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# Food System Transformation in Mozambique: An Assessment of Changing Diet Quality in the context of a Rising Middle Class

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**Abstract**

Robust income growth combined with the highest urban population growth in the world is driving very rapid changes in the food system of Sub-Saharan Africa. Demand is increasing for higher quality foods, including fresh produce, meat and dairy products as well as more processed foods, with poorer nutritional value. The overweight and obesity epidemic that first began among developed nations is not sparing the expanding middle classes within developing countries, leading to a double burden of over and under nourished populations in these areas. As rapidly expanding towns and cities proliferate across Sub-Saharan Africa, urban areas can also become deserts for fresh or less-processed nutritious foods. Urban farming has been one way that the food desert challenge in urban areas is ameliorated, and in Mozambique, even in the largest city center of Maputo, one in ten households owns their own farm land. In the context of rapid urbanization and income growth in Mozambique, this paper finds that both growing incomes and the consumption of processed foods are associated with a worsening of negative factors in the diet. Furthermore, urbanization, controlling for income, is associated more strongly with a worsening of negative factors than with an improvement in positive factors in the diet. However the effect on nutrition of owning one's own farm, controlling for the share of others in the household's area that have a farm, is positive and significant for urban households, primarily driven by these households purchasing fewer unhealthy foods. These findings have important implications concerning the role of urban farming for improving dietary quality.

**Key words:**

Nutrition, Dietary diversity, Dietary quality, Urbanization, Food Deserts, Urban Farming, Mozambique

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## 1. Introduction, Research Questions & Hypotheses

Robust income growth combined with the highest urban population growth in the world is driving very rapid changes in the food system of Sub-Saharan Africa. Demand is increasing for higher quality foods, including fresh produce, meat and dairy products as well as more processed foods, with poorer nutritional value. The overweight and obesity epidemic that first began among developed nations is not sparing the expanding middle classes within developing countries, leading to a double burden of over and under nourished populations in these areas. As rapidly expanding towns and cities proliferate across Sub-Saharan Africa, urban areas can also become deserts for fresh or less-processed nutritious foods. Urban farming has been one way that the food desert challenge in urban areas is ameliorated, and in Mozambique - the focus of this paper - even in the largest city center of Maputo, one out of ten households owns their own farm land. In the context of rapid urbanization and income growth, this paper seeks to understand the key drivers and likely evolution of diet quality in Mozambique, in both its positive and negative dimensions, while specifically examining the potential role that urban farming might play within this transition.

Previous literature has looked at diet quality and its relationship to income, food prices, food expenditure, plot size and crop diversity among farmers, as well as a variety of household socio-demographic characteristics (Rashid et al 2011, Gaiha et al 2014, Darmon & Drewnowski 2008, Mabli et al 2010, Sodjinou et al 2009, Delisle et al 2009, Delisle et al 2010). But no one has analytically showed a relationship between own farming, city size, and nutritional outcomes. Furthermore, of those who have looked at urban farming and nutrition, no dietary quality measures such as those we developed for this study have been used (Zezza & Tasciotti 2010, Maxwell 1995, Armar-Klemesu 2000, Foeken and Mwangi 2000, Madaleno 2000, Bellows et al 2003).

We suggest five hypotheses in this study. One, the consumption of processed foods is significantly associated with worsening of negative factors in the diet. Two, income growth is associated with simultaneous improvement in positive dimensions of diet and worsening of negative dimensions. Three, the income effect on diet does not significantly differ across rural- and urban areas. Four, urbanization, (while controlling for income), is associated more strongly with a worsening of negative factors than with an improvement in positive factors. Five, not all households who are interested in eating fresh foods are able to achieve access to land to do so, however among those that are that are, having one's own farm allows the household to achieve an even more healthy diet as a result.

The rest of this paper is structured as follows: Section two describes the data and methods used in the analysis. Section three gives some descriptive statistics illustrating initial results from two methods which were explored and compared. Section four gives the output of the analysis, which is two-fold: the first section of the results will give an assessment of the patterns and drivers of current household level dietary quality (using Imamura's measure as well as others) over space (rural, large cities, secondary cities), household income levels, household education, and other demographic variables. The second section of the results anticipates the likely directions of change in diet quality over these same dimensions, based on expected income growth and expenditure elasticities developed for several alternative food groupings. By using several approaches to the projection, we are able to assess how robust the expectations can be regarding patterns of near-term evolution of diet quality. Section five summarizes our findings and concludes.

## 2. Data & Methods

This study uses Mozambique's nationally representative 2008/09 IOF (*Inquérito de Orçamento Familiar*) household budget survey, which was conducted from September of 2008 to September of 2009 to assess current levels, patterns, and drivers in diet quality, and to anticipate directions of change over the next years.  The IOF survey is an expenditure survey conducted in a similar style to a Living Standards Measurement Study (LSMS), and includes a large number of food items (384 unique food items in 2008/09), thus lending itself well to such analysis. These items include those purchased for household consumption, those consumed from the household's own agricultural production, and those acquired by means of compensation, for example as a payment or partial payment for work performed or meals offered to employees on the job. Responses were recorded by the household themselves over a three day period of time, or if the the respondents were not able to fill out the questionnaire themselves, the data represent a three-day recall period completed by the enumerator on their second interview visit to the household.  The analysis methods we employ build on the pioneering work by Jack Fiedler and colleagues on use of expenditure surveys for dietary assessments.

We also adapt Imamura et al.'s diet quality measure for this data set (2015), which is a combined score calculated by assigning to each household a combination of positive points on the basis of increasing acquisition of nine healthy food or nutrient items (wholegrains, fruit, vegetables, fish, nuts/seeds, beans/legumes, fiber, calcium, and polyunsaturated fat) and negative points on the basis of acquisition of six unhealthy food/nutrient items (sugar-sweetened beverages, unprocessed red meat, processed meat, cholesterol, sodium and saturated fat).  Corresponding applied nutritional parameters come primarily from the U.S. Department of Agriculture (USDA) food composition table, complemented when needed by other sources, including a more limited Mozambique-specific food composition table produced by Korkalo et al in 2011.

Two alternative methods are used to normalize household food quantity acquisition. In the first method, we take the approach of Smith and Subandoro (2007), among others, to generate daily per adult equivalent quantities in unit weights, of foods and nutrients acquired (whether purchased, received in kind or produced from one's own farm). In the second method, we follow the example of Mabli et al. (2010) who suggest that methods using per adult equivalent standardizations, as compared to daily recommended values, for example, is a method that has fallen into disfavor, and recommend normalizing consumption to a 1,000 kilocalorie diet over all recorded food acquisition by the household, thus removing any adult equivalent or daily standardization. In this second approach, household size in adult equivalents is then included as a right-hand-side variable in the multi-variate analysis. In both approaches, quantities are adjusted for edible percentages and account for milliliter to gram conversion factors of liquid food items. We find the results from applying both methods to the generation of various dietary quality indicators to be useful, and where our regression analyses are carried out with both approaches, we find very similar and robust results between the two.

**3. Descriptive Statistics**

Using the per adult equivalent normalization approach, the first of the two methods described above, implied daily kilocalorie consumption per adult equivalent at the household level is a reasonable 2,056 kcal median, or 2,220 kcal/day mean. The six most common foods households mention acquiring within the one week recall period of the survey are vegetables (93% of all households), followed by cereals, fruit, nuts, fish, and roots (see table 3.1). Meats ranked 10$^{th}$ out of 13 categories, with 31% of households consuming meat during the given week.

In terms of the density of foods eaten in grams, cereal acquisition ranked highest at an average 300.5g/day/adult equivalent (primarily uncooked grains, although bread and other processed or prepared cereal products are also represented here, for example muffins or cake), followed by fruit, vegetables, roots, nuts then fish, at an average 29.4g/day/adult equivalent.

Using the same processing/perishability categorizations generated for cross-country studies such as those performed by Tschirley et al (2015a, 2015b), foods that are perishable and unprocessed are the most commonly acquired items (the group into which many fruits and vegetables are categorized), with a 70%

participation rate (see table 3.2). Perishable and highly processed foods were the least commonly consumed items, with a 31% participation rate.

