Exploring the effects of increasing underutilized crops on consumers’ diets: The case of millet in Uganda

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Abstract:

Known in the literature as neglected, underutilized or orphan crops, they have been cited as having the potential to improve food security; however, the literature also highlighted that consumers in developing countries are increasingly abandoning their traditional diets, where those crops are part of and replacing them by western diets. In that context, the purpose of this paper is to investigate the implications of expanding the consumption of neglected crops on current diets by considering consumers’ preferences and uses a modified version of the microeconomic consumer problem, which was augmented with linear constraints using generalized rationing theory. The method was applied to the consumption of millet by three Ugandan socioeconomic groups: rural, urban-poor and urban-affluent. The results indicate that millet can contribute to improve the intake of macronutrients and some micronutrients. However, the results also show that under the current preferences increasing substantially the quantity of millet in the diet will require a significant reduction of its price and the net impact on nutrition, as measure by the mean adequacy ratio, will be only slightly positive for the rural and urban-poor households; this points out the importance of work encouraging consumers’ appreciation for millet as part of the everyday diet.

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Abstract

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Keywords: Underutilized crops, millet, consumption, generalized rationing theory, Sub-Saharan Africa, Uganda.

I. Introduction

Green Revolution research focused on yields of a few staple crops, supporting the production of enough affordable calories for many human populations (AOCC, 2016). This, however, was at the expense of research into yield and quality improvement and resilience of so-called orphan crops that often have a better balance of essential nutrients than staples.

Some of these orphan crops have the capacity to be used in the management/feeding of farmed animals, food processing and the wider food system (e.g., Qaim, 1999; Dawson et al., 2009; ATDF, 2009). They also can be produced in more sustainable ways than major staples that do not fully consider external costs to the environment (Dawson et al., 2009; AOCC, 2016).

The current strategy regarding orphan crops can be represented by the African Orphan Crops Consortium (AOCC, 2016), which focuses on applying crop improvement genetics to annual and perennial orphan food crops to increase their resilience to climate change, improve their productivity and quality under an assumption that the resultant diversity of a range of such crops can be translated into a higher consumption diversity. However, Sibhatu et al. (2015) found in rural areas that greater production diversity was not necessarily reflected in greater dietary diversity of such products. The connection between production and consumption may be even more tenuous in urban areas due to the adoption of western diets (e.g., Hawkes, 2006; Moodie et al., 2013) displacing more traditional diets that include more orphan crops (e.g., Worku et al., 2017). Other factors explaining changes in diets over recent decades include the increased power of multi-national food companies, government subsidy patterns that support major staple crop production, farm mechanisation, the consolidation of plant breeding companies and limited investments in breeding programmes for orphan and new crops (Khoury et al., 2014).

The uptake of orphan crops by consumers (demand side) is important because it helps ensure producers a fair and sustainable return for their products, connecting them with markets, itself an effective tool against poverty (African Development Bank Group, 2016). In addition, the supply of products that respond to consumer preferences can also be seen as an effective tool to support healthy diets in situations where consumers face complex choices. This is needed as Africa's consumer markets are showing an expansion of ultraprocessed products (Moodie et al., 2013), which as noted above are displacing more traditional dietary patterns (based on fresh and perishable whole or minimally processed foods, some of which are orphan crops, consumption of such products are more suitable socially, environmentally and nutritionally), a fact that could be associated to increasing levels of non-communicable diseases (The Guardian, 2013).

Most of the support to increase the amounts consumed of orphan crops has been from "supply side" researchers (e.g., Dawson et al., 2009; Mayes et al., 2011; Cheng et al., 2017), who have focused on highlighting their nutritional and environmental properties to justify additional work improving the characteristics of those crops (e.g., yields, agronomic properties, environmental impact). However, it is important to note that increasing the consumption of orphan crops in the diet may bring changes in its composition (e.g., through the relationship with other products and also by the satisfaction of a budget constraint), and therefore, in the nutrients intake. Therefore, an evaluation of the nutritional advantages of orphan crops should be done in the context of the diet and not in isolation.

Based on the aforementioned context the purpose of this paper is to investigate the implications of expanding the consumption of neglected crops on current diets by considering consumers' preferences in the form of price and income elasticities and a modified version of the microeconomic consumer problem, which was augmented with linear constraints using generalized rationing theory (Jackson, 1991; Irz et al., 2015).

The above method was applied to a case study, i.e., the consumption of millet in Uganda. The choice of millet was due not only to the fact that it is one of the selected cereal orphan crops for research by the African Orphan Crops Consortium (AOCC, 2016) and cereals contribute over 40 per cent of total direct human dietary calorie intake in Eastern Africa (Gierend and Orr, 2015), but also because it is within the international mandate of the CGIAR (formerly the Consultative Group for International Agricultural Research) group and in particular ICRISAT (Gierend and Orr, 2015).

The selection of Uganda was due to the contraction on the apparent consumption of millet over time (according to FAOSTAT figures has been decreasing at a rate of 4.7 per cent per year since 1968)[1]. In addition, the Government of Uganda is interested to expand the production and consumption of millet as shown on the work at the Mukono Zonal Agricultural Research Institute (Muzardi), where they are working with millet varieties originated from China as part of a partnership between Uganda and China, which is supported by the UN Food and Agriculture Organisation (FAO) to transfer expertise and exchange technology between the countries (GlobalFoodMate, 2013).

The structure of the paper is as follows: it starts reviewing the consumption of millet in the Sub-Saharan Africa, as it is the selected orphan crop to study. Then, it turns to the case of Uganda and briefly describes its consumption patterns. It is followed by the methods and data used to evaluate the implication of increasing the consumption of millet. The next section discusses the results and the last section presents the conclusions.

II. Consumption of millet in Sub-Saharan Africa

Figure 1 shows the apparent per capita consumption of millet, maize and wheat in six Sub-Saharan countries (i.e., Ethiopia, Kenya, Malawi, Nigeria, Tanzania and Uganda) for the period 1961 to 2013.

Despite its role on African regional diets, with the exception of Ethiopia and Malawi where the figures show an increasing apparent consumption, all the other countries show decreasing trends. Moreover in all the countries, the differences in the consumption of millet with respect to that of maize and wheat are quite significant.

The number of studies analysing the consumption of millets in Sub-Saharan Africa in limited, an exception is the study by Gierend and Orr (2015) for ICRISAT, which focussed on the demand for millet and sorghum in Eastern and Southern Africa. They show that while the per capita consumption on the region is static, there are differences between the four countries they studied (i.e., Ethiopia, Kenya, Tanzania and Uganda). In Kenya and Tanzania, consumption per capita between 2000 and 2013 did not change. In Ethiopia, however, the annual consumption rose from 4.5 kg/head in 2000 to 8.0 kg/head in 2013, while in Uganda consumption per head fell from 29 to 5 kg/head in just over the decade.

[1] This significant decrease happens despite the fact that millet is described as a staple food crop for many communities in different parts of Uganda (e.g., Northern, Western and Eastern regions), where besides being grown for food and to earn an income, it is also central to many cultural practices such as child naming, traditional marriage ceremonies, and welcoming special guests (GlobalFoodMate, 2013).

Figure 1 - Apparent per capita per day consumption of millet, maize and wheat and their products in selected Sub Saharan African countries

Figure 1.a - Ethiopia

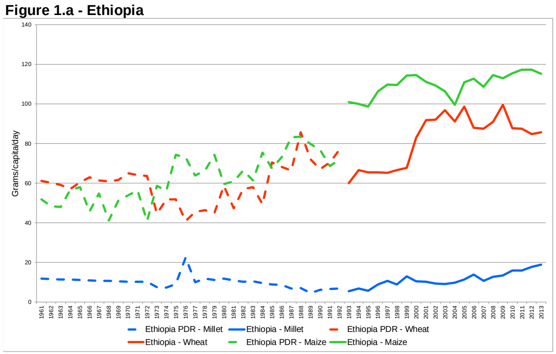


Figure 1.b - Kenya

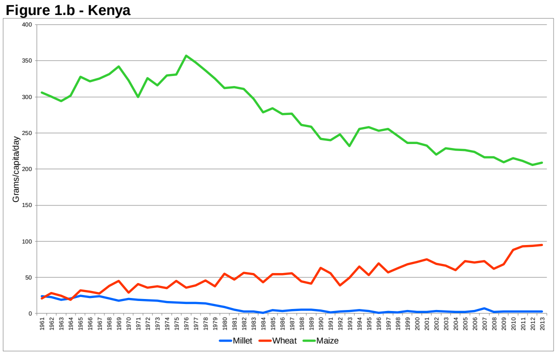


Figure 1.c - Malawi

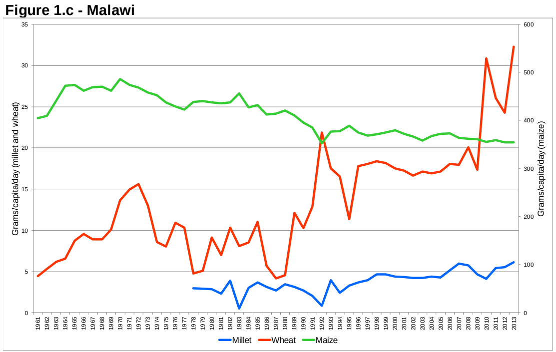


Figure 1.d - Nigeria

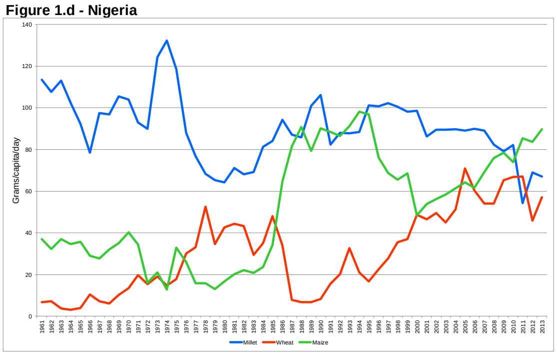


Figure 1.e - Tanzania

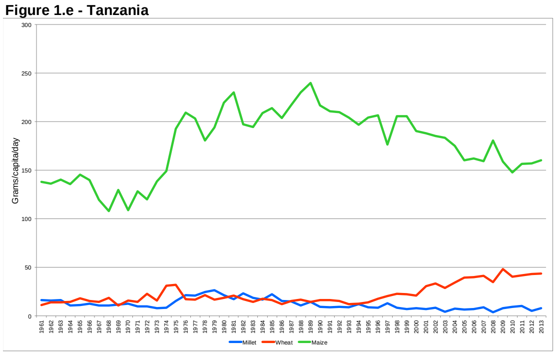
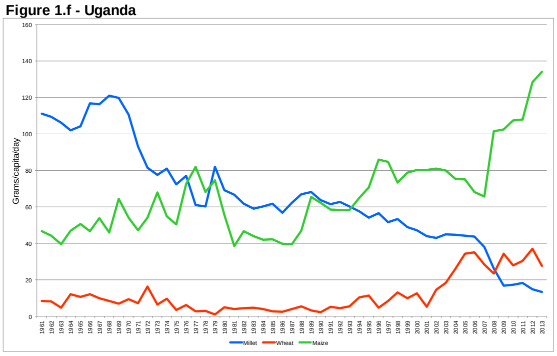


Figure 1.f - Uganda



Source: Based on FAOSTAT data.

Gierend and Orr (2015) found that millet consumption was biased towards rural areas and consumption of millets was concentrated in the rural areas where millets were grown. Considering all their studied countries, consumption averaged 7.2 kg/head in rural areas compared to 3.7 kg/head in urban areas. This rural bias was strongest in Ethiopia, where rural consumption averaged 10.6 kg/head compared to 3.3 kg/head in urban areas. In Kenya, 33 per cent of consumer demand for millet was urban, and urban demand was also high in Uganda (24 per cent) and Tanzania (17 per cent). Urban demand for millets was highest in Tanzania (46,000 tonnes) followed by Uganda (43,000 tonnes), Ethiopia (42,000 tonnes), and Kenya (21,000 tonnes).

As regards the relationship of millet consumption and income groups, Gierend and Orr (2015) found that the consumer demand for millets rose with income in all four countries. They explained this finding as a reflection of the appreciation for millet's taste and nutritional value, which is also shown on the fact that millet is not considered an inferior good (i.e., its consumption increases with income). This evidence was the strongest in Tanzania, where millet consumption averaged 10 kg/head in the high income group compared to 3.2 kg/head in the low income group. In Kenya, the difference in consumption between the high and low income groups was smallest (1.7 and 1.6 kg/head).

III. Increasing consumption of millet in Uganda's diet

This section starts with a brief description of Uganda's consumption patterns, followed by the methods and data used to analyse the increase of millet in Uganda's diet.

III.1 Uganda consumption patterns

The 2013 Comprehensive Food Security and Vulnerability Analysis (CFSVA) for Uganda (UBOS and WFP, 2013) using household survey data from 2009/2010 assessed that 48 per cent of the population consumes less than the required daily amount of calories, which is similar across all regions.

39 per cent of households have low dietary diversity as their diet consists of only four or less food groups out of seven (cereals, tubers; pulses, nuts; vegetables; fruits; milk; meat, fish, eggs; oil) a week, which varies from 22 per cent in Kampala to 55 per cent in the Western region. Rural and urban Ugandans depend for 71 per cent and 59 percent, respectively, of their food energy on staples. For 48 per cent of rural and 20 per cent of urban households, staple dependency even exceeds 75 per cent.

Generally, rural households are more likely to be food insecure, as reflected in most indicators, except calorie deficiency. Geographically, the Northern region has the highest incidence of food insecurity indicated by several measures. The Western region has a particularly high prevalence of low dietary diversity.

According to the CFSVA, Ugandans consume a large variety of staples in which matooke, cassava, maize as well as sweet potatoes are the most important ones in terms of calories. Rice and wheat are increasingly consumed particularly by urban and higher income households. Cereals are eaten daily, vegetables six times, pulses four times and fruits, meat, fish and milk two times a week in an average Ugandan diet.

Furthermore, the study notes that based on cross-sectional household survey data, monetary poverty is closely related to food insecurity in Uganda. The likelihood of being food energy deficient, having low dietary diversity and depending on staples as the major food energy source increases with declining household income.

This brief overview of Uganda's diet highlights that two major dimensions when studying the diet are the differentiation by rural/urban by income one. These dimensions need to be later reflected in the empirical analysis.

III.2 Methods

The methodology to evaluate the effects of increasing the consumption of millet in the Ugandan diet is based on Irz et al. (2015, 2016) who adapted the work by Jackson (1991) on generalized rationing theory to the case of linear constraints, and extended it by deriving the comparative statics results necessary to empirically estimate healthy diets compatible with consumer preferences.

The starting point of the methodology is neoclassical consumer theory that assumes that an individual chooses the consumption of H goods in quantities $x = (x_1,..., x_H)$ to maximize a strictly increasing, strictly quasi-concave, twice differentiable utility function $U = U(x_1,..., x_H)$, subject to a linear budget constraint $p \cdot x \leq M$, where p is a price vector and M denotes income. In addition, departing from the standard model, the consumer faces N additional linear constraints.

