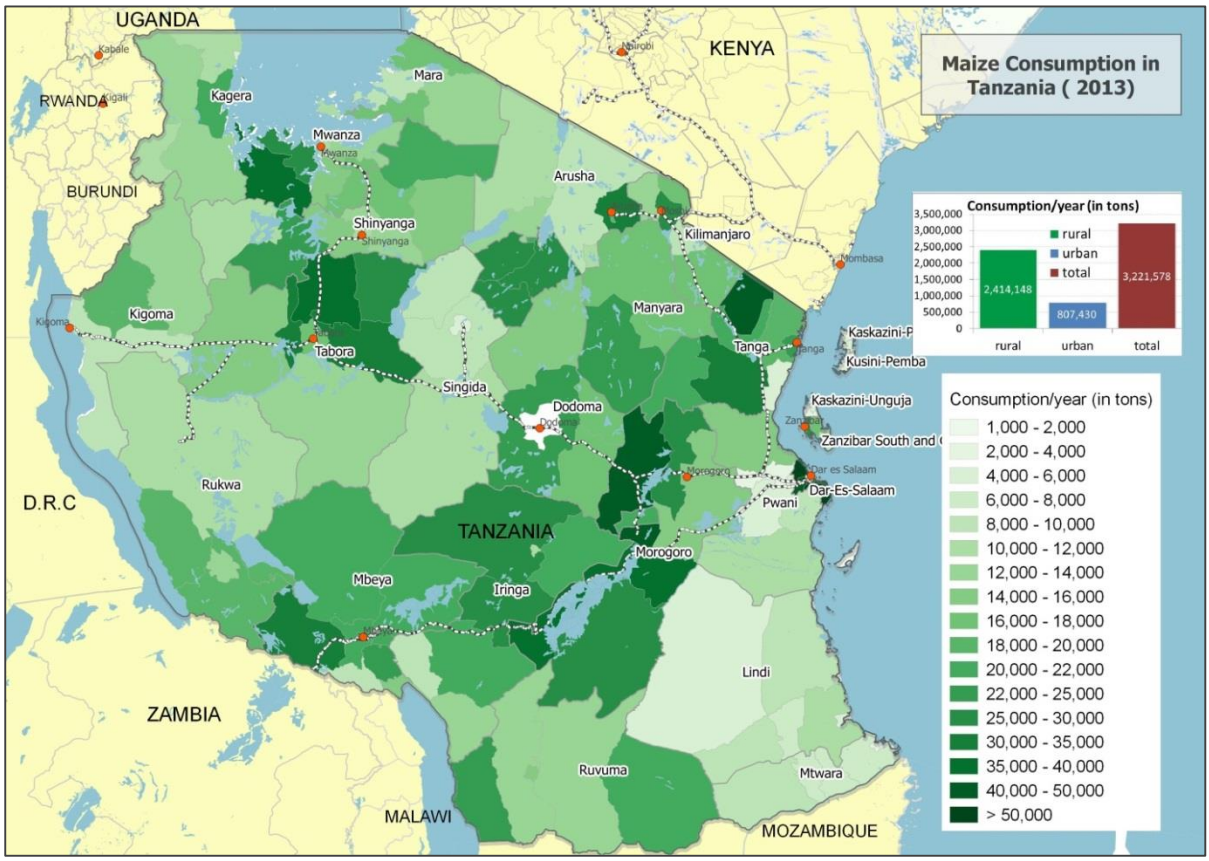
Map 13: Millet consumption in Tanzania (2013)



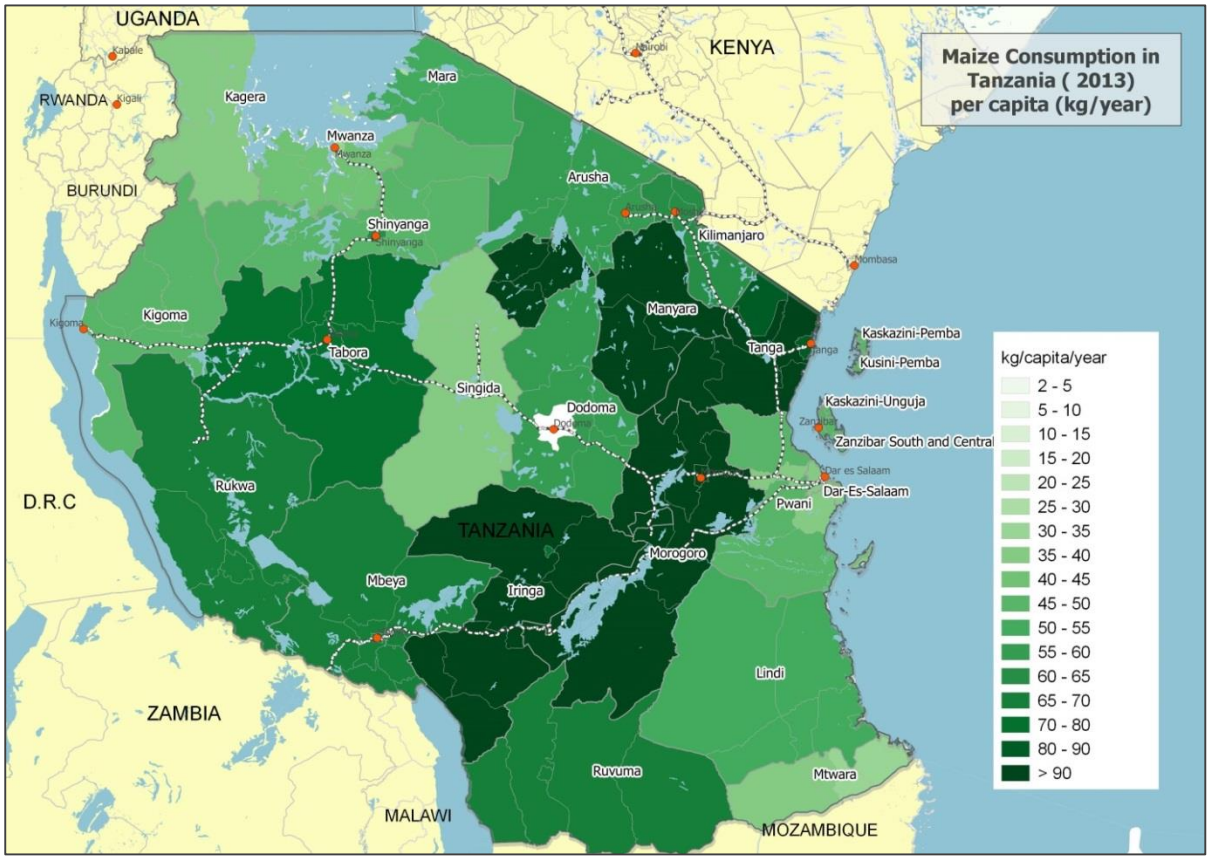
Map 14: Per capita millet consumption in Tanzania (2013)



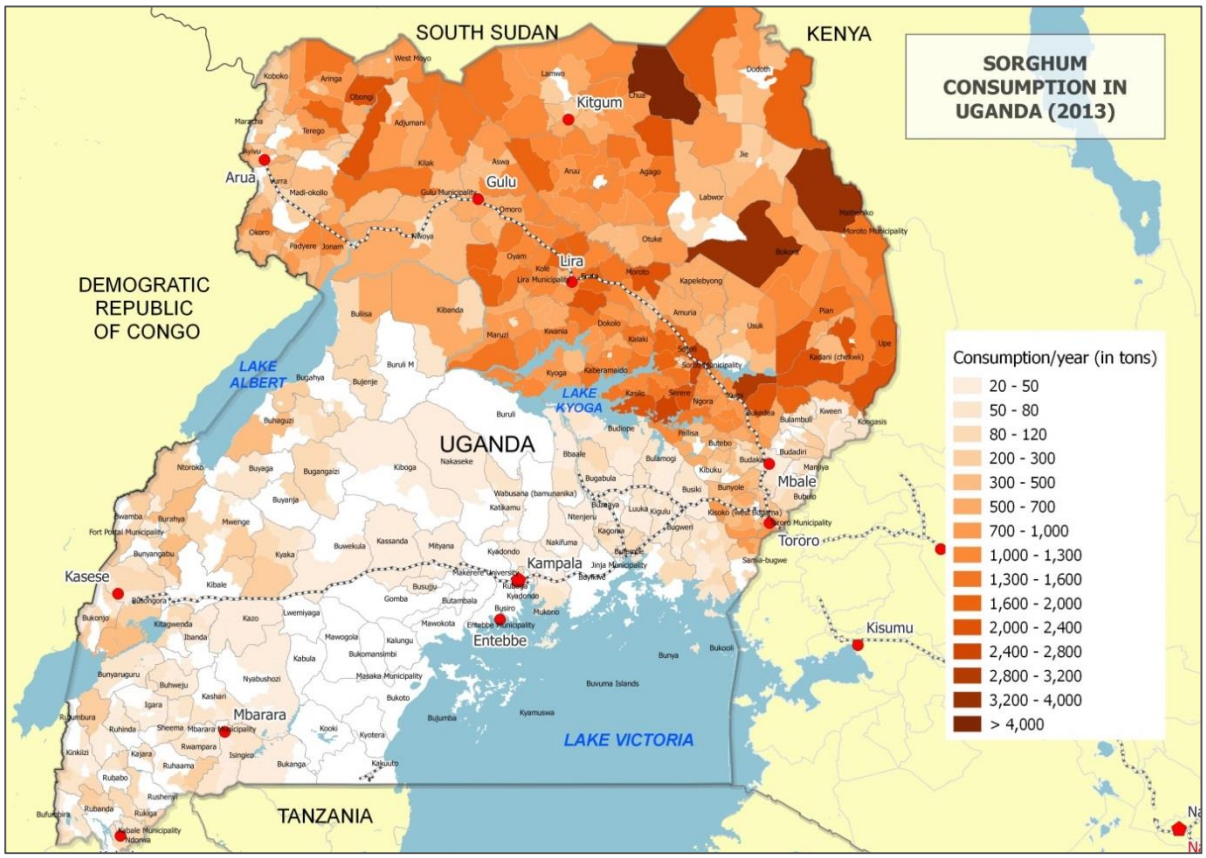
Map 15: Maize consumption in Tanzania (2013)



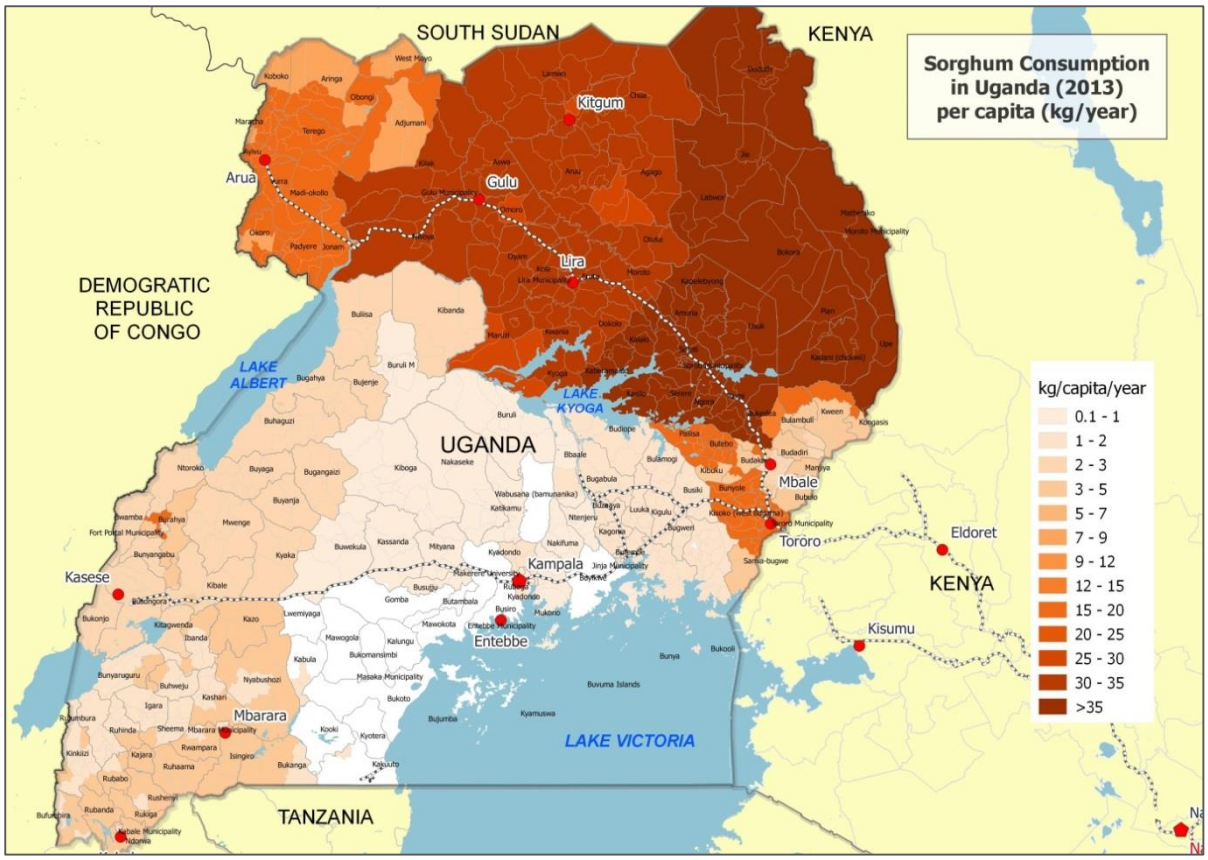
Map 16: Per capita maize consumption in Tanzania (2013)



