ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 13 No. 3
June 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

SEASONAL PRICE VARIABILITY AND THE EFFECTIVE DEMAND FOR NUTRIENTS: EVIDENCE FROM CEREALS MARKETS IN MALI

Camara OM[1*]

Oumou M Camara

*Corresponding author email: ocamara@ifdc.org

[1]International Fertilizer Development Center, TVA Reservation Road P.O. Box 2040, Muscle Shoals, Alabama. USA

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 13 No. 3
June 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

ABSTRACT

A key outcome of the food policy reforms initiated in the 1980s in Mali was the liberalization of the cereals markets in order to stimulate agricultural production and reduce reliance on imported rice. These market reforms resulted in more variable food prices because grain prices were no longer fixed by the government but rather influenced by the seasonal pattern of production and availability, regional and international supply and demand conditions. Malian policy makers have often expressed their concerns about seasonal grain price variation in Mali. However, measurements of its immediate effects on households' effective demand for nutrients have been relatively scarce. This study uses panel data from a 2000-2001 household consumption survey undertaken in Bamako to estimate nutrient-income and price elasticities by season and for the entire year and examine the effects of intra-year price variation on nutrient demand. The study finds that real income has a statistically significant positive impact on the demand for calories, protein, calcium, vitamin A, and iron and that the income elasticities for calories (from 0.102 to 0.193) varies less across seasons than those for micronutrients (for example vitamin A from 0.492 to 0.725). During the lean season, a 10 percent increase in real incomes will improve calorie availability from staples and other foods by 1.36 and 3.36 percent, respectively. The pooled data results show that a 10 percent growth in real incomes will increase the demand for calories (+1.62 %), protein (+1.91%), calcium (+1.98%), vitamin A (+7.21%) and iron (+1.29%). The findings of this study have several implications for food policy design in Mali, and possibly for other Sahelian countries. The most striking result is that in the face of seasonal variations in the price of staples, Bamako households attempt to "defend" their calorie consumption by reducing the consumption of higher-cost but more nutrient-rich foods. Thus, the price fluctuations of staples can significantly affect the consumption of protein and micronutrients that the staples themselves do not contain. Measures to bring about more stability of the staple-food markets (regional trade policies, better infrastructure) would thus have impacts on nutrition and on the demands for other more nutrient-rich products well beyond the staple-foods. In other words, if you are interested in Vitamin A or iron consumption, the path to affect those most may be through the staple foods market, even though most Malian staples are not rich in those micronutrients.

Key words: Nutrition, Seasonal, Price, Income, Mali

INTRODUCTION

A key outcome of the food policy reforms initiated in the 1980s in Mali (the Structural Adjustment Programs and the 1994 Franc CFA devaluation) was the liberalization of the cereals markets in order to stimulate agricultural production and reduce reliance on imported rice [1]. The production and physical availability of cereals in most markets improved with the reforms, as farmers responded to the higher prices that resulted from the reforms. However, economic access to food remained a problem, especially for the growing number of low-income urban households, partly because the higher food prices caused a decline in their purchasing power as their nominal incomes grew more slowly than the price of basic staples. Furthermore, the market reforms had also resulted in more variable food prices because grain prices are no longer fixed by the government but rather influenced by the seasonal pattern of production and availability, regional and international supply and demand conditions, and by the political situation in neighboring countries such as Côte d'Ivoire [1]. An earlier study found that the coefficient of variation of monthly prices for rice, millet and maize, increased from 7, 26, and 23 percent in the 1990-93 periods to 12, 30, and 28 percent in the 1994-97 periods [1].

Previous studies have shown that the stability of urban households' real income from one season to another constitutes an important determinant of household food security [2,3,4]. However, measurements of the immediate effects of seasonal grain price variation on households' effective demand for nutrients have been relatively scarce in Mali. Most of the empirical evidence in Mali and West Africa has been on the long-term adjustment of households' consumption patterns to price and income changes and has addressed the question of whether the price elasticity of demand varies with the level of income [5,6,7]. These studies have not examined the critical question of whether the income elasticity of demand for commodities varies with the level of relative prices faced by households. Malian urban households are net food purchasers, earn cash income, allocate 54 percent of their income on food, and spend 40 to 50 percent of their food budget on cereals [5,7]. Therefore, variation in the prices of basic staples throughout the year can significantly affect real purchasing power and thus households' food consumption choices, resulting in significant protein and micronutrient deficiencies.

This paper examines the effective demand for nutrients at the household level in Bamako, Mali. Specifically, it seeks to determine whether the effective demand for nutrients is responsive to changes in real incomes and relative prices and whether the magnitude of the nutrient income and price elasticities change from one season to another. This would mean that seasonal changes in real incomes could affect not only the quantity (level) but also the quality (nutrition) of food consumed in households in any given season. From a policy perspective, this implies that safety-net programs may be more or less effective at different periods of the year, depending on the set of relative prices faced by households and their real incomes at the time of their implementation. Most of the empirical evidence on the determinants of nutrient demand has focused on the effects of income on the demand for nutrients [8,9,10].

This study, through the estimation of nutrient-price elasticities by season and for the entire year, attempts to extend that analysis by looking at the effects of intra-year price variation on nutrient demand, thereby providing information that could lead to improved food policy formulation in Mali.

MATERIAL AND METHODS

The Data

The panel data used in this study is from a 2000-2001 survey undertaken in Bamako by the *Direction Régionale du Plan et de la Statistique* (DRPS), Michigan State University (MSU), the *Assemblée Permanente des Chambres d'Agriculture du Mali* (APCAM), and the *Centre d'Analyse et de Formulation de Politiques de Développement* (CAFPD). This data set is valid although taken more than ten years ago because it provides valuable information on the intra-year price variation in the staple foods and the impact of seasonal price fluctuations on nutrient consumption; which are issues that consumers still face today.

