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Urbanization as a driver of changing food demand in Africa

Evidence from rural-urban migration in Tanzania

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Executive summary

Ensuring food and nutrition security in Africa in a context of uncertain agricultural growth and a rapidly growing population remains an enormous challenge. While much of the attention has been focused on supply-side issues, the need for improved understanding of the demand side has been largely ignored. Factors as income, urbanization, education and female labour participation have important implications on food and nutrition security outcomes, through their role in shaping the patterns of food demand.

Drivers of food demand

Most research on food demand has investigated the role of income growth on the amount and composition of food consumption. Also the role of education and nutrition knowledge on food diets has received considerable attention. Yet, while it is widely acknowledged that the rapid urbanization of Sub-Saharan Africa is playing an important role in observed changes in food demand, our understanding of the impact of urbanization is very limited.

Comparisons of food diets in urban vs. rural settings reveal significant differences. While total food consumption is usually higher in urban areas, the share of basic staples such as cereals and tubers tends to be lower, while the share of animal-source foods (dairy, meat, fish) is typically larger in cities. Also the share of processed foods and meals consumed outside the house is typically much more important among urban dwellers.

Yet, these different consumption patterns are not necessarily to be attributed to the urban or rural environment itself. It is well known that incomes and education levels in the cities are larger, the share of own-produced food is much lower, people have different occupations, and the food on offer is different, with supermarkets, imported and processed foods becoming increasingly important. Yet, it is not clear how much of the observed differences in food consumption among rural and urban locations are related to each of these factors.

Rural-urban migration and food demand in Tanzania

In this report, we dig further into the role of the urbanization process in shaping food demand. We make use of unique panel data for the United Republic of Tanzania in which rural-urban migrants are being interviewed on their consumption habits, both before and after they migrated from rural to urban areas. In this way we can control for individual specific characteristics and test the role of a number of potential pathways through which urbanization is supposedly affecting food demand. In addition, the fact that we observe households in which some individuals migrate and others do not, allows us to restrict the comparison to those originating from the same baseline household, effectively addressing concerns that observed or unobserved heterogeneity across migrant and non-migrant families may distort the results. As such, this study goes beyond the simple comparison of rural and urban diets and generates insights on the pathways through which urbanization is affecting food demand.

First of all, our results confirm that when people migrate from rural to urban areas their consumption patterns do change considerably. Individuals relocating to urban areas experience a considerably stronger decrease in their consumption of basic staple foods – especially maize, cassava and sweet potato, while the consumption of more easily prepared rice and processed cereal products rises. Urban residence also induces greater consumption of high-sugar foods and drinks as well as prepared meals outside the home.

However, contrary to what is often claimed, living in an urban environment is not found to contribute positively to the intake of fats, meat, fish and dairy, nor to diet diversity. Our results suggest that these often mentioned differences between rural and urban areas can instead be attributed to socio-economic differences, not the urban location in itself. Also the growth of unhealthy food consumption that is often associated with urbanization can in a large part be linked to rising incomes instead of to the urban environment. As a result, concerns over unhealthy diets may spread to less-urbanized areas as income start growing there as well.

Regarding the consumption of meat, fish and dairy, but also fruits, vegetables and legumes, our results suggest that they tend to increase with rising incomes. Consumption of foods that are typically home-produced in rural areas, like maize, cassava, fruits and vegetables, tends to reduce when people move out of agriculture, which may suggest that even though people have a preference for consuming these goods when they become richer, the availability of fresh products may be constraining consumption in urban areas.

Lessons and challenges

Our study confirms that diets in Africa are rapidly changing, poses challenges for food and nutrition policies, but also for agriculture. We summarize a number of general trends and lessons for policy makers in the field of agriculture, nutrition and health:

1. Nutrition and public health policies have been largely directed towards undernutrition, mostly in rural areas. While this focus is justifiable today, public health authorities need to take into account that – at current rates of income growth and urbanization growth – concerns regarding overnutrition and obesity will pose new challenges for public health in the near future and policies should anticipate upcoming changes.

2. Urban life is associated with the increased consumption of processed foods and meals consumed outside the home. Yet, these foods tend to be high in fat, sugar and salt, and street foods may be inferior in terms of quality and safety. It is not clear in how far people are well-informed on these nutritional implications when opting for more convenient dietary choices. Policies to inform consumers on the nutritional value of their diets, and the long term health consequences may help adjust consumption behaviour.

4. Targeting of nutrition policies needs to be done carefully. Many nutritional programs are targeting women because it is believed that improved nutrition knowledge of mothers may affect the diets of the entire household and especially of children. While this focus is well-justified when concerned about child malnutrition, the increase in consumption of less healthy meals outside the house is particularly strong among male, urban residents. Specific targeting may be needed to reach this group of consumers.

5. Dietary changes will not be limited to urban areas. Our results show that the lower intake of traditional staples, and the increased demand for high-sugar foods, and processed, ready-to-eat foods is largely explained by the higher incomes in urban areas. This means that we may expect similar changes to take place in rural areas, once incomes start growing faster in those areas as well. Nutrition and health policies may anticipate these changes by extending their focus to less urbanized areas where incomes are growing and diets start changing as well.

6. The consumption of fresh perishable foods, including staple foods such as cassava and cooking bananas, but also fruits and vegetables, tends to reduce when people move to the city. In rural areas these products are often self-produced, while in urban environments they need to be bought, and they are typically more expensive in urban than rural areas. Policies to facilitate the availability, distribution and (cold) storage of fresh produce to the cities could lead to an increase in consumption of fresh products in urban areas. This would provide opportunities for rural producers, while at the same time improving nutrition and dietary diversity of urban dwellers.

7. The consumption of processed foods like bread and pasta, or soft drinks is found to be typically linked to the urban environment, with its different lifestyle and the closeness of supermarkets and imported goods. Many of these processed foods are currently imported. While the nutritional concerns over this dietary shift need to be taken into account, this growing demand also creates opportunities for domestic agriculture and food industries. Most food processing facilities are currently located around capital cities, but consumption of these goods is expected to increase in secondary towns as well, where linkages to local farmers may be more easily established and where competition with imported processed foods may be less severe. Policies supporting investment in agro-businesses may help the development of a (healthy) food processing industry.

1 Introduction

With uncertain prospects on agricultural productivity increases, the challenge of how to feed the growing world population has received a lot of scrutiny (FAO, 2009; Collier and Dercon, 2014; Regmi and Meade, 2013). Much of the attention has however been focused on supply-side issues rather than on improving our understanding of demand-side drivers. In addition, most research has focused on the role of income and prices as determinants of food demand, though the importance of other variables is increasingly recognized. Urbanization in particular, has been put forward as a crucial driver of structural changes in food consumption patterns. Especially in Sub-Saharan Africa, where the urban population is growing at an unprecedented rate, it will be a major factor shaping future food demand.

Regmi and Dyck (2001:8) in fact posit that "food demand analysis conducted without taking into consideration the underlying structural shifts resulting from urbanization can lead to misleading results and erroneous food demand forecasts". Moreover, urbanization is commonly associated with the 'nutrition transition', giving rise to and accelerating profound shifts in diets, physical activity and the prevalence of the double burden of malnutrition, i.e. it is hypothesized that though many urban poor are still facing food insecurity, other urban subpopulations suffer from dietary excess and obesity as a consequence of the transition towards diets high in saturated fats, sugar, and refined foods, but low in fibre (e.g. Popkin, 1999; 2001; Popkin and Gordon-Larsen, 2004). However, the extent to which these changes in diets can be attributed to living in an urban environment remains poorly understood. Analysing the impact of urbanization on diet structure has therefore been defined as "a key public health issue" (Popkin, 1999:1908).

While high-income countries have been highly urbanized for several decades, developing countries are catching up very fast. In particular Sub-Saharan Africa is currently in the midst of an unprecedented urbanization wave. Though still the least urbanized region in the world, it is experiencing the strongest rate of urban population growth, at more than 4 % per year. By 2050, 56% of inhabitants in Sub-Saharan Africa are projected to be living in urban areas. Combined with continued population growth rates, this means that the African urban population is likely to triple by mid-century: from less than 400 million in 2015 to about 1200 million in 2050 (UN, 2015). The number of large cities with populations between 5 and 10 million in Africa is also expected to increase, from three in 2014 to twelve in 2030. Yet, urban population growth is not concentrated in large cities only. Also small towns are growing fast and urbanization rates are highest in medium-sized cities (less than 500,000 inhabitants) in Africa (UN, 2015).

This major spatial transformation means that Sub-Saharan Africa will shift rapidly from a population dispersed across small rural settlements dominated by smallholder subsistence agriculture towards one that is concentrated in larger, dense urban settlements characterised by industrial and service activities (Montgomery et al., 2004). Meeting urban food demand in years to come will thus constitute a formidable task for this region. An improved understanding of the impact of urbanization on individuals' food consumption in this context is therefore crucial for policy makers to design appropriate agricultural and nutritional policies to ensure African populations with sufficient, nutritious and healthy food.

Though a substantial literature discusses the impact of urbanization on food consumption, sound empirical evidence is very scarce (see Section 1). To date, the majority of existing research is based on the descriptive comparison of food demand in rural versus urban areas. While this observation in itself is interesting, it does not provide many insights on why we observe this difference, whether this is the result of an "urban location" effect, or whether it merely reflects different socio-economic differences between rural and urban residents.

In this report, we dig further into the role of the urbanization process in shaping food demand. Based on panel data for the United Republic of Tanzania in which rural-urban migrants are being tracked, we compare individual's consumption patterns before and after having migrated from rural to urban areas and assess how this differs from their initial household members who stayed in their rural villages. In this way we can control for individual specific characteristics, as well as heterogeneity across migrant and non-migrant families. In sum, the rich nature of the data and the tracking of individuals allows us to more accurately capture the effect of living in an urban environment and test the role of a number of potential pathways through which urbanization is supposedly affecting food demand. As such, to the best of our knowledge, this study is the first one to go beyond simple comparisons of rural and urban diets and use nationally representative panel data to generate insights on how and through which pathways urbanization is affecting food demand.

The report is structured as follows. Section 1 introduces the chapter and section 2 provides an overview of the literature on the drivers of food demand, with a particular focus on the interaction of each of these drivers with urbanization. Section 3 describes the existing empirical evidence regarding urbanization and food consumption. Section 4 briefly describes the main food consumption patterns in Tanzania and the country's relevance as a case study for this particular topic. Section 5 describes the data and provides descriptive statistics on food consumption and diet diversity. The methodology is set out in Section 6, as well as the results of the regression analysis. Section 7 concludes and formulates implications for policy.

2 Urbanization and other drivers of food consumption: revisiting the literature

Evolutions in the demand for food can be attributed to a variety of factors. Obviously, population growth is a major driver of aggregate food demand, especially with population growth rates expected to remain high in Africa in the coming decades. Yet, in addition to this increase in the number of mouths to be fed, also individual food consumption is undergoing significant changes.

This section provides an overview of the main drivers of *per capita* food demand, including income, education, occupation, socio-cultural food environment and supply-side determinants. The process of urbanization is linked to almost each of these factors, and we therefore end our discussion of each of these drivers with a discussion of its link to urbanization and how this might ultimately explain observed differences in food consumption in rural and urban areas.

2.1 Income

In line with Sen's (1981) core thesis – that food access accounts for most food insecurity – the ability to purchase food and therefore income is a crucial determinant of the level and the composition of food demand, including in developing countries. Engel's law states that as income rises, the proportion of income spent on food declines, even if total food expenditures keep rising. Even when food consumption reaches the level of saturation in terms of energy requirements, additional income will result in more diet diversification, improved quality, convenience, and so on (Regmi and Meade, 2013).

