

**Patterns and determinants of fruit and vegetable
consumption in sub-Saharan Africa:
a multicountry comparison**

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Patterns and determinants of fruit and vegetable consumption in sub-Saharan Africa: a multicountry comparison

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1. Introduction

Low fruit and vegetable intake is a main contributor to micronutrient deficiencies in the developing world, especially in populations with low intakes of nutrient-dense animal source foods such as meat and dairy products. Inadequate intake of fruit and vegetables is also increasingly recognized as one of the key risk factors for cardiovascular diseases and some forms of cancers, the two leading causes of death in the world today (*1*). No longer limited to developed countries, chronic degenerative diseases are spreading within the developing world at unprecedented rates, especially in countries undergoing rapid economic development and related changes in diets and lifestyles. The World Health Organization estimates that low fruit and vegetable intake contributes to approximately 2.7 million deaths a year from chronic diseases and causes about 31% of ischaemic heart diseases and 11% of strokes worldwide. It ranks low fruit and vegetable intake as the sixth main risk factor for mortality in the world (*1*).

In spite of the growing body of evidence highlighting the protective effect of fruit and vegetables, their intakes are still grossly inadequate both in developed and developing countries (IARC 2003). Nationally representative data on fruit and vegetable consumption in 21 countries¹ — most of which are from the developed world — show that average intakes reach the WHO/FAO minimum recommended level of 400 g per capita per day (or 146 kg per year) in only three countries (Israel, Italy and Spain) (IARC 2003). Supply, on the other hand, more than meets the needs. Although the availability of fruit and vegetables in the lowest-income countries is only one half of the recommended intakes (~86 kg per capita per year), supply exceeds the needed amounts in high-income

¹ The countries included in this analysis include Australia, China, India, Israel, the Philippines, several European countries, and the United States of America.

countries (average 223 kg per capita per year) (Pollack 2001). The gap in intake, however, appears to be far wider than the gap in availability, if judged by the information available on consumption levels. Examples from India, Mali and Pakistan reveal intakes of 100 g per capita per day or lower, compared to 300 g in Australia, several European countries and the United States of America; and 400 g in Israel, Italy and Spain (Pollack 2001).

Why are intakes of fruit and vegetables so far from ideal levels, and what can be done to improve this situation? What are the factors that shape consumption behaviour related to fruit and vegetables, and what is their relative importance in different countries at varying levels of development and in different subpopulation groups? This paper looks at some of these issues from the demand side. Using nationally representative household data sets from 10 sub-Saharan African countries, the analysis documents fruit and vegetable consumption patterns in this region and examines their determinants. More specifically, the analysis addresses the following three objectives:

- a) Describe household-level fruit and vegetable consumption patterns in 10 sub-Saharan African countries; and compare consumption patterns across countries, urban and rural areas, and income groups;
- b) Compute income elasticities for the consumption of fruit and vegetables and compare these elasticities across countries, urban and rural areas, and income groups;
- c) Analyse the determinants of the demand for fruit and vegetables in different countries, focusing on the role of household economic and demographic characteristics.

This analysis will provide crucial information to help guide future policy initiatives to promote and facilitate greater consumption of fruit and vegetables in sub-Saharan Africa. Effective programmes and policies are urgently needed to influence consumption behaviour and foster fruit and vegetable intake. The success of these initiatives will depend on how effectively they can address the main constraints to consumption among the poor.

2. Conceptual framework

In order to examine the determinants of fruit and vegetable consumption in developing countries, it is useful to begin with a review of the economic theory of household decisions. In the standard household model, households use their resources (labour, skills, land and equipment) to achieve the highest level of utility (satisfaction) possible. These decisions result in a certain level of income, although this may not be the highest possible income since the household may choose to sacrifice some income for more leisure and/or to have a more stable income flow. In practice, households that are near the margin of subsistence probably cannot “afford” much leisure and are likely to be close to the maximum income feasible with their resources and skills.

Consumption patterns are determined by the combination of three main factors: the income level and preferences of the household, and market prices. Preferences are, in turn, affected by the composition of the household, its members’ knowledge and education, habits and cultural norms, personal experience, and, in the case of food, the biological factors that affect hunger. Production and consumption decisions are “separable” in the sense that production decisions do not depend on consumption preferences. Consumption decisions depend on total income but not on the composition or source of income.

Two key assumptions of the separable household model are: buying prices and selling prices are the same; and the household resources are pooled and the household has a single set of preferences. In recent decades, these two assumptions have been relaxed, leading to more complex but more realistic models of household behaviour. First, the non-separable model was developed for farm households who grow food and face large costs in getting goods to and from the market (5). These transaction costs create a gap between the buying and selling prices of the same item. As a result, for a range of market prices, the household does not participate in the market for the item, producing only for its own consumption needs. This implies that production decisions are partly determined by consumption needs and that consumption is partly dependent on production opportunities. Fruit and vegetables are highly perishable, so the cost of getting them to or from the market will be high for households in remote rural areas. Thus, the

consumption of some fruit and vegetables may be constrained by whether or not they can be grown by the household. Access to water, seeds, and information on horticultural production methods may limit both production and consumption of fruit and vegetables.

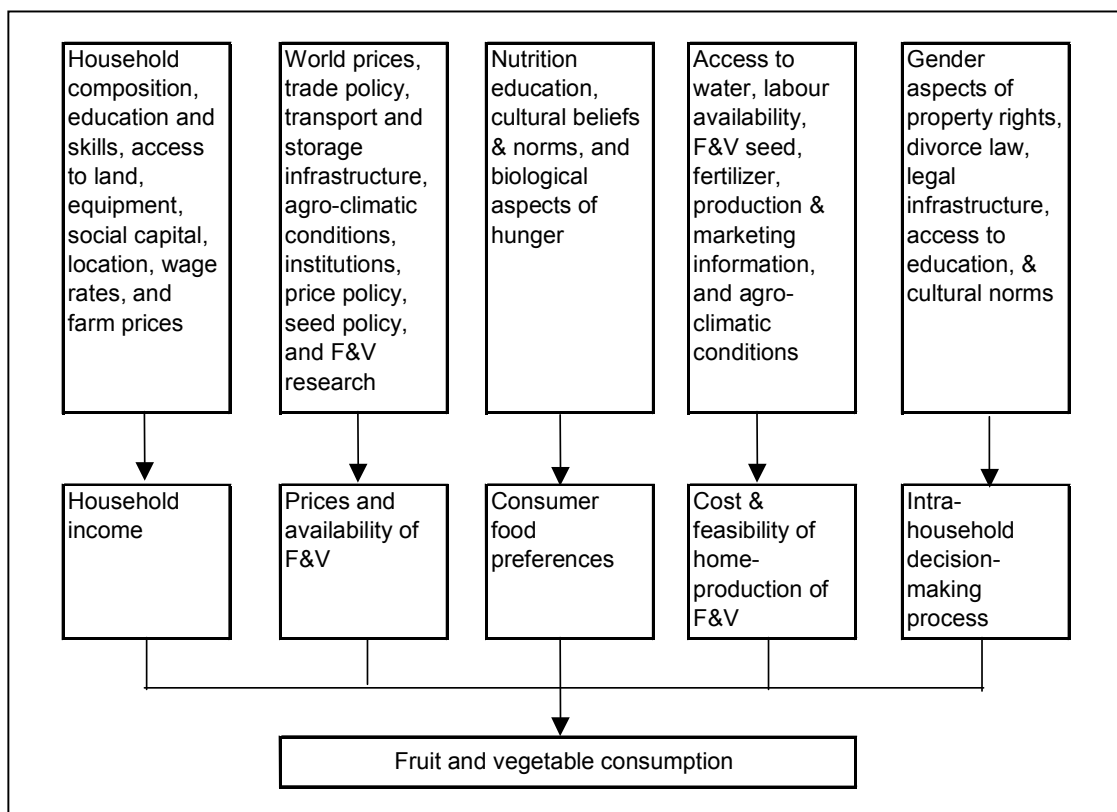
Second, the assumption that households pool resources and have a single set of preferences has been questioned by research on intrahousehold allocation of resources and gender roles within the household. Empirical research has shown that husbands and wives often have unequal control over resources, that they may not pool income, and that their consumption priorities may differ. Some alternative household models assume a cooperative solution in which the distribution of benefits depends on the bargaining position of each based on the threat of non-cooperation or separation. Other models assume a non-cooperative solution in which each partner maximizes utility (satisfaction) subject to the decisions of the other. In either case, the consumption patterns will depend partly on the legal and socioeconomic status of each partner and their ability to monitor each other's behaviour (Quisumbing 2003).

Applying the standard household model and the two extensions to fruit and vegetable consumption, the following factors are the main influences on consumption:

- Household income,
- The prices and availability of fruit and vegetables relative to other prices,
- Household members' preferences,
- The cost to the household and feasibility of fruit and vegetable production, and
- The decision-making power of women relative to men in the household.

These five hypothesized determinants of fruit and vegetable consumption are illustrated in Figure 1, along with some of the policy and non-policy factors that may affect them.

Figure 1. Conceptual framework of determinants of fruit and vegetable consumption



3. Review of previous research

The determinants influencing fruit and vegetable consumption illustrated in Figure 1 do not affect all households equally. This section provides a selective review of evidence about the importance of each constraint under different circumstances.

3.1 Household income

The demand for fruit and vegetables increases with higher incomes, although the share of total expenditure allocated to fruit and vegetables tends to decline (4, 7). This implies that at low-income levels, the demand for fruit and vegetables is small. This is largely due to the fact that low-income households must prioritize the fulfilment of their basic energy requirements to avoid hunger, and that fruit and vegetables tend to be an expensive source of energy. A study in Rwanda for example showed that starchy staples

such as sorghum, cassava, sweet potatoes and cooking bananas were the cheapest sources of energy, whereas goat and beef were five times more costly, and tomatoes were 12 times more expensive (Minot 1992). Similarly, a study in Cambodia found that vegetables cost between 10 and 40 times more per kilocalorie than rice, and certain fruits were up to 100 times more expensive than rice per unit of energy (Prescott and Pradham 1997).

