



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

**Optimal Dietary Blending for Household Food Security in  
Southwestern Nigeria: Lessons from Published Data**

**Ebenezer O. Ogunyinka**

Graduate Student

Department of Agricultural Economics

Kansas State University, 342 Waters Hall, Manhattan 66506, Kansas

email: [eogun@agecon.ksu.edu](mailto:eogun@agecon.ksu.edu)

**David W. Norman**

Professor

Department of Agricultural Economics

Kansas State University, 342 Waters Hall, Manhattan 66506, Kansas

email: [dnorman@agecon.ksu.edu](mailto:dnorman@agecon.ksu.edu)

*Selected Paper prepared for presentation at the Western Agricultural Economics Association Annual Meeting at The Denver Adam's Mark Hotel, Denver, Colorado,  
July 11-15, 2003*

## **Abstract**

The study estimates the optimal dietary intake of Lagos State residents. Analysis of the available data indicates over-consumption of all nutrients which suggests that the common nutrition related health problems in Lagos State could be attributed to excessive nutrient intake. Consumption at the optimal level would ensure adequate nutrients at a cost within people's income limitations. The results however revealed the inadequacies of using published data for the analysis. An independent diet recall survey is therefore recommended.

## **1. Introduction**

### ***1.1 Justification for the Study***

Several strategies, policies and plans have been put in place over the years in an attempt to alleviate poverty in Nigeria. The standard of living, however, is still very low. Among the factors that have been attributed to the low living standards are: inadequate income, declining per capita food supply, as well as a lack of commitment to the effective implementation of poverty reduction programs. The introduction of the structural adjustment program (SAP) in 1986, which was mainly to move Nigeria toward market-oriented economy, was seen by many people as aggravating the above factors, particularly in urban areas where prices of staple foods have skyrocketed and where the SAP has recorded its stiffest opposition.

Although periodic household surveys have been implemented to analyze the degree and the levels of poverty in Nigeria, most of the analysis has been confined to looking at households' demographic and economic characteristics. A search of the economic literature indicated that recent studies in the general area of Nigerian food security vis-à-vis dietary composition are virtually non-existent. This paper is therefore designed to partially fill this la-

cuna in the literature. This study also holds implications for the urban poor, many of whom are vulnerable to specific health hazards because of their lack of knowledge about the appropriate (i.e., healthy) composition and level of nutrient intake. The results of this study indicate the least cost way of attaining such a diet from among the food items those people consume. Since most of the foods they consume are locally available (i.e., with little or no items being imported), it will not only potentially save the country some foreign exchange that is often expended on importation of expensive and unnecessary/undesirable food items but also highlight areas where changes are urgently needed. If the implications of this study are taken seriously, the long-run benefits of this to agricultural development in particular, and overall economic advancement in general, could be significant. This will occur through improvements in the overall efficiency/productivity of workers and improved processing of agricultural products, in which the composition of foods could be made more compatible with that required for a healthy living style.

The objectives of the study are therefore to:

- Identify the cheapest sources of nutrients required for a healthy diet from the foods already available to the people.
- Simulate the effect of changes in prices and food supply on the per capita food mix.
- Estimate the optimum dietary composition and the food mix that will ensure the nutritional needs of the households are met.

The paper is organized as follows. The next sub-section provides a summary of the different governmental programs that have been directed towards poverty alleviation. Section 2 is devoted to a brief overview of nutrition principles and a literature review. The data sources and the estimation procedures are discussed in Section 3. In Section 4 are presented

the results and associated discussion. A summary and policy implications arising from the findings and a concluding remark are given in Section 5. Finally the paper concludes with some concerns about the quality of the data used in the analysis and hence the possibility of drawing erroneous conclusions.

## ***1.2 Background Information***

Nigeria is the world 10<sup>th</sup> most populous country with a population density of 120.10 persons per square kilometer (Euromonitor, 2001). It however ranks among the poorest nations as the annual growth rate of the real GDP stood at an average of 4.1 percent between 1984 and 1995 (Table 1) and it is identified as a vulnerable population from a health viewpoint. In 1999, the annual minimum wage was \$300. This is generally regarded as very low when compared with other countries such as Cote d'Ivoire, India, and United States with \$871, \$408, and \$8,056, respectively (World Bank, 2002). Nevertheless Table 2 indicates a decline in the percentage of the Nigerian population living below the poverty line from 43.0 in 1985 to 34.1 in 1992-93, while the morbidity and mortality rates, shown in Panels A and B of Table 3 also reveal a downward trend since 1980. Despite this seemingly 'good news', these indicators are still considered very high especially when they are compared with other nations, mainly high income and some Sub-Saharan African countries.

The major focus of successive governmental policies directed towards poverty alleviation in Nigeria has been to help the most vulnerable sections of the society (i.e., the poor) achieve sustainable livelihoods (United Nations, 1997). The approach has been to economically empower communities, families, and individuals through a sustained, well coordinated,

and comprehensive programme relating to poverty alleviation. This is undoubtedly related to the fact that poverty is a major cause of malnutrition and its associated health problems.