Several studies confirm that income does not only increase the amount spent on food, but also positively affects diet diversity (Moon et al., 2002; Theil and Finke, 1983; Thiele and Weiss, 2003). Yet, this does not necessarily translate into healthier diets and improved nutritional status. Consumers may put less emphasis on nutrient value, and more on how tasty the food is, what status it confers, and how much time is required in preparation (Behrman and Wolfe, 1984:108). This means that large income elasticities for food expenditures may not be inconsistent with small income elasticities for nutrients.

Typically, consumption of "higher valued" food is expected to increase with income, whereas "staples" will be consumed less. While it is generally assumed that fruit, vegetables, animal products and processed foods constitute the former, it has to be noted that this categorization of food items is highly context specific and linked to local taste and production patterns. The case of rice provides an illustrative example of such regional differences. Though an inferior good in several Asian countries - for which the share in food consumption falls with rising levels of income - (Huang and David, 1993), rice can be considered a luxury good in several Sub-Sahara African countries (Kennedy and Reardon, 1994). A meta-analysis of income elasticities in Africa confirms the large regional heterogeneity in income elasticity estimates across the continent, while the increase in consumption of animal-source foods as people get richer does seem to constitute a general trend (Melo et al., 2015; Colen et al., 2018).

The influence of urbanization on food consumption is commonly linked to changes in income (Regmi and Dyck, 2001). Stage et al. (2010: 204) even hypothesize that "the difference between urban and rural households' patterns of food consumption is not caused by urbanization and cultural change but income differences". Available micro-level evidence appears to suggest that rural-urban migration has positive income and consumption growth effects (e.g. Beegle et al., 2011; Nguyen et al., 2015; Christiaensen et al., 2013). Christiaensen et al. (2013) further stress that different processes of structural and rural-urban transformation may be associated with different rates of economic growth, and poverty reduction. The authors demonstrate that most of the

poverty decline can be attributed to rural diversification and migration to small towns rather than big cities.

2.2 Education and nutrition knowledge

Education in general, and nutrition knowledge more specifically, is often argued to affect peoples' food consumption choices. Though dissemination of information does not automatically lead to behavioural change, it is likely that to some extent people will abandon those dietary behaviours that they know to be unhealthy (Nestle et al., 1998).

Several studies on various population groups in developed countries show that the education is associated with healthier dietary habits (e.g. Morris et al., 1992; Georgiou et al., 1997; Payette and Shatenstein, 2005; Blanck et al., 2007) Because of the primacy of women in household food production, purchasing and preparation, women's schooling in particular is frequently hypothesized to affect food consumption. Though female education of course influences income-earning opportunities, Berhman and Wolfe (1984) emphasize the potential impact on household tastes, whether through changing her own preferences or by increasing decision-making power. Using data from the United States, Variyam et al. (1999) demonstrate that nutrition knowledge acts as a pathway through which maternal education influences children's diet. The link between maternal education and dietary intake has been confirmed for other developed countries as well (e.g. Navia et al., 2003; Vereecken and Maes, 2010; Cribb et al., 2011).

Evidence from developing countries confirms this. A study from Indonesia shows that households allocate substantially larger shares of their budget to micronutrient-rich foods and smaller shares to rice when the mother has nutrition knowledge, part of which could be attributed to maternal schooling (Block, 2004). Abdulai and Aubert (2004) similarly demonstrate that in Tanzania women's schooling increases the expenditure shares for meat fish and eggs, fruits and vegetables and dairy products, and reduces the share of cereals and pulses. In addition, the authors show that households with more educated women, and therefore supposedly more health information knowledge, tend to consume food with lower saturated fat and cholesterol contents and more nutritious diets.

Hirvonen et al. (2017) find that nutrition knowledge leads to considerable improvements in children's dietary diversity in Ethiopia, but only in areas with relatively good market access. Hence, in addition to the fact that access to schools and education quality are often better in urban areas (e.g. Sahn and Stifel, 2003; Zhang, 2006; Agrawal, 2014), also good access to food markets is higher in urban localities or areas characterized by high-population density. As such, the role of education and nutrition knowledge (e.g. through informational campaigns) may translate into more nutritional diets in well-connected areas only.

2.3 Occupation

Employment status, labour time and distance to work are likely to affect the opportunity cost of time for acquiring and preparing food. Female labour participation in particular, is assumed to affect household food consumption, as it increases the opportunity cost of women's time for preparing food. It is therefore likely to induce higher consumption of food items with shorter preparation time, prepared food, or food consumed outside the house. Senauer et al. (1986) provide empirical evidence that higher value of women's time, based on labour force participation and wages, has a positive effect on the consumption of timesaving foods, especially commercially baked bread. Kennedy and Reardon (1994) similarly find that the shift to rice, a product with lower processing and cooking costs relative to traditional coarse grain cereals, and street foods in urban Burkina Faso and bread in rural Kenya is related to the extent of women working outside the home. Evidence from Nairobi also indicates that when mothers have outside

employment, the frequency of street food consumption is higher (van't Riet et al., 2001). Regarding the diversity of food consumed, Thiele and Weiss (2003) demonstrate that diet diversity in Germany is considerably lower when the person responsible for the housekeeping is pursuing a full-time job.

Urbanization can be linked to changes in labour opportunities that could have important consequences for food consumption. Huang and David (1993) for example show that in Asia demand for more conveniently consumed food is greater in urban areas where both parents typically work outside of home and travel time between work and home is large. In particular, urbanization is accompanied by trends towards less physically demanding occupations (Ruel et al., 2008) with a shift away from high-energy expenditure activities such as farming, mining, and forestry towards the service sector (Popkin, 1999). This will not only affect urban citizens' energy requirements, but can increase female labour opportunities. It is in fact commonly assumed that female labour participation is higher in urban areas (Huang and Bouis, 2001; Regmi and Dyck, 2001). In addition, employment in urban areas can be argued to bring about long commuting distances, resulting in greater preferences for easy-to-prepare foods and snacks away from home (Bourne et al., 2002). Finally, Mendez and Popkin (2004) also stress that occupational patterns in urban areas are less compatible with home food production.

2.4 Socio-cultural food environment

Food habits are among the most deeply ingrained forms of human behaviour. There is wide agreement that culture, religion and the embedded traditional knowledge are major determinants of food consumption (Atkins and Bowler, 2001; Counihan and Van Esterik, 2013; Fieldhouse, 1995; Kittler et al., 2011). People construct their perceptions, beliefs and attitudes about food on the basis of cultural and religious values (Nestle et al., 1998). Moreover, Briones Alonso (2015) emphasizes that they will not only shape diets and food preferences but also affect intra-household distribution patterns, child feeding practices and food processing and preparation techniques.

As the impact of culture, religion and traditional knowledge is inherently localized, it is likely to be affected by urbanization. The nutrition transition, which is often linked to urbanization, is often argued to stem from the acculturation of people in more traditional societies into preferring a more "Western" diet higher in fat and sugar (Nestle et al., 1998). Watson (1997) for example documents that the appeal of fast food chains in Beijing is related to the fact that it allows customers to participate in the transnational cultural system rather than the taste or convenience of the food. Huang and Bouis (2001) note that urban residents are more likely to be exposed to a rich variety of dietary food patterns and Regmi and Dyck (2001) actually conclude that exposure to more global urban eating patterns will result in the consumption of many Western-style foods.

In addition, culture is continuously changing, adapting to altered circumstances and incorporating new information (Fieldhouse, 1995). As such, there is an important interaction with media and advertising. De Nigris (1997) for example hypothesizes that under the pressure of advertising, traditional eating patterns in Africa may be abandoned. Crush et al. (2011:26) argue that in Southern Africa "media and advertising contribute to shaping food preferences and choices of the urban poor, creating a powerful wave of dietary change, affecting both the quantity and quality of food eaten". The authors argue that the desire for "status foods" and "aspirational foods", often linked to the fast food industry, is a powerful driver of food choices. Pingali and Khwaja (2004) provide an illustrative example from urban slums in India where food stalls mimic the branded products of fast food outlets. Mendez and Popkin (2004) and Kearney (2010) similarly stress that greater access to (international) modern mass media that accompanies urbanization will affect food consumption.

2.5 Supply-side determinants

Individual and household food consumption is of course largely determined by the availability of different food items, which is in turn influenced by changes in the production of and trade in food products.

World trade liberalization affects the food chain at varying levels. Foreign direct investment into food processing, service and retail has for example risen rapidly (Hawkes, 2005) and changes in trade policies have further facilitated the rising availability and consumption of meat, dairy products and processed foods (Thow and Hawkes, 2009; Kearney, 2010)

A key component of food system changes driving shifts in dietary patterns is modern food distribution and sales, and in particular the rise of supermarkets in developing countries (Reardon et al., 2003). By increasing the availability of a wide variety of foods at lower prices, supermarkets can promote more diverse, higher quality diets. Tessier et al. (2008: 768) for example find that in Tunis "a slight improvement in dietary quality can be observed among people who use supermarkets regularly". However, it has been noted that supermarkets in developing countries mostly tend to focus on packaged and processed foods (Reardon et al., 2003). Evidence from Guatemala (Asfaw, 2008; 2010) and Kenya (Kimenju et al., 2015) suggests that people buying at supermarkets indeed tend to consume more processed foods. Rischke et al. (2015) demonstrate that in the Kenyan study, the results were mostly driven by an increase in primary processed foods (e.g. rice, sugar and cooking oils) rather than highly processed foods (e.g. breakfast cereals, bread and sweets). Timperio et al. (2008) present evidence from Australia that suggests that the availability of supermarkets close to home may have a negative effect on children's fruit and vegetable intake. Hawkes (2008:657) further argues that the most universally applicable dietary implication is that "supermarkets encourage consumers to eat more, whatever the food". Several studies from developed countries confirm a positive relationship between the density of food outlets and food purchases (Ni Mhurchu et al., 2013). And also for Kenya it was found that frequent supermarket consumers in Kenya consume more (Rischke et al., 2015).

Similarly, the expansion of fast food companies around the world is changing the food environment as well. The impact of the proximity of fast-food chains on diets in the developed world is however, still subject of debate (Fleischhacker et al., 2011). Currently, there is a tremendous expansion of major fast food companies in Africa and the associated advertisements and sales promotions have been argued to play a key role in stimulating demand for fast foods, especially among the younger generation (Kinabo, 2004). To date however, there is no empirical information on the impact of the spread of fast food chains in developing countries on food intake.

These supply-side determinants of food consumption are likely to differ between rural and urban areas. Urban areas typically offer a wider choice of dietary patterns from foreign cultures (Regmi and Dyck, 2001) as they are more likely to carry imported food items (Codjoe et al., 2016). Teklu (1996) for example demonstrates that the composition of starchy staples is more separable from domestic production patterns in urban areas. Evidence from Ethiopia confirms that households and children with better access to markets consume more diverse diets (Abay & Hirvonen, 2017; Stifel & Minten, 2017) and their food consumption is less dependent on their own agricultural production (Hirvonen & Hoddinott, 2017). Tschirley et al. (2015) show that the share of imports in food expenditures is considerable higher in urban Tanzania. Moreover, within developing countries, supermarket operators generally make the decision to locate in more affluent, urbanising cities (Hawkes et al., 2009). A similar reasoning applies to fast-food chains. As such, urbanization is likely to influence food consumption through increased exposure to supermarkets and fast food outlets. Codjoe et al. (2016), argue that processed and packaged foods in general are more widely available in urban areas, in part because food-manufacturing sectors are based nearby.