Those N constraints could be, for instance, maximum dietary intakes of nutrients (e.g., salt, total fat, saturated fat, or free sugars), and their linearity implies an assumption of constant nutritional coefficients for any food i and nutrient n, the value of which is known from food composition tables. The constraints could also be food-based constraints (such as recommendations on consumption of fruit and vegetables or starchy products). The additional N constraints are expressed as:

$$(1) \qquad \sum_{i=1}^{H} a_i^n x_i \leq r_n \qquad n = 1,..., N$$

The method to solve the modified utility maximisation problem relies on the notion of shadow prices, i.e., prices that would have to prevail for the unconstrained individual to choose the same bundle of goods as chosen when adding the constrains in (1). Duality theory is used to relate constrained and unconstrained problems in order to identify the properties of demand functions under additional constraints. Let the compensated (Hicksian) demand functions of the standard problem be by $h_i(p,U)$, and those of the constrained model $\tilde{h}_i(p,U,A,r)$, where A is the $(N \times H)$ matrix of coefficients in (1), and r the N-vector of maximum amounts. By definition of the vector of shadow prices $\tilde{p}$, the following equality holds:

$$(2) \qquad \tilde{h}_i(p,U,A,r) = h_i(\tilde{p},U)$$

The minimum-expenditure function of the constrained problem $\tilde{C}(p,U,A,r)$ can be related to the ordinary expenditure function $C(p,U)$ through the following steps, using (3):

$$(3) \qquad \tilde{C}(p,U,A,r) = \sum_{j=1}^{H} p_j \tilde{h}_j(p,U,A,r) = C(\tilde{p},U) + \sum_{j=1}^{H} (p_j - \tilde{p}_j) h_j(\tilde{p},U)$$

The constrained regime is fully characterised by the combination of the unconstrained demand functions, unconstrained expenditure function and the shadow prices. The shadow prices can be calculated using the idea that they minimise the expenditure subject to the additional constraints. Thus, using (3), the Lagrange function of the constrained problem is given by (4):

$$(4) \qquad L = C(\tilde{p},U) + \sum_{j=1}^{H} (p_j - \tilde{p}_j) h_j(\tilde{p},U) + \sum_{n=1}^{N} \mu_n \left(r_n - \sum_{j=1}^{H} a_j^n h_j(\tilde{p},U) \right)$$

Assuming non-satiations so all the shadow prices are positive, the Kuhn-Tucker conditions derived from (4) are in (5):

$$(5) \qquad \begin{aligned} &\frac{\partial L}{\partial \tilde{p}_i} = \frac{\partial C}{\partial \tilde{p}_i} - h_i + \sum_{j=1}^{H} (p_j - \tilde{p}_j) \frac{\partial h_j}{\partial \tilde{p}_i} - \sum_{n=1}^{N} \mu_n \left(\sum_{j=1}^{H} a_j^n \frac{\partial h_j}{\partial \tilde{p}_i} \right) = 0 \qquad i = 1,\dots, H \\ &\frac{\partial L}{\partial \mu_n} = \mu_n \left(r_n - \sum_{j=1}^{H} a_j^n h_j \right) = 0 \qquad n = 1,\dots, N \\ &\mu_n \geq 0, \qquad n = 1,\dots, N \end{aligned}$$

Using Shephard's lemma and denoting $\partial h_i / \partial p_j$ (i.e., the Slutsky term) by s_{ij} the first equation in (5) becomes:

$$(6) \qquad \sum_{j=1}^{H} \left[(p_j - \tilde{p}_j) - \sum_{n=1}^{N} \mu_n a_j^n \right] s_{ji} = 0, \qquad i = 1,\dots, H$$

For (6) to hold it is necessary that the term in brackets to be equal to zero. Assuming all the N constraints are binding, the shadow price problem in (5) reduces to (7):

$$(7) \qquad \begin{aligned} &\tilde{p}_i = p_i - \sum_{n=1}^{N} \mu_n a_i^n, \qquad i = 1,\dots, H \\ &\sum_{i=1}^{H} a_i^n h_i(\tilde{p},U) = r_n, \quad n = 1,\dots, N \end{aligned}$$

Due to its non-linear nature (7) cannot be solved analyticaly; however, Irz et al. (2015) provide a method where the solution can be computed iteratively. In fact, they simulate the impact of adopting recommendations in a Marshallian context, i.e. holding income (or total expenditure) and prices constant. The structure of the solution procedure is as follows (Irz et al, 2015, provide the formulas for the case of N additional constraints):

a. Given a percentage change in the level of the additional constraints (i.e., the r_n), the changes in Hicksian demands are calculated ($\partial h / \partial r$).
b. The quantities (i.e., Hicksian quantities) thus obtained and original prices are then combined to calculate the compensating variation (CV)

associated to the imposition of the additional constraints. The CV is given by $C(p,U)-\tilde{C}(p,U,A,r)=-\sum_{n=1}^{N}\sum_{i=1}^{H}p_i\left(\frac{\partial h_i}{\partial r_n}\right)$.

c. The CV, which hypothetically would allow the consumer to maintain her utility level, is then removed to calculate the corresponding changes in the Marshallian demand (i.e., Δx) as: $\Delta x=\Delta h=\tilde{h}\cdot\eta\cdot\frac{CV}{p\cdot\tilde{h}}$.
d. Note that because the additional constraints are directly imposed on the Hicksian demands rather than Marshallian ones, there is no guarantee that the diets calculated in step c will satisfy the constraints. Therefore, there is the need to evaluate the constraints using the resulting Marshallian demands.
e. If this Marshallian solution satisfies the constraints, then the procedure finishes. If the solution does not satisfy the recommendation, the changes in the constraints need to be adjusted in the first step and the procedure run again.

In addition of solving the consumer problem of including higher quantities of millet in the diet, this study also estimated the change in the nutritional value of the diet (in contrast of the nutritional value of millet alone). This was done by computing the Mean Adequacy Ratio (MAR), which estimates the percentage of mean daily intake of beneficial nutrients with 100 per cent representing a diet which would conform to all of these nutritional requirements (Vieux et al., 2013). The nutrients used on the formula, chosen due to data availability, were 10, namely: calcium, iron, zinc, vitamin C, thiamine (vitamin B1), riboflavin (vitamin B2), niacin (vitamin B3), vitamin B6, folate and vitamin A. Note that the components of the MAR are truncated to 100 so excesses of one of the nutrients cannot compensate the lack of another nutrient. The formula of the MAR is given by (16), where c_i is the intake of nutrient i, R_i is the recommended intake of nutrient i.[2]

$$(16)\qquad MAR=\frac{1}{10}\times\sum_{i=1}^{10}\frac{c_i}{R_i}\times 100$$

To summarise, the method extends the theory of the consumer under rationing, showing that adjustments in consumption can be estimated by combining data on food consumption, price (Hicksian and Marshallian) and

[2] As the data is on per capita terms (i.e., not differentiated by male or female), it was not possible to evaluate the requirements by gender (see Omiat and Shively, 2007); therefore, the evaluated requirement were the maximum of the male and female. In addition, it should be noted due to lack of nutritional information it was not possible to compute the Mean Excess Ratio (MER), which is an indicator of bad nutritional quality (probably important for affluent groups). It is calculated as the mean daily percentage of maximum recommended values for three harmful nutrients, namely, saturated fats, sodium and free sugars (Vieux et al, 2013).

expenditure elasticities, as well as food composition data. In the next section the method is applied to analyse the case of millet on Uganda's diet.

III.3 Data and implementation

Given the consumption characteristics of Uganda's population the use of average elasticities, quantities, prices and food composition information is not the best approach; therefore, a compromise between the number of possible consumers' groups and the relevance of those groups was reached by considering three differentiated cases: rural consumers, poor urban consumers and affluent urban consumers.

Most of the required information for the three aforementioned groups was obtained from Boysen (2016), who estimated unconditional (Marshallian and Hicksian) own price elasticities and income (expenditure) elasticities for Uganda by expenditure quintile using a two-stage budgeting demand system including 1 non-food and 14 food items based on the 2012/2013 Ugandan National Household Survey (UNHS), a nationally representative survey of 6,887 households. In the first stage households allocate their consumption budget to food and non-food items. In the second budgeting stage, households allocate the food budget to 14 different item groups. Then, the three aforementioned consumers' groups were established as rural (i.e., average rural), poor urban group (i.e., average of information for the first three urban quintiles) and affluent urban group (i.e., average of the top two quintiles).

The 14 items groups in Boysen (2016) do not fully fit the purpose of this study due to the fact that millet is aggregated with other cereals in the groups of "other cereals", therefore, an additional budget stage was added by estimating several conditional demand systems and using the formulas of Carpentier and Guyomard (2001) to compute the unconditional budgetary third stage[3]. The structure of the final demand system can be seen in Figure 2, which considers a total of 28 categories.

The nutritional analysis (e.g., for the computation of the MAR) requires actual quantities and prices. A limitation of many Living Standard Measurement Surveys as the Uganda's is that the recorded quantities are not uniformed (e.g., quantities are recorded in the measurement provided by the interviewee and this can be small, medium or large buckets, heaps, clusters among other measurements) whilst the nutritional information is provided for specific weights (e.g., per 100 grams).[4] The approach adopted was to use the retail prices recorded by product by the Uganda Bureau of Statistics (UBOS) (2013), which cover the period analysed by Boysen (2016) and six price collection points in the country. These prices, which expressed in Uganda

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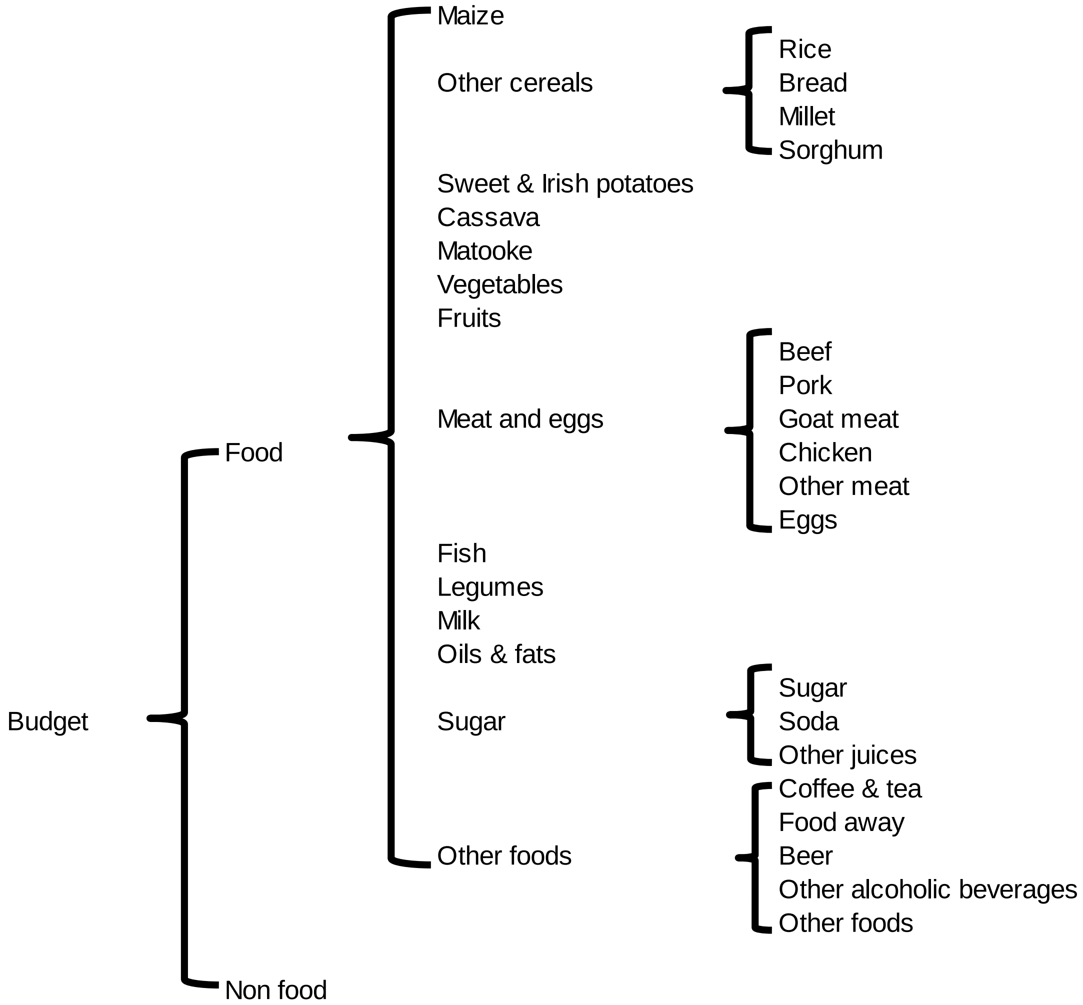
[3] Those conditional demand results are presented here as they are intermediate results to compute the unconditional elasticities but are available from the authors upon.

[4] Note that Boysen (2016) only provides relative prices and does not report quantities.

Shillings per metric unit, were used to obtain the quantities consumed of each one of the three studied groups.

Figure 2: Uganda augmented demand system



Source: Based on Boysen (2016)

Using the above procedure Table 1 was constructed, with information for the three studied groups. A remaining point was the computations of cross price elasticities, which are important because they represent the connection between the different products. The approach to compute them was to calibrate those elasticities using the Beghin et al. (2004), which allows estimate a demand system that is theoretically consistent with consumer theory.

Beghin et al. method is a flexible calibration technique for partial demand systems, combining the developments in incomplete demand systems (LaFrance and Hanemann, 1989; LaFrance, 1998) and a set of restrictions conditioned on the available elasticity estimates. The technique accommodates various degrees of knowledge on cross-price elasticities, satisfies curvature restrictions, and allows the recovery of an exact welfare measure for policy analysis (i.e., the equivalent variation).