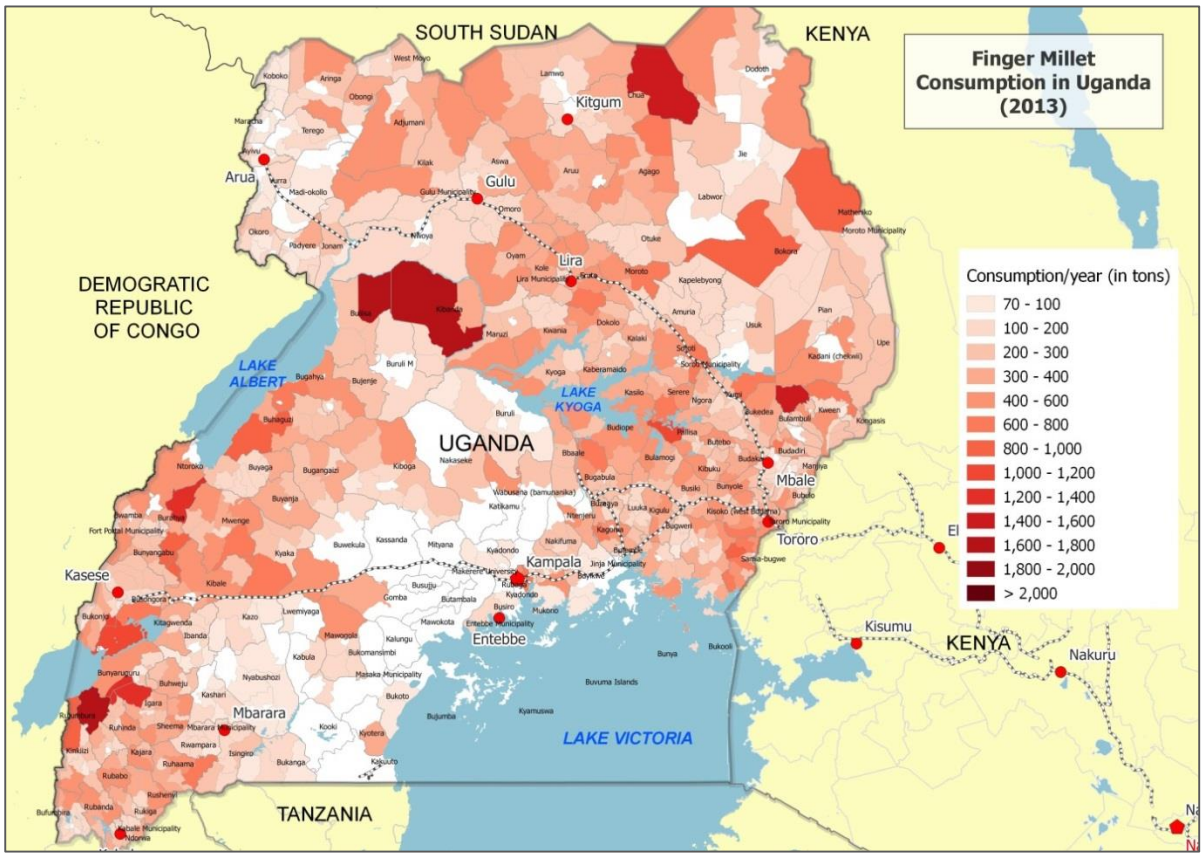
Map 17: Sorghum consumption in Uganda (2013)



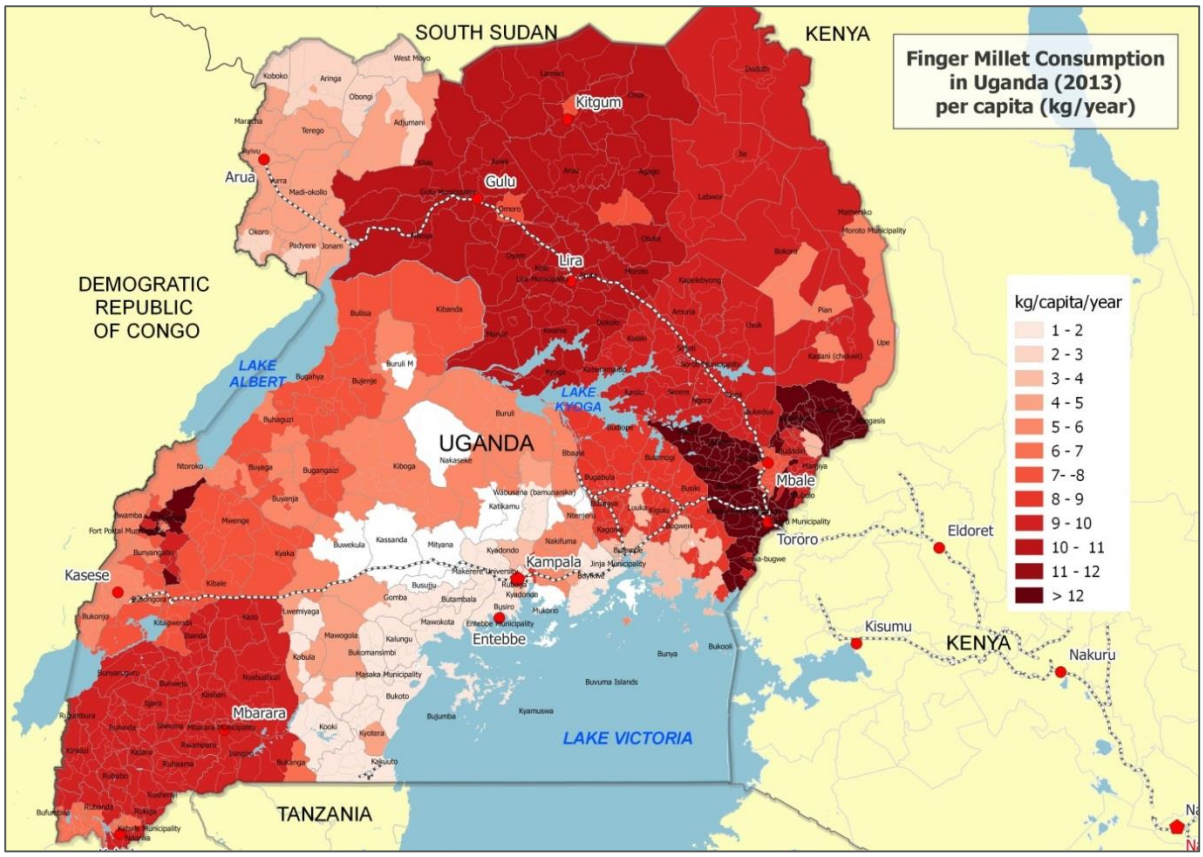
Map 18: Per capita sorghum consumption in Uganda (2013)



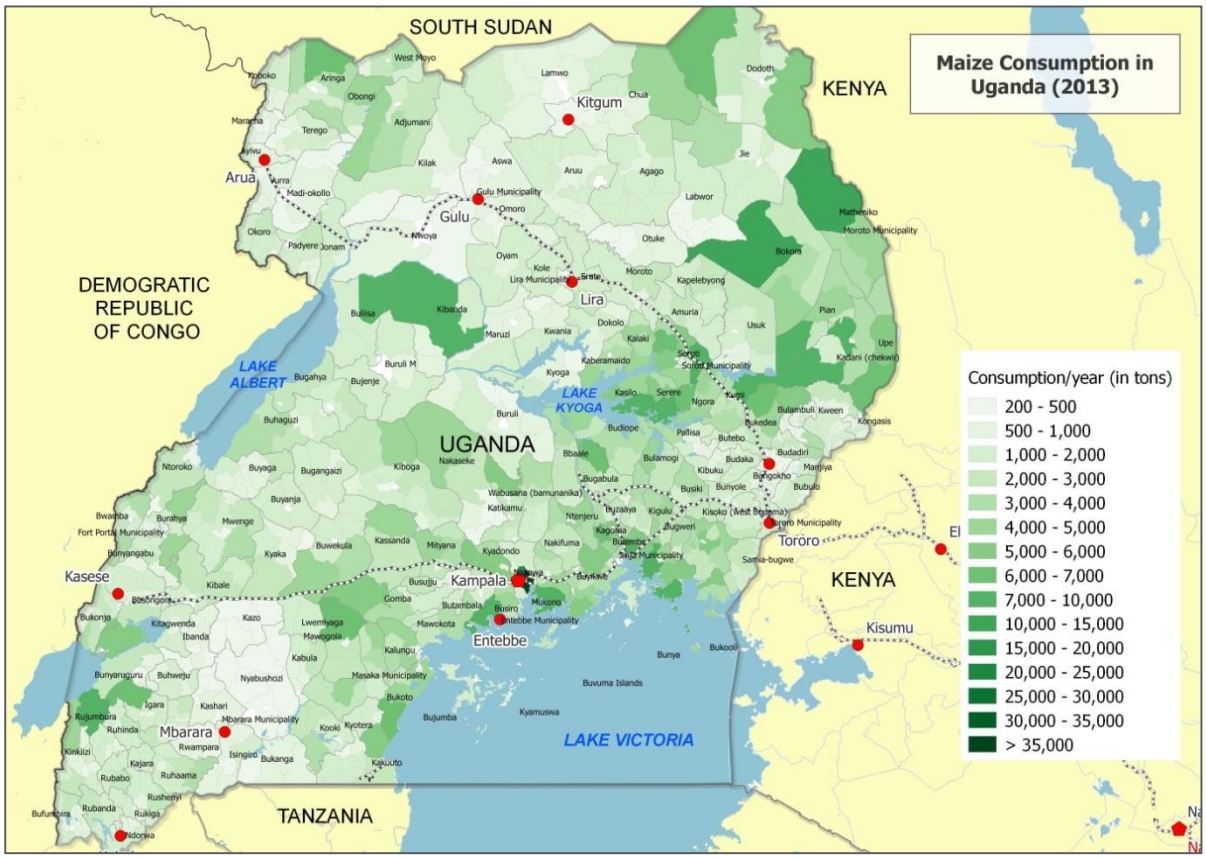
Map 19: Millet consumption in Uganda (2013)



Map 20: Per capita millet consumption in Uganda (2013)



Map 21: Maize consumption in Uganda (2013)



Map 22: Per capita maize consumption in Uganda (2013)

7. Cereal Prices and Elasticity of Demand

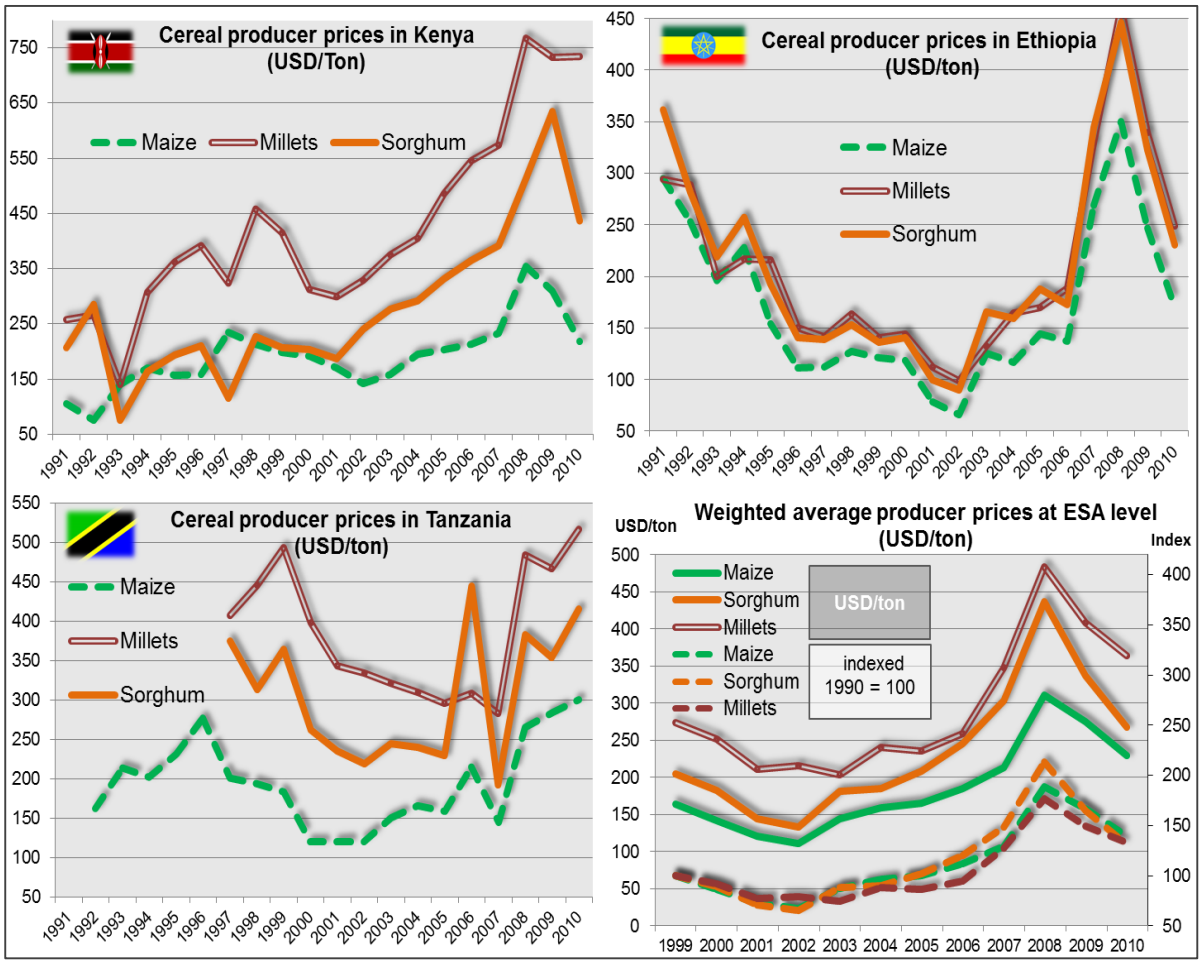
Section 7.1 of this Section summarizes information on long-term prices of cereals and compares price trends between maize, sorghum and millets. Section 7.2 brings together the available information on price and income elasticities.