**Table 3.1** Most commonly represented food groups purchased among Mozambique households

| Food Group | Participation Rate | Mean (g) | Median (g) | Std Dev | COV | Participation Rate Ranking |
|---|---|---|---|---|---|---|
| Vegetables | 93% | 160.8 | 61.5 | 0.54 | 3.38 | 1 |
| Cereals | 87% | 300.5 | 322.2 | 0.21 | 0.68 | 2 |
| Fruit | 84% | 186.0 | 94.1 | 0.38 | 2.06 | 3 |
| Nuts | 78% | 61.9 | 36.2 | 0.09 | 1.43 | 4 |
| Fish | 72% | 29.4 | 10.8 | 0.06 | 2.04 | 5 |
| Roots | 53% | 130.1 | 24.3 | 0.24 | 1.84 | 6 |
| Miscellaneous | 41% | 10.0 | 0.0 | 0.05 | 6.59 | 7 |
| Oil | 49% | 7.0 | 0.0 | 0.02 | 2.15 | 8 |
| Sugars | 36% | 14.8 | 0.0 | 0.04 | 2.45 | 9 |
| Meat | 31% | 20.7 | 0.0 | 0.07 | 3.22 | 10 |
| Beverages | 21% | 17.1 | 0.0 | 0.23 | 13.55 | 11 |
| Egg | 8% | 1.2 | 0.0 | 0.01 | 6.27 | 12 |
| Milk | 3% | 1.0 | 0.0 | 0.01 | 10.52 | 13 |

**Source:** 2008/2009 IOF data
**Notes:** Foods are categorized according to Zezza and Tasciotti's 13 comprehensive food groups (see Annex 1). Quantities are daily per adult equivalent edible percentage kgs acquired. The coefficient of variation (COV) for the categories of beverages, milk, vegetables and fruits are high due to the standardization to a 2,000 kcal diet, which in many cases causes the quantities of these high density, low calorie items, to be overrepresented in the household's collective diet.

**Table 3.2** Most commonly represented processing/perishable groups purchased among Mozambique households

| Processing / Perishable Food Categories | Participation Rate | Mean (g) | Median (g) | Std Dev | COV | Participation Rate Ranking |
|---|---|---|---|---|---|---|
| Unprocessed and Perishable | 70% | 76.7 | 34.5 | 0.11 | 1.39 | 1 |
| High Processed and Non Perishable | 66% | 99.1 | 10.6 | 0.18 | 1.82 | 2 |
| Low Processed and Non Perishable | 61% | 89.3 | 22.6 | 0.14 | 1.62 | 3 |
| Unprocessed and Non Perishable | 56% | 83.3 | 16.5 | 0.14 | 1.68 | 4 |
| Low Processed and Perishable | 55% | 13.7 | 2.3 | 0.03 | 2.47 | 5 |
| High Processed and Perishable | 31% | 7.6 | 0.0 | 0.04 | 5.58 | 6 |

**Source:** 2008/2009 IOF data
**Notes:** Foods are categorized according to Tschirley et al.'s six processing and perishable categories (2015). Quantities are daily per adult equivalent edible percentage kgs acquired.

**Table 3.3** Farm ownership and city size

| City Size where Household is located | Someone in the household owns land | |
|---|---|---|
| Rural | 4,301 | 98% |
| Small Town (<100k) | 2,542 | 83% |
| Secondary city (100k-999k) | 1,094 | 49% |
| Large city (> 1m) | 152 | 13% |
| Total (N = 10,877) | 8,089 | 74% |

**Source:** 2008/2009 IOF data

Perhaps not surprisingly, the share of households owning land falls significantly with the household's location in a city of increasing size (see table 3.3). As we will see in the next section, household nutrition is also monotonically more negative with increasing city size. Fifty-eight percent of urban households own a farm compared to 98% in rural areas.

## 4. Results

### 4a. Patterns and Drivers of Current Household Level Dietary Quality

This section assesses the patterns and drivers of current household level dietary quality (using our adapted Imamura measure as well as others) over space (rural, small towns, secondary cities, and large cities), household income levels (proxied by total household expenditure), household education, and other demographic variables.

***Indicators of Dietary Diversity***

First, we briefly describe some of the key indicators of dietary diversity suggested in the literature, which we replicate or alter for our regression analysis as alternative outcome variables. Table 4.1 summarizes these indicators.

The primary measure of dietary quality we use is adapted from the measure created by Imamura et al. (2015). It is a score calculated by assigning to each household a combination of positive points on the basis of increasing acquisition of nine healthy food or nutrient items (wholegrains, fruit, vegetables, fish, nuts/seeds, beans/legumes, fiber, calcium, and polyunsaturated fat) and negative points on the basis of acquisition of six unhealthy food/nutrient items (sugar-sweetened beverages, unprocessed red meat, processed meat, cholesterol, sodium and saturated fat). The resulting value is then standardized to a 100 point scale. It is represented by the variable *imindex_std*.

We also decompose the adapted Imamura et al. combined diet quality measure into both positive and negative dimension individual scores (*imposindex_std* and *imnegindex_std*), with higher scores always indicating a better dietary outcome, whether it is increasing consumption of positive food items or decreasing consumption of negative food items. These are also standardized to a 100 point scale.

We generate and compare several dietary diversity scores, computed in one of three ways: (1) according to the number of different comprehensive food groups represented by each household (a method referenced by Sodjinou; Smith & Subandoro 2007; and Zezza & Tasciotti 2010, represented in the analysis by variables *dicscr13* and *divscr7)*, (2) as a simple count of the different food items the household reported having acquired (a method employed by Zezza & Tasciotti 2010, and represented by the variable *foodcount*), or (3) via several alternative versions of a food diversity index (variables *fdi13quant*, *fdi13expen*, *fdi7quant*,and *fdi10quant*), which are calculated as the sum of squares of the shares of the various food items in the food consumption basket (Gaiha et al 2012). These are created separately as a function of food quantities and as a function of food expenditures. The regression results in relation to the different dietary diversity score specifications are robust in that they yield quite similar estimates.

**Table 4.1** Regression Outcome Variables

| Dietary Quality Indicators | Definition/Further Explanation | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| **Imamura Indices** | Combination scores of positive points for positive items consumed, and negative for negative items consumed. Scores of 1-5 given on the basis of the food's per adult equivalent consumption quintile. | | | | | |
| *imindex_std* | Imamura Combined Index – a combined score of the consumption of healthy and unhealthy foods. | | | | | |
| *imposindex_std* | Imamura Positive Index (higher score = more consumption of healthy foods). | | | | | |
| *imnegindex_std* | Imamura Negative Index (higher score = less consumption of unhealthy foods). | | | | | |
| **Dietary Diversity Scores** | Defined as the total number of different food groups consumed over a given recall period, irrespective of the frequency and the amounts consumed. | | | | | |
| *divscr13* | Calculated on the basis of the food categorizations taken from Zezza and Tasciotti (2010), this is an exhaustive categorization of 13 subcomponents including sweets as one and oils/fats as another. | 10876 | 6.6 | 2.1 | 1.0 | 13.0 |
| *divscr7* | Similar to Gaiha et al's five groups (2012), this indicator excludes any beverages or misc group, and is defined over the following seven food groups, as offered by Smith and Subandoro (2007): 1 - cereals, roots and tubers, 2 - pulses and legumes, 3 - dairy products, 4 - meats, fish and seafood, and eggs, 5 - oils and fats, 6 - fruits, and 7 - vegetables. | 10876 | 4.5 | 1.2 | 0.0 | 7.0 |
| *foodcount* | A simple count of the different food items the HH reported having consumed during the reference period. | 10876 | 11.0 | 4.8 | 1.0 | 43.0 |
| **Food Diversity Indices** | Taken from Gaiha et al, this is constructed as the sum of squares of the shares of the various food items in the food consumption basket. A high value of the index implies a more concentrated food basket and low value implies a more diverse food basket. The five food groups to construct the FDI in Gaiha et al are: (i) cereals and pulses; (ii) milk, milk products, eggs, and meats; (iii) oil; (iv) sugar; and (v) fruits and vegetables. | | | | | |
| *fdi13quant* | Generated on the basis of food **quantities** acquired among the Zezza and Tasciotti's exhaustive categorization of 13 subcomponents (2010), including sweets as one and oils/fats as another (see annex table 6.1). | 10876 | 0.3 | 0.1 | 0.1 | 1.0 |
| *fdi13expen* | Generated on the basis of food **expenditures** acquired among the Zezza and Tasciotti's exhaustive categorization of 13 subcomponents (2010), including sweets as one and oils/fats as another. | 10876 | 0.4 | 0.2 | 0.1 | 1.0 |
| *fdi7quant* | Generated on the basis of food quantities acquired among the seven food groups offered by Smith and Subandoro (2007), and excludes any beverages or misc group. | 10876 | 0.4 | 0.1 | 0.1 | 1.0 |