The fact that fruit and vegetables are an expensive source of energy is an important constraint for poor households. For example, the poor in Cambodia must allocate half of their budgets to low-quality rice just to reach the recommended energy intake of 2200 kcal per person per day.² Given the need for other foods to contribute protein and fat to the diet and the need for non-food goods and services, it is clear that fruit and vegetable consumption will be quite limited at these income levels. It is not surprising that where household income is near subsistence level, large quantities of grains and starchy staples and few fruit and vegetables are consumed (9).

One of the most ambitious attempts to examine international food demand patterns is provided by Seale and colleagues (10). They use data on 114 countries from the International Comparison Project (ICP)³ to estimate the effect of price and income on the demand for different food and non-food categories, where each country represents one observation. According to the ICP data, the budget share allocated to fruit and vegetables represents 10–25 % of the food budget of most countries. The average budget share declines from 20 % among the low-income countries to 18 % in middle-income countries and 15 % in high-income countries.⁴ The income elasticity of fruit and

² This is based on the median per capita value of consumption for the poorest quintile of Cambodian households (734 riels), the price of broken rice in rural areas (571 riels/kg), and the caloric value of rice (3500 kcal/kg).

³ The ICP is a large project carried out by the World Bank to gather comparable data on prices, the composition of demand, income, and poverty for a large set of countries. An important goal is to avoid the bias that results from converting local currency values into US dollars using the exchange rate. Since services and non-tradable goods are generally less expensive in low-income countries, using the exchange rate exaggerates the differences in income between high-income and low-income countries. Instead, the ICP constructs a price index for each country and converts local values into dollars using the ratio of the local price index to the US price index. In this way, the values in each country are converted based on the purchasing power of its currency as measured using a standard basket of goods and services.

⁴ The authors use a non-standard definition of low-, middle-, and high-income countries based on the ratio of income to that of the United States. Low-income countries have incomes less than 15% of the US level and include Georgia, the Syrian Arab Republic and Zimbabwe at the top end. Middle-income countries have incomes 15–45% of the US level and range from Egypt near the bottom to Argentina near

vegetable demand is 0.60–0.70 in most African and South Asian countries (low-income countries), 0.30–0.44 in most Latin American countries (middle-income countries), and 0.20–0.37 in industrialized countries. Thus, rises in income are associated with greater increases in the demand for fruit and vegetables in poorer compared to wealthier countries; and income increases are generally associated with larger increases in the demand for fruit than for vegetables (as suggested by the larger income elasticities of demand for fruit than for vegetables).

Higher income is associated not only with an increase in the *volume* of fruit and vegetables consumed, but also with an increase in the *diversity* of fruit and vegetables. For example, 1993 household survey data from Viet Nam show that the average number of distinct fruit and vegetables consumed rises from 4.5 out of 10 in the lowest income quintile to 6.9 in the highest income quintile (Minot 2002).

3.2 Prices and availability

Using the ICP data on 114 countries, Seale and colleagues (10) also estimated price elasticities of demand for fruit and vegetables. Their analysis shows own-price elasticities of demand for fruit and vegetables ranging from –0.35 to –0.50 among most African and South Asian countries, –0.35 to –0.45 in most Latin American countries, and between –0.10 and –0.30 in the industrialized nations. This confirms the conventional wisdom that low-income households are more sensitive to prices than higher-income households. It also suggests that policies to reduce the market price of fruit and vegetables can have a significant impact on fruit and vegetable consumption, particularly for low-income households.

Given the perishability of fruit and vegetables and the limited infrastructure in many developing countries, another constraint to fruit and vegetable consumption is the fact that many are not available at all during part of the year. Technologies to extend the harvest period or to facilitate storage are particularly important for fruit and vegetables (Ali and Tsou 1997), as well as preservation methods such as solar drying, to extend their period of availability throughout the year (IVACG 1993).

the top. The high-income countries include the industrialized nations, including some newly industrialized countries such as China, Hong Kong Special Administrative Region, the Republic of Korea and Singapore.

Fruit and vegetable prices are also affected by trade policy. Import tariffs or highly restrictive sanitary and phytosanitary requirements are sometimes established at least partly for the purpose of protecting domestic producers. An unintended consequence is that they reduce fruit and vegetable consumption by raising domestic prices.

3.3 Consumer preferences

The factors described above — income, prices and availability — affect what consumers *are able to* purchase or consume. Consumer preferences, on the other hand, shape the decisions that consumers make regarding what they *choose to* purchase or consume. As argued previously, until the physiological need to satisfy hunger is met, households have little choice but to focus on cheap sources of energy such as grains and starchy staples. Once they have satisfied their basic energy needs, households start diversifying their diets by including animal source foods, dairy products and fruit and vegetables. At this stage, the role of consumer preferences in shaping food consumption patterns becomes more important.

Fruit and vegetable consumption has clear health and nutrition benefits: fruit and vegetables are a relatively cheap source of essential micronutrients and they are protective against chronic diseases. The vast majority of consumers, however, are unaware of the health benefits of consuming fruit and vegetables in abundance, even in developed countries. In the United States, health awareness and knowledge of the number of fruit and vegetable servings recommended per day have been associated with greater fruit and vegetable intakes. Other important factors included taste and preferences, and having developed the habit of eating these products during childhood (14). Several demographic factors such as female gender, age, education, income and nonsmoking status are also associated with greater fruit and vegetable intake in this population (*Subar et al. 1995; Nayga 1995*). A recent review, also focusing on developed countries, highlights the importance of several non-economic factors in determining fruit and vegetable consumption choices; these include sensory appeal, familiarity and habit, social desirability, personal and food ideology, convenience and media and advertising (Pollard, Kirk, and Cade 2002).

Very little is known about how consumer preferences regarding fruit and vegetables affect consumption in low-income countries. Taboos and cultural beliefs are likely to play a significant role in many populations, especially for selected physiological or age groups such as pregnant and lactating women or young infants. Mangoes, for example, are believed to cause diarrhoea in young children in many cultures, and therefore, intake of this excellent source of vitamin A by young children — who are also at highest risk of vitamin A deficiency — is often constrained. Dietary restrictions during lactation — another period of high vulnerability to micronutrient deficiencies — are also widespread in developing countries and often include several fruit and vegetables because of their perceived harm either to the mother or to her young infant (12, 18).

Maternal education has been consistently associated with positive child health and nutrition outcomes as well as with better child feeding and care practices (see for example 19, 20). In certain cases, maternal knowledge has been found to mediate the effect of maternal education on child outcomes (21) whereas in others, knowledge appeared to be a stronger predictor of child health than formal education (Block 2002). The role of maternal education or knowledge in shaping food consumption patterns, however, is not well documented. In Haiti, maternal education was associated with greater dietary diversity in young children's diets, but no information is available on the association between maternal education and household dietary quality or fruit and vegetable consumption (Menon and Ruel 2003). One study in Indonesia, however, shows that mothers who have greater nutrition knowledge devote the same share of their budgets to food, but allocate a larger share of their food budget to foods that are rich in micronutrients, including fruit and vegetables (Block 2003).

3.4 Cost and feasibility of on-farm production

As discussed earlier, if markets are efficient and transportation costs are only a small share of food prices, then consumption patterns depend on total income, prices, and preferences, but not on production opportunities. In this scenario fruit and vegetable consumption would not be related to whether the household could grow fruits and vegetable. The fact that urban fruit and vegetable consumption is sometimes higher than rural consumption is a confirmation of this idea. However, in the presence of large

transaction costs that impede market transactions, household consumption patterns will be affected in part by what the householders can produce for themselves.

There is little research on the degree to which fruit and vegetable consumption is affected by home production, after controlling for income and prices. Ali and Tsou (12) report that a programme to promote home gardens in Bangladesh significantly increased the volume of vegetable consumption compared to those that did not participate. Although it is difficult to control for selection bias in a voluntary programme such as this, it seems plausible that, in areas where markets work imperfectly, the promotion of home gardens could be an effective means of increasing fruit and vegetable consumption. Ample evidence exists to support that theory, mostly from experience with small-scale home gardening initiatives to promote vitamin-A intake (25). These studies show that promotional efforts, especially those that combine production interventions with strong education and behaviour change activities, do translate into greater consumption of the targeted vitamin A-rich fruit and vegetables.

The constraint on home production of fruit and vegetables is not the land requirement. Ali and Tsou (12) show that even a 16m² garden can meet 40 % of a family's calcium needs and almost all its vitamin C requirements. Rather, the constraints are more likely to be labour, water, and information. Vegetable production is significantly more labour-intensive than most field crops because of water requirements and pest control. Fruit and vegetables also tend to be more water-intensive and management-intensive than other crops.

3.5 Intrahousehold decision-making process

Research on the intrahousehold allocation of resources indicates that households in which women have more control over resources (due to legal rights, greater inheritance, high share of assets, or simply the absence of the husband) or higher social status tend to place a higher priority on child health and nutrition in allocating household resources. For example, Smith and collaborators (25), using data from 36 demographic and health surveys, show that women's status has a positive and statistically significant

effect on the nutritional status of her children.⁵ This appeared to be due to the better health of higher-status women and their use of better child-care practices. Several studies in developing countries also show that a higher share of assets held by women increases food budget shares or household total energy intake (Quisumbing et al. 1995).

Female-headed households may be considered a case where women have full decision-making power, shedding light on differences in food consumption patterns between men and women. A study of household budget data from Rwanda found that female-headed households allocated a larger share of their budget to fruit and vegetables (4.5 % compared to 3.1 %) than male-headed households (Ministère du Plan 1988). Female-headed households also spent a larger share on pulses and tubers, but a smaller share on animal products and beverages. An econometric analysis focusing on selected food products found that the consumption of leafy greens was significantly greater among female-headed households than male-headed households, even after controlling for income and other household characteristics. A study of Viet Nam, however, found no statistically significant difference between the fruit and vegetable consumption patterns among male- and female-headed households (Minot 1992). Thus, the effect of female status or female control on fruit and vegetable consumption patterns remains a hypothesis for further research.

