FOOD CONSUMPTION ANALYSIS AND RELATED PARAMETERS FOR OUAGADOUGOU, BURKINA.

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Consumption sets the stage for production. When consumption trends change, there can be an effect on the level and types of goods that are produced. Thus when designing new agricultural technologies and food policy, a view of the long term consumption patterns and their likely impact on production must be taken into consideration. For example, if in five to ten years through technology intervention sorghum production is increased, will the increase be absorbed by consumers, at what price, and what are the effects on sorghum and other staple food production? The results from consumption analysis can be used as one of the indicators as to where research resources should or should not be targeted. This paper reviews the consumption, production and imports of staple foods in Burkina. An analysis of various consumption parameters is undertaken and conclusions drawn with respect to future consumption patterns.

Food consumption analysis may be seen as a two step process. The first step concerns the understanding of the patterns of consumption of different food items by specific consuming units, for example individual households, nations or groups of nations, and how these patterns evolve in time and space in response to changing economic and non-economic conditions. Economic variables usually thought to affect consumption behavior include the purchasing power of and the prices faced by the consuming unit. Non-economic variables that determine household consumption patterns include population, household size, education, and ethnic group make up. This first step in analysing consumption leads to the derivation of various consumption parameters -- e.g., income and price elasticities -- which characterize the consumption decision process of the consuming unit.

The second step consists in using the parameters generated in the first step to address micro or macro level food or agricultural policies. In the specific case of Burkina Faso, the major issue is that of food sufficiency. Alleviating this problem means that enough food must be supplied through an increase in either domestic production or imports. The question is thus raised of which commodities to promote. In approaching such a question, one must bear in mind the dichotomic nature of food consumption habits between urban and rural populations. The rural population's diet is sorghum and millet based and these crops are all grown locally. In contrast, the urban diet includes a high proportion of rice and wheat products, which are mainly imported.

In absolute terms, the quantities consumed nationwide of sorghum

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and millet outweigh by far those of rice and wheat (compare Tables 1, 2, and 3). However the recent phonomena of rising incomes combined with increased imports of wheat and rice under foreign aid programs have caused an increase in the proportion of wheat and rice consumed (Table 4). Foreign aid increased in response to the agricultural crisis that shook Burkina Faso starting in the late sixties and early seventies. It is generally believed that these relatively new products have reshaped consumers' preferences. To what extent such a preference shift has occurred towards rice and wheat is not known.

Table 1. Production, inports, and consumption of sorghum, millet, and maize in Burkina Faso, 1978-81.[1]

Agricul. years	Domestic Production				Imports[2] (M)	Consumption[3] (C)	M/C
	Sorghum	Millet	Maize	Total			
	metric tons (X1000)						%
1978/79	635.0	377.9	107.7	1,120.6	11.6	988.4	1.2
1979/80	635.2	377.7	99.5	1,130.4	20.4	981.2	2.1
1980/81	546.9	350.7	104.5	1,002.1	19.8	871.6	2.3
1981/82	658.8	442.8	118.6	1,220.1	12.2	1,049.4	3.6

[1]The data on domestic production and imports are taken from MDR-DEP (1983).
[2]Combines sorghum-millet-maize.
[3]Consumption was computed as imports + production upon adjusting for seeds and waste for the latter. The usual 15% of wastes and seeds was applied to total production.

Table 4 shows clearly an increase in the relative importance of wheat/rice; however the paucity of the number of observations does not allow one to draw conclusions with great confidence.

The assessment of these preference changes is however of great importance for agricultural macro policy planning. Indeed the knowledge of who consumes what and how patterns of consumption are likely to evolve are as of primary importance for commodity planning. In more concrete terms, the response of agricultural scientists to the food deficit situation in Burkina has been to develop new technologies to increase production of sorghum and millet. What is the future of sorghum and millet in the human diet? Are sorghum and millet likely to remain the preferred cereals in the future?