The sampling frame was adapted from that developed by the Direction Nationale de la Statistique et du Plan for the 1989 national Budget Consumption Survey. Data collection took place in Bamako, the capital city of Mali. The surveyed households were selected using a two-stage stratified random sample design. At the first stage, a representative sample of five "Sections d'Enumeration", geographical units that encompass 1000 to 1500 inhabitants in urban areas, were randomly selected. At the second stage, 8 households were randomly selected within each enumeration area to arrive at the targeted number of households (40).

The survey was conducted in four rounds, one week in each quarter of the year, during the period of August 2000 to May 2001. The choice of the period for the interview was dictated by the agricultural season in Mali. Although the survey was conducted over a single year, it constitutes a basis for policy formulation because the price variations observed during that year were similar to previous years. The four surveys covered 40 Food Consumption Units (FCU), the sample size in each being the same. An FCU is defined as a group of related individuals who share at least one meal together per day. The same 40 households were tracked over time and interviewed in all four periods in order to capture the seasonal variation in consumption. Along with detailed information on food (at and away from home) and non-food consumption and expenditure, the surveys also collected data on the demographic characteristics of households. There was no sample attrition.

Data collection for this study was designed to minimize recall bias from memory lapse in recalling quantities purchased. This was achieved by shortening the gap between the time of food purchase and the interview, as enumerators were present in the household when the person responsible for market purchases returned from the market. Also, by using scales and not asking respondents to recall food purchases, the

ajfand SCHOLARLY, PEER REVIEWED AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT Volume 13 No. 3 June 2013 PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST ISSN 1684 5374

study minimized measurement error in the quantity of calorie and nutrients available for household consumption.

The seasons were defined based on agricultural activities in Mali. The harvest season extends from September through November for millet, sorghum, and maize; from November through December for rainfed rice; and from October through November for irrigated rice. In a typical year, cereals prices tend to fall during the harvest season. The post-harvest season extends from December through February and also corresponds to the cold season. Prices of cereals are generally lowest during the post-harvest season, as granaries are full during this period and grain availability in urban markets is highest. The planting season extends from May through July for millet, maize, and sorghum, from June-July for rainfed rice and from October through December for irrigated rice. The hot season extends from March through May. From this point on, grain stocks begin to gradually decrease and reach their lowest levels during the lean season, also called the "hungry" season, which occurs right before the first harvest, primarily in August.

Nutrient Demand Functions Estimation

The demand for total calories, calories from staples, calories from other foods, protein, calcium, iron, and vitamin A is estimated separately for each season and the entire year using Engel functions.[1] The nutrient demand functions are specified as a log-linear function of the form below [11]:

$$\ln N_{kht} = \alpha + \beta \ln Y_{ht} + \gamma \ln P_{ht} + \delta \ln AE_{ht} + u_{kht} \qquad (1)$$

where,

k indexes calories and nutrients (calories, calories from staples, calories from other foods, protein, calcium, iron, and vitamin A)

h indexes an household (h = 1,…,40)

t indexes seasons (planting, lean (pre-harvest), harvest, and post-harvest; t = 1, 2, 3, 4)

N is calorie and nutrient demand (amounts of nutrients available in household per adult equivalent (AE))

Y is total real household monthly expenditure per adult equivalent

P is a vector of food prices (P1 = price of rice, P2 = price of millet-sorghum, P3 = price of beef, P4 = price of dry fish, and P5 = price of green leaves)

AE is household size in adult equivalents

u is an error term

[1] These particular nutrients were chosen because of the main types of nutrient deficiencies that persist in Mali.

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 13 No. 3
June 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Household demand for calories and nutrients is expressed as a function of food prices, real incomes, and household size[2]. Real monthly expenditures (food and non-food) of households are used as proxy for income[3]. The calorie and nutrient estimates represent calorie and nutrients in foods that are available for household consumption and not actual nutrient intakes by individuals. The prices of rice and millet-sorghum (P1 and P2) are included in the analysis in order to measure the effect of staple prices on nutrient demand. The prices of beef (P3) and dry fish (P4) are chosen to assess the impact of meat and fish prices on the demand for nutrients as these foods are important sources of protein. The price of green leaves (potato leaves, spinach) (P5) is included in the analysis to account for the effect of vegetable prices on nutrient demand estimates since green leaves are the main sources of vitamin A and calcium in the diets of urban households.

Weekly prices of cereals data observed over the year 2000-2001 for 12 markets in the capital city, Bamako, was obtained from the Mali Market Information System bureau called "Observatoire du Marché Agricole" (OMA). Unit values were used as proxies for the prices of beef, dry fish, and green leaves.

This study assumes that all the explanatory variables are exogenous (uncorrelated with the error term). The Ordinary Least Squares (OLS) method is chosen to estimate the parameters of the nutrient demand functions because it yields estimates that are unbiased and consistent under the exogeneity assumption. OLS has been widely applied in many empirical studies to estimate nutrient demand functions [5,10,11]. The demand for nutrients is estimated, as specified in Equation (1), by OLS separately for each season and for the pooled data (data pooled across all 4 seasons). The stability of the estimated nutrient income and price elasticities across seasons is assessed using the Chow test.

RESULTS

Seasonality in Food Prices

During the survey year, the price of rice was high during the lean season, averaging about 275 CFA Francs per kilogram, *but* reached its highest level, 279 CFA Francs per kilogram, during the harvest season (Figure 1). As the new harvest began to reach urban markets, the price of rice started to gradually decline and reached its lowest level, about 262 CFA Francs per kg during the post-harvest season. Millet-sorghum and maize show similar price movements across seasons.