7.1. Cereal Price Trends

Figure 27 shows long-terms trends in prices of major cereals between 1991 and 2010. Across all four countries, the price relationship between sorghum, millets and maize was constant, with millet as the most expensive cereal, followed by sorghum, with maize as the cheapest cereal. Price differentials were smallest in Ethiopia and greatest in Kenya.

Prices in Kenya showed a steady upward trend for all three cereals and less price volatility. Moreover, prices in Kenya tended to be 50 to 70% higher than in Ethiopia or Tanzania. Sorghum and millet prices increased much faster than for maize, posing a challenge to buyers. In contrast, cereal prices in Tanzania remained fairly stable between 1991 and 2010, but with large medium-term price swings, particularly for sorghum and millets. Cereal prices in Ethiopia were high in 1991 but dropped by almost two thirds in the following ten years until 2001. Prices then recovered but reached a new high when the financial crisis in 2007 disrupted international commodity markets.

Figure 27: Long-term cereal producer prices in four ESA countries (USD/ton)

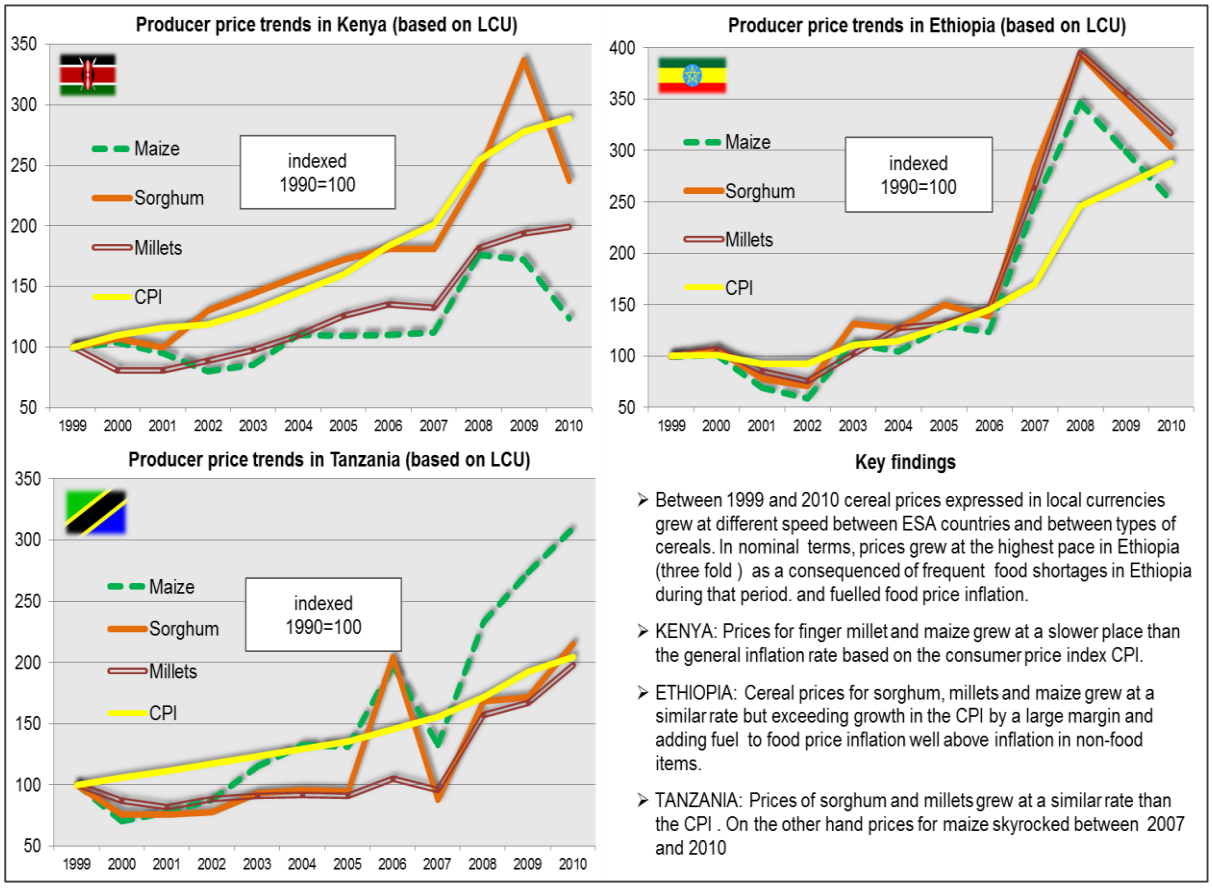


Source: own calculations based on price data from World Bank, Africa Development Indicators 2013

Figure 28 shows price trends between 1999 and 2010 in local currencies, compared with the consumer price index (CPI) as an indicator for inflation. By excluding exchange rate effects with the US dollar, the upward trend in cereal prices becomes clearer for all four ESA countries.

For Ethiopia, the decline in cereal prices between 1991 and 2000 disappears. This can only be explained by government intervention to devalue the Birr against the US dollar. The most significant differences in cereal prices between Kenya, Ethiopia and Tanzania can be found by benchmarking price trends against the general inflation rate (CPI). Three distinct patterns appear. In Kenya, cereal prices grew more slowly than inflation, so cereals became relatively less expensive. In Tanzania, cereal prices increased in line with inflation. In Ethiopia, from 2006 cereal prices exceeded the rate of inflation by 50% in some years, but then fell to match inflation. This suggests that Ethiopia experienced periods of food shortage that led to rapid food price inflation.

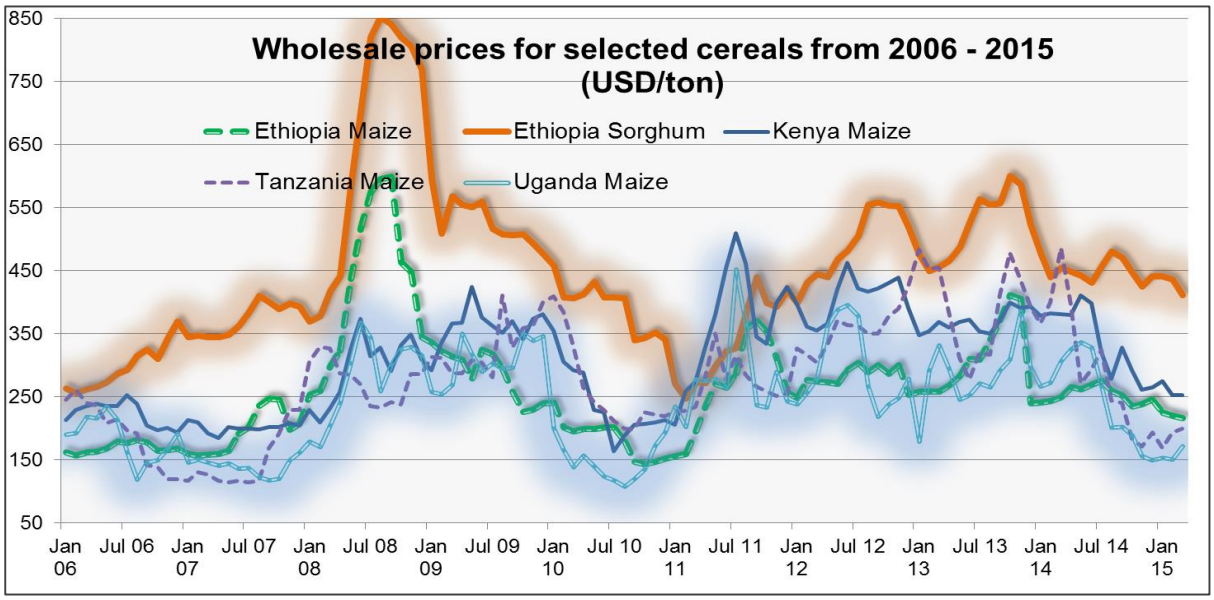
Figure 28: Producer price trends and CPI in four ESA countries (1999 - 2010)



Source: own calculations based on CPI from World Bank WDI, prices from ADI 2013. LCU = local currency unit

Figure 29 shows wholesale prices in USD between 2006 and 2015. Prices were retrieved from the FAO food price monitoring and analysis tool. Sorghum prices were available only for Ethiopia, while only maize prices were available for Kenya and Tanzania. Prices peaked in 2008, then dropped for the next seven to eight years before stabilizing at around 450 USD/ton for sorghum in Ethiopia and 250-450 USD for maize. Maize prices remained highest in Kenya, followed by Tanzania and Uganda. However, seasonal price volatility remains persistent in the maize economy.

Figure 29: Wholesale prices of cereals in four ESA countries (2006 - 2015)



Source: own calculation based on price data from FAO 'Food Price Monitoring and Analysis Tool'

7.2. Price-, Cross-Price- and Expenditure Elasticities

This section summarizes available information from published secondary sources about the price responsiveness of cereals with regard to consumption and expenditures. The concept of elasticity is a standard quantitative measurement of the direction and extent of changes in demand with regard to changes in prices. Table 15 highlights some of the key findings from the elasticity information that will be elaborated country by country further in this section. The elasticities show the percentage change in demand in response to a 1 % change in price or in income.

Table 15: Price responsiveness of cereal consumption in ESA countries: an overview

		Kenya	Ethiopia	Tanzania	Uganda
		% change in demand for a 1 % increase in price (compensated own price elasticity)			
National	Sorghum	-0.605	-0.66		
	Maize	-0.436	-0.75	-0.713	-0.68
Rural	sorghum/millet	-1.018	-0.84		
	Maize	-0.626	-0.873	-1.021	
Urban	sorghum/millet	-1.051	-0.902		
	Maize	-0.702	-0.904	-0.703	
		% change in demand for a 1 % increase in the price of the competing cereal (cross price elasticity)			
	sorghum/maize	0.339	-0.07		
		% change in demand for a 1 % increase in income (expenditure elasticity)			
	sorghum	0.766	0.77		
	maize	0.928	0.928	0.907	0.68

Nzuma and Sarker (2008),; Musyoka et al. (2014) ; Tafere et al. (2010); Mafuru and Marsh (2003); Boysen (2012).

'Own-price' elasticity refers to the change in consumer demand for a 1 % increase in the price of sorghum and millets. All price elasticities have values below 1, or are 'inelastic'. In other words, a 1 % increase in price will not reduce demand by the same amount, which is typical for staple food such as cereals The own price elasticity for sorghum in Kenya and Ethiopia is around -0.6 which means that a price increase of sorghum of 1 % lowers consumption by around 0.6%. Vice versa, if the price of sorghum price drops by 1 %, then consumption increases only by 0.6%. Maize is also price inelastic with a value of -0.4 in Kenya and -0.75 in Ethiopia. Similar values are reported for Tanzania and Kenya. No information about sorghum in Tanzania and Uganda were attainable. Examination of price elasticity by rural and urban areas does not indicate significant differences which deviates from the general trend that consumption of staple foods in urban areas tend to be more price responsive than in rural areas simply as a consequence of more alternative food choices in the market. These values of own price elasticity are typical for staple foods such as cereals.

'Cross-price elasticity' refers to the change in consumer demand for sorghum and millets for a 1 % increase in the price of a competing cereal such as maize. Table 15 picks the cross price elasticity between sorghum and maize which is very low (0.3) for Kenya and close to zero for Ethiopia. A value of 0.3 means that if the sorghum price increases by 1% then the consumption of maize increases by merely 0.3% by substituting some of the sorghum with maize. This suggests limited substitution between sorghum and maize in ESA, suggesting that sorghum is consumed in specific regions where consumers do not have ready access to maize, either because maize is not widely grown in those regions or because there is limited domestic trade. ICRISAT's findings on sorghum consumption in Kenya and Tanzania (Schipmann-Schwarze et al. 2013) underline that cereals in general (incl. maize, sorghum, millets, wheat) are utilized by households in complementary fashion and not as substitutes. By comparing maize with sorghum, maize is mostly consumed as ugali, followed by Makande (a maize bean dish) and as porridge to a minor extent. By contrast, sorghum and finger millet are mostly consumed as porridge, while only one third of the interviewed households also prepare ugali from sorghum. Moreover, finger millet is used to prepare alcoholic drinks, particularly in rural and urban non-production areas. In Kenya and Tanzania, wheat is mostly used to prepare chapattis and mandazis which indicates that wheat is basically supplementary to consumption of other cereals.