Appropriate answers to these questions again require taking into account the dualistic nature of consumption patterns in Burkina Faso, i.e., urban vs rural. Extended time series data are required for tracking the possible change in the structure of consumers' preferences within each of the two sectors. Such data are however not available. To date, the only large scale household budget and consumption studies that encompassed both rural and urban areas were conducted

Tableau 2. Domestic production, imports, and consumption of rice in Burkina Faso, 1978-81.[1]

Agricul. years	Domestic production[2]	Private Imports[3] (M)	Foreign Aid (A)	Total Consumption[4] (C)	A+M / C	A/C	A / A+M
	metric tons (x 100)						
1978/79	25,565	7,981	2,270	31,981	32.1	7.1	22.1
1979/80	30,499	21,158	4,422	51,504	49.7	8.6	17.3
1980/81	26,138	24,832	5.503	52,552	57.7	10.5	18.1
1981/82	29,405	11,520	3,558	40,072	37.6	8.9	23.6

[1]Data on domestic production, private imports, and foreign aid are taken from MDR-DEP statistics publication (1983).
[2]Original data were in terms of paddy rice. A factor of conversion of 0.65 has been applied to arrive at the shelled rice equivalent .
[3]Private imports means imports by the private sector which requires foreign exchange.
[4]Total consumption is obtained as the sum of imported rice and domestic production, after a correction for seeds and wastes for the latter. It is usually assumed that 15% of local production is accounted for by seeds and wastes.

Table 3. Imports of wheat, Burkina Faso, 1976-80.[1]

Year	Imports
	metric tons
1976/77	15,500
1977/78	28,100
1978/79	23,100
1979/80	36,040
1980/81	50,391

[1]Source: Morris (1982).

Table 4. Relative importance of sorghum-millet and rice-wheat in consumption.[1]

Year	Ratio wheat-rice/millet-sorghum
1978/79	5.6
1979/80	8.9
1980/81	11.8

[1]Source: Combining Tables 1-3.

3

in 1950-52 and 1963-64.[1] Extensive research in consumer behavior regained attention with the urban consumer study which generated the data used in this paper, and with the on-going studies of the International Food Policy Research Institute (IFPRI) and the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT).

The data for the consumption analysis of this study were collected over the period of September 1982 to August 1983. The objectives of the study are:

(1) examine the patterns of consumption of the urban household, and
(2) evaluate the direction of change of these patterns of consumption over time.

The information generated, though referring only to the urban population, which accounts for a small proportion of total population, is useful for policy planners. The urban center is situated at a crossroads between the domestic agricultural sector of which it constitutes an important market for locally produced millet and sorghum, and a foreign sector which supplies it with part of its rice needs and its entire wheat consumption requirements. A knowledge of urban consumption parameters therefore permits inferences on their demand for sorghum and millet, which directly affects the farmers' willingness to produce these crops above subsistence levels. The significance of this for the development of new technology for millet and sorghum is that for such technology to be adopted by the farmer it must be profitable, which implies that the product must be at least marketable. Were the estimated demand parameters to indicate some tendency to consume more rice and wheat products in the future, this would signify a greater dependence of the country on the foreign market, given the current situation. This would also imply a lesser likelihood of farmers to increase millet and sorghum production above subsistence level through technological innovation.

The organization of the paper is as follows. The theoretical background on which the expose draws is first presented. Then follows a section on the methodology utilized, including a brief description of the data employed. Finally, an analysis of the results follows, with emphasis on their implications and the conclusions that can be drawn.

BRIEF THEORETICAL BACKGROUND

The following analysis takes the household as the unit of analysis, as opposed to the individual consumer in traditional consumer theory. The basic assumption of the analysis is that a household purchases goods in optimal quantities, meaning that these quantities are generated from the household's attempt to maximize its satisfaction of consuming such goods, given its environmental conditions, its income and the prices of the goods. This results in an allocation of the total budget among goods such that the expenditure on each good is a function of its own price, the prices of other goods, income and household characteristics including size and consumption by age and sex, education, and social status.

The importance of such functions imbedding household preferences is that they permit the prediction of a household's future behavior when

[1]See MDR-DEP, 1983 for a tabular analysis of the results of these surveys.

