From Corn to Popcorn ?

Urbanization and food consumption in Sub-Sahara Africa: Evidence from rural-urban migrants in Tanzania

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Abstract

Sub-Saharan Africa is currently in the midst of an unprecedented wave of urbanization that is expected to have wide-ranging implications for food and nutrition security. Though this spatial transformation of the population is increasingly put forward as one of the main drivers of changes in food consumption patterns, empirical evidence remains scarce and the comparative descriptive design of existing research is prone to selection bias as urban residence is far from random. Based upon unique longitudinal data from the Tanzania National Panel Survey, this study will be the first to assess the impact of urbanization on food consumption through comparing individuals' food consumption patterns before and after they have migrated from rural to urban areas. We find that even after controlling for individual fixed heterogeneity, baseline observable characteristics and initial household fixed effects, urbanization is significantly associated with important changes in dietary patterns, including a shift away from traditional staples towards more high-sugar, processed and ready-to-eat foods. These findings combined with the fact that we find no support for the hypothesis that urbanization is associated with more diverse diets, again raise concerns about the nutritional quality of diets in an urbanizing world and call for focused policy action in urban areas.

Introduction

Sub-Saharan Africa is currently in the midst of an unprecedented urbanization wave. The region is rapidly shifting from a population dispersed across small rural settlements dominated by agriculture towards one that is concentrated in larger, dense urban settlements characterised by industrial and service activities. Though at present still the least urbanized region in the world, at more than 4 % per year Sub-Sahara Africa is experiencing the strongest urban population growth such that 55 % of its inhabitants are projected to be living in urban areas by 2050 (UN, 2015).

This spatial transformation is widely believed to be one of the driving forces behind the "nutrition transition", giving rise to and accelerating profound shifts in diets, physical activity and the prevalence of the double burden of malnutrition. More specifically, it is hypothesized that though many urban population are still faced with food insecurity, subpopulations suffer from dietary excess and obesity as a consequence of the transition towards diets high in sugar, fats and refined foods, but low in fibre (e.g. Popkin, 1999; 2001; Popkin and Gordon-Larsen, 2004).

Though a substantial literature discusses the impact of urbanization on food consumption, sound empirical evidence remains scarce. To date, the majority of existing research is based on comparative descriptive analysis. This approach has serious limitations, as urban residence is unlikely to be the sole difference between urban and rural population groups. As such, it remains unclear whether the identified differences in food consumption patterns can be attributed to a unique urban residence effect, or whether they merely reflect other socioeconomic disparities between urban and rural residents. In addition, little is understood about the pathways through which urbanization affects food consumption. While some authors put forward potential reasons as to why rural and urban food consumption may differ, the validity of these claims has not been tested.

This paper aims to improve our understanding of the impact of this rural-urban transition from a micro-level perspective. More specifically, we seek to address the issue of selection bias by going beyond simple comparisons of rural and urban residents and elaborating an innovative identification strategy focussing on rural-urban migrants. Based upon unique longitudinal survey data from Tanzania, this study will be the first to investigate the impact of urbanization on food consumption through the comparison of individuals' dietary patterns before and after they relocate from rural to urban areas. This specification allows us to control for individual fixed heterogeneity and initial household fixed effects. In addition, we will be the first to empirically assess the role of several pathways in explaining the changes in food consumption associated with urbanization.

The remainder of this paper is organized as follows. The first section briefly reviews the available empirical evidence on the effect of urbanization on food consumption. Next, we discuss the food environment in Tanzania and the country's relevance as a case study for this particular topic. The methodology will be set out in Section 3. Finally, the data and results are discussed in Section 4 and Section 5 concludes.

1. Urbanization and food consumption: Revisiting the literature

Urbanization interacts with several key determinants of food consumption. The shift away from agriculture for example implies that more people are employed in sectors with lower energy requirements (Popkin 1998; 1999; 2001). Another common assumption is that urbanization raises opportunity costs of time through improved (female) labour market opportunities, thus inducing greater preference for foods with shorter preparation time (Huang and Bouis, 2001; Regmi and Dyck, 2001). Others have pointed to the associated income growth (Stage et al., 2010; Regmi and Dyck, 2001). Urban areas are also characterized by markedly different food environments, which influences the availability and affordability of food. For instance, the ongoing expansion of supermarket and fast food chains in the developing world is still mainly concentrated in urban areas (Hawkes et al., 2009). Another line of thought focuses on the socio-cultural food environment and changes in preferences and habits that arise as a consequence of exposure to more global eating patterns in urban areas (Huang and Bouis, 2001; Regmi and Dyck, 2001) or of improved access to formal or informal nutrition knowledge.

A substantial literature attempts to estimate the impact on food consumption. Cross-country studies demonstrate that higher urbanization rates are associated with increasing consumption of animal source foods (Rae, 1998, Delgado, 2003) and sweeteners and fats (Drenowski and Popkin, 1997; Popkin, 1999; Popkin and Nielsen, 2003). Time series analysis then again shows that urbanization significantly affected cereal consumption patterns in Burkina Faso, Mali (Delgado, 1989) and Asia (Huang and David, 1993).

As mentioned above, the majority of existing research is based on comparative descriptive analysis. Studies comparing rural and urban diets in Asia point to elevated levels of meat consumption (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), lower grain or rice consumption (Huang and Bouis, 1996; 2001; Popkin and Du, 2003; Zhai et al., 2009) and increased likelihood of eating meals away from home (Zheng and Henneberry, 2009) in urban areas. Other differences include that urban diets are more diverse (Popkin and Du, 2003) and contain more fats and refined carbohydrates (Shetty, 2002; Popkin and Du, 2003; Mendez and Popkin, 2004). The latter is confirmed for Latin American (Arimond and Ruel, 2004; Willaarts et al., 2013)and Sub-Saharan African countries (De Nigris, 1997; Bourne et al., 2002; Abdulai and Aubert, 2004;Smith et al., 2006), where urban diets tend to be less dominated by traditional staples (De Nigris, 1997; Maxwell et al., 2000; Hassen et al., 2016). Multiple studies also indicate increased consumption of processed cereal products including bread (Maxwell et al., 2000; Hassen et al., 2016) and growing reliance on street foods (Maxwell et al., 2000; Maruapula et al., 2011).

Several authors however, discuss the limitations of this approach. Popkin (1999) for example argues that these descriptive studies contribute little to our understanding of the causes for these differences. In particular, there is no clear sense if these can be attributed to a unique urban residence effect or just reflect differences in socioeconomic factors. In addition, we have no knowledge about the timing of these effects. Finally, Huang and Bouis (2001:62) conclude that "an ideal data set for measuring structural shifts in food demand patterns records 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 in Ecuador. During an interview, women were asked to report the frequency of consumption of different food items before and after migrating. The lack of actual panel data however, raises concerns about recall bias. To the best of our knowledge, this study will be the first to employ a panel data approach to assess changes in food consumption after migrating from rural to urban areas.

2. The setting: Tanzania

As one of the world's most rapidly growing and urbanizing countries, Tanzania – a low-income, low human development country in East Africa – provides an extremely relevant case study to investigate the impact or urbanization on food consumption. Average urban population growth over the past two decades amounted to 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). The former capital, Dar es Salaam (DSM) is even expected to hit the ten million mark by 2030 and become one of the 20 largest cities in the world by 2050 (UN, 2015).

Whereas urbanization is mostly the result of the natural increase of the urban population, Tanzania is also increasingly characterized by large internal migration movements. According to the most recent Census, over 1.5 million people moved to a different region between 2011 and 2012. Especially DSM appears to attract internal migration, with a staggering 52.8 % of its inhabitants in 2012 having moved there from different regions in the country (NBS, 2015).

Over the past two decades, the country has 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, DSM, progress was much less pronounced in other areas and large (urban-rural) disparities remain.

Despite considerable progress, 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 already 13.3 % of women estimated to be obese (WHO, 2015).

In addition, at an estimated 8.51 % per annum between 2002 and 2012, Tanzania has been faced with strong food price inflation, which has resulted in food prices increasing faster than non-food prices (Adam et al., 2012). More generally, the food environment in Tanzania is undergoing rapid changes. The "supermarket revolution" has arrived in the capital. DSM now hosts various supermarket chains. This transformation is still just taking root in secondary cities, most notably via the increase in small supermarkets (Ijumba et al., 2015). Processed and imported foods are also widely available in urban areas and their share in the budget is expected to increase dramatically in the future (Ijumba et al., 2015; Tschirley et al., 2015).

3. Data and identification strategy

3.1 Tanzania National Panel Survey

The Tanzania National Panel Survey (TNPS) conducted as part of the World Bank Living Standards Measurement Study-Integrated Surveys on Agriculture project, is a nationally representative panel survey. A sample of 3,265 households was first interviewed in 2008/09. The second round relocated 3,168 baseline households and had a total sample size of 3,924 households. Finally, the 2012/13 round covered 3,786 of these households, bringing up the total sample size to 5,015. Overall, the TNPS has thus maintained remarkably low attrition rates.

The survey includes a one-week diet recall questionnaire at household level reporting food consumption of 59 different items deriving from purchases, own production or other sources in grams, litres or pieces. In addition, each individual reported the monetary value of their consumption of food and beverages outside the home. In order to quantify food consumption all these units were converted to grams and kilocalories, based on the detailed local conversion factors (Deweerdt et al., 2014).

The final sample consists of a balanced panel of 13,849 individuals for which information on food consumption was plausible[2]. These individuals belonged to 1,869 rural and 1,022 urban households in the baseline. In 2012/13, after several household had split and some individuals had migrated, this corresponded to 4,223 households. As can be derived from Table 1, despite the relatively short time span, the TNPS captures considerable migration flows.

An important caveat in this type of research is that there is no consensus about how to define or measure the concepts of rurality and urbanicity (Waldorf, 2006). Our main analysis will be based upon the classification that accompanies the TNPS taken from the 2002 Population and Household Census, which applied the definition of the National Bureau of Statistics[3]. We however, accommodate concerns about the stale dichotomy between rural and urban development communities and the growing recognition that that the distinction between secondary cities and large cities is a central one for analysis and for policy (Christiaensen et al., 2013) by distinguishing DSM from other urban areas. The former capital clearly stands out in terms of population – 4.36 million, accounting for 10 % of the total Tanzania Mainland population according to the 2012 census – and is characterized by a markedly different food (retail) environment (cfr. supra).

Table 1: Migration matrix

		2012/2013			
		In same location	In different location		
			Rural	Secondary cities	DSM
2008/2009	Rural	8,395	729	151	93
	Secondary cities	2,482	139	256	35
	DSM	1,172	29	52	316

[2] In line with Deweerdt et al. (2014), we exclude individuals for which the recorded food consumption per adult equivalent per day was below 400 kcal. or above 6500 kcal.

[3] According to this definition all regional and district headquarters, regardless of their size or population density; all areas that lie outside the boundaries of these headquarters but possess urban characteristics; and all areas that are not adjacent to any other urban area but still possess urban characteristics are considered to be “urban”. Areas are classified as rural or urban by the Region Census Committees based on mostly qualitative criteria (Muzzini and Lindeboom, 2008).

3.2 Identification strategy

As mentioned above, the simple 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. Perhaps the most promising approach to study the impact of urbanization on food consumption is to compare individuals' dietary patterns before and after they migrated from rural to urban areas.

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 moved to other rural areas or urban areas. This specification controls for individual fixed heterogeneity, thus resolving a large number of possible sources of endogeneity, which are likely to affect both migration and food consumption.