4. Methods

4.1 Definitions

Fruit is defined botanically as the ripened ovary of a seed-bearing plant that contains the seed(s) (IARC 2003). By this definition, zucchini, tomatoes, peppers, peapods, and even the seed pods of deciduous trees are fruit. Fruit is more commonly defined as the sweet, fleshy, edible part of plants that contains the seed(s), excluding the non-sweet examples such as those listed above. Vegetables are broadly defined as the edible portions of a plant (excluding fruit and seeds), such as the roots, tubers, stems, and leaves. A more common definition excludes sugar crops such as sugarcane and sugar

⁵ Women's status is measured using an index that combines information on maternal age at marriage, the age difference between her and her husband, the education difference between her and her husband, and whether or not she earns a cash income.

beet, as well as starchy root crops such cassava, yams, and taro. The Food and Agriculture Organization (FAO) defines fruit and vegetables to include nuts, pulses, sugar crops, and starchy root crops. This paper's focus of interest is related to the micronutrient content of fruit and vegetables, so fruit and vegetables are defined to exclude nuts, pulses, sugar crops, and starchy root crops. White potatoes are included, but not sweet potatoes, cassava or yams. Sweet bananas are included but not cooking bananas, recognizing that any classification is somewhat arbitrary.

4.2 Data

The analysis uses nationally representative household expenditure survey data from 10 sub-Saharan African countries. The data sets were previously selected to derive national and global estimates of food insecurity in developing countries (Smith 2004). They were selected from 76 nationally representative surveys conducted in the 1990s (Smith 2004). In addition to being nationally representative, the data sets had to have the following information on household food consumption:

- Data collected from a comprehensive list of at least 30 food items
- Recall period of one month or less
- Data available on home-produced food as well as on monetary purchases
- Complementary data available for converting reported food acquisition data to metric quantities (metric weights or prices).

The list of countries and basic information on the surveys are presented in Table 1. Table 2 is a summary of the approaches used to collect data on food consumption patterns (for more information on the data sets and data transformations and cleaning, see Smith, 29).

Table 1. Basic information on data sets, from 10 sub-Saharan countries

Country	Year of data collection	Name of survey	Data collection agency	Survey duration (months)	Number of households surveyed
Burundi	1998	Enquête Prioritaire 1998 — <i>Etude nationale sur les conditions de vie des populations</i>	Institut de Statistiques et d'Etudes Economiques du Burundi	6	6668
Ethiopia	1999	Household income, consumption and expenditure survey 1999/2000	Central Statistical Authority of Ethiopia	9 ¹	17 332
Ghana	1998	Ghana living standards survey 4	Ghana Statistical Service	12	6000
Guinea	1994	<i>Enquête intégrale sur les conditions de vie des ménages guinéens avec module budget et consommation</i>	Direction Nationale de la Statistique	12	4416
Kenya	1997	Welfare monitoring survey III	Central Bureau of Statistics	3	10 874
Malawi	1997	Integrated Household Survey 1997/98	National Statistical Office	12	12 960
Mozambique	1996	Mozambique <i>inquerito nacional aos agregados familiares sobre as condicoes de vida</i>	Instituto Nacional de Estatistica	15	8289
Rwanda	2000	<i>Enquête intégrale sur les conditions de vie des ménages au Rwanda</i>	Direction de la Statistique du Ministère des Finances et de la Planification Economique	urban areas: 15 rural areas: 12	6450
Tanzania	2000	Tanzanian household budget survey	National Bureau of Statistics of Tanzania	12	22 178
Uganda	1999	Uganda national household survey 1999/2000	Uganda Bureau of Statistics	12	10 700

¹ This survey was undertaken in two rounds of 2–3 months (over a period of 9 months), each representing key seasons of the annual cycle.

Source: World Bank (36)

Table 2. Summary of approaches used in the surveys for collection of data on food consumption patterns

Country	Number of food items ¹	Number of fruit ¹ categories	Number of vegetable ¹ categories	Means of data collection	Food sources for which data collected	Number of visits	Recall period (days)	Reference period ² (days)
Burundi	33	5	7	interview	Purchases, home production	1	15	15
Ethiopia	213	5	12	interview	Purchases, home production, inkind	8 ³	3–4	28
Ghana	109	8	9	diary	Purchases, home production, gifts	literate: 6 illiterate: 30	1	30
Guinea	112	6	11	interview	Purchases, home production	urban: 10 rural: 7	urban: 3 rural: 2	urban: 30 rural: 14
Kenya	70	7	8	interview	Purchases, home production	1	7	7
Malawi	274	6	11	diary and interview	Purchases, home production, inkind	purchases: 1-9 other: 1	purchases: 1-3 other: 3	purchases: 14-28 other: 3
Mozambique	217	3	14	interview	Purchases, home production, inkind	3	first visit: 1 others: 3	7
Rwanda	94	6	11	interview	Purchases, home production	urban: 10 rural: 7	urban: 3 rural: 2	urban: 30 rural: 14
Tanzania	129	7	10	diary	Purchases, home production, inkind	literate: 2-3 illiterate: 30	1	30
Uganda	47	4	6	interview	Purchases, home production, gifts	1	7	7

¹This is the number of food items used for the final analysis, not the original number listed in the questionnaire. In some cases fewer food items are used for the analysis as some items had to be combined for conversion to metric quantities.

²The recall period is the time over which the respondent is asked to describe food consumption for each visit. The “reference period” is the time period over which consumption data is recorded. Generally, the reference period is equal to the number of visits multiplied by the recall period. When the diary method was used, the recall period is one day (households are to fill in the diary on a daily basis), and the reference period is the length of time the diary is maintained.

³The Ethiopia survey was undertaken in two rounds during the slack and the peak (harvest) seasons. The information here is for each individual round.

4.3 Variables

Consumption of fruit and vegetables:

Data on fruit and vegetable consumption were derived from the food expenditure questionnaire, which includes the value of purchases, home consumption and in-kind transfers⁶ over a given reference period. The number varied of individual vegetables and fruits for which information was collected (see Table 2). Fruits commonly found across all countries were bananas, oranges and lemon/limes. Common vegetables included onions, carrots, tomato and cabbage. Canned and dried fruit and vegetables were included in their respective fruit and vegetable categories, but jams and marmalades were excluded from the fruit group. Only information on foods acquired for consumption at home was available in the surveys; no information was available on food consumed outside the home.

Expenditure quintile

The total per capita expenditure (including the value of home consumption) was used as a measure of household well-being. The households were divided into five equal groups to illustrate differences across income (expenditure) groups.

Budget shares

Food budget shares and total expenditure budget shares were computed. Food budget shares are defined as the percentage of the food budget of a household that is allocated to specific commodities (in this case fruit and vegetables). Total expenditure budget shares are the percentage of the total budget of a household that is allocated to the commodities of interest. Budget shares were computed for fruit, vegetables, and fruit and vegetables combined.

Household demographic characteristics

The following household demographic variables were used in the analyses: gender of the head of household, the total household size, the proportion of children 0–16

⁶ The surveys collected information on consumption of food from home production, food purchases, and food received through barter or transfer over the reference period. This is not equal to food intake because households may purchase some food for storage or they may consume food from storage. However, it is probably a fairly good proxy for consumption on average, particularly for consumption of perishables such as fruit and vegetables. For convenience, this measure is referred to as "consumption" throughout the paper.

years of age in the household and the proportion of adults over 30 years old in the household.

Education

A household-level education variable was used in the analysis. The variable measured whether any adult household member had primary education or secondary or higher education. Thus, the variable had three categories: 0: no adult member had either primary or secondary education; 1: at least one adult member had primary education, but none had secondary education or higher; 2: at least one adult member had secondary or higher education. For simplicity, this variable is referred to as “household educational level”.

Area of residence

The analyses used the survey’s definitions of urban and rural areas to look at differences between urban and rural areas in fruit and vegetable consumption patterns and income elasticities.

4.4 Analytical methodology

This section provides a descriptive analysis of some basic statistics regarding differences in fruit and vegetable consumption among countries, between urban and rural areas, and across income groups.

Regression analysis is used to examine the factors that influence the demand for fruit and vegetables. The Working-Lessor functional form is used, as follows:

$$s = \alpha + \beta \ln(x) + \sum_i \gamma_i Z_i + e .$$

where s is the share of the total budget spent on a commodity, x is the total per capita expenditure of the household, Z_i are a set of household characteristics that may affect demand, and e is the residual which represents the effect of variables not included in the equation. Regression analysis generates values for α , β , and γ so that the equation best describes the data. In this case, regression analysis is used to “explain” the budget share of fruit and vegetables in terms of the total per capita expenditure of the household, household composition, education of the head of household, and place of residence.

The effect of changes in income on fruit and vegetable demand is measured by the β coefficient.⁷ If $\beta > 0$, the budget share rises with higher income, and the item is considered a “luxury”. If $\beta < 0$, the budget share falls with higher income; and it is considered a “necessity”, in economic terminology. If $\beta = 0$, the budget share is constant across income levels.

The income elasticity⁸ (η) can be calculated using the coefficient on per capita expenditure (β) and the budget share (s) as follows:

$$\eta = 1 + \frac{\beta}{s}$$

Since the budget share (s) varies across households, the normal practice is to evaluate the income elasticity at the average budget share. If $\eta > 1$, the item is a luxury, while if $0 < \eta < 1$ it is a necessity.

The γ coefficient indicates the change in budget share associated with a one-unit change in the corresponding variable Z . For example, if Z_i is the variable indicating whether the household has a female head, then $\gamma_i = 2$ implies that, other factors being equal, a female-headed household has a budget share two percentage points higher than a male-headed household. Similarly, the value of the γ coefficient associated with household size indicates the effect of an additional member on the budget share.