---

[2] Although data was collected on foods away from home (FAFH) expenditures, these were not included in the econometric analysis for issues of multi-collinearity between the income (total expenditure) and FAFH variables.

[3] The value of gifts and remittances from or to other households was excluded from the computation of total incomes/expenditures, as their inclusion would involve double counting if the transfers show up in the consumption of other households.

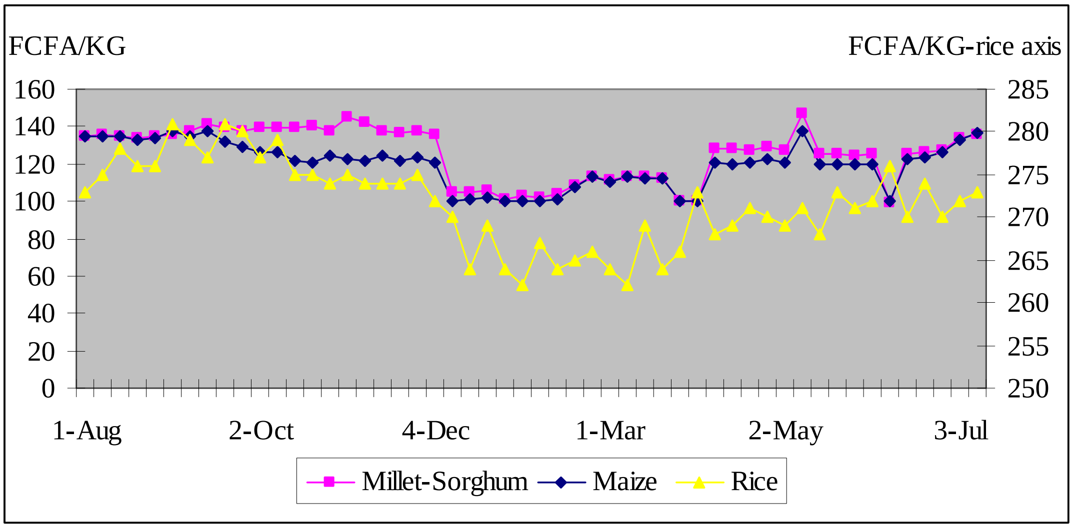

Figure 1: Average Rice, Millet-Sorghum, and Maize Retail Prices in Bamako (CFA/KG) from August 2000 to July 2001

Seasonality in Income/Expenditure

The mean nominal expenditures per adult equivalent decrease by 36 percent between the lean and post-harvest season, increase by 4 percent between the harvest and post-harvest season, and drop by 18 percent between the post-harvest and planting seasons (Table 1). Once total expenditures are disaggregated into food and non-food expenditures in order to uncover the causes of the seasonal changes in expenditures, the results indicate that much of the observed seasonal variation in expenditures could be attributed to changes in non-food expenditures, as food expenditures remain fairly stable across seasons.

There are two possible explanations, which are not mutually exclusive, for the observed seasonal variation in non-food expenditures. The issue for households could either be one of smoothing consumption in the face of variable income and/or one of meeting seasonally high expenditure requirements in the face of relatively stable income. The data on households' sources of income indicates that it may be the latter, as household income sources vary across seasons (Table 2). The magnitude of aid, as high as 22 percent, can be explained by the fact that not only the Malian economy has become more monetized than in 1985 but also the terms of trade have shifted towards rural areas because of higher incomes in rural areas (Table 2). One must also keep in mind that, given the extreme level of poverty that prevails in Bamako, households will have limited scope for discretion with respect to their spending.

Seasonality in Calorie and Nutrient Availability

Figure 2 shows the distribution of calorie availability across households and across seasons. The results indicate that 48 percent of households are unable to meet the 2200 minimum daily calorie per person requirement during the lean season. During

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 13 No. 3
June 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

the planting season, the results indicate that about 68 percent of households cannot achieve the minimum calorie availability levels.

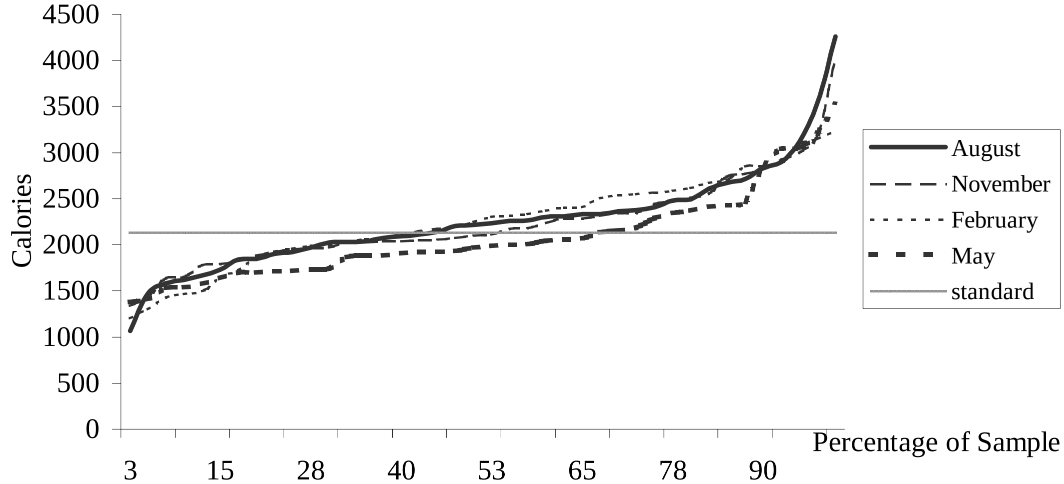

Figure 2: Distribution of Calorie Availability across Households by Season

NB: "Standard" refers to the FAO's minimum daily energy requirement of 2,200 kcal per adult equivalent at the time of the study data was collected