It is important to note however, that in the absence of experimental data, heterogeneity affecting both food consumption and the process of migration remains a key concern. These data offer excellent opportunities to control for a wide set of factors in this respect. First, we can control for a set of individual characteristics that may affect food consumption and possibly migration. In addition, we can control for initial household fixed effects since we observe 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:

$$\Delta C_{i,t+1,t} = \alpha + \beta_1 M^{Rural}_{i,t+1} + \beta_2 M^{Sec.Cit.}_{i,t+1} + \beta_3 M^{DSM}_{i,t+1} + \gamma X_{i,t} + \delta_{i,h} + \epsilon_{i,t}$$

Where $C_{i,t+1,t}$ represents the change in food consumption for individual i between period t+1 and t. $M^{Rural}_{i,t+1}$, $M^{Sec.cit.}_{i,t+1}$ and $M^{DSM.}_{i,t+1}$ are dummy variables equal to one when individual i stayed in the baseline rural community, migrated to a different rural area, secondary city or DSM respectively by period t+1. The term $X_{i,t}$ represents a vector of individual level characteristics that that may affect both food consumption and the process of migration; age, sex, relation to the household head, education and marital status in the baseline period[4]. Finally, $\delta_{i,h}$ stands for the initial household fixed effects and $\epsilon_{i,t}$ represents the error term.

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 serve as a control group. Our main analysis is therefore based upon the comparison of individuals who relocated from rural areas with those who remained in their original rural communities, thus focussing on the 9,368 individuals[5] represented in the first row of Table 1. The impact of urbanization should be reflected in the coefficients of the dummies for migration to urban areas. In addition, we formally assess whether the urban destination rather than migration in general matters by testing whether the coefficients for relocation to secondary cities and DSM are significantly different from those for rural-rural migration.

[4] We attribute missing values to zero years of schooling and include 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 and again include a dummy variable for the original missing values.

[5] When focussing on meals and snacks consumed outside the home, which were reported in a separate section of the questionnaire that had a higher non-response rate, the sample size is reduced to 8,392.

4. Data and results

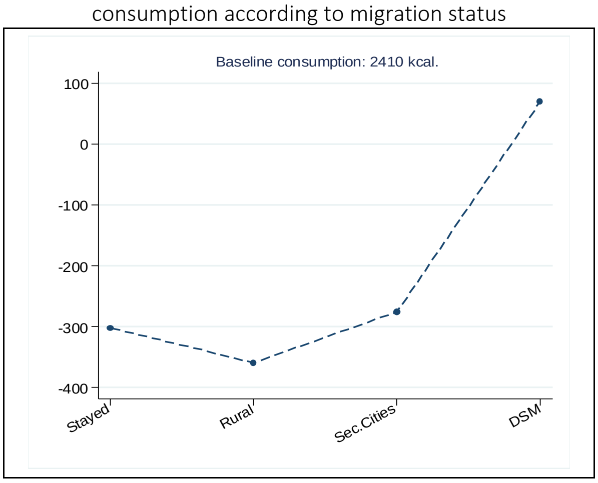
4.1 Food consumption

For this part of the analysis, we focus on the consumption of 12 food categories[6], of which 3 are further subdivided per product type, expressed in kilocalories per capita per day[7].

4.1.1 Descriptive analysis

Figure 1 depicts the mean change in total food intake between 2008/09 and 2012/13 across individuals who stayed in their original rural community and those who moved elsewhere. On average total food consumption has decreased. This could to some extent be explained by the sharply rising food prices during this 5-year period. Contrary to prior findings (e.g. Abdulai and Aubert, 2004; Hassen et al., 2016), these data seem to suggest that urbanization has a positive impact on total energy intake. The decline in total energy intake is smaller for migrants to secondary cities and those who moved to DSM even experienced a slight increase.

Figure 1: Mean change in total food consumption according to migration status



Food consumption is expressed in kcal. per capita per day.

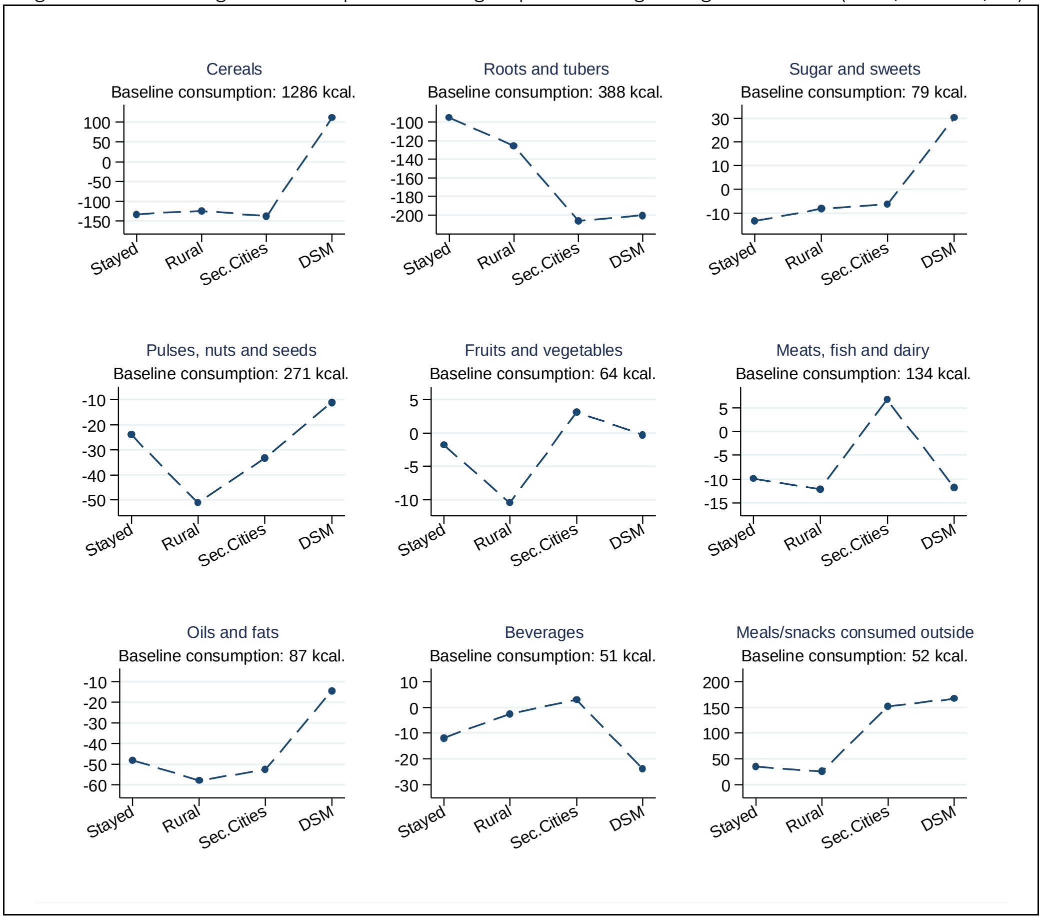
It line with the hypothesis that urbanization has a greater impact on the composition rather than the level of food consumption (Regmi and Dyck, 2001), we aim to further disentangle changes in dietary patterns associated with rural-urban migration by focusing on mean changes in the consumption of different food (sub) groups.

Figure 2, demonstrates that while increasing for those who moved to DSM, the consumption of cereals decreased over time for non-migrants and for migrants to other rural areas and secondary cities. Further disaggregation (see Figure 3) reveals large increases in the consumption of processed cereal products after moving to more urbanized areas. This is in line with findings from Ghana (Maxwell et al., 2000) and could be related to the hypothesis that higher opportunity costs of time will induce urban consumers to prefer food products with shorter preparation times. Similar to previous studies documenting that urban diets in Sub-Saharan Africa are less dominated by traditional staples (De Nigris, 1997; Maxwell et al., 2000), the descriptive statistics further suggest a shift away from cassava and maize in particular. Interestingly, the latter appears to be particularly pronounced for migrants to secondary cities.

[6] For the categorization of food items into groups, we largely followed the structure of the survey (see Appendix A). To limit the size of the tables, we further aggregated "fruits" with "vegetables"; "pulses" with "nuts and seeds" and "meat, fish and eggs" with "milk".

[7] Considering food consumption per adult equivalent rather than per capita does not alter our findings (see Appendix B, Tables B1-B3).

Figure 2: Mean change in consumption of food groups according to migration status (2008/09-2012/13)



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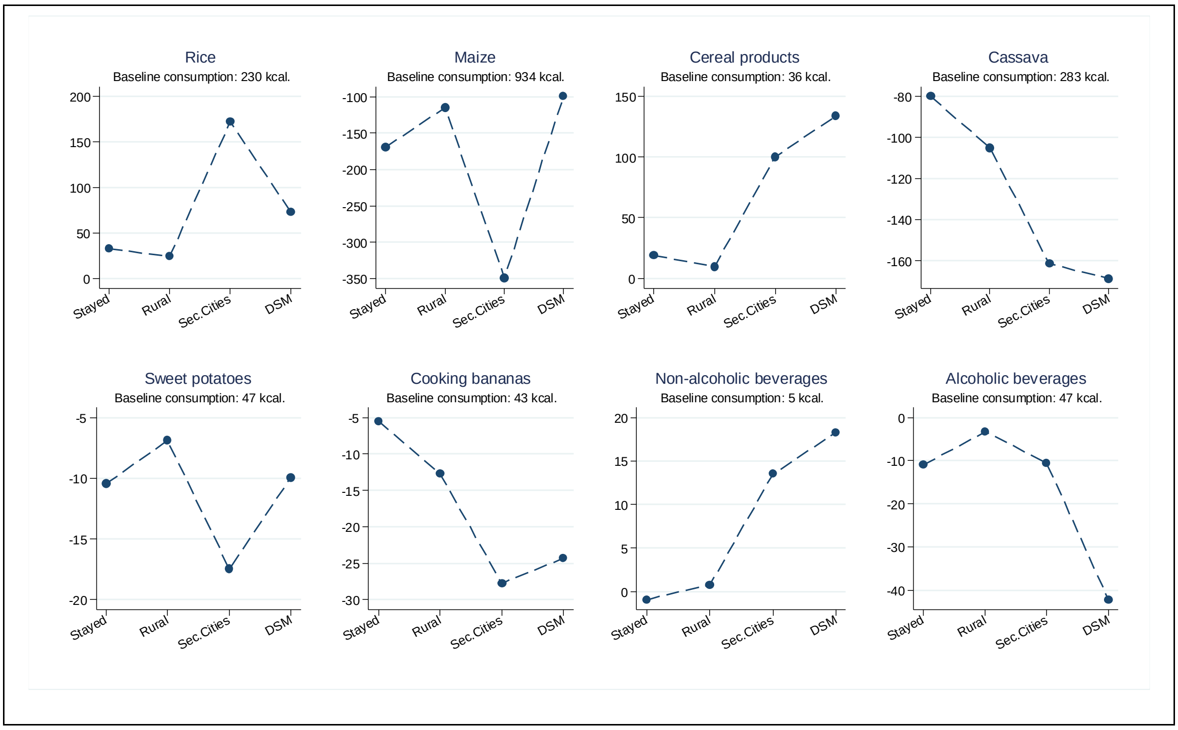
Another notable difference appears for meals and snacks consumed outside the home. Though there was a general rising trend over time, this increase appears to be much greater for people who moved to more urbanized areas and DSM in particular. On average, the latter consumed an additional 192 kcal. worth of meals and snacks outside the home, compared to a modest increase of 33 kcal. for individuals who remained in their original rural communities.

In keeping with earlier findings (McIntyre, 2002; Abdulai and Aubert, 2004) these data show support for concerns about the health implications of urban diets (Popkin, 1999; 2004; 2012). Compared to those who relocated to DSM, the decline in daily intake of oils and fats was over three times greater for individuals who remained in their baseline rural communities. Likewise, though declining for individuals that stayed, the consumption of sugar and sweets increased for those who moved to the former capital. In addition, there appears to be a much larger increase in the consumption of high-sugar processed cereal products such as buns, cakes and biscuits and sugary non-alcoholic beverages.