4

confronted with changing prices and income. This assumes that the preference structure itself remains unchanged during the process. However such predictions become feasible only if the exact nature of the function is known (i.e., the mathematical form and the values of the parameters characterizing such form) which in theory is possible if we have already observed the household's patterns of purchasing when confronted with varying income and prices. That is, data on quantities purchased are needed either for the same household(s) over many time periods, or for different households at the same point in time.

The system of functions representing the household's preferences becomes quickly large and unmanageable if one considers each good individually. For practical reasons there is a need to scale down the problem by combining goods into broader categories. For instance the entire set of a household's goods may be divided into food and nonfood; food in turn may be subdivided into cereals, meat, vegetables, etc. The actual grouping depends upon empirical issues such as the data available and the objective of the study.

Even by aggregating goods, the resulting number of subsets may still be too large for the data at hand. An assumption commonly made in order to empirically identify the parameters of the system is that budget allocation is a sequential process whereby the household first allocates income among very broad categories (e.g., food and nonfood); the portion of income accruing to each group is then allocated among goods that compose the group, without further reference to goods not belonging in the group. In order for such a multi-stage budgeting to be legitimate, the household's preferences must be separable into the categories. That is, in generating household's utility, the trade-off between any two goods in a category so as to keep utility unchanged is independent of marginal changes in goods not belonging in that category. When this assumption is invoked, the number of parameters to estimate is drastically reduced (see Phlips, 1974; Johnson, Hassan, and Green, 1984; and Barewal and Goddard, 1985 for more development on separability and sequential budgeting).

METHODOLOGY OF STUDY

The data that are used in the analysis are a time series of cross-sections generated by a survey conducted in Ouagadougou from September 1982 to August 1983. A total of 73 households were interviewed; the data gathered included the weekly expenditures on each of 63 products, the sources and amount of household monthly income, and a set of household characteristics including household size and composition by age and sex, formal education, occupation, urbanization, religion, and ethnic group of the head of household. The expenditure data were complemented by price data generated through a market survey over the same period. For a more thorough description of the survey procedure, see Sawadogo, 1985.

Data are aggregated in two ways to facilitate the analysis. First, weekly data are collapsed into 12 montly observations. Then the 63 original products are combined into five food groups and one non-food group. The five food groups are:

(1) the traditional cereals, i.e., sorghum, millet, and maize;
(2) the new type cereals, i.e., rice and wheat products;
(3) meat;
(4) vegetables and sauce products; and

(5) other foods.

To allow for the comparison among different income categories, the sample has been subdivided into three subsamples based on income. The first subsample is made of the lowest income people and is the first quartile of the income distribution (less than 30,000 CFA/month). The second subsample represents the second and third quartiles (30,000 to 85,000 CFA/month). The third subsample represents the upper income households, i.e., the fourth quartile (above 85,000 CFA/month).

A preliminary analysis of the data was performed by computing average expenditures and average expenditure shares, by income group and for each commodity group (Tables 5 and 6).

Table 5. Sample monthly average expenditures and prices, by income stratum.

Category	Income stratum			
	Entire sample	Lower income	Medium income	Upper income
	FCFA/month			
Total expenditure	33,699	23,258	35,389	42,483
Food	21,700	17,309	22,538	25,217
Nonfood	11,999	5,949	12,851	17,266
Traditional cereals (sorghum-millet-maize)	3,011	2,915	3,772	1,821
New-type cereals (wheat-rice)	4,138	3,483	4,459	1,821
Meat	3,874	2,728	3,551	5,704
Vegetables	4,630	3,937	4,500	5,629
Other food	6,057	4,246	6,256	7,743
Prices	FCFA/kg			
Traditional cereals	81	82	80	82
Price of new cereals	142	143	141	141
Price of meat	647	635	659	640
Price of other food	446	444	446	445
Aggregate price of food	456	447	436	502

On average upper income people spend more than lower income households (Table 5). With regard to food, the same observation is made. The upper income stratum spends on average 25,000 CFA/month for food, vs 22,000 for the middle income, and 17,000 for the lowest income strata. Also, the low and mid-income classes spend more on cereals than the upper income class. In particular the average lower income household spends 2,915 CFA on sorghum, millet, and maize monthly,compared to 3,772 for the middle and 1,821 for the upper income households. This pattern is reversed regarding more expensive foods such as meat and vegetables for which the higher income families spend on average significantly more than the lower income households. The conclusion is that there are indeed

6

differences in consumption patterns between upper income and lower income households. The latter tend to consume more of the less expensive foods (cereals) while the former spend considerable amounts on more expensive foods (meat and vegetables).