Over the years, major initiatives of government relating to poverty alleviation in Nigeria have been:

- Better Life for Rural Women (BLRW), now known as the Family Economic Advancement Program (FEAP). It is a nationwide economic program that focuses on the empowerment of women especially in the rural areas. Its major problem has been that of inadequate funding which has resulted in the major beneficiaries being among the high-income urban class.
- Primary Health Care which is expected to implement preventive health care activities at the grass roots level. As with other medical services, the absence of an efficient health insurance industry appears to have been the major factor inhibiting the success of this program.
- The nationwide Agricultural Development Programs (ADP), co-sponsored by the World Bank, the Federal Government of Nigeria and the government of each state of the Federation. Since the early 1990s, as a result of the gradual disengagement of the World Bank from the program, it has suffered increasingly from poor management and inadequate funding. As a result the agricultural sector has largely been neglected. Complementing the ADPs have been: the National Agricultural Land Development Authority (NALDA) which was established to promote integrated rural development; the River Basin Development Authorities (RBDAs) for irrigation purposes; and the National Directorate of Employment (NDE), which promotes self employment among school leavers, college and university graduates.

- The Rural Banking Scheme which resulted in the establishment of the People's Bank of Nigeria (PBN) and various Community Banks. The latter are located at each local government's headquarters and together with the former extend small amounts of credit to people in the informal sector of the economy in order to strengthen their economic activities in cities, towns and villages. However, the provision of rural infrastructure is still the responsibility of government (i.e., at the federal, state or local level) and was administered, especially in the late 1980s and early 1990s, by the Directorate for Food, Road and Rural Infrastructure (DFRFI), a public parastatal that provides rural access roads linking farming communities, markets, and sinks bore holes for provision of rural water supplies.
- Other programs include the National Economic Recovery Fund (NERFUND) that provides easy access to credit by small and medium scale entrepreneurs, and the Mobile Education System that provides basic education for nomads as well as riverside and creek residents like the Ijaws.

Some of the above programs are supported, financially and technically, by international donors such as the United Nations Development Program (UNDP), the European Union (EU), non-government organizations (NGOs), the World Bank, etc. They are key players in international efforts geared towards improving the nutritional status of the world's growing population.

In spite of these programs however, poverty is still pervasive in Nigeria with an estimated 40 percent of the Nigerian population now living in poverty. Although, numerous reasons abound for the persistent poverty and associated health problems, continuing political instability and frequent regime changes resulting in discontinuities in interest and effort have

undoubtedly been major inhibiting factors. These have been compounded further by frequent ethnic tension and conflicts that inevitably destabilize economic activities.

The current Poverty Alleviation Scheme (PAS), including the minimum wage law, is focusing on challenges posed by the pervasive poverty problem above through: integrated human development policies, including income generation; local institution strengthening and capacity-building; greater involvement of NGOs and local government in providing delivery mechanisms; investment in human capital development with special emphasis on rural areas, urban poor, women and children; and establishment of an appropriate infrastructure and support system to facilitate the alleviation of poverty by implementing and promoting projects, programs, enterprises and sustainable life styles at the grass roots level. One issue that may hinder the implementation of this new strategy is that of resource control agitation by some ethnic groups. The Federal Government legally has ownership/control over such resources. However, for this scheme to succeed there needs to be a modification of this policy to gradually transfer greater control of these resources toward the local people. There appears to be some progress in this direction but the outcome is still somewhat uncertain.

## **2. Fundamental Principles of Nutrition and Literature Review**

### ***2.1 Nutrition***

The science of nutrition was first recognized as a distinct discipline in 1934 with the organization of the American Institute of Nutrition (Guthrie, 1967). Numerous definitions of nutrition abound in the literature. These range from: its simple expression as the science of nourishing the body properly; as a science devoted to ascertaining the requirements of the body for food constituents both qualitatively and quantitatively and to the selection of foods



to meet these requirements; to its concern with specific social, economic, cultural, and psychological implications of food and eating. There has been a general consensus among nutritionists that these definitions are basically concerned with the changes that occur in food and the way in which the body uses food from the time it is ingested until it is eventually incorporated into the body tissues, participates in biological reactions, or is excreted from the body. This includes the study of digestion, absorption, and transportation of nutrients to the cells and their metabolism within the many types of body cells.

The nutrients in food are those chemical components of food that perform one of three roles in the body: to supply energy, to regulate body processes, or to promote the growth and repair of body tissue. These roles contribute to the physical growth of individuals, albeit within the limits imposed by heredity, which in turn influence productivity, behavior, health, and emotional stability of the individual (Guthrie, 1967). The essential nutrients comprise of those nutrients that must be provided by food consumed because they cannot be synthesized by the body. These can be divided into six main groups namely carbohydrates, lipids or fats, protein, minerals, vitamins, and water. These must be provided in the diet, as they are absolutely essential for body growth and functioning. Any undesirable results due to lack of these essential nutrients in the diet are reversed only by their further consumption.

In general, failure of the body to receive the various nutrients in food in correct amounts makes them unable to perform their functions properly. Excess availability in the body can also lead to serious health problem. It is therefore necessary to consume them at the levels compatible with maintenance of normal health.

## ***2.2 Literature Review***

Unlike nutrition related studies in the livestock industry, very few studies appear to have been done in the general area of human dietary combination and optimization. Many nutrition-related articles, especially in Africa, report results of studies of the nutrient composition of food without necessarily linking it to the optimal levels desirable for human consumption, despite awareness about daily recommended levels required of the different nutrients.

Africans generally derive most of their nutrients from similar types of food, particularly from domestically produced starchy roots and tubers (e.g., such as cassava and yam), cereals, and grains. The levels of food intake or the recommended dietary allowances (RDAs) for individuals, however, are influenced by a number of factors such as climate, age, sex, physical activity, health, etc. (National Research Council, 1989, Staten, 1991, Grediagin *et al*, 1995, Imbeault *et al*, 1997), as well as factors associated with heredity (Miller *et al*, 1990). Other factors likely to influence actual food intake include appetite, socio-economic status, body composition and, according to FAO/WHO/UNU (1985), uniqueness of individuals.