Figure 3: Mean change in consumption of food subgroups according to migration status (2008/09-2012/13)



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4.1.2 Regression analysis

Next, we regress the difference in the consumption of the different food (sub) groups between 2008/2009 and 2012/2013 on dummy variables for migration from the baseline rural communities to different rural areas, secondary cities and DSM respectively. As mentioned above, those who did not migrate and remained in their original rural area serve as a control group.

The results of the regressions summarized in Table 2 largely confirm the trends identified in the descriptive analysis. We find a much stronger shift away from roots and tubers and cassava in particular (see Table 3) and towards meals and snacks consumed outside the home for migrants to secondary cities and DSM in that order. The coefficients for both dummies are highly significant and the F-test results further indicate that the impact of rural-urban migration is different from rural-rural migration, suggesting that the urban destination matters.

Compared to those who remained in their original rural communities, on average individuals who migrated to DSM experienced an additional increase of the consumption of meals and snacks consumed outside the household of 297 kcal. whereas the change over time in their intake of roots and tubers was 249 kcal. lower.

Table 2: Change in the consumption of food groups (2008/09-2012/13)

	ΔTotal	ΔCereals	ΔRoots, tubers	ΔSugar, sweets	ΔPulses, nuts, seeds	ΔFruits, veg.	ΔMeat, fish, dairy	ΔOils, fats	ΔBev.	ΔMeals /snacks cons. outs.
Baseline cons.	*2410.24*	*1,285.87*	*388.41*	*78.59*	*271.14*	*63.78*	*134.15*	*87.03*	*51.14*	*51.74*
M^{Rural}	-3.377	3.474	4.377	11.22*	-8.218	-35.96**	-12.18	-5.376	22.97	-3.252
	(77.37)	(53.82)	(31.65)	(6.138)	(6.592)	(17.96)	(12.87)	(6.403)	(25.61)	(37.46)
$M^{Sec. Cit.}$	142.3	106.4	-167.2***	11.11	-13.61	-29.12	16.06	-8.147	4.787	229.8***
	(147.4)	(120.5)	(45.46)	(11.27)	(10.09)	(33.12)	(24.05)	(18.55)	(27.16)	(78.39)
M^{DSM}	-142.5	-301.5**	-250.1***	55.01***	10.44	-34.54	6.903	11.78	37.85	297.7***
	(196.2)	(145.5)	(60.22)	(18.57)	(14.60)	(56.35)	(29.03)	(16.69)	(40.71)	(108.8)
Const.	-380.0***	-180.0***	-98.25***	-20.38***	-4.836*	-39.27***	-20.83***	-51.32***	-6.526	36.93**
	(28.91)	(17.38)	(9.048)	(1.863)	(2.521)	(5.813)	(3.874)	(2.449)	(13.62)	(15.71)
Contr.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368	9368	8937
R^2	0.847	0.916	0.919	0.890	0.912	0.912	0.890	0.909	0.369	0.477
$M^{Rural} = M^{Sec.cit}$	0.796	0.641	10.09***	0.000	0.216	0.034	0.966	0.021	0.275	7.294***
	0.372	0.424	0.002	0.993	0.642	0.854	0.326	0.886	0.600	0.007
$M^{Rural} = M^{DSM}$	0.447	4.079**	12.78***	5.319**	1.469	0.001	0.391	0.911	0.110	7.344***
	0.504	0.043	0.000	0.021	0.225	0.981	0.532*	0.340	0.740	0.007
$M^{Sec. Cit.} = M^{DSM}$	1.414	4.940**	1.274	4.296**	1.934	0.007	0.060	0.675	0.489	0.264
	0.234	0.026	0.259	0.038	0.164	0.932	0.806	0.411	0.484	0.607

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Interestingly, contrary to the findings from the descriptive analysis, we also see a significantly negative effect of migration to DSM on the growth in the energy intake deriving from cereals. Delving deeper into the different types of cereals (see Table 3), we find that this mostly derives from a declining maize consumption after migrating to the former capital. While in the descriptive analysis it appeared that the drop in maize consumption was much more pronounced for those who moved to secondary cities, after controlling for initial household fixed effects only the coefficient for migration to DSM is highly significant and negative. In line with trends identified in the descriptive analysis and Delgado (1989), the regression results however, do confirm a stronger growth in the consumption of rice for those who moved to secondary cities. In addition, both types of rural-urban migration are significantly associated with a stronger growth in the consumption of processed cereal products over time.

Though the coefficient for migration to DSM is larger in terms of magnitude for most of the regressions, the results of the F-test indicate that with exception of the regression on the growth in consumption of sugar and sweets, the difference between the effect of relocation to secondary cities and DSM respectively is not statistically significant.

Finally, we note that these regression results partly confirm concerns about the health implications of the “nutrition transition” associated with urbanization. Compared to those who remained in their baseline rural communities or moved to other rural areas, rural-urban migrants experienced a stronger increase in the intake of high-sugar food items including processed cereal products and non-alcoholic beverages (see Table 3). In addition, the coefficient for migration to DSM is significantly positive in the regression on the change in the consumption of sugar and sweets over time (see Table 2).

Table 3: Change in the consumption of food subgroups (2008/09-2012/13)

	ΔRice	ΔMaize	ΔCereal products	ΔCassava	ΔSweet potatoes	ΔCooking bananas	ΔNon-alc. beverages	ΔAlc. beverages
Baseline cons.	*230.08*	*933.62*	*35.77*	*283.26*	*46.66*	*42.88*	*4.61*	*46.53*
M^{Rural}	31.59	-45.94	-5.575	14.90	-4.383	-8.163	2.423	20.54
	(28.46)	(46.20)	(8.671)	(29.92)	(7.032)	(5.903)	(2.093)	(25.53)
$M^{Sec. Cit.}$	114.5**	-100.7	90.19***	-134.8***	-10.76	-19.59**	26.44***	-21.65
	(53.76)	(98.38)	(25.88)	(42.22)	(11.58)	(9.991)	(8.490)	(25.60)
M^{DSM}	54.26	-308.2***	105.0***	-192.8***	-6.042	-45.93***	21.04***	16.81
	(74.05)	(99.32)	(33.18)	(59.44)	(6.266)	(13.17)	(6.587)	(39.64)
Const.	3.872	-175.4***	6.377**	-78.75***	-10.69***	-7.287***	0.165	-6.691
	(9.365)	(15.14)	(2.989)	(8.559)	(2.111)	(1.847)	(1.092)	(13.56)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368
R^2	0.884	0.926	0.874	0.918	0.906	0.915	0.415	0.368
$M^{Rural} = M^{Sec.cit}$	1.934	0.270	12.59***	8.826***	0.199	0.971	7.451***	1.616
	0.164	0.603	0.000	0.003	0.655	0.324	0.006	0.204
$M^{Rural} = M^{DSM}$	0.080	6.217**	10.82***	8.726***	0.037	7.570***	7.548***	0.007
	0.778	0.013	0.001	0.003	0.847	0.006	0.006	0.932
$M^{Sec. Cit.} = M^{DSM}$	0.455	2.335	0.125	0.666	0.135	2.667	0.245	0.718
	0.500	0.127	0.724	0.414	0.713	0.102	0.621	0.397

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2 Diet diversity

A very straightforward way to measure diet diversity is to count the number of food items or 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 report both. The count measure – although easy to interpret – has the disadvantage that it does not consider 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 is calculated using the following formula:

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

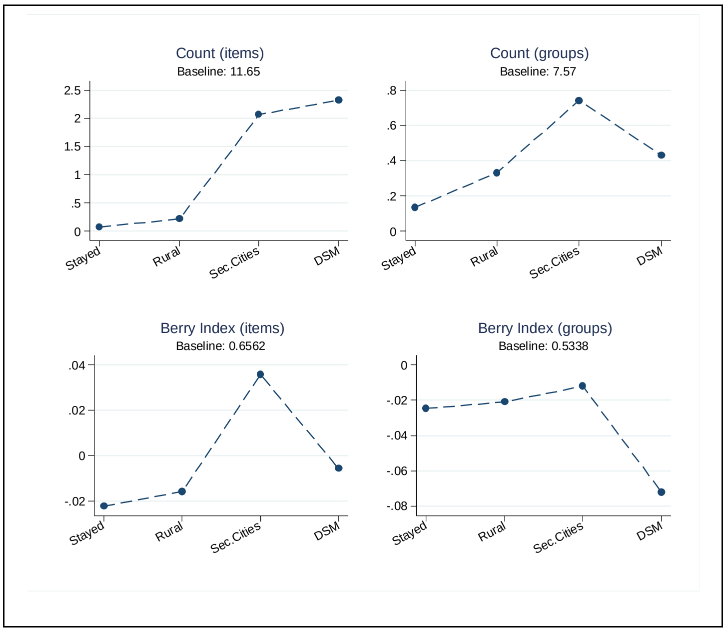
This index ranges from 0, in the case where food consumption is entirely based on one food item or group, to 1-1/n, when n food items or groups are consumed in equal proportions[8].

4.2.1 Descriptive analysis

Figure 4 depicts the mean change in the count measures and the Berry Indices based on individual food items and broad food groups between 2008/09 and 2012/13 according to migration status. When focussing on the count of food items – the most commonly used measure of diversity in economic studies – our results confirm previous findings and suggest that individuals consume more diverse diets after migrating to urbanized areas, whereas there was virtually no change for non-migrants and those who moved to other rural areas. Interestingly, the increase in the number of food groups consumed is largest for migrants to secondary cities.

[8] For this particular dataset n equals 55 or 12 when considering food items or broader food groups respectively. The upper bound of the Berry Index is therefore equal to 0.982 or 0.917 respectively.

Figure 4: Mean change in diet diversity according to migration status



Looking at the Berry Indices, we even find that the sharpest decline in diet diversity has occurred among migrants to DSM. To some extent, this decline can be explained by the increased reliance on foods consumed outside. As we are not able to distinguish between the different components of these meals, we could be underestimating diversity. When focussing only on foods consumed at home[9] however, we find a similar pattern. This could in theory be mitigated by the fact that meals and snacks consumed outside are more diverse. Information from food diaries (Deweerdt et al., 2014) however reveals that these meals consumed outside are mostly starch-based and thus unlikely to contribute positively to diet diversity.

4.2.2 Regression analysis

When taking on the same approach as previous studies and thus simply comparing dietary diversity in rural and urban settings, we find that urban residence is associated with higher values for all four measures of dietary diversity (see Appendix B, Table B4). However, once we address the selection bias by controlling for individual fixed heterogeneity and initial household fixed effects, the results of our regression analysis indicate that – regardless of the measurement – people do not consume more diverse diets after relocating to urbanized areas. This contradicts previous findings on the relationship between urbanization and diet diversity (De Nigris, 1997; Bourne et al., 2002; Abdulai and Aubert, 2004; Smith et al., 2006) and seems to suggest that the observed difference in dietary diversity between rural and urban areas is largely driven by selection bias rather than urbanization.

[9] Additional information can be obtained from the corresponding author upon request.

Table 4: Changes in diet diversity

	ΔCount (items)	ΔBI (items)	ΔCount (groups)	ΔBI (groups)
Baseline	11.651	*0.656*	*7.568*	*0.534*
M^{Rural}	-0.271	0.010	0.002	-0.002
	(0.344)	(0.015)	(0.171)	(0.015)
$M^{Sec. Cit.}$	0.957	0.037	0.028	-0.033
	(0.817)	(0.029)	(0.349)	(0.027)
M^{DSM}	1.574	0.049	0.116	-0.002
	(0.967)	(0.035)	(0.473)	(0.035)
Const.	-0.301***	-0.040***	-0.020	-0.035***
	(0.111)	(0.005)	(0.055)	(0.005)
Controls	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓
N	9368	9368	9368	9368
R^2	0.869	0.864	0.853	0.853
$M^{Rural} = M^{Sec.cit}$	2.026	0.715	0.005	1.070
	0.155	0.398	0.946	0.301
$M^{Rural} = M^{DSM}$	3.197*	1.025	0.053	0.000
	0.074	0.311	0.817	0.985
$M^{Sec. Cit.} = M^{DSM}$	0.244	0.068	0.024	0.530
	0.621	0.794	0.878	0.466

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.3 Pathways

Next, we attempt to capture some of the pathways that could explain the impact of urbanization on food consumption. As mentioned above, 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".