These conclusions are corroborated by the results in Table 6 which contains the average shares of individual products out of the total expenditure. For the entire sample, the average household allocates 73 percent of its expenditure to food and 27 percent to nonfood. By income stratum, the share of food declines from 79 percent for the low income household to 72 percent and 68 percent for the mid and upper income households. The share of cereals decreases significantly from the low income (24%) to the mid income (21%) and high income households (12%). One notes that the share of the new type cereals exceeds that of the traditional cereals for all income strata. The difference appears more significant for the upper income households who spend on average three percent of their income on sorghum, millet, and corn vs nine percent on rice and wheat.

Table 6. Monthly average expenditure shares [1] by income stratum.

	Income Stratum			
Category	Entire sample	Low income	Medium income	Upper income
Food	.73	.79	.72	.68
Nonfood	.27	.21	.28	.32
Traditional cereals	.08	.10	.09	.03
New cereals	.12	.14	.12	.09
Meat	.15	.13	.13	.18
Vegetables	.18	.21	.17	.18
Other food	.20	.21	.21	.20

[1]Computed by dividing the expenditure of the commodity by total expenditure.

The two tables suggest that there is some relationship between consumption and income (total expenditure)[1]. It is the purpose of the following section to investigate the nature of this relationship.

ANALYSIS OF RESULTS

The Linear Expenditure System (LES) was used to estimate the income and price parameters. Estimates of the LES basic parameters that are

[1]Similar tabular analysis has been performed using education and household size as independent variables. In both cases no clearcut correlation was evident between consumption and these variables. It was then decided not to pursue further investigation and these two variables.

used to compute the marginal budget shares, the income and price elasticities are found in Sawadogo, 1985.

Effect of income. Marginal budget shares, which refer to the portion of additional income that is spent on a particular commodity, are shown in Table 7. While the average budget shares shown in Table 5 represent an actual situation (the household spends X percent of its income on commodity Y), the marginal budget shares represent a tendency and hence suggest what the future is likely to be. For example, while the average budget shares indicate that the average household in the sample allocates 73 percent of its budget to food, the marginal budget shares suggest that of an additional 100 CFA, the household allocates only 32.6 CFA to food, the remainder being allocated to nonfood. The marginal share of food decreases as one moves from the lower to the upper income strata, from a high 48.9 percent to a low 28.3 percent.

Table 7. Marginal budget shares estimates using nonlinear least squares on LES.

Budget category	Entire sample	Lower 25%	Middle 25%	Upper 25%
	%			
Food	32.6	48.9	30.6	28.3
Nonfood	67.4	51.1	69.4	71.7
Tradcer	8.3	16.8	8.7	5.4
Newcer	10.5	18.0	10.2	8.8
Meat	3.7	3.9	2.9	3.4
Vegetable	2.5	2.9	2.2	2.5
Other Food	7.6	7.4	6.6	8.2

It is important to note that the cereals, wheat and rice have consistently a higher marginal share than the traditional cereals. Of any additional 100 CFA, households on average allocate about 10 CFA to wheat and rice against eight CFA to sorghum, millet, and corn. Low income households would allocate 18 CFA to wheat and rice and 16 CFA to the traditional cereals, mid income households 10.2 CFA and 8.7 CFA and upper income households 8.8 and 5.4 CFA. For all income groups, the combined share of cereals equals or outweighs the combined share of all other foods. This suggests that at the margin cereals still appear as a major contributor to the urban household diet.