In addition, there are some concerns about elevated food prices in urban areas, although evidence is ambiguous. While imported food items may be cheaper and more easily available, domestically produced food may be more relatively expensive because of heightened transportation and distribution costs in urban areas (e.g. De Nigris, 1997). Some have argued that the positive effect of higher urban incomes on food expenditures could to some extent be offset by the fact that the cost of living is likely to be greater in urban than rural areas of developing economies (Ravallion and van de Walle, 1991; Nord, 2000). Cali and Menon (2012) however, conclude that the direction of the net effect of urbanization on consumer prices for agricultural and thus food products is a priori ambiguous. In addition, though commonly mentioned as a possible cause for rising food prices from a macroeconomic perspective, Stage et al. (2010) argue that there is little evidence on the link between urbanization and food prices. Differences in relative prices are however, likely to affect diet composition. Evidence from Indonesia suggests that relative prices biased consumption away from grains, towards food items rich in protein and fats (Chernichovsky and Meesook, 1984).

3 Urbanization and food consumption: empirical evidence

Throughout our discussion, it became clear that urbanization interacts with several key determinants of food consumption. It is in fact commonly assumed that urbanization is one of the primary driving forces behind the "nutrition transition" following from rapid changes in the levels and composition of dietary and activity patterns that is linked to the spread of obesity in developing countries (e.g. Popkin, 1999; Popkin et al, 2012). Popkin (1999: 1908) therefore argues that "analysing the impact of urbanization on diet structure is a key public health issue". As such, there is a substantial empirical literature investigating the impact of urbanization on food consumption.

Cross-country evidence

Several cross-country studies attempt to estimate the impact of urbanization on food consumption. In studies on animal source food consumption for East Asia (Rae, 1998) and developing countries in general (Delgado, 2003) finds that urbanization elasticities are always positive, i.e. higher degrees of urbanization always correspond to increases in consumption. Drenowski and Popkin (1997) and Popkin and Nielsen (2003) show that higher rates of urbanization are associated with substantial increases in the consumption of sweeteners and fats. Popkin (1999), who in addition demonstrates that contrasts between urban and rural dietary patterns are more marked in lower income countries, confirms this. Huang and David (1993) find that urbanization has significantly affected patterns of cereal consumption in Asia with a negative effect on the consumption of rice and coarse grains but a consistent increase in wheat consumption, which they link to the greater convenience of consuming (processed) wheat products. For Africa, Delgado (1989) finds that the share of urban population in total population has a strong and significant effect on the share of (imported) rice in cereals consumption in Burkina Faso and Mali, leading him to the conclusion that urbanization rather than price was driving substitution over time toward imported cereals.

Rural versus urban consumption patterns

Most of the literature attempts to capture the impact of urbanization by comparing food consumption in rural and urban areas within the same country. We will summarize the evidence from developing countries on these urban-rural comparisons in food consumption by region here below.

Asia

Several Asian – mostly Chinese - case studies reveal elevated levels of meat consumption in urban areas (Huang and Bouis, 1996; Popkin, 1999; Regmi and Dyck, 2001; Huang and Bouis, 2001; Popkin and Du, 2003; Ma et al., 2004; Zhai et al., 2009) and lower grain or rice consumption (Huang and Bouis, 1996; 2001; Popkin and Du, 2003; Zhai et al., 2009). Most evidence also indicates lower consumption of fruits and vegetables in urban areas (Huang and Bouis, 1996; Huang and Bouis, 2001; Popkin and Du, 2003; Mendez and Popkin, 2004). Regmi and Dyck (2001) and Shetty (2002) on the contrary, conclude that urban residents in China and Indonesia and India respectively consume more fruits and vegetables. Other differences include that diets in urban areas are more diverse (Popkin and Du, 2003) and contain more oils, fats and refined carbohydrates (Shetty, 2002; Popkin and Du, 2003; Mendez and Popkin, 2004). Finally, Zheng and Henneberry (2009) emphasize the increased likelihood of eating meals away from home for residents of bigger cities in China.

Sub-Saharan Africa

Evidence suggests that compared to rural patterns of food consumption, urban diets in Sub-Saharan African countries are more diversified (De Nigris, 1997; Smith et al., 2006)

and less dominated by traditional staples (De Nigris, 1997; Maxwell et al., 2000). Several studies also indicate increased consumption of processed cereal products including bread (Maxwell et al., 2000) and growing reliance on street foods in urban centres (Maxwell et al., 2000; Maruapula et al., 2011). A detailed study from Botswana further suggests that consumption of fruits, vegetables, and fizzy drinks is more common in cities and towns. In addition, they find a shift away from "traditional diets" in cities (Maruapula et al., 2011). Looking at the micronutrient composition of diets in urban and rural areas, MacIntyre et al. (2002) and Bourne et al. (2002) demonstrate that while the percentage of energy provided by carbohydrates decreased, fat intake increases with urbanization in South Africa. Abdulai and Aubert (2004) even find that households residing in urban areas in Tanzania have lower intakes of all nutrients except saturated fats and cholesterol.

Latin America

Finally, evidence from Latin America similarly points to higher diet diversity in urban areas (Arimond and Ruel, 2004). In addition, Willaarts et al. (2013) find that though total food intake in grams is higher in rural areas in Brazil, urban residents consume much more high-calorie products like processed foods and food items high in sugar.

Identifying the causes of rural-urban differences

Several authors however, discuss the limitations of these rural-urban comparisons. In particular, they can be misleading as urban residence is unlikely to be the sole factor in which these population groups differ. Popkin (1999) argues that these descriptive comparisons contribute little to our understanding of the causes for these differences as there is no clear sense if these can be attributed to a unique urban residence effect or just reflect differences in other socioeconomic factors. Several authors also mention that we have no knowledge about the timing of these effects (Popkin, 1999). Finally, Huang and Bouis (2001:62) conclude that "an ideal data set for measuring structural shifts in food demand patterns would record foods consumed before and after a large number of families migrated from rural to urban areas".

Witcher et al. (1988) adopt a somewhat similar approach to study the effect of rural-urban migration on food consumption patterns in Ecuador. During an interview, women were asked to report the frequency of consumption of different food items before and after migrating. The study reveals less frequent consumption of whole grains, which appear to be substituted with processed cereal products, less frequent consumption of "indigenous", traditional foods and more frequent consumption of foods containing sugar. Increased consumption of beef, bread and fruits because of increased availability were also reported. The lack of actual panel data however, raises concerns about recall bias.

Overall, it is evident that food consumption patterns are highly different in urban vs. rural areas. But what exactly drives these differences is less clear. To the best of our knowledge, this study will be the first to employ a panel data approach to assess changes in individual food consumption after migrating from rural to urban areas. As we will discuss in detail in Section 5 and 6, this allows us to control for individual fixed heterogeneity as well as initial household fixed effects and provides insights into the underlying pathways through which urbanization affects food demand.

4 The setting: Tanzania

Tanzania (officially the United Republic of Tanzania) is a low-income, low human development country in East Africa with over 53 million inhabitants that reflects a range of Sub-Saharan environments where the proportion of hungry people is highest and increasing (De Weerdt et al., 2014).

At 3.15 % per year, Tanzania's population growth is among the fastest in the world. According to the UN (2016), the country's population has a high probability of tripling between 2015 and 2100. In addition, the country is experiencing rapid urbanization. The average urban population growth over the past two decades was over 5 %. As a result, close to 31 % of the population is currently living in urban areas, compared to 20.5 % in 1995 (World Bank, 2016). Dar es Salaam is predicted to become one of the 20 largest cities in the world by 2050. The growth of the urban population however goes beyond the expansion of Dar es Salaam, with other cities and towns accounting for a stable two thirds of the urban population expansion for the past 50 years (Ambroz and Wenban-Smith, 2014).

Over the past two decades, the country has also experienced a period of relatively rapid macroeconomic growth, with an average annual GDP per capita growth rate close to 3 % between 1995 and 2014 (World Bank, 2016). While according to the 2012 National Household Budget Survey, poverty declined dramatically in the former capital, Dar es Salaam, progress was much less pronounced in other areas and large (urban-rural) disparities remain.

Table 1. Poverty rates in Tanzania

	1991/92		2000/01		2007		2011/12 [c]	
	Basic needs [a]	*Food* [b]	*Basic needs*	*Food*	*Basic needs*	*Food*	*Basic needs*	*Food*
Dar es Salaam	28.1	13	17.6	7.5	16.4	7.4	4.2	1
Other urban areas	28.7	15	25.8	13.2	24.1	12.9	21.7	8.7
Rural areas	40.8	23.1	38.7	20.4	37.6	18.4	33.3	11.3

Source: TNBS, HBS (2007;2011/2012)

[a] Based on the basic needs poverty line (incl. food and non-food items).
[b] Based on the monetary value of a minimum food bundle of 2,200 kcal. per person per day.
[c] Due to changes in the methodology in the 2011/12 HBS, the poverty statistics are not strictly comparable over time.

Despite considerable progress, it has been noted that food security gains are not matching national economic gains (WFP, 2013). An estimated 34.8 % of children under five – 44.2 and 30.8 % in rural and urban areas respectively - was still affected by stunting in 2010-2011 (WHO, 2014). At the same time, the prevalence of overweight and obesity is rising rapidly especially in urban areas with 13.3 % of women estimated to be obese compared to a modest 3.1 % in rural areas (WHO, 2015).

The food environment in Tanzania is undergoing rapid changes as well. The "supermarket revolution" has arrived in Dar es Salaam. The city now hosts at least 30 large outlets across at least 12 supermarket chains as well as hundreds of small mini-supermarkets widely dispersed across the city and a rapidly growing number of "new format retail clusters" that feature parking areas and four-to-five shops. This transformation is still just taking root in secondary cities, most notably via the increase in small supermarkets (Ijumba et al., 2015). Ijumba et al. (2015) further estimate that approximately 39, 44 and 31 % of food products available in Dar es Salaam, Arusha and Mwanza are imported. These changes will affect food consumption, as it has been demonstrated that purchased

food already accounts for a large share of the overall food economy in this region and is bound to become increasingly important (Tschirley et al., 2015).

Evidence also suggests that processed foods are widely available in urban areas in East and Southern Africa. Tschirley et al. (2015) find that processed foods represent over 40 % of the entire food budget and 70 % of purchased foods and these shares are expected to increase dramatically in the future. While the latter does not differ between urban and rural areas, the share of processed foods in the total food budget is more than twice as high in urban areas (64 % compared to 30.2 %).

In addition, at an estimated 8.51 % per annum between 2002 and 2012, Tanzania has been faced with strong food price inflation, predominantly driven by supply-side factors including domestic agricultural shocks and the global food price crises, which has resulted in food prices increasing faster than non-food prices (Adam et al., 2012).