'Expenditure elasticity' refers to the change in consumer demand for sorghum and millets for a 1 % increase in expenditure, or household income. Expenditure elasticities for major cereals in the ESA region are below 'one' which indicates that sorghum and millets are 'inferior goods', or a good for which consumer demand falls as income rises. . However, the expenditure elasticity for maize is closer to 1, indicating that it is less of an 'inferior good' than sorghum. A value of 0.9 for maize implies that if household income increases by 1 % then expenditure on maize will increase by 0.9%.

KENYA

The two main sources of information for Kenya are Musyoka et al. (2014) and Nzuma and Sarker, (2008). The analysis by Musyoka et al (2014) used the 2005/2006 Kenya Integrated Household Expenditure Survey and grouped millets together with sorghum. Nzuma and Sarkar (2008) treated millets and sorghum separately.

Table 16 presents the Marshallian (uncompensated) and Hicksian (compensated) elasticities of demand for grain cereals in Kenya (Nzuma and Sarker, 2008). In general, all the

estimated elasticities are price inelastic. Specifically, the own-price elasticities are negative and significant at least at the five percent level. The short-run own-price Marshallian elasticities of demand for maize, wheat, rice and sorghum are - 0.53, - 0.26, -0.66 and –0.79 respectively. The consumer demand elasticity estimates show only minimal changes in price response between the short-run and the long-run. All long-run, own-price Marshallian elasticities are larger in absolute terms than their short-run counterparts. In the long-run, consumers adjust demand more to price changes than in the short-run, thus long-run demand functions are more price and expenditure responsive than their short-run counterparts. The cross-price Marshallian elasticities possess similar signs both in the short-run and in the long-run but are fairly low in magnitude. The sign of the cross-price elasticities between maize, wheat, rice and sorghum indicate a complementary relationship between maize, wheat and rice (negative sign) in consumption and a substitutive relationship (positive sign) between maize, wheat and rice with sorghum, in descending order. This means that, if prices for maize, wheat and rice increase, the consumption of sorghum increases as consumers save by shifting to sorghum. In this regard the Hicksian (compensated) elasticity provides a better measure of substitutability since it only captures substitution effects and leaves out income effects.

Table 16: Short and long-run price elasticities for cereals in Kenya[10].

	Uncompensated, short-run				**Compensated, short-run**			
	Maize	Wheat	Rice	Sorghum	Maize	Wheat	Rice	Sorghum
Maize	**-0.531**	-0.432	-0.226	0.101	**-0.203**	-0.149	-0.702	0.415
Wheat	-0.29	**-0.26**	-0.045	0.089	-0.09	**-0.123**	-0.612	0.254
Rice	-0.081	-0.096	**-0.659**	-0.021	-0.055	-0.079	**-0.639**	0.001
Sorghum	*0.073*	*0.162*	*-0.878*	***-0.794***	*0.348*	*0.351*	*0.009*	***-0.576***
	Uncompensated, long-run				**Compensated, long-run**			
	Maize	Wheat	Rice	Sorghum	Maize	Wheat	Rice	Sorghum
Maize	**-0.803**	-0.171	-0.012	0.05	**-0.436**	-0.168	-0.064	0.404
Wheat	-0.118	**-0.345**	-0.022	0-085	-0.102	**-0.196**	-0.515	0.253
Rice	-0.033	-0.084	**-0.923**	-0.013	-0.005	-0.066	**-0.895**	0.009
Sorghum	*0.036*	*0.154*	*-0.769*	***-0.86***	*0.339*	*0.348*	*0.099*	***-0.605***

Source: Nzuma and Sarker (2008)

Table 17 reveals that price responsiveness was generally higher in urban areas. Patterns of household consumption of sorghum and millets did not differ between the urban and rural locations. . The price elasticity for sorghum and millets was unity or slightly above unity across the two locations (1.06 for urban households and 1.02 for rural households). Musyoka et al. (2014) argue that the elastic behaviour of sorghum and millets and rather

[10] Uncompensated elasticity is derived from the '**Marshallian**' demand model (after the economist Alfred Marshall). Marshallian demand curves are simply conventional market or individual demand curves which combine income and substitution effects from a price change in a demand good. Compensated elasticity is based on the '**Hicksian**' demand model (after the economist J.R. Hicks). Hicksian demand curves are composed solely of substitution effects while ignoring income effects from a price change in a demand good. Hicksian demand is also called 'compensated' demand and follows from the fact that to keep the consumer on the same utility indifference curve as prices vary one would have to adjust the consumer's income, i.e. compensate them (Autor, 2010).

small differences between rural and urban areas is unexpected and quite distinct from other cereals and food groups. Higher responsiveness to prices in urban areas reflects the fact that urban households rely on the market for 96 % of their cereal consumption, compared to just 23 % for rural households, and are consequently more sensitive to changes in market prices.

Table 17: Rural and urban price elasticities for cereals in Kenya

	Uncompensated, rural				**Compensated, rural**			
	Maize	Wheat	Rice	Sorghum/ millet	Maize	Wheat	Rice	Sorghum/ millet
Maize	**-0.785****	0.01	-0.014*	0.007**	**-0.626****	0.168**	0.144**	0.166**
Wheat	0.008	**-0.882****	-0.001	-0.008	0.078**	**-0.812****	0.069**	0.062**
Rice	-0.064*	0.008	**-0.840****	0.01	-0.018	0.053**	**-0.795****	0.055**
Sorghum/ millet	*0.264***	*-0.031*	*0.077**	***-1.024*****	*0.270***	*-0.025*	*0.083***	***-1.018*****
	Uncompensated, urban				**Compensated, urban**			
	Maize	Wheat	Rice	SM	Maize	Wheat	Rice	SM
Maize	**-0.794****	-0.002	0.013	0.002	**-0.702****	0.090**	0.105**	0.094**
Wheat	-0.031	**-0.997****	-0.012	0.001	0.090**	**-0.877****	0.108**	0.121**
Rice	0.03	-0.011	**-0.836****	-0.004	0.076	0.036	**-0.789****	0.043**
Sorghum/ millet	*0.052*	*0.136*	*-0.05*	***-1.058*****	*0.059*	*0.143*	*-0.043*	***-1.051*****

Source: Musyoka et al. (2014); **p<0.01, *p<0.05

The estimated expenditure elasticities in Table 18 all have positive signs indicating that at current levels of consumption, rising income leads to higher cereal consumption. Changes in income for urban households have a more significant effect on cereal consumption than for rural households, except for maize. As the economy grows, urban households will consume more wheat, rice, sorghum and millets than rural households, with the opposite being true for maize. In the case of sorghum, this seems counter-intuitive and contradicts Kamau et al. (2011) who reported stagnant consumption and expenditure for sorghum as income rises. Expenditures elasticities in the long-run are highest for maize, followed by rice, wheat and sorghum. These results confirm previous findings with regard to cereal preferences and income levels. With the exception of wheat, the elasticity values from Musyoka et al. (2014) and Nzuma and Sarker (2008) match fairly well.

Table 18: Expenditure elasticities for cereals in Kenya

	rural	urban	short-run	long-run
Maize	0.936	0.850	0.828	0.928
Wheat	1.041	1.154	0.568	0.618
Rice	0.907	0.908	0.643	0.92
Sorghum/millet	0.429	0.810	0.657	0.766

Source: Musyoka et al. (2014); Nzuma and Sarker (2008).

ETHIOPIA

Table 19, 20 and 21 summarize results for Ethiopia. As predicted by theory, the compensated own-price elasticities are negative for all commodities. That they are also close to -1 suggests that most of the commodities are own-price unitary elastic. Own-price elasticities of maize and sorghum are the furthest away from -1. Cross-price effects are also present, although they appear rather weak for most commodity pairs. Among the four major cereals (teff, wheat, maize, and sorghum) complementarity is detected between the *tef*-sorghum and maize-sorghum pairs, while substitution appears to be the link between *tef* and wheat. These results suggest limited possibilities for substitution and/or complementarity for cereal consumption in Ethiopia. Agro-ecological diversity and limited trade are likely to constrain the scope for substitution between cereals.. As Table 19 shows, own and cross price elasticities differ only marginally between rural and urban areas. Own-price elasticity in urban areas seems to be slightly higher.

Table 19: Compensated price elasticities of cereals in Ethiopia[11]

		Teff	Wheat	Barley	Maize	Sorghum
National	Teff	**-0.89**	0.10	0.06	0.05	-0.10
	Wheat	0.06	**-0.98**	0.05	0.04	0.05
	Barley	-0.02	0.00	**-0.95**	-0.02	-0.04
	Maize	0.04	0.05	0.04	**-0.75**	-0.05
	Sorghum	-0.03	0.04	0.02	-0.07	**-0.66**
Rural	Teff	**-0.905**	0.051	0.04	0.03	-0.077
	Wheat	0.027	**-0.978**	0.028	0.034	0.022
	Barley	-0.003	0.009	**-0.976**	0.003	-0.009
	Maize	0.031	0.043	0.037	**-0.873**	0.001
	Sorghum	0.007	0.053	0.048	0.012	**-0.84**
Urban	Teff	**-0.862**	0.094	0.083	0.07	-0.042
	Wheat	0.013	**-0.992**	0.015	0.022	0.008
	Barley	-0.005	0.007	**-0.978**	0	-0.014
	Maize	0.001	0.011	0.006	**-0.904**	-0.031
	Sorghum	-0.053	-0.009	-0.014	-0.5	**-0.902**

Source: Tafere et al. (2010), based on CSSA HICE 2004/05 data

The expenditure elasticity estimates indicate that most commodities are 'normal' goods, though some are marginally so (Table 20). The negative expenditure elasticities of 'other cereals' and barley indicate that these are 'inferior' goods. 'Other cereals' is dominated by millet, and the negative elasticity reflects urban demand. Demand for *tef*, other cereals, processed cereals, pulses, animal products, and services rises with income, consistent with the view that *tef* and animal products are considered superior foods (Tafere et al., 2010). By

[11] The authors of this IFPRI study empirically investigated the responsiveness of demand for various food and non-food items to changes in price and expenditure using the Quadratic Linear Almost Ideal Demand Model (AIDM). The demand system was estimated using non-linear Seemingly Unrelated Regression (NSURE) technique using Household Income Consumption Expenditure Survey 2004/05 data collected by Central Statistical Agency of Ethiopia.

contrast, wheat, maize, and sorghum, appear as expenditure-inelastic. This suggests that in most parts of Ethiopia maize and sorghum are relatively less desired cereals, while wheat is associated with food aid.

Table 20: Expenditure shares and expenditure elasticities of cereals in Ethiopia

	Expenditure Share (%)			Expenditure Elasticity of Demand (QU-AIDM		
	National	Rural	Urban	National	Rural	Urban
Teff	4.96	4.37	8.17	1.69	1.08	1.14
Wheat	5.06	5.53	2.57	0.78	0.42	0.41
Barley	2.55	2.91	0.57	-0.44	0.06	0.33
Maize	4.97	5.66	1.05	0.92	0.62	0.58
Sorghum	**4.71**	**5.39**	**1.05**	**0.77**	**1.00**	**-0.81**
Other Cereals	0.89	0.97	0.47	-6.70	2.30	-6.70
Processed Cereals	1.91	0.96	7	2.33	-1.29	1.04
Total Cereals	25.05	25.79	20.88			

Tafere et al. 2010). based on CSSA HICE 2004/05 data

Elasticity estimates for cereals vary according to alternative demand models and estimation procedures though they appear to be robust for most crops. With regard to sorghum the own price elasticity ranges between -0.66 and -0.83 and the expenditure elasticity between 0.54 and 1.82. The authors do not explain the positive own-price elasticity from the LA-AIDM model for sorghum and maize, though it is questionable that they result from an 'inverse' consumption function. Expenditure elasticity estimates show that most consumption items are normal goods (Table 21). The QU-AIDM model indicates that tef, other cereals, processed cereals, and animal products have elastic demand in both urban and rural areas. This supports the claims above about public perception of the different cereals. Interestingly, in rural areas processed cereals and other cereals appear to be 'inferior' goods.

Table 21: Elasticity estimates from alternative demand models, Ethiopia

	Expenditure elasticity					Compensated Own-price Elasticity				
	QU-AIDM Cens.	QU-AIDM Un-cens.	QU-AIDM Un-cens. (EA)	LA-AIDM Un-cens.	QU-AIDM Cens. (10 Com. groups)	QU-AIDM Cens.	QU-AIDM Un-cens	QU-AIDM Un-cens. (EA)	LA-AIDM Un-cens.	QU-AIDM Cens. (10 Com. groups)
Teff	1.69	1.12	0.81	1.01	0.69	-0.89	-0.92	-0.91	-0.96	-1.02
Wheat	0.78	1.08	0.83	0.99	1.19	-0.98	-0.95	-0.98	-1.03	-0.96
Barley	-0.44	1.08	0.81	0.92		-0.95	-0.76	-0.71	-0.02	
Maize	0.92	0.40	0.56	1.05	0.94	-0.75	-0.96	-0.94	2.06	-0.74
Sorghum	**0.77**	**0.61**	**0.54**	**0.90**	**1.82**	**-0.66**	**-0.83**	**-0.77**	**3.66**	**-0.66**
Other Cereals	-6.7	-2.25	-1.65	0.99		-1.07	-1.04	-1.05	-3.28	

Tafere et al. (2010). Based on CSSA HICE 2004/05 data

In summary, Ethiopian households display significant consumption response to changes in price, expenditure and income. Price elasticities of demand for cereals are roughly the same in urban and rural areas of the country, while expenditure elasticities show the opposite pattern in rural and urban area.