Two qualifications should be made regarding this analysis. By using budget share as the dependent variable, the effect of higher income on fruit and vegetable spending is being estimated, including both increases in the volume of consumption and increase in the average price of fruit and vegetables consumed. Changes in the average price could be due to switching to higher quality cabbage or to switching from cabbage to strawberries.

Second, prices have not been included in the regression analysis. This may bias the estimated coefficients for the independent variables if they are correlated with price. For

⁷ Strictly speaking, the β coefficient measures the effect of a one-unit change in the logarithm of total per capita expenditure on the budget share of the commodity. The term “income” is used because per capita expenditure is a proxy for income and because it avoids confusion between total per capita expenditure and expenditure on the commodity.

⁸ More precisely, this is the elasticity of expenditure on the commodity with respect to total expenditure of the household. In other words, an elasticity of 2.0 implies that if per capita expenditure of the household increases by 1%, the per capita spending on the commodity will rise by 2% .

example, if urban prices for the same goods tend to be higher, this will bias the urban coefficient downward, since it will pick up both the effect of living in urban areas and the (negative) effect of prices being higher in urban areas.

5. Results

5.1 Fruit and vegetable consumption patterns in sub-Saharan Africa

Table 3 and Figure 2 summarize the patterns of fruit and vegetable consumption in 10 countries of sub-Saharan Africa, ranked by ascending order of per capita gross domestic product (GDP) in 2000. Total expenditure, food expenditure and budget shares are also presented.

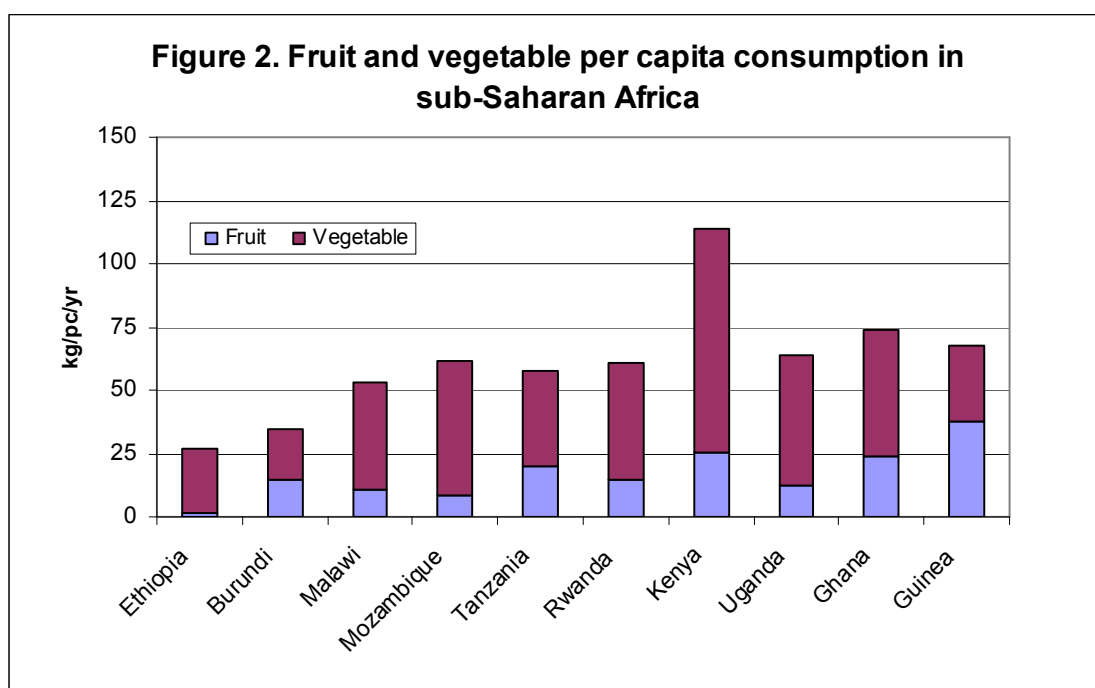


Table 3. Summary of fruit and vegetables consumption patterns in sub-Saharan Africa¹

	Ethiopia	Burundi	Malawi	Mozambique	Tanzania	Rwanda	Kenya	Uganda	Ghana	Guinea
Fruit										
Percentage of households consuming	20	49	46	22	71	57	46	20	62	75
Quantity (kg/person/y)	1.3	14.8	11.1	8.5	20.1	14.8	25.8	12.4	23.5	37.4
Value (US\$/person/y) ²	0.4	2.7	2.7	1.6	3.1	4.4	6.0	1.6	7.7	7.9
Price (US\$/kg)	0.34	0.19	0.25	0.19	0.16	0.30	0.23	0.13	0.33	0.21
Percentage of food budget	0.4	1.8	1.9	1.2	2.5	4.2	1.9	1.1	2.1	3.7
Percentage of total budget	0.3	1.3	1.2	0.8	1.7	3.4	1.3	0.6	1.3	1.9
Vegetables										
Percentage of households consuming	93	72	94	93	98	91	89	88	96	95
Quantity (kg/person/y)	25.4	19.6	41.8	52.9	37.7	46.2	88.3	51.8	50.1	30.6
Value (US\$/person/y)	3.3	8.8	18.4	16.6	10.1	10.3	21.7	9.0	28.6	14.8
Price (US\$/kg)	0.13	0.45	0.44	0.31	0.27	0.22	0.25	0.17	0.57	0.48
Percentage of food budget	4.1	4.1	12.2	13.5	9.4	11.4	7.9	8.1	9.2	6.9
Percentage of total budget	2.5	2.9	8.2	9.0	6.6	9.2	5.6	4.6	5.6	3.6

Table 3 cont'd. Summary of fruit and vegetables consumption patterns in sub-Saharan Africa¹

	Ethiopia	Burundi	Malawi	Mozambique	Tanzania	Rwanda	Kenya	Uganda	Ghana	Guinea
Fruit & vegetables										
Percentage of households consuming	94	81	96	94	99	94	91	89	99	98
Quantity (kg/person/y)	26.7	34.4	52.8	61.4	57.8	62.8	114.0	64.2	73.7	68.1
Value (US\$/person/y)	3.8	11.5	22.7	18.1	13.2	15.3	27.7	10.6	36.3	22.7
Price (US\$/kg)	0.14	0.34	0.43	0.29	0.23	0.24	0.24	0.17	0.49	0.33
Percentage of food budget	4.5	5.8	14.1	14.7	11.8	15.6	9.8	9.2	11.3	10.6
Percentage of total budget	2.7	4.1	9.3	9.8	8.3	12.6	6.9	5.1	6.9	5.5
Percentage of households consuming < 146 kg/person/year	99	72	92	90	91	90	47	88	87	87
Sample characteristics										
Per capita total expenditure	145.76	261.88	322.28	221.17	175.60	143.10	497.47	265.35	583.78	480.56
Per capita food expenditure	82.29	190.81	161.80	136.19	116.00	98.98	289.88	124.68	328.04	208.32
Food as percentage of total expenditure	56	73	50	62	66	69	58	47	56	43

¹Countries are ranked by ascending order of per capita GDP in 2000.

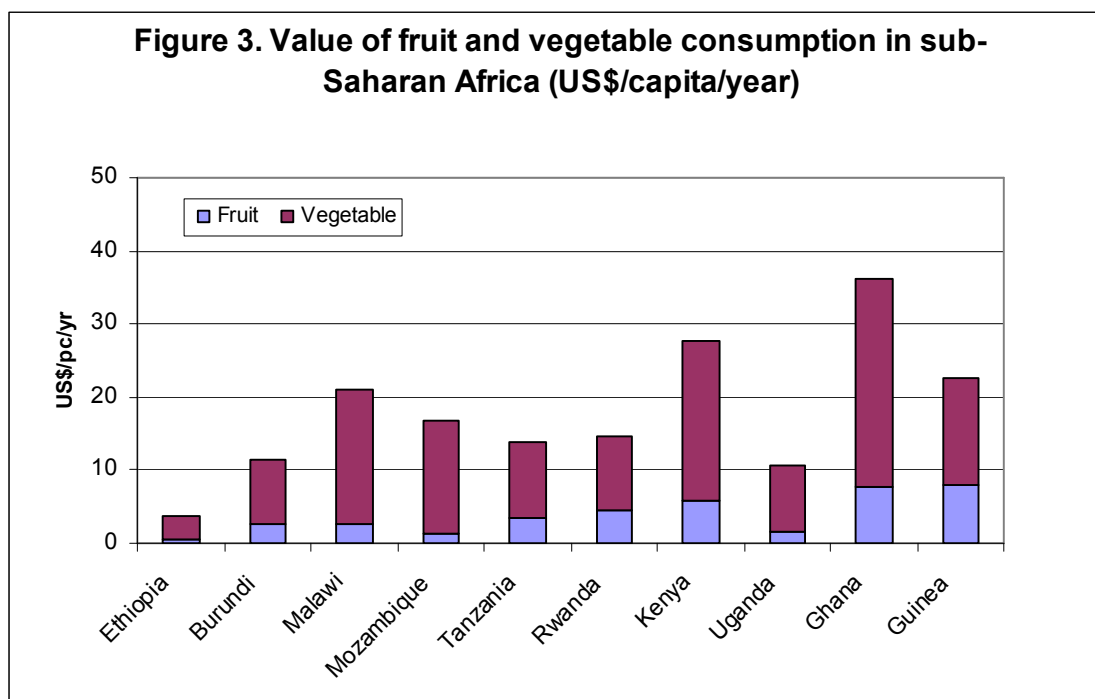
²The dollar figures are calculated using the official exchange rate the year the survey was carried out and inflated to 2000 prices using the GDP deflator for the United States.

Although vegetable consumption is almost universal in the countries studied, fruit consumption is much less common and is more variable across countries. In Ethiopia, Mozambique and Uganda, for example, only about one-fifth of all households consume fruit, whereas approximately half do so in Burundi, Malawi, Rwanda and Kenya, and three-quarters of the households do so in Tanzania and Guinea.