Table 1: Uganda – Consumption by socioeconomic group

Goods	Units	**Rural**						**Urban-lower quintiles**						**Urban-upper quintiles**					
		Quantities	Prices	Total expenditure UGX	Own-Price Elasticity	Income Elasticities	Food shares	Quantities	Prices	Total expenditure UGX	Own-Price Elasticity	Income Elasticities	Food shares	Quantities	Prices	Total expenditure UGX	Own-Price Elasticity	Income Elasticities	Food shares
Millet	(Kg)	6.6	1,506.0	9,875.1	-1.228	0.950	0.0160	5.0	1,506.0	7,483.1	-1.011	0.596	0.0137	8.0	1,506.0	12,016.2	-1.014	0.405	0.0090
Maize	(Kg)	39.3	1,616.8	63,571.2	-1.450	1.010	0.1030	31.4	1,717.1	53,841.6	-1.427	0.713	0.0983	31.4	1,890.8	59,413.2	-1.730	0.430	0.0445
Rice	(Kg)	3.1	3,361.9	10,492.3	-1.207	0.949	0.0170	6.1	3,369.5	20,624.1	-0.976	0.596	0.0377	11.2	5,497.4	61,415.9	-0.977	0.405	0.0460
Bread	(500g)	2.5	1,962.2	4,937.6	-1.233	0.951	0.0080	5.9	1,975.0	11,680.9	-1.193	0.598	0.0213	32.7	1,855.3	60,748.4	-1.344	0.406	0.0455
Sorghum	(Kg)	9.9	1,615.0	16,047.1	-1.319	0.950	0.0260	4.7	1,703.2	8,030.6	-0.992	0.596	0.0147	1.4	1,397.5	2,002.7	-1.013	0.404	0.0015
Sweet & Irish potatoes	(Kg)	109.6	625.0	68,508.8	-0.990	1.030	0.1110	80.4	658.5	52,929.0	-0.703	0.773	0.0967	79.0	752.1	59,413.2	-0.405	0.500	0.0445
Cassava	(Kg)	94.0	807.4	75,915.2	-0.570	0.550	0.1230	47.8	816.5	39,057.9	-0.690	0.613	0.0713	38.3	836.8	32,043.1	-0.210	0.485	0.0240
Matooke	(Kg)	95.5	575.3	54,930.5	-0.950	1.530	0.0890	89.5	522.1	46,723.5	-1.263	1.263	0.0853	229.4	555.8	127,504.8	-0.905	0.715	0.0955
Vegetables	(Kg)	42.1	1,011.3	42,586.6	-0.470	0.050	0.0690	32.2	1,216.6	39,130.9	-0.637	0.427	0.0715	47.0	1,313.0	61,683.0	-0.470	0.225	0.0462
Fruits	(Kg)	18.9	1,110.4	20,984.7	-1.210	1.240	0.0340	16.1	1,202.2	19,346.5	-0.633	1.073	0.0353	37.5	1,636.0	61,415.9	-0.620	0.845	0.0460
Beef	(Kg)	3.1	7,268.2	22,219.1	-1.082	1.919	0.0360	3.4	7,331.3	24,986.1	-0.881	1.869	0.0456	13.0	7,541.9	98,065.2	-0.453	1.074	0.0735
Pork	(Kg)	0.7	8,304.2	6,172.0	-1.114	1.920	0.0100	0.7	8,021.0	5,292.9	-0.916	1.870	0.0097	1.6	7,467.4	12,283.2	-0.908	1.075	0.0092
Goat meat	(Kg)	0.9	8,633.3	7,406.4	-1.106	1.921	0.0120	0.6	8,638.2	5,292.9	-0.912	1.871	0.0097	2.0	8,836.5	18,024.2	-0.893	1.075	0.0135
Chicken	(Kg)	1.5	9,955.1	14,812.7	-1.122	1.920	0.0240	0.9	10,280.4	9,490.7	-0.873	1.870	0.0173	3.6	10,237.0	37,183.3	-0.824	1.075	0.0279
Other meat	(Kg)	0.1	10,000.0	1,234.4	-1.119	1.917	0.0020	0.1	10,000.0	730.1	-0.890	1.865	0.0013	0.3	10,000.0	2,670.3	-0.344	1.072	0.0020
Eggs	(2 eggs)	4.1	599.6	2,468.8	-1.139	1.934	0.0040	4.9	596.3	2,920.2	-0.994	1.880	0.0053	27.4	597.3	16,355.3	-0.949	1.079	0.0123
Fish	(Kg)	2.0	12,467.7	25,305.1	-1.370	1.620	0.0410	1.7	14,201.9	24,456.8	-1.330	1.513	0.0447	4.7	12,076.1	56,743.0	-1.250	1.045	0.0425
Pulses, legumes, nuts	(Kg)	27.5	2,675.4	73,569.8	-0.760	0.660	0.1192	25.3	2,629.4	66,416.7	-0.837	0.617	0.1213	32.5	2,913.3	94,794.2	-0.765	0.360	0.0710
Milk	(Ltr)	17.8	1,054.4	18,762.8	-1.420	1.550	0.0304	19.4	1,030.7	19,967.0	-1.400	1.383	0.0365	61.5	1,041.9	64,086.2	-1.180	0.755	0.0480
Oils & fats	(300ml)	4.2	3,096.2	12,961.1	-0.610	0.770	0.0210	7.9	2,075.5	16,316.7	-0.673	0.717	0.0298	12.8	2,712.7	34,713.4	-0.560	0.375	0.0260
Sugar	(Kg)	3.8	5,368.9	20,367.5	-0.946	1.170	0.0330	4.9	5,477.4	26,993.8	-1.038	0.747	0.0493	11.6	5,447.8	63,418.6	-0.975	0.545	0.0475
Soda	(300ml)	3.1	1,000.0	3,086.0	-0.965	1.170	0.0050	3.5	1,000.0	3,467.8	-0.973	0.746	0.0063	29.4	1,000.0	29,372.8	-0.977	0.545	0.0220
Other juices	(Ltr)	0.0	1,031.7	0.6	-0.818	1.174	0.0000	1.0	951.4	912.6	-0.982	0.747	0.0017	5.6	961.7	5,340.5	-0.988	0.545	0.0040
Coffee & tea	(Kg)	15.5	79.7	1,234.4	-0.947	1.077	0.0020	24.9	73.9	1,843.4	-0.927	1.360	0.0034	29.7	159.8	4,739.7	-0.845	1.099	0.0036
Food away	(Kg)	16.4	1,031.7	16,911.2	-1.565	1.081	0.0274	25.9	951.4	24,621.1	-0.887	1.364	0.0450	223.5	961.7	214,955.8	-0.899	1.106	0.1610
Beer	(500ml)	1.0	2,436.1	2,468.8	-0.683	1.078	0.0040	0.7	2,423.0	1,642.6	-0.733	1.359	0.0030	8.4	2,381.9	20,026.9	-0.291	1.103	0.0150
Other alcoholic beverages	(300ml)	9.2	1,003.1	9,257.9	-1.802	1.080	0.0150	2.9	1,002.9	2,920.2	-2.654	1.365	0.0053	4.7	1,003.1	4,673.0	-7.493	1.110	0.0035
Other foods	(500g)	8.7	1,270.4	11,109.5	-1.348	1.078	0.0180	34.8	299.3	10,421.5	-0.946	1.360	0.0190	7.5	2,679.7	20,026.9	-1.005	1.097	0.0150
Total annual per capita expenditure (000 UGX)				1,094.3						1,107.1						4,055.7			

Notes: The quantities are per capita per year. UGX stands for Uganda Shillings.
Sources: Boysen (2016), UBOS (2013).

For the purpose of completeness, a brief description of the calibration procedure is provided below, more detail is available at Beghin et al. (2004). The calibration approach builds on the Linquad structure (LaFrance et al., 2002) as the foundation for the partial demand system. The Linquad demand system is generated from the following expenditure function, $C(p, p_z, \theta)$[5]:

$$(8) \qquad C(p, p_z, \theta) = p'\varepsilon + \tfrac{1}{2}p'Vp + \delta(p_z) + \theta(p_z, U)e^{\chi' p}$$

Where $\delta(p_z)$ is an arbitrary real value function of p_z, i.e., the prices of all the other goods not considered on the incomplete demand system. $\theta(p_z, U)$ is the constant of integration, which is increasing in U, and χ, ε and V are the vectors and matrix of parameters to be recovered in the calibration. Applying Shepherd's lemma to (8) the Hicksian demands are obtained.

$$(9) \qquad h = \varepsilon + Vp + \chi\left[\theta(p_z, U)e^{\chi' p}\right]$$

The integrating factor, $\theta(p_z, U)e^{\chi' p}$, makes the demand system an exact system of partial differential equations. The Linquad expenditure function (8) provides a complete solution class to this system of differentials and represents the exhaustive class of expenditure functions generating demands for x that are linear in total income (M) and linear and quadratic in prices for x.

Solving the expenditure function (8) for $\theta(p_z, U)e^{\chi' p}$ and replacing expenditure with M for income yields the Linquad Marshallian demands (10):

$$(10) \qquad x = \varepsilon + Vp + \chi\left(M - \varepsilon' p - \tfrac{1}{2}p'Vp - \delta(p_z)\right)$$

Then, the Marshallian elasticities (ε_{ij}) are given by (11):

$$(11) \qquad \varepsilon_{ij} = \left[\nu_{ij} - \chi_i\left(\varepsilon_j + \sum_{k=1}^{H}\nu_{jk}p_k\right)\right]p_j / x_i \qquad i = 1,\ldots, H;\ j = 1,\ldots, H$$

The Slutsky matrix (S) is given by (12):

$$(12) \qquad S = V + \left(M - \varepsilon' p - \tfrac{1}{2}p'Vp - \delta(p_z)\right)\chi\chi'$$

The Hicksian elasticities (ε_{ij}^h) are given by (13):

$$(13) \qquad \varepsilon_{ij}^h = \left[\nu_{ij} - \chi_i\chi_j\left(M - \varepsilon' p - \tfrac{1}{2}p'Vp - \delta(p_z)\right)\right]p_j / x_i \qquad i = 1,\ldots, H;\ j = 1,\ldots, H$$

[5] $C(p, p_z, \theta)$ is a quasi-expenditure function since it relates to an incomplete demand system (i.e., represents only part of the total expenditure such as the food expenditure). However, it will be called expenditure function to avoid additional notation.

The necessary information set for the calibration is as follows: income and own-price elasticity estimates, levels of Marshallian demands x, the total income (or expenditure M) and prices. This assumes that no cross price elasticities are available and need to be computed.

The calibration involves the recovery of elements of the H-vectors χ and ε, together with the elements of the $H \times H$ matrix (i.e., ν_{ij}). The calibration imposes symmetry and negative semi-definiteness of the Hessian of the expenditure function. In the system, homogeneity degree 1 in prices for the expenditure function is imposed by deflating prices by a consumer price index although homogeneity in prices plays no role in the recovery of parameters in the calibration procedure.

The calibration is done sequentially. First, point estimates of derivatives of demand with respect to income χ are obtained from the known income elasticity estimates such as $\chi_i = x_i\eta_i / M$. Then, income response parameters are substituted into (10) and (11). Next, price responses are recovered from the point estimates corresponding to the available price elasticities, evaluated at the reference level of the data. Then, all price responses together with restrictions on S from integrability, and the observed demanded quantities are used to estimate the remaining parameters of the demand system.

Both procedures, the microeconomic consumer problem augmented with linear constraints and the calibration of elasticities were implemented in MS Excel by means of Visual Basic for Application (VBA) routines. The calibrated Marshallian and Hicksian cross price elasticity matrices by consumer group and also the food composition information are presented in the Annex.

IV. Results and discussion

The implemented simulation model was used for two simulations that aimed to increase the amount of millet in the diets of the three consumer groups by 50 per cent and by 100 per cent (i.e., duplicate it). Note that on the one hand, although these percentages might appear large, the quantities of millet in the diet are small, so the actual increase in quantity on the consumer diet is not that high. On the other hand, large increases on the demand of millet are needed to encourage expansion on the supply of millet.

Figures 3.a and 3.b present the simulation results for the rural group, 4.a and 4.b for the poor urban group and 5.a and 5.b for the affluent urban groups. They present the changes of quantities in the diets and changes of nutrients.

The changes of quantities (i.e., figures 3.a, 4.a and 5.a) show the rise of millet, which despite the high simulated increases still represents a small percentage on the diet in comparison with other staples such as matooke or maize. Note that the higher amount of millet on the diet brings changes on it due to two reasons preferences for the different foods and the fact that they compete on the consumer budget.

Figures 3.a, 4.a and 5.a show that most of the changes occur on the quantities of staples (maize, other cereals, potatoes and matooke), although the other foods are also slightly affected. This is common for all the groups although as shown in Figure 5.a the changes are less significant.

Figure 3.a – Rural group – Simulation of annual consumption (in 100 grams)

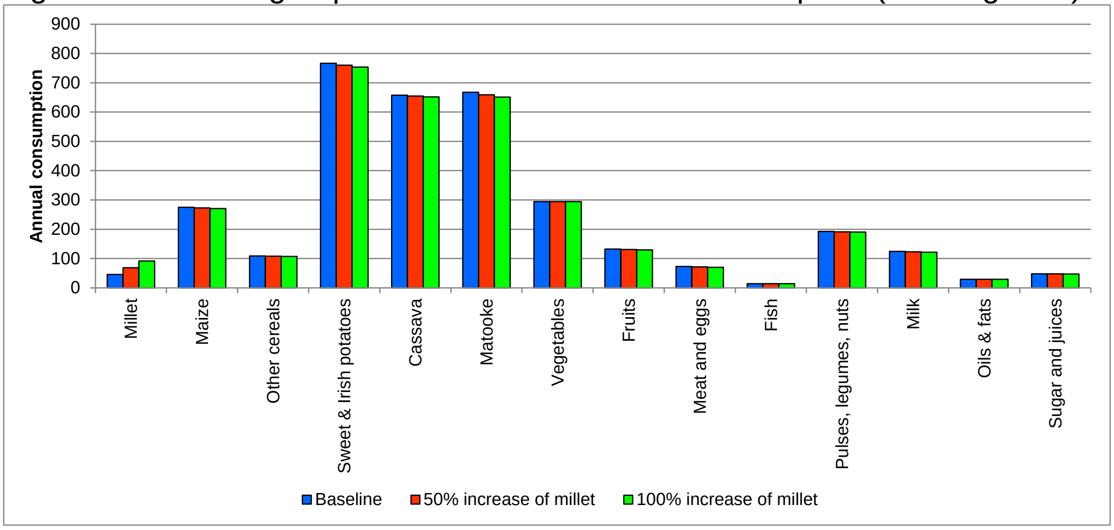
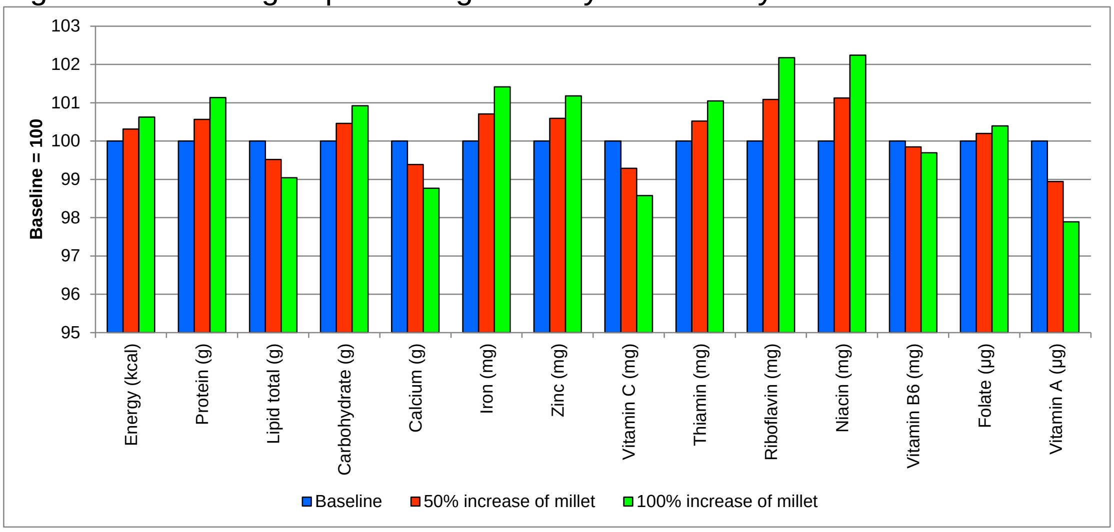


Figure 3.b - Rural group – Change in daily nutrients by scenario



Figures 3.b, 4.b, and 5.b show the changes in nutrients in terms of indices (being the baseline equal to 100). All the Figures show that the introduction of millet increases the amount of calories in the diet with respect to the baseline. In terms of macronutrients (i.e., proteins, lipids and carbohydrates) the results indicate that millet contributes positively to the diet of all the groups. These are deficiencies that have been mentioned in the literature particularly regarding women (e.g., Bachou, 2002).