Evidence from the Kagera region in Tanzania shows that internal migration and especially moving out of agriculture significantly contributed to consumption growth (Beegle et al., 2011). Using the same data, Christiaensen et al. (2013) demonstrate that rural diversification and secondary city development leads to more inclusive growth patterns than metropolitization. To assess to what extent the observed changes in dietary patterns are driven by income growth we include the difference in the logarithm of per capita total household expenditures[10] over time (see Appendix D, Table D1 and D4).

In addition, given the importance of moving out of agriculture demonstrated in the abovementioned research (Beegle et al., 2011; Christiaensen et al., 2013) and the associated changes in energy requirements (Popkin, 1998; 1999; 2001) as well as the clear link between home food production and consumption, we include a dummy variable capturing the transition from a household headed by a farmer to a non-farming household (see Appendix D, Table D2 and D5).

Finally, we consider the fact that migrating to urban areas could go hand in hand with important shifts in household composition[11], which could in turn influence household's food choices. To this end we include the number of individuals ages 0 to 5, 6 to 15, 16 to 60 and above 61 years old respectively (see Appendix D, Table D3 and D6).

[10] Fisher price indices calculated based on food items by stratum and quarter were employed to adjust the nominal consumption aggregate for spatial and temporal price differences.

[11] Descriptive statistics reveal that urban households tend to be smaller and are characterised by a lower age dependency ratio.

From the results of the regressions summarized in Table 5 and 6, we can derive that several of the changes in consumption patterns that were captured by the migration variables in the previous regressions, can to some extent be explained by changes in income, remoteness, economic activities and household composition.

Table 5: Change in the consumption of food groups (2008/09-2012/13)

	ΔTotal	ΔCereals	ΔRoots, tubers	ΔSugar, sweets	ΔPulses, nuts, seeds	ΔFruits, veg.	ΔMeat, fish, dairy	ΔOils, fats	ΔBev.	ΔMeals /snacks cons. Outs.
Baseline cons.	*2409.16*	*1,285.02*	*388.93*	*78.49*	*270.85*	*63.72*	*133.81*	*87.13*	*51.32*	*51.33*
M^{Rural}	-25.84	-31.39	5.508	5.148	-34.89**	-7.874	-14.50	-2.269	30.92	3.645
	(64.55)	(50.67)	(31.59)	(6.088)	(17.64)	(6.442)	(11.82)	(6.608)	(27.04)	(30.34)
$M^{Sec. Cit.}$	-141.4	-20.45	-103.3**	-15.47	-31.94	-24.28**	-28.33	-16.96	22.26	79.23
	(139.1)	(124.7)	(43.61)	(10.94)	(35.85)	(10.78)	(23.86)	(20.52)	(30.55)	(71.53)
M^{DSM}	-616.6***	-521.4***	-205.9***	28.04	-35.46	-1.177	-42.32	-4.182	74.23*	53.24
	(162.2)	(136.6)	(68.15)	(19.49)	(54.38)	(16.17)	(26.44)	(16.77)	(44.55)	(108.3)
ΔLn(exp.)	992.1***	426.9***	20.58	37.68***	98.88***	37.28***	115.2***	25.69***	6.738	215.2***
	(52.26)	(40.29)	(20.64)	(4.243)	(13.18)	(5.474)	(9.481)	(4.931)	(15.95)	(26.94)
ΔFarm	-300.6***	-75.55	-101.9***	5.995	-100.0***	-34.64***	-11.69	-14.31	-42.41**	85.09**
	(69.75)	(57.44)	(31.44)	(6.881)	(20.11)	(7.061)	(14.14)	(9.151)	(21.26)	(37.09)
Δ0-5	4.426	-5.638	-13.97**	6.401***	-6.950	3.387**	3.809	-1.526	7.607	10.70
	(17.35)	(13.69)	(6.092)	(1.455)	(4.689)	(1.582)	(2.826)	(1.599)	(5.957)	(6.832)
Δ5-15	-33.14**	-14.87	-4.163	-2.871**	-13.02***	-5.367***	-2.104	-0.339	2.674	6.572
	(15.62)	(12.69)	(6.041)	(1.243)	(4.031)	(1.779)	(2.654)	(1.809)	(4.810)	(6.708)
Δ16-60	31.88**	33.53***	7.041	2.072	3.111	-3.734**	6.281**	7.059***	-10.68*	-13.55*
	(15.89)	(12.30)	(5.793)	(1.460)	(4.171)	(1.873)	(2.863)	(1.686)	(5.723)	(7.398)
Δ61 +	79.68*	12.67	44.23***	-1.787	23.63*	-2.030	14.36*	-3.980	15.99	-25.88
	(42.20)	(31.95)	(15.98)	(3.388)	(13.01)	(5.579)	(7.654)	(4.390)	(17.55)	(19.07)
Const.	-801.3***	-393.8***	-105.1***	-42.44***	-42.11***	4.427	-88.01***	-77.49***	0.133	-53.09**
	(57.14)	(41.29)	(18.67)	(4.979)	(13.99)	(4.952)	(8.068)	(5.018)	(20.31)	(24.31)
Contr.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	8286	8286	8286	8286	8286	8286	8286	8286	8286	7939
R^2	0.880	0.934	0.928	0.918	0.924	0.924	0.923	0.918	0.373	0.470
$M^{Rural} = M^{Sec.cit}$	0.605	0.007	4.445**	2.803*	0.005	1.827	0.255	0.475	0.060	1.015
	0.437	0.933	0.035	0.094	0.941	0.177	0.613	0.491	0.807	0.314
$M^{Rural} = M^{DSM}$	12.40***	12.28***	7.165***	1.385	0.000	0.162	1.058	0.011	0.852	0.209
	0.000	0.000	0.007	0.239	0.992***	0.687	0.304	0.916	0.356	0.648
$M^{Sec. Cit.} = M^{DSM}$	5.374**	7.821***	1.796	4.121**	0.003	1.605	0.177	0.248	1.005	0.042
	0.021	0.005	0.180	0.042	0.955	0.205	0.674	0.618	0.316	0.837

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In particular, most of the effect on the increase in consumption of meals and snacks outside of the home after migrating to more urbanized areas appears to be explained by income growth. The coefficients for migration to secondary cities and DSM have been reduced dramatically in terms of magnitude and are no longer statistically significant.

The stronger growth in the consumption of high-sugar food items such as sugar and sweets, processed cereal products and non-alcoholic beverages – arguably luxury products – is clearly linked to changes in income as well (see Table 6). The coefficients for rural-urban migration and especially for relocation to DSM have declined in terms of magnitude as well as significance.

Interestingly, after controlling for changes in income and household composition, the shift away from several traditional staple food products after relocating to more urbanized areas becomes even more pronounced. The coefficient for moving to the former capital in the regression on the growth in the consumption of cereals, maize, cassava and cooking bananas has gained significance and magnitude.

Similarly, we now see a significantly negative effect of migration to DSM on the growth in the consumption of pulses[12]. This is particularly striking since it strongly refutes the claim that differences in urban and rural dietary patterns are merely a reflection of differing incomes.

We further note that whereas in the main regression it appeared that relocation to urban areas was not associated with a significant change in the growth of total food consumption, once income growth is accounted for the effect of moving to DSM is significantly negative. This could imply that though keeping all else equal individuals would adjust their energy intake towards the lower requirements for an urban lifestyle, in reality this is completely offset by increases in income.

The results also indicate that moving out of agriculture accounts for a considerable part of the negative impact of relocation to urban areas on the growth of the consumption of roots and tubers - cassava and cooking bananas in particular - as well as maize, all crops that are typically consumed from home production in rural areas.

We further note that an increase in the number of working-age household members and a decrease in the number of children, appear to be strongly associated with the consumption of cereals and maize in particular. After controlling for changes in household composition, the coefficients for migration to DSM has actually increased in terms of magnitude (see Appendix D, Table D3). This seems to suggest that to some extent, the negative effect of urbanization of the intake of cereals is off-set by changes in household composition after moving to urbanized areas.

Table 6: Changes in the consumption of food subgroups (2008/09-2012/13) - Pathways

	ΔRice	ΔMaize	ΔCereal products	ΔCassava	ΔSweet potatoes	ΔCooking bananas	ΔNon-alc. beverages	ΔAlc. beverages
Baseline cons.	*229.06*	*933.30*	*35.63*	*283.52*	*46.84*	*43.03*	*4.61*	*46.71*
M^{Rural}	-3.198	-41.37	-15.49*	10.04	-1.696	-3.442	1.318	29.60
	(28.55)	(46.93)	(9.049)	(29.43)	(7.464)	(5.781)	(2.019)	(26.97)
$M^{Sec. Cit.}$	10.25	-113.7	53.37*	-57.21	-13.65	-26.42**	22.14***	0.114
	(54.19)	(106.1)	(27.46)	(38.95)	(12.54)	(11.30)	(8.518)	(29.46)
M^{DSM}	-57.70	-382.7***	84.08**	-143.5**	-6.022	-46.86***	14.51**	59.72
	(65.44)	(106.7)	(32.74)	(67.16)	(8.345)	(14.23)	(6.952)	(43.51)
ΔLn(exp.)	162.6***	180.6***	42.62***	-22.44	17.40***	15.99***	8.111***	-1.373
	(20.59)	(32.41)	(6.987)	(18.53)	(4.736)	(4.242)	(1.636)	(15.88)
ΔFarm	65.04**	-153.3***	24.79*	-79.24***	-11.53	-11.44*	2.680	-45.08**
	(26.53)	(49.84)	(13.10)	(28.77)	(8.003)	(6.802)	(2.168)	(21.21)
Δ0-5	-5.422	-37.34***	-0.947	-17.57***	0.840	1.905*	0.691	6.916
	(6.254)	(12.85)	(2.091)	(5.673)	(2.219)	(1.141)	(0.512)	(5.955)
Δ5-15	-15.26**	-0.576	-3.210*	-5.961	2.628	-1.477	-0.211	2.885
	(6.423)	(11.92)	(1.916)	(5.353)	(1.936)	(1.485)	(0.490)	(4.785)
Δ16-60	11.70*	15.32	-1.120	7.212	0.823	-0.988	-0.606	-10.08*
	(6.834)	(12.18)	(2.634)	(5.306)	(1.571)	(1.303)	(0.616)	(5.704)
Δ61 +	-10.31	-12.60	-8.574*	57.55***	-2.266	2.817	0.329	11.99
	(14.25)	(28.03)	(4.411)	(15.79)	(4.511)	(3.166)	(0.927)	(15.77)
Const.	-52.05***	-215.9***	3.414	-61.32***	-26.64***	-9.125**	-2.593	2.726
	(19.03)	(36.63)	(7.530)	(17.01)	(5.594)	(4.125)	(1.945)	(20.18)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓
N	9264	9264	9264	9264	9264	9264	9264	9264
R^2	0.904	0.934	0.889	0.926	0.911	0.922	0.423	0.369

[12] Though not significant in the regression on the aggregate category of pulses, nuts and seeds, the dummy for migration to urban areas is significant at the 5 % level in the regression on pulses. Additional information can be obtained from the corresponding author upon request.