In a study conducted by Ssewanyana and Ahmadi-Esfahani (2001), using cross-sectional data, it was estimated that rural Ugandan households derived over 30 percent, 40 percent and 60 percent of their protein, iron and food energy intake, respectively, from starchy staples.

Onimawo (2001) experimentally investigated the causes of variability in energy and nutrient intakes among 22 males and 16 female students at a College of Agriculture in Nigeria who were between the ages of 18 to 28. Mean energy intakes were found to be higher in males with  $2362 \pm 146$  kcal (i.e., mean  $\pm$  standard deviation) than in females ( $2028 \pm 137$  kcal) irrespective of the units of measurement. In addition, the inter-individual and monthly

variations in energy and nutrient intakes between the two sexes were significant. This supports the fact that sex is a significant determinant of food intake, but as with other studies, it did not focus on the economic aspects of dietary intakes.

In terms of age and climate, the charts for the RDAs (Foster and Leathers, 1991) and the international food composition tables (FAO, 1954 and 1982) clarify the issue of varying food intakes among different age categories and across climatic regions of the world.

Boukari *et al* (2001) analyzed selected West African foods for calcium composition to help in planning food-based intervention programs to improve mineral nutrition. Other related research studies include Aremu (1988), Aremu and Abara (1992), Ferguson *et al*, (1993), Akpanabiatu *et al* (1998), Schoeninger *et al* (2001), etc.

### **3. Data and Analytical Procedures**

#### ***3.1 Area of the Study and Data Used***

The study area was Lagos State. It lies in the southwestern part of Nigeria dominated by the Yoruba ethnic group. It is bounded both in the north and the east by Ogun State, in the west by the Republic of Benin and in the south by the Atlantic Ocean. The state lies within the rainforest belt, which is the most common type of vegetation to the south of Nigeria. However, the state's inland waterways, lagoons and creeks are dotted by mangrove and fresh water swamp forests. The state, which was once the capital city of Nigeria, has the smallest land area of 3,345 square kilometers representing 0.4% of Nigeria's total land area and an estimated population of 5 million people, 88 percent of which live in metropolitan Lagos (FOS, 1991). This amounts to a population density of 1,495 inhabitants per square kilometer – the highest in Nigeria. Many people assume that Lagos State does not practice

agriculture because of its minute size. Despite its small size, however, it is richly endowed with cultivable land scattered in all five of its administrative divisions (i.e., Lagos, Ikeja, Bagry, Ikorodu, and Epe). Agriculture in the State is predominantly in the hands of rural dwellers with small farm plots, producing:

- Arable crops such as maize, cassava, vegetables, yam, melon, cocoyam, and groundnuts
- Tree crops such as coconut and oil palm.
- Animal products such as eggs, broilers, and fish.

Lagos state has a unique characteristic of being a mini-Nigeria, meaning that, almost 250 ethnic groups of Nigeria are well represented and they all constitute a large market for the agricultural products produced locally or imported, mainly from other parts of Nigeria.

The data used in this study cover two periods, namely before and after the implementation of the Structural Adjustment Program (SAP) (i.e., in this paper they are termed the Pre-SAP and SAP periods). They were collected as part of a national household survey conducted -- starting in February 1990 and lasting 18 months -- by a study team cosponsored by the Central Bank of Nigeria (CBN) and the Nigerian Institute of Social and Economic Research (NISER). The data were originally collected to study the impact of SAP on agriculture and rural life in Nigeria. The Pre-SAP contains data from 1984/85 period while the SAP period contains the average computed from 3-year-observations, namely, 1987, 1988 and 1989. The period 1986 was omitted because it was regarded as a water shed period. The purpose was to implement a comprehensive appraisal of the impact of the SAP on Nigerian agriculture and rural life. The Lagos State data were collected randomly from the five administrative divisions comprising, then, of a total of 12 local government areas (LGAs) and there was a concerted effort to ensure that every part of the state was represented in the sam-

ple. A total of 200 questionnaires were administered statewide (Table 4), with the household being the target respondent. The average number of people per household in Lagos State was established, during the survey, to be 7.134 while the average total household incomes were N6,030.50 and N6,087.10 for the Pre-SAP and SAP periods, respectively. Observations on the food composition of 20 major nutrients and their recommended dietary allowances (RDAs) were obtained from local food science studies such as Aremu (1988), Ferguson *et al* (1993), and Boukari *et al* (2001). Those that were not available locally were obtained as proxy data from the USDA and FAO.

The household expenditure data, however, have some limitations. These include illiteracy of some respondents, lack of record keeping, the need for self-protection of privacy, and feeling of distrust on part of the respondents towards government and its interviewers. These factors are expected to have caused some irregularities in the data collection exercise.

### ***3.2 Method of Analysis***

Table 5 represents the average amount of actual food consumed per Lagos State household during the Pre-SAP period and Table 6 during the SAP Period. The data include the major types of food consumed weekly, their quantities and unit prices. Preliminary computation involved their conversion to daily per capita levels and units that conform to the nutrient content of the food. The average of the RDAs across sex and age groups from 11 years upward was used. This was necessary because in the survey, consumption data within households were not disaggregated by gender and age.

The Pre-SAP period provides the base data which were analyzed with the help of linear programming (LP). The objective was to minimize the actual per capita expenditure on

food, hereafter referred to as TC, subject to the constraints of the nutrient composition per unit of food item, the RDA, and the actual food consumed. An estimation of the degree to which consumption of the nutrient in relation to need was deficient or surplus was made. The sensitivity of the results to actual changes in the prices and food availability was examined using the SAP period observations.