TANZANIA

Elasticity analyses for the food sector in Tanzania are scarce, with only four major publications in the public domain. Unfortunately, most of the studies are based on old data sets, and do not give detailed information about cereals. Only maize and rice are reported separately, while wheat, barley, sorghum, and millets are grouped together as 'cereals' and no individual elasticities are available. Results from these studies are summarised in Table 22.

Table 22: Elasticity studies for cereals in Tanzania

			price elasticity			expenditure elasticity
Weliwita et al. 2003			uncompensated			
			maize	rice	other cereals	
data source household budget survey 1991/92 coverage mainland TZ		maize	**-0.900**	0.019	-0.100	0.988
		rice	0.006	**-0.981**	-0.002	0.951
		other cereals	-0.039	0.007	**-0.846**	1.053
			compensated			
		maize	**-0.713**	0.198	0.099	
		rice	0.103	**-0.887**	0.101	
		other cereals	0.044	0.086	**1.053**	
Mafuru and Marsh 2003			price elasticity			expenditure elasticity
			maize	rice		
data source Tanzania human resource survey 1999 coverage lake zone	total	maize	**-0.829**	-0.095		0.907
		rice	-0.191	**-1.147**		1.100
	rural	maize	**-1.021**	-0.151		1.032
		rice	-0.246	**-1.164**		1.060
	urban	maize	**-0.737**	-0.011		0.895
		rice	-0.127	**-1.006**		1.299
Aubert, D and Abdulai, A 2000			price elasticity			expenditure elasticity
data source own survey 1999 coverage Dar es Salaam, Mbeya region	pooled	cereals and pulses	**-0.958**			0.741
	low income	cereals and pulses	**-1.031**			0.935
	high income	cereals and pulses	**0.872**			0.666
Chongela, J, Nandala, V and Korabandi, S 2014			own price elasticity			income elasticity
data source household budget survey (HBS) 2007 coverage mainland TZ		cereals	**-0.941**			0.981
		cereal products	**-0.786**			0.946

Source: own table

Mafuru and Marsh (2003) provide estimates of own price, cross price and expenditure elasticities for four food items (maize, rice, beef and fish) for 106 rural and 172 urban households, respectively, sampled from the Lake Zone. Their data derives from the Tanzania Human Resource Survey (THRS), which covered 4,900 households in 222

clusters nationwide, of which 43 clusters (946 households) were from the Lake Zone. The survey covered the period June 1998 - April 1999.

In the pooled sample own-prices of all food items are positive, implying that a unit increase in price of the food items would increase total food expenditure. However, Mafuru and Marsh (2003) indicate that none of the prices is statistically significantly different from zero. Cross-commodity prices have mixed signs. In the maize share equation, prices of rice, beef and fish are negative, but only rice and fish cross-prices are statistically significant at the 5 % and 10 % levels, respectively. In all the sub-samples, the coefficients for own-price elasticity of maize and rice are negative, which is consistent with demand theory. Expenditure elasticities for all food items are positive, implying that maize and rice are 'normal' goods. In the pooled sample, expenditure elasticities are close to unity, implying that a 1 % increase in household income leads to a 1 % increase in household expenditure on each food item. Elasticities were also close to unity for the rural sample. For the urban sample, the expenditure elasticity for rice is 1.3 (expenditure on rice rises faster than income), implying that rice is regarded as luxury good by urban consumers. By contrast, because maize is a necessity the expenditure elasticities are less than one.

Weliwita et al. (2003) calculated compensated and uncompensated own-price, cross-price and expenditure elasticities for a total of 142 food items aggregated into 12 groups. Cereals were subdivided into maize, rice and 'other'. The analysis used the household budget survey conducted between December 1991 and November 1992 by the Bureau of Statistics. Households were selected from the nationwide National Master Sample (NMS) that covers both rural and urban areas. The expenditure elasticities for all food groups are positive implying that all food categories are 'normal' goods and that rising income generally increases consumption. For cereals, expenditures elasticities are close to unity with little difference between maize, rice and 'other' cereals. Cross price elasticities are rather weak and mostly positive except for 'other' cereals, indicating weak substitution effects between maize, rice and 'other' cereals.

In 1999 Aubert and Abdulai (2000) surveyed 200 households in Dar-es-Salaam, and 100 households each in Dar-es-Salaam rural, Mbeya urban, and Mbeya rural. Although expenditure was not estimated for individual cereals but for cereals as a group together with pulses, they differentiated price and expenditure elasticities by income. Their results show that poor households were more responsive to changes in expenditures for cereals and pulses (0.9354) than high income households (0.6655), pointing to a food deficit for low income households. Price responsiveness was also higher for low income households (-1.0311), indicating the need for poor households to adjust their limited food budget according to the cheapest food source.

Chongela et al. (2014) used the 2007 household budget survey (HBS) conducted by the National Bureau of Statistics (NBS). Cereals are differentiated into cereals and processed cereals products but not by different cereal types. Own price elasticity of cereals is negative and close to unity (-0.941) while it is somewhat lower for cereal products (-0.786). Income elasticities are positive and close to unity indicating a fairly strong response by demand to increasing income.

UGANDA

Uganda has the least complete information on demand elasticities, with only one source based on the UNHS 2005/06 household survey (Boysen, 2012). The subdivision of food items differs from the studies for other countries. In the first stage, elasticities are estimated for the entire food group. In the second stage, 12 food sub-categories are identified, with maize as the only cereal. Sorghum and millets are entirely excluded. Table 23 highlights the results of the food elasticities as a single entity. It contains mean expenditure per capita ($\underline{M}$) and food shares (ω_F) as computed from the samples, and expenditure (η_F), uncompensated ϵ_{FM}) and compensated price (ϵ_{FH})) elasticities computed from the demand model and evaluated at the means of the three household groups and the total sample for rural and urban households, respectively.

Total expenditure ($\underline{M}$) shows strong income differences between rural and urban areas which have to be taken into account when comparing statistics between rural and urban household groups. The share of expenditure spent on food (ω_F) in the sample decreases with rising expenditure but this trend is steeper in urban areas. Expenditure elasticities of food demand are positive and significant for all household groups and decrease with rising expenditure levels. Price elasticities are all negative and significant. Rural and urban households' expenditures are inelastic to food price changes (<1) but urban households have substantially larger price elasticities. In general, urban households seem to be more willing to adjust food consumption when incomes or prices change. The lower responsiveness of rural households to income and price changes suggest that most consumption by rural households consists of own-production, which cannot change in the short-term, and a limited choice of alternative food sources. Moreover, price changes have no direct impact on production for own-consumption.

Table 23: Food demand elasticities for Uganda

		rural				urban			
		expenditure level				expenditure level			
	symbol	low	mid	high	mean	low	mid	high	mean
Expenditures (UG shillings)	$\underline{M}$	156,495	319,996	2,621,221	961,184	282,292	708,810	2,910,296	1,244,602
food expenditure share (%)	ω_F	65	63	52	60	54	44	34	44
Expenditure elasticity	η_F	0.89	0.88	0.85	0.87	0.80	0.78	0.77	0.80
uncompensated (marshallian) price elasticity	ϵ_{FM}	-0.80	-0.80	-0.75	-0.79	-0.95	-0.93	-0.91	-0.93
compensated (hicksian) price elasticity	ϵ_{FH}	-0.23	-0.24	-0.31	-0.26	-0.51	-0.59	-0.65	-0.58

Source: Boysen (2012), based on UNHS 2005/06

Expenditure elasticities are presented in Table 24. The elasticities were evaluated separately for each level of household income. All expenditure elasticities are positive and generally statistically significant at the 5% level. For most food groups, expenditure decreases with rising income. For the poorest households in rural areas, *matooke* and livestock products are luxury foods since the expenditure elasticity is above 1. For the poorest households in urban areas, the same is true for livestock. Consumption of these products will rise more than

proportionately with rising income, but elasticities decrease with rising income levels, suggesting that they become necessities for the richest households. Maize has a higher priority in rural areas, particularly among poorer households (0.62), but in urban areas it declines and becomes an 'inferior' good with rising income (0.37).

Table 24: Food expenditure elasticities for Uganda

	rural				urban			
	low	middle	high	mean	low	middle	high	mean
Matooke,	1.1	0.96	0.84	0.9	0.84	0.75	0.65	0.7
Sweet	0.74	0.69	0.29	0.53	0.53	0.46	0.26	0.5
Cassava,	0.69	0.66	0.76	0.74	0.68	0.53	0.12	0.59
Maize,	**0.62**	**0.58**	**0.69**	**0.68**	**0.45**	**0.26**	**0.06**	**0.37**
Livestock	2.49	1.51	0.84	1.14	1.88	1.26	0.94	1.19
Fats	0.87	0.87	0.91	0.9	0.67	0.6	0.5	0.6
Beans,	0.67	0.61	0.49	0.6	0.52	0.43	0.53	0.54
Sugar	0.61	0.74	0.82	0.79	0.75	0.68	0.51	0.63

Source: Boysen (2012), based on UNHS 2005/06

Table 25: Rural compensated food price and cross-price elasticities for Uganda

		Matooke	Sweet potato	Cassava	**Maize**	Livestock products	Beans
low income	Matooke	**-0.89**	0.15	-0.01	0.15	-0.13	-0.08
	Sweet potato	0.1	**-0.74**	0.01	0.11	0.02	0.09
	Cassava	-0.02	0.01	**-0.69**	0.36	0.07	0.05
	Maize	0.08	0.1	0.38	**-0.87**	0.05	-0.07
	Livestock products	-0.24	0.04	0.21	0.22	**-1.41**	0.4
	Beans	-0.13	0.11	0.07	-0.1	0.17	**-0.78**
middle income	Matooke,	**-0.87**	0.13	0.02	0.1	-0.01	-0.01
	Sweet potato	0.16	**-0.74**	-0.01	0.09	0.06	0.07
	Cassava	0.01	-0.01	**-0.65**	0.41	0.11	0.03
	Maize	0.14	0.1	0.44	**-0.89**	0.09	-0.13
	Livestock products	-0.05	0.07	0.13	0.13	**-1.12**	0.21
	Beans	-0.12	0.12	0.04	-0.17	0.23	**-0.76**
high income	Matooke,	**-0.85**	0.09	0	0.06	0.06	-0.02
	Sweet potato	0.24	**-0.68**	-0.09	0.04	0.12	0.04
	Cassava	-0.03	-0.09	**-0.53**	0.57	0.13	0.02
	Maize	0.15	0.09	0.57	**-0.88**	0.09	-0.2
	Livestock products	0.06	0.05	0.06	0.04	**-0.94**	0.11
	Beans	-0.17	0.11	0	-0.29	0.32	**-0.7**

Source: Boysen 2012, based on UNHS 2005/06

Table 25 shows price and cross-price elasticities for rural areas. All own-price elasticities are negative and most are statistically significant. Only livestock products are price-elastic across all income groups, while demand for other items is inelastic. All other food items

decreases with rising expenditure level. Luxury foods like livestock products are more susceptible to price changes as they are optional while 'inferior' foods like maize and beans are staples whose consumption is maintained even if prices go up. A similar pattern can be observed in urban households, where maize becomes very price inelastic with rising income

To identify whether foods are substitutes or complements, we turn to the compensated cross-price elasticities in Table 25 and Table 26 which single out the pure price effect in contrast to the uncompensated (Marshallian) price elasticity. For the poorest households, there is a symmetric and complementary relationship between *matooke* and livestock products, *matooke* and beans, maize and beans in rural area, and between *matooke* and cassava in urban areas. Maize is a substitute for all other products except beans, but only in rural areas. In urban areas, maize is a substitute for livestock products and all other food items.

Table 26: Urban compensated food price and cross-price elasticities for Uganda

		Matooke	Sweet potato	Cassava	**Maize**	Livestock products	Beans
low income	Matooke	**-0.91**	0.23	-0.42	0.18	-0.19	0.03
	Sweet potato	0.15	**-0.93**	0.21	0.11	-0.02	0.00
	Cassava	-0.17	0.16	**-0.70**	0.11	0.04	0.02
	Maize	0.09	0.05	0.08	**-0.77**	0.01	0.06
	Livestock products	-0.21	0.01	0.07	0.04	**-1.41**	0.21
	Beans	0.02	-0.03	0.00	0.09	0.16	**-0.70**
middle income	Matooke,	**-0.92**	0.11	-0.16	0.10	-0.06	0.03
	Sweet potato	0.22	**-0.93**	0.24	0.09	-0.01	-0.04
	Cassava	-0.39	0.29	**-0.43**	0.10	0.13	-0.05
	Maize	0.17	0.04	0.06	**-0.68**	0.03	0.03
	Livestock products	-0.08	0.00	0.06	0.02	**-1.19**	0.12
	Beans	0.04	-0.09	-0.07	0.05	0.26	**-0.59**
high income	Matooke,	**-0.91**	0.08	-0.14	0.07	0.00	0.01
	Sweet potato	0.43	**-0.89**	0.50	0.12	-0.08	-0.16
	Cassava	-1.17	0.74	**0.55**	0.16	0.35	-0.21
	Maize	0.26	0.06	0.07	**-0.41**	-0.04	0.02
	Livestock products	-0.01	-0.01	0.04	-0.01	**-1.05**	**0.07**
	Beans	0.02	-0.16	-0.14	0.04	0.35	-0.37

Source: Boysen 2012, based on UNHS 2005/06

8. Conclusions

This study synthesised research on consumer demand for cereals in ESA, including analysis of national household expenditure surveys for Kenya, Ethiopia, Uganda and Tanzania conducted by ICRISAT over the period 2012-2014. The analysis focuses on these four countries.