$M^{Rural} = M^{Sec.cit}$	0.050	0.419	5.914**	2.092	0.615	3.343*	5.834**	0.742
	0.824	0.517	0.015	0.148	0.433	0.068	0.016	0.389
$M^{Rural} = M^{DSM}$	0.594	9.288***	9.345***	3.914	0.195	8.898***	3.583*	0.430
	0.441	0.002	0.002	0.048	0.659	0.003	0.058	0.512
$M^{Sec. Cit.} = M^{DSM}$	0.724	3.496*	0.555	1.367	0.298	1.403	0.502	1.415
	0.395	0.062	0.456	0.242	0.585	0.236	0.478	0.234

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Finally, we note that though not significantly affected by rural-urban migration, income growth is associated with significant increases in diet diversity (see Appendix D, Table D7). This is in line with previous findings (Moon et al., 2002; Theil and Finke, 1983; Thiele and Weiss, 2003) and could explain to some extent why studies based on the comparison of rural and wealthier urban population groups find that people tend to consume more diverse diets in urban areas.

4.4 Robustness checks

To examine the robustness of our results, we first repeat our analysis for the share of the different food (sub) groups in total energy intake (see Appendix D, Table D1-D2). The results demonstrate that except for the negative effect on the change in the consumption of cereals, all the previously identified trends in the growth of the level of food consumption are reflected in significant shifts in the evolution of the composition of diets over time.

Second, as mentioned above, an important caveat in this type research is the lack of consensus on a clear classification of rural and urban areas. We will therefore conduct two robustness checks in order to ascertain that out results are not driven by this particular categorization.

First, we repeat the analysis defining primary cities as locations with more than 500,000 inhabitants. According to the 2012 Census this holds for DSM and Mwanza. The results of the regressions summarized in Appendix B (Table 3-6), demonstrate that our findings are not altered when adjusting the definition of primary cities.

In a next step, we move away from administrative boundaries and focus on local population density estimates instead. It can be argued that population density is a crucial gradient in delineating the rural-urban nexus as it can generate the agglomeration economies that are defining features or urban centres (Chomitz et al., 2005). This seems particularly relevant in the case of Tanzania, since Muzzini and Lindeboom (2008) find that approximately 17% of the population in mainland Tanzania reside in high density settlements (>150 people/km²) that possess significantly different characteristics than rural areas but are not officially recognized as 'urban'. The authors continue to state that "failing to account for population density may significantly underestimate urbanization at least in half of the regions".

Our measure of population density is based upon WorldPop data[13], which provides population density estimates per 100m². Following the DHS methodology[14] to preserve anonymity, approximate GPS coordinates are available for most of the sampled households in the TNPS. More specifically, the coordinate modification strategy relies on random offset of cluster centerpoint coordinates. In line with Gollin et al. (2015), we take this into account when linking the TNPS GPS data with the raster data from WorldPop by extracting the average population density within a 5km radius around the reported coordinates.

[13] The production of the WorldPop spatial datasets principally follows the methodologies outlined in Stevens et al (2015), Alegana et al (2015), Deville et al (2014), Linard et al (2012), Gaughan et al (2013) and Tatem et al (2007).
[14] Information on the DHS methodology can be found at http://spatialdata.dhsprogram.com/methodology/

The results of the regressions including the logarithm of local population density as our main explanatory variable of interest (see Appendix D, Tables D76-D8), confirm that the previously established effects. In line with the results of our main analysis, we find that moving to a more densely populated area is associated with a significantly stronger growth in the consumption of meals and snacks outside the home, sugar and sweets, (sugary) processed cereal products and non-alcoholic beverages and a more pronounced decline in the energy intake deriving from traditional staple food items such as maize and roots and tubers. We again find no support for the hypothesis that urbanization, as captured by the concentration of the population in this case, is associated with significant improvements in dietary diversity.

5. Conclusion

Although urbanization is increasingly put forward as one of the main determinants of changes in food consumption patterns in the developing world, our understanding of its effects on diets remains limited. Using unique panel data from the Tanzania National Panel Survey for the period between 2008/09 and 2012/13 this paper provides empirical evidence on the impact of rural-urban migration on the consumption of different food groups 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 evidence presented in this paper strongly suggests that urbanization is associated with important shifts in dietary patterns. Even after controlling for individual fixed heterogeneity, baseline observable characteristics and initial household fixed effects, we find that individuals who relocated to more urbanized areas experience a significantly larger increase in the consumption of processed and ready-to-eat foods. The analysis further indicates a general shift away from traditional staples such as pulses, maize and cassava, which is much more pronounced for those who moved to urban areas.

Moreover, the results mostly confirm concerns about the healthiness of urban diets. We find evidence of an association between urbanization and heightened consumption of sugar and high-sugar food items including buns, cakes, biscuits, sweets and sodas. In addition, contrary to previous findings (e.g. De Nigris, 1997; Smith et al., 2006) our results show that after controlling for initial household fixed effects urbanization is not associated with more diverse diets, nor do we find evidence of a positive impact on the consumption of healthier food groups such as fruits and vegetables or animal-source foods.

Whereas the declining consumption of roots and tubers for those who moved to urban areas appears to be linked to the transition out of agriculture, our results further indicate that a considerable part of the effect of rural-urban migration on dietary patterns can be explained by changes in income. In particular, the increasing importance of meals and snacks consumed outside the home, processed cereal products and non-alcoholic beverages appears to be largely attributable to income growth. It is important to note however, that even after controlling for income, the coefficients for rural-urban migration remain highly significant in several of the regressions. Moreover, in the case of traditional staple food items – maize, cassava, cooking bananas and pulses – it appears that the negative effect of moving to an urban area is in fact to some extent offset by rising incomes and the associated increases in consumption. Overall, these results thus clearly negate 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.

These results clearly demonstrate that food demand analysis done without taking into consideration the underlying structural shifts resulting from urbanization can lead to misleading results and erroneous food demand forecasts. In addition, though a more detailed analysis of the nutritional value of diets is required, our findings again raise some concerns about the nutritional quality of diets in an urbanizing world and call for focused policy action in urban areas.

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Appendix A

Table A1: Food items included in the analysis

Food group	Food subgroup	Food items
Cereals	Rice	Rice (paddy) Rice (husked)
	Maize	Maize (green, cob) Maize (grain) Maize (flour)
	Cereal products	Bread Buns, cakes and biscuits Macaroni, spaghetti Other cereal products
	Other cereals	Millet and sorghum (grain) Millet and sorghum (flour) Wheat, barley grain and other cereals
Roots and tubers	Cassava	Cassava fresh Cassava dry/flour
	Sweet potatoes	Sweet potatoes
	Cooking bananas	Cooking bananas, plantains
	Other roots and tubers	Yams/cocoyams Irish potatoes Other roots and tubers
Sugar and sweets		Sugar Sweets Honey, syrups, jams, marmalade, jellies, canned fruits Sweets, ice-cream (consumed outside the hh)
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 (including dagaa) Dried/salted/canned fish and seafood (incl. dagaa)
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
Beverages	Non-alcoholic beverages	Tea dry Coffee and cocoa Bottled/canned soft drinks (soda, juice, water) Prepared tea, coffee Sodas and other non-alcoholic drinks (consumed outside the hh)
	Alcoholic beverages	Bottled beer Local brews Wine and spirits Kibuku and other local brews (consumed outside the hh) Wine, commercial beer and spirits (consumed outside the hh)
Meals and snacks consumed outside the hh		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

Appendix B: Additional regression results

Table B1 : Change in the consumption of food groups (2008/09-2012/13)

	ΔTotal	ΔCereals	ΔRoots, tubers	ΔSugar, sweets	ΔPulses, nuts, seeds	ΔFruits, veg.	ΔMeat, fish, dairy	ΔOils, fats	ΔBev.	ΔMeals /snacks cons. Outs.
Baseline cons.		*1611.81*	*481.19*	*97.93*	*337.72*	*78.09*	*166.26*	*108.6*	*51.93*	*51.74*
M^{Rural}	-50.95	12.90	-21.63	11.42	-16.10**	-46.80**	-18.82	-10.68	22.44	-3.252
	(88.24)	(64.52)	(36.58)	(7.199)	(7.263)	(21.56)	(15.05)	(7.252)	(25.67)	(37.46)
$M^{Sec. Cit.}$	87.10	114.3	-207.5***	12.12	-12.57	-50.59	12.73	-7.474	4.161	229.8***
	(164.2)	(137.2)	(53.94)	(13.27)	(10.86)	(37.99)	(26.28)	(21.32)	(27.17)	(78.39)
M^{DSM}	-346.2	-386.9**	-345.5***	55.89***	10.04	-43.53	-9.318	14.05	37.44	297.7***
	(225.3)	(164.4)	(89.32)	(20.67)	(16.40)	(62.53)	(33.74)	(19.77)	(40.50)	(108.8)
Const.	-521.6***	-251.3***	-123.9***	-26.98***	-7.011**	-52.55***	-27.96***	-64.69***	-8.687	36.93**
	(32.09)	(20.95)	(11.06)	(2.265)	(2.797)	(7.073)	(4.475)	(2.528)	(13.50)	(15.71)
Contr.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368	9368	8937
R^2	0.870	0.921	0.924	0.897	0.918	0.915	0.899	0.920	0.403	0.477
$M^{Rural} = M^{Sec.cit}$	0.569	0.471	8.520***	0.002	0.078	0.008	0.986	0.021	0.278	7.294***
	0.451	0.493	0.004	0.963	0.780	0.930	0.321	0.885	0.598	0.007
$M^{Rural} = M^{DSM}$	1.511	5.444**	9.622***	4.347**	2.291	0.002	0.071	1.332	0.113	7.344***
	0.219	0.020	0.002	0.037	0.130	0.960	0.789	0.248	0.737	0.007
$M^{Sec. Cit.} = M^{DSM}$	2.542	5.816**	1.829	3.311*	1.384	0.010	0.273	0.576	0.499	0.264
	0.111	0.016	0.176	0.069	0.239	0.922	0.601	0.448	0.480	0.607

Food consumption is expressed in kcal. per adult equivalent per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B2 : Change in the consumption of food subgroups (2008/09-2012/13)

	ΔRice	ΔMaize	ΔCereal products	ΔCassava	ΔSweet potatoes	ΔCooking bananas	ΔNon-alc. beverages	ΔAlc. beverages
Baseline cons.	*284.35*	*1171.87*	*44.79*	*355.38*	*57.92*	*48.83*	*5.3*	*51.93*
M^{Rural}	46.36	-55.41	-8.219	-5.155	-5.156	-12.55**	2.378	20.07
	(36.04)	(55.10)	(10.09)	(35.00)	(8.742)	(5.754)	(2.096)	(25.59)
$M^{Sec. Cit.}$	123.0*	-126.0	110.4***	-168.5***	-12.01	-24.87**	26.47***	-22.30
	(63.94)	(111.8)	(30.38)	(50.32)	(14.67)	(11.20)	(8.484)	(25.61)
M^{DSM}	53.04	-387.8***	113.5***	-278.6***	-8.338	-53.21***	21.07***	16.37
	(83.66)	(120.2)	(36.23)	(89.00)	(7.714)	(14.75)	(6.592)	(39.41)
Const.	-4.000	-235.2***	6.472*	-101.4***	-13.05***	-7.344***	-0.395	-8.292
	(11.73)	(18.24)	(3.543)	(10.46)	(2.607)	(2.187)	(1.092)	(13.43)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368
R^2	0.884	0.929	0.885	0.924	0.907	0.921	0.478	0.402
$M^{Rural} = M^{Sec.cit}$	1.130	0.342	14.23***	7.470***	0.147	0.922	7.505***	1.625
	0.288	0.558	0.000	0.006	0.701	0.337	0.006	0.202
$M^{Rural} = M^{DSM}$	0.005	6.850***	10.74***	6.906***	0.090	7.194***	7.597***	0.007
	0.942	0.009	0.001	0.009	0.765	0.007	0.006	0.933
$M^{Sec. Cit.} = M^{DSM}$	0.463	2.702	0.004	1.209	0.052	2.456	0.244	0.732
	0.496	0.100	0.947	0.272	0.819	0.117	0.621	0.392