With respect micronutrients, the results indicate that the expansion of millet in the diet improves the quantities of iron, zinc, riboflavin and niacin in all groups. It, however, has negative effects on calcium, vitamin C, and vitamin A in all the groups. The remaining micronutrients (i.e., thiamine, vitamin B6 and folate) showed differences by group. Thus, thiamine increased in the rural and affluent urban group, whilst decreasing on the poor urban group; vitamin B6 decreased on the rural and poor urban group and increased in the affluent urban group and folate decreased on the urban groups and increased in the rural group.

Figure 4.a – Urban lower quintiles – Simulation of annual consumption (in 100 grams)

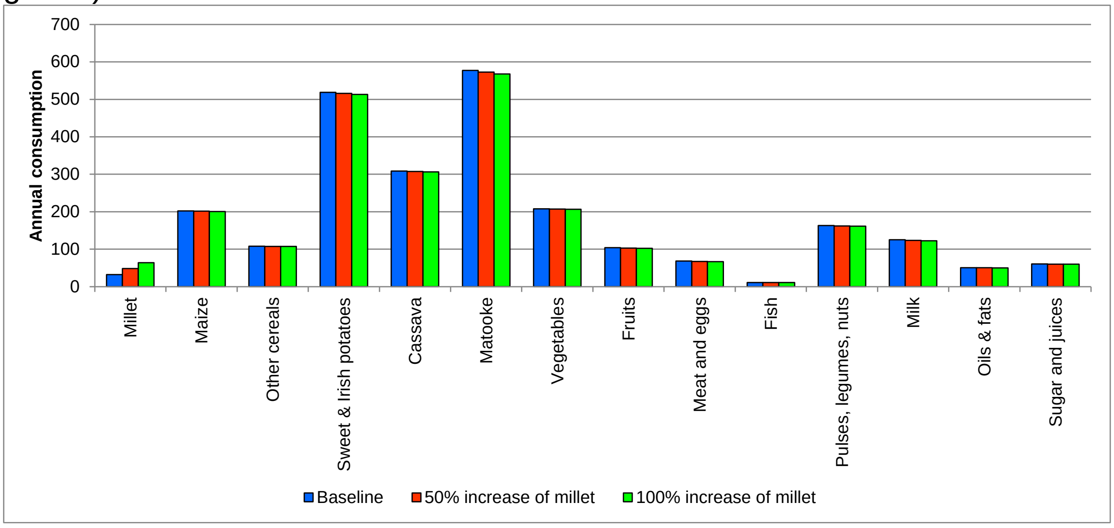
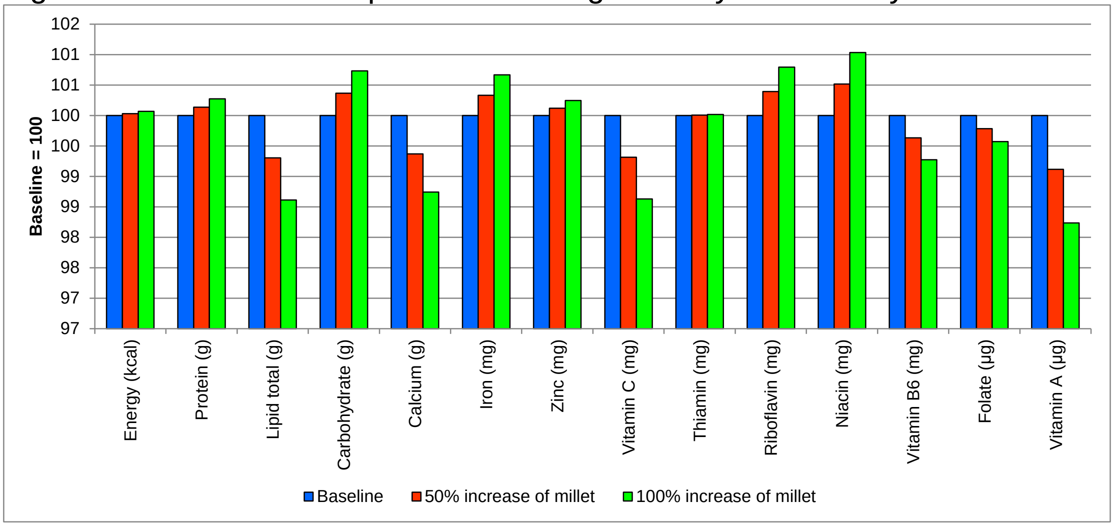


Figure 4.b - Urban lower quintiles – Change in daily nutrients by scenario



USAID (2014) points out micronutrient deficiencies in Uganda, particularly vitamin A and iron, which are highly prevalent in women and children. The results indicate whilst iron may increase with more millet, vitamin A show decreases for all the groups. The latter might be explained by the reduction of matooke on the diet, which as shown by food composition table (Table A.4 in the Annex), bring vitamin A to the diet, whilst millet does not.

Figure 5.a – Urban upper quintiles – Simulation of annual consumption (100 grams)

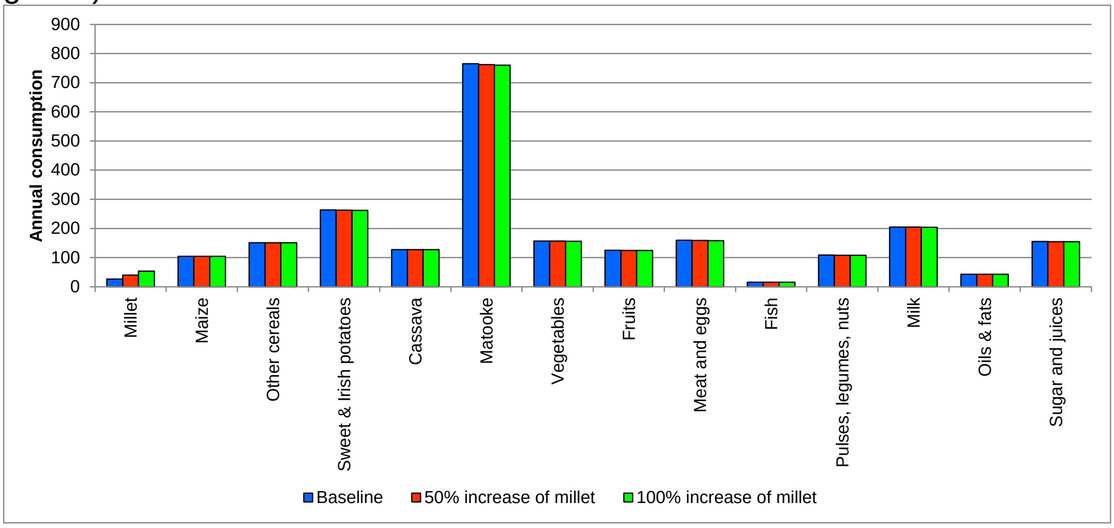
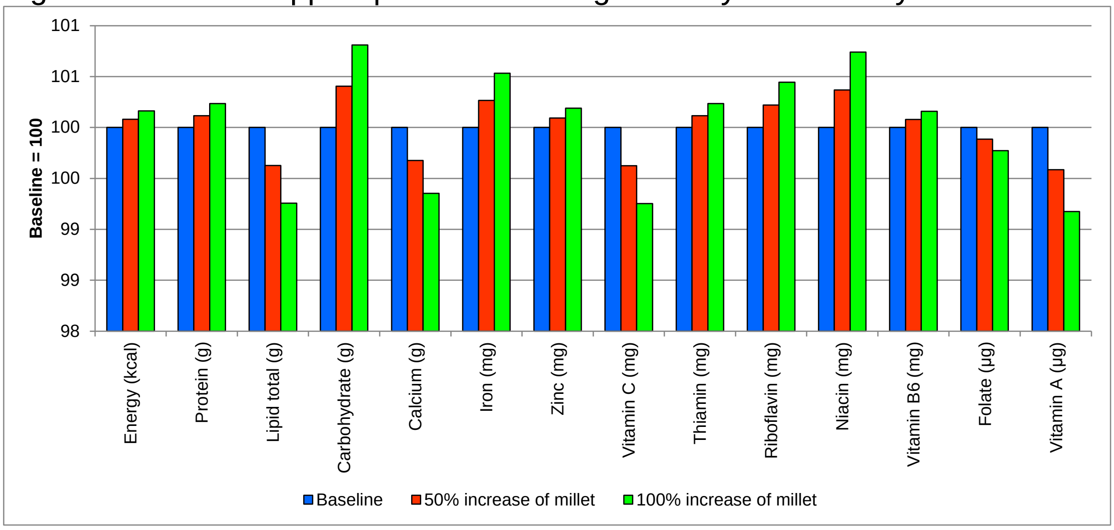


Figure 5.b - Urban upper quintiles – Change in daily nutrients by scenario

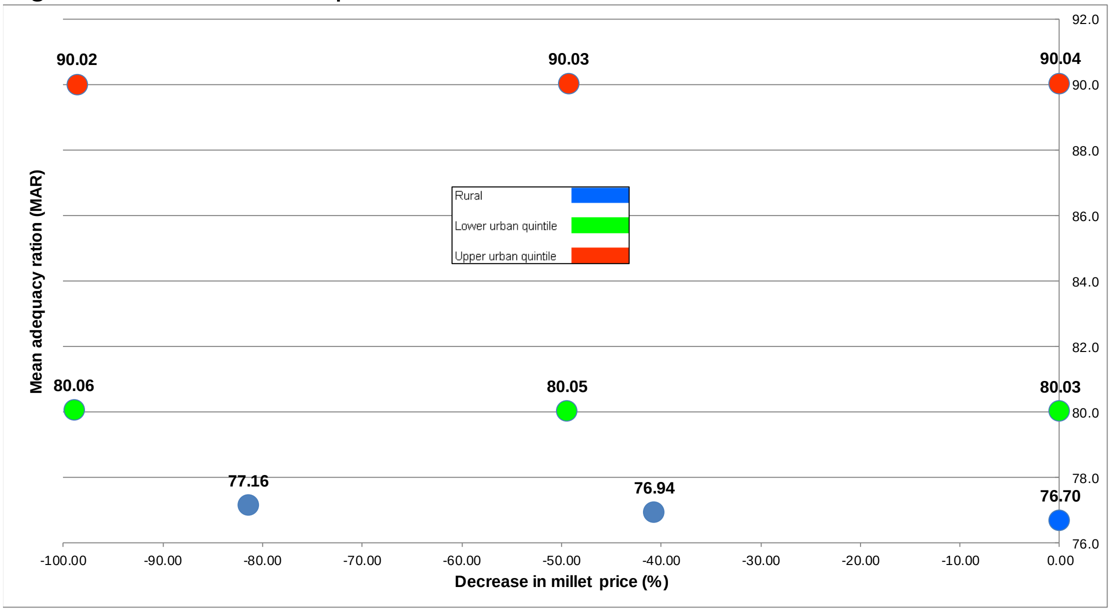


The purpose of Figure 6 is to summarise the information from the simulations by presenting the trade off for the three groups between the changes in the price of millet required to increase the quantity demanded as simulated and the MAR as a measure of nutritional quality.

As the increase in the quantity of millet negatively relates to the change in price, the baseline case is on the right hand side, in the middle is result of the increase on the quantity of millet by 50 per cent and the left hand side is results of increasing the quantity by 100 per cent.

Despite the marginal changes in the MAR indicator, the groups that benefit most of the expansion of millet on the diet are the rural, followed by the urban poor. The MAR urban affluent group slightly decreases with the increases of millet.

Figure 6 – Decrease in price and MAR due to increase of millet in the diet



Note: The baseline results are to the right; dots in the middle are the results of increasing millet in the diet by 50 per cent and the dot to the right are the results from duplicating the quantities of millet in the diet.

As regards the required change in the millet prices required for it to enter into the simulated quantities, the rural group requires the least reduction in prices to increase their consumption of millet than the other two groups. Nevertheless, this indicates that to increase the quantity of millet on the diet, under the current conditions (i.e., consumers' preferences), substantive reductions in price would be required. These reductions are, of course, unrealistic.

The results in Figure 6 points to two conclusions: one is that the evaluation of the nutritional benefits of the expansion of millet (or any other product) needs to be done within the context of the diet, where the expansion of one product may displace partially other(s) products. This explains the low MAR indicators and also some of the nutritional results of Figures 3.b, 4.b and 5.b. This is in contrast with recommendations of increasing millet in the diet and based only on its nutritional characteristics or comparing it with other staples.

The other conclusion from Figure 6 is that without changing consumers' preferences regarding millet, reducing the price (say by significantly expanding the supply) to increase the quantity demanded of millet in Uganda would be ineffective. This is clear from the substantive decrease in prices required to expand the consumption of millet. Therefore, there is the actual need improve consumers' appreciation for millet (e.g., their willingness to pay), which only can come from behavioural change.

Moreover, as indicated by USAID (2014) the causes of undernutrition in Uganda vary by region and these amongst many other factors includes cultural and social traditions that are part of consumers' preferences. According to them producing more staple food does not guarantee improved nutrition and neither increasing income. Thus, to increase millet in the diet in the case of Uganda, first, there is the need to understand consumers' views and perceptions of millet, such as in the work based on ethnographic evidence on millet in India by Chera (2017).

Only after considering consumers' views of millet as food it would be possible to envisage a strategy to reintroduced millet on the Uganda diet. This may be done by improving the value proposition offered to consumers by bringing new products, which can be segmented according to the market in order to increase their accessibility. Another way could be to promote the crop as an ingredient replacing or complementing other cereals in the preparation of food such as breakfast cereals or biscuits.[6]

V. Conclusions

Neglected, underutilized or orphan crops have been cited as having the potential to play a number of roles in the improvement of food security; however, consumers in developing countries are also increasingly abandoning their traditional diets and increasingly replacing those crops as part of the adoption of western diets.

The purpose of this paper has been to investigate the implications of expanding the consumption of neglected crops on current diets (i.e., the recommendation) by considering consumers' preferences in the form of price and income elasticities and a modified version of the microeconomic consumer problem, which was augmented with linear constraints using generalized rationing theory. The method was applied to a case study namely the consumption of millet in Uganda considering three socioeconomic groups.