Seasonal variations in the availability of micronutrients are much more pronounced than those in calorie availability. Bamako households tend to diversify their diets, through greater consumption of non-staple commodities, only during periods of greater food availability in urban markets, when food prices are relatively low (harvest and post-harvest seasons). The availability of calories and nutrients, as manifested in the nutrient adequacy ratios (NARs), is greatest in urban households during the lean season and lowest during the planting season (Table 3). Average nutrient availability in Bamako households increases by 9.5 percent when away-from-home foods are taken into account. Bamako households would now be able to meet minimum daily calorie requirements during all seasons; however, they would still not be able to satisfy the recommended dietary allowance (RDA) for vitamin A, vitamin C, calcium, and iron in all seasons considered.

Regression Results

The results of the regressions are presented in Table 4. Five noteworthy findings emerge from the estimation of the nutrient-demand functions.

First, **improvements in real incomes will have a positive impact on calorie and nutrient availability in Bamako households**. The pooled data results show that a 10 percent growth in real incomes will increase the demand for calories (+1.62 %), protein (+1.91%), calcium (+1.98%), vitamin A (+7.21%) and iron (+1.29%).

Second, **households will increase their consumption of foods that contain essential nutrients more rapidly than that of staple foods, as their real incomes increase**. The pooled data results indicate that the income elasticities of protein, calcium, and vitamin A are higher than those of calories. Also, calories from staples are far less responsive to changes in real incomes than calories from other foods. A 10 percent increase in real incomes will increase the amount of calories from staples by 0.7 percent and that of calories from other foods by 3.64 percent. During the lean season, a 10 percent increase in real incomes will improve calorie availability from staples and other foods by 1.36 and 3.36 percent, respectively. Hence, households will tend to shift to more expensive sources of calories, foods that are rich in micronutrients, as their disposable income increases. Furthermore, the income elasticity of demand for calories is lower than the estimated food-income elasticity for Bamako households by Camara [12], 0.626 in August, 0.463 in November, 0.577 in February, 0.574 in May, and 0.516 for the pooled data [12]. Calorie-income elasticities are expected to be lower than food-income elasticities because households will tend to substitute between cheaper and more expensive sources of calories as purchasing power varies [10]. This finding is evidence that households are upgrading the quality of their diets, especially for Vitamin A, substituting more expensive sources of calories for cheaper sources, as their income increases. These results show that diet diversification occurs as households' incomes rise.

Third, **Bamako households' demand for nutrients is responsive to changes in food prices**. The estimated nutrient price elasticities indicate that (1) the price of millet sorghum has a statistically significantly negative and less than proportionate effect on the effective demand for nutrients in any given season; (2) the price of dry fish has a negative and statistical significant effect on the amounts of calcium demanded by households; (3) the price of green leaves has a negative statistically significant impact on the demand for calcium and vitamin A; and (4) the price of rice and beef have a statistically significant effect on the availability of calories and nutrients during the lean season, and for the pooled data.

Fourth, **the magnitude of the calorie and nutrient income and price elasticities will change from one season to another.** The null hypothesis of stability in the nutrient income parameters across seasons was rejected at the 10 percent level for all the estimated coefficients, except for calcium, suggesting that there is a statistically significant shift in the estimated calorie and nutrient-income elasticities across seasons. A 1(one) percent increase in urban households' real incomes will increase calorie availability by 0.193 % and 0.170 % during the lean and post-harvest seasons, respectively. Also, the Chow test results indicate a degree of non-constancy of many price parameters across seasons, as the test of stability in the price coefficients was rejected at the 10 percent level for 13 out of 35 estimated coefficients.

The extent of households' behavioral adaptations typically depends on the efficient functioning of price, capital, and wage markets. In this case, the instability of demand parameters across seasons in Mali can be explained by several factors:

1. Households' income streams are far from predictable.
2. Households are not able to smooth fluctuations in income by saving or dis-saving (borrowing), even if the seasonal variability in cereal prices is predictable, because capital markets are inefficient and the pattern of earnings and savings is unstable and unpredictable.
3. The nature of households' preferences, which are a reflection of their desire to obtain food, seem to depend on the season considered, pointing to separability of households' preferences across seasons, as households seem to maximize utility in each season subject to current disposable income and set of relative prices faced in that season. This means that preferences within one season can be described independently of other seasons.

Fifth, **the adjustments Bamako households make to their food baskets to maintain calorie consumption more or less constant across seasons will have a greater impact on the consumption of foods that contribute essential vitamins and minerals**, such as calcium and vitamin A, to urban households' diets. The results indicate that the income elasticities vary noticeably across seasons, especially for micronutrients (example, from 0.492 during the harvest season to 0.725 during the lean season for vitamin A). The higher income elasticity of demand for vitamin A during the post-harvest season (0.680) can be partly explained by the low availability (higher prices) of spinach and green leaves during the cool dry season, which corresponds to the growing season for most horticultural crops. In contrast, the income elasticities for calories (from 0.102 to 0.193) vary less across seasons than those for vitamin A (from 0.492 to 0.725).