When consumption of fruit and vegetables is combined, most countries reach 90 % consumption or higher, except Burundi where 19 % of households consume neither fruit nor vegetables. These figures, however, must be interpreted with caution because they are influenced by the reference period of the survey, which varies between 7 and 30 days (see Table 2).

Not surprisingly, average consumption (in kg per capita per year) is lower for fruit than vegetables in most countries (see Figure 2), and so is the average value (in US dollars)⁹ of consumption (Figure 3). With wide variations between countries, the value of vegetable consumption is between twofold and elevenfold higher than that of fruit in the sub-Saharan countries studied. In all countries except Ethiopia and Rwanda, vegetables are more expensive than fruit: i.e. the cost per kg of vegetable is higher than the cost per kg of fruit (see Table 3).

⁹ The dollar figures are calculated using the official exchange rate the year the survey was carried out and inflated to 2000 prices using the GDP deflator for the United States.



Overall, there is a general positive trend of increasing consumption of fruit and vegetables as GDP per capita goes up, but the trend is not fully linear. Kenya stands out in this respect, with a particularly high consumption of vegetables. An enormous gap exists between mean consumption of fruit and vegetables and the WHO/FAO recommendation to consume a minimum of 400 g per capita per day (or 146 kg per capita per year). None of the countries reach the WHO/FAO recommended minimum level, and with the exception of Kenya, mean consumption in most countries does not even reach half of this recommended level (Figure 2). Table 3 also shows the percentage of households in each country that fails to meet this recommended intake. In all countries except Kenya, more than 70 % of the households fail to meet the recommended daily intakes of fruit and vegetables, and in five countries 90 % or more of the households fail to make the recommended minimum level.

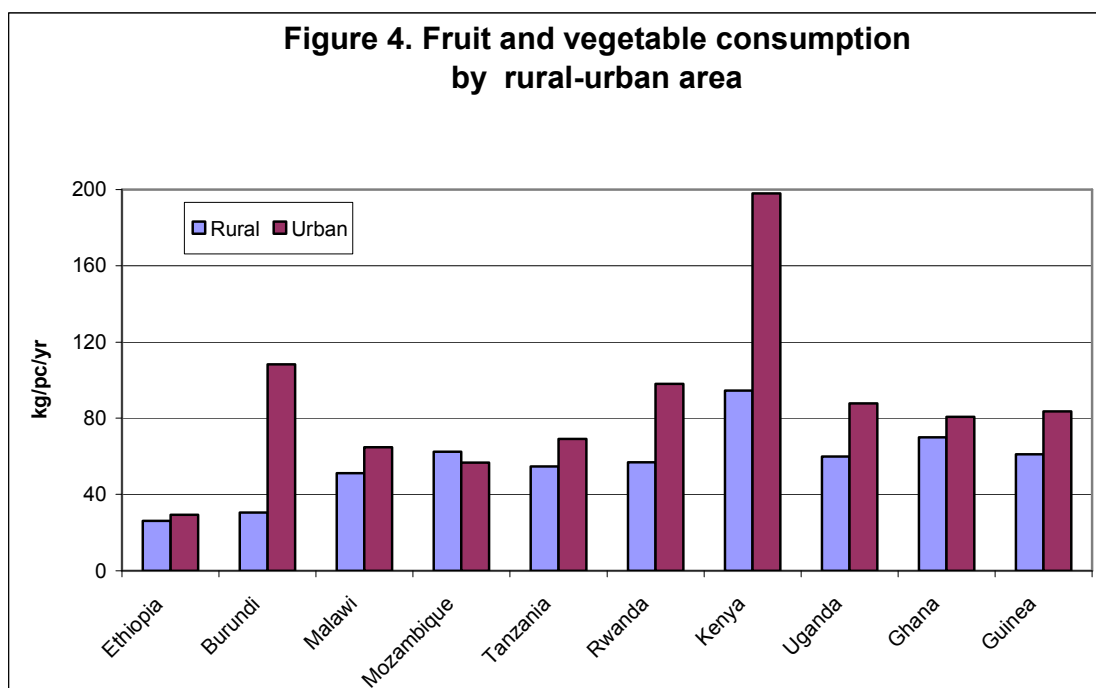
As expected, countries with a higher mean consumption of fruit and vegetables also have higher *value* of consumption (Figure 3), but the trends in intakes and values are not fully consistent. This reflects differences in prices between countries, as suggested in Table 3. The cost per kg of fruit and vegetables tends to be higher in Burundi, Malawi,

Ghana and Guinea, with Ghana reaching a high of \$0.49 per kg (\$0.33 for fruits and \$0.57 for vegetables) (see Table 3).

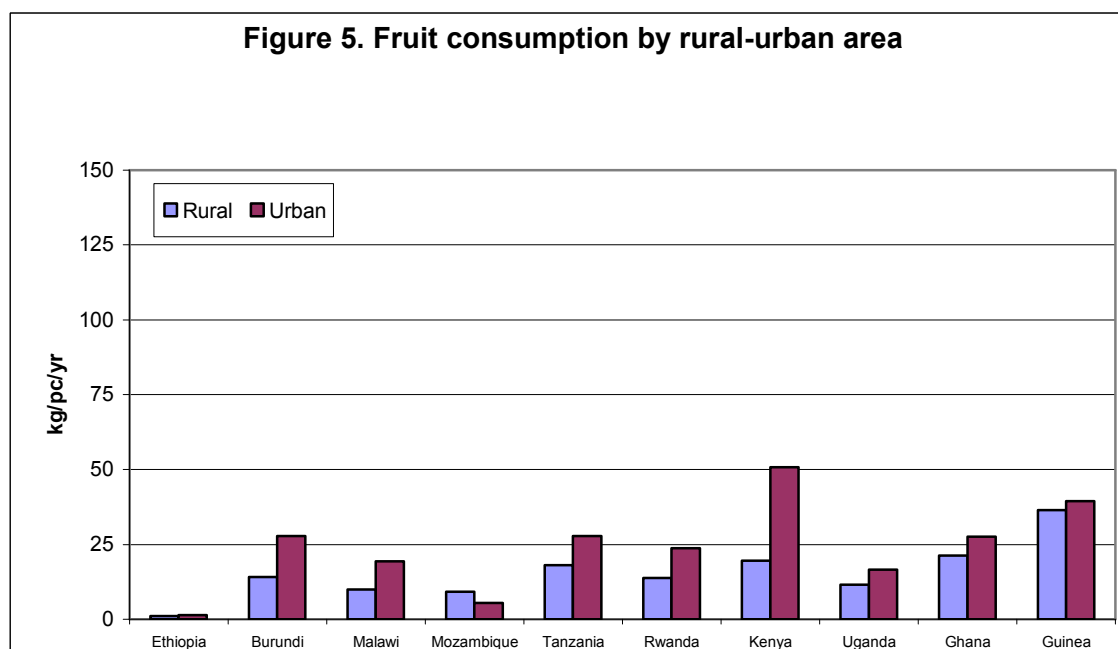
Households in these poor countries of sub-Saharan Africa spend a large percentage of their income on food, ranging from 43 % in Guinea up to 73 % in Burundi. The overall trend is as expected, i.e. food budget shares decrease as incomes and GDP per capita increase, but again, the trend is not fully consistent. The percentage of the food budget spent on fruit and vegetables is generally small ranging from a low 4.5 % in Ethiopia to 15.6 % in Rwanda.

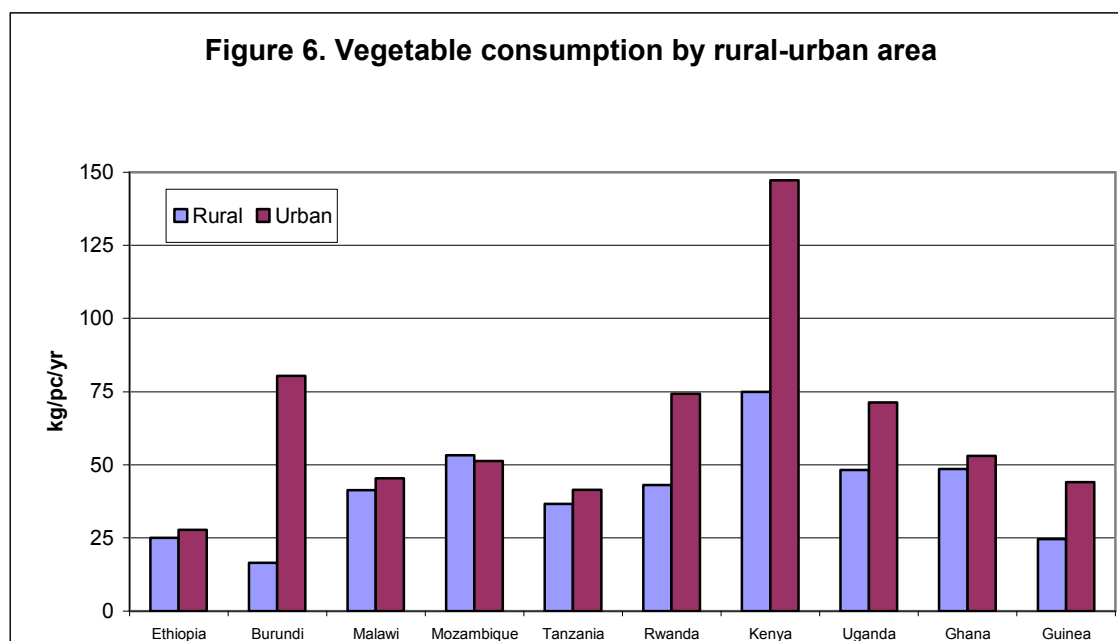
5.2 Urban/rural differences in fruit and vegetable consumption patterns

The diets of urban dwellers are generally more diverse than those of their rural counterparts (Ruel and Garrett 2003; Smith 2004; Smith, Ruel, and Ndiaye 2003; Regmi and Dyck 2001). It is believed that this is due to a combination of factors including the availability of a wider variety of foods in urban markets, the availability of storage facilities, changes in lifestyles and cultural patterns, and the need for convenience leading to the purchase of more processed foods. Figure 4 confirms that fruit and vegetable consumption is generally higher in urban areas compared to rural areas. Differences are relatively small, except in Burundi and Kenya where consumption in urban areas seems particularly high. Ethiopia stands out as a country with extremely low consumption of fruit and vegetables, both in urban and rural areas. Only urban Kenya reaches (and exceeds) the WHO/FAO recommended minimum level of fruit and vegetable intake.