5 Data and descriptive statistics

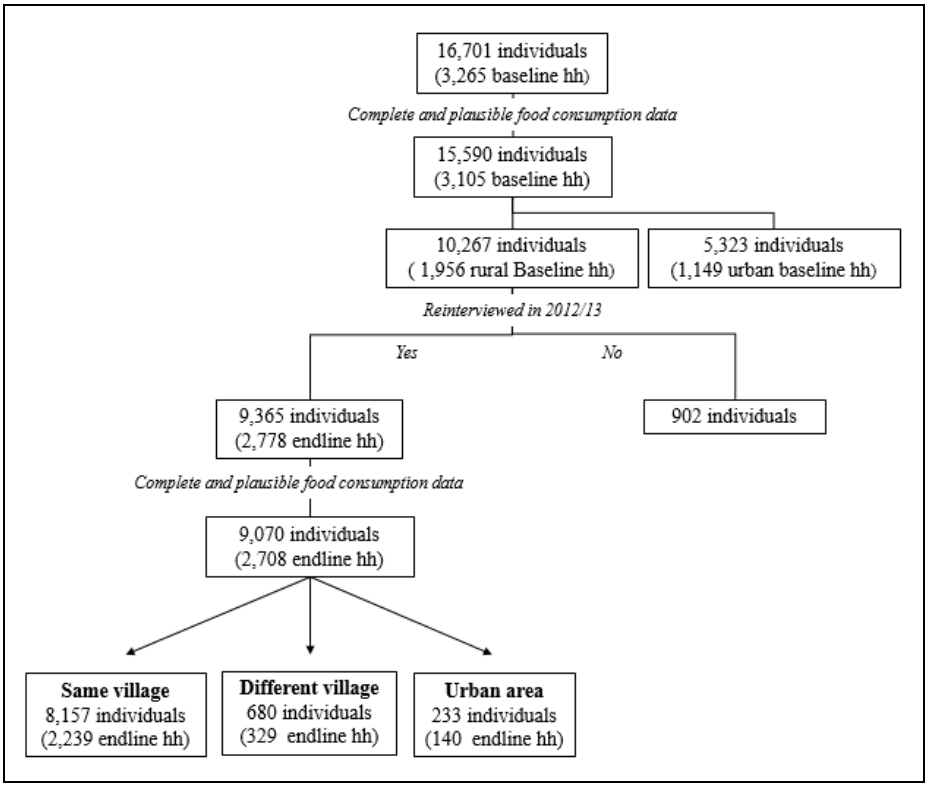
5.1 Survey data

As mentioned above, the comparison of food consumption patterns in rural and urban areas is unlikely to capture the true impact of urbanization as location is far from random, which raises concerns about selection bias. A promising approach to study the impact of urbanization on food consumption is therefore to compare individuals' dietary patterns before and after they migrated from rural to urban areas.

Using a unique set of panel data tracking rural-urban migrants we will analyse how rural-migration affects total food consumption, food consumption by food category, as well as a measure of diet diversity. In addition, information on income, economic activity and prices allow us to disentangle the effect of the urban location itself from these other factors that are likely to accompany the urbanization process.

We use data from the Tanzania National Panel Survey (TNPS). The TNPS is a nationally representative panel survey covering four years that was conducted as part of the Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) project[1]. All three rounds of data collection (2008/09, 2010/11, 2012/13) have been implemented by the Tanzania National Bureau of Statistics (NBS). The initial sample (2008/09) of 3,265 households was designed to be representative of the entire country as well as of urban/rural and major agro-ecological zones. Considering only individuals for which complete and plausible consumption data were available, this corresponds to 15,590 individuals. Of these, 10,267 were residing in rural areas and 5,323 were residing in urban areas in 2008/09. For the main analysis we will only focus on those individuals living in rural areas in the baseline (see Figure 1).

Figure 1: Sample



Source: TNPS 2008/09 and 2012/13

[1] A World Bank project aimed at generating nationally representative, household panel data.

The 2012/13 round relocated and re-interviewed members of the same households, including those members who had migrated[2]. Out of the 10,267 individuals, 9,365 were re-interviewed in 2012/13. Overall, the TNPS has thus maintained remarkably low attrition rates. After removing those individuals with incomplete or implausible consumption information, the final sample of the main analysis corresponds to 9,070 individuals, belonging to 2,708 households. As for information on food consumption, this survey includes a one-week diet recall questionnaire. Respondents are asked to report household consumption of 59 different food items, organized within 11 broader groups[3], in grams, litres or pieces. Besides the total volume of consumption, respondents were asked to indicate the amounts that were purchased, derived from own production or gifts and other sources. In addition, each household member was asked to give the monetary value in Tanzanian Shillings (TZS) of their consumption of 7 types[4] of food and beverages that were consumed outside home over the past 7 days. In order to quantify food consumption all these units (both food items consumed at home as food consumed outside home) were converted to grams, based on the detailed conversion factors developed for the SHWALITA survey, short for Survey of Household Welfare and Labour in Tanzania. Similarly, the conversion of grams to kcal. was based De Weerdt et al. (2014). We excluded four food items[5] from our analysis, as information on the energy contents was not available (for the final list of food items included, see Annex A, Table A1 and A2).

5.2 Rural-urban migration

Table 2 clearly shows that despite the relatively short time span, the TNPS captures considerable migration flows. 10 percent of individuals in the survey have migrated over the 4-year period 2008/09-2012/13. Out of 913 migrants, the majority (680) moved to another rural area (at least one-hour drive away from the original location), and 233 moved into urban areas.

Figure 2 provides some information on the motivations to migrate according to the destination. It appears that though the largest part of all migration can be explained by marriage and other family reasons, better services or housing and reasons related to work are more important for rural-urban migration than for rural-rural migration.

Later in the analysis, we will distinguish urban areas in Dar es Salaam and Mwanza from secondary cities as they clearly stand out in terms of population and are characterized by a markedly different food (retail) environment (cfr. supra). While motivations for migration are similar among secondary towns and primary cities , non-surprisingly work-related reasons are somewhat more important when moving to the latter.

Table 2. Migration matrix

		2012/2013		
		In same location	In different location	
			Rural	Urban
2008/2009	Rural	8,157	680	233

Source: TNPS (2008/09-2012/13)

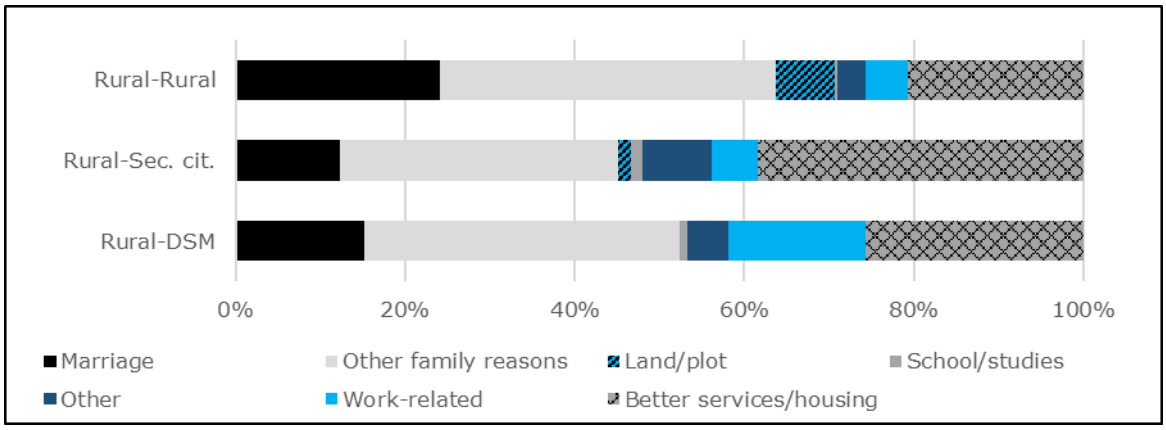
[2] We applied strict criteria for distinguishing migrants. Only those individuals whose 2012/13 location was more than a one hour drive away from their baseline location were considered to have migrated.

[3] Cereals, starches, sugar and sweets, pulses, nuts and seeds, vegetables, fruits, Meat, fish and eggs, milk and milk products, oils and fats, spices and beverages.

[4] Full meals, barbecued meat, chips, roast bananas, other snacks prepared on charcoal, kibuku and other local brews, wine, commercial beer and spirits, sodas and other non-alcoholic drinks, sweets and ice-cream, tea coffee, samosa, cake and other snacks.

[5] Package fish, salt, other spices and other raw materials for drinks, altogether making up on average 0.82% of total food intake in grams.

Figure 2. Migration motivations



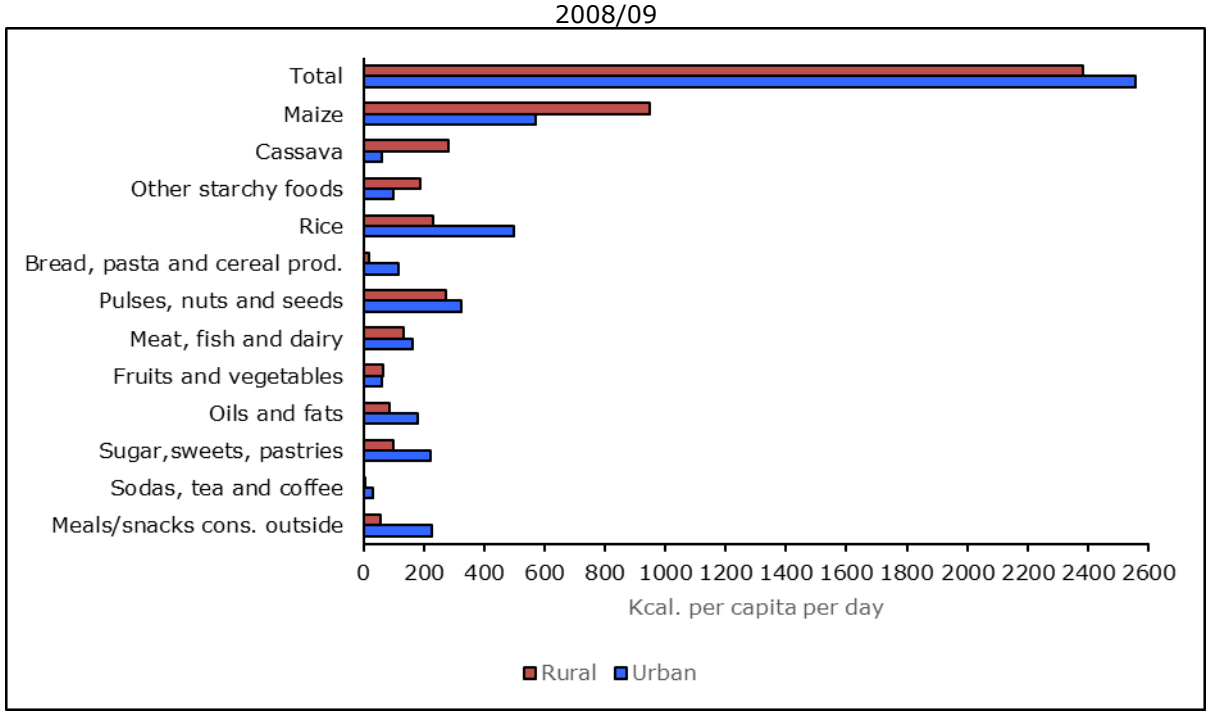
Source: TNPS(2008/09-2012/13)

5.3 Food consumption

We describe food consumption across different categories based on the nationally representative TNPS data. We aggregate the consumption items into 12 different categories of food (and non-alcoholic beverages), expressed in kilocalories per capita per day. Details on the food items contained in each category are provided in Table A1 and A2 in Annex A.

To allow for the comparison to the existing literature which is largely based on cross-sectional comparative descriptive analysis, Figure 3 depicts average total calorie intake per capita per day and for calorie intake for each of the 12 categories for individuals in rural and urban areas in the 2008/09 round of the TNPS.

Figure 3. Average food consumption in 2008/09



Food consumption is expressed in kcal. per capita per day. The sample consists of 10,267 and 5,322 individuals living in rural and urban areas. All rural-urban differences are significant at the 1 % level.
Source: TNPS (2008/09)

Overall, these data suggest that contrary to previous findings from Tanzania (Abdulai and Aubert, 2004) and other Sub-Saharan African countries (De Nigris, 1997; Smith et al., 2006), average total food consumption per capita is slightly larger in urban compared to rural areas. First of all, urban residents derive much less energy from traditional staple foods such as maize, cassava, and 'other starchy food', which includes sweet potatoes and cooking bananas. Especially the consumption of cassava is much lower in cities, while the consumption of rice is twice as much, and the consumption of bread and other processed cereal products is 7 times larger. Aside from this, the differences in diets among rural and urban areas correspond to what is commonly found by earlier studies in this region (De Nigris, 1997; Maxwell et al., 2000; Vorster et al., 2005). The elevated levels of consumption of sugar and sweets, (sugary) non-alcoholic drinks and oils and fats, resulting in a considerably higher share in total energy intake, are however in line with concerns about the nutrition transition as described by Popkin (1999; 2004; 2012). These descriptive statistics also appear to support the hypothesis that people living in urban areas prefer foods with shorter or no preparation time, as is reflected in the greater importance of meals and snacks consumed outside (more than 4 times larger than in rural areas), rice and processed cereal products (bread, buns, cakes, biscuits and pasta).