The results show that the introduction of millet increases the amount of calories in the diet and also the macronutrients for all the groups. With respect micronutrients, the expansion of millet in the diet improves the quantities of iron, zinc, riboflavin and niacin in all groups. It, however, has negative effects on calcium, vitamin C, and vitamin A in all the groups. The remaining micronutrients (i.e., thiamine, vitamin B6 and folate) showed differences by group. The reduction of vitamin A might be explained by the partial substitution of matooke on the diet.

In addition, the results also indicate that under current preferences to substantially increase the quantity of millet on the consumers' diet will require an unrealistic significant reduction of millet's prices with net impact on nutrition that will be slightly positive for the rural and poor urban households. This results points out the need to work on increasing consumers' appreciation for millet as part of their everyday diet.

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[6] Relevant to the above according to Mintel's Global New Product Development (GNPD) database, over 10,000 products sold in South Africa and Nigeria are made from wheat and potato. In contrast, only few products are made of orphan crops. This is remarkable since some academic research has been carried out to explore the behaviour of doughs formed from these starch sources (e.g., Angilioni et al., 2013).

As Chera (2017) remarks, appeals to consumers cannot be a mere afterthought, nor can they simply be framed in terms of development policy or agricultural advantages. Potential nutritional, environmental, and economic benefits of embracing agricultural biodiversity are not likely to be enough to change their preferences as regards millets. There is the need to bring millet closer to consumers' tastes and preferences which will be a slow interdisciplinary process with roles for both natural and social scientists. Only in this way, the millet value chain in Uganda (or similarly in the case of other orphan crops) will bring sustainable benefits in economic terms, food security and improved nutrition.

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Annex

Table A1: Calibrated elasticities - Group rural

	Millet	Maize	Rice	Bread	Sorghum	Sweet and Irish Potatoes	Cassava	Matooke	Vegetables	Fruits	Beef	Pork	Goat meat	Chicken	Other meat	Eggs	Fish	Pulses, legumes, nuts	Milk	Oils and fats	Sugar	Soda	Other juices	Coffee and tea	Food away from home	Beer	Other alcoholic beverages	Other foods
Hicksian elasticities																												
Millet	-1.219	0.021	0.003	0.002	0.005	0.023	0.014	0.027	0.001	0.008	0.014	0.004	0.005	0.009	0.001	0.002	0.013	0.016	0.009	0.003	0.008	0.001	0.000	0.000	0.006	0.001	0.003	0.004
Maize	0.003	-1.391	0.003	0.002	0.005	0.024	0.014	0.029	0.001	0.009	0.015	0.004	0.005	0.010	0.001	0.002	0.014	0.017	0.010	0.003	0.008	0.001	0.000	0.000	0.006	0.001	0.003	0.004
Rice	0.003	0.021	-1.198	0.002	0.005	0.023	0.014	0.027	0.001	0.008	0.014	0.004	0.005	0.009	0.001	0.002	0.013	0.016	0.009	0.003	0.008	0.001	0.000	0.000	0.006	0.001	0.003	0.004
Bread	0.003	0.021	0.003	-1.228	0.005	0.023	0.014	0.027	0.001	0.008	0.014	0.004	0.005	0.009	0.001	0.002	0.013	0.016	0.009	0.003	0.008	0.001	0.000	0.000	0.006	0.001	0.003	0.004
Sorghum	0.003	0.021	0.003	0.002	-1.305	0.023	0.014	0.027	0.001	0.008	0.014	0.004	0.005	0.009	0.001	0.002	0.013	0.016	0.009	0.003	0.008	0.001	0.000	0.000	0.006	0.001	0.003	0.004
Sweet and Irish Potatoes	0.003	0.023	0.004	0.002	0.005	-0.926	0.015	0.030	0.001	0.009	0.015	0.004	0.005	0.010	0.001	0.002	0.014	0.017	0.010	0.004	0.008	0.001	0.000	0.000	0.006	0.001	0.004	0.004
Cassava	0.002	0.012	0.002	0.001	0.003	0.013	-0.532	0.016	0.000	0.005	0.008	0.002	0.003	0.005	0.000	0.001	0.008	0.009	0.005	0.002	0.004	0.001	0.000	0.000	0.003	0.001	0.002	0.002
Matooke	0.005	0.034	0.005	0.002	0.008	0.037	0.022	-0.873	0.001	0.014	0.022	0.006	0.007	0.015	0.001	0.003	0.022	0.025	0.015	0.005	0.013	0.002	0.000	0.001	0.010	0.001	0.005	0.006
Vegetables	0.000	0.001	0.000	0.000	0.000	0.001	0.001	0.001	-0.468	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fruits	0.004	0.027	0.004	0.002	0.006	0.030	0.018	0.036	0.001	-1.186	0.018	0.005	0.006	0.012	0.001	0.002	0.017	0.021	0.012	0.004	0.010	0.002	0.000	0.001	0.008	0.001	0.004	0.005
Beef	0.006	0.042	0.007	0.003	0.010	0.046	0.027	0.055	0.001	0.017	-1.043	0.008	0.009	0.019	0.002	0.003	0.027	0.032	0.019	0.007	0.016	0.002	0.000	0.001	0.012	0.002	0.007	0.008
Pork	0.006	0.042	0.007	0.003	0.010	0.047	0.028	0.055	0.001	0.017	0.028	-1.103	0.009	0.019	0.002	0.003	0.027	0.032	0.019	0.007	0.016	0.002	0.000	0.001	0.012	0.002	0.007	0.008
Goat meat	0.006	0.042	0.007	0.003	0.010	0.047	0.028	0.055	0.001	0.017	0.028	0.008	-1.093	0.019	0.002	0.003	0.027	0.032	0.019	0.007	0.016	0.002	0.000	0.001	0.012	0.002	0.007	0.008
Chicken	0.006	0.042	0.007	0.003	0.010	0.047	0.028	0.055	0.001	0.017	0.028	0.008	0.009	-1.096	0.002	0.003	0.027	0.032	0.019	0.007	0.016	0.002	0.000	0.001	0.012	0.002	0.007	0.008
Other meat	0.006	0.042	0.007	0.003	0.010	0.046	0.027	0.055	0.001	0.017	0.028	0.008	0.009	0.019	-1.117	0.003	0.027	0.032	0.019	0.007	0.016	0.002	0.000	0.001	0.012	0.002	0.007	0.008
Eggs	0.006	0.043	0.007	0.003	0.010	0.047	0.028	0.056	0.001	0.017	0.028	0.008	0.009	0.019	0.002	-1.135	0.027	0.032	0.019	0.007	0.016	0.002	0.000	0.001	0.012	0.002	0.007	0.008
Fish	0.005	0.036	0.006	0.003	0.008	0.039	0.023	0.047	0.001	0.014	0.024	0.007	0.008	0.016	0.001	0.003	-1.333	0.027	0.016	0.006	0.013	0.002	0.000	0.001	0.010	0.001	0.006	0.007
Pulses, legumes, nuts	0.002	0.015	0.002	0.001	0.003	0.016	0.009	0.019	0.000	0.006	0.010	0.003	0.003	0.006	0.001	0.001	0.009	-0.716	0.007	0.002	0.005	0.001	0.000	0.000	0.004	0.001	0.002	0.003
Milk	0.005	0.034	0.005	0.002	0.008	0.038	0.022	0.045	0.001	0.014	0.023	0.006	0.008	0.015	0.001	0.003	0.022	0.026	-1.393	0.005	0.013	0.002	0.000	0.001	0.010	0.001	0.005	0.006
Oils and fats	0.002	0.017	0.003	0.001	0.004	0.019	0.011	0.022	0.001	0.007	0.011	0.003	0.004	0.008	0.001	0.001	0.011	0.013	0.008	-0.601	0.006	0.001	0.000	0.000	0.005	0.001	0.003	0.003
Sugar	0.004	0.026	0.004	0.002	0.006	0.028	0.017	0.034	0.001	0.010	0.017	0.005	0.006	0.011	0.001	0.002	0.016	0.020	0.012	0.004	-0.924	0.001	0.000	0.001	0.007	0.001	0.004	0.005
Soda	0.004	0.026	0.004	0.002	0.006	0.028	0.017	0.034	0.001	0.010	0.017	0.005	0.006	0.011	0.001	0.002	0.016	0.019	0.012	0.004	0.010	-0.961	0.000	0.001	0.007	0.001	0.004	0.005
Other juices	0.004	0.026	0.004	0.002	0.006	0.028	0.017	0.034	0.001	0.010	0.017	0.005	0.006	0.011	0.001	0.002	0.017	0.020	0.012	0.004	0.010	0.001	-0.818	0.001	0.007	0.001	0.004	0.005
Coffee & tea	0.003	0.024	0.004	0.002	0.006	0.026	0.015	0.031	0.001	0.010	0.016	0.004	0.005	0.011	0.001	0.002	0.015	0.018	0.011	0.004	0.009	0.001	0.000	-0.946	0.007	0.001	0.004	0.004
Food away	0.003	0.024	0.004	0.002	0.006	0.026	0.015	0.031	0.001	0.010	0.016	0.004	0.005	0.011	0.001	0.002	0.015	0.018	0.011	0.004	0.009	0.001	0.000	0.000	-1.549	0.001	0.004	0.004
Beer	0.003	0.024	0.004	0.002	0.006	0.026	0.015	0.031	0.001	0.010	0.016	0.004	0.005	0.011	0.001	0.002	0.015	0.018	0.011	0.004	0.009	0.001	0.000	0.000	0.007	-0.680	0.004	0.004
Other alcoholic beverages	0.003	0.024	0.004	0.002	0.006	0.026	0.015	0.031	0.001	0.010	0.016	0.004	0.005	0.011	0.001	0.002	0.015	0.018	0.011	0.004	0.009	0.001	0.000	0.000	0.007	0.001	-1.793	0.004
Other foods	0.003	0.024	0.004	0.002	0.006	0.026	0.015	0.031	0.001	0.010	0.016	0.004	0.005	0.011	0.001	0.002	0.015	0.018	0.011	0.004	0.009	0.001	0.000	0.000	0.007	0.001	0.004	-1.337
Marshallian elasticities																												
Millet	-1.228	-0.034	-0.006	-0.003	-0.009	-0.036	-0.052	-0.020	-0.036	-0.010	-0.005	-0.001	-0.002	-0.004	0.000	-0.001	-0.009	-0.048	-0.007	-0.008	-0.010	-0.002	0.000	-0.001	-0.009	-0.001	-0.005	-0.006
Maize	-0.006	-1.450	-0.006	-0.003	-0.010	-0.039	-0.056	-0.022	-0.039	-0.010	-0.006	-0.002	-0.002	-0.004	0.000	-0.001	-0.009	-0.051	-0.007	-0.009	-0.011	-0.002	0.000	-0.001	-0.009	-0.001	-0.005	-0.006
Rice	-0.006	-0.034	-1.207	-0.003	-0.009	-0.036	-0.052	-0.020	-0.036	-0.010	-0.005	-0.001	-0.002	-0.004	0.000	-0.001	-0.009	-0.048	-0.007	-0.008	-0.010	-0.002	0.000	-0.001	-0.009	-0.001	-0.005	-0.006
Bread	-0.006	-0.034	-0.006	-1.233	-0.009	-0.037	-0.052	-0.020	-0.036	-0.010	-0.005	-0.001	-0.002	-0.004	0.000	-0.001	-0.009	-0.048	-0.007	-0.008	-0.010	-0.002	0.000	-0.001	-0.009	-0.001	-0.005	-0.006
Sorghum	-0.006	-0.034	-0.006	-0.003	-1.319	-0.036	-0.052	-0.020	-0.036	-0.010	-0.005	-0.001	-0.002	-0.004	0.000	-0.001	-0.009	-0.048	-0.007	-0.008	-0.010	-0.002	0.000	-0.001	-0.009	-0.001	-0.005	-0.006
Sweet and Irish Potatoes	-0.006	-0.037	-0.006	-0.003	-0.010	-0.990	-0.057	-0.022	-0.039	-0.011	-0.006	-0.002	-0.002	-0.004	0.000	-0.001	-0.009	-0.052	-0.007	-0.009	-0.011	-0.002	0.000	-0.001	-0.009	-0.001	-0.005	-0.006
Cassava	-0.003	-0.020	-0.003	-0.002	-0.005	-0.021	-0.570	-0.012	-0.021	-0.006	-0.003	-0.001	-0.001	-0.002	0.000	0.000	-0.005	-0.028	-0.004	-0.005	-0.006	-0.001	0.000	0.000	-0.005	-0.001	-0.003	-0.003
Matooke	-0.009	-0.055	-0.009	-0.004	-0.014	-0.059	-0.084	-0.950	-0.058	-0.016	-0.009	-0.002	-0.003	-0.006	0.000	-0.001	-0.014	-0.077	-0.011	-0.013	-0.016	-0.002	0.000	-0.001	-0.014	-0.002	-0.008	-0.009
Vegetables	0.000	-0.002	0.000	0.000	0.000	-0.002	-0.003	-0.001	-0.470	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.003	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Fruits	-0.007	-0.045	-0.008	-0.004	-0.012	-0.048	-0.068	-0.026	-0.047	-1.210	-0.007	-0.002	-0.002	-0.005	0.000	-0.001	-0.011	-0.063	-0.009	-0.010	-0.013	-0.002	0.000	-0.001	-0.011	-0.002	-0.006	-0.007
Beef	-0.011	-0.069	-0.012	-0.006	-0.018	-0.074	-0.106	-0.041	-0.073	-0.020	-1.082	-0.003	-0.004	-0.007	-0.001	-0.001	-0.017	-0.097	-0.014	-0.016	-0.020	-0.003	0.000	-0.001	-0.018	-0.003	-0.010	-0.012
Pork	-0.011	-0.069	-0.012	-0.006	-0.018	-0.074	-0.106	-0.041	-0.073	-0.020	-0.011	-1.114	-0.004	-0.007	-0.001	-0.001	-0.017	-0.097	-0.014	-0.016	-0.020	-0.003	0.000	-0.001	-0.018	-0.003	-0.010	-0.012
Goat meat	-0.011	-0.069	-0.012	-0.006	-0.018	-0.074	-0.106	-0.041	-0.073	-0.020	-0.011	-0.003	-1.106	-0.007	-0.001	-0.001	-0.017	-0.097	-0.014	-0.016	-0.020	-0.003	0.000	-0.001	-0.018	-0.003	-0.010	-0.012
Chicken	-0.011	-0.069	-0.012	-0.006	-0.018	-0.074	-0.106	-0.041	-0.073	-0.020	-0.011	-0.003	-0.004	-1.122	-0.001	-0.001	-0.017	-0.097	-0.014	-0.016	-0.020	-0.003	0.000	-0.001	-0.018	-0.003	-0.010	-0.012
Other meat	-0.011	-0.069	-0.012	-0.006	-0.018	-0.074	-0.105	-0.041	-0.073	-0.020	-0.011	-0.003	-0.004	-0.007	-1.119	-0.001	-0.017	-0.097	-0.014	-0.016	-0.020	-0.003	0.000	-0.001	-0.018	-0.003	-0.010	-0.012
Eggs	-0.011	-0.070	-0.012	-0.006	-0.018	-0.074	-0.106	-0.041	-0.074	-0.020	-0.011	-0.003	-0.004	-0.007	-0.001	-1.139	-0.018	-0.098	-0.014	-0.016	-0.020	-0.003	0.000	-0.001	-0.018	-0.003	-0.010	-0.012
Fish	-0.009	-0.058	-0.010	-0.005	-0.015	-0.062	-0.089	-0.035	-0.062	-0.017	-0.009	-0.003	-0.003	-0.006	-0.001	-0.001	-1.370	-0.082	-0.012	-0.014	-0.017	-0.003	0.000	-0.001	-0.015	-0.002	-0.008	-0.010
Pulses, legumes, nuts	-0.004	-0.024	-0.004	-0.002	-0.006	-0.025	-0.036	-0.014	-0.025	-0.007	-0.004	-0.001	-0.001	-0.002	0.000	0.000	-0.006	-0.760	-0.005	-0.006	-0.007	-0.001	0.000	0.000	-0.006	-0.001	-0.003	-0.004
Milk	-0.009	-0.056	-0.010	-0.004	-0.015	-0.059	-0.085	-0.033	-0.059	-0.016	-0.009	-0.002	-0.003	-0.006	0.000	-0.001	-0.014	-0.078	-1.420	-0.013	-0.016	-0.002	0.000	-0.001	-0.014	-0.002	-0.008	-0.009
Oils and fats	-0.004	-0.028	-0.005	-0.002	-0.007	-0.030	-0.042	-0.016	-0.029	-0.008	-0.004	-0.001	-0.001	-0.003	0.000	0.000	-0.007	-0.039	-0.006	-0.610	-0.008	-0.001	0.000	-0.001	-0.007	-0.001	-0.004	-0.005
Sugar	-0.007	-0.042	-0.007	-0.003	-0.011	-0.045	-0.064	-0.025	-0.045	-0.012	-0.007	-0.002	-0.002	-0.004	0.000	-0.001	-0.011	-0.059	-0.008	-0.010	-0.946	-0.002	0.000	-0.001	-0.011	-0.002	-0.006	-0.007
Soda	-0.007	-0.042	-0.007	-0.003	-0.011	-0.045	-0.064	-0.025	-0.045	-0.012	-0.007	-0.002	-0.002	-0.004	0.000	-0.001	-0.011	-0.059	-0.008	-0.010	-0.012	-0.965	0.000	-0.001	-0.011	-0.002	-0.006	-0.007
Other juices	-0.007	-0.042	-0.007	-0.003	-0.011	-0.045	-0.065	-0.025	-0.045	-0.012	-0.007	-0.002	-0.002	-0.004	0.000	-0.001	-0.011	-0.059	-0.008	-0.010	-0.012	-0.002	-0.818	-0.001	-0.011	-0.002	-0.006	-0.007
Coffee & tea	-0.006	-0.039	-0.007	-0.003	-0.010	-0.041	-0.059	-0.023	-0.041	-0.011	-0.006	-0.002	-0.002	-0.004	0.000	-0.001	-0.010	-0.054	-0.008	-0.009	-0.011	-0.002	0.000	-0.947	-0.010	-0.001	-0.005	-0.007
Food away	-0.006	-0.039	-0.007	-0.003	-0.010	-0.042	-0.060	-0.023	-0.041	-0.011	-0.006	-0.002	-0.002	-0.004	0.000	-0.001	-0.010	-0.055	-0.008	-0.009	-0.011	-0.002	0.000	-0.001	-1.565	-0.001	-0.005	-0.007
Beer	-0.006	-0.039	-0.007	-0.003	-0.010	-0.041	-0.059	-0.023	-0.041	-0.011	-0.006	-0.002	-0.002	-0.004	0.000	-0.001	-0.010	-0.055	-0.008	-0.009	-0.011	-0.002	0.000	-0.001	-0.010	-0.683	-0.005	-0.007
Other alcoholic beverages	-0.006	-0.039	-0.007	-0.003	-0.010	-0.041	-0.059	-0.023	-0.041	-0.011	-0.006	-0.002	-0.002	-0.004	0.000	-0.001	-0.010	-0.055	-0.008	-0.009	-0.011	-0.002	0.000	-0.001	-0.010	-0.001	-1.802	-0.007
Other foods	-0.006	-0.039	-0.007	-0.003	-0.010	-0.041	-0.059	-0.023	-0.041	-0.011	-0.006	-0.002	-0.002	-0.004	0.000	-0.001	-0.010	-0.054	-0.008	-0.009	-0.011	-0.002	0.000	-0.001	-0.010	-0.001	-0.005	-1.348
Income elasticities	0.950	1.010	0.949	0.951	0.950	1.030	0.550	1.530	0.050	1.240	1.919	1.920	1.921	1.920	1.917	1.934	1.620	0.660	1.550	0.770	1.170	1.170	1.174	1.077	1.081	1.078	1.080	1.078