Another income parameter that combines marginal and average budget shares is the income elasticity defined as the ratio of marginal budget share to average budget share at constant prices. This measure has the advantage of being dimensionless, i.e., it is not affected by a change in the units of measurement (eg. from 1 FCFA to 1,000 CFA). Income (or expenditures) elasticities are shown in Table 8, by income stratum. The income elasticity of food is .45, meaning that for a 1% increase in total income, expenditure on food will increase by 4.5%. It is usually expected that income elasticities for food are high in developing as compared with developed countries. The numbers found here are

9

comparable to the results of other studies in developing countries[1].

Table 8. Income elasticities computed from LES parameter estimates.

Budget category	Entire sample	Lower 25%	Middle 25%	Upper 25%
	%			
Food	.45	.62	.43	.42
Nonfood	2.50	2.43	2.48	2.24
Tradcer (sorghum, millet, maize)	.75	1.29	.67	1.08
Newcer (wheat, rice)	.66	1.06	.64	.68
Meat	.19	.23	.17	.13
Vegetable	.10	.11	.09	.10
Other food	.27	.28	.22	.27

One notes the high values of income elasticities for cereals. When total expenditure is increased by 10 percent, consumption of sorghum, millet, and maize increases by 7.5% for the average household in the sample. An increase of total income by 10 percent is accompanied with an increase of 6.8 percent in the consumption of wheat and rice. These elasticity values are even higher for the lower income class, respectively, 1.29 and 1.06. Thus cereals appear as "superior" goods for the lowest income class. The empirical implication of these results is that cereal consumption by the lower class can be promoted through policies tending to raise the level of income in this class. A transfer of income from the very rich to the poor would increase aggregate consumption of wheat and rice because the income elasticity of the rich (.68) is significantly lower than that of the poor (1.06). The higher than expected income elasticity of the traditional cereals for the upper income class (1.08) can be explained by a very low average expenditure share on these cereals. (Recall that the income elasticity is the ratio of the marginal to the average budget share).

Effect of prices . In the short run, prices play an important role in the allocation of resources among goods. A price increase has two effects. The first effect is that, everything else constant, the household's purchasing power decreases. The second effect is that the good whose price has increased becomes relatively more expensive than other goods, and as a consequence, a rational household will substitute away from this good. These two types of effects are combined into a single measure which is the cross price elasticity. The latter measures the relative change in consumption of a good following a relative change in the price of the same good or of another good. In the first case the elasticity is referred to as own price elasticity, and in the second case as cross-price elasticity.

[1]Sigma One Corporation, 1983 finds the following numbers for urban Sudan: 73 for overall sample, .092 for lower income, .755 for mid-income, and .514 for higher income households.

9

Own Price elasticity estimates are shown in Table 9. All price elasticities are negative as theoretically expected. When aggregate food price index increases (decreases) by 10%, the average household's food consumption decreases (increases) 5.6%. The lower income households have a higher response to price changes than the higher income households. An interesting result is the price elasticity of cereals, which is very high at all income levels, with an absolute value greater than one in all cases. A one percent decrease (increase) of the price of traditional cereals will cause an increase (a decrease) of 2.58 percent in consumption for the average household. For these cereals, the magnitude of the price response increases as income increases. Economic theory does not provide any answer to whether this is the "normal" pattern or not. The response of wheat and rice to a price change is also very high. It is again to be noted that the higher income households have a higher response than lower income households.

Table 9. Estimates of own price elasticities using nonlinear least squares on LES.