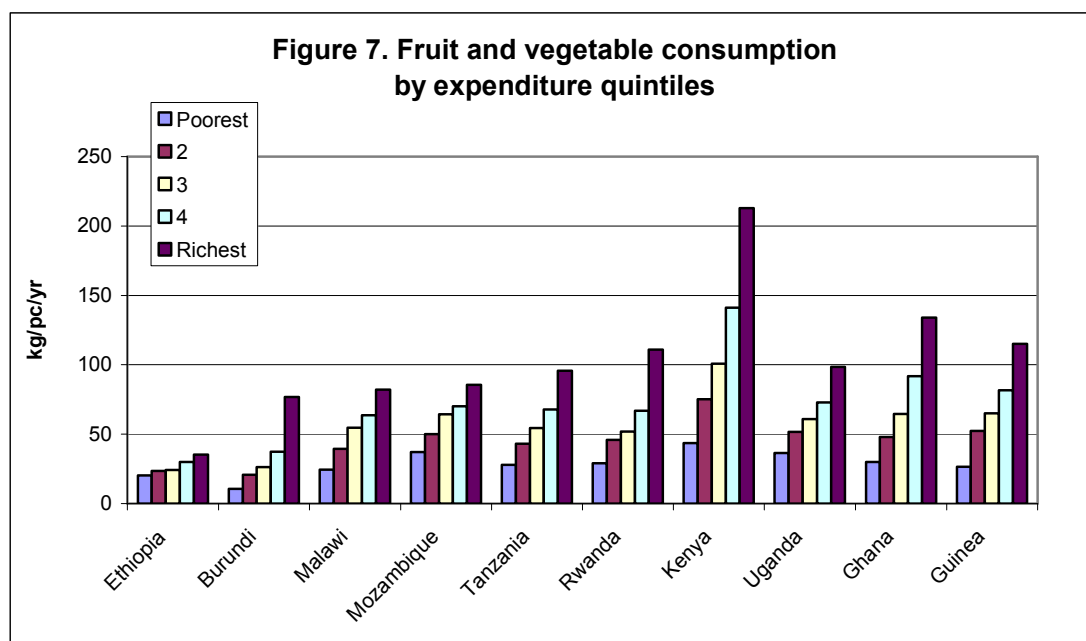
Figures 5 and 6 show similar patterns of urban/rural differences for fruit and vegetable consumption respectively, although the urban advantage is more striking for vegetables than fruits in several countries. The consumption by Kenya's urban population of vegetables seems excessively high compared to other African countries.





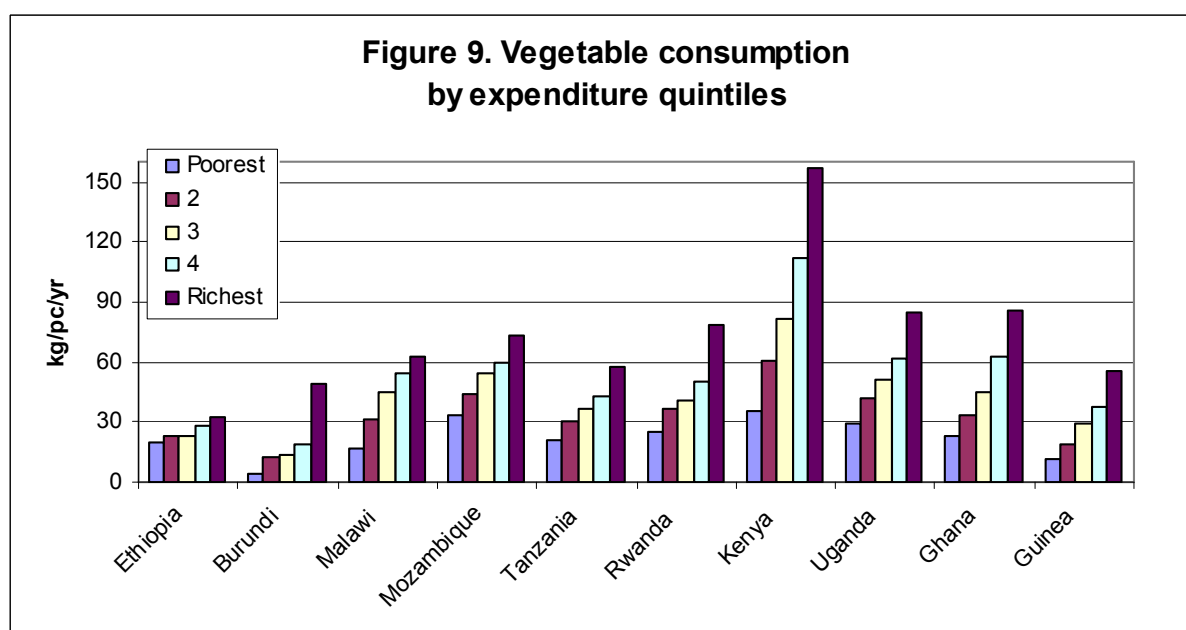
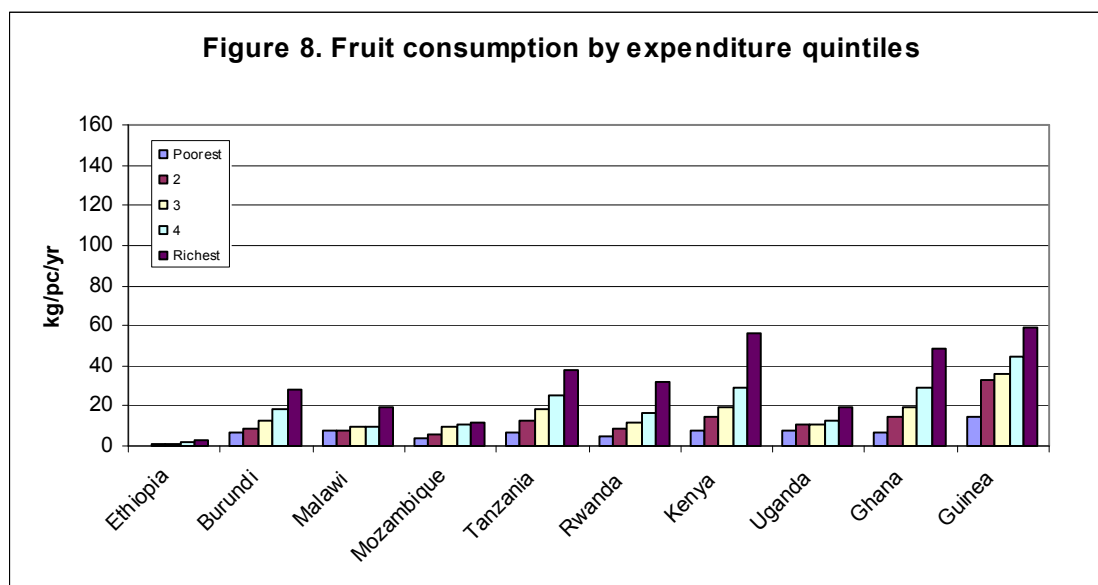
5.3 Socioeconomic differences in fruit and vegetable consumption

The data show very large socioeconomic differentials in consumption of fruit and vegetables (Figure 7), with steady increases in consumption as income increases. In several countries the largest increases are found between the top two income quintiles. The magnitude of the differences between the lowest and highest income quintiles range from twofold in Mozambique to eightfold in Burundi. Consumption of fruit and vegetables among the poorest income quintiles is very low in the region (less than 30 kg per capita per year in 6 of the 10 countries).



Although the top income quintiles have markedly higher average consumption of fruit and vegetables than the lowest ones, the higher income groups meet the WHO/FAO minimum recommended levels of 400g per day, or 146 kg per capita per year only in two countries (Kenya and Ghana).

The socioeconomic gradients for vegetables are generally larger than for fruit (see figures 8 and 9). Thus, it might be expected that rising incomes in sub-Saharan Africa would result in much larger increases in vegetable than in fruit consumption.



5.4 Determinants of the demand for fruit and vegetables

In tables 4 to 7 the results of the regression models are presented, examining the determinants of the demand for fruit and vegetables. Table 4 summarizes the estimated income elasticities, Table 5 gives the regression coefficients for the model of fruit and vegetable demand combined, and tables 6 and 7 give the coefficients for the separate models for fruit and vegetables.