| Dietary Quality Indicators | Definition/Further Explanation | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| *fdi10quant* | Generated on the basis of food quantities acquired among the 10 food items identified by Imamura et al, 2015: Wholegrain, fruit, vegetable, fish, nuts&seeds, beans&legumes, milk, sugar-sweetened beverages, unprocessed red meats, and processed meats (excluding fruit juice). | 10876 | 0.4 | 0.2 | 0.1 | 1.0 |
| **General/Overall Indicators** | | | | | | |
| *AMDS* | Alternative Mediterranean Diet Score (AMDS or AMED), generated on the basis of the table referenced in annex table 6.2. | 10876 | 3.3 | 1.3 | 0.0 | 8.0 |
| *healthflsc* | Healthfulness Score: How consumed diets compare to the WHO/FAO recommendations in the areas of total fat, saturated fatty acids, polyunsaturated fatty acids, cholesterol, sugar, protein, fibre, fruits, vegetables, and nuts. Created on the basis of percentage contributions, for more detail, see annex tables 6.3 through 6.7. | 10876 | 2.9 | 1.0 | 0.0 | 7.0 |
| **Macronutrient Diet Composition Scores** | | | | | | |
| *macroratiosc* | Macronutrient ratio score on the basis of widely accepted general guidelines as the desirable ranges of carbohydrate: protein: fat proportions. For more detail, see annex table 6.8. | | | | | |
| *monosatratio* | Ratio of monounsaturated to saturated fatty acids. | 10876 | 1.7 | 1.6 | 0.0 | 10.8 |
| *sfatpct1* | Saturated fat share of total energy. | 10876 | 0.1 | 0.1 | 0.0 | 0.8 |
| *pfatpct1* | Polyunsaturated fat share of total energy. | 10876 | 0.0 | 0.0 | 0.0 | 0.2 |
| *lippct1* | Total fat share of total energy. | 10876 | 0.2 | 0.1 | 0.0 | 0.9 |

**Source:** 2008/2009 IOF data

**Table 4.2 Determinants of Dietary Quality**

| VARIABLES | lnimindex | lnimposindex | lnimnegindex | divscr13 | AMDS | healthflsc | macroratiosc | monosatratio |
|---|---|---|---|---|---|---|---|---|
| hgender | 0.0297*** | 0.0231* | 0.0367*** | -0.214 | 0.017 | 0.346*** | 0.0252 | -0.0602 |
| hage | -9.09E-06 | -7.92e-05*** | 6.97e-05*** | -0.00196*** | -0.00058*** | -0.000402* | -0.000369 | -0.00136*** |
| 1.citysize | -0.00728** | 0.00937 | -0.0229*** | 0.548*** | 0.0381 | -0.0702* | 0.195 | 0.00049 |
| 2.citysize | -0.0180*** | 0.0131 | -0.0473*** | 1.041*** | -0.120* | -0.184*** | 0.205 | -0.423*** |
| 3.citysize | -0.0374*** | -0.0242 | -0.0529*** | 1.574*** | -0.0338 | 0.190* | 0.450* | -1.053*** |
| shareownfarm | -0.0352*** | -0.0262 | -0.0494*** | 0.376 | -0.322** | -0.451*** | 0.168 | 0.184 |
| ownfarmShare ownfarm | 0.0400*** | -0.0154 | 0.103*** | -0.622*** | -0.14 | 0.268*** | 0.0422 | -0.296** |
| totexp | -0.00244*** | 0.000248 | -0.00534*** | 0.0401*** | 0.000281 | 0.0195*** | 0.0152** | 0.00482 |
| fhhheduc | 0.000171 | 0.000561 | 4.66E-05 | 0.0592*** | 0.0112 | 0.00733 | -0.0105 | -0.0155 |
| mhhheduc | -0.00254* | -0.00287 | -0.00244* | 0.0432* | -0.0147 | -0.0154 | 0.0251 | 0.0374*** |
| fsalaried | -0.0375*** | -0.0386*** | -0.0407*** | -0.392** | -0.341*** | -0.453*** | -0.0552 | -0.417*** |
| fcontp | -0.0127*** | -0.00141 | -0.0241*** | 0.291*** | 0.0406 | -0.0810* | -0.0923 | -0.154*** |
| fnowork | -0.0201*** | -0.0179* | -0.0235*** | -0.0692 | -0.152** | -0.279*** | 0.0265 | -0.178** |
| msalaried | 0.00629 | 0.022 | -0.00955 | 0.292* | 0.154 | 0.0599 | 0.143 | -0.0634 |
| mcontp | 0.0188*** | 0.0243** | 0.0155* | 0.420*** | 0.184** | 0.358*** | -0.0765 | -0.0627 |
| mnowork | 0.0199* | 0.0203 | 0.0205 | -0.127 | 0.0864 | 0.163 | -0.199 | -0.333*** |
| nkidslt5 | -0.00450*** | -0.00517* | -0.00386** | 0.116*** | -0.000271 | -0.0438** | 0.0451 | 0.0107 |
| nkids1220 | -0.00504*** | -0.00579* | -0.00396** | 0.109*** | -0.0247 | -0.0840*** | -0.0347 | -0.0677*** |
| nummeals | 0.00397 | 0.0263*** | -0.0176*** | 0.571*** | 0.208*** | 0.157*** | -0.0502 | 0.0713*** |
| Constant | 3.867*** | 3.113*** | 3.213*** | 3.561*** | 2.935*** | 3.297*** | 2.789*** | 1.932*** |
| R-squared | 0.061 | 0.014 | 0.185 | 0.174 | 0.02 | 0.042 | 0.025 | 0.042 |

Significance at 1% (***); 5% (**); 10% (*).

The Alternative Mediterranean Diet Score (*AMDS*) and the Healthfulness Score (*healthflsc*) are two overarching scores which assign a value based on how consumed diets compare to the WHO/FAO recommendations in the areas of total fat, saturated fatty acids, polyunsaturated fatty acids, cholesterol, sugar, protein, fiber, fruits, vegetables, and nuts (Sodjinou et al 2009, Deslise et al 2009). The AMDS is fashioned after Fung et al.'s application in their article from the journal of clinical nutrition (2005).

The Macronutrient Ratio Score (*macroratiosc*) is calculated on the basis of conformance to the widely accepted general guidelines of desirable ranges for energy proportions from carbohydrates, protein and fat (Kim et al 2003, Deslise et al 2009). Lastly, the ratio of monounsaturated to saturated fatty acids (*monosatratio*) is also used as its own indicator of dietary quality (Deslise et al 2009), a higher score being more desirable. Variables *lippct, sfatpct,* and *pfatpct* represent the total, saturated, and polyunsaturated fat shares of total energy.

***Regression Results***

Here, we summarize some of our main regression take-aways. The dependent variable definitions and full regression results are reported in annex tables 6.9 through 6.12, but a shortened set of regression results can be found in table 4.2. Note that food share-specific regression results are based on the all-inclusive food categories as suggested in Zezza & Tasciotti (2010).

Households having a female head has almost an invariably positive effect on nutrition, across diet quality or dietary diversity indicators and significant particularly in the case of the Imamura scores, both more positive and less negative dimensions, as well as the "healthfulness score" as fashioned after Sodjinou et al. Food share-specific regressions indicate that female headed households consume significantly more cereals and vegetables as well as a significantly less sugars, syrups, sweet, oils and fats.

Increasing age overall has a negative effect on nutrition, although is related to significant decreases in acquisition of both positive and negative items of the Imamura index. Increasing age has a strong and robust negative effect on dietary diversity, Mediterranean diet score, healthfulness score, and monosaturated to saturated fat ratio.

Living in an urban area has an increasingly negative effect on dietary quality the larger the city (robust across Imamura index, healthfulness score, Mediteranean diet score, and the mono/saturated fat ratio), primarily via increased negative food item consumption, but also through a decrease in positive food items. Food share-specific regressions indicate an increase specifically in sugar, fat and (non-specific) beverage shares of food expenditures as city size increases, and decreases in vegetable and nuts/seeds/legume shares. Living in an urban area has an increasingly positive effect on dietary diversity as city size increases. Food-specific regressions indicate an increase specifically in fruit shares of food expenditures in the cities over 1 million, and increasing shares of fish expenditures as city size increases from rural to small towns (less than 100k) and medium size urban centers (100-999k).

The share of those owning their own farms has a negative effect on dietary quality (both Imamura index, the healthfulness score, and the alternative Mediterranean diet score), perhaps picking up in part on farming households located in lower income urban areas via the increase in acquisition of negative items rich in oil and fats.

Owning one’s own farm, controlling for the share of those who own their own farm in the surrounding area (area defined by a geographical unit with 6 to 84 housholds, or an average 15), has a positive and significant effect on dietary quality (both the Imamura index, the healthfulness score and a decrease in the percentage of total fat calories in the diet) via a strong and significant decrease in negative items acquired. At the same time, owning one’s own farm also has a negative and significant effect on dietary diversity. This may be due to farmers relying more heavily on their own production and not visiting a market as frequently. Food-specific regressions indicate an increase specifically in cereals/grains, starchy/roots/tubers/legumes and nut/seed/legume group shares of food expenditures and a decrease in sugar, fat, beverages and meat shares among households owning their own farms.