Budget category	Entire sample	Lower 25%	Middle 25%	Upper 25%
	%			
Food	-.56	-.71	-.55	.53
Tradcer (sorghum, millet, maize)	-2.58	-2.04	-2.58	-3.23
Newcer (wheat, rice)	-2.37	-1.83	-2.54	-2.22
Vegetables	-.57	-.34	-.60	-.52
Other food	-1.23	-.71	-1.24	-1.20

Cross price elasticity estimates are shown in Table 10. Their magnitude is significantly smaller than the own price elasticities in Table 9, meaning that the change in the price of good affects in the first place the good and then other goods. The importance of crop price elasticities is that they show the nature of the relationship, substitutability or complementarity, between two goods. When the cross price elasticity is negative, the goods are (gross) complements; when it is positive, they are (gross) substitutes. Hence the table suggests that traditional and new type cereals are complementary in consumption. This is not what was expected. One would expect wheat and rice on one hand and sorghum, millet, and maize, on the other hand to be substitutes. The results may be attributed to a low price variation: if prices did not change "enough" during the period of observation, reactions of households toward substitution cannot be observed. New type cereals and traditional cereals appear to be "balanced" in the sense that their respective responses are of similar magnitudes. Such is not the case for meat and traditional cereals, for example. A change in the price of meat has little impact on consumption of traditional cereals, whereas a change in the price of the latter drastically affects the consumption of meat, particularly for the middle income households.

10

Table 10. Estimated cross price elasticities using nonlinear least squares on LES.

Category	Entire sample	Lower 25%	Middle 25%	Upper 25%
	%			
Tradcer/newcer[1]	-.10	-.16	-.10	-.07
Newcer/tradcer	-.09	-.18	-.09	-.07
Tradcer/meat	.003	.06	.001	.02
Meat/tradcer	1.01	.12	3.89	.89
Tradcer/vegetables	.03	.12	.02	.03
Vegetables tradcer	.06	.04	.08	.04
Tradcer/other food	-.02	.06	.02	-.02
Other food/tradcer	-.25	.20	-.27	-.21
Newcer/meat	.003	.06	.001	.03
Meat/newcer	1.23	.11	4.58	.11
Newcer/vegetables	.04	.14	.02	.04
Vegetables/newcer	.08	.04	.09	.05
Newcer/other food	-.03	.07	-.02	.03
Other food/newcer	-.32	.20	-.32	-.29
Meat/vegetables	-.41	.09	-1.10	-.05
Vegetables/meat	-.002	-.01	-.001	-.02
Meat/other food	.61	-.04	.94	.03
Other food/meat	.01	-.07	.002	.09
Vegetables/other food	.02	-.01	.02	.01
Other food/vegetables	.11	-.15	.08	.14

[1] $A/B = \frac{\partial A}{\partial P_B} \cdot \frac{P_B}{A}$ = elasticity of A with respect to price of B.

SUMMARY AND CONCLUSIONS

The major finding of this study is that both traditional cereals (millet-sorghum) and new type cereals (wheat-rice) are very responsive to income and to their own prices. These high response values are observed at all income levels. For every 100 FCFA of additional income received by the households, both types of cereals claim an important part. The findings suggest that sorghum is far from becoming an inferior good (i.e., one whose demand decreases as income increases) for the average urban household in Burkina Faso. This conclusion is also expected to prevail at the rural household's level, since it usually has less income.

The findings suggest the following conclusions:

(1) It appears that the demand for sorghum and millet can still be made greater in urban centers by raising consumers' incomes or by lowering cereal prices. New technology in sorghum and millet production is expected to bring lower prices by increasing productivity. In that case, the price elasticities found by the analysis suggest that the farm level excess supply is potentially absorbable by urban consumers. Hence the problem of a market for increased production of sorghum and millet seems not to be an accute one in the near future. In any case a combination of lower prices and a transfer of income to the lower income households would increase demand for millet and sorghum.

(2) This analysis is limited to the urban consumer: one expects however to find even greater responses of consumption to income and prices in rural sectors for those categories of households who are not farmers or who do not produce enough for their consumption requirement. The possibilities of substitution are limited in rural areas so that any increase in income or a price decrease of sorghum/millet will be first and foremost felt on these crops.

A limitation of these findings is their time span (one year) which may not be long enough to allow for significant changes in prices and households' adjustment to these new prices. This insufficient relative price variability may explain the very low values found for the cross price elasticities. A more exhaustive analysis (encompassing both rural and urban areas and for longer time periods than one year) is needed to more accurately assess the dynamics of preference changes of consumers over time and what this implies.

12

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