The LP problem is set up as follows:

$$\begin{aligned} \text{Min } TC &= \sum_{j=1}^n P_j X_j \\ \text{Subject to :} \\ \sum_{j=1}^n a_{ij} X_j &\geq b_i \\ X_j \pm d &= c_j \\ X_j &\geq 0 \end{aligned}$$

Where:  $i=1,2,\dots,m$  is the number of nutrient constraints,  $j=1,2,\dots,n$  is the number of food items,  $P_j$  is the price per unit of food items consumed,  $X_j$  is the decision variable, that is the food mix,  $a_{ij}$  is the nutrient composition per unit of food item,  $b_i$  is the RDA,  $c_j$  is the food actually consumed, and  $d$  is the simple deviation between the optimal food mix and the actual food consumption. A positive value of  $d$  indicates a surplus of the specific nutrient compared with its need, while a negative value indicates a deficiency. The constraints chronologically refer to RDA, food consumption and non-negativity, respectively.

Premium solver in Microsoft Excel was used to solve the LP problem. Although the sensitivity report from the solver, which usually shows the range within which the solution remains unchanged in response to a change in the various coefficients of the model, could also be obtained, this approach was not adopted because SAP period data, shown in Table 6,

were available and these were used to analyze the sensitivity of the solution to changes in the variables of the model (i.e., price and food availability changes).

#### **4. Results and Discussion**

There are four major important constituents of the solution to the analysis: The optimal food mix; the minimum cost obtainable from the consumption pattern; the deviations from the recommended dietary allowance; and the sensitivity presentation.

##### ***4.1 Optimal Food Mix and its Sensitivity***

Table 7 shows the optimal food mix derivable from the typical food consumption of Lagosians. These results would be expected to occur if people are consuming at the minimum total cost. Only maize, sorghum and lafun (i.e., a cassava derivative like gari) would be the major food items consumed at Pre-SAP while millet replaced maize during SAP period if the people would be willing to consume at minimize cost. The reduction in the consumption of fruits and meat, by 32.47 and 75.47 percent, respectively, appears to have allowed some eggs and fish to be introduced during the SAP period although at higher total cost. For lafun and palm oil, the optimal daily per capita food consumption went up from the pre-SAP period by 2.87 and 11.16 percent respectively. It was however surprising that gari and beans would not be selected as part of the mix despite their importance in the people's actual consumption. The fact that vegetables, which are important parts of a Nigerian meal, are not selected render the results suspect since this type of mix is unlikely to be satisfactory to consumers, although there was a significant increase in the consumption of animal protein, especially eggs and fish.

From a practical point of view, the above outcome would be expected since those food items whose consumption increases due to a decrease in real income would be classified as inferior goods, while those whose consumption decreases would be categorized as normal goods. In this case therefore, maize, millet, lafun, gari, etc., as also indicated in Tables 5 and 6, remained inferior goods. The decline in sorghum consumption is not surprising as it is often mixed with maize -- consumption of which increases -- in the preparation of various grain-related meals.

#### ***4.2 Optimal Cost of Food***

The optimal food mix presented above is derivable from the foods actually consumed at a minimum cost of N3.65 and N5.47 per day for the Pre-SAP and SAP periods, respectively (Table 8). The actual cost at Pre-SAP and SAP periods were N20.82 and N33.43 which show that Lagos residents were not minimizing their cost of nutrient acquisition during both periods. However, because Nigerians spend about 70% of their income on food and comparing these cost figures to the average daily per capita income in Lagos State, which were N28.18 (Pre-SAP) and N28.44 (SAP), it implies that people were only able to survive especially during the Pre-SAP period either through borrowing, home production and/or obtaining other sources of income.<sup>1</sup>

Possible problems relating to the above could, however be avoided, if consumers are better informed about the potential optimal food mix. As Table 8 shows, the actual cost increased by 60.56 percent without an apparent compensating increase in income, while the optimal cost only increased by about 50 percent, but would still be within reach of people's

---

<sup>1</sup> Estimates of incomes from household surveys also tend to be notoriously inaccurate and are very likely to be undercounted (i.e., not disclosed by the respondent).



incomes. Having said that the diet would be less varied and perhaps be less palatable and therefore less acceptable from the consumers' viewpoint!

#### ***4.3 Dietary Intake and Deviations from the RDA***

The data in Table 9 indicate an unanticipated result namely that there was in actual fact over consumption of all nutrients during both the Pre-SAP and SAP periods, as in both periods they all exceeded the average RDAs. Perhaps the results for energy, carbohydrate and fat consumption are not so surprising as starchy roots and tubers constitutes the major foods of the people. The results are however questionable for other nutrients especially protein, deficiencies of which is expected to be encountered among populations where diet is heavily based on starchy foods. This therefore raises serious question marks about the validity of some of the data.

In Columns 5 and 6 of Table 9 are presented the ratio of nutrient intakes both at Pre-SAP and SAP vis-à-vis the average RDAs. The last column compares the ratio for the nutrient intakes in the two periods. The intakes of iron, selenium, vitamins A, K, C and B-12 declined between the Pre-SAP and the SAP periods since they were less than 1. Similar results are derived for the optimal dietary intake as shown in Table 10. Once again there was no indication that less than optimal amounts would be consumed – not surprising because of the way the LP was set up but a number were consumed at the optimal levels. The ratio between consumption of specific nutrients between the Pre-SAP and SAP periods sometimes declined but in both periods sufficient amount of those nutrients was being consumed.