DISCUSSIONS

The findings of this study have several implications for food policy design in Mali, and possibly for other Sahelian countries. The most striking result is that in the face of seasonal variations in the price of staples, Bamako households attempt to "defend" their calorie consumption by reducing the consumption of higher-cost but more nutrient-rich foods. Thus, the price fluctuations of staples can significantly affect the consumption of protein and micronutrients that the staples themselves do not contain. Measures to bring about more stability of the staple-food markets (regional trade policies, better infrastructure) would thus have impacts on nutrition and on the demands for other more nutrient-rich products well beyond the staple-foods. In other words, if one is interested in Vitamin A or iron consumption, the path to affect those most maybe through the staple food market, even though most Malian staples aren't rich in those micronutrients.

Investment in marketing and telecommunication infrastructure to support food and information flows to the market may be effective tools to reduce fluctuations in cereal prices. Aker has demonstrated that cell phones have provided an alternative and cheaper search technology to grain traders and other market actors in Niger [13]. Cell phones reduced grain price dispersion across markets by a minimum of 6.4 percent and reduce intra-annual price variation by 10 percent [13]. In Mali, much remains to be done although the creation of the Malian Cereal Market Information System by the Agricultural Market Outlook in 1989 has improved market transparency, increased market competition, stimulated private investments in storage and trucking, and triggered growth in regional ties and partnerships [14]. Dembélé *et al.*, have shown that OMA needs to develop cost-effective ways to provide timely market information to Mali's private sector [14]. The Market Information System bureau must also place greater emphasis on the provision of information on regional markets and strengthen its capacity to develop and implement marketing extension programs. OMA will also need to develop tools to identify and report to market participants the quality requirements of different market segments [14].

The results of this study also suggest that the impacts of a uniform food policy on the quantity and quality of food available will vary by season, since many of the estimated nutrient income and price parameters were not stable across seasons. This implies that the effectiveness of food policies will be contingent upon whether or not they are systematically synchronized with the short-run response of households' consumption patterns to income and price changes.

The positive nutrient-income elasticities imply that increasing households' real incomes (including through reducing seasonal price spikes for staple foods) will improve both the quantity (calories) and the quality (protein, minerals, and vitamins) of food available in those households and thereby will be an effective mechanism in reducing malnutrition. Hence, policies that aim at increasing households' real incomes will also improve their nutrition. Better nutrition outcomes can, in turn, translate into improved worker productivity [15]. Furthermore, studies have shown that investments in improving early childhood nutrition (before the age of three) are associated with large increases in wage rates for men and therefore can be long-term drivers of economic growth [16].

Finally, as the results indicate that households do substitute less expensive sources of calories for cheaper sources with rising income, increased investments in the production and marketing of horticultural commodities and animal products can yield the productivity gains necessary to substantially reduce the price of horticultural goods so that low-income households can readily access these foods. Expanded consumption of these products, which are often produced in urban and peri-urban areas, offer the potential to substantially reduce malnutrition, especially vitamin A deficiency. Because their production and marketing is labor-intensive, they also offer the possibility of expanding employment and reducing poverty in urban areas. Another possibility is storing these micronutrient-rich foods (drying, canning) to make them more available at other seasons.

CONCLUSION

The results indicate that the effective demand for nutrients is responsive to changes in real incomes and relative prices and that there is evidence of seasonal changes in income and price responsiveness. Because the data used in this study was gathered at the household level and could not be used to assess the effect of price and income changes at the individual level, the study was not able to investigate the issue of food distribution within the household. Future studies can be designed to obtain information on the distribution of food within the household to enable the identification of vulnerable groups (children, pregnant and lactating women, and the elderly) in low-income households. Gathering such information will also permit the analysis of the nutritional status of household members.

ACKNOWLEDGEMENT

The author is grateful to the following individuals and institutions for making this study possible:

- Professor John Staatz from the Michigan State University Department of Agricultural Economics for review and comments;
- The 40 households in Mali for their generous cooperation in sharing detailed economic data; and
- The United States Agency for International Development (USAID) for funding the study.

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 13 No. 3
June 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Table 1: Monthly Mean Nominal and Real Expenditure per Adult Equivalent (CFA Francs) and Seasonal Changes in Expenditure (%) (n = 40)

Income	Phase				% Change Between		
	L	H	PH	P	H-L	PH-H	P-PH
	Mean Monthly Expenditure/AE						
Nominal Expenditure	33471	21774	22149	18793	-35	2	-15
Real Expenditure	32496	20936	21714	17729	-36	4	-18
Food	9500	8817	8403	8508	-7	-5	1
Non Food	23971	12957	13746	10285	-46	6	-25
Food Budget Share	28	40	38	45	43	-6	19
Non Food Budget Share	72	60	62	55	-17	4	-12
	Food Budget Allocation (%)						
Rice	19	22	23	21	15	3	-8
Other Staples	10	11	11	12	9	-5	17
Meat and Fish	16	17	17	14	6	2	-21
Vegetables	13	12	12	11	-10	3	-8
Oil	4	3	4	3	-28	14	-25
Sugar	6	6	6	7	-2	0	10
Others	12	10	11	10	-14	3	-3
FAFH	19	18	17	22	-1	-8	31
Total	100	100	100	100			

Table 1 cont…

Income	Phase				% Change Between		
	L	H	PH	P	H-L	PH-H	P-PH
	Non Food Budget Allocation						
Education	4	6	1	2	37	-78	62
Housewares	19	21	13	11	9	-39	-16
Personal Care	25	14	26	7	-47	94	-73
Health	18	13	15	31	-29	20	106
Hygiene	4	5	5	6	48	-13	24
Energy and Utilities	14	17	19	21	22	11	12
Tobacco	1	4	2	4	180	-42	67
Transportation	12	17	15	16	45	-12	4
Recreation	3	4	4	3	41	-4	-23
Total	100	100	100	100			