Total expenditure has a negative effect on dietary quality; however has mixed effects on dietary diversity between both of our methodological approaches - the per adult equivalent and 1000 calorie normalization techniques. Total expenditure has a positive effect on the healthfulness score, the macronutrient ratio score, and the poly and monounsaturated fat share of total energy measures, so these results are a bit hard to discern, and discussed further in the next section on income projections. Food group share analysis indicates an increase specifically in meat, beverages, eggs and milk product food expenditure shares and a decrease in vegetable, fish, nut/seed/legume and roots/tubers shares as well as sugary foods, as total expenditure increases.

Both male and female household head education is has a positive effect on dietary diversity, educated female heads, more strongly so. Food-specific regressions indicate an increase specifically in milk and meat expenditure shares among these households. Education of male heads specifically has a negative effect on dietary quality as it regards significant increased consumption of negative items, while also having a positive effect on the monosaturated to saturated fat ratio via a significant reduction in consumption of saturated fats in these households. The effect on these indicators of female household head education were insignificant. Food-specific regressions indicate a decrease specifically in nuts/legumes and vegetables expenditure shares and an increase in oil/fat and beverage shares among these households headed by educated males.

The number of adult equivalents in each home also has a negative effect on dietary quality as it relates to significant increased consumption of negative items as well as a lower monosaturated to saturated fat ratio. Food-specific regressions indicate an increase in the share of sugar, syrups and sweets expenditures with increasing household size.

Male *conta propria* self-employment is the only category of employment among male or female household heads which has a significant and positive effect on nutrition quality and also shows a significant strong relationship to increased dietary diversity, an increased healthfulness and AMDS score, and a decreased saturated fat percentage of total energy. It appears these positive effects are primarily via the impact of both a significant increase in positive food or nutrients acquired and significant decrease in negative food or nutrients acquired among these households. Food group share-specific regressions indicate an increase in cereals and grain expenditures and a decrease in oil and fat expenditures among this group.

Female salaried employment is the only employment category among male or female household heads which has a significant and negative effect on nutrition quality, dietary diversity and other nutrition indicators (AMDS, healthfulness score, and mono-saturated fat ratio, via significant increases in saturated fat). Other employment categories had more mixed results, sometimes positive and sometimes negative depending on the indicator. Food group share-specific regressions indicate a significant increase in sugar and fat food group share expenditures among female household head salaried employees, however also significant increases in fish and milk shares.

Having kids less than five years old and kids ages 12 to 20 seems to have a generally negative effect on household nutrition, although this effect is not significant across all results, the strongest driver deriving from increased negative food item consumption, especially among families with adolescents.

**4b. Expected Evolution of Dietary Quality as Incomes Rise**

Again, using the processing/perishability categorizations mentioned in section three, now including two categories that capture own production and level of perishability, we look at the nutritional heterogeneity across these. The eight comprehensive food groupings are as follows: 1. Own produced and perishable, 2. Own produced and unperishable, 3. Unprocessed and perishable, 4. Unprocessed and nonperishable, 5. Low processed and perishable, 6. Low processed and nonperishable, 7. High processed and perishable, and 8. High processed and non-perishable. In addition to this, we also compare these eight processing/perishability categories to the three food classification groups offered by Monteiro et al according to the degree and purpose of industrial processing, listed in annex table 6.13 (2010).

Through ANOVA regressions (coefficients reported in table 4.3) we find that these eight categories do indeed explain a fair part of the Imamura diet quality index, with an R-squared of 0.27 at the community level, and of 0.20 at the household level, and all but one category significant in both. Monteiro's three groups, on the other hand, explained very little (at the household level, an R-squared of 0.12 and at the community level, an R-squared of 0.13), despite each included category being significant, which is an interesting result, since nutrition was a key motivation for Monteiro et al's classification.

**Table 4.3** How much of the Imamura combined index is explained by the eight-group processing/perishability food categorization budget shares

| | These categories increase diet quality: | Level of Significance | |
|---|---|---|---|
| | Food Category | HH<br>*R2=0.20* | Community<br>*R2=0.27* |
| 2 | Own production and non-perishable | 2.3*** | 2.0 |
| 4 | Unprocessed and non-perishable | 8.2*** | 20.0*** |
| | These categories decrease diet quality: | | |
| 3 | Unprocessed and perishable | 0.4 | -12.1*** |
| 5 | Low processed and perishable | -8.9*** | -19.6*** |
| 6 | Low processed and non-perishable | -4.1*** | -5.6** |
| 7 | High processed and perishable | -8.7*** | -9.1*** |
| 8 | High processed and non-perishable | -9.2*** | -10.0*** |

**Source:** 2008/2009 IOF data
**Notes**: Results are relative to the "own production and perishable" default group number one. (*** p<0.01, ** p<0.05, * p<0.1)

Relative to the own production and perishable default group, the only two food categorization shares which explained an improvement in the Imamura combined diet quality index from the eight described above are share two, own production and non-perishable foods, as well as share four, unprocessed and non-perishable foods. Consumption of foods in any of the low or high processed food categories corresponds to a negative effect on dietary quality (frequent items in these groups include common quality rice, white corn maize, normal wheat bread, traditional liquor, wine, etc).

***How is dietary quality then likely to evolve given expected income growth?***

By looking at expenditure elasticities developed for several alternative food groupings, we begin to address the question of how dietary quality is likely to evolve given expected income growth.

While the results on the overall expenditure relationship to dietary quality are mixed in the analysis of the drivers and patterns of dietary decisions above, the food expenditure elasticity to the Imamura et al dietary quality indices, by comparison, are positive and insignificant.  That is to say, for a 10% increase in food spending, the nutritional value of food purchased as measured by this index is ambivalently better. However for an increase in overall spending (a proxy for income level), dietary quality, as measured by the Imamura indices, decreases.

The elasticity of demand for several essential vitamins and minerals, fiber, and other micronutrients, show that several, if not most, of these items are inferior goods. While vitamin A is projected to (dramatically) increase with increasing expenditure on food, vitamins C, Riboflavin and Vitamin B12 are projected to substantially decrease, and these appear to be much lower than the trajectories of the lowest-income group of Americans in Mabli et al's study, using data from 1996.  A full list of vitamin and mineral elasticities given a 1% increase in total daily expenditure in Purchase Power Parity per adult equivalent on food is given in table 4.4.

There can be no doubt that the dropping vegetable, as well as fruit food shares – although the latter, insignificantly so, which are being driven by increasing total household expenditures are also related to the negative elasticities for many of these essential vitamins and minerals. And as mentioned in the previous section, the food group expenditure shares of roots/tubers/legumes, nuts/seeds, cereals/grains and fish/shellfish are also expected to decrease with increasing total expenditure, while meat, egg and beverage shares increase.

**Table 4.4** Vitamin and Mineral Food Expenditure Elasticities

| | N | % missing values | Food Expenditure Elasticity |
|---|---|---|---|
| Vitamin A iu | 10,836 | 0.4% | 0.38 |
| Vitamin B6 mg | 10,872 | 0.0% | 0.05 |
| Vitamin B12 g | 8,751 | 19.5% | -0.30 |
| Vitamin E mg | 10,855 | 0.2% | -0.09 |
| Total Folate g | 10,869 | 0.1% | -0.08 |
| Niacin mg | 10,872 | 0.0% | -0.01 |
| Riboflavin (B2) mg | 10,872 | 0.0% | -0.50 |
| Vitamin C mg | 10,813 | 0.6% | -0.44 |
| Calcium mg | 10,875 | 0.0% | -0.11 |
| Iron mg | 10,874 | 0.0% | -0.19 |
| Magnesium mg | 10,872 | 0.0% | -0.02 |
| Phosphorous mg | 10,873 | 0.0% | 0.01 |
| Zinc mg | 10,871 | 0.0% | 0.08 |
| Sodium mg | 10,875 | 0.0% | -0.11 |

**Note:** All significant at the $p < .01$ level except for Niacin and Phosphorous**.**
**Source:** 2008/2009 IOF data

We can see from these results, that as incomes rise and Mozambique's expenditure capacity increases, there will be significant and positive increases in the shares of purchased food which is highly processed, and are shown to decrease dietary quality. This will be concurrently accompanied by a significant drop in shares of own production of food consumed, as well as a drop in the share of food purchased which is unprocessed and nonperishable, both of which are associated with significantly increasing dietary quality.

**5. Conclusion**

In conclusion, we return to our original five hypotheses. One, as we hypothesized, the consumption of processed foods is significantly and strongly associated with the worsening of negative factors in the diet.