## **5. Summary, Policy Implication of Findings and Conclusion.**

### ***5.1 Summary***

Contrary to popular belief that, due to migration of people into Lagos from all parts of the country, the state suffers from insufficient food and inadequate nutrient intake, the findings from this study imply that the daily nutrient needs of the people can be met from the quantities of food available. This conclusion -- see below -- could be suspect since the data were derived from an expenditure survey which might have contained inaccuracies over-estimating respondents' state of poverty or which might have seriously underestimated shrinkage, spoilage and wastage. On the other hand the results are theoretically possible because of huge amounts of food imported into the State from other parts of the country. Some of the food brought to Lagos appears to be cheaper than would be expected, possibly due to those in the food marketing business purchasing them directly from farmers immediately at harvest or engaging in pre-harvest price negotiations. Rural communities are thus likely to be penalized for such strategies during the off season when they compete for the remaining food supplies.

As far as the cost-income relationship is concerned, the results from the optimal intakes indicate that incomes would be adequate as far as ensuring adequate diets if the optimal food mix is acceptable to the people. Nevertheless, it is likely that, in actual fact, many of the poorer people are likely to eat a relatively higher proportion of the starchy food staples (i.e., inferior or income inelastic foods) at the expense of more income elastic foods that could contribute to healthier diets.

## ***5.2 Policy Implications of Findings***

If the results of the study are to be believed – see discussion below – they indicate the need for a number of major initiatives to be pursued if the diets and welfare of poorer people in Lagos State are to be improved.

The first is the need for greater focus on educating consumers with respect to good nutrition and the selection of food items that provide a better mix of nutrients for efficient use by the body. It would seem desirable to encourage where feasible a gradual shift from heavy consumption of those excess energy-yielding starchy foods to those that give, on average, the daily RDA. This shifting could be facilitated by rigorous food processing than currently practiced, international trade or other marketing services (e.g. labeling), which enables the replacement of excess energy-yielding food for the ones that give the appropriate combination of nutrients needed. In addition, the data collection agency should incorporate the people's preference ratings in future surveys -- with higher (less) scores indicating more (less) desirable foods – so that more food items could be represented in the mix.

The second initiative requires an income generation program complemented with a food aid component specifically targeted at the poor that will improve their purchasing power and enable them to shift away from so much reliance on the cheap inferior starchy food crops thereby impacting positively on both the physical health and economic welfare. Moreover, there is urgent need of not only the reassessment of some of the current government initiatives at alleviating poverty such as highlighted earlier (see Sub-Section 1.2), but also comprehensive relieve programs to help cushion the effect of the general macroeconomic activities of the government.

A major concern arising from the results of this study is the fact that the actual nutrient intakes appear much higher than that required per day (i.e., compare Tables 5 and 6 with 7), with energy-yielding ones like carbohydrate, protein and fat the most important. This, if true, would have very serious deleterious health implications. Although the findings refer to the amounts per person per day – obviously not all the items are consumed every day. In this sense weekly or monthly units would perhaps result in a better outcome. Although the optimal nutrient intakes are more than required in some cases, the excessive ones concern those minerals and soluble vitamins that pose no threat to health.

### ***5.3 Conclusion: A Major Caveat About the Data***

However, the validity of the above analytical findings and the resulting policy implications are very dependent on the quality of data used for the study. It is now apparent that serious concerns need to be raised with respect to this data set. When it became apparent that this might be an issue, nutrition experts were consulted who affirmed reservations about the potential validity of the data. The validity of the data about the different quantities of food consumed (see Tables 5 and 6 compared with 7) is particularly questionable. For example, the large quantities of millet and sorghum consumed in a community where roots and tubers constitute the major traditional food are particularly suspect on two grounds. Millet and sorghum are only likely to be consumed in relatively large quantities by the Hausa who dominate in the northern not southern parts of Nigeria. In addition a household of seven would never consume 2.5 bags and 5.0 bags (i.e., 25 kg each) respectively of millet per week during the Pre-SAP and SAP periods (Tables 5 and 6), respectively.

It is likely that the way in which the questionnaires were worded and the characteristics of the enumerators contributed to misleading and/or inaccurate information being given by the respondents. Respondents will answer questions on expenditures over a longer period differently and probably more inaccurately than questions relating to questions about what was actually eaten within the last few hours. The survey instrument focused on expenditure rather than actual food intake. Other data that are particularly suspect, for reasons mentioned earlier, include the validity of the income data during the Pre-SAP and SAP Periods which was reputed to be N6030.50 and N6087.10 per household respectively.

Therefore, given the above concerns, the results of this paper should be viewed with considerable skepticism, a conclusion which was unanticipated when a general abstract of this paper was submitted for the meeting. Obviously it would be important to repeat the analysis in this paper on another data set derived from the use of a more rigorous survey instrument that focuses on food consumption itself, before giving much credence to the results and policy implications discussed in this paper. Unfortunately collection of good quality data involves substantial resources both in terms of quality enumerators and money, which are often scarce in low-income countries. The lesson is clear: bad data results in bad results and suspect policy implications.