Cereals

Consumer demand for cereals in ESA remains high because of rapid population growth, which increases aggregate demand, and low incomes, which means that expenditure on cereals account for a high share of the household budget. Between 2000 and 2013, population in these four countries grew by 50 % from 150 to 225 million. Cereal consumption in ESA is dominated by maize, which is the main staple. Over the period 2000 to 2013, consumption of maize increased by 13 %, from 55 to 62 kg/head. However, demand for sorghum increased by 48 %, from 14.9 to 22 kg/head. The story for millets was less encouraging, with demand falling slightly from 6 to 5.7 kg/head. This decline reflected increasing civil unrest in northern Uganda from 2007, which resulted in a steep fall in millet production. The increase in cereal consumption per head reflects the low average income of consumers in the ESA region, which means that increases in income are spent on staple food. The share of household income spent on cereals ranged from 49 % in Ethiopia to 38 % in Tanzania, 26 % in Uganda and 21 % in Kenya. As long as population growth remains high, and incomes remain low, consumer demand for cereals in ESA will remain strong and will continue to grow.

Sorghum

Consumer demand for sorghum in ESA over the period 2000-2013 shows strong growth with rising levels of absolute consumption. Within this general scenario of increasing consumer demand, however, there were important differences between countries, between rural-urban locations, and between income groups.

Consumer demand for sorghum was highest in Ethiopia, where between 2000 and 2013 consumption per head increased from 22 to 43 kg/head. Everywhere else, however, consumer demand was flat. In Tanzania, consumption per head averaged 15.2 kg in 2000 and 14.6 in 2013, while in Kenya consumption averaged 2.0 kg/head in 2000 and 2.0 and 2.4 kg/head in 2013. At the opposite extreme from Ethiopia, consumption in Uganda fell from 11.6 kg/head in 2000 to 6.5 kg/head in 2013. Rising consumer demand for sorghum in ESA is therefore driven by demand in Ethiopia. Since Ethiopia has a high rate of population growth (2.6 % per annum) and households spend 19 % of their income on sorghum, demand for sorghum in Ethiopia seems likely to grow. In the rest of ESA, however, consumer demand seems likely to remain constant, and growth in demand for sorghum will depend on demand for other uses.

Urbanisation is an important demand driver. Generally, urbanisation has had a negative effect on consumer demand for sorghum in ESA. Consumption per head for Ethiopia, Uganda and Tanzania averaged 11.5 kg/AE in urban areas compared to 40.9 kg/AE in rural areas. This decline in cereal consumption per head with urbanisation is not unique to sorghum. Maize consumption per head was also much higher in rural than in urban areas (128 kg/AE and 61 kg/AE, respectively) (Table 12). These differences in the absolute level of

consumption reflect higher incomes in urban areas (which allowed greater choice in food) as well as the cost of transportation. Consumption of sorghum per head was higher in urban areas close to centres of sorghum production (25 kg/head) than in urban areas located further away (2.6 kg/head) (Figure 25). By contrast, the consumption of maize showed relatively little change between urban areas close to or far from the centres of production. This reflects the fact that maize is more widely grown than sorghum, and also more likely to be sold.

Income is another important demand driver. Here, the picture for sorghum is mixed. In Uganda and Tanzania, rising income reduces consumer demand. In Tanzania, for example consumer demand dropped from 27 kg/head in the low income group to 9.6 kg/head in the high income group, while in Uganda consumption fell from 9.3 kg/head in the low income group to 1.8 kg/head in the high income group. In these countries, therefore, sorghum is an inferior good, consistent with its reputation as 'a poor man's crop'. In Ethiopia, by contrast, rising income increased consumer demand. Sorghum consumption rose from 35.9 kg/head in the low income group to 53.3 kg/head in the high income group (Figure 26). This indicates that sorghum in Ethiopia is not regarded as 'a poor man's crop' and that consumers will not switch to alternative cereals as incomes rise. This may reflect the fact that sorghum is preferred to maize for making *injera*, which is the most popular form of cereal consumption in Ethiopia.

The third driver of consumer demand is price. In all four countries the producer price of sorghum was higher than the producer price for maize, but below the price for millets, making sorghum a relatively high-priced cereal for consumers compared to maize. Generally, a 1 % increase in the price of sorghum will reduce consumer demand by 1 %, but by between 0.6 % and 0.7 %. This reflects sorghum's position as a staple food, for which consumer demand is inelastic. By contrast, a 1 % increase in income does not increase consumer demand for sorghum by 1%, but by about 0.7 %.

Millets

Consumer demand for millets showed no growth over the period 2000 and 2013 with consumption at the regional level flat-lining at a low level of 6 kg/head. As with sorghum, however, this regional picture conceals important differences in consumer demand between countries, between rural and urban locations, and between levels of household income.

Consumer demand for millets was the lowest of all the three cereals in the four ESA countries. Historically, consumption per head was highest in Uganda (17 kg/head in 2000), but with relatively low levels of consumption in Ethiopia (4.5 kg/head), Tanzania (5.7 kg/head) and Kenya (1.1 kg/head). However, millet consumption in Uganda dropped abruptly as the result of civil unrest in northern Uganda, plunging from 17.2 kg/head in 2007 to 4.9 kg/head in 2013. Falling consumption of millet was compensated by increasing consumption of maize, which rose from 29 kg/head in 2000 to 48 kg/head in 2013. The end of civil unrest in northern Uganda will increase consumer demand for millet but it is unclear if this will ever reach previous levels.

For ESA as a whole, consumer demand for millets is lower in urban areas, averaging 5.9 kg/AE per year compared to 11.5 kg/AE in rural areas. The exception is Kenya, where urban demand exceeds rural demand (3.9 kg/AE per year compared to 2.3 kg/AE in rural areas). In fact consumer demand for millets in Kenya is higher in urban areas than in the rural areas

where millets are produced. In Tanzania, similarly, millet consumption in urban areas far from the major areas of millet production centres is also fairly high (4.3 kg/head) compared to consumption in the rural areas where millets are produced (6.1 kg/head). This is consistent with millets being a cash crop, with strong market potential. By contrast, in Ethiopia and Uganda the consumer demand for millets in urban areas far from areas where millet is grown is extremely low (0.7 kg/head and 0.5 kg/head, respectively). This suggests that in Ethiopia and Uganda millets are not a cash crop but are grown primarily for home consumption. Marketing campaigns to promote millets as health foods should therefore focus on Kenya and Tanzania where there is already strong market demand in urban areas.

In all four ESA countries, consumer demand for millets rose with income. Unlike sorghum, millets are not an inferior good. Consumption levels among high-income households varied across the four countries. Among high-income consumers in Kenya, the average annual consumption of millets (1.7 kg/head) was well below levels among high-income consumers in neighbouring Tanzania (9.7 kg/head) and Uganda (5.7 kg/head). This suggests considerable scope to increase the consumption of millets among high-income consumers in Kenya. Millets were the highest priced cereal in all four ESA countries, and well above the level for maize. This reflects its status as a high-value crop. Elasticities of demand are not available separately for millets and sorghum. However, in Kenya a 1 % increase in income increases demand for both sorghum and millets by 0.7 %. Given the higher consumption of millets among high-income consumers, however, we would the income elasticity of demand for millet to be higher than for sorghum.

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ANNEX

----------ESA----------

Table A-1: Production, available supply and food supply in ESA countries (2000-2013)

	Production				Available supply				Food Supply			
Year	Sorghum	Millets	Maize	All three	Sorghum	Millets	Maize	All three	Sorghum	Millets	Maize	All three
	000' tons											
2013	5,608	1,422	18,169	25,199	5,578	1,433	17,617	24,629	5,074	1,278	14,028	20,381
2012	4,946	1,275	17,597	23,817	4,929	1,290	17,127	23,346	4,454	1,148	13,677	19,280
2011	5,355	1,329	16,338	23,022	4,994	1,329	14,938	21,261	4,501	1,176	11,505	17,182
2010	5,313	1,308	15,557	22,178	4,903	1,322	13,975	20,200	4,409	1,169	10,998	16,576
2009	4,154	1,140	12,017	17,311	4,511	1,140	12,991	18,642	4,090	1,002	10,599	15,690
2008	3,607	947	13,899	18,454	3,957	958	13,756	18,671	3,585	840	10,830	15,254
2007	3,892	1,557	11,186	16,635	3,913	1,593	11,631	17,137	3,488	1,366	9,504	14,358
2006	3,456	1,513	11,958	16,927	3,595	1,511	11,734	16,840	3,146	1,298	9,520	13,963
2005	3,044	1,341	11,186	15,572	3,121	1,343	11,441	15,905	2,696	1,146	9,303	13,145
2004	2,860	1,289	11,245	15,393	2,940	1,287	10,976	15,202	2,571	1,095	8,934	12,600
2003	2,531	1,100	9,369	13,000	2,706	1,121	10,692	14,519	2,405	949	9,065	12,418
2002	2,725	1,202	10,860	14,786	2,726	1,204	10,507	14,437	2,409	1,025	8,793	12,228
2001	2,780	1,151	9,915	13,846	2,888	1,156	9,799	13,842	2,569	984	8,765	12,318
2000	2,229	1,118	7,904	11,251	2,614	1,193	9,644	13,452	2,325	1,018	8,695	12,038

Source: own calculation, based on FAO commodity balance sheets

Table A-2: Per capita consumption of sorghum, millets and maize in ESA countries (2013) in kg/capita/year

	SORGHUM					MILLETS					MAIZE				
year	ETH	KE	TZ	UG	ESA	ETH	KE	TZ	UG	ESA	ETH	KE	TZ	UG	ESA
2013	42.56	2.37	14.58	6.55	22.52	8.02	1.42	5.59	4.94	5.67	56.95	81.97	65.41	48.21	62.27
2012	36.27	2.93	15.15	7.61	20.34	7.56	1.70	3.82	5.47	5.24	53.91	89.39	64.25	49.59	62.44
2011	37.46	2.82	15.00	9.63	21.14	6.83	1.40	5.82	5.71	5.36	42.91	77.52	57.65	40.66	52.58
2010	38.30	2.04	15.36	8.81	21.31	6.82	1.35	6.73	5.42	5.49	42.26	78.79	54.66	39.45	51.71
2009	35.83	3.03	14.78	8.64	20.33	5.77	1.29	5.90	5.24	4.83	41.35	76.85	58.56	37.43	51.47
2008	33.06	1.04	11.92	9.68	18.33	5.48	1.01	2.97	5.93	4.12	42.30	79.88	66.67	37.10	54.18
2007	27.14	2.96	18.86	13.61	18.36	4.59	3.40	6.49	16.64	6.71	39.79	79.19	58.88	23.98	49.19
2006	26.00	3.54	13.96	14.22	17.03	5.97	1.69	5.28	15.94	6.57	41.18	82.12	59.77	24.87	50.72
2005	20.88	3.61	14.65	14.19	15.02	4.85	1.20	4.81	16.18	5.93	40.50	83.18	59.03	27.51	50.94
2004	22.56	1.50	13.45	12.25	14.74	4.18	1.17	5.57	16.36	5.82	36.37	83.10	64.54	27.54	50.39
2003	23.49	2.88	7.78	12.29	14.19	3.93	1.49	2.61	16.46	5.14	38.85	84.15	67.59	29.26	52.62
2002	22.64	2.67	11.24	12.91	14.63	3.94	1.75	5.94	15.69	5.79	39.90	80.42	68.16	29.59	52.54
2001	22.83	2.76	17.15	13.14	16.05	4.34	1.06	5.18	16.08	5.70	40.55	84.99	69.04	29.32	53.92
2000	22.10	1.97	15.19	11.83	14.94	4.50	1.11	5.72	17.21	6.07	41.85	86.51	70.08	29.31	55.04

Source: own calculation, based on Worldbank population statistics, FAO commodity balances

----------Kenya----------

Table A-3: Dryland cereals in Kenya by region: area, production and yields in 2012

	Sorghum			Finger millet		
Province	Area (ha)	Production (mt)	Yield (mt/ha)	Area (ha)	Production (mt)	Yield (mt/ha)
National	223,799	166,627	0.74	118,289	74,916	0.63
Nairobi	18	4	0.22			
Central	2,177	1,496	0.69	85	115	1.35
Coast	2,553	725	0.28	247	63	0.26
Eastern	140,805	74,309	0.53	77,860	40,926	0.53
North Eastern	530	83	0.16	89	1	0.01
Nyanza	55,604	65,451	1.18	22,791	17,195	0.75
Rift Valley	12,704	14,148	1.11	12,704	14,148	1.11
Western	9,408	10,411	1.11	4,513	2,468	0.55

Source: Ministry of Agriculture of Kenya 2013

Table A-4: Population and adult equivalents for Kenya (2009)