Table 4. Summary of estimated expenditure elasticities of demand for fruit and vegetables¹

	Ethiopia	Burundi	Malawi	Mozambique	Tanzania	Rwanda	Kenya	Uganda	Ghana	Guinea
Overall										
Fruit	2.13	0.60	0.67	0.93	1.16	0.99	1.00	1.28	1.18	0.91
Vegetables	0.60	1.13	0.91	0.57	0.62	0.65	0.61	0.52	0.82	0.77
Fruit & vegetables	0.75	0.97	0.88	0.60	0.73	0.74	0.68	0.60	0.89	0.82
Fruit & vegetables by expenditure quintile										
Poorest	0.43	1.04	1.23	0.76	0.53	0.63	0.69	-0.06	0.94	0.74
2	0.54	0.47	1.17	1.43	1.51	0.43	0.91	0.59	0.69	1.39
3	0.99	1.05	0.77	0.82	1.13	0.57	0.67	1.16	1.01	1.13
4	0.96	0.95	0.35	0.30	0.86	0.85	0.36	0.73	0.99	1.18
Richest	0.63	0.90	0.75	0.70	0.72	0.86	0.53	0.68	0.71	0.60
Fruit & vegetables by urban/rural area										
Urban	0.68	0.96	0.81	0.71	0.81	0.90	0.48	0.75	0.90	0.69
Rural	0.76	0.97	0.89	0.56	0.72	0.72	0.74	0.56	0.88	0.90

¹Countries are ranked by ascending order of GDP per capita in 2000

Table 5. Determinants of the demand for fruit and vegetables ¹

	Ethiopia	Burundi	Malawi	<i>Mozambique</i>	Tanzania	Rwanda	Kenya	Uganda	Ghana	Guinea
Ln per capita expenditure	-0.0069*	-0.0014	-0.0109*	-0.0392*	-0.0217*	-0.0328*	-0.0218*	-0.0205*	-0.0076*	-0.0100*
Household size	-0.0008*	-0.0005	-0.0017	-0.0043*	-0.0029*	-0.0002	-0.0023*	-0.0015*	0.0004	0.0000
Female household head	0.0037*	0.0009	0.0191*	0.0058	0.0093*	0.0153*	0.0052*	0.0100*	0.0075*	0.0012
Primary education	-0.0001	0.0124*	0.0075*	-0.0023	0.0006	-0.0060	0.0059*	-0.0065*	-0.0036*	0.0014
Secondary education	0.0028*	0.0069	-0.0144*	0.0018	0.0015	-0.0151*	0.0071*	-0.0060*	-0.0104*	-0.0078*
Children share (1–16 years)	0.0000	0.0000	0.0001	0.0000	0.0001	0.0001	0.0001*	0.0000	0.0000	0.0000
Adult share (>30 years)	0.0000	-0.0001	0.0001*	0.0000	0.0002*	0.0001*	0.0000	0.0000*	0.0001*	0.0001*
Urban	0.0091*	N/A	-0.0206*	-0.0156*	0.0046*	-0.0058	0.0190*	0.0015	-0.0114*	0.0069*
Intercept	0.0671*	0.0758*	0.1106*	0.4787*	0.2006*	0.2853*	0.1542*	0.1843*	0.1335*	0.1243*
R-square	0.06	0.03	0.05	0.14	0.16	0.08	0.07	0.09	0.12	0.14
No. of observations	17 294	6391	6288	7859	21 420	6317	10 411	9834	5354	4286

¹ All models included regional dummy variables; the coefficients are not shown for simplicity.

* Significant at the 1–10% level

Table 6. Determinants of the demand for fruit ¹

	Ethiopia	Burundi	Malawi	Mozambique	Tanzania	Rwanda	Kenya	Uganda	Ghana	Guinea
Ln per capita expenditure	0.0029*	-0.0050*	-0.0040*	-0.0006	0.0027*	-0.0002	0.0000	0.0015*	0.0023*	-0.0017
Household size	0.0001	-0.0008*	-0.0002	0.0000	0.0004*	0.0021*	-0.0003*	0.0000	0.0005*	0.0000
Female household head	0.0018*	-0.0045*	0.0000	0.0017*	0.0012	0.0052*	0.0014*	-0.0004	-0.0014	-0.0019
Primary education	-0.0008	0.0015	0.0007	-0.0005	0.0002	0.0002	0.0024*	0.0001	-0.0006	0.0000
Secondary education	-0.0001	0.0041*	0.0006	0.0002	-0.0003	-0.0083*	0.0025*	0.0011	-0.0026*	-0.0038*
Children share (1–16 years)	0.0000*	0.0000	0.0000	0.0000	0.0001*	0.0000	0.0001*	0.0001*	0.0000	0.0000
Adult share (>30 years)	0.0000	0.0000	0.0000	0.0000	0.0000*	0.0001*	0.0000	0.0000*	0.0000	0.0000
Urban	-0.0030*		0.0016	-0.0025	0.0043*	-0.0050	0.0014	0.0013*	-0.0076*	-0.0033*
Intercept	0.0037	0.0472*	0.0201*	0.0090*	0.0144*	0.0166	0.0090*	-0.0073*	-0.0067	0.0353
R-square	0.07	0.04	0.01	0.02	0.18	0.05	0.02	0.02	0.05	0.11
No. of observations	17 294	6391	6288	7859	21 420	6317	10 411	9834	5354	4286

¹ All models included regional dummy variables; the coefficients are not shown for simplicity.

* Significant at the 1–10% level.

Table 7. Determinants of the demand for vegetables ¹

	Ethiopia	Burundi	Malawi	Mozambique	Tanzania	Rwanda	Kenya	Uganda	Ghana	Guinea
Ln per capita expenditure	-0.0097*	0.0036*	-0.0070*	-0.0386*	-0.0386*	-0.0326*	-0.0218*	-0.0220*	-0.0099*	-0.0082*
Household size	-0.0009*	0.0003	-0.0015	-0.0044*	-0.0044*	-0.0023*	-0.0020*	-0.0015*	-0.0002	-0.0001
Female household head	0.0019*	0.0054	0.0191*	0.0041	0.0041*	0.0101*	0.0037*	0.0105*	0.0088*	0.0030
Primary education	0.0007	0.0109*	0.0068	-0.0017	-0.0017	-0.0062	0.0036	-0.0066*	-0.0030*	0.0014
Secondary education	0.0029*	0.0028	-0.0151*	0.0016	0.0016	-0.0068	0.0046*	-0.0071*	-0.0078*	-0.0041*
Children share (1–16 years)	0.0000	0.0000	-0.0151*	0.0000	0.0000	0.0001	0.0000*	-0.0001*	0.0000	0.0000
Adult share (>30 years)	0.0000	-0.0001	0.0001	0.0000	0.0000*	0.0000	0.0000	0.0001*	0.0001*	0.0001*
Urban	0.0122*		-0.0221*	-0.0131	-0.0131	-0.0008	0.0176*	0.0002	-0.0038*	0.0102*
Intercept	0.0634*	0.0286*	0.0905*	0.4697*	0.2150*	0.2687*	0.1451*	0.1916*	0.1403*	0.0890*
R-square	0.13	0.06	0.04	0.15	0.16	0.08	0.09	0.11	0.16	0.12
No. of observations	17 294	6391	6288	7859	21 420	6317	10 411	9834	5354	4286

¹ All models included regional dummy variables; the coefficients are not shown for simplicity

* Significant at the 1–10% level.

Income elasticities of demand for fruit and vegetables

In Table 4 the income elasticities¹⁰ of demand for fruit, vegetables and fruit and vegetables combined are seen for the 10 countries studied. All income elasticities of demand for fruit and vegetables combined are lower than one, and values range between 0.60 and 0.97. This indicates that a 10 % increase in income is associated with a 6–10 % increase in the percentage of total budget allocated to fruit and vegetables. Highest income elasticities are found in Burundi, Malawi and Ghana (all greater than 0.85) and the lowest elasticities are found in Mozambique and Uganda (both = 0.60). This finding suggests that fruit and vegetables are “necessities” in the economic sense that, as income grows, spending on fruit and vegetables also grows, but at a somewhat slower pace.

The estimated income elasticities for fruit are greater than the elasticities for vegetables in all countries except Burundi and Malawi. While most income elasticities for fruit are close to or greater than one, all income elasticities for vegetables, except Burundi, are lower than one. This suggests that as income increases, the demand for fruit is likely to increase faster than the demand for vegetables. This is particularly true for countries such as Ethiopia and Uganda where the differences between fruit and vegetable income elasticities are twofold or greater. For instance, in Ethiopia, which has the largest income elasticity for fruit, a 10 % increase in income is likely to lead to a 6 % increase in the demand for vegetables and a 21 % increase in the demand for fruit.

No clear pattern emerges when comparing income elasticities for fruit and vegetables by income quintile. Although there is a tendency for the highest income quintiles to have lower elasticities for fruit and vegetables, the relationship is not consistent across countries.

The patterns of differences in income elasticities for fruit and vegetable by urban and rural area are also inconsistent; income elasticities for fruit and vegetables in urban areas are larger than rural areas in five countries, but lower in four other countries and similar in the remaining one. Similar results were found when looking at income

¹⁰ Because expenditure (x) appears both in the denominator of the dependent variable (s) and as an independent variable, any error in measuring expenditure may cause a spurious negative correlation, biasing the estimated value of β downward. Thus, the income elasticities reported here should be considered a lower limit of the true values.

elasticities for fruit and vegetable separately – i.e. the patterns of change in elasticities with income quintile and urban/rural areas were inconsistent (not shown).

Household size and composition

Household size is negatively associated with the demand for fruit and vegetables in the majority of countries i.e. larger households allocate a lower share of their budget to fruit and vegetable purchases (see Table 5). The negative association between household size and demand is also found in most countries in the demand equation for vegetables, but in only two countries for the demand for fruit (see tables 6 and 7). This may be due to economies of scale in larger households. Adult share is positively associated with the budget allocated to fruit and vegetables in several countries, probably due to differences in food preferences across age groups. This phenomenon was documented previously in Viet Nam. In this country, households with a larger proportion of older residents allocated larger shares of their budgets to fruit, particularly oranges, bananas and mangoes (11).

Sex of head of household

The regression analysis also provides of view of any differences in the fruit and vegetable consumption patterns of male- versus female-headed households after controlling for income, household composition, location, and other variables. The results indicate that female-headed households spend a larger share of their budget on fruit and vegetables. The difference is statistically significant in 7 of the 10 countries studied (see Table 5). The pattern is stronger and more consistent for vegetables than for fruit (see tables 6 and 7). This supports the idea that men and women may have different spending priorities, with women giving a higher priority to diet quality. These results are consistent with the argument that diet quality is improved when women have more control over household decisions (Smith et al. 2003).