Note: L = August = lean season, H = November = harvest, PH = February = post-harvest and P = May = planting; FAFH = Food Away From Home

Table 2: Source of Income for the Head of Household by Season (n = 40)

Income Source of Head of Household	Phase					Percentage Change Between		
	Lean	Harvest	Post-Harvest	Planting	Average	H-L	PH-H	P-PH
Salaries	33	40	45	43	40	21	13	-4
Commercial activities	17	22	20	20	20	29	-10	0
Agricultural activities	5	5	5	8	6	0	0	25
Aid	22	12	12	12	15	-83	0	0
Other activities	23	20	17	17	19	-13	-15	0

Note: L = August = lean season, H = November = harvest, PH = February = post-harvest and P = May = planting; FAFH = Food Away From Home

Table 3: Nutrient Availability, Nutrient Adequacy Ratios, and Percentage Change in Nutrients Availability across Seasons (n = 40)

Phase	Food Energy	Carbo-hydrate	Protein	Vitamins		Minerals	
				Vit A	Vit C	Calcium	Iron
	Kcal	Grams		Microgram	mg	mg	
L	2263	409	61	428	38	490	23
H	2236	413	59	338	32	396	23
PH	2251	414	58	392	36	431	22
P	2087	398	52	284	26	355	22
				Nutrient Adequacy Ratios (%)			
L	103	136	96	71	84	49	40
H	102	138	93	56	70	40	39
PH	102	138	92	65	80	43	37
P	95	133	83	47	58	36	37
				Percentage Change (%)			
H-L	-1	1	-3	-21	-17	-19	-1
PH-H	1	0	-1	16	13	9	-5
P-PH	-7	-4	-10	-28	-27	-18	-1

Note: L = August = lean season, H = November = harvest, PH = February = post-harvest and P = May = planting; FAFH = Food Away From Home

Table 4: Nutrient Demand Estimates (n = 40 by season and 160 for the pooled regression)

Independent Variables	Dependent Variable: Log of																	
	Total Calories						Calories From Staples						Calories From Other Foods					
	L	H	PH	P	Pooled	Chow	L	H	PH	P	Pooled	Chow	L	H	PH	P	Pooled	Chow
RIAE	0.193	0.102	0.170	0.166	0.162	4.390	0.136	-0.034	0.080	0.114	0.070	1.800	0.336	0.401	0.325	0.310	0.364	5.860
	(3.03)	(1.05)	**(2.29)**	**(2.12)**	**(4.62)**	***(0.00)***	**(1.77)**	(0.31)	(1.08)	(1.23)	**(1.79)**	***(0.09)***	**(3.45)**	**(3.01)**	**(2.16)**	**(2.43)**	**(6.28)**	*(0.00)*
P*rice*	-1.260	0.032	0.383	-0.396	-0.245	1.320	-0.965	-0.157	0.359	-0.780	-0.316	0.840	-1.989	0.507	0.303	1.027	-0.025	1.570
	(2.97)	(0.09)	(0.90)	(0.67)	(1.27)	*(0.24)*	**(1.88)**	(0.39)	(0.85)	(1.11)	(1.46)	*(0.55)*	**(3.06)**	(1.04)	(0.35)	(1.06)	(0.08)	*(0.15)*
P*ms*	-0.359	-0.008	-0.402	-0.228	-0.174	3.360	-0.524	-0.140	-0.504	-0.373	-0.279	4.400	-0.056	0.314	-0.112	0.147	0.083	1.690
	(3.00)	(0.07)	**(2.89)**	(1.57)	**(3.18)**	***(0.00)***	**(3.62)**	(1.07)	**(3.62)**	(2.16)	**(4.56)**	***(0.00)***	(0.31)	**(1.96)**	(0.40)	(0.62)	(0.92)	*(0.12)*
P*beef*	0.039	0.073	0.120	0.031	0.045	1.300	-0.059	0.043	0.034	0.021	-0.015	0.550	0.287	0.100	0.275	0.061	0.181	2.210
	(0.43)	(0.50)	(1.12)	(0.29)	(0.87)	*(0.26)*	(0.54)	(0.26)	(0.31)	(0.17)	(0.26)	*(0.80)*	**(2.07)**	(0.50)	(1.26)	(0.36)	**(2.10)**	*(0.04)*
P*dryfish*	-0.057	-0.001	-0.179	0.017	-0.058	1.880	-0.069	-0.008	-0.137	0.100	-0.043	1.010	-0.043	-0.002	-0.274	-0.153	-0.104	1.940
	(0.81)	(0.01)	**(2.17)**	(0.13)	(1.43)	***(0.08)***	(0.80)	(0.08)	(1.66)	(0.65)	(0.94)	*(0.43)*	(0.40)	(0.02)	(1.64)	(0.72)	(1.54)	*(0.07)*

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 13 No. 3
June 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Table 4 cont….