	Population (2009)			Adult Equivalent (2009)		
Province	Total	Rural	Urban	Total	Rural	Urban
National	38,610,097	28,944,468	8,427,333	24,131,311	18,090,293	5,267,083
Nairobi	3,138,369	0	3,138,369	1,961,481	0	1,961,481
Central	4,383,743	3,175,519	1,101,021	2,739,839	1,984,699	688,138
Coast	3,325,307	1,935,741	1,038,585	2,078,317	1,209,838	649,116
Eastern	5,668,123	5,087,345	480,165	3,542,577	3,179,591	300,103
North Eastern	2,310,757	1,951,163	285,896	1,444,223	1,219,477	178,685
Nyanza	5,442,711	4,702,460	487,192	3,401,694	2,939,038	304,495
Rift Valley	10,006,805	8,159,452	1,544,235	6,254,253	5,099,658	965,147
Western	4,334,282	3,932,788	351,870	2,708,926	2,457,993	219,919

Source: Kenya National Bureau of Statistics 2009

Table A-5: Finger millet consumption in Kenya in kg/AE/Y, rural vs urban (updated for 2013)

	Consumption per adult equivalent			Aggregated consumption		
	Total	Rural	Urban	Total	Rural	Urban
Province	kg/AE/Y	kg/AE/Y	kg/AE/Y	tons	tons	tons
National	**3.10**	**2.78**	**3.69**	**74,916**	**50,340**	**19,443**
Nairobi	4.16	0.00	4.16	8,150	0	8,150
Central	4.56	4.49	4.71	12,499	8,904	3,244
Coast	5.40	5.13	5.71	11,213	6,206	3,705
Eastern	3.18	2.67	4.78	11,266	8,487	1,434
North Eastern	1.74	1.62	1.94	2,515	1,974	347
Nyanza	3.43	3.63	3.02	11,655	10,654	919
Rift Valley	1.91	1.63	2.57	11,958	8,302	2,485
Western	1.79	1.42	2.41	4,846	3,490	531

Source: own calculation based on ERA 2013, ICRISAT 2012

Table A-6: Maize consumption in Kenya in kg/AE/Y, rural vs urban (updated for 2013)

	Consumption per adult equivalent			Aggregated consumption		
	Total	Rural	Urban	Total	Rural	Urban
Province	kg/AE/Y	kg/AE/Y	kg/AE/Y	tons	tons	tons
National	**150.86**	**181.01**	**96.63**	**3,640,424**	**3,274,500**	**508,978**
Nairobi	25.95	0.00	25.95	50,906	0	50,906
Central	66.93	83.49	31.70	183,366	165,705	21,811
Coast	64.28	96.96	25.73	133,584	117,312	16,703
Eastern	138.05	162.12	62.07	489,046	515,487	18,626
North Eastern	39.32	50.91	21.54	56,781	62,086	3848.071
Nyanza	237.55	262.62	186.20	808,083	771,858	56696.74
Rift Valley	172.84	194.59	121.48	1,080,961	992,356	117,248
Western	250.14	267.70	219.66	677,619	658,012	48307.82

Source: own calculation based on ERA 2013, ICRISAT 2012

Table A-7: Finger millet consumption in Kenya by proximity (updated for 2013)

	rural close	rural far	urban close	urban far
	kg/AE/Y			
Nairobi	0.00	0.00	0.00	2.31
Central	2.08	0.00	3.20	2.61
Coast	2.38	0.00	3.20	3.17
Eastern	1.24	0.00	3.20	2.65
North Eastern	0.75	0.00	3.20	1.08
Nyanza	2.96	1.87	4.33	1.44
Rift Valley	2.56	0.75	2.81	1.68
Western	2.75	0.61	2.66	1.35

Source: own calculation based on ERA 2013, ICRISAT 2012

Table A-8: Maize consumption in Kenya by proximity (updated for 2013)

	rural close	rural far	urban close	urban far
	kg/AE/Y			
National	116.3	96.7	78.1	45.2
Nairobi	0.0	0.0	14.1	8.2
Central	46.9	39.0	17.2	10.0
Coast	54.4	45.3	14.0	8.1
Eastern	91.0	75.7	33.7	19.5
North Eastern	28.6	23.8	11.7	6.8
Nyanza	156.2	135.6	100.0	102.8
Rift Valley	106.3	111.0	72.1	63.4
Western	158.5	71.7	119.2	119.9

Source: own calculation based on ERA 2013, ICRISAT 2012

Table A-9: FAO Commodity balance sheets for cereals in Kenya

Kenya	SUPPLY (in tons)					DOMESTIC UTILIZATION (in tons)					
	Pro-duction	Change in stocks	Imports	Exports	Available Supply	Feed	Seed	Waste	Other uses	Pro-cessing	Food supply
SORGHUM											
Annual growth	3.9%				4.2%						3.9%
2013	139	0	29	23	145	17	4	18	0	32	105
2012	167	0	35	27	174	21	5	22	0	39	127
2011	160	0	58	50	168	22	4	23	0	36	119
2010	164	0	10	50	124	17	5	19	0	25	83
2009	99	0	59	2	156	15	3	17	0	37	121
2008	54	0	3	1	57	7	3	6	0	12	40
2007	147	0	1	1	147	16	3	16	0	34	112
2006	131	0	38	0	169	17	3	19	0	40	130
2005	150	0	17	0	167	16	3	19	0	39	129
2004	70	0	0	0	69	7	2	8	0	16	52
2003	127	0	0	0	127	13	2	14	0	30	98
2002	116	0	0	0	115	12	3	13	0	27	88
2001	117	0	0	1	116	12	3	13	0	27	89
2000	82	0	2	1	82	8	3	9	0	19	62
FINGER MILLET											
Annual growth	2.6%				4.0%						4.3%
2013	64	0	15	0	79	6	2	9	0	16	63
2012	75	0	18	0	93	7	2	10	0	19	74
2011	73	0	2	0	76	6	2	8	0	15	59
2010	54	0	17	0	71	6	2	8	0	14	55
2009	54	0	12	0	66	5	2	7	0	13	52
2008	38	0	11	0	50	3	2	6	0	10	39
2007	120	0	39	0	158	10	2	18	0	33	128
2006	79	0	1	0	80	6	3	9	0	16	62
2005	53	0	4	0	57	5	3	6	0	11	43
2004	50	0	2	0	53	4	2	6	0	10	41
2003	64	0	3	1	65	5	2	7	0	13	50
2002	72	0	2	0	74	6	2	8	0	14	58
2001	45	0	1	0	45	4	2	5	0	9	34
2000	45	0	1	0	46	4	2	5	0	9	35
MAIZE											
Annual growth	3.3%				2.2%						2.1%
2013	3,391	-61	596	34	3,893	106	68	83	3	18	3,636
2012	3,600	-65	633	36	4,133	112	73	88	3	19	3,860
2011	3,377	-160	314	15	3,516	120	65	73	8	11	3,258
2010	3,465	-250	259	18	3,456	95	64	74	2	12	3,223
2009	2,439	-700	1,554	17	3,276	80	57	79	1	12	3,061
2008	2,367	701	263	34	3,297	80	54	66	1	36	3,097
2007	2,929	147	173	61	3,188	80	54	64	0	8	2,990
2006	3,247	-167	160	30	3,211	76	48	68	1	12	3,018
2005	2,906	131	133	20	3,149	57	53	63	0	19	2,977
2004	2,607	219	265	23	3,067	58	53	61	1	12	2,895
2003	2,711	225	108	35	3,009	55	41	61	0	22	2,853
2002	2,409	418	19	35	2,811	50	50	57	1	0	2,654
2001	2,790	-206	324	6	2,902	62	48	62	1	0	2,730
2000	2,160	292	418	7	2,862	49	49	57	2	8	2,706

Source: FAOSTAT

Table A-10: Mean monthly food and non-food consumption per adult euqivalent in Kenya (KSh)

	Kenya	in percent	Rural	in percent	Urban	in percent
Food	**1,754**	**51.1**	**1,453**	**62.3**	**2,642**	**39.6**
Cereals	**359**	**10.5**	**360**	**15.4**	**355**	**5.3**
Bread	72	2.1	43	1.8	156	2.3
Tubers	106	3.1	108	4.6	99	1.5
Poultry	38	1.1	33	1.4	53	0.8
Meat	158	4.6	110	4.7	301	4.5
Fish	39	1.1	28	1.2	72	1.1
Milk, eggs	196	5.7	113	4.8	163	2.4
Oils	71	2.1	62	2.7	97	1.5
Fruits	89	2.6	68	2.9	150	2.2
Vegetables	160	4.7	130	5.6	249	3.7
Pulses	103	3.0	108	4.6	85	1.3
Sugar	111	3.2	106	4.5	125	1.9
Non-alcoholic beverages	68	2.0	41	1.8	47	0.7
Alcohol	58	1.7	37	1.6	120	1.8
Restaurants	113	3.3	37	1.6	335	5.0
Spices and condiments	11	0.3	15	0.6	12	0.2
Non-food	**1,678**	**48.9**	**878**	**37.7**	**4,032**	**60.4**
Tobacco	28	0.8	24	1.0	40	0.6
Water	33	1.0	17	0.7	82	1.2
Fuels	177	5.2	113	4.8	366	5.5
Refuse,sewage	2	0.1	0	0.0	0	0.0
Clothing & personal footwear	283	8.2	304	13.0	232	3.5
Household,	191	5.6	97	4.2	117	1.8
Furnishings & maintenance	15	0.4	23	1.0	17	0.3
Domestic services	45	1.3	18	0.8	22	0.3
Transportation	232	6.8	108	4.6	596	8.9
Communication	99	2.9	39	1.7	275	4.1
Recreation	56	1.6	16	0.7	174	2.6
House rent	238	6.9	na	na	na	na
Education	224	6.5	152	6.5	435	6.5
Health	27	0.8	22	0.9	43	0.6
Total	**3,432**	**100**	**2,331**	**100**	**6,674**	**100**

Source: Ministry of Planning and National Development 2007, based on Kenya Integrated Household Budget Survey- 2005/06

----------Ethiopia----------

Table A-11: Sorghum Consumption in Ethiopia by Rural/Urban Strata (2004/05)

Region	Unit consumption 2004/05 (kg/AE/Y)			Aggregate Consumption 2004/05		
	National 2004/05 kg/AE/ Year	Rural 2004/05 kg/AE/ Year	Urban 2004/05 kg/AE/ Year	National 2004/05 mt/year	Rural 2004/05 mt/year	Urban 2004/05 mt/year
Tigray	70.5	81.65	28.85	170,594	158,850	13,683
Afar	8.79	14.89	2.35	6,850	10,060	244
Amhara	43.53	46.9	17.17	465,338	439,696	22,576
Oromia	43.59	48.22	11.15	693,235	680,212	20,038
Somale	54.15	71.34	18.88	129,259	146,451	6,309
Benishangul Gumuz	104.66	114.42	43.42	49,851	47,142	2,792
SNNPR	32.24	34.65	7.45	283,736	274,452	6,557
Harari	67.85	149.48	14.2	8,137	8,210	923
Addis Ababa	0.6	0.52	0.6	1,090	0	1,090
Dire Dawa	52.37	147.93	12.3	11,209	10,068	1,795
National	**42.24**	**48.06**	**11.53**	**1,819,298**	**1,775,141**	**76,007**

Source: ICRISAT 2012a, FAO commodity balances

Table A-12: Updated Sorghum Consumption in Ethiopia by Rural/Urban Strata (2012/13)

Region	Unit consumption 2012/13 (kg/AE/Y)			Aggregate Consumption 2012/13		
	National 2012/13 kg/AE/ Year	Rural 2012/13 kg/AE/ Year	Urban 2012/13 kg/AE/ Year	National 2012/13 mt/year	Rural 2012/13 mt/year	Urban 2012/13 mt/year
Tigray	108.3	125.4	44.3	330,400	307,654	26,500
Afar	13.5	22.9	3.6	12,132	17,819	431
Amhara	66.9	72.0	26.4	783,062	739,911	37,991
Oromia	67.0	74.1	17.1	1,236,559	1,213,330	35,742
Somale	83.2	109.6	29.0	229,995	260,587	11,227
Benishangul Gumuz	160.8	175.8	66.7	95,875	90,666	5,370
SNNPR	49.5	53.2	11.4	506,785	490,201	11,711
Harari	104.2	229.6	21.8	14,311	14,440	1,623
Addis Ababa	0.9	0.8	0.9	1,858	0	1,858
Dire Dawa	80.4	227.2	18.9	19,493	17,510	3,122
National	**64.9**	**73.8**	**17.7**	**3,230,471**	**3,152,118**	**135,576**

Source: ICRISAT 2012a, FAO commodity balances

Table A-13: Finger Millet Consumption in Ethiopia by Rural/Urban Strata (2004/05)

Region	Unit consumption 2004/05 (kg/AE/Y)			Aggregate Consumption 2004/05		
	National 2004/05	Rural 2004/05	Urban 2004/05	National 2004/05	Rural 2004/05	Urban 2004/05
	kg/AE/ Year	kg/AE/ Year	kg/AE/ Year	mt/year	mt/year	mt/year
Tigray	5.27	6.35	1.22	16,078	15,576	730
Afar	0.02	0.01	0.03	18	8	4
Amhara	8.97	9.38	5.73	105,043	96,334	8,253
Oromia	3.27	3.66	0.56	60,387	59,952	1,169
Somale	0.19	0.18	0.21	525	428	81
Benishangul Gumuz	21.47	22.17	17.11	12,803	11,436	1,377
SNNPR	1.39	1.49	0.42	14,224	13,722	430
Harari	0.02	0.03	0.01	3	2	1
Addis Ababa	0.07	0.01	0.07	141	0	141
Dire Dawa	0.07	0.01	0.09	17	1	15
National	**4.63**	**1.66**	**5.19**	**209,240**	**197,458**	**12,200**