Two, income growth is associated with the worsening of negative dimensions of diet, however is not consistently associated with simultaneous improvement in positive dimensions of diet, nor are these results, when positive, significant. In fact, some of our results do show the troubling result of significant decreases in consumption of positive dimensions of diet with households' rising income.

Three, whether the income effect on diet does significantly differ across rural and urban areas varies based on the method of standardization we applied to household food acquisition. When the approach is used that normalizes total food acquisition to a 1,000 calorie diet, the income effect on diet is negative and significant and this does not significantly differ across rural and urban areas, as we hypothesized. However when the approach is used that normalizes food acquisition by day and per adult equivalent, the income effect is negative and significant in the urban areas, but positive and significant in the rural areas.

Four, as we hypothesized, urbanization, controlling for income, is associated more strongly with a worsening of negative factors than with an improvement in positive factors.

Five, we assumed that households interested in eating fresh foods are more likely to seek out land to farm so that they can eat more fresh food, regardless of if they are actually able to achieve access to land to do so or not. We then asked, for those that do gain access to farm land, does this allow them to eat even *more* healthy diets than they would otherwise? Our results show that as we hypothesized, controlling for the share of others in one household's area that have a farm, the effect on nutrition of owning one's own farm is positive and significant, primarily driven by these households purchasing lesser amounts of negative food items.

As the Mozambican middle class grows and urbanization continues, it will be an uphill battle for households to prioritize good nutritional choices in their diets, and this analysis shows that particularly vulnerable groups may be educated and/or salaried females and parents of adolescents and children under five. Especially in urban settings, sugar and fat dense foods may very well become the most accessible and convenient food to be found, however, are lacking in essential nutrients. Yet even in urban contexts, there are many households who have been able to find ways of growing some of the food they consume for themselves, and this study shows that doing so is associated with these same households acquiring more healthy items in their diets in general, and achieving even greater nutrition than their counterparts. Further research is needed on the topic of what opportunities urban farming may present, moving into the future, to prevent highly processed and unhealthy foods from crowding out households' opportunities to consume a nutritious whole foods diet.

## 6. Annex Tables

The following tables provide supplementary material for the text of the main body of this paper.

**Annex Table 6.1.** Zezza and Tasciotti's 13 comprehensive food groups (2010)

| Food group | Content of the goup |
|---|---|
| Food group 1 | Cereals and grain products |
| Food group 2 | Starchy, roots, tubers and legumes |
| Food group 3 | Nuts, seeds and legumes |
| Food group 4 | Vegetables |
| Food group 5 | Fruits |
| Food group 6 | Sugar, syrup and sweets |
| Food group 7 | Meat and poultry |
| Food group 8 | Fish and shellfish |
| Food group 9 | Milk and milk products |
| Food group 10 | Oil and fats |
| Food group 11 | Beverages |
| Food group 12 | Eggs |
| Food group 13 | Miscellaneous |

**Annex Table 6.2**. The Alternate Mediterranean Diet Score, as defined by Fung et al. (2005)

| Food Group | Foods Included | Criteria for 1 point[a] |
|---|---|---|
| Vegetables | All vegetables except potatoes | Greater than median intake (Servings/d) |
| Legumes | Ftofu, string beans, peas, beans | Greater than median intake (Servings/d) |
| Fruit | All fruit and juices | Greater than median intake (Servings/d) |
| Nuts | Nuts, peanut butter | Greater than median intake (Servings/d) |
| Whole grains | Whole-grain ready-to-eat cereals, cooked cereals, crackers, dark breads, brown rice, other grains, wheat germ, bran, popcorn | Greater than median intake (Servings/d) |
| Red and processed meats | Hot dogs, deli meat, bacon, hamburger, beef | Greater than median intake (Servings/d) |
| Fish | Fish and shrimp, breaded fish | Greater than median intake (Servings/d) |
| Ratio of monunsaturated to saturated fat | - | Greater than median intake (Servings/d) |
| Ethanol | Wine, beer, "light" beer, liquor | 5-25 g/d |

[a] 0 points if these criteria are not met.

***How the Healthfulness Dietary Quality Score was generated relative to FAO/WHO guidelines***

**Annex Table 6.3** The FAO/WHO guideline ranges of population nutrient intake goals (2003)

| Dietary factor | Goal (% of total energy,unless otherwise stated) |
|---|---|
| Total fat | 15-30% |
| Saturated fatty acids | < 10% |
| Polyunsaturated fatty acids (PUFAS) | 6-10% |
| n-6 Polyunsaturated fatty acids (PUFAS) | 5-8% |
| n-3 Polyunsaturated fatty acids (PUFAS) | 1-2% |
| Trans fatty acids | <1% |
| Monounsaturated fatty acids (MUFAS) | By difference[a] |
| Total carbohydrate | 55-75%[b] |
| Free sugars[c] | < 10% |
| Protein | 10-15%[d] |
| Cholesterol | <300 mg per day |
| Sodium chloride (sodium)[e] | <5g per day (<2g per day) |
| Fruits and vegetables | > 400 g per day |
| Total dietary fibre | From foods[f] |
| Non-starch polysaccharides (NSP) | From foods[f] |

[a] This is calculated as: total fat – (saturated fatty acides + polyunsaturated fatty acids + trans fatty acids)
[b] The percentage of total energy available after taking into account thtat consumed as protein and fat, hence the wide range.
[c] The term "Free sugars" refers to all monosaccharides and disaccharides added to foods by the manufacturer, cook or consumer, plus sugars naturally present in honey, syrups and fruit juices.
[d] The suggested arrange should be seen in the light of the Joing WHO/FAO/UNU Expert Consultation on Protein and Amino Acid Requirements in Human Nutrition, held in Geneva from 9 to 16 April 2002.
[e] Salt should be iodized appropriately. The need to adjust salt iodization, depending on observed sodium intake and surveillance of iodine status of the population, should be recognized.
[f] See page 58 of the full report, under "Non-starch poly saccharides"

Sodjinou et al, in their 2009 study, create a healthfulness score by assigning a score of 1 for each item if the recommendation was met, and 0 if it was not, for a maximum of 8. Similarly, in this study we give a score of 1 for each item if the recommendation was met, per the following list, also for a maximum of 8.

**Annex Table 6.4** Sodjinou et al's criteria for generating their "Healthfulness Score"

| |
|---|
| Fat percent of total energy falls between 15 and 30% |
| Saturated fat percent of total energy is lower than 10% |
| Polyunsaturated fat percentage of total energy is between 6-10% |
| Carbohydrate percentage of total energy is between 55 and 75% |
| Protein percentage of total energy is between 10 and 15% |
| Cholesterol acquisition is lower than 300 mg/day |
| Fruit and vegetable acquisition is greater than 400mg/day |
| Fiber acquisition is greater than 25g/day |

**Annex Table 6.5** Our Healthfulness Dietary Qualty Score Individual component results

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Fat percent of total energy | 10745 | 0.23 | 0.09 | 0.00 | 0.85 |
| Saturated fat percent of total energy | 10745 | 0.07 | 0.06 | 0.00 | 0.76 |
| Polyunsaturated fat percentage of total energy | 10745 | 0.04 | 0.02 | 0.00 | 0.19 |
| Carbohydrate percentage of total energy | 10745 | 0.64 | 0.11 | 0.00 | 1.00 |
| Protein percentage of total energy | 10745 | 0.23 | 0.08 | 0.00 | 0.81 |
| Daily Cholesterol acquisition | 10745 | 509.24 | 858.11 | 0.00 | 29086.58 |
| Fruit and Vegetable acquisition | 10745 | 328.14 | 330.99 | 0.00 | 3402.35 |
| Daily fiber acquisition | 10745 | 40.55 | 29.96 | 0.00 | 253.42 |

**Annex Table 6.6** Our Healthfulness Dietary Qualty Score Distribution

| Healthfulness Score | Frequency | Percent | Cumulative Percent |
|---|---|---|---|
| 0 | 66.00 | 0.61 | 0.61 |
| 1 | 356.00 | 3.31 | 3.93 |
| 2 | 1334.00 | 12.42 | 16.34 |
| 3 | 2701.00 | 25.14 | 41.48 |
| 4 | 3382.00 | 31.48 | 72.95 |
| 5 | 2242.00 | 20.87 | 93.82 |
| 6 | 607.00 | 5.65 | 99.47 |
| 7 | 57.00 | 0.53 | 100.00 |

Note that this method is also similar to the criteria used for the healthy diet indicator offered by Huijbregts et al. (1997), based on the dietary guidelines for the prevention of chronic diseases.