5.4 Diet diversity

In order to assess whether urban diets are more diverse, we construct several measures of diet diversity. A very straightforward way to measure diet diversity is to count the number of food items or food groups consumed. As there is no consensus in the literature as to whether individual food products or broader food groups should be used while assessing diet diversity as a proxy for more nutritious diets (e.g. Torheim et al., 2004), we will report both.

The count measure - although easy to interpret - has the disadvantage that it does not consider information on the distribution of food consumption. There are alternative measures that overcome this problem such as the Berry Index (Berry, 1971), which has gained popularity in the literature (e.g. Thiele and Weiss, 2003; Drescher and Goddard, 2011; Hertzfeld et al., 2014).

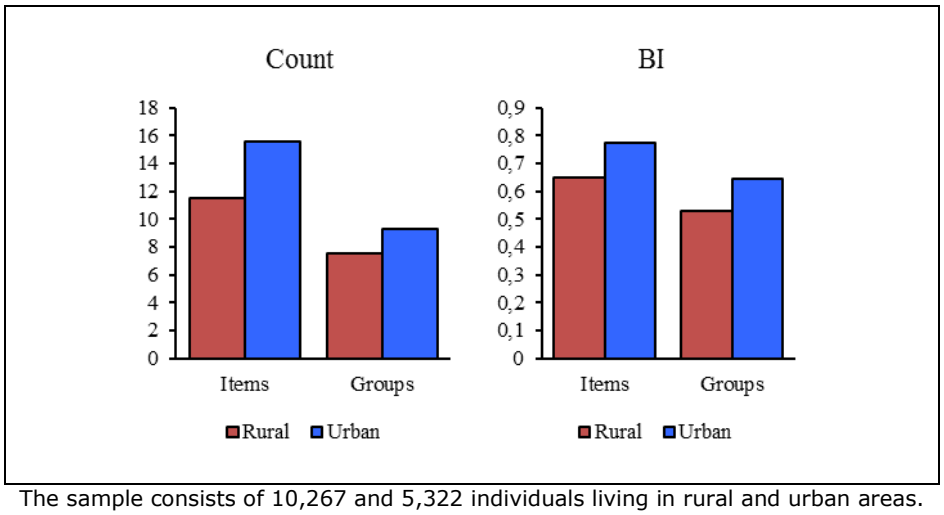
The Berry Index (BI) is calculated using the following formula:

$BI = 1 - \sum s_i^2$ where s_i is the share of the ith food item/group in total food consumption in kcal./grams.

This index ranges from 0, which corresponds to the case where food consumption is entirely based on one food item or group, to 1-1/n, when n food items or groups are consumed in equal proportions. For this particular dataset n – and thus the maximum value of the count measure – equals 57 or 12 when considering food items or broader food groups respectively. The upper bound of the Berry Index is therefore equal to 0.983 or 0.917 respectively.

Figure 4 shows that, compared to rural areas, diet diversity is greater in towns and cities. This difference is especially striking when focusing on the number of different food items consumed. A similar but slightly less pronounced pattern arises for the Berry Index. We further note that the difference between rural and urban areas in terms of the diversity in food groups rather than items consumed seems more modest.

Figure 4: Average diet diversity in 2008/09



The sample consists of 10,267 and 5,322 individuals living in rural and urban areas.
All rural-urban differences are significant at the 1 % level.
Source: TNPS (2008/09)

6 Regression results

As mentioned above, a simple cross-sectional comparison of average food consumption patterns in rural and urban areas is unlikely to capture the true impact of living in an urban environment. Ideally, we would want to observe the same individual in both settings. Yet, in the absence of such experimental data, heterogeneity affecting both food consumption and the process of migration remains a key concern. Table 3 demonstrates that on average women, individuals with more years of schooling, those who are employed outside of agriculture and from less wealthy families are more likely to migrate. Interestingly, wealthier and more educated migrants are more likely to move to urban areas. Individuals from farmer households are less likely to migrate, and if they do so, they are much more likely to move to another rural area. Table 3 also suggests that rural-rural migrants are more similar to those who are not migrating than to rural-urban migrants.

Table 3. Baseline characteristics (2008/09)

	Rural stayed (8157)	Rural-rural migrants (680)	T-stat. Ha: diff ≠ 0	Rural-urban migrants (233)	T-stat. Ha: diff ≠ 0
Age	22.379	21.713	0.857	20.639	1.345
Sex (1=male, 2=female)	1.5140	1.568	-2.689***	1.571	-1.710*
Education (years)	3.172	3.204	-0.241	4.429	-5.646***
Married	0.317	0.346	-1.542	0.245	2.342**
Household head or spouse	0.335	0.356	-1.131	0.292	1.3637
Child of household head	0.501	0.490	0.568	0.506	-0.162
Household size	6.911	5.912	6.254***	6.021	3.296***
Farming household	0.835	0.835	0.509	0.579	10.284***
Total consumption per capita (TZS)	379,697.7	392,611.7	-1.292	474,440.4	-5.649***

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
Source: TNPS(2008/09)

To address this heterogeneity and in line with Beegle et al. (2011), we employ a difference-in-difference estimator, comparing changes in food consumption of those who stayed in their baseline rural community with those who migrated to other rural areas or urban areas. Our specification controls for individual fixed heterogeneity and resolves a large number of possible sources of endogeneity, such as risk aversion or education, which are likely to affect both migration and food consumption. In addition, we control for initial household fixed effects because we observe baseline households in which some individuals migrate and others do not. This controls for observable and unobservable factors fixed to the family. In sum, the regression model looks as follows:

$$\Delta C_{i,t+1,t} = \alpha + \beta_1 M_{i,t+1}^{rural} + \beta_2 M_{i,t+1}^{urban} + \gamma X_{i,t} + \delta_{i,h} + \epsilon_{i,t}$$

where $\Delta C_{i,t+1,t}$ is the absolute change in one of the measures for food consumption for individual i between period t+1 and t. $M_{i,t+1}^{rural}$ and $M_{i,t+1}^{urban.}$ are dummy variables that equal one when individual i migrated to a different rural area or urban area respectively by period t+1. Since we include data from all individuals living in rural areas at baseline, those who did not migrate and remained in their original rural community will serve as a control group. The term $X_{i,t}$ represents a vector of individual level baseline characteristics that may affect both food consumption and the process of migration; namely age, sex, relation to the household head, education and marital status[6]. Finally, $\delta_{i,h}$ stands for the initial household fixed effects and $\epsilon_{i,t}$ represents the error term.

[6] We have attributed missing values for level of education to zero years of schooling and included a dummy variable that equals one when the observation was originally reported as missing. Similarly, we assume that individuals are unmarried when information on their marital status is missing.

The impact of urbanization should be reflected in the coefficients of the dummies for migration to urban areas (i.e. coefficients β_1 and β_2). In addition, we formally assess whether the urban destination rather than migration in general matters by testing, using an F-test, whether the coefficients for migration to cities are significantly different from those for rural-rural migrants.

6.1 Food consumption

Table 5 depicts the results of the regressions on the absolute changes in kilocalories per capita per day between 2008/09 and 2012/13 for each of the 12 food categories considered. Table 6 reports the results when using the share of energy derived from each of these 12 categories instead, which allows to assess the relative importance of these changes.

The results of the regressions summarized in Table 4 and 5 largely confirm a much stronger shift away from home consumption of traditional staples after relocating to urban areas. The differences in maize and cassava consumption growth are large and highly significant: rural-urban migration leads to an additional decline of 172 and 131 kilocalories per day for maize and cassava respectively, compared to household members remaining in their original rural villages. This corresponds to a decline in the share of these food items in total food consumption. At the baseline, maize and cassava accounted for 39% and 12% of total energy intake, and urban migration leads to a decline in the importance of these staples of 7.5 and 6.8 percentage points. A similar trend is found for the consumption of other starchy foods; and of cooking bananas in particular.

The analysis further reveals a positive effect of relocation to urban areas on the consumption of rice, bread and other cereal products; time-saving goods that have commonly been associated with busy urban lifestyles (e.g. Frimpong, 2013; Huang and David, 1993; Kennedy and Reardon, 1994; Maxwell et al. 2000; Senauer et al., 1986).

Regarding the consumption of high-sugar foods – sugar, sweets, pastries and soda's – the regressions find a much stronger growth for those relocating to urban areas, which confirms concerns about the sweetening of urban diets (e.g. Popkin, 1999; Popkin and Nielsen, 2003). Also the increase in consumption of meals and snacks outside the home is much stronger for those individuals that moved to urban areas. Whereas this food category was negligible for rural residents at the baseline (56 kcal on average), this increases with 254 kcal when moving to urban areas, i.e. a five-fold increase. Note that this shift is highly driven by male migrants. When restricting the analysis to women (Tables B1 and B2 in appendix), the coefficient on rural-urban migration becomes insignificant.

No significant effect of rural-urban migration on the intake of oils and fats is found. However, note that the share of meals consumed outside rises by an additional 10.6% of total energy intake, which likely raises fat content of diets. Relocation to urban areas also does not seem to contribute to a greater intake of nutritious food groups such as animal source products, fruits and vegetables and pulses, nuts and seeds.

The last rows of Tables 4 and 5 assess whether there is a difference between moving to urban areas or remaining in rural areas. It tests the equality between the rural and urban migrant dummies. Except for rice, comparing urban to rural migrants produces differences similar in magnitude and significance, which means that the dietary shifts we identified earlier are related to living in an urban environment and not to migration per se.

Table 4. Results regressions of changes in food consumption[a] (2008/09-2012/13)

	ΔTotal	Δmaize	Δcassava	Δother starchy foods	Δrice	Δbread, pasta, cereal products	Δpulses, nuts, seeds	Δmeat, fish, dairy	Δfruits, veg.	Δoils, fats	Δsugar, sweets, pastries	Δsodas, tea, coffee	Δmeals, snacks cons. Outs.
Baseline cons.	*2377.49*	*940.45*	*283.67*	*190.31*	*228.23*	*16.60*	*273.67*	*134.35*	*64.93*	*87.57*	*97.23*	*4.84*	*55.62*
M^{Rural}	20.62	-13.51	20.38	16.75	37.82	12.17*	-37.66**	-1.818	-4.752	-3.615	-7.987	2.196	0.644
	(80.71)	(51.08)	(32.55)	(16.13)	(29.00)	(6.390)	(19.14)	(13.65)	(6.962)	(6.809)	(11.29)	(2.257)	(37.73)
M^{Urban}	88.28	-172.0**	-130.6***	-99.06**	93.54*	68.95***	-21.41	17.23	-4.903	-2.425	57.41***	24.48***	257.1***
	(131.6)	(77.22)	(34.59)	(40.42)	(49.18)	(17.46)	(31.98)	(19.99)	(9.457)	(14.91)	(18.73)	(6.010)	(65.31)
Const	-378.4***	-175.7***	-84.71***	-34.20***	11.67	0.352	-38.15***	-21.24***	-6.817***	-51.72***	-12.30***	-0.0847	34.54**
	(25.97)	(15.40)	(8.568)	(7.431)	(9.191)	(1.817)	(5.711)	(3.844)	(2.536)	(2.466)	(3.243)	(1.200)	(16.07)
Controls[b]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070
$M^{Rural} = M^{Urban.}$	0.201	3.270*	9.150***	7.621***	0.946	9.630***	0.194	0.585	0.000	0.005	9.959***	12.13***	12.45***