Source: ICRISAT 2012a, FAO commodity balances

Table a-14: Updated Finger Millet Consumption in Ethiopia by Rural/Urban Strata (2013/14)

Region	Unit consumption 2013/14 (kg/AE/Y)			Aggregate Consumption 2013/14		
	National 2013/14	Rural 2013/14	Urban 2013/14	National 2013/14	Rural 2013/14	Urban 2013/14
	kg/AE/ Year	kg/AE/ Year	kg/AE/ Year	mt/year	mt/year	mt/year
Tigray	21.4	25.8	4.9	65,234	63,196	2,960
Afar	0.1	0.0	0.1	73	32	15
Amhara	36.4	38.1	23.2	426,197	390,859	33,487
Oromia	13.3	14.8	2.3	245,011	243,244	4,741
Somale	0.8	0.7	0.9	2,131	1,737	330
Benishangul Gumuz	87.1	90.0	69.4	51,948	46,400	5,589
SNNPR	5.6	6.0	1.7	57,710	55,676	1,744
Harari	0.1	0.1	0.0	11	8	3
Addis Ababa	0.3	0.0	0.3	573	0	573
Dire Dawa	0.3	0.0	0.4	69	3	60
National	**16.9**	**19.0**	**6.2**	**848,957**	**801,154**	**49,501**

Source: ICRISAT 2012a, FAO commodity balances

Table A-15: FAO Commodity balance sheets for cereals in Ethiopia

Ethiopia	SUPPLY (in tons)					DOMESTIC UTILIZATION (in tons)					
	Pro-duction	Change in stocks	Imports	Exports	Available Supply	Feed	Seed	Waste	Other uses	Pro-cessing	Food supply
SORGHUM											
Annual growth	9.7%				7.6%						8.1%
2013	4,338	0	0	0	4,338	0	0	0	0	0	4,338
2012	3,604	0	0	0	3,604	0	0	0	0	0	3,604
2011	3,951	-400	53	22	3,583	0	34	200	1,100	0	3,349
2010	3,960	-700	352	22	3,590	0	38	216	1,100	0	3,336
2009	2,971	0	269	0	3,240	0	38	162	850	0	3,040
2008	2,659	0	253	2	2,910	0	32	146	800	0	2,732
2007	2,316	0	16	2	2,330	0	31	117	350	0	2,183
2006	2,174	0	1	1	2,173	0	29	109	160	0	2,035
2005	1,716	0	3	13	1,705	0	29	86	0	0	1,590
2004	1,742	40	5	2	1,785	0	25	89	0	0	1,671
2003	1,784	0	24	1	1,807	0	26	90	0	0	1,691
2002	1,546	140	10	1	1,695	0	27	85	0	0	1,584
2001	1,549	100	9	0	1,657	0	23	83	0	0	1,552
2000	1,188	370	7	1	1,564	0	27	78	0	0	1,459
FINGER MILLET											
Annual growth	6.8%				6.8%						6.9%
2013	807	0	0	0	807	0	12	40	0	113	754
2012	742	0	0	0	742	0	11	37	0	104	694
2011	652	0	0	0	652	0	9	33	0	92	611
2010	635	0	0	0	635	0	9	32	0	89	594
2009	524	0	0	0	524	0	8	26	0	73	490
2008	484	0	0	0	484	0	7	24	0	68	453
2007	397	0	0	0	397	0	8	20	0	55	369
2006	500	0	0	0	500	0	7	25	0	70	468
2005	397	0	0	0	397	0	8	20	0	55	370
2004	333	0	0	0	333	0	7	17	0	46	310
2003	305	0	0	1	304	0	6	15	0	42	283
2002	306	0	0	9	297	0	6	15	0	41	276
2001	316	0	0	0	316	0	6	16	0	44	295
2000	320	0	0	0	320	0	7	16	0	45	297
MAIZE											
Annual growth	6.7%				5.2%						4.8%
2013	6,674	-529	69	29	6,185	414	72	338	0	9	5,359
2012	6,158	-488	64	27	5,707	382	67	312	0	8	4,945
2011	6,069	-1,250	31	60	4,790	600	50	304	0	0	3,836
2010	4,986	-650	32	36	4,332	350	51	251	0	1	3,680
2009	3,897	0	57	0	3,954	200	49	198	0	0	3,508
2008	3,776	0	73	0	3,850	120	44	191	0	28	3,495
2007	3,337	150	34	0	3,521	100	44	176	0	0	3,201
2006	4,030	-500	62	1	3,591	120	42	204	0	0	3,224
2005	3,912	-500	31	3	3,440	120	38	197	0	0	3,085
2004	2,906	50	36	11	2,981	90	49	148	0	0	2,694
2003	2,744	240	88	1	3,071	80	45	150	0	1	2,797
2002	2,826	240	6	13	3,059	70	45	153	0	0	2,791
2001	3,298	-300	32	1	3,029	70	38	166	0	0	2,755
2000	2,683	320	29	0	3,031	70	47	151	0	0	2,763

Source: FAO commodity balances

----------Tanzania----------

Table A-16: FAO Commodity balance sheets for cereals in Tanzania

Tanzania	SUPPLY (in tons)					DOMESTIC UTILIZATION (in tons)					
	Pro-duction	Change in stocks	Imports	Exports	Available Supply	Feed	Seed	Waste	Other uses	Pro-cessing	Food supply
SORGHUM											
Annual growth	2.4%				2.4%						2.4%
2013	832	0	2	2	832	17	12	85	0	359	718
2012	839	0	2	2	839	17	12	86	0	362	724
2011	807	0	1	2	805	16	13	81	0	348	695
2010	799	0	1	1	799	16	12	80	0	345	691
2009	709	30	5	0	744	15	9	74	0	322	645
2008	551	40	2	4	589	12	13	59	0	252	505
2007	971	-70	0	0	901	19	9	97	0	388	776
2006	712	0	1	0	713	71	12	71	0	279	558
2005	730	0	0	2	728	73	13	73	0	284	569
2004	649	0	1	0	649	65	11	65	0	254	508
2003	199	150	0	0	349	17	10	35	0	143	286
2002	636	-150	0	0	486	13	7	64	0	201	403
2001	692	0	0	0	691	14	10	69	0	299	599
2000	598	0	0	1	598	12	9	60	0	258	517
FINGER MILLET											
Annual growth	2.8%				2.6%						2.5%
2013	323	0	0	4	319	6	5	32	0	138	275
2012	214	0	0	2	212	4	3	21	0	91	182
2011	312	0	0	1	311	6	4	31	0	135	270
2010	351	0	0	1	350	7	5	35	0	151	303
2009	312	0	0	12	300	6	5	31	0	129	258
2008	150	0	2	2	150	3	6	15	0	63	126
2007	308	0	0	1	307	6	3	31	0	133	267
2006	247	0	0	0	246	5	6	25	0	105	211
2005	219	0	0	2	217	4	4	22	0	93	187
2004	246	0	0	2	244	5	4	25	0	105	210
2003	91	21	0	0	112	2	5	9	0	37	96
2002	233	11	0	0	244	5	3	23	0	101	213
2001	207	5	0	1	211	4	5	21	0	88	181
2000	219	5	0	0	224	4	3	22	0	95	195
MAIZE											
Annual growth	7.4%				4.8%						2.2%
2013	5,356	-253	35	37	5,102	1,034	87	760	10	24	3,222
2012	5,104	-241	34	35	4,862	985	83	724	9	23	3,070
2011	4,341	0	30	18	4,352	700	82	898	4	21	2,672
2010	4,733	-750	31	15	3,999	850	66	625	8	21	2,458
2009	3,326	400	24	8	3,742	700	61	426	7	18	2,555
2008	5,441	-800	38	18	4,662	1,100	59	678	11	18	2,824
2007	3,659	135	19	88	3,725	800	80	424	10	18	2,421
2006	3,423	30	304	24	3,734	870	52	424	8	18	2,387
2005	3,132	500	57	103	3,586	820	51	423	7	12	2,292
2004	4,651	-1,095	221	54	3,724	650	62	574	9	17	2,437
2003	2,614	830	88	169	3,363	540	63	275	9	12	2,485
2002	4,408	-900	95	169	3,435	550	69	375	6	12	2,441
2001	2,653	0	94	29	2,718	110	34	164	4	12	2,409
2000	1,965	630	67	17	2,645	100	17	144	6	12	2,384

Source: FAO commodity balances

Table A-17: Mean monthly food expenditures b COICOP group (current year price, nominal figure monthly, TZ Shillings

	2007 HBS			2011/12 HBS			food ratio (%)		non-food ratio	
	food	non-food	total	food	non-food	total	2007	2011/12	2007	2011/12
1st decile	33,586	19,933	53,520	98,740	40,167	138,907	62.8	71.1	37.3	28.9
2nd decile	48,411	27,879	76,289	135,772	57,500	193,272	63.5	70.3	36.5	29.8
3rd decile	56,171	35,608	91,779	140,646	66,092	206,738	61.2	68.0	38.8	32.0
4th decile	64,069	45,421	109,490	164,772	80,368	245,139	58.5	67.2	41.5	32.8
5th decile	79,199	46,142	125,341	174,257	81,747	256,004	63.2	68.1	36.8	31.9
6th decile	76,800	56,954	133,754	178,286	98,975	277,261	57.4	64.3	42.6	35.7
7th decile	83,197	66,595	149,792	201,799	120,559	322,358	55.5	62.6	44.5	37.4
8th decile	94,581	80,800	175,381	197,920	140,198	338,119	53.9	58.5	46.1	41.5
9th deile	118,159	117,920	236,079	229,830	189,857	419,687	50.1	54.8	50.0	45.2
top decile	132,258	221,447	354,705	260,958	505,380	766,338	37.6	34.1	62.4	66.0
total	78,750	71,874	150,625	178,301	138,079	316,380	52.3	56.4	47.7	43.6

Source: National Bureau of Statistics 2014b. Tanzania Mainland Household Budget Survey Main Report, 2011/12.

----------Uganda----------

Table A-18: FAO Commodity balance sheets for cereals in Uganda

Uganda	SUPPLY (in tons)					DOMESTIC UTILIZATION (in tons)					
	Pro-duction	Change in stocks	Imports	Exports	Available Supply	Feed	Seed	Waste	Other uses	Pro-cessing	Food supply
SORGHUM											
Annual growth	-1.3%				-1.1%						-1.1%
2013	299	0	25	5	319	32	8	32	0	148	246
2012	336	0	28	6	358	36	9	36	0	166	277
2011	437	0	2	1	438	44	11	44	0	203	339
2010	391	0	6	7	390	40	11	40	0	180	300
2009	374	0	8	11	371	38	11	38	0	170	284
2008	342	0	74	16	401	42	10	42	0	185	308
2007	458	0	78	0	535	54	10	54	0	251	418
2006	440	0	101	0	540	54	9	54	0	254	423
2005	449	0	73	0	521	52	9	52	0	245	408
2004	399	0	38	0	436	44	9	44	0	204	340
2003	421	0	2	0	423	42	9	42	0	198	330
2002	427	0	3	0	430	43	9	43	0	201	335
2001	423	0	0	0	423	42	9	42	0	198	330
2000	361	10	0	1	370	37	8	37	0	172	287
FINGER MILLET											
Annual growth	-5.9%				-6.7%						-6.7%
2013	228	0	0	1	227	23	3	16	0	28	186
2012	244	0	0	1	243	24	3	17	0	30	199
2011	292	0	0	2	290	29	4	20	0	35	236
2010	268	0	0	2	266	27	4	19	0	32	217
2009	250	0	0	0	249	25	4	17	0	30	203
2008	275	0	0	2	273	27	5	19	0	33	222
2007	732	0	0	1	731	73	5	51	0	90	602
2006	687	0	0	2	685	69	11	48	0	84	557
2005	672	0	0	0	672	67	11	47	0	82	547
2004	659	0	0	2	657	66	11	46	0	80	534
2003	640	0	0	1	639	64	10	45	0	78	520
2002	590	0	0	1	589	59	10	41	0	72	479
2001	584	0	0	0	584	58	10	41	0	71	475
2000	534	70	0	0	604	60	10	42	0	74	492
MAIZE											
Annual growth	6.8%				5.8%						5.6%
2013	2,748	-203	35	143	2,438	276	38	312	1	313	1,812
2012	2,734	-201	35	142	2,426	275	38	311	1	311	1,802
2011	2,551	-200	22	92	2,280	257	33	252	1	309	1,739
2010	2,374	0	7	193	2,188	237	32	282	1	295	1,636
2009	2,355	-250	13	100	2,018	236	31	276	1	244	1,475
2008	2,315	-350	55	72	1,948	234	28	272	2	233	1,414
2007	1,262	0	43	107	1,197	127	26	152	1	155	892
2006	1,258	0	60	118	1,199	130	25	154	1	150	890
2005	1,237	40	79	90	1,265	133	25	158	1	159	950
2004	1,080	60	153	89	1,204	124	23	148	1	143	908
2003	1,300	-100	89	41	1,248	135	23	160	1	145	930
2002	1,217	0	48	62	1,203	125	21	149	0	140	908
2001	1,174	0	15	39	1,149	118	20	141	0	135	870
2000	1,096	0	19	9	1,106	111	20	133	0	130	842

Source: FAO commodity balances