Table A2: Calibrated elasticities - Group urban-lower quintiles

	Millet	Maize	Rice	Bread	Sorghum	Sweet and Irish Potatoes	Cassava	Matooke	Vegetables	Fruits	Beef	Pork	Goat meat	Chicken	Other meat	Eggs	Fish	Pulses, legumes, nuts	Milk	Oils and fats	Sugar	Soda	Other juices	Coffee and tea	Food away from home	Beer	Other alcoholic beverages	Other foods
Hicksian elasticities																												
Millet	-1.007	0.010	0.003	0.002	0.001	0.011	0.006	0.016	0.005	0.006	0.013	0.003	0.003	0.005	0.000	0.001	0.010	0.011	0.007	0.003	0.005	0.001	0.000	0.001	0.009	0.001	0.001	0.004
Maize	0.001	-1.392	0.004	0.002	0.002	0.013	0.008	0.019	0.005	0.007	0.015	0.003	0.003	0.006	0.000	0.002	0.012	0.013	0.009	0.004	0.007	0.001	0.000	0.001	0.011	0.001	0.001	0.005
Rice	0.001	0.010	-0.965	0.002	0.001	0.011	0.006	0.016	0.005	0.006	0.013	0.003	0.003	0.005	0.000	0.001	0.010	0.011	0.007	0.003	0.005	0.001	0.000	0.001	0.009	0.001	0.001	0.004
Bread	0.001	0.010	0.003	-1.187	0.001	0.011	0.007	0.016	0.005	0.006	0.013	0.003	0.003	0.005	0.000	0.001	0.010	0.011	0.008	0.003	0.005	0.001	0.000	0.001	0.009	0.001	0.001	0.004
Sorghum	0.001	0.010	0.003	0.002	-0.988	0.011	0.006	0.016	0.005	0.006	0.013	0.003	0.003	0.005	0.000	0.001	0.010	0.011	0.007	0.003	0.005	0.001	0.000	0.001	0.009	0.001	0.001	0.004
Sweet and Irish Potatoes	0.002	0.014	0.004	0.002	0.002	-0.666	0.008	0.021	0.006	0.007	0.016	0.003	0.003	0.006	0.000	0.002	0.013	0.014	0.010	0.004	0.007	0.001	0.000	0.001	0.012	0.001	0.001	0.005
Cassava	0.001	0.011	0.003	0.002	0.001	0.011	-0.668	0.016	0.005	0.006	0.013	0.003	0.003	0.005	0.000	0.002	0.010	0.011	0.008	0.003	0.006	0.001	0.000	0.001	0.009	0.001	0.001	0.004
Matooke	0.003	0.022	0.007	0.004	0.003	0.024	0.014	-1.210	0.010	0.012	0.027	0.006	0.006	0.010	0.001	0.003	0.021	0.024	0.016	0.007	0.012	0.001	0.000	0.001	0.019	0.001	0.002	0.008
Vegetables	0.001	0.007	0.002	0.001	0.001	0.008	0.005	0.011	-0.622	0.004	0.009	0.002	0.002	0.003	0.000	0.001	0.007	0.008	0.005	0.002	0.004	0.001	0.000	0.000	0.007	0.000	0.001	0.003
Fruits	0.002	0.019	0.006	0.003	0.002	0.020	0.012	0.029	0.008	-0.615	0.023	0.005	0.005	0.009	0.001	0.003	0.018	0.020	0.013	0.006	0.010	0.001	0.000	0.001	0.016	0.001	0.002	0.007
Beef	0.004	0.033	0.010	0.006	0.004	0.035	0.020	0.050	0.014	0.018	-0.839	0.008	0.008	0.015	0.001	0.005	0.031	0.035	0.023	0.010	0.017	0.002	0.001	0.002	0.029	0.002	0.003	0.012
Pork	0.004	0.033	0.010	0.006	0.004	0.035	0.020	0.050	0.014	0.018	0.040	-0.907	0.008	0.015	0.001	0.005	0.031	0.035	0.023	0.010	0.017	0.002	0.001	0.002	0.029	0.002	0.003	0.012
Goat meat	0.004	0.033	0.010	0.006	0.004	0.035	0.020	0.050	0.014	0.018	0.040	0.008	-0.903	0.015	0.001	0.005	0.031	0.035	0.024	0.010	0.017	0.002	0.001	0.002	0.029	0.002	0.003	0.012
Chicken	0.004	0.033	0.010	0.006	0.004	0.035	0.020	0.050	0.014	0.018	0.040	0.008	0.008	-0.857	0.001	0.005	0.031	0.035	0.023	0.010	0.017	0.002	0.001	0.002	0.029	0.002	0.003	0.012
Other meat	0.004	0.033	0.010	0.006	0.004	0.035	0.020	0.050	0.014	0.018	0.040	0.008	0.008	0.015	-0.889	0.005	0.031	0.035	0.023	0.010	0.017	0.002	0.001	0.002	0.028	0.002	0.003	0.012
Eggs	0.004	0.033	0.011	0.006	0.004	0.035	0.020	0.050	0.014	0.018	0.040	0.008	0.008	0.015	0.001	-0.989	0.032	0.035	0.024	0.010	0.017	0.002	0.001	0.002	0.029	0.002	0.003	0.012
Fish	0.003	0.026	0.008	0.005	0.003	0.028	0.016	0.041	0.011	0.014	0.032	0.007	0.007	0.012	0.001	0.004	-1.297	0.028	0.019	0.008	0.014	0.002	0.000	0.002	0.023	0.002	0.003	0.010
Pulses, legumes, nuts	0.001	0.011	0.003	0.002	0.001	0.011	0.007	0.017	0.005	0.006	0.013	0.003	0.003	0.005	0.000	0.002	0.010	-0.800	0.008	0.003	0.006	0.001	0.000	0.001	0.009	0.001	0.001	0.004
Milk	0.003	0.024	0.008	0.004	0.003	0.026	0.015	0.037	0.011	0.013	0.029	0.006	0.006	0.011	0.001	0.003	0.023	0.026	-1.375	0.007	0.013	0.002	0.000	0.002	0.021	0.001	0.003	0.009
Oils and fats	0.001	0.013	0.004	0.002	0.002	0.013	0.008	0.019	0.005	0.007	0.015	0.003	0.003	0.006	0.000	0.002	0.012	0.013	0.009	-0.663	0.007	0.001	0.000	0.001	0.011	0.001	0.001	0.005
Sugar	0.002	0.013	0.004	0.002	0.002	0.014	0.008	0.020	0.006	0.007	0.016	0.003	0.003	0.006	0.000	0.002	0.013	0.014	0.009	0.004	-1.020	0.001	0.000	0.001	0.011	0.001	0.001	0.005
Soda	0.002	0.013	0.004	0.002	0.002	0.014	0.008	0.020	0.006	0.007	0.016	0.003	0.003	0.006	0.000	0.002	0.013	0.014	0.009	0.004	0.007	-0.970	0.000	0.001	0.011	0.001	0.001	0.005
Other juices	0.002	0.013	0.004	0.002	0.002	0.014	0.008	0.020	0.006	0.007	0.016	0.003	0.003	0.006	0.000	0.002	0.013	0.014	0.009	0.004	0.007	0.001	-0.982	0.001	0.011	0.001	0.001	0.005
Coffee & tea	0.003	0.024	0.008	0.004	0.003	0.025	0.015	0.037	0.010	0.013	0.029	0.006	0.006	0.011	0.001	0.003	0.023	0.025	0.017	0.007	0.012	0.002	0.000	-0.925	0.021	0.001	0.002	0.009
Food away	0.003	0.024	0.008	0.004	0.003	0.025	0.015	0.037	0.010	0.013	0.029	0.006	0.006	0.011	0.001	0.003	0.023	0.025	0.017	0.007	0.013	0.002	0.000	0.002	-0.857	0.001	0.002	0.009
Beer	0.003	0.024	0.008	0.004	0.003	0.025	0.015	0.036	0.010	0.013	0.029	0.006	0.006	0.011	0.001	0.003	0.023	0.025	0.017	0.007	0.012	0.002	0.000	0.002	0.021	-0.731	0.002	0.009
Other alcoholic beverages	0.003	0.024	0.008	0.004	0.003	0.025	0.015	0.037	0.010	0.013	0.029	0.006	0.006	0.011	0.001	0.003	0.023	0.025	0.017	0.007	0.013	0.002	0.000	0.002	0.021	0.001	-2.650	0.009
Other foods	0.003	0.024	0.008	0.004	0.003	0.025	0.015	0.037	0.010	0.013	0.029	0.006	0.006	0.011	0.001	0.003	0.023	0.025	0.017	0.007	0.012	0.002	0.000	0.002	0.021	0.001	0.002	-0.933
Marshallian elasticities																												
Millet	-1.011	-0.019	-0.008	-0.004	-0.003	-0.017	-0.015	-0.009	-0.017	-0.005	-0.001	0.000	0.000	0.000	0.000	0.000	-0.003	-0.025	-0.003	-0.006	-0.009	-0.001	0.000	0.000	-0.004	0.000	0.000	-0.002
Maize	-0.003	-1.427	-0.009	-0.005	-0.004	-0.021	-0.017	-0.011	-0.020	-0.006	-0.001	0.000	0.000	0.000	0.000	0.000	-0.004	-0.030	-0.004	-0.007	-0.011	-0.001	0.000	0.000	-0.005	0.000	-0.001	-0.002
Rice	-0.003	-0.019	-0.976	-0.004	-0.003	-0.017	-0.015	-0.009	-0.017	-0.005	-0.001	0.000	0.000	0.000	0.000	0.000	-0.003	-0.025	-0.003	-0.006	-0.009	-0.001	0.000	0.000	-0.004	0.000	0.000	-0.002
Bread	-0.003	-0.019	-0.008	-1.193	-0.003	-0.017	-0.015	-0.009	-0.017	-0.005	-0.001	0.000	0.000	0.000	0.000	0.000	-0.003	-0.025	-0.003	-0.006	-0.009	-0.001	0.000	0.000	-0.004	0.000	0.000	-0.002
Sorghum	-0.003	-0.019	-0.008	-0.004	-0.992	-0.017	-0.015	-0.009	-0.017	-0.005	-0.001	0.000	0.000	0.000	0.000	0.000	-0.003	-0.025	-0.003	-0.006	-0.009	-0.001	0.000	0.000	-0.004	0.000	0.000	-0.002
Sweet and Irish Potatoes	-0.004	-0.024	-0.010	-0.006	-0.004	-0.703	-0.019	-0.012	-0.021	-0.006	-0.001	0.000	0.000	0.000	0.000	0.000	-0.004	-0.032	-0.004	-0.007	-0.012	-0.002	0.000	0.000	-0.005	0.000	-0.001	-0.002
Cassava	-0.003	-0.019	-0.008	-0.005	-0.003	-0.018	-0.690	-0.009	-0.017	-0.005	-0.001	0.000	0.000	0.000	0.000	0.000	-0.003	-0.025	-0.003	-0.006	-0.009	-0.001	0.000	0.000	-0.004	0.000	-0.001	-0.002
Matooke	-0.006	-0.039	-0.016	-0.009	-0.006	-0.037	-0.031	-1.263	-0.035	-0.010	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.007	-0.052	-0.007	-0.012	-0.019	-0.002	-0.001	-0.001	-0.009	-0.001	-0.001	-0.004
Vegetables	-0.002	-0.013	-0.006	-0.003	-0.002	-0.012	-0.010	-0.007	-0.637	-0.003	-0.001	0.000	0.000	0.000	0.000	0.000	-0.002	-0.018	-0.002	-0.004	-0.006	-0.001	0.000	0.000	-0.003	0.000	0.000	-0.001
Fruits	-0.005	-0.033	-0.014	-0.008	-0.005	-0.031	-0.026	-0.016	-0.030	-0.633	-0.001	0.000	0.000	-0.001	0.000	0.000	-0.006	-0.044	-0.006	-0.010	-0.016	-0.002	-0.001	-0.001	-0.007	-0.001	-0.001	-0.003
Beef	-0.009	-0.058	-0.024	-0.014	-0.009	-0.055	-0.046	-0.029	-0.052	-0.015	-0.881	-0.001	-0.001	-0.001	0.000	0.000	-0.010	-0.077	-0.010	-0.018	-0.028	-0.004	-0.001	-0.001	-0.013	-0.001	-0.002	-0.006
Pork	-0.009	-0.058	-0.024	-0.014	-0.009	-0.055	-0.046	-0.029	-0.052	-0.015	-0.002	-0.916	-0.001	-0.001	0.000	0.000	-0.010	-0.077	-0.010	-0.018	-0.028	-0.004	-0.001	-0.001	-0.013	-0.001	-0.002	-0.006
Goat meat	-0.009	-0.058	-0.024	-0.014	-0.009	-0.055	-0.046	-0.029	-0.052	-0.015	-0.002	-0.001	-0.912	-0.001	0.000	0.000	-0.010	-0.077	-0.010	-0.018	-0.028	-0.004	-0.001	-0.001	-0.013	-0.001	-0.002	-0.006
Chicken	-0.009	-0.058	-0.024	-0.014	-0.009	-0.055	-0.046	-0.029	-0.052	-0.015	-0.002	-0.001	-0.001	-0.873	0.000	0.000	-0.010	-0.077	-0.010	-0.018	-0.028	-0.004	-0.001	-0.001	-0.013	-0.001	-0.002	-0.006
Other meat	-0.009	-0.058	-0.024	-0.014	-0.009	-0.054	-0.045	-0.029	-0.052	-0.015	-0.002	-0.001	-0.001	-0.001	-0.890	0.000	-0.010	-0.077	-0.010	-0.018	-0.028	-0.004	-0.001	-0.001	-0.013	-0.001	-0.002	-0.006
Eggs	-0.009	-0.059	-0.025	-0.014	-0.010	-0.055	-0.046	-0.029	-0.052	-0.015	-0.002	-0.001	-0.001	-0.001	0.000	-0.994	-0.010	-0.078	-0.010	-0.018	-0.029	-0.004	-0.001	-0.001	-0.013	-0.001	-0.002	-0.006
Fish	-0.007	-0.047	-0.020	-0.011	-0.008	-0.044	-0.037	-0.023	-0.042	-0.012	-0.002	0.000	0.000	-0.001	0.000	0.000	-1.330	-0.063	-0.008	-0.014	-0.023	-0.003	-0.001	-0.001	-0.011	-0.001	-0.001	-0.004
Pulses, legumes, nuts	-0.003	-0.019	-0.008	-0.005	-0.003	-0.018	-0.015	-0.009	-0.017	-0.005	-0.001	0.000	0.000	0.000	0.000	0.000	-0.003	-0.837	-0.003	-0.006	-0.009	-0.001	0.000	0.000	-0.004	0.000	-0.001	-0.002
Milk	-0.007	-0.043	-0.018	-0.010	-0.007	-0.040	-0.034	-0.021	-0.038	-0.011	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.007	-0.057	-1.400	-0.013	-0.021	-0.003	-0.001	-0.001	-0.010	-0.001	-0.001	-0.004
Oils and fats	-0.003	-0.022	-0.009	-0.005	-0.004	-0.021	-0.017	-0.011	-0.020	-0.006	-0.001	0.000	0.000	0.000	0.000	0.000	-0.004	-0.030	-0.004	-0.673	-0.011	-0.001	0.000	0.000	-0.005	0.000	-0.001	-0.002
Sugar	-0.004	-0.023	-0.010	-0.006	-0.004	-0.022	-0.018	-0.011	-0.021	-0.006	-0.001	0.000	0.000	0.000	0.000	0.000	-0.004	-0.031	-0.004	-0.007	-1.038	-0.001	0.000	0.000	-0.005	0.000	-0.001	-0.002
Soda	-0.004	-0.023	-0.010	-0.006	-0.004	-0.022	-0.018	-0.011	-0.021	-0.006	-0.001	0.000	0.000	0.000	0.000	0.000	-0.004	-0.031	-0.004	-0.007	-0.011	-0.973	0.000	0.000	-0.005	0.000	-0.001	-0.002
Other juices	-0.004	-0.023	-0.010	-0.006	-0.004	-0.022	-0.018	-0.011	-0.021	-0.006	-0.001	0.000	0.000	0.000	0.000	0.000	-0.004	-0.031	-0.004	-0.007	-0.011	-0.001	-0.982	0.000	-0.005	0.000	-0.001	-0.002
Coffee & tea	-0.006	-0.042	-0.018	-0.010	-0.007	-0.040	-0.033	-0.021	-0.038	-0.011	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.007	-0.056	-0.007	-0.013	-0.021	-0.003	-0.001	-0.927	-0.009	-0.001	-0.001	-0.004
Food away	-0.006	-0.043	-0.018	-0.010	-0.007	-0.040	-0.033	-0.021	-0.038	-0.011	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.007	-0.056	-0.007	-0.013	-0.021	-0.003	-0.001	-0.001	-0.887	-0.001	-0.001	-0.004
Beer	-0.006	-0.042	-0.018	-0.010	-0.007	-0.040	-0.033	-0.021	-0.038	-0.011	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.007	-0.056	-0.007	-0.013	-0.021	-0.003	-0.001	-0.001	-0.009	-0.733	-0.001	-0.004
Other alcoholic beverages	-0.006	-0.043	-0.018	-0.010	-0.007	-0.040	-0.033	-0.021	-0.038	-0.011	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.007	-0.056	-0.007	-0.013	-0.021	-0.003	-0.001	-0.001	-0.009	-0.001	-2.654	-0.004
Other foods	-0.006	-0.042	-0.018	-0.010	-0.007	-0.040	-0.033	-0.021	-0.038	-0.011	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.007	-0.056	-0.007	-0.013	-0.021	-0.003	-0.001	-0.001	-0.009	-0.001	-0.001	-0.946
Income elasticities	0.596	0.713	0.596	0.598	0.596	0.773	0.613	1.263	0.427	1.073	1.869	1.870	1.871	1.870	1.865	1.880	1.513	0.617	1.383	0.717	0.747	0.746	0.747	1.360	1.364	1.359	1.365	1.360