**Annex Table 6.7** The Healthy Diet Indicator offered by Huijbregts et al.

| | **Dichotomous value** | |
|---|---|---|
| **Nutrient or food group (daily intake)** | **1** | **0** |
| Saturated fatty acids | 0-10 | >10 |
| Polyunsaturated fatty acids | 3-7 | <3 or >7 |
| Protein | 10-15 | <10 or >15 |
| Complex carbohydrates | 50-70 | <50 or >70 |
| Dietary fibre (g) | 27-40 | <27 or >40 |
| Fruits and vegetables (g) | >400 | <400 |
| Pulses, nuts, seeds (g) | >30 | <30 |
| Monosaccharides and disaccharides | 0-10 | >10 |
| Cholesterol (mg) | 0-300 | >300 |

**Note:** Values are percentage of energy intake unless indicated otherwise.

**Annex Table 6.8.** Macronutrient ratio score cutoff values, per Kim et al, 2003

Macronutrient ratio (carbohydrate: protein: fat), for 0 to 6 points:

55 ~ 65: 10 ~ 15: 15 ~ 25 = 6
52 ~ 68: 9 ~ 16: 13 ~ 27 = 4
50 ~ 70:8 ~ 17:12 ~ 30 = 2
Otherwise = 0

Widely accepted general guidelines were chosen as the desirable ranges for the proportions of energy from carbohydrates, protein and fat.

**Annex Table 6.9.** Independent Variables used in the Regression Analysis

| | |
|---|---|
| hgender | HH head gender (0 = male, 1 = female) |
| hage | HH head age |
| citysize | 0 = rural, 1=small town (<100k), 2=secondary city (100k – 1m), 3=large city (> 1m) |
| ownfarm-smallcity | City size interacted with variable for if anyone in the HH owned his or her own farm |
| ownfarm-medcity | City size interacted with variable for if anyone in the HH owned his or her own farm |
| ownfarmlgcity | City size interacted with variable for if anyone in the HH owned his or her own farm |
| shareownfarm | Share of HHs in district-aldeia/bairro-urban area with at least 1 family member owning farmland |
| ownfarmShare-ownfarm | "*Shareownfarm*" interacted with *ownfarm* dummy variable for if anyone in the HH owned his or her own farm |
| totexp | Total daily expenditure in per adult equivalent |
| fhhheduc | Highest level of education completed by female head or female spouse of head |
| mhhheduc | Highest level of education completed by male head or male spouse of head |
| fsalaried | Female head or female spouse of head works for govt, public or private sector (dummy, 1 = yes 0 = no) |
| fcontap | Female head or female spouse of head works *conta própria* (self employed) with or without employees (dummy, 1 = yes 0 = no) |
| fnowork | Female head or female spouse of head does not work (dummy, 1 = yes 0 = no) |
| msalaried | Male head or male spouse of head works for government, public or private sector (dummy, 1 = yes 0 = no) |
| mcontap | Male head or male spouse of head works *conta própria* (self employed) with or without employees (dummy, 1 = yes 0 = no) |
| mnowork | Male head or male spouse of head does not work (dummy, 1 = yes 0 = no) |
| nkidslt5 | Number of kids under age 5 |
| nkids1220 | Number of kids between 12 and 20 |
| nummeals | Number of meals the family shared the previous day (0-3) |

**Annex Table 6.10** Full Regression Results

| VARIABLES | lnimindex | lnimposindex | lnimnegindex | divscr13 | divscr7 | foodcount | fdi13quant | fdi7quant | fdi13expen | fdi10quant | AMDS | healthflsc | macroratios | monosatratio | sfatpct1 | pfatpct1 | lippct1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| hgender | 0.0297*** | 0.0231* | 0.0367*** | -0.214 | 0.0301 | -0.194 | -0.00659 | -0.0182 | 0.0173 | -0.0217* | 0.017 | 0.346*** | 0.0252 | -0.0602 | -0.00775 | -0.000715 | -0.0161** |
| hage | -9.09E-06 | -7.92e-05*** | 6.97e-05*** | -0.00196*** | -0.000873** | -0.00217*** | 0.000135*** | 0.000153*** | 0.000130*** | 0.000110*** | -0.000582*** | -0.000402* | -0.000369 | -0.00136*** | -5.51E-06 | -1.96e-05*** | -9.43e-05*** |
| 1.citysize | -0.00728** | 0.00937 | -0.0229*** | 0.548*** | 0.317*** | 0.716*** | -0.0181*** | -0.0145*** | -0.0239*** | -0.0136** | 0.0381 | -0.0702* | 0.195 | 0.00049 | 0.0102*** | 0.000375 | 0.0189*** |
| 2.citysize | -0.0180*** | 0.0131 | -0.0473*** | 1.041*** | 0.715*** | 2.091*** | -0.0385*** | -0.0368*** | -0.0687*** | -0.0291*** | -0.120* | -0.184*** | 0.205 | -0.423*** | 0.0184*** | -0.00054 | 0.0273*** |
| 3.citysize | -0.0374*** | -0.0242 | -0.0529*** | 1.574*** | 0.761*** | 5.130*** | -0.0609*** | -0.0688*** | -0.102*** | -0.0492*** | -0.0338 | 0.190* | 0.450* | -1.053*** | 0.0206*** | -0.00927*** | -0.00288 |
| shareownfarm | -0.0352*** | -0.0262 | -0.0494*** | 0.376 | 0.542*** | -0.00391 | 0.0126 | 0.0257 | -0.0153 | 0.0303 | -0.322** | -0.451*** | 0.168 | 0.184 | 0.00538 | -0.00404** | 0.0127 |
| OwnfarmShareownfarm | 0.0400*** | -0.0154 | 0.103*** | -0.622*** | -0.123 | -1.093*** | 0.0115 | -0.002 | 0.0734*** | 0.0349*** | -0.14 | 0.268*** | 0.0422 | -0.296** | 0.0037 | -0.00737*** | -0.0267*** |
| totexp | -0.00244*** | 0.000248 | -0.00534*** | 0.0401*** | 0.0115*** | 0.0694*** | -0.00199*** | -0.00164*** | 0.00160*** | -0.00114** | 0.000281 | 0.0195*** | 0.0152** | 0.00482 | 6.35E-05 | 0.000249*** | 0.000105 |
| fhhheduc | 0.000171 | 0.000561 | 4.66E-05 | 0.0592*** | 0.0312*** | 0.132*** | -0.00322** | -0.00338** | -0.00731*** | -0.00389* | 0.0112 | 0.00733 | -0.0105 | -0.0155 | 0.000202 | 0.000184 | 0.000572 |
| mhhheduc | -0.00254* | -0.00287 | -0.00244* | 0.0432* | 0.0291** | 0.0786* | -0.000988 | -0.000275 | -0.00149 | -0.0017 | -0.0147 | -0.0154 | 0.0251 | 0.0374*** | -0.00123** | 0.000161 | -0.000886 |
| fsalaried | -0.0375*** | -0.0386*** | -0.0407*** | -0.392** | -0.250*** | -0.851** | 0.0203* | 0.0153 | -0.00251 | 0.0351*** | -0.341*** | -0.453*** | -0.0552 | -0.417*** | 0.0137*** | -0.00102 | 0.00382 |
| fcontp | -0.0127*** | -0.00141 | -0.0241*** | 0.291*** | 0.175*** | 0.710*** | -0.00765 | -0.00969* | -0.0260*** | -0.00442 | 0.0406 | -0.0810* | -0.0923 | -0.154*** | 0.00967*** | 0.00244*** | 0.0254*** |
| fnowork | -0.0201*** | -0.0179* | -0.0235*** | -0.0692 | -0.0135 | -0.147 | 0.00531 | -0.000596 | -0.00136 | 0.0118 | -0.152** | -0.279*** | 0.0265 | -0.178** | 0.0106*** | 0.00129* | 0.0184*** |
| msalaried | 0.00629 | 0.022 | -0.00955 | 0.292* | 0.259*** | 0.791*** | -0.0326*** | -0.0431*** | -0.0196 | -0.0408*** | 0.154 | 0.0599 | 0.143 | -0.0634 | -0.0043 | 0.00166 | -0.000531 |
| mcontp | 0.0188*** | 0.0243** | 0.0155* | 0.420*** | 0.408*** | 0.838*** | -0.0324*** | -0.0446*** | -0.00995 | -0.0467*** | 0.184** | 0.358*** | -0.0765 | -0.0627 | -0.0128** | 0.00219** | -0.00397 |
| mnowork | 0.0199* | 0.0203 | 0.0205 | -0.127 | -0.121 | -0.103 | -0.0142 | -0.0171 | 0.00133 | -0.022 | 0.0864 | 0.163 | -0.199 | -0.333*** | -0.00474 | -0.00016 | -0.0168** |
| nkidslt5 | -0.00450*** | -0.00517* | -0.00386** | 0.116*** | 0.0464*** | 0.237*** | 0.00706*** | 0.00857*** | 0.00546** | 0.00800*** | -0.000271 | -0.0438** | 0.0451 | 0.0107 | 0.00012 | 0.000182 | 0.000959 |
| nkids1220 | -0.00504*** | -0.00579* | -0.00396** | 0.109*** | 0.0452*** | 0.333*** | 9.99E-05 | 0.00101 | 0.00117 | -0.000916 | -0.0247 | -0.0840*** | -0.0347 | -0.0677*** | 0.00269*** | 0.00019 | 0.00332*** |
| nummeals | 0.00397 | 0.0263*** | -0.0176*** | 0.571*** | 0.301*** | 1.300*** | -0.0268*** | -0.0260*** | -0.0213*** | -0.0345*** | 0.208*** | 0.157*** | -0.0502 | 0.0713*** | -0.00478*** | 0.00147*** | -0.00159 |
| Constant | 3.867*** | 3.113*** | 3.213*** | 3.561*** | 2.368*** | 4.570*** | 0.421*** | 0.506*** | 0.443*** | 0.532*** | 2.935*** | 3.297*** | 2.789*** | 1.932*** | 0.0746*** | 0.0428*** | 0.222*** |
| | | | | | | | | | | | | | | | | | |
| Observations | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 1,783 | 10,873 | 10,873 | 10,873 | 10,873 |
| R-squared | 0.061 | 0.014 | 0.185 | 0.174 | 0.101 | 0.236 | 0.075 | 0.063 | 0.11 | 0.065 | 0.02 | 0.042 | 0.025 | 0.042 | 0.037 | 0.061 | 0.051 |