[a] Food consumption is expressed in kcal. per capita per day.
[b] We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.
Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5. Results regressions of changes in the composition of food consumption[a] (2008/09-2012/13)

	Δmaize	Δcassava	Δother starchy foods	Δrice	Δbread, pasta, cereal products	Δpulses, nuts, seeds	Δmeat, fish, dairy	Δfruits, veg.	Δoils, fats	Δsugar, sweets, pastries	Δsodas, tea, coffee	Δmeal, snacks cons. Outs.
Baseline share (%)	*38.58*	*11.99*	*8.37*	*9.79*	*0.73*	*11.67*	*5.89*	*2.80*	*3.78*	*4.36*	*1.91*	*1.84*
M^{Rural}	-0.134	-1.382	1.503*	1.151	0.490*	-0.615	-0.522	-0.261	-0.040	-0.358	0.111	0.056
	(1.774)	(1.285)	(0.783)	(1.021)	(0.266)	(0.728)	(0.536)	(0.300)	(0.247)	(0.407)	(0.082)	(1.560)
M^{Urban}	-7.494**	-6.838***	-2.889**	2.973*	2.388***	-1.295	-0.407	-0.375	-0.055	2.409***	0.873***	10.71***
	(2.987)	(1.449)	(1.163)	(1.804)	(0.547)	(0.947)	(0.661)	(0.385)	(0.481)	(0.693)	(0.222)	(2.871)
Const.	0.201	-1.628***	-0.509	1.740***	0.054	-0.033	-0.284*	0.085	-2.032***	-0.160	0.019	2.547***
	(0.608)	(0.365)	(0.357)	(0.344)	(0.072)	(0.226)	(0.162)	(0.103)	(0.093)	(0.129)	(0.042)	(0.635)
Controls[b]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070
$M^{Rural} = M^{Urban.}$	4.571**	8.304***	10.85***	0.805	10.14***	0.347	0.019	0.061	0.001	13.07***	9.756***	11.50***

[a] Food consumption of different categories is expressed as a share of total per capita per day energy intake.
[b] We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6.2 Diet diversity

Table 6 summarizes the results of the regressions for the different measures of diet diversity, but shows little support for the hypothesis that living in an urban environment contributes positively to diet diversity.

Table 6. Results regressions of changes in diet diversity (2008/09-2012/13)

	Δcount (items)	ΔBI[a] (items)	Δcount (groups)	ΔBI[a] (groups)
Baseline	*11.52*	*0.649*	*7.52*	*0.532*
M^{Rural}	-0.422	0.012	-0.036	-0.002
	(0.354)	(0.016)	(0.180)	(0.016)
$M^{Urban.}$	1.205*	0.037	-0.018	-0.010
	(0.666)	(0.024)	(0.301)	(0.023)
Const.	-0.253**	-0.039***	0.007	-0.031***
	(0.111)	(0.005)	(0.056)	(0.005)
Controls[b]	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓
N	9070	9070	9070	9070
$M^{Rural} = M^{Urban}$	4.827**	0.777	0.003	0.083

[a] Based upon food consumption in kcal. per capita per day. [b]We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status. Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Looking at the number of food items consumed, there is some evidence that individuals that relocated to urban areas experienced a slightly stronger increase in diet diversity compared to those who remained in their baseline rural villages. However, regarding the number of food groups or both Berry indices, no significant difference was found. Hence, the higher urban diet diversity observed in our own cross-sectional comparison seems to be largely driven by selection bias. This raises the question whether also other cross-sectional studies (e.g. De Nigris (1997), Bourne et al (2002), Abdulai and Aubert (2004), Smith et al. (2006)) that find higher diet diversity in urban areas, may actually be measuring selection bias instead of a true urbanization effect.

6.3 Secondary towns versus large cities

The variety in the African urban environments is large. Dorosh and Thurlow (2013) show that the urban population in Sub-Saharan Africa is bimodally distributed. 40% lives in major cities with a population above 1,000,000 inhabitants and 40% in small towns with less than 250,000 people. They have largely different sectoral compositions and differ largely in terms of average incomes, poverty levels and food environments. Large cities are better connected to international markets, have thicker markets, a markedly higher presence of supermarkets (Hawkes, 2008) and options for eating out. Secondary towns are instead closer related to rural areas and may have cheaper supplies of locally produced food products.

In order to assess how these different factors affect food consumption we explore how our results differ when splitting up migrants by type of urban locality the move to. We distinguish the largest cities Dar es Salaam and Mwanza from smaller secondary towns.

Table 7. Results regressions of changes in food consumption[a] on migration to different rural areas, secondary towns or cities (2008/09-2012/13)

	Δtotal	Δmaize	Δcassava	Δother starchy foods	Δrice	Δbread, pasta, cereal products	Δpulses, nuts, seeds	Δmeat, fish, dairy	Δfruits, veg.	Δoils, fats	Δsugar, sweets, pastries	Δsodas, tea, coffee	Δmeals, snacks cons. Outs.
Baseline cons.	*2377.49*	*940.45*	*283.67*	*190.31*	*228.23*	*16.60*	*273.67*	*134.35*	*64.93*	*87.57*	*97.23*	*4.84*	*55.62*
M^{Rural}	16.71	-16.08	20.10	14.80	37.10	12.40*	-37.91**	-1.728	-4.562	-3.276	-7.586	2.126	1.325
	(80.60)	(51.08)	(32.44)	(16.20)	(28.89)	(6.381)	(19.13)	(13.71)	(6.973)	(6.797)	(11.31)	(2.276)	(37.84)
$M^{Sec.\ Towns}$	252.0	-64.64	-118.7***	-17.26	123.5**	59.40**	-10.96	13.48	-12.88	-16.60	40.63*	27.40***	228.6***
	(166.5)	(108.7)	(41.66)	(33.26)	(62.66)	(24.85)	(36.57)	(27.56)	(11.94)	(22.83)	(23.19)	(9.279)	(84.04)
M^{Cities}	-132.1	-316.5***	-146.7**	-209.2**	53.17	81.82***	-35.49	22.28	5.838	16.66	80.01***	20.55***	295.5***
	(207.7)	(101.3)	(58.65)	(81.64)	(77.49)	(23.15)	(56.15)	(28.52)	(15.12)	(15.89)	(29.77)	(6.277)	(101.1)
Const.	-378.8***	-176.0***	-84.74***	-34.41***	11.59	0.377	-38.18***	-21.24***	-6.795***	-51.69***	-12.26***	-0.0925	34.62**
	(25.89)	(15.37)	(8.576)	(7.387)	(9.185)	(1.801)	(5.713)	(3.843)	(2.534)	(2.468)	(3.240)	(1.199)	(16.07)
Controls[b]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070	9070
$M^{Rural} = M^{Sec.\ Towns}$	1.680	0.171	7.019***	0.785	1.626	3.352*	0.434	0.218	0.381	0.315	3.620*	6.683***	6.063**
$M^{Rural} = M^{Cities}$	0.456	7.695***	5.485**	7.611***	0.036	8.676***	0.002	0.620	0.426	1.335	8.291***	8.549***	8.122***
$M^{Sec.\ Towns} = M^{Cities}$	2.098	2.920*	0.151	4.784**	0.504	0.439	0.135	0.049	0.953	1.440	1.116	0.379	0.264

[a] Based upon food consumption in kcal. per capita per day.
[b] We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.
Standard errors in parentheses.
P< 0.10, ** $p < 0.05$, *** $p < 0.01$

Table 8. Regression of changes in food consumption[a] incl. pathways (2008/09-2012/13)

	Δtotal (at home)	Δmaize	Δcassava	Δother starchy foods	Δrice	Δbread, pasta, cereal products	Δpulses, nuts, seeds	Δmeat, fish, dairy	ΔFruits, veg.	ΔOils, fats	ΔSugar, sweets, pastries[b]	ΔSodas, tea, coffee[b]	ΔMeals, snacks cons. outs.
Baseline cons.	*2320.88*	*940.52*	*283.81*	*190.85*	*227.43*	*16.58*	*273.46*	*134.14*	*64.84*	*87.55*	*96.29*	*4.83*	*55.26*
M^{Rural}	-24.97	-14.40	-3.568	10.78	16.40	10.66	-31.70*	-13.12	-6.589	-0.956	-18.50*	-0.106	1.995
	(67.55)	(51.97)	(32.41)	(17.07)	(28.89)	(6.635)	(18.23)	(11.94)	(6.853)	(7.068)	(10.46)	(1.769)	(30.70)
M^{Urban}	-325.4**	-139.9	21.41	-50.25	19.21	55.75***	0.847	-6.437	-9.419	-20.57	17.59	17.15***	67.04
	(137.4)	(87.37)	(40.41)	(32.05)	(48.23)	(17.70)	(35.01)	(20.55)	(10.32)	(17.02)	(20.42)	(5.934)	(63.24)
ΔFarm	-350.1***	-166.9***	-62.81**	-18.88	66.72**	3.732	-108.9***	-13.63	-29.44***	-15.93	25.23**	2.834	88.55**
	(75.81)	(50.96)	(24.52)	(19.11)	(27.20)	(9.079)	(20.85)	(13.93)	(7.196)	(9.727)	(12.06)	(2.046)	(37.71)
ΔLn(Cons. pc)	764.6***	196.2***	-3.038	47.58***	165.8***	22.27***	111.5***	109.9***	42.37***	22.26***	57.39***	7.722***	222.2***
	(61.32)	(32.08)	(19.76)	(12.24)	(20.58)	(4.687)	(13.24)	(9.927)	(5.819)	(5.278)	(6.522)	(1.388)	(26.95)
PI_{Total}	-466.4***	-32.41	-260.9***	8.625	12.49	7.388	-34.10	29.32	-9.950	23.77	9.414	-0.308	
	(128.8)	(103.7)	(93.63)	(33.50)	(53.22)	(12.43)	(33.20)	(24.40)	(15.39)	(18.83)	(16.88)	(4.641)	
PI_j		-256.8	-816.9***	-639.6***	-559.9***	-343.1**	-94.22	-42.54***	-50.62	-9.668**	10.10	0.317	
		(291.3)	(201.5)	(193.6)	(154.0)	(170.2)	(58.64)	(14.61)	(34.37)	(4.745)	(29.42)	(1.749)	
Const.	1622.9***	1089.3**	1700.6***	260.2*	541.6*	64.92	495.5***	78.96	142.7*	111.1**	5.297	3.035	-55.87***
	(611.4)	(474.5)	(449.2)	(135.0)	(283.2)	(74.52)	(173.4)	(102.0)	(86.55)	(54.53)	(79.70)	(26.61)	(16.89)
Controls[c]	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	8995	8995	8995	8995	8995	8995	8995	8995	8995	8995	8995	8995	8995
$M^{Rural} = M^{Urban}$	4.320**	1.536	0.234	3.142*	0.003	5.788**	0.675	0.0738	0.055	1.096	2.854*	8.210***	0.974

[a] Based upon food consumption in kcal. per capita per day.
[b] Whereas the dependent variable includes both home and outside consumption, the price index is based upon the former. Restricting our analysis to at home consumption does not alter out findings.
[d] Since the data do not contain price information for meals and snacks consumed outside the home, no price index could be included for this food category.
[d] We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The results in Table 7 show that coefficient for relocation to large cities is consistently larger in all but one of the regressions. Also, the coefficient for migration to secondary towns is not significantly different from zero for maize, other starchy foods, sugar sweets and pastries.