Table A3: Calibrated elasticities - Group urban-upper quintiles

	Millet	Maize	Rice	Bread	Sorghum	Sweet and Irish Potatoes	Cassava	Matooke	Vegetables	Fruits	Beef	Pork	Goat meat	Chicken	Other meat	Eggs	Fish	Pulses, legumes, nuts	Milk	Oils and fats	Sugar	Soda	Other juices	Coffee and tea	Food away from home	Beer	Other alcoholic beverages	Other foods
Hicksian elasticities																												
Millet	-1.013	0.002	0.002	0.002	0.000	0.002	0.001	0.006	0.001	0.004	0.007	0.001	0.001	0.003	0.000	0.001	0.004	0.002	0.003	0.001	0.002	0.001	0.000	0.000	0.016	0.002	0.000	0.002
Maize	0.000	-1.724	0.002	0.002	0.000	0.002	0.001	0.007	0.001	0.004	0.008	0.001	0.001	0.003	0.000	0.001	0.004	0.003	0.004	0.001	0.003	0.001	0.000	0.000	0.017	0.002	0.000	0.002
Rice	0.000	0.002	-0.971	0.002	0.000	0.002	0.001	0.006	0.001	0.004	0.007	0.001	0.001	0.003	0.000	0.001	0.004	0.002	0.003	0.001	0.002	0.001	0.000	0.000	0.016	0.002	0.000	0.002
Bread	0.000	0.002	0.002	-1.338	0.000	0.002	0.001	0.006	0.001	0.004	0.007	0.001	0.001	0.003	0.000	0.001	0.004	0.002	0.003	0.001	0.002	0.001	0.000	0.000	0.017	0.002	0.000	0.002
Sorghum	0.000	0.002	0.002	0.002	-1.013	0.002	0.001	0.006	0.001	0.004	0.007	0.001	0.001	0.003	0.000	0.001	0.004	0.002	0.003	0.001	0.002	0.001	0.000	0.000	0.016	0.002	0.000	0.002
Sweet and Irish Potatoes	0.000	0.002	0.002	0.002	0.000	-0.398	0.001	0.008	0.001	0.004	0.009	0.001	0.002	0.003	0.000	0.002	0.005	0.003	0.004	0.001	0.003	0.001	0.000	0.000	0.020	0.002	0.000	0.002
Cassava	0.000	0.002	0.002	0.002	0.000	0.002	-0.206	0.008	0.001	0.004	0.009	0.001	0.002	0.003	0.000	0.001	0.005	0.003	0.004	0.001	0.003	0.001	0.000	0.000	0.020	0.002	0.000	0.002
Matooke	0.001	0.003	0.003	0.003	0.000	0.004	0.002	-0.883	0.002	0.006	0.013	0.002	0.002	0.005	0.000	0.002	0.007	0.004	0.006	0.002	0.004	0.002	0.000	0.001	0.029	0.003	0.001	0.003
Vegetables	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.004	-0.467	0.002	0.004	0.001	0.001	0.002	0.000	0.001	0.002	0.001	0.002	0.001	0.001	0.001	0.000	0.000	0.009	0.001	0.000	0.001
Fruits	0.001	0.004	0.004	0.004	0.000	0.004	0.002	0.013	0.002	-0.607	0.015	0.002	0.003	0.006	0.000	0.003	0.009	0.005	0.007	0.002	0.005	0.002	0.000	0.001	0.034	0.003	0.001	0.003
Beef	0.001	0.005	0.005	0.005	0.000	0.005	0.003	0.017	0.003	0.010	-0.427	0.002	0.004	0.007	0.001	0.003	0.011	0.006	0.009	0.002	0.006	0.003	0.001	0.001	0.044	0.004	0.001	0.004
Pork	0.001	0.005	0.005	0.005	0.000	0.005	0.003	0.017	0.003	0.010	0.019	-0.905	0.004	0.007	0.001	0.003	0.011	0.006	0.009	0.002	0.006	0.003	0.001	0.001	0.044	0.004	0.001	0.004
Goat meat	0.001	0.005	0.005	0.005	0.000	0.005	0.003	0.017	0.003	0.010	0.019	0.002	-0.888	0.007	0.001	0.003	0.011	0.006	0.009	0.002	0.006	0.003	0.001	0.001	0.044	0.004	0.001	0.004
Chicken	0.001	0.005	0.005	0.005	0.000	0.005	0.003	0.017	0.003	0.010	0.019	0.002	0.004	-0.814	0.001	0.003	0.011	0.006	0.009	0.002	0.006	0.003	0.001	0.001	0.044	0.004	0.001	0.004
Other meat	0.001	0.005	0.005	0.005	0.000	0.005	0.003	0.017	0.003	0.010	0.019	0.002	0.004	0.007	-0.343	0.003	0.011	0.006	0.009	0.002	0.006	0.003	0.001	0.001	0.044	0.004	0.001	0.004
Eggs	0.001	0.005	0.005	0.005	0.000	0.005	0.003	0.017	0.003	0.010	0.019	0.002	0.004	0.007	0.001	-0.944	0.011	0.006	0.009	0.002	0.006	0.003	0.001	0.001	0.044	0.004	0.001	0.004
Fish	0.001	0.005	0.004	0.004	0.000	0.005	0.003	0.016	0.002	0.009	0.019	0.002	0.003	0.007	0.001	0.003	-1.235	0.006	0.009	0.002	0.006	0.003	0.001	0.001	0.043	0.004	0.001	0.004
Pulses, legumes, nuts	0.000	0.002	0.002	0.002	0.000	0.002	0.001	0.006	0.001	0.003	0.006	0.001	0.001	0.002	0.000	0.001	0.004	-0.757	0.003	0.001	0.002	0.001	0.000	0.000	0.015	0.001	0.000	0.001
Milk	0.001	0.003	0.003	0.003	0.000	0.004	0.002	0.012	0.002	0.007	0.014	0.002	0.003	0.005	0.000	0.002	0.008	0.004	-1.168	0.002	0.004	0.002	0.000	0.001	0.031	0.003	0.001	0.003
Oils and fats	0.000	0.002	0.002	0.002	0.000	0.002	0.001	0.006	0.001	0.003	0.007	0.001	0.001	0.003	0.000	0.001	0.004	0.002	0.003	-0.557	0.002	0.001	0.000	0.000	0.015	0.001	0.000	0.001
Sugar	0.000	0.002	0.002	0.002	0.000	0.003	0.001	0.009	0.001	0.005	0.010	0.001	0.002	0.004	0.000	0.002	0.006	0.003	0.005	0.001	-0.966	0.001	0.000	0.000	0.022	0.002	0.000	0.002
Soda	0.000	0.002	0.002	0.002	0.000	0.003	0.001	0.009	0.001	0.005	0.010	0.001	0.002	0.004	0.000	0.002	0.006	0.003	0.005	0.001	0.003	-0.974	0.000	0.000	0.022	0.002	0.000	0.002
Other juices	0.000	0.002	0.002	0.002	0.000	0.003	0.001	0.009	0.001	0.005	0.010	0.001	0.002	0.004	0.000	0.002	0.006	0.003	0.005	0.001	0.003	0.001	-0.987	0.000	0.022	0.002	0.000	0.002
Coffee & tea	0.001	0.005	0.005	0.005	0.000	0.006	0.003	0.017	0.003	0.010	0.020	0.002	0.004	0.008	0.001	0.003	0.011	0.006	0.009	0.002	0.007	0.003	0.001	-0.844	0.045	0.004	0.001	0.004
Food away	0.001	0.005	0.005	0.005	0.000	0.006	0.003	0.017	0.003	0.010	0.020	0.002	0.004	0.008	0.001	0.003	0.011	0.006	0.009	0.002	0.007	0.003	0.001	0.001	-0.840	0.004	0.001	0.004
Beer	0.001	0.005	0.005	0.005	0.000	0.006	0.003	0.017	0.003	0.010	0.020	0.002	0.004	0.008	0.001	0.003	0.011	0.006	0.009	0.002	0.007	0.003	0.001	0.001	0.045	-0.286	0.001	0.004
Other alcoholic beverages	0.001	0.005	0.005	0.005	0.000	0.006	0.003	0.017	0.003	0.010	0.020	0.003	0.004	0.008	0.001	0.003	0.011	0.006	0.009	0.002	0.007	0.003	0.001	0.001	0.045	0.004	-7.492	0.004
Other foods	0.001	0.005	0.005	0.005	0.000	0.006	0.003	0.017	0.003	0.010	0.020	0.002	0.004	0.008	0.001	0.003	0.011	0.006	0.009	0.002	0.006	0.003	0.001	0.001	0.045	0.004	0.001	-1.000
Marshallian elasticities																												
Millet	-1.014	-0.004	-0.004	-0.004	0.000	-0.004	-0.002	-0.006	-0.005	-0.003	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.002	-0.007	-0.003	-0.003	-0.004	-0.002	0.000	0.000	-0.005	0.000	0.000	0.000
Maize	-0.001	-1.730	-0.005	-0.005	0.000	-0.004	-0.002	-0.007	-0.006	-0.003	-0.003	0.000	0.000	-0.001	0.000	0.000	-0.002	-0.008	-0.003	-0.003	-0.004	-0.002	0.000	0.000	-0.005	0.000	0.000	-0.001
Rice	-0.001	-0.004	-0.977	-0.004	0.000	-0.004	-0.002	-0.006	-0.005	-0.003	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.002	-0.007	-0.003	-0.003	-0.004	-0.002	0.000	0.000	-0.005	0.000	0.000	0.000
Bread	-0.001	-0.004	-0.004	-1.344	0.000	-0.004	-0.002	-0.006	-0.005	-0.003	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.002	-0.007	-0.003	-0.003	-0.004	-0.002	0.000	0.000	-0.005	0.000	0.000	0.000
Sorghum	-0.001	-0.004	-0.004	-0.004	-1.013	-0.004	-0.002	-0.006	-0.005	-0.003	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.002	-0.007	-0.003	-0.003	-0.004	-0.002	0.000	0.000	-0.005	0.000	0.000	0.000
Sweet and Irish Potatoes	-0.001	-0.005	-0.005	-0.005	0.000	-0.405	-0.003	-0.008	-0.006	-0.003	-0.003	0.000	-0.001	-0.001	0.000	-0.001	-0.002	-0.009	-0.004	-0.003	-0.005	-0.002	0.000	0.000	-0.006	-0.001	0.000	-0.001
Cassava	-0.001	-0.005	-0.005	-0.005	0.000	-0.005	-0.210	-0.008	-0.006	-0.003	-0.003	0.000	-0.001	-0.001	0.000	0.000	-0.002	-0.009	-0.004	-0.003	-0.005	-0.002	0.000	0.000	-0.006	-0.001	0.000	-0.001
Matooke	-0.002	-0.007	-0.008	-0.008	0.000	-0.007	-0.004	-0.905	-0.009	-0.004	-0.004	-0.001	-0.001	-0.002	0.000	-0.001	-0.003	-0.013	-0.005	-0.005	-0.007	-0.003	-0.001	0.000	-0.009	-0.001	0.000	-0.001