*** p<0.01, ** p<0.05, * p<0.1; green highlighting is a significantly positive effect, orange highlighting is a significantly negative effect

**Annex Table 6.11** Full Regression Results using alternative standardization method

| VARIABLES | lnimindex | lnimposindex | lnimnegindex | divscr13 | divscr7 | foodcount | fdi13quant | fdi7quant | fdi13expen | fdi10quant | monosatratio | sfatpct1 | pfatpct1 | monofatshare | lippct1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| hgender | 0.0266*** | 0.0269** | 0.0280*** | -0.168 | 0.039 | -0.0593 | -0.00996 | -0.0211* | 0.0222* | -0.0297** | -0.0602 | -0.00775 | -0.000715 | -0.306 | -0.0161** |
| hage | -6.00E-06 | -9.53e-05*** | 8.75e-05*** | -0.00215*** | -0.000910*** | -0.00272*** | 9.77e-05*** | 0.000113*** | 0.000113*** | 9.09e-05*** | -0.00136*** | -5.51E-06 | -1.96e-05*** | -0.00320*** | -9.43e-05*** |
| 1.citysize | -0.0176*** | -0.00137 | -0.0314*** | 0.554*** | 0.319*** | 0.727*** | -0.0165*** | -0.0112** | -0.0234*** | -0.0161*** | 0.00049 | 0.0102*** | 0.000375 | -0.0284 | 0.0189*** |
| 2.citysize | -0.0463*** | -0.0524*** | -0.0384*** | 1.016*** | 0.707*** | 2.038*** | -0.0326*** | -0.0254*** | -0.0700*** | -0.0304*** | -0.423*** | 0.0184*** | -0.00054 | -0.748 | 0.0273*** |
| 3.citysize | -0.0685*** | -0.0890*** | -0.0483*** | 1.690*** | 0.812*** | 5.333*** | -0.0758*** | -0.0721*** | -0.0981*** | -0.0684*** | -1.053*** | 0.0206*** | -0.00927*** | -2.371* | -0.00288 |
| shareownfarm | -0.0659*** | -0.133*** | 0.00337 | 0.365 | 0.523*** | 0.0263 | 0.0374** | 0.0558*** | -0.0123 | 0.0433** | 0.184 | 0.00538 | -0.00404** | 0.59 | 0.0127 |
| OwnfarmShare ownfarm | 0.0511*** | 0.000889 | 0.106*** | -0.679*** | -0.136 | -1.240*** | -0.00171 | -0.0142 | 0.0679*** | 0.0287** | -0.296** | 0.0037 | -0.00737*** | -3.375*** | -0.0267*** |
| tothhexp | -1.07e-05*** | -6.15e-06*** | -1.46e-05*** | -4.33E-06 | **-2.52e-05*** | **-4.33E-05** | 1.35E-06 | 2.59E-07 | -1.71E-07 | **5.04e-06**** | 0.00482 | 6.35E-05 | 0.000249*** | 5.04E-05 | 0.000105 |
| fhhheduc | 0.00145 | 0.00294 | -0.00021 | 0.0780*** | 0.0391*** | 0.170*** | -0.00485*** | -0.00449*** | -0.00646*** | -0.00541** | -0.0155 | 0.000202 | 0.000184 | -0.158** | 0.000572 |
| mhhheduc | -0.002 | -0.0014 | -0.00264* | 0.0622*** | 0.0373*** | 0.118** | -0.00197 | -0.000177 | -0.000605 | -0.00178 | 0.0374*** | -0.00123** | 0.000161 | 0.0796 | -0.000886 |
| fsalaried | -0.0327*** | -0.0422*** | -0.0273** | -0.346** | -0.218** | -0.779** | 0.0190* | 0.0202* | -0.00229 | 0.0320** | -0.417*** | 0.0137*** | -0.00102 | 0.0751 | 0.00382 |
| fcontp | -0.0183*** | -0.0245*** | -0.0135*** | 0.271*** | 0.172*** | 0.662*** | -0.00458 | -0.00627 | -0.0276*** | 0.000705 | -0.154*** | 0.00967*** | 0.00244*** | -0.399** | 0.0254*** |
| fnowork | -0.0239*** | -0.0312*** | -0.0179** | -0.107 | -0.0246 | -0.222 | 0.0111 | 0.00713 | -0.00302 | 0.0178* | -0.178** | 0.0106*** | 0.00129* | -0.119 | 0.0184*** |
| msalaried | 0.00982 | 0.0244 | -0.00544 | 0.228 | 0.237*** | 0.644** | -0.0305** | -0.0462*** | -0.0232* | -0.0492*** | -0.0634 | -0.0043 | 0.00166 | -0.261 | -0.000531 |
| mcontp | 0.0236*** | 0.0208* | 0.0284*** | 0.375** | 0.394*** | 0.728*** | -0.0422*** | -0.0570*** | -0.0126 | -0.0582*** | -0.0627 | -0.0128** | 0.00219** | -1.378*** | -0.00397 |
| mnowork | 0.0281*** | 0.0484*** | 0.00808 | -0.185 | -0.139 | -0.238 | -0.0258 | -0.026 | -0.0021 | -0.0355* | -0.333*** | -0.00474 | -0.00016 | -1.009** | -0.0168** |
| adulteq | 0.00134 | 0.000188 | 0.00297* | 0.0546** | 0.0102 | 0.191*** | 0.00415** | 0.00653*** | 0.00685*** | -0.00125 | -0.0647*** | -0.0521 | -0.124*** | -0.308*** | -0.508** |
| nkidslt5 | -0.000758 | -0.0023 | 0.000565 | 0.0526* | 0.0326* | 0.0504 | 0.00217 | 0.00204 | -0.000838 | 0.00745** | 0.0526** | -0.323** | 0.0178 | 0.0578 | -0.278 |
| nkids1220 | -0.00293 | -0.00389 | -0.00283 | 0.0317 | 0.0299 | 0.1 | -0.00521* | -0.00717** | -0.00680** | -0.0013 | -0.00132 | -0.154 | 0.0181 | 0.0777 | -0.0814 |
| nummeals | 0.00333 | 0.0217*** | -0.0141*** | 0.586*** | 0.308*** | 1.316*** | -0.0302*** | -0.0303*** | -0.0212*** | -0.0333*** | 0.111*** | -1.284*** | **-0.187**** | **-0.373** | -2.020*** |
| Constant | 4.001*** | 3.337*** | 3.249*** | 3.585*** | 2.385*** | 4.468*** | 0.440*** | 0.514*** | 0.435*** | 0.548*** | 2.343*** | 9.931*** | 4.851*** | 9.612*** | 26.01*** |
| | | | | | | | | | | | | | | | |
| Observations | 10,875 | 10,875 | 10,875 | 10,875 | 10,875 | 10,875 | 10,875 | 10,875 | 10,875 | 10,875 | 10,875 | 10,875 | 10,875 | 10,872 | 10,875 |
| R-squared | 0.085 | 0.017 | 0.19 | 0.171 | 0.1 | 0.236 | 0.059 | 0.053 | 0.11 | 0.061 | 0.035 | 0.028 | 0.031 | 0.021 | 0.035 |