## References

- Akpanabiatu, M. I., N. B. Basse, E. O. Udosen, and E. U. Eyong: "Evaluation of Some Minerals and Toxicants in some Nigerian Soup Meals." *J. Food Comp. Anal.*, 11 (1998): 292-297.
- Aremu, C. Y.: "Chemical Estimation of Iron, Zinc, Copper and Phytic Acid in Selected Foodstuffs." *Food Chem.*, 27 (1988): 77-82.
- Aremu, C. Y. and A. E. Abara: "Hydrocyanate, Oxalate, Calcium and Zinc in Selected Brands of Nigerian Cocoa Beverages." *Plant Food Hum. Nutr.* 42 (1992): 231-237.
- Boukari, Isbatou, Nathan W. Shier, Xinia E. Fernandez R., Jacquelyn Frisch, Bruce A. Watkins, Lisa Pawloski, and Alyce D. Fly: "Calcium Analysis of Selected Western African Foods." *J. Food Comp. Anal.*, 14 (2001): 37-42.
- CBN/NISER: "The Impact of SAP on Nigerian Agriculture and Rural Life," Vol. II, Bendel, Kwara, Lagos and Ondo State (1992): 101-140.
- Euromonitor: The World Economic Factbook. 9<sup>th</sup> ed., Antony Rowe Ltd., Chippenham, Wiltshire, Great Britain, 2001/2002: 17-20.
- FAO: Food Composition Tables – Minerals and Vitamins for International Use. A report prepared by Charlotte Chatfield, Nutrition Division, *FAO Nutrition Studies*, March 1954: 1-49.
- FAO: Food Composition Tables for the Near East. A research Project sponsored by FAO and USDA. *FAO Food and Nutrition Paper*, Rome (1982).
- FAO/WHO/UNU: "Food and Agriculture Organization/World Health Organization/United Nations University: Energy and Protein Requirements." *Report of a Joint Expert Consultation*. Tech. Report Serial No. 724.
- Federal Office of Statistics: Annual Abstract of Statistics, 1991 ed., Lagos, Nigeria. 1-24.
- Ferguson, E. L., R. S. Gibson, C. Opare-Obisaw, F. Osei-Opare, A. M. Stephen, J. Lehrfeld, and L. U. Thompson: "The zinc, calcium, copper, manganese, non-starch polysaccharide and phytate content of seventy-eight locally grown and prepared African foods." *J. Food Comp. Anal.*, 6 (1993): 87-99.
- Foster, P. and Howard D. Leathers: The World Food Problem: Tackling the Causes of Undernutrition in the Third World. 2<sup>nd</sup> ed., Lynne Rienner Publishers, Inc., Boulder, London (1999): 26-31.
- Grediagin, M A., M. Cody, J. Rupp, D. Benardot and R. Shern: "Exercise intensity does not affect Body Composition Change in untrained, moderately over fat Women." *J. Am Diet Assoc.*, 95 (1995): 661-665.

- Guthrie, A. Helen: Introductory Nutrition. Food and Nutrition Dept. The Pennsylvania State Univ., University park, Pennsylvania. The C. V. Mosby Company (1967): 3-269.
- Imbeault, P., S. Saint-Pierre, N. Ameras and A. Tremblay: “Acute Effects of Exercise on Energy Intake and Feeding Behavior.” *Br. J. Nutr.*, 77 (1997): 511-521.
- Miller, W. C., A. K. Linderman, J. Wallace and Niderpruem: “Diet Composition, Energy Intake and Exercise in Relation to Body Fat in Men and Women.” *Am. J. Clin Nutr.*, 52 (1990): 426-430.
- National Research Council: Recommended Dietary Allowances. Subcommittee on the Tenth Edition of the RDAs, 10th ed. National Academy Press, Washington, D. C. (1989).
- Onimawo, I. A: “Inter-Individual Variations in Energy and Nutrient Intake Among Young Nigerian Adults.” *Ecology and Food Nutrition, An International Journal*, Vol. 40, No. 2 (2001): 127-141.
- Schoeninger, J. Margaret, Henry T. Bunn, Shawn S. Murray, and Judith A. Marlett: “Composition of Tubers Used by Hadza Foragers of Tanzania.” *J. Food Comp. Anal.*, 14 (2001): 15-25.
- Ssewanyana, N. Sarah, and Fredoun Z. Ahmadi-Esfahani: “Household Food Security in Rural Uganda: A Statistical Analysis” *Ecology and Food Nutrition, An International Journal*, Vol. 40, No. 2 (2001): 93-125.
- Staten, M. A: “The Effect of Exercise on Food Intake in men and women.” *Am. J. Clin. Nutr.*, 53 (1991): 27-31.
- United Nations: “Social Aspects of Sustainable Development in Nigeria.” The fifth Session of the United Nations Commission on Sustainable Development, 1997. Available at <http://www.un.org/esa/agenda21/natlinfo/countr/nigeria/social.htm>
- World Bank: World Development Indicators, Development Data Center, Washington DC, USA, 2002: 65.

**Table 1: Annual Rates of Growth of Real GDP, Nigeria (1984-1995)**

Year	GDP	Year	GDP
1984	5.8	1990	7.5
1985	10.5	1991	6.0
1986	-1.8	1992	2.6
1987	-4.0	1993	2.2
1988	9.4	1994	-0.6
1989	8.5	1995	2.6

Source: Drawn from The World Economic Outlook Database, IMF, December 2001

**Table 2: Percentage of Nigerian Population below Poverty Line**

Survey Type: Survey Year:	National		International (at 1985 Prices)	
	1985	1992-93	1997	
Sector: Rural	49.5	36.4	Less than \$1 a day	70.2
Urban	31.7	30.4	Less than \$2 a day	90.8
National	43.0	34.1		

Source: World Bank Development Indicators, Development Data Center, World Bank, Washington DC, USA, 2002: p. 69

**Table 3: Selected Social and Health Indicators of Poverty, Nigeria**

Panel A: From Survey Year 1990		
	Poorest Quintile	Richest Quintile
Infant Mortality Rate (per 1000 live birth)	102	69
Delivery Attendance by Doctor, Nurses, etc <sup>a</sup>	12	70
Prevalence of Child Malnutrition <sup>b</sup>	40	22
Total Fertility Rate (birth per woman)	6.6	4.7
Panel B: Trend in Indicators		
Year:	1980	2000
Life Expectancy at birth (years)	46	47
Infant Mortality Rate (per 1000 live birth)	99	84
Under Five Mortality Rate (per 1000)	196	153

Source: World Bank Development Indicators, Development Data Center, World Bank, Washington DC, USA, 2002: p. 72 & 123.