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B3: Change in diet diversity (2008/09-2012/13)

	ΔBI (items)	ΔBI (groups)
Baseline	*0.657*	*0.534*
M^{Rural}	0.010	-0.002
	(0.015)	(0.015)
$M^{Sec. Cit.}$	0.037	-0.033
	(0.029)	(0.027)
M^{DSM}	0.049	-0.002
	(0.035)	(0.035)
Const.	-0.040***	-0.035***
	(0.005)	(0.005)
Controls	✓	✓
IHHFE	✓	✓
N	9368	9368
R^2	0.867	0.857
$M^{Rural} = M^{Sec.cit}$	0.729	1.031
	0.393	0.310
$M^{Rural} = M^{DSM}$	1.056	0.001
	0.304	0.980
$M^{Sec. Cit.} = M^{DSM}$	0.070	0.523
	0.791	0.470

Food consumption is expressed in kcal. per adult equivalent per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B4: Diet diversity (2012/13)

	Count (items)	BI (items)	Count (groups)	BI (groups)
Secondary cities	2.435***	0.060***	0.973***	0.020***
	(0.115)	(0.004)	(0.0474)	(0.00392)
DSM	5.472***	0.136***	1.630***	0.060***
	(0.150)	(0.004)	(0.056)	(0.004)
Const.	11.15***	0.612***	7.457***	0.487***
	(0.182)	(0.007)	(0.080)	(0.007)
Controls	✓	✓	✓	✓
IHHFE	No	No	No	No
N	13849	13849	13849	13849
R^2	0.180	0.091	0.112	0.037
Secondary cities = DSM	303.6	244.8	101.6	64.33
	0.000***	0.000***	0.000***	0.000***

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix C: Pathways

Table C1: Change in the consumption of food groups (2008/09-2012/13) Pathways (income growth)

	ΔTotal	ΔCereals	ΔRoots tubers	ΔSugar, sweets	ΔPulses, nuts, seeds	ΔFruits, veg.	ΔMeat, fish, dairy	ΔOils, fats	ΔBev.	ΔMeals /snacks cons. Outs.
Baseline cons.	*2409.16*	*1,285.02*	*388.93*	*78.49*	*270.85*	*63.72*	*133.81*	*87.13*	*51.32*	*51.33*
M^{Rural}	-42.99	-30.82	-2.965	6.280	-8.950	-38.07**	-15.84	-3.121	23.68	8.142
	(65.43)	(51.21)	(31.55)	(5.945)	(6.530)	(17.91)	(11.76)	(6.555)	(27.68)	(30.20)
$M^{Sec. Cit.}$	-251.4*	-48.52	-147.1***	-13.94	-31.79***	-62.71*	-37.31	-22.17	6.558	112.2
	(135.5)	(122.7)	(41.87)	(10.87)	(11.21)	(34.44)	(23.97)	(20.77)	(30.51)	(69.95)
M^{DSM}	-705.0***	-515.2***	-259.9***	36.34**	-11.25	-70.32	-44.20*	-2.486	45.55	84.45
	(157.6)	(135.6)	(65.47)	(18.36)	(15.16)	(54.81)	(24.87)	(16.36)	(45.36)	(107.0)
ΔLn(exp.)	962.9***	417.6***	12.91	36.55***	38.08***	99.86***	109.6***	21.77***	-0.894	223.1***
	(51.69)	(38.54)	(19.53)	(4.096)	(5.245)	(12.85)	(9.486)	(4.816)	(15.01)	(28.26)
Const.	-772.2***	-339.1***	-100.8***	-34.19***	-19.60***	-76.78***	-63.55***	-60.27***	-11.58	-68.00***
	(34.06)	(22.16)	(11.77)	(2.581)	(3.205)	(8.112)	(5.425)	(3.196)	(15.63)	(17.79)
Contr.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9264	9264	9264	9264	9264	9264	9264	9264	9264	8864
R^2	0.880	0.933	0.924	0.904	0.921	0.923	0.915	0.914	0.369	0.468
$M^{Rural} = M^{Sec.cit}$	2.007	0.019	8.010***	2.698	3.256*	0.406	0.588	0.779	0.231	1.990
	0.157	0.891	0.005	0.101	0.071	0.524	0.443	0.378	0.631	0.158
$M^{Rural} = M^{DSM}$	16.17***	12.14***	11.15***	2.566	0.021	0.322	1.166	0.001	0.218	0.501
	0.000	0.000	0.001	0.109	0.886	0.570	0.280	0.971	0.640	0.479
$M^{Sec. Cit.} = M^{DSM}$	5.062**	6.860***	2.226	5.785**	1.309	0.015	0.044	0.597	0.575	0.049
	0.025	0.009	0.136	0.016	0.253	0.903	0.835	0.440	0.448	0.825

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C2: Change in the consumption of food groups (2008/09-2012/13) Pathways (moving out of agriculture)

	ΔTotal	ΔCereals	ΔRoots, tubers	ΔSugar, sweets	ΔPulses, nuts, seeds	ΔFruits, veg.	ΔMeat, fish, dairy	ΔOils, fats	ΔBev.	ΔMeals /snacks cons. Outs.
Baseline cons.	*2410.24*	*1,285.87*	*388.41*	*78.59*	*271.14*	*63.78*	*134.15*	*87.03*	*51.14*	*51.74*
M^{Rural}	-4.010	1.010	14.47	9.719	-6.348	-28.91	-14.04	-4.632	26.08	-22.40
	(77.96)	(54.37)	(31.72)	(6.146)	(6.600)	(17.67)	(12.99)	(6.418)	(25.97)	(36.61)
$M^{Sec. Cit.}$	139.6	96.15	-125.1***	4.849	-5.804	0.312	8.267	-5.042	17.77	155.5*
	(149.7)	(122.4)	(46.70)	(11.48)	(10.46)	(34.52)	(24.70)	(18.71)	(28.57)	(80.90)
M^{DSM}	-145.4	-312.7**	-204.5***	48.24**	18.88	-2.702	-1.527	15.14	51.90	212.9*
	(198.5)	(145.5)	(62.82)	(18.99)	(15.00)	(57.24)	(29.25)	(16.89)	(40.02)	(109.7)
ΔFarm	6.674	25.96	-106.3***	15.80**	-19.70***	-74.31***	19.68	-7.840	-32.78	192.7***
	(77.92)	(56.93)	(28.73)	(6.825)	(6.643)	(19.56)	(13.93)	(8.415)	(20.76)	(45.41)
Const.	-380.7***	-182.5***	-88.01***	-21.91***	-2.938	-32.11***	-22.73***	-50.56***	-3.368	18.08
	(29.96)	(18.39)	(9.237)	(2.035)	(2.593)	(6.173)	(4.129)	(2.696)	(13.71)	(16.00)
Contr.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368	9368	8937
R^2	0.847	0.916	0.920	0.891	0.912	0.913	0.891	0.909	0.369	0.482
$M^{Rural} = M^{Sec.cit}$	0.768	0.541	6.632**	0.148	0.002	0.585	0.595	0.000	0.057	4.132**
	0.381	0.462	0.010	0.700	0.963	0.444	0.440	0.983	0.811	0.042
$M^{Rural} = M^{DSM}$	0.458	4.355**	9.034***	4.002**	2.603	0.193	0.169	1.187	0.351	4.442**
	0.499	0.037	0.003	0.046	0.107	0.661	0.681	0.276	0.554	0.035
$M^{Sec. Cit.} = M^{DSM}$	1.416	4.964**	1.148	4.189**	2.029	0.002	0.071	0.690	0.523	0.188
	0.234	0.026	0.284	0.041	0.154	0.962	0.791	0.406	0.470	0.665

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table C3: Change in the consumption of food groups (2008/09-2012/13) – Pathways (hh. Composition)

	ΔTotal	ΔCereals	ΔRoots, tubers	ΔSugar, sweets	ΔPulses, nuts, seeds	ΔFruits, veg.	ΔMeat, fish, dairy	ΔOils, fats	ΔBev.	ΔMeals /snacks cons. Outs.
Baseline cons.	*2410.24*	*1,285.87*	*388.41*	*78.59*	*271.14*	*63.78*	*134.15*	*87.03*	*51.14*	*51.74*
M^{Rural}	-66.85	-22.62	4.987	8.595	-12.83**	-46.63***	-18.09	-6.989	25.46	-16.71
	(74.74)	(52.53)	(31.56)	(6.181)	(6.410)	(17.74)	(12.98)	(6.454)	(25.43)	(36.90)
$M^{Sec. Cit.}$	62.02	80.36	-153.1***	8.219	-21.45**	-42.01	11.80	-9.207	9.538	183.6**
	(148.2)	(120.7)	(45.77)	(11.21)	(9.956)	(33.38)	(23.11)	(18.33)	(26.28)	(75.47)
M^{DSM}	-293.7	-385.6***	-228.9***	45.11**	0.573	-55.12	-8.666	3.077	51.76	257.6**
	(199.5)	(147.3)	(60.68)	(19.25)	(15.21)	(55.33)	(30.46)	(17.07)	(40.94)	(107.4)
Δ0-5	-57.51**	-38.31**	-14.64**	4.414***	-0.00254	-14.10***	-2.556	-3.500**	5.973	9.292
	(25.40)	(15.92)	(6.106)	(1.567)	(1.615)	(4.632)	(3.341)	(1.667)	(5.722)	(8.223)
Δ5-15	-126.8***	-53.35***	-4.039	-6.421***	-8.767***	-21.06***	-13.95***	-3.372*	3.425	-16.54**
	(19.03)	(12.98)	(5.536)	(1.252)	(1.786)	(3.952)	(2.993)	(1.734)	(4.454)	(7.809)
Δ16-60	66.21***	64.26***	6.231	3.369**	-0.986	9.610**	10.49***	8.551***	-9.741*	-29.15***
	(18.96)	(13.01)	(5.633)	(1.443)	(1.768)	(4.049)	(2.939)	(1.693)	(5.317)	(8.885)
Δ61 +	69.44	18.63	70.77***	-3.377	-0.0354	21.93*	12.41*	-2.331	12.87	-76.45***
	(44.26)	(30.37)	(16.47)	(3.247)	(5.125)	(12.10)	(7.388)	(3.895)	(15.19)	(21.24)
Const.	-211.7***	-193.6***	-109.3***	-19.83***	19.25***	-4.275	-18.51**	-62.80***	1.545	174.5***
	(64.87)	(39.77)	(14.94)	(4.524)	(4.781)	(12.16)	(7.891)	(4.062)	(17.40)	(31.60)
Contr.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368	9368	8937
R^2	0.852	0.918	0.920	0.893	0.914	0.915	0.893	0.911	0.369	0.484
$M^{Rural} = M^{Sec.cit}$	0.635	0.642	8.581***	0.001	0.581	0.015	1.188	0.014	0.217	5.731**
	0.425	0.423	0.003	0.976	0.446	0.902	0.276	0.908	0.641	0.017
$M^{Rural} = M^{DSM}$	1.182	5.672**	10.70***	3.522*	0.727	0.022	0.090	0.308	0.333	6.337**
	0.277	0.017	0.001	0.061	0.394	0.883	0.765	0.579	0.564	0.012
$M^{Sec. Cit.} = M^{DSM}$	2.201	6.385**	1.064	2.935*	1.606	0.043	0.300	0.255	0.783	0.324
	0.138	0.012	0.302	0.087	0.205	0.835	0.584	0.613	0.376	0.569

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C4: Changes in the consumption of food subgroups (2008/09-2012/13) – Pathways (income growth)