Independent Variables	Dependent Variable: Log of																	
	Total Calories						Calories From Staples						Calories From Other Foods					
	L	H	PH	P	Pooled	Chow	L	H	PH	P	Pooled	Chow	L	H	PH	P	Pooled	Chow
P*leaves*	-0.146	-0.093	0.028	-0.030	-0.027	1.650	-0.146	-0.112	0.008	-0.015	-0.039	1.080	-0.164	-0.054	0.041	-0.208	-0.047	1.820
	(2.54)	(1.22)	(0.64)	(0.46)	(1.00)	*(0.13)*	**(2.10)**	(1.30)	(0.18)	(0.19)	(1.29)	*(0.38)*	(1.86)	(0.51)	(0.46)	**(1.96)**	(1.06)	*(0.09)*
AE	-0.106	-0.003	-0.050	-0.086	-0.036		-0.179	-0.013	-0.075	-0.087	-0.068		0.041	0.047	-0.010	-0.057	0.046	
	(1.87)	(0.03)	(0.80)	(1.28)	(1.17)		(2.63)	(0.15)	(1.19)	(1.10)	(1.96)		(0.48)	(0.44)	(0.08)	(0.52)	(0.90)	
(Constant)	16.337	6.869	6.765	9.929	9.125		16.438	9.555	8.118	12.212	10.770		14.659	-1.214	2.923	-0.291	3.281	
	(5.88)	**(3.25)**	**(3.07)**	**(3.13)**	**(8.26)**		**(4.90)**	**(4.02)**	**(3.69)**	**(3.24)**	**(8.69)**		**(3.45)**	(0.42)	(0.66)	(0.06)	**(1.80)**	
F	4.750	0.660	2.540	2.210	6.700		3.710	0.640	2.450	2.250	5.610		4.810	3.010	1.200	2.210	7.780	
R-square	0.510	0.126	0.357	0.326	0.236		0.448	0.123	0.350	0.331	0.205		0.513	0.396	0.208	0.326	0.269	

Notes: RIAE = Real Income per Adult Equivalent; ms = millet-sorghum. L = August = lean season, H = November = harvest, PH = February = post-harvest and P = May = planting; T-values are reported in parentheses; bold t-values indicate that the estimated coefficients are statistically significant at the 10 percent level; P-values for the Chow test are in italics

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 13 No. 3 June 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Table 4: Nutrient Demand Estimates (continued)

Independent Variables	Dependent Variable: Log of											
	Protein						Vitamin A					
	L	H	PH	P	Pooled	Chow	L	H	PH	P	Pooled	Chow
Real income/AE	0.210	0.090	0.192	0.213	0.191	4.150	0.725	0.492	0.680	0.597	0.721	2.240
	(2.70)	(0.81)	**(2.05)**	**(2.55)**	**(4.74)**	***(0.00)***	**(2.66)**	(1.30)	**(2.04)**	(1.59)	**(4.90)**	***(0.03)***
Price	-1.246	0.483	0.266	-0.430	-0.083	1.180	-1.159	-0.190	2.766	0.329	0.324	0.680
	(2.40)	(1.19)	(0.50)	(0.68)	(0.37)	*(0.32)*	(0.64)	(0.14)	(1.45)	(0.12)	(0.40)	*(0.69)*
P*millet-sorghum*	-0.378	0.012	-0.317	-0.242	-0.181	2.430	0.369	0.110	-0.916	0.709	-0.081	0.670
	(2.58)	(0.09)	**(1.81)**	(1.56)	(2.87)	***(0.02)***	(0.72)	**(0.24)**	(1.47)	(1.02)	(0.35)	*(0.70)*
P*beef*	-0.039	0.026	0.097	-0.037	-0.010	1.150	0.414	0.162	-0.276	-0.203	0.026	0.330
	(0.35)	(0.16)	(0.72)	(0.33)	(0.16)	*(0.34)*	(1.07)	(0.29)	(0.57)	(0.41)	(0.12)	*(0.94)*
P*dryfish*	-0.067	-0.052	-0.230	0.025	-0.110	2.100	0.195	0.060	-0.163	-0.208	0.042	0.150
	(0.78)	(0.53)	**(2.22)**	(0.18)	**(2.36)**	**(0.05)**	(0.64)	(0.18)	(0.44)	(0.33)	(0.25)	*(0.99)*
P*leaves*	-0.123	-0.122	-0.051	-0.006	-0.054	1.600	-0.191	-0.248	-0.183	-0.498	-0.262	1.040
	(1.75)	(1.40)	(0.92)	(0.08)	(1.75)	*(0.14)*	(0.77)	(0.83)	(0.93)	(1.60)	**(2.34)**	*(0.41)*
AE	-0.044	0.021	-0.029	-0.017	0.002		0.258	-0.042	-0.092	0.400	0.200	
	(0.64)	(0.24)	(0.36)	(0.24)	(0.05)		(1.07)	(0.14)	(0.33)	(1.25)	(1.54)	
(Constant)	12.937	1.476	4.103	6.274	5.201		1.489	2.625	-5.714	0.443	-0.350	
	(3.81)	(0.61)	(1.48)	**(1.85)**	**(4.08)**		(0.13)	(0.32)	(0.58)	(0.03)	(0.08)	
F	3.100	0.670	1.960	1.940	6.270		1.960	0.650	1.470	1.360	5.060	
R-square	0.404	0.128	0.300	0.299	0.224		0.301	0.124	0.244	0.230	0.189	

Note: L = August = lean season, H = November = harvest, PH = February = post-harvest and P = May = planting; FAFH = Food Away From Home

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 13 No. 3
June 2013
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Table 4: Nutrient Demand Estimates (continued)