*** p<0.01, ** p<0.05, * p<0.1; green highlighting is a significantly positive effect, orange highlighting is a significantly negative effect

**Annex Table 6.12** Food Expenditure Share Regressions

| VARIABLES | cerealshr | rootshr | nutshr | vegshr | frushr | fishshr | mlkshr | eggshr | bevshr | meatshr | sugshr | oilshr | miscshr |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| hgender | 0.0409** | 0.00167 | 0.00618 | 0.0162** | -0.0131 | -0.0197** | -0.000143 | 0.000855 | 5.46E-05 | -0.0204*** | -0.00387* | -0.00616** | -0.00254* |
| hage | -0.000204*** | 0.000318*** | -1.62E-05 | 3.22E-05 | -3.56E-05 | 2.19E-05 | -6.03E-07 | -6.50e-06*** | -8.88e-06** | -4.05e-05* | -1.15e-05** | -3.64e-05*** | -1.25e-05*** |
| 1.citysize | 0.0198** | -0.0305*** | -0.00844** | -0.00369 | -0.0150*** | 0.0214*** | 5.30E-05 | -0.000562 | 0.00412*** | -0.00181 | 0.00628*** | 0.00727*** | 0.00106** |
| 2.citysize | -0.0224* | 0.0187** | -0.0135** | -0.0353*** | -0.00374 | 0.0540*** | -0.00053 | -0.000165 | -0.00254 | -0.00979 | 0.00482** | 0.00955*** | 0.000874 |
| 3.citysize | -0.0876*** | 0.0690*** | -0.0183** | -0.0373*** | 0.0175*** | 0.00407 | 0.00254 | 0.00267 | 0.0267*** | -0.0105 | 0.000324 | 0.00232 | 0.0285*** |
| shareownfarm | -0.151*** | 0.158*** | -0.0433*** | -0.110*** | 0.00333 | 0.0965*** | 0.000198 | 0.00171 | 0.00458 | 0.0413** | -0.000798 | 0.00979* | -0.0096 |
| OwnfarmShare ownfarm | 0.0953*** | 0.0680*** | 0.0297*** | 0.00432 | -0.00351 | -0.0922*** | -0.00128 | -0.00103 | -0.0165*** | -0.0390*** | -0.00994*** | -0.0263*** | -0.00761** |
| totexp | 0.00409*** | -0.00419*** | -0.00220*** | -0.00235*** | -0.000709** | -0.00202*** | 0.000295*** | 0.000194*** | 0.00289*** | 0.00414*** | -0.000354*** | -0.000281** | 0.000497*** |
| fhhheduc | -0.00545** | 0.00198 | -0.000297 | -0.000452 | -0.000162 | 0.000935 | 0.000202* | 0.000211 | -0.00063 | 0.00348*** | 0.000598* | 0.000144 | -0.000557* |
| mhhheduc | -0.000205 | -0.000795 | -0.00378*** | -0.00182* | -0.00156 | 0.000535 | 7.98E-05 | 0.000401** | 0.00296*** | 0.00294* | -4.90E-05 | 0.000938** | 0.000345 |
| fsalaried | -0.0359** | 0.00592 | -0.00644 | 0.0160* | 0.00275 | 0.0168* | 0.00546** | -0.0014 | 0.00154 | 0.00382 | -0.00405* | -0.00727** | 0.00282 |
| fcontp | -0.0261*** | 0.00343 | -0.00356 | 0.00632* | 0.00286 | 0.0197*** | 3.68E-05 | -0.00220*** | -0.000941 | -0.00505 | 0.00318*** | 0.00264** | -0.000276 |
| fnowork | -0.0221 | 0.00916 | -0.00221 | -0.000646 | 0.00233 | 0.0155** | 0.00176 | -0.000895 | -0.00848** | 0.00673 | 0.000604 | -0.00153 | -0.000233 |
| msalaried | 0.0231 | -0.0129 | -0.00213 | -0.00475 | -0.0178 | 0.0164** | 0.000788 | -0.0004 | 0.0027 | -0.00314 | -0.000932 | -0.000653 | -0.000268 |
| mcontp | 0.0404** | 0.00539 | 0.00168 | -0.00763 | -0.0256* | 0.0106 | 6.16E-05 | -0.000609 | -0.00166 | -0.011 | -0.00237 | -0.00664*** | -0.0027 |
| mnowork | 0.00117 | -0.0247 | 0.0319** | 0.0240* | -0.00449 | -0.0226** | 0.000537 | 0.00235 | -0.00328 | 0.00477 | 0.00248 | -0.00873* | -0.00336 |
| nkidslt5 | 0.00917** | -0.00724** | -0.00641*** | -0.00112 | 0.00345 | -0.0028 | 0.000309** | -0.000578** | 0.000577 | 0.00446** | 0.000398 | 3.98E-05 | -0.000265 |
| nkids1220 | 0.00717** | -0.00513 | -0.00410** | 0.000663 | -0.000446 | -0.000214 | 0.000256** | -0.000121 | -0.000449 | 0.00284** | 0.000512 | -0.000123 | -0.000854*** |
| nummeals | 0.0206*** | -0.0186*** | -0.00456 | -0.0150*** | -0.00171 | 0.00336 | 0.000176 | 0.00141*** | 0.000457 | 0.0108*** | 0.00308*** | 0.00237*** | -0.00242*** |
| Constant | 0.304*** | 0.0211 | 0.164*** | 0.236*** | 0.117*** | 0.0660*** | -0.000668 | -0.000491 | 0.00843 | 0.00948 | 0.0129*** | 0.0308*** | 0.0318*** |
| | | | | | | | | | | | | | |
| Observations | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 | 10,873 |
| R-squared | 0.021 | 0.105 | 0.022 | 0.051 | 0.009 | 0.068 | 0.035 | 0.011 | 0.113 | 0.053 | 0.032 | 0.068 | 0.109 |

*** p<0.01, ** p<0.05, * p<0.1; green highlighting is a significantly positive effect, orange highlighting is a significantly negative effect

**Annex Table 6.13** Monteiro et al's food groupings (2010)

Table 1

Food classification based on the extent and purpose of industrial processing.

| Food group | Extent and purpose of processing | Examples * |
|---|---|---|
| Group 1: unprocessed or minimally processed foods | No processing, or mostly physical processes used to make single whole foods more durable, accessible, convenient, palatable, or safe | Fresh, chilled, frozen, vacuum-packed fruits, vegetables, fungi, roots and tubers; grains (cereals) in general; fresh, frozen and dried beans and other pulses (legumes); dried fruits and 100% unsweetened fruit juices; unsalted nuts and seeds; fresh, dried, chilled, frozen meats, poultry and fish; fresh and pasteurized milk, fermented milk such as plain yoghurt; eggs; teas, coffee, herb infusions, tap water, bottled spring water |
| Group 2: processed culinary or food industry ingredients | Extraction and purification of components of single whole foods, resulting in producing ingredients used in the preparation and cooking of dishes and meals made up from Group 1 foods in homes or traditional restaurants, or else in the formulation by manufacturers of Group 3 foods | Vegetable oils, margarine, butter, milk cream lard; sugar, sweeteners in general; salt; starches, flours, and "raw" pastas and noodles (made from flour with the addition only of water); and food industry ingredients usually not sold to consumers as such, including high fructose corn syrup, lactose, milk and soy proteins, gums, and preservatives and cosmetic additives |
| Group 3: ultra-processed food products | Processing of a mix of Group 2 ingredients and Group 1 foodstuffs in order to create durable, accessible, convenient, and palatable ready-to-eat or to-heat food products liable to be consumed as snacks or desserts or to replace home-prepared dishes | Breads, biscuits (cookies), cakes and pastries; ice cream; jams (preserves); fruits canned in syrup; chocolates, confectionery (candies), cereal bars, breakfast cereals with added sugar; chips, crisps; sauces; savoury and sweet snack products; cheeses; sugared fruit and milk drinks and sugared and "no-cal" cola, and other soft drinks; frozen pasta and pizza dishes; pre-prepared meat, poultry, fish, vegetable and other "recipe" dishes; processed meat including chicken nuggets, hot dogs, sausages, burgers, fish sticks; canned or dehydrated soups, stews and pot noodle, salted, pickled, smoked or cured meat and fish; vegetables bottled or canned in brine, fish canned in oil; infant formulas, follow-on milks, baby food |

* These listings do not include alcoholic drinks. The examples given are not meant to be complete. Many others can be added, especially to group 3, using the general principles specified in the text and as indicated in the second column.

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