	ΔRice	ΔMaize	ΔCereal products	ΔCassava	ΔSweet potatoes	ΔCooking bananas	ΔNon-alc. beverages	ΔAlc. beverages
Baseline cons.	*229.06*	*933.30*	*35.63*	*283.52*	*46.84*	*43.03*	*4.61*	*46.71*
M^{Rural}	12.12	-49.62	-10.90	5.363	-4.175	-4.254	1.563	22.12
	(28.66)	(46.73)	(8.701)	(29.51)	(7.394)	(5.661)	(1.929)	(27.60)
$M^{Sec.\ Cit.}$	36.32	-153.7	64.94**	-92.03**	-18.07	-30.25***	22.99***	-16.44
	(54.45)	(105.1)	(27.34)	(36.93)	(13.07)	(11.32)	(8.304)	(29.23)
M^{DSM}	-11.91	-429.7***	97.28***	-188.1***	-10.25	-51.46***	15.17**	30.38
	(64.66)	(107.0)	(31.73)	(64.32)	(7.134)	(14.45)	(6.694)	(44.33)
ΔLn(exp.)	183.0***	176.6***	50.36***	-23.44	12.70***	15.17***	8.530***	-9.424
	(20.69)	(29.83)	(6.926)	(17.59)	(4.044)	(3.783)	(1.529)	(14.96)
Const.	-67.05***	-240.4***	-12.59***	-67.05***	-16.58***	-12.81***	-3.759***	-7.825
	(12.28)	(18.95)	(4.226)	(10.87)	(2.785)	(2.265)	(1.133)	(15.56)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓
N	9264	9264	9264	9264	9264	9264	9264	9264
R^2	0.903	0.933	0.887	0.924	0.911	0.922	0.423	0.368
$M^{Rural} = M^{Sec.cit}$	0.161	0.860	7.160***	4.577**	0.776	4.197**	6.386**	1.269
	0.688	0.354	0.007	0.032	0.378	0.041	0.012	0.260
$M^{Rural} = M^{DSM}$	0.117	11.20***	11.39***	6.574**	0.430	10.18***	3.984**	0.033
	0.732	0.001	0.001	0.010	0.512	0.001	0.046	0.857
$M^{Sec.\ Cit.} = M^{DSM}$	0.359	3.610*	0.634	1.747	0.316	1.477	0.525	0.891
	0.549	0.058	0.426	0.186	0.574	0.224	0.469	0.345

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C5: Changes in the consumption of food subgroups (2008/09-2012/13) – Pathways (moving out of agriculture)

	ΔRice	ΔMaize	ΔCereal products	ΔCassava	ΔSweet potatoes	ΔCooking bananas	ΔNon-alc. beverages	ΔAlc. beverages
Baseline cons.	*230.08*	*933.62*	*35.77*	*283.26*	*46.66*	*42.88*	*4.61*	*46.53*
M^{Rural}	21.61	-36.16	-9.256	24.08	-3.752	-7.619	1.767	24.31
	(28.31)	(46.76)	(8.776)	(30.04)	(7.073)	(6.001)	(2.099)	(25.89)
$M^{Sec. Cit.}$	72.87	-59.92	74.83***	-96.46**	-8.126	-17.32*	23.70***	-5.932
	(53.00)	(101.5)	(25.89)	(43.57)	(11.17)	(10.38)	(8.706)	(27.17)
M^{DSM}	9.207	-264.0***	88.37***	-151.3**	-3.197	-43.48***	18.08***	33.82
	(73.99)	(99.66)	(33.17)	(61.93)	(7.281)	(13.08)	(6.810)	(38.90)
ΔFarm	105.1***	-103.0**	38.77***	-96.75***	-6.641	-5.730	6.911***	-39.69*
	(27.93)	(45.19)	(12.56)	(26.79)	(7.276)	(6.490)	(2.175)	(20.71)
Const.	-6.257	-165.5***	2.642	-69.43***	-10.05***	-6.735***	-0.501	-2.867
	(9.737)	(15.60)	(3.260)	(8.720)	(2.365)	(2.064)	(1.092)	(13.64)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368
R^2	0.886	0.927	0.876	0.919	0.906	0.915	0.416	0.368
$M^{Rural} = M^{Sec.cit}$	0.753	0.050	9.829***	5.656***	0.099	0.688	6.010**	0.828
	0.385	0.823	0.002	0.017	0.754	0.407	0.014	0.363
$M^{Rural} = M^{DSM}$	0.024	4.789**	8.556***	5.962**	0.004	7.045***	5.536**	0.050
	0.877	0.029	0.003	0.015	0.951	0.008	0.019	0.823
$M^{Sec. Cit.} = M^{DSM}$	0.520	2.275	0.105	0.582	0.147	2.648	0.265	0.770
	0.471	0.132	0.746	0.445	0.702	0.104	0.607	0.380

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C6: Changes in the consumption of food subgroups (2008/09-2012/13) – Pathways (hh. Composition)

	ΔRice	ΔMaize	ΔCereal products	ΔCassava	ΔSweet potatoes	ΔCooking bananas	ΔNon-alc. beverages	ΔAlc. beverages
Baseline cons.	*230.08*	*933.62*	*35.77*	*283.26*	*46.66*	*42.88*	*4.61*	*46.53*
M^{Rural}	14.01	-57.74	-10.59	16.35	-3.629	-9.606	1.858	23.60
	(28.60)	(45.33)	(8.769)	(29.77)	(7.111)	(5.919)	(2.121)	(25.36)
$M^{Sec. Cit.}$	86.69	-119.3	79.97***	-121.2***	-9.575	-20.71**	25.21***	-15.67
	(53.24)	(97.60)	(26.12)	(42.38)	(11.64)	(10.08)	(8.424)	(24.77)
M^{DSM}	0.900	-340.8***	90.94***	-169.0***	-5.271	-48.46***	19.95***	31.82
	(72.90)	(100.6)	(33.90)	(59.84)	(7.143)	(13.20)	(6.595)	(39.87)
Δ0-5	-13.88**	-57.49***	-2.928	-14.36**	0.490	-0.554	0.422	5.551
	(6.212)	(12.66)	(2.211)	(5.587)	(2.094)	(1.282)	(0.484)	(5.712)
Δ5-15	-32.23***	-14.57	-8.134***	-1.442	1.427	-3.388**	-0.995**	4.420
	(6.416)	(11.42)	(1.985)	(4.935)	(1.771)	(1.320)	(0.447)	(4.428)
Δ16-60	20.56***	34.74***	1.189	3.008	0.573	1.226	-0.794	-8.947*
	(6.957)	(11.81)	(2.563)	(5.237)	(1.567)	(1.371)	(0.577)	(5.283)
Δ61 +	-14.45	8.679	-8.997**	66.36***	-1.687	4.706	-0.692	13.56
	(14.67)	(26.97)	(4.586)	(15.64)	(4.379)	(3.184)	(0.984)	(15.17)
Const.	44.88**	-166.0***	29.43***	-85.52***	-15.96***	-3.460	4.547**	-3.002
	(18.50)	(30.43)	(6.806)	(13.88)	(4.211)	(3.268)	(1.875)	(17.27)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368
R^2	0.887	0.928	0.876	0.920	0.906	0.916	0.416	0.368
$M^{Rural} = M^{Sec.cit}$	1.490	0.350	11.18***	7.477***	0.177	0.911	7.125***	1.443
	0.222	0.554	0.001	0.006	0.674	0.340	0.008	0.230
$M^{Rural} = M^{DSM}$	0.028	7.154**	8.932***	6.887***	0.034	7.997***	7.191***	0.034
	0.868	0.008	0.003	0.009	0.853	0.005	0.007	0.854
$M^{Sec. Cit.} = M^{DSM}$	0.951	2.696	0.067	0.452	0.112	3.007*	0.236	1.075
	0.330	0.101	0.796	0.501	0.738	0.083	0.627	0.300

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table C7: Changes in diet diversity (2008/09-2012/13) - Pathways

	ΔCount (items)	ΔBI (items)	ΔCount (groups)	ΔBI (groups)
Baseline level	*11.654*	*0.656*	*7.570*	*0.534*
M^{Rural}	-0.392	0.006	-0.021	0.003
	(0.329)	(0.014)	(0.163)	(0.015)
$M^{Sec. Cit.}$	-0.103	0.005	-0.200	-0.038
	(0.829)	(0.029)	(0.330)	(0.027)
M^{DSM}	0.538	0.0342	-0.134	0.006
	(0.900)	(0.034)	(0.475)	(0.035)
ΔFarm	2.090***	0.060***	0.684***	0.050***
	(0.278)	(0.013)	(0.129)	(0.011)
ΔLn(exp.)	0.401	-0.026*	-0.137	-0.045***
	(0.356)	(0.015)	(0.173)	(0.015)
Δ0-5	0.144	0.005	0.126***	0.006*
	(0.107)	(0.004)	(0.049)	(0.004)
Δ5-15	0.0537	-0.004	-0.025	0.000
	(0.079)	(0.003)	(0.037)	(0.003)
Δ16-60	0.295***	0.004	0.171***	0.003
	(0.091)	(0.004)	(0.039)	(0.003)
Δ 61 +	-0.468***	-0.012*	-0.252***	-0.005
	(0.167)	(0.008)	(0.081)	(0.008)
Const.	-2.179***	-0.065***	-0.783***	-0.064***
	(0.311)	(0.013)	(0.140)	(0.012)
Controls	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓
N	9264	9264	9264	9264
R^2	0.891	0.882	0.876	0.866
$M^{Rural} = M^{Sec.cit}$	0.111	0.000	0.247	1.972
	0.740	0.994	0.619	0.160
$M^{Rural} = M^{DSM}$	0.947	0.627	0.053	0.005
	0.331	0.428	0.819	0.943
$M^{Sec. Cit.} = M^{DSM}$	0.289	0.466	0.014	1.123
	0.591	0.495	0.907	0.289

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix D: Robustness checks

Table D1 : Change in the share of food groups (2008/09-2012/13)

	ΔCereals	ΔRoots, tubers	ΔSugar, sweets	ΔPulses, nuts, seeds	ΔFruits, veg.	ΔMeat, fish, dairy	ΔOils, fats	ΔBev.	ΔMeals /snacks cons. Outs.
Baseline share	*52.58 %*	*16.73 %*	*3.59 %*	*11.47 %*	*2.73 %*	*5.85 %*	*3.73 %*	*1.70 %*	*1.68%*
M^{Rural}	0.960	-0.935	0.409*	-0.627	-0.294	-0.733	0.0119	0.651	-0.213
	(1.564)	(1.282)	(0.247)	(0.680)	(0.281)	(0.478)	(0.228)	(0.574)	(1.553)
$M^{Sec. Cit.}$	1.557	-8.625***	0.299	-1.743	-0.553	-0.784	-0.00835	0.215	10.07***
	(3.833)	(1.984)	(0.474)	(1.167)	(0.446)	(0.890)	(0.681)	(0.732)	(3.785)
M^{DSM}	-4.243	-10.26***	2.224***	-0.685	0.0687	-0.635	0.206	1.092	11.21***
	(3.825)	(2.075)	(0.681)	(1.407)	(0.539)	(0.948)	(0.547)	(0.881)	(4.196)
Const.	2.207***	-1.862***	-0.581***	-0.0156	0.163	-0.185	-1.989***	-0.243	2.478***
	(0.608)	(0.396)	(0.0829)	(0.230)	(0.103)	(0.163)	(0.0908)	(0.318)	(0.624)
Contr.	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368	8937
R^2	0.836	0.887	0.906	0.908	0.907	0.888	0.912	0.486	0.551
$M^{Rural} = M^{Sec.cit}$	0.022	11.32***	0.0439	0.714	0.257	0.002	0.001	0.235	6.308**
	0.884	0.001	0.834	0.398	0.612	0.960	0.977	0.628	0.012
$M^{Rural} = M^{DSM}$	1.703	15.18***	6.406**	0.001	0.389	0.009	0.111	0.206	7.139***
	0.192	0.000	0.011	0.969	0.533	0.923	0.739	0.650	0.008
$M^{Sec. Cit.} = M^{DSM}$	1.207	0.343	5.515**	0.333	0.820	0.013	0.063	0.614	0.041
	0.272	0.558	0.019	0.564	0.365	0.909	0.802	0.433	0.839