Education

Having at least one household member with secondary education is negatively associated with the household budget allocated to fruit and vegetables in five countries (see Table 5). This finding is somewhat surprising in light of the link between education (and maternal education in particular) and child health status. It may be related to women's employment outside the home. Since the education of household members is

correlated; an educated household member may indicate an educated mother who is more likely to work outside the home. As a result, the household may be moving away from fresh fruits and especially fresh vegetables towards processed foods that require less preparation time. As hypothesized, secondary education is more strongly associated with declining budget shares for vegetables than fruit, probably reflecting the fact that vegetables require more preparation time (see tables 6 and 7). Information on maternal education would be needed to test this hypothesis more rigorously.

Location

Area of residence shows inconsistent patterns of association with fruit and vegetable demand: urban residence is significantly associated with a greater share of budget allocated to fruit and vegetables in four countries, but a smaller share in three other countries. Differences were not statistically significant in two countries and no information on rural/urban location was available for Burundi (see Table 5). There are no consistent patterns in the separate fruit and vegetable models (see tables 6 and 7). Urban areas probably have higher prices for fruit and vegetables, which would reduce the demand, but they also have a wider selection of fruit and vegetables, which could result in greater demand. Finally, the statistical significance of many regional dummies in the models (not shown in the tables) confirms the existence of significant regional differences in the demand for fruit and vegetables within countries. These in turn may reflect differences in prices and availability between regions.

6. Discussion

Abundant intake of fruit and vegetables is clearly a positive solution for problems of poor diet quality in the developing world. Fruit and vegetables are a relatively cheap source of essential micronutrients. They are a cost-effective way to prevent micronutrient deficiencies and protective against chronic diseases, the main killers in the world today. Although WHO/FAO recommend minimum fruit and vegetable intakes of 146 kg per person per year, few countries achieve this level, even among industrialized nations. The main thrust of this paper was to document fruit and vegetable consumption patterns in low-income countries of sub-Saharan Africa and to explore the main constraints to increased intakes. It is crucial to understand the household-level factors that influence the

demand for fruit and vegetables in these vulnerable populations to ensure the success of promotional efforts to foster fruit and vegetable consumption in the future.

6.1 Current knowledge of the factors that affect food consumption patterns, with a focus on fruit and vegetables

Standard economic models of household behaviour suggest that income, price, and consumer preferences are the main determinants of food consumption patterns. An extended model that takes into account the high costs of participating in market transactions in some rural areas suggests that the cost of producing fruit and vegetables for own consumption could also influence fruit and vegetable consumption. Finally, research on intrahousehold allocation of resources suggests that priorities differ among members of the household. “Household decisions” may therefore be the result of an implicit bargaining process within the household. In this case, decisions about fruit and vegetable consumption, and the allocation of food among household members will be influenced by the status of women relative to men. Box 1 summarizes previous research findings concerning the importance of these five factors in influencing fruit and vegetable consumption.

Box 1

Summary of current knowledge regarding factors that influence fruit and vegetable consumption patterns

- **Income** Fruit and vegetable consumption rises with income. The income elasticity of demand for fruit and vegetables in poor countries is estimated to be 0.60 – 0.70.
- **Prices and availability** Estimated price elasticities for fruit and vegetables are estimated to range from -0.35 to -0.50. Anecdotal evidence suggests that the seasonal availability of many fruit and vegetables also limits their consumption.
- **Consumer preferences** The wide variation in per-capita consumption of fruit and vegetables across households, even after holding income and price constant, suggests that consumer preferences play an important role. Preferences may be universal (such as the demand for calories and fat), cultural, or household-specific or individual-specific. Research in industrialized countries suggests that psychosocial factors, health and nutrition awareness and knowledge, and formal education all play an important role in determining fruit and vegetable consumption.
- **Home production** Promotion of home production of fruit and vegetables is one potential strategy to increase their consumption at the household level. Production interventions need to be complemented by effective education and behaviour-change strategies to achieve a significant impact on consumption.
- **Intrahousehold decision-making** Research has shown a link between the status of women (relative to men) and child nutritional and health outcomes. It suggests that male- and female-headed households often behave differently relative to food consumption. The effect of gender relations on fruit and vegetable consumption remains under-researched.

6.2 Key findings of the analysis of fruit and vegetable consumption in sub-Saharan Africa

The levels of fruit and vegetable consumption documented in this paper's analysis of sub-Saharan African countries are characteristic of very poor countries, ranging from 27 kg to 114 kg per capita per year, far below the WHO/FAO recommended minimum of

146 kg per person per year. These levels are generally comparable to those estimated by IARC (2) using FAO data. Estimates of fruit and vegetable consumption in that study range from 36 kg to 80 kg per person per year in different regions of sub-Saharan Africa.

The share of the budget allocated to fruit and vegetables in this paper's sample countries is in the range of 3–13 %. According to the ICP data, fruit and vegetables account for 11 % of the budget for low-income countries, defined as those whose incomes are less than 15 % of that of the United States (10, 33).

Previous studies have suggested that per-capita consumption of fruit and vegetables in urban areas is at least as great as in rural areas (Ali and Tsou 1997; Mueller et al. 2001). This paper confirms such a pattern and suggests a wider urban/rural gap for consumption of fruit than vegetables. However, when income and household demographic factors in demand equations are controlled for, the pattern of urban/rural differences is inconsistent. This suggests that the advantage of urban households relative to fruit and vegetable intake is mainly due to greater income, rather than to city life itself.

Research has shown that fruit and vegetable consumption rises with income, although at a different rate. In economic terms, fruit and vegetables are necessities, having an income elasticity between 0 and 1. Seale et al (10) estimate a demand system using cross-country regression analysis of the 114 countries in the ICP data. At the low levels of income of sub-Saharan African countries, their model suggests that the income elasticities of fruit and vegetables would be between 0.60 and 0.70. This paper's income elasticity estimates, generated from 10 nationally representative household surveys, were in the range of 0.60 to 0.97. Given the difference in methodology, the correspondence is quite close. As in other studies, the analysis of countries from sub-Saharan Africa in this paper confirms that the diversity of fruit and vegetable consumption increases with higher incomes. For example, in Ghana, the average number of fruit and vegetables consumed during the reference period rises from 1.4 out of 10 in the poorest quintile to 3.1 in the richest quintile. In Uganda, the corresponding numbers are 4.8 and 6.2, from a list of 17 fruit and vegetables.

In most of the countries studied, female-headed households allocated a significantly larger share of their budget to fruit and vegetables than male-headed households. The pattern was stronger and more consistent in the case of the demand for

vegetables than in the demand for fruit. These findings are consistent with previous research suggesting that women typically spend a higher proportion of their income on food and health care services for their children than men (27).

Somewhat surprisingly, households with a more highly educated member (i.e. secondary education or higher) tended to spend a lower percentage of their income on fruit and vegetables compared with those with lower levels of education. This may be linked to women working outside the home and purchasing more processed, convenience foods, which are likely to contain lower amounts of vegetables than home-prepared meals.

A brief summary of these findings is presented in Box 2.

Box 2

Summary of findings regarding fruit and vegetable consumption patterns and their determinants in sub-Saharan Africa

- The consumption of fruit and vegetables in the 10 sub-Saharan African countries studied ranges from 27 kg to 114 kg per person per year, far below the recommended 146 kg per person per year.
- The share of the total budget allocated to fruit and vegetable consumption ranges from 3 % to 13 %. The *food* budget share ranges from 4.5 % to 16 %.
- The demand for fruit and vegetables rises with increasing income, although at a slower rate than income. The income elasticities for fruit and vegetables range from 0.60 to 0.97 and are generally higher for fruit than vegetables.
- In most of the countries studied, female-headed households spend significantly more on fruit and vegetables, and particularly on vegetables, than male-headed households.
- Fruit and vegetable consumption among urban households is consistently greater than (or approximately equal to) that of rural households. The urban advantage, however, seems to be related to differences in income rather than city life itself.
- Controlling for income, households with a member who has secondary education or higher tended to consume smaller quantities of fruit and vegetables than those with lower education. This is likely to be related to women's involvement in work outside the home and related preferences for processed foods that may contain lower amounts of vegetables.

6.3 Implications and recommendations

- This paper's analysis highlights the importance of economic factors in shaping fruit and vegetable consumption patterns in sub-Saharan Africa. The poorest of the poor are forced to allocate a large share of their resources to producing or purchasing starchy staples, which are by far the cheapest sources of energy. For these households, it may be unrealistic to even attempt to advise them to divert their scarce household resources into fruit and vegetables until they have satisfied their daily energy requirements and other basic needs.
- Income growth will contribute to greater consumption of fruit and vegetables in the long run. Growth alone is unlikely to help developing countries reach WHO/FAO-recommended levels of intake in the short-term or even medium term. Given the higher income elasticities of fruit, income growth will result in faster increases in fruit consumption than vegetables. The pace is likely to be too slow to achieve significant health benefits within an acceptable timeframe.
- Households that are able to achieve an adequate energy intake are more likely to respond favourably to promotional efforts to encourage and facilitate greater consumption of fruit and vegetables. Parallel programmes still need to be implemented to alleviate income, price and availability constraints, which prevent poor households from achieving recommended levels of fruit and vegetable consumption.
- Programmes to reduce the price and increase the availability of fruit and vegetables should focus on extending the duration of the harvest period, processing fruit and vegetables into forms that can be stored, reducing post-harvest losses, and making fruit and vegetable marketing less risky. This can be accomplished with agronomic and post-harvest research and extension, as well as with investment in transportation and communication infrastructure.
- Programmes to promote orchards and vegetable gardens as a means of increasing household fruit and vegetable consumption are more likely to succeed in remote rural areas. In areas with good market access, increased fruit and vegetable production on

the farm is likely to replace purchases or increase sales without affecting consumption appreciably.

- The price of fruit and vegetables can be decreased by reducing import tariffs, and removing unnecessary sanitary and phytosanitary restrictions on fruit and vegetable imports.
- Education and behaviour-change programmes to promote fruit and vegetable consumption should be based on local knowledge regarding the demographic, cultural and psychosocial factors that affect consumer choices. These should focus on translating accurate and useful information to consumers about the health benefits of abundant fruit and vegetable consumption.

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