Note: a = % of births in 5 years prior to the survey. b = % of children under 5.



**Table 4: Sample Stratification and Selection**

Administrative Division	LGA	Selected LGA	# Villages Selected	Respondents	Row* Total
Lagos	Lagos Island	Eti-Osa	4	10	40
	Lagos Mainland				
	Eti-Osa				
Ikeja	Mushin	Agege	4	10	40
	Agege				
	Ikeja				
	Shomolu				
Badagry	Ojo	Badagry	4	10	40
	Badagry				
Ikorodu	Ikorodu	Ikorodu	4	10	40
Epe	Ibeju/Lekki	Epe	4	10	40
	Epe				

Source: CBN/NISER National Field Survey, 1990. \* means a grand column total of 200 questionnaires administered statewide

**Table 5: Household Consumption Expenditure in Lagos State (Pre-SAP Period)**

Food Type	Qty/week (kg)	Percapita/day (kg)	Unit Price (N)	Average Cost*
Maize	11.08	0.2219	3.76	0.83
Millet	65.75	1.3166	3.07	4.04
Rice	18.13	0.3631	4.71	1.71
Sorghum	36.05	0.7219	2.24	1.62
Lafun	8.22	0.1646	2.02	0.33
Gari	15.41	0.3086	3.03	0.94
Plantains	9.49	0.1900	3.71	0.71
Yam	16.85	0.3374	3.68	1.24
Yam Flour	3.55	0.0711	7.52	0.53
Beans	8.74	0.1750	5.04	0.88
Vegetables	4.14	0.0829	18.42	1.53
Fruits	17.13	0.3430	0.80	0.27
Meat	14.32	0.2868	5.66	1.62
Egg <sup>1</sup>	6.63	0.1328	13.26	1.76
Fish	12.89	0.2581	7.45	1.92
Palm Oil <sup>2</sup>	11.17	0.2237	3.94	0.88

\* Actual weekly average totals N1039.88, amounting to N20.82 per person per day, 1 = measured in crates, 2 = measured in liters. **Note:** Only columns 1,2 & 4 are the original data reported in CBN / NISER National Field Study, 1990

**Table 6: Household Consumption Expenditure in Lagos State (SAP Period)**

Food Type	Qty/week (kg)	Percapita/day (kg)	Unit Price (N)	Average Cost*
Maize	15.36	0.3076	4.75	1.46
Millet	126.67	2.5365	2.14	5.43
Rice <sup>+</sup>	16.84	0.3372	7.35	2.48
Sorghum <sup>+</sup>	16.22	0.3248	3.21	1.04
Lafun	14.22	0.2848	2.01	0.57
Gari	21.24	0.4253	3.59	1.53
Plantains	29.53	0.5913	6.37	3.77
Yam <sup>+</sup>	13.28	0.2659	6.53	1.74
Yam Flour	3.70	0.0741	15.76	1.17
Beans	19.98	0.4001	7.09	2.84
Vegetables	5.57	0.1115	43.53	4.86
Fruits <sup>+</sup>	7.53	0.1508	1.91	0.29
Meat <sup>+</sup>	2.62	0.0525	9.97	0.52
Egg <sup>1,+</sup>	4.42	0.0885	15.81	1.40
Fish <sup>+</sup>	9.27	0.1856	10.66	1.98
Palm Oil <sup>2</sup>	20.21	0.4047	5.84	2.36

\* Actual average cost totals N1669.19, amounting to N33.43 per person per day, + = consumption decreases at SAP, 1 = measured in crates, 2 = measured in liters. **Note:** Only columns 1,2 & 4 are the original data reported in CBN / NISER National Field Study, 1990.

**Table 7: Optimal Daily Percapita Food Mix**

Food Type	Pre-SAP (g)	SAP (g)	Δ Optimal Mix	% Change
Maize	347.08	0.00	-347.08	-
Millet	0.00	616.90	616.90	-
Rice <sup>+</sup>	0.00	0.00	0.00	0.00
Sorghum <sup>+</sup>	34.76	13.83	-20.92	-60.20
Lafun	238.39	245.24	6.85	2.87
Gari	0.00	0.00	0.00	0.00
Plantains	0.00	0.00	0.00	0.00
Yam <sup>+</sup>	0.00	0.00	0.00	0.00
Yam Flour	0.00	0.00	0.00	0.00
Beans	0.00	0.00	0.00	0.00
Vegetables	0.00	0.00	0.00	0.00
Fruits <sup>+</sup>	996.66	673.00	-323.66	-32.47
Meat <sup>+</sup>	150.00	36.79	-113.21	-75.47
Egg <sup>1,+</sup>	0.00	20.68	20.68	-
Fish <sup>+</sup>	0.00	131.82	131.82	-
Palm Oil <sup>2</sup>	35.91	39.92	4.01	11.16