Independent Variables	Dependent Variable: Log of											
	Calcium						Iron					
	L	H	PH	P	Pooled	Chow	L	H	PH	P	Pooled	Chow
Real income/AE	0.128	0.097	0.160	0.276	0.198	1.630	0.209	0.012	0.087	0.157	0.129	2.680
	(0.97)	(0.76)	(1.08)	**(2.11)**	**(3.28)**	*(0.13)*	**(2.36)**	(0.10)	(0.87)	(1.30)	**(2.61)**	***(0.01)***
Price	-0.927	1.269	0.136	-0.121	0.292	1.090	-1.830	0.399	0.354	-1.023	-0.203	1.990
	(1.05)	**(2.69)**	(0.16)	(0.12)	(0.87)	*(0.37)*	**(3.10)**	(0.87)	(0.63)	(1.12)	(0.74)	***(0.06)***
P*millet-sorghum*	-0.368	-0.062	-0.318	0.022	-0.157	1.220	-0.730	-0.015	-0.621	0.010	-0.240	4.460
	(1.48)	(0.40)	(1.15)	(0.09)	**(1.67)**	*(0.30)*	**(4.38)**	(0.10)	**(3.34)**	(0.04)	**(3.11)**	***(0.00)***
P*beef*	0.070	-0.058	0.059	-0.096	0.014	0.830	-0.150	-0.052	-0.112	-0.116	-0.114	1.520
	(0.37)	(0.30)	(0.28)	(0.55)	(0.16)	*(0.56)*	(1.19)	(0.28)	(0.78)	(0.72)	(1.55)	*(0.17)*
P*dryfish*	-0.170	-0.236	-0.434	-0.224	-0.293	2.820	0.131	-0.021	-0.176	0.038	-0.020	1.810
	(1.16)	**(2.08)**	**(2.65)**	(1.02)	**(4.19)**	***(0.01)***	(1.33)	(0.19)	(1.60)	(0.19)	(0.35)	***(0.09)***
P*leaves*	-0.223	-0.267	-0.148	0.028	-0.144	2.140	-0.129	-0.137	-0.023	-0.032	-0.047	1.450
	(1.87)	**(2.63)**	(1.69)	(0.26)	**(3.14)**	***(0.04)***	(1.61)	(1.38)	(0.40)	(0.32)	(1.25)	*(0.19)*
AE	-0.124	-0.154	-0.198	0.013	-0.111		-0.060	-0.010	0.014	0.027	0.030	
	(1.06)	(1.49)	(1.58)	(0.12)	(2.08)		(0.77)	(0.10)	(0.16)	(0.26)	(0.68)	
(Constant)	14.485	2.445	9.677	6.627	6.841		16.409	2.151	5.618	8.249	5.623	
	(2.52)	(0.88)	**(2.22)**	(1.25)	**(3.59)**		**(4.25)**	(0.79)	**(1.91)**	(1.68)	**(3.60)**	
F	1.220	3.050	2.340	0.900	7.100		4.470	0.410	2.360	0.700	3.250	
R-square	0.211	0.400	0.338	0.164	0.246		0.494	0.082	0.340	0.133	0.130	

Note: L = August = lean season, H = November = harvest, PH = February = post-harvest and P = May = planting; FAFH = Food Away From Home.

REFERENCES

1. **Dembélé NN and JM Staatz** The Impact of Market Reform on Agricultural Transformation in Mali. MSU Agricultural Economics Staff Paper No. 99-29. June 1999.

2. **Chambers R** Introduction. **In**: R. Chambers, R. Longhurst, and A. Pacey (eds.). Seasonal Dimensions to Rural Poverty. London: Frances Pinter, 1981: 1-8.

3. **Sahn E** Seasonal Variability in Third World Agriculture: The Consequences for Food Security. John Hopkins University Press, Baltimore and London: 1989.

4. **Paxson CH** Consumption and Income Seasonality in Thailand. *Journal of Political Economy*. 1993; **101(1)**: 39-72.

5. **Rogers BL and M Lowdermilk** Price Policy and Food Consumption in Urban Mali. *Food Policy*. 1991; **16**: 461-473.

6. **Diagana B, Akindès F, Savadogo K, Reardon T and JM Staatz** Effects of the CFA Franc Devaluation on Urban Food Consumption in West Africa: Overview and Cross-Country Comparisons. *Food Policy*. 1999; **24(5)**: 465-478.

7. **Singare K, Reardon T, Camara Y, Wanzala M, Teme B and O Sanogo** Household consumption responses to the franc CFA devaluation: evidence from urban Mali. *Food Policy*. 1999; **24(5)**: 517-534.

8. **Behrman JR and A Deolalikar** Will Developing Country Nutrition Improve with Income? A Case Study for Rural South India. *Journal of Political Economy*. 1987; **95**:492-507.

9. **Bhargava A** Estimating Short and Long Run Income Elasticity of Foods and Nutrients for Rural South India. *Journal of the Royal Statistical Society*. 1991;**154**: 157-74.

10. **Subramanian S and A Deaton** The Demand for Food and Calories. *Journal of Political Economy*. 1996; **104(1)**.

11. **Skoufias E** The sensitivity of calorie-income demand elasticity to price changes: evidence from Indonesia. FCND Discussion Paper 141. Washington, D.C.: International Food Policy Research Institute (IFPRI). 2002.

12. **Camara MO** The Impact of Seasonal Changes in Real Incomes and Relative Prices on Households' Consumption Patterns in Bamako, Mali. Michigan State University Ph.D. dissertation. 2004.

13. **Aker, Jenny** Does Digital Provide or Divide? The Impact of Cell Phones on Grain Markets in Niger. Berkeley Working Paper. 2007.

14. **Dembélé NN, Tefft JF and JM Staatz** Mali's Market Information System: Innovative Evolution in Support of a Dynamic Private Sector. PS 56. CDIE Reference PN-ADF-720. 2000.

15. **Strauss J and D Thomas** The Shape of the Calorie Expenditure Curve. Yale University Economic Growth Centre Discussion Paper No. 595. 1990.

16. **Hoddinott J, Maluccio JA, Behrman JR, Flores R, and R Martorell** Effect of a nutrition intervention during early childhood on economic productivity in Guatemalan adults. *The Lancet*. 2008; **371(9610)**: 411-416.