Food consumption is expressed in kcal. per adult equivalent per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D2 : Change in the share of food subgroups (2008/09-2012/13)

	ΔRice	ΔMaize	ΔCereal products	ΔCassava	ΔSweet potatoes	ΔCooking bananas	ΔNon-alc. beverages	ΔAlc. beverages
Baseline share	*9.78 %*	*37.72 %*	*1.48 %*	*12 %*	*2.01 %*	*2.06 %*	*1.51 %*	*0.19 %*
M^{Rural}	1.122	-0.767	-0.226	-1.288	0.489	-0.0925	0.113	0.539
	(0.973)	(1.649)	(0.330)	(1.200)	(0.399)	(0.249)	(0.0771)	(0.567)
$M^{Sec. Cit.}$	3.793*	-5.714	3.787***	-7.660***	0.200	-0.907**	1.066***	-0.851
	(2.095)	(3.896)	(0.974)	(1.877)	(0.459)	(0.447)	(0.352)	(0.607)
M^{DSM}	2.544	-7.987**	3.444***	-7.576***	-0.963*	-1.617***	0.655***	0.437
	(2.593)	(3.964)	(0.916)	(2.017)	(0.523)	(0.446)	(0.218)	(0.847)
Const.	1.474***	0.393	0.472***	-1.523***	-0.106	-0.230***	0.00808	-0.251
	(0.344)	(0.620)	(0.108)	(0.367)	(0.134)	(0.0892)	(0.0385)	(0.315)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368
R^2	0.873	0.868	0.901	0.893	0.877	0.913	0.528	0.476
$M^{Rural} = M^{Sec.cit}$	1.395	1.434	15.57***	8.750***	0.249	2.582	6.551**	3.103*
	0.238	0.231	0.000	0.003	0.618	0.108	0.011	0.078
$M^{Rural} = M^{DSM}$	0.271	2.778*	15.15***	7.317***	5.038**	9.810***	5.786**	0.012
	0.603	0.096	0.000	0.007	0.025	0.002	0.016	0.913
$M^{Sec. Cit.} = M^{DSM}$	0.148	0.174	0.0681	0.001	2.995*	1.332	0.957	1.629
	0.700	0.676	0.794	0.975	0.084	0.248	0.328	0.202

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D3: Change in the consumption of food groups (2008/09-2012/13)

	ΔCereals	ΔRoots, tubers	ΔSugar, sweets	ΔPulses, nuts, seeds	ΔFruits, veg.	ΔMeat, fish, dairy	ΔOils, fats	ΔBev.	ΔMeals /snacks cons. Outs.
Baseline cons.	*1,285.87*	*388.41*	*78.59*	*271.14*	*63.78*	*134.15*	*87.03*	*51.14*	*51.74*
M^{Rural}	3.167	4.265	11.36^{*}	-8.174	-35.93^{**}	-12.05	-5.343	23.14	-3.427
	(53.73)	(31.64)	(6.123)	(6.595)	(17.96)	(12.89)	(6.406)	(25.63)	(37.51)
$M^{Sec. Cit.}$	84.17	-169.1^{***}	7.991	-13.66	-31.13	8.709	-7.982	-1.254	246.5^{***}
	(126.4)	(48.39)	(10.58)	(10.41)	(36.66)	(25.36)	(20.81)	(28.36)	(86.11)
$M^{DSM-Mwanza}$	-209.6	-234.6^{***}	51.78^{***}	6.676	-31.25	17.26	8.409	39.89	266.5^{***}
	(139.8)	(55.03)	(17.66)	(13.57)	(48.57)	(27.34)	(14.59)	(37.53)	(96.07)
Const.	-180.6^{***}	-98.40^{***}	-20.26^{***}	-4.785^{*}	-39.26^{***}	-20.78^{***}	-51.28^{***}	-6.396	36.94^{**}
	(17.38)	(9.066)	(1.851)	(2.521)	(5.815)	(3.863)	(2.462)	(13.63)	(15.71)
Contr.	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368	8937
R^2	0.916	0.919	0.890	0.912	0.912	0.890	0.909	0.369	0.477
$M^{Rural} = M^{Sec.cit}$	0.366	9.340^{***}	0.080	0.212	0.014	0.476	0.0149	0.453	7.053^{***}
	0.545	0.002	0.777	0.645	0.905	0.490	0.903	0.501	0.008
$M^{Rural} = M^{DSM}$	2.144	13.13^{***}	4.969^{**}	1.061	0.008	1.019	0.746	0.163	7.496^{***}
	0.143	0.000	0.026	0.303	0.927	0.313	0.388	0.687	0.006
$M^{Sec. Cit.} = M^{DSM}$	2.570	0.842	4.821	1.483	0.000	0.053	0.436	0.809	0.024
	0.109	0.359	0.028	0.223	0.998	0.818	0.509	0.368	0.876

Food consumption is expressed in kcal. per capita per day.

Standard errors in parentheses.

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

Table D4: Change in the consumption of food subgroups (2008/09-2012/13)

	ΔRice	ΔMaize	ΔCereal products	ΔCassava	ΔSweet potatoes	ΔCooking bananas	ΔNon-alc. beverages	ΔAlc. beverages
Baseline cons.	*230.08*	*933.62*	*35.77*	*283.26*	*46.66*	*42.88*	*4.61*	*46.53*
M^{Rural}	31.57	-46.10	-5.562	15.05	-4.590	-8.241	2.330	20.81
	(28.44)	(46.18)	(8.681)	(29.93)	(6.986)	(5.911)	(2.102)	(25.56)
$M^{Sec. Cit.}$	110.0**	-112.0	90.87***	-147.9***	0.499	-18.02*	30.81***	-32.07
	(55.93)	(103.3)	(28.64)	(45.76)	(9.427)	(10.54)	(9.285)	(25.87)
$M^{DSM+Mwanza}$	69.29	-261.5***	101.8***	-167.6***	-20.41*	-43.64***	16.61***	23.28
	(68.79)	(97.95)	(29.06)	(52.71)	(11.95)	(12.28)	(6.086)	(37.16)
Const.	3.792	-175.7***	6.401**	-78.74***	-10.79***	-7.358***	0.110	-6.505
	(9.377)	(15.13)	(2.978)	(8.582)	(2.101)	(1.844)	(1.090)	(13.56)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓
N	9368	9368	9368	9368	9368	9368	9368	9368
R^2	0.884	0.926	0.874	0.918	0.906	0.915	0.416	0.368
$M^{Rural} = M^{Sec.cit}$	1.624	0.358	10.49***	9.204***	0.204	0.654	8.695***	2.399
	0.203	0.550	0.001	0.002	0.651	0.419	0.003	0.121
$M^{Rural} = M^{DSM}$	0.252	4.327**	13.22***	8.219***	1.156	7.449***	5.292**	0.004
	0.616	0.038	0.000	0.004	0.282	0.006	0.021	0.952
$M^{Sec. Cit.} = M^{DSM}$	0.222	1.174	0.072	0.084	1.985	2.613	1.595	1.596
	0.638	0.279	0.788	0.772	0.159	0.106	0.207	0.207

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D5: Changes in diet diversity (2008/09-2012/13)

	ΔCount (items)	ΔBI (items)	ΔCount (groups)	ΔBI (groups)
Baseline	11.651	*0.656*	*7.568*	*0.534*
M^{Rural}	-0.268	0.010	0.003	-0.002
	(0.344)	(0.015)	(0.170)	(0.015)
$M^{Sec. Cit.}$	0.860	0.043	-0.025	-0.030
	(0.847)	(0.030)	(0.382)	(0.028)
$M^{DSM+Mwanza}$	1.593*	0.040	0.166	-0.010
	(0.917)	(0.033)	(0.417)	(0.032)
Const.	-0.298***	-0.040***	-0.0188	-0.035***
	(0.110)	(0.005)	(0.055)	(0.005)
Controls	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓
N	9368	9368	9368	9368
R^2	0.869	0.864	0.853	0.853
$M^{Rural} = M^{Sec.cit}$	1.581	0.962	0.005	0.806
	0.209	0.327	0.945	0.369
$M^{Rural} = M^{DSM}$	3.648*	0.704	0.137	0.046
	0.056	0.402	0.711	0.830
$M^{Sec. Cit.} = M^{DSM}$	0.357	0.004	0.120	0.245
	0.550	0.951	0.730	0.621

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D6: Change in the consumption of food groups (2008/09-2012/13)

	ΔTotal	ΔCereals	ΔRoots, tubers	ΔSugar, sweets	ΔPulses, nuts, seeds	ΔFruits, veg.	ΔMeat, fish, dairy	ΔOils, fats	ΔBev.	ΔMeals /snacks cons. Outs.
Baseline cons.	*2411..89*	*1287.93*	*385.97*	*78.82*	*272*	*63.86*	*134.40*	*87.34*	*51.37*	*51.73*
Ln(Pop.density)	-6.769	-32.59	-74.77^{***}	9.590^{***}	-15.31^{*}	-4.027	-3.755	3.931	-4.276	115.8^{***}
	(33.55)	(26.76)	(15.51)	(2.748)	(9.000)	(2.518)	(5.136)	(3.650)	(6.701)	(25.18)
Const.	-374.3^{***}	-158.5^{***}	-46.44^{***}	-25.55^{***}	-31.27^{***}	-3.845	-20.07^{***}	-54.85^{***}	-1.798	-40.16^{*}
	(37.29)	(25.08)	(12.99)	(2.592)	(8.454)	(2.914)	(5.367)	(3.595)	(14.98)	(22.19)
Contr.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
N	9309	9309	9309	9309	9309	9309	9309	9309	9309	8886
R^2	0.848	0.916	0.919	0.893	0.914	0.917	0.891	0.912	0.369	0.482

Food consumption is expressed in kcal. per capita per day.

Standard errors in parentheses.

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

Table D7: Change in the consumption of food subgroups (2008/09-2012/13)

	ΔRice	ΔMaize	ΔCereal products	ΔCassava	ΔSweet potatoes	ΔCooking bananas	ΔNon-alc. beverages	ΔAlc. beverages
Baseline cons.	*231.15*	*934.08*	*35.88*	*281.03*	*46.22*	*43.10*	*4.62*	*46.75*
Ln(Pop.density)	6.982	-54.94***	28.12***	-68.20***	-3.730**	-3.441	7.102***	-11.38*
	(15.29)	(19.36)	(6.654)	(15.12)	(1.888)	(2.146)	(1.864)	(6.360)
Const.	4.461	-145.9***	-12.38**	-30.43**	-8.533***	-5.755**	-4.152***	2.354
	(13.77)	(20.42)	(5.193)	(12.52)	(2.540)	(2.295)	(1.510)	(14.87)
Controls	✓	✓	✓	✓	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓	✓	✓	✓	✓
N	9309	9309	9309	9309	9309	9309	9309	9309
R^2	0.886	0.927	0.874	0.918	0.906	0.914	0.413	0.368

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D8: Changes in diet diversity (2008/09-2012/13)

	ΔCount (items)	ΔBI (items)	ΔCount (groups)	ΔBI (groups)
Baseline	*11.659*	*0.656*	*7.569*	*0.534*
Ln(Pop.density)	0.296	-0.000	-0.007	-0.009
	(0.223)	(0.009)	(0.106)	(0.008)
Const.	-0.480***	-0.037***	0.008	-0.028***
	(0.179)	(0.008)	(0.087)	(0.007)
Controls	✓	✓	✓	✓
IHHFE	✓	✓	✓	✓
N	9309	9309	9309	9309
R^2	0.871	0.866	0.856	0.856

Food consumption is expressed in kcal. per capita per day.
Standard errors in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$