Source: Results from the Solver

**Table 8: Daily Per capita Minimum Cost (N) for the Food Mix**

	Pre-SAP	SAP	Change	% Change
Actual	20.82	33.43	12.61	60.56
Optimal	3.65	5.47	1.82	49.86
Change	-17.17	-27.96	-	-
% Change	-82.47	-83.63	-	-

**Source:** Results from the Solver

**Table 9: Actual Dietary Deviations from the Recommended Dietary Allowance**

Nutrients Name	Average RDA	Nutrient Intake		Nutrient Ratio		
		Pre-SAP	SAP	Pre-SAP <sup>a</sup>	SAP <sup>b</sup>	PS <sup>c</sup>
Food Energy (kcal)	2025.00	15837.77	22749.86	7.82	11.23	1.44
Protein (g)	43.67	437.76	520.07	10.03	11.91	1.19
Fat (g)	81.43	379.63	581.63	4.66	7.14	1.53
Carbohydrate (g)	246.95	2792.70	4052.63	11.31	16.41	1.45
Calcium (mg)	1214.29	2040.77	2599.35	1.68	2.14	1.27
Phosphorus (mg)	766.67	7605.44	8099.63	9.92	10.56	1.06
Iron (mg)	9.17	192.28	145.69	20.98	15.89	0.76
Magnesium (mg)	228.57	1595.65	2462.32	6.98	10.77	1.54
Manganese (mg)	1.68	9.05	14.17	5.38	8.42	1.57
Copper (mg)	0.75	4.40	7.48	5.88	9.99	1.70
Zinc (mg)	8.00	33.13	45.07	4.14	5.63	1.36
Selenium (mcg)	56.00	333.06	251.96	5.95	4.50	0.76
Vitamin A (mcg)	542.86	2472.59	2421.08	4.55	4.46	0.98
Vitamin E (mg ATE)	8.57	51.92	96.37	6.06	11.24	1.86
Vitamin K (mcg)	55.71	76.37	20.40	1.37	0.37	0.27
Thiamine: Vit B1 (mg)	1.14	6.45	7.26	5.65	6.35	1.13
Riboflavin: Vit B2 (mg)	1.17	6.03	6.09	5.15	5.20	1.01
Niacin: Nicotinic acid (mg)	15.14	95.78	111.14	6.33	7.34	1.16
Ascorbic acid: Vit C (mg)	43.57	285.66	226.22	6.56	5.19	0.79
Folacin: Folic acid (mcg)	182.00	1157.11	1642.00	6.36	9.02	1.42
Cobalamin: Vit B-12 (mcg)	2.40	9.90	4.05	4.12	1.69	0.41
Pyridoxine: Vit B-6 (mg)	1.43	7.32	9.57	5.13	6.70	1.31
Panhotenic acid 'APF' (mg)	5.00	15.00	15.43	3.00	3.09	1.03

**Source:** Results from the Solver. Note: a and b use the average RDA as base, while c means SAP:Pre-SAP ratio (i.e., P is the Pre-SAP and S is SAP).

**Table 10: Optimal Dietary Deviations from the Recommended Dietary Allowance**

Nutrients Name	Average RDA	Nutrient Intake		Nutrient Ratio		
		Pre-SAP	SAP	Pre-SAP <sup>a</sup>	SAP <sup>b</sup>	PS <sup>c</sup>
Food Energy (kcal)	2025.00	3318.39	3930.01	1.64	1.94	1.18
Protein (g)	43.67	73.93	105.61	1.69	2.42	1.43
Fat (g)	81.43	81.43	81.43	1.00	1.00	1.00
Carbohydrate (g)	246.95	599.69	738.96	2.43	2.99	1.23
Calcium (mg)	1214.29	1214.29	1214.29	1.00	1.00	1.00
Phosphorus (mg)	766.67	1413.33	1422.75	1.84	1.86	1.01
Iron (mg)	9.17	46.92	32.53	5.12	3.55	0.69
Magnesium (mg)	228.57	599.67	522.41	2.62	2.29	0.87
Manganese (mg)	1.68	1.68	1.68	1.00	1.00	1.00
Copper (mg)	0.75	1.09	1.00	1.46	1.33	0.91
Zinc (mg)	8.00	11.48	8.94	1.44	1.12	0.78
Selenium (mcg)	56.00	86.70	91.46	1.55	1.63	1.05
Vitamin A (mcg)	542.86	2102.76	1712.97	3.87	3.16	0.81
Vitamin E (mg ATE)	8.57	11.03	12.04	1.29	1.40	1.09
Vitamin K (mcg)	55.71	99.61	55.71	1.79	1.00	0.56
Thiamine: Vit B1 (mg)	1.14	2.14	1.39	1.87	1.21	0.65
Riboflavin: Vit B2 (mg)	1.17	1.17	1.17	1.00	1.00	1.00
Niacin: Nicotinic acid (mg)	15.14	15.70	15.14	1.04	1.00	0.96
Ascorbic acid: Vit C (mg)	43.57	332.35	241.15	7.63	5.53	0.73
Folacin: Folic acid (mcg)	182.00	370.86	399.52	2.04	2.20	1.08
Cobalamin: Vit B-12 (mcg)	2.40	2.40	2.40	1.00	1.00	1.00
Pyridoxine: Vit B-6 (mg)	1.43	3.54	2.31	2.48	1.61	0.65
Panthenic acid 'APF' (mg)	5.00	5.00	5.00	1.00	1.00	1.00

**Source:** Results from the Solver. Note: a and b use the average RDA as base, c means SAP:Pre-SAP ratio (i.e., P is the Pre-SAP and S is SAP), while \* indicates that nutrients are binding.