Vegetables	0.000	-0.002	-0.002	-0.002	0.000	-0.002	-0.001	-0.004	-0.470	-0.001	-0.001	0.000	0.000	-0.001	0.000	0.000	-0.001	-0.004	-0.002	-0.001	-0.002	-0.001	0.000	0.000	-0.003	0.000	0.000	0.000
Fruits	-0.002	-0.009	-0.009	-0.009	0.000	-0.008	-0.004	-0.013	-0.011	-0.620	-0.005	-0.001	-0.001	-0.002	0.000	-0.001	-0.003	-0.015	-0.006	-0.005	-0.008	-0.004	-0.001	0.000	-0.010	-0.001	0.000	-0.001
Beef	-0.002	-0.011	-0.012	-0.012	0.000	-0.010	-0.006	-0.017	-0.014	-0.007	-0.453	-0.001	-0.001	-0.003	0.000	-0.001	-0.004	-0.019	-0.008	-0.007	-0.010	-0.005	-0.001	0.000	-0.013	-0.001	0.000	-0.001
Pork	-0.002	-0.011	-0.012	-0.012	0.000	-0.010	-0.006	-0.017	-0.014	-0.007	-0.007	-0.908	-0.001	-0.003	0.000	-0.001	-0.004	-0.019	-0.008	-0.007	-0.010	-0.005	-0.001	0.000	-0.013	-0.001	0.000	-0.001
Goat meat	-0.002	-0.011	-0.012	-0.012	0.000	-0.010	-0.006	-0.017	-0.014	-0.007	-0.007	-0.001	-0.893	-0.003	0.000	-0.001	-0.004	-0.019	-0.008	-0.007	-0.010	-0.005	-0.001	0.000	-0.013	-0.001	0.000	-0.001
Chicken	-0.002	-0.011	-0.012	-0.012	0.000	-0.010	-0.006	-0.017	-0.014	-0.007	-0.007	-0.001	-0.001	-0.824	0.000	-0.001	-0.004	-0.019	-0.008	-0.007	-0.010	-0.005	-0.001	0.000	-0.013	-0.001	0.000	-0.001
Other meat	-0.002	-0.011	-0.012	-0.012	0.000	-0.010	-0.006	-0.017	-0.014	-0.007	-0.007	-0.001	-0.001	-0.002	-0.344	-0.001	-0.004	-0.019	-0.008	-0.007	-0.010	-0.005	-0.001	0.000	-0.013	-0.001	0.000	-0.001
Eggs	-0.002	-0.011	-0.012	-0.012	0.000	-0.010	-0.006	-0.017	-0.014	-0.007	-0.007	-0.001	-0.001	-0.003	0.000	-0.949	-0.004	-0.019	-0.008	-0.007	-0.010	-0.005	-0.001	0.000	-0.013	-0.001	0.000	-0.001
Fish	-0.002	-0.011	-0.011	-0.011	0.000	-0.010	-0.005	-0.017	-0.013	-0.007	-0.006	-0.001	-0.001	-0.002	0.000	-0.001	-1.250	-0.018	-0.008	-0.007	-0.010	-0.005	-0.001	0.000	-0.013	-0.001	0.000	-0.001
Pulses, legumes, nuts	-0.001	-0.004	-0.004	-0.004	0.000	-0.003	-0.002	-0.006	-0.005	-0.002	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.001	-0.765	-0.003	-0.002	-0.003	-0.002	0.000	0.000	-0.004	0.000	0.000	0.000
Milk	-0.002	-0.008	-0.008	-0.008	0.000	-0.007	-0.004	-0.012	-0.010	-0.005	-0.005	-0.001	-0.001	-0.002	0.000	-0.001	-0.003	-0.013	-1.180	-0.005	-0.007	-0.003	-0.001	0.000	-0.009	-0.001	0.000	-0.001
Oils and fats	-0.001	-0.004	-0.004	-0.004	0.000	-0.004	-0.002	-0.006	-0.005	-0.002	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.001	-0.007	-0.003	-0.560	-0.004	-0.002	0.000	0.000	-0.005	0.000	0.000	0.000
Sugar	-0.001	-0.006	-0.006	-0.006	0.000	-0.005	-0.003	-0.009	-0.007	-0.003	-0.003	0.000	-0.001	-0.001	0.000	-0.001	-0.002	-0.010	-0.004	-0.003	-0.975	-0.002	0.000	0.000	-0.007	-0.001	0.000	-0.001
Soda	-0.001	-0.006	-0.006	-0.006	0.000	-0.005	-0.003	-0.009	-0.007	-0.003	-0.003	0.000	-0.001	-0.001	0.000	-0.001	-0.002	-0.010	-0.004	-0.003	-0.005	-0.977	0.000	0.000	-0.007	-0.001	0.000	-0.001
Other juices	-0.001	-0.006	-0.006	-0.006	0.000	-0.005	-0.003	-0.009	-0.007	-0.003	-0.003	0.000	-0.001	-0.001	0.000	-0.001	-0.002	-0.010	-0.004	-0.003	-0.005	-0.002	-0.988	0.000	-0.007	-0.001	0.000	-0.001
Coffee & tea	-0.002	-0.011	-0.012	-0.012	0.000	-0.011	-0.006	-0.017	-0.014	-0.007	-0.007	-0.001	-0.001	-0.003	0.000	-0.001	-0.004	-0.019	-0.008	-0.007	-0.011	-0.005	-0.001	-0.845	-0.014	-0.001	0.000	-0.001
Food away	-0.002	-0.011	-0.012	-0.012	0.000	-0.011	-0.006	-0.018	-0.014	-0.007	-0.007	-0.001	-0.001	-0.003	0.000	-0.001	-0.004	-0.019	-0.008	-0.007	-0.011	-0.005	-0.001	0.000	-0.899	-0.001	0.000	-0.001
Beer	-0.002	-0.011	-0.012	-0.012	0.000	-0.011	-0.006	-0.017	-0.014	-0.007	-0.007	-0.001	-0.001	-0.003	0.000	-0.001	-0.004	-0.019	-0.008	-0.007	-0.011	-0.005	-0.001	0.000	-0.014	-0.291	0.000	-0.001
Other alcoholic beverages	-0.002	-0.011	-0.012	-0.012	0.000	-0.011	-0.006	-0.018	-0.014	-0.007	-0.007	-0.001	-0.001	-0.003	0.000	-0.001	-0.004	-0.019	-0.008	-0.007	-0.011	-0.005	-0.001	0.000	-0.014	-0.001	-7.493	-0.001
Other foods	-0.002	-0.011	-0.012	-0.012	0.000	-0.010	-0.006	-0.017	-0.014	-0.007	-0.007	-0.001	-0.001	-0.003	0.000	-0.001	-0.004	-0.019	-0.008	-0.007	-0.011	-0.005	-0.001	0.000	-0.014	-0.001	0.000	-1.005
Income elasticities	0.405	0.430	0.405	0.406	0.404	0.500	0.485	0.715	0.225	0.845	1.074	1.075	1.075	1.075	1.072	1.079	1.045	0.360	0.755	0.375	0.545	0.545	0.545	1.099	1.106	1.103	1.110	1.097

Table A4: Food composition (based on 100 grams)

	Nutrients													
	Energy (kcal)	Protein (g)	Lipid total (g)	Carbohydrate (g)	Calcium (g)	Iron (mg)	Zinc (mg)	Vitamin C (mg)	Thiamin Vitamin B1 (mg)	Riboflavin Vitamin B2 (mg)	Niacin Vitamin B3 (mg)	Vitamin B6 (mg)	Folate (µg dietary folate equivalence)	Vitamin A (µg retinol equivalent)
Millet flour	374.000	10.900	4.200	72.100	8.000	3.000	1.700	0.000	0.416	0.287	4.668	0.380	84.000	0.000
Maize	369.000	7.300	1.800	79.200	3.000	1.100	0.700	0.000	0.140	0.050	1.000	0.198	30.000	0.000
Rice	361.000	7.050	1.650	77.750	21.000	1.300	1.600	0.000	0.242	0.046	2.954	0.327	14.500	0.000
Bread	266.000	7.600	3.300	50.600	151.000	3.700	0.700	0.000	0.455	0.331	4.385	0.084	25.000	0.000
Sorghum	339.000	11.300	3.300	74.600	28.000	4.400	1.600	0.000	0.237	0.142	2.927	0.150	14.000	0.000
Sweet and Irish Potatoes	97.000	2.100	0.100	22.450	26.500	0.800	0.350	11.500	0.094	0.058	0.908	0.290	15.500	0.000
Cassava	237.000	2.000	0.500	57.350	23.500	1.100	0.500	46.300	0.199	0.049	1.127	0.394	31.500	4.000
Matooke	122.000	1.300	0.400	31.900	3.000	0.600	0.100	18.400	0.052	0.054	0.686	0.299	22.000	56.000
Vegetables	31.500	1.150	0.150	7.200	18.000	0.350	0.150	15.400	0.053	0.034	0.308	0.101	14.000	16.000
Fruits	72.000	0.800	0.200	18.400	6.000	0.850	1.850	47.350	0.026	0.052	0.433	0.234	16.000	4.000
Beef	251.000	18.200	19.200	0.000	7.000	1.900	3.700	0.000	0.090	0.160	3.150	0.380	6.000	0.000
Pork	200.000	19.500	12.900	0.000	19.000	0.800	1.900	0.600	0.892	0.253	4.492	0.456	5.000	2.000
Goat meat	109.000	20.600	2.300	0.000	13.000	2.800	4.000	0.000	0.110	0.490	3.750	0.200	5.000	0.000
Chicken	215.000	18.600	15.100	0.000	11.000	0.900	1.300	1.600	0.060	0.120	6.801	0.350	6.000	42.000
Other meat	222.000	18.300	16.000	0.000	12.000	1.000	1.300	0.700	0.048	0.088	5.926	0.350	4.000	44.000
Eggs	143.000	12.600	9.900	0.800	53.000	1.800	1.100	0.000	0.069	0.478	0.070	0.143	47.000	140.000
Fish	96.000	20.100	1.700	0.000	10.000	0.600	0.300	0.000	0.041	0.063	3.903	0.162	24.000	0.000
Pulses, legumes, nuts	457.000	23.600	25.200	39.350	102.500	4.850	2.800	3.150	0.677	0.174	6.620	0.411	382.500	0.000
Milk	60.000	3.200	3.300	4.500	113.000	0.000	0.400	0.000	0.044	0.183	0.107	0.036	5.000	28.000
Oils and fats	884.000	0.000	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sugar	54.000	0.600	0.100	13.000	8.000	1.400	0.000	3.000	0.020	0.010	0.100	0.000	0.000	0.000
Soda	48.000	0.000	0.000	12.300	5.000	0.100	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other juices	45.000	0.700	0.200	10.400	11.000	0.200	0.050	50.000	0.090	0.030	0.400	0.040	30.000	10.000
Coffee & tea	1.000	0.100	0.000	0.200	0.000	0.010	0.000	0.000	1.000	0.000	1.000	2.000	0.000	0.000
Beer	41.000	0.300	0.000	3.700	5.000	0.000	0.000	0.000	0.010	0.030	0.510	0.050	6.000	0.000
Other alcoholic beverages	263.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Hotz et al. (2012).