Table B3 in appendix shows the results of the regression for diet diversity when splitting up urban migration into migration to secondary towns or cities. The number of food items consumed is significantly larger for migration to cities only. However, as before, other dietary diversity indices are not found to be significantly affected by rural-urban migration.

6.4 Pathways

Finally, we attempt to capture some of the pathways that could explain the impact of urbanization on food consumption patterns. Understanding the underlying mechanisms will help to develop policies that appropriately respond to the dietary changes associated with urbanization. More specifically, we will assess the influence of changes in income and prices, and moving out of agriculture. Income is proxied by the difference in the logarithm of per capita total household expenditures between the two LSMS-ISA waves, i.e. before and after migration took place. To control for prices, we constructed a price index (see Table A3 in appendix for details on the independent variables used). This allows us to assess to what extent changes in food consumption patterns after migrating are driven by differences in prices. Moving out of agriculture is captured by including a dummy variable for transitioning from a household headed by a farmer[7] to a non-farming household. The results in Table 8 show that higher prices and leaving agriculture reduce total calorie intake, while rising incomes increase it. Once controlling for these factors, the urban residence effect on total calorie consumption becomes significantly negative.

The decline in traditional staple food consumption is partly explained by moving out of agriculture. This is in line with the fact that maize and cassava are mostly consumed from home production in rural areas. And also the intake of fruits and vegetables reduces as one moves out of farming. In addition, a substantial part of the shift away from cassava is also related to prices. The price of cassava in urban areas is considerably larger than the price in rural areas. For other starchy foods the pattern is similar.

Table 8 shows that income growth largely explains the increased consumption of bread, pasta and other cereal products, high sugar-foods and consumption of meals and snacks outside of the home after migrating to urbanized areas. The coefficients for urban migration reduce dramatically in terms of magnitude and significance after controlling for the difference in income. For the categories of sugar, sweets and pastries and meals and snacks consumed outside the home, the migration dummy even becomes insignificant after controlling for the difference in income.

Moving out of agriculture also contributes to explaining the increase in consumption of more conveniently consumed goods such as bread and meals away from home, which is in line with the increased opportunity cost of times and commuting distances in urban areas.

Only for bread, pasta and other cereal products and for the category of sodas, tea and coffee, the urbanization dummy remains significant after including these pathways. It is possible that consumption of these goods is typically related to the urban lifestyle and supply environment, with supermarkets and the closeness of local food processing.

Regarding the role of the different pathways in explaining differences in diet diversity, the results in Table B4 in Appendix B show that income has a positive effect on diet diversity. After controlling for income, the urban migration dummy loses significance.

[7] Each respondent was asked to report what activity they depended on most for income.

6.5 Additional analyses

Robustness tests and more advanced regressions have been performed including the alternative measures of urbanization (using population density instead of the administrative categories of rural and urban areas), the time since migration (to test whether changes in consumption patterns are immediate or whether they adapt slowly), the impact of attrition on results (using attrition-weighted regressions), and the role of income, prices and moving out of farming in the impact of urbanization on dietary change. For the results of these additional regressions we refer to Cockx, Colen and De Weerdt (2018).

7 Conclusions, lessons and challenges

Achieving food and nutrition security remains a huge challenge for Africa. While much of the attention has gone to the supply-side and on ways to increase agriculture and food production, demand side developments are equally important. Rising incomes, urbanization, education and nutrition knowledge, different lifestyles and occupations, female labour participation, supermarkets and the global trade of food products are all mentioned to be important drivers shaping food consumption, and thus food and nutrition security.

The potential role of urbanization in shaping food demand in Sub-Saharan Africa has been highlighted by many. Africa is the fastest urbanizing continent in the world, with an urban population expected to triple by 2050. This fast urbanization is increasingly recognized as a major determinant of changes in eating patterns in the developing world. Yet, our understanding of its impact on diets and the underlying mechanisms through which they take place remains limited. Since urban and rural populations differ in many more respects than only the environment they reside in, it is not clear how much of the observed differences in their diets are related to the urban location in itself and to what extent they merely reflect other socioeconomic disparities between urban and rural residents.

Using data from the Tanzania National Panel Survey for 2008/09 - 2012/13 that traced individuals who migrated to different locations, this report provides empirical evidence on the impact of moving to an urban area on the consumption of different food groups, their share in total food consumption, and diet diversity. Not only is this focus on rural-urban migrants novel in the literature, it also enables us to more accurately capture the effect of urbanization on food consumption as we are able to observe the same individual in a rural and urban setting. In addition, the panel nature of the data allows us to further improve the identification strategy by controlling for initial household fixed effects.

Overall, the results confirm that urbanization is associated with important shifts in dietary patterns. Individuals who relocated to urbanized areas experience a significantly larger increase in the consumption of processed, high-sugar and ready-to-eat foods. The analysis further indicates a general shift away from traditional staples such as maize, cassava and cooking bananas, which is much more pronounced for those who moved to urban areas. However, contrary to previous findings (e.g. De Nigris, 1997; Smith et al., 2006) we find very limited evidence of a positive effect on diet diversity, nor do the results show that urbanization is associated with increased consumption of animal-source foods.

Our analysis goes further in exploring the underlying mechanisms driving these changes in food consumption patterns. In addition to the new urban environment with different food supply and relative prices in which migrants arrive, we find that a large part of the observed shifts in dietary patterns associated with urbanization are driven by the transition to off-farm employment and the income growth that come along with it. In particular, the increased intake of more conveniently prepared and consumed foods such as bread, rice and prepared meals as well as sugary food products that is linked to rural-urban migration, appears to be largely attributable to increases in income that come along with migration. Moving out of farming then again seems to account for a sizeable part of the shift away from starches, such as cassava and cooking bananas, and also seems to reduce the consumption of fruits and vegetables, all of which are mostly consumed from home production in rural areas. It is important to note however, that even after controlling for income, the coefficients for rural-urban migration remain highly significant for several food categories. For example, the increased consumption of processed cereal products and beverages cannot be explained by income, prices or moving out of farming only. This suggests there must be an additional 'urban' impact.

Hence, our results show that income plays a crucial role in explaining the impact of urbanization on dietary changes. Therefore, similar changes in dietary patterns can be expected when incomes start rising in less urbanized areas as well. However, the claim

made by Stage et al. (2010) that the difference between urban and rural households' patterns of food consumption is caused by income only seems to be too strong. Other aspects, such as the differences in food prices, losing the link to own-produced food, the different lifestyle and supply environment in cities also play a non-negligible role.

Lessons and challenges

For food and nutrition security to be met in both rural and urban areas, a focus on the supply side alone will not be sufficient. While increasing agricultural production and food availability is crucial, the evolutions taking place on the demand side cannot be ignored. In Africa, just as in the rest of the world, structural changes are taking place in the demand for food, and urbanization is identified as one of the key drivers behind this transformation of diets. Agricultural and nutritional policies will need to take this into account when addressing nutrition and public health, but also when developing agricultural policies that need to support the provision of sufficient and healthy foods. We summarize a number of general trends and lessons for policy makers:

1. Nutrition and public health policies have been largely directed towards undernutrition, mostly in rural areas. While this focus is justifiable today, public health authorities need to take into account that – at current rates of income growth and urbanization growth – concerns regarding overnutrition and obesity will pose new challenges for public health in the near future and policies should anticipate upcoming changes.

2. Urban life is associated with the increased consumption of processed foods and meals consumed outside the home. Yet, these foods tend to be high in fat, sugar and salt, and street foods may be inferior in terms of quality and safety. It is not clear in how far people are well-informed on these nutritional implications when opting for more convenient dietary choices. Policies to inform consumers on the nutritional value of their diets, and the long term health consequences may help adjust consumption behaviour.

4. Targeting of nutrition policies needs to be done carefully. Many nutritional programs are targeting women because it is believed that improved nutrition knowledge of mothers may affect the diets of the entire household and especially of children. While this focus is well-justified when concerned about child malnutrition, the increase in consumption of less healthy meals outside the house is particularly strong among male, urban residents. Specific targeting may be needed to reach this group of consumers.

5. Dietary changes will not be limited to urban areas. Our results show that the lower intake of traditional staples and the increased demand for high-sugar foods, and processed, ready-to-eat foods is largely explained by the higher incomes in urban areas. This means that we may expect similar changes to take place in rural areas, once incomes start growing faster in those areas as well. Nutrition and health policies may anticipate these changes by extending their focus to less urbanized areas where incomes are growing and diets start changing as well.

6. The consumption of fresh perishable foods, including staple foods such as cassava and cooking bananas, but also fruits and vegetables, tends to reduce when people move to the city. In rural areas these products are often self-produced, while in urban environments they need to be bought, and they are typically more expensive in urban than rural areas. Policies to facilitate the availability, distribution and (cold) storage of fresh produce to the cities could lead to an increase in consumption of fresh products in urban areas. This would provide opportunities for rural producers, while at the same time improving nutrition and dietary diversity of urban dwellers.

7. The consumption of processed foods like bread and pasta, or soft drinks is found to be typically linked to the urban environment, with its different lifestyle and the closeness of supermarkets and imported goods. Many of these processed foods are currently imported. While the nutritional concerns over this dietary shift need to be taken into account, this growing demand also creates opportunities for domestic agriculture and food industries. Most food processing facilities are currently located around capital cities,

but consumption of these goods is expected to increase in secondary towns as well, where linkages to local farmers may be more easily established and where competition with imported processed foods may be less severe. Policies supporting investment in agro-businesses may help the development of a (healthy) food processing industry.

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Annex A : Food categories and variables

Table A1. Food categories

Food category	Food items
Maize	Maize (green, cob) Maize (grain) Maize (flour)
Cassava	Cassava fresh Cassava dry/flour
Other starchy foods	Millet and sorghum (grain) Millet and sorghum (flour) Wheat, barley grain and other cereals Sweet potatoes Cooking bananas, plantains Yams/cocoyams Irish potatoes Other roots and tubers
Rice	Rice (paddy) Rice (husked)
Bread, pasta, cereal products	Bread Macaroni, spaghetti Other cereal products
Pulses, nuts and seeds	Peas, beans, lentils and other pulses Groundnuts in shell/shelled Coconuts (mature/immature) Cashew, almonds and other nuts Seeds and products from nuts/seeds (excl. cooking oil)
Meat, fish and dairy	Goat meat Beef including minced sausage Pork including sausages and bacon Chicken and other poultry Wild birds and insects Other domestic/wild meat products Eggs Fresh fish and seafood (including dagaa) Dried/salted/canned fish and seafood (incl. dagaa) Fresh milk Milk products (like cream, cheese, yoghurt etc.) Canned milk/milk powder
Fruits and vegetables	Ripe bananas Citrus fruits (oranges, lemon, tangerines, etc.) Mangoes, avocadoes and other fruits Sugarcane Onions, tomatoes, carrots and green pepper, other viungo Spinach, cabbage and other green vegetables Canned, dried and wild vegetables
Oils and fats	Cooking oil Butter, margarine, ghee and other fat products
Sugar and sweets	Sugar Sweets Honey, syrups, jams, marmalade, jellies, canned fruits Maandazi (donuts), cakes, biscuits Sweets, ice-cream (consumed outside home)
Sodas, tea and coffee	Tea dry Coffee and cocoa Bottled/canned soft drinks (soda, juice, water) Prepared tea, coffee Sodas and other non-alcoholic drinks (consumed outside home)
Meals and snacks consumed outside home	Full meals (breakfast, lunch or dinner) Barbecued meat, chips, roast bananas and other snacks prepared on charcoal Tea, coffee, samosa, cake and other hoteli snacks

Table A2. Food groups (used to determine diet diversity)

Food group	Food items
Cereals	Rice (paddy) Rice (husked) Maize (green, cob) Maize (grain) Maize (flour) Bread Macaroni, spaghetti Other cereal products Millet and sorghum (grain) Millet and sorghum (flour) Wheat, barley grain and other cereals
Roots and tubers	Cassava fresh Cassava dry/flour Sweet potatoes Cooking bananas, plantains Yams/cocoyams Irish potatoes Other roots and tubers
Sugar and sweets	Sugar Sweets Honey, syrups, jams, marmalade, jellies, canned fruits Maandazi (donuts), cakes, biscuits Sweets, ice-cream (consumed outside home)
Pulses	Peas, beans, lentils and other pulses
Nuts and seeds	Groundnuts (in shell/shelled) Coconuts (mature/immature) Cashew, almonds and other nuts Seeds and products from nuts/seeds (excl. cooking oil)
Fruits	Ripe bananas Citrus fruits (oranges, lemon, tangerines, etc.) Mangoes, avocadoes and other fruits Sugarcane
Vegetables	Onions, tomatoes, carrots and green pepper, other viungo Spinach, cabbage and other green vegetables Canned, dried and wild vegetables
Meat, fish and eggs	Goat meat Beef including minced sausage Pork including sausages and bacon Chicken and other poultry Wild birds and insects Other domestic/wild meat products Eggs Fresh fish and seafood Dried/salted/canned fish and seafood
Milk	Fresh milk Milk products (like cream, cheese, yoghurt etc.) Canned milk/milk powder
Oils and fats	Cooking oil Butter, margarine, ghee and other fat products
Sodas, tea and coffee	Tea dry Coffee and cocoa Bottled/canned soft drinks (soda, juice, water) Prepared tea, coffee Sodas and other non-alcoholic drinks (consumed outside home)
Meals and snacks consumed outside home	Full meals (breakfast, lunch or dinner) Barbecued meat, chips, roast bananas and other snacks prepared on charcoal Tea, coffee, samosa, cake and other hoteli snacks

Table A3. Independent variables

M^{Rural}	Migration to different rural area Dummy variable equal to one when in 2012/13 individual was found to reside in a household in a different and distant (>1hour drive) rural (as defined by the 2002 Census classification) area than during the 2008/09 round.
M^{Urban}	Migration to urban area Dummy variable equal to one when in 2012/13 individual was found to reside in a distant (> 1hour drive) urban (as defined by the 2002 Census classification) household.
$M^{Sec.\ Towns}$	Migration to secondary town Dummy variable equal to one when in 2012/13 individual was found to reside in a distant (> 1hour drive) urban (as defined by the 2002 Census classification) household outside of Dar es Salaam or the Ilemela or Nyamanga districts in Mwanza.
M^{Cities}	Migration to city Dummy variable equal to one when in 2012/13 individual was found to reside in a distant (> 1hour drive) urban (as defined by the 2002 Census classification) household in Dar es Salaam or the Ilemela or Nyamanga districts in Mwanza.
Controls	- Age Self-reported age expressed in years - Sex 1 = male, 2 = female - Education Years of schooling derived from information on "highest grade obtained". - Relation to the household head Dummy variables for household head/spouse and child of household head. - Marital status 0= unmarried, 12 = married. Marital status was not reported for respondents below the age of 12 and therefore assumed to be zero.
ΔFarm	Transition out of farming Dummy variable that equals one when an individual who was part of a household headed by a farmer in 2008/09, resided in a non-farming household by 2012/13, be it because of the individual's relocation or because the household head switched to off-farm employment over time.
ΔLn(Cons. pc)	Income growth The difference in the logarithm of real – adjusted for – total household consumption per capita over time.
PI_{Total} PI_j	Price index For each food category *j* composed of a group of food items *f* (PI_j), as well as for the all food categories jointly (PI_{Total}), an individual-specific a Laspeyres-type price index PI_j is constructed: $PI_j = \frac{\Sigma_f(p_{f,2012/13} \cdot q_{f,2008/09})}{\Sigma_f(p_{f,2008/09} \cdot q_{f,2008/09})}$ where $q_{f,2008/09}$ is the amount of kcal consumed from food item *f* by the individual's household in 2008/09, $p_{f,2008/09}$ and $p_{f,2012/13}$ are the median prices of food item *f* in the location where the individual was residing during the baseline and endline interviews respectively. This price index weighs the price of (one kcal of) each food item in food category *j* by its contribution in 2008 to the total expenses of food category *j* in 2008/09. For migrants, this price index thus measures whether the migrant needs to pay more or less to keep the same consumption basket he or she had before migration, compared to the case in which he or she would not have migrated. For each food item, price information is derived from the reported value and amount purchased by each household. The median price is derived across all enumeration areas that are classified as rural/secondary town/city within the same region. In the case of less than 10 price observations for a food item, the median is taken at a higher level (regional, urban classification, or across the whole sample). For meals consumed outside, no price information is available. As such, no price index could be constructed, nor is this category included in the price index for total food.

Annex B: Additional regression results

Table B1: Results regressions of changes in food consumption for women (2008/09-2012/13)

	ΔTotal	ΔMaize	ΔCassava	ΔOther starchy foods	ΔRice	ΔBread, pasta, cereal products	ΔPulses, nuts, seeds	ΔMeat, fish, dairy	ΔFruits, veg.	ΔOils, fats	ΔSugar, Sweets, pastries	ΔSodas, tea, coffee	ΔMeals, snacks cons. outs.
Baseline	*2347.43*	*935.53*	*294.88*	*192.43*	*222.60*	*17.06*	*273.80*	*131.17*	*64.41*	*87.27*	*96.29*	*3.42*	*28.58*
M^{Rural}	-53.80	-67.82	17.51	22.60	46.12	10.47	-54.08*	-22.17	-2.105	-7.481	-3.477	0.813	5.820
	(112.1)	(70.53)	(50.25)	(20.16)	(43.31)	(9.581)	(28.99)	(14.50)	(10.73)	(9.935)	(13.09)	(2.260)	(45.99)
M^{Urban}	-10.67	-100.7	-139.7***	-121.3*	158.1**	75.96***	-24.49	36.63	-4.119	11.49	74.08***	2.245	21.19
	(206.7)	(109.1)	(53.71)	(70.04)	(69.71)	(21.15)	(47.95)	(23.25)	(14.46)	(21.77)	(25.36)	(6.269)	(53.56)
Const.	-365.2***	-189.4***	-90.77***	-26.91***	13.62	1.011	-26.49***	-16.20***	-7.193***	-53.63***	-5.361	-0.962	37.08**
	(33.90)	(19.40)	(12.89)	(9.480)	(13.76)	(2.403)	(8.002)	(3.990)	(2.620)	(2.827)	(4.163)	(0.918)	(15.70)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	4711	4711	4711	4711	4711	4711	4711	4711	4711	4711	4711	4711	4711
F-stat. Ha: $M^{Urban} \neq M^{Rural}$	0.036	0.071	4.936**	4.241**	1.755	8.636***	0.268	4.963**	0.015	0.692	8.390***	0.040	0.045

Notes: Food consumption is expressed in kcal per capita per day.
We control for individual baseline characteristics; age, relation to the household head, education and marital status.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B2. Results regressions of changes in food consumption for men (2008/09-2012/13)

	ΔTotal	ΔMaize	ΔCassava	ΔOther starchy foods	ΔRice	ΔBread, pasta, cereal products	ΔPulses, nuts, seeds	ΔMeat, fish, dairy	ΔFruits, veg.	ΔOils, fats	ΔSugar, sweets, pastries	ΔSodas, tea, coffee	ΔMeals, snacks cons. outs.
Baseline	*2409.99*	*945.77*	*271.55*	*188.02*	*243.32*	*16.10*	*273.53*	*137.79*	*65.50*	*87.89*	*98.25*	*6.38*	*84.87*
M^{Rural}	88.30	142.7	-5.527	-0.139	14.19	11.07	-16.52	-12.47	-14.19	-1.075	-7.213	7.557	-30.12
	(167.8)	(96.26)	(48.91)	(34.48)	(49.02)	(11.13)	(35.24)	(27.62)	(10.96)	(11.50)	(25.29)	(6.455)	(94.72)
M^{Urban}	165.1	-308.1**	-92.63***	-62.63**	-11.53	59.61*	-30.88	19.09	-10.13	-33.68	22.77	50.45***	562.7***
	(180.3)	(133.1)	(32.25)	(27.45)	(88.16)	(32.06)	(43.42)	(36.51)	(15.37)	(28.03)	(35.32)	(11.88)	(147.6)
Const.	-370.3***	-198.9***	-80.58***	-34.91***	24.70**	2.846	-34.73***	-18.49***	-0.246	-46.95***	-5.889	-2.107	24.96
	(37.72)	(21.83)	(9.879)	(7.249)	(10.63)	(2.938)	(6.473)	(5.438)	(4.007)	(3.254)	(4.676)	(2.013)	(23.98)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	4359	4359	4359	4359	4359	4359	4359	4359	4359	4359	4359	4359	4359
F-stat. Ha: $M^{Urban} \neq M^{Rural}$	0.100	7.709***	2.342	2.078	0.067	2.035	0.069	0.490	0.047	1.077	0.464	10.44***	11.84***

Notes: Food consumption is expressed in kcal per capita per day.
We control for individual baseline characteristics; age, relation to the household head, education and marital status.
Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B3. Results regressions of changes in diet diversity on migration to different rural areas, secondary towns or cities (2008/09-2012/13)

	ΔCount (items)	ΔBI (items)	ΔCount (groups)	ΔBI (groups)
Baseline	*11.52*	*0.649*	*7.52*	*0.532*
M^{Rural}	-0.408	0.012	-0.031	-0.002
	(0.353)	(0.016)	(0.180)	(0.016)
$M^{Sec.\ Towns.}$	0.634	0.033	-0.202	-0.023
	(0.909)	(0.031)	(0.392)	(0.030)
M^{Cities}	1.973**	0.042	0.230	0.007
	(0.932)	(0.036)	(0.456)	(0.036)
Const.	-0.251**	-0.039***	0.002	-0.031***
	(0.111)	(0.005)	(0.056)	(0.005)
Controls	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓
N	9070	9070	9070	9070
F-stat. Ha: $M^{Sec.\ Towns} \neq M^{Rural}$	1.182	0.373	0.162	0.407
F-stat. Ha: $M^{Cities} \neq M^{Rural}$	5.739**	0.573	0.301	0.058
F-stat. Ha: $M^{Sec.\ Towns} \neq M^{Cities}$	1.077	0.031	0.523	0.434

Notes: Based upon food consumption in kcal per capita per day.
We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.

Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B4. Results regressions of changes in diet diversity incl. pathways (2008/09-2012/13)

	ΔCount (items)	ΔBI (items)	ΔCount (groups)	ΔBI (groups)
Baseline	*11.52*	*0.570*	*7.52*	*0.532*
M^{Rural}	-0.539	0.009	-0.042	-0.004
	(0.338)	(0.015)	(0.171)	(0.016)
M^{Urban}	0.324	0.021	-0.110	-0.0110
	(0.678)	(0.025)	(0.301)	(0.0237)
ΔFarm	0.625*	-0.025	-0.040	-0.035**
	(0.379)	(0.016)	(0.184)	(0.016)
ΔLn(Cons. pc)	1.730***	0.061***	0.547***	0.051***
	(0.287)	(0.013)	(0.137)	(0.012)
Const.	-0.803***	-0.051***	-0.133*	-0.039***
	(0.142)	(0.007)	(0.068)	(0.006)
Controls	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓
N	8995	8995	8995	8995
F-stat. Ha: $M^{Urban} \neq M^{Rural}$	1.409	0.175	0.043	0.063

Notes: Based upon food consumption in kcal per capita per day.
We control for individual baseline characteristics; age, sex, relation to the household head, education and marital status.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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