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CENTER FOR RESEARCH ON ECONOMIC DEVELOPMENT
The University of Michigan
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CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES: CAMEROON AND SENEGAL

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FOREWARD

The impact of agricultural development projects and policies upon the nutritional well-being of rural families has been a topic of increasing concern in the past few years. As rural areas become more integrated into the commercial sector, farm production becomes more specialized, and farmers' consumption grows more diverse and dependent on external sources. The end result upon the nutrition of village farmers cannot be readily foreseen. Analysis of the problem is made particularly complex by the simultaneous role of farmers as consumers and producers of food and other agricultural products.

This project report presents the results of research conducted by the University of Michigan's Center for Research on Economic Development (CRED). This research was funded by the U.S. Agency for International Development (AID) under the technical supervision of the U.S. Department of Agriculture's Nutrition Economics Group as part of AID's effort to develop a workable methodology to trace the food consumption effects of development interventions in specific rural settings. Our basic approach has been to incorporate family food consumption considerations into the overall decision making process of farmers, i.e., to consider simultaneous choices regarding farm production and food consumption at the family farm level.

Part I of the project report contains two country studies, for Cameroon and Senegal, while Part II contains papers on the analytical methodology and survey techniques. The Senegal country study was carried out by Clark Ross and Henri Josserand in the Diourbel region of the Peanut Basin. It focuses on the tradeoffs between peanut and millet production, and on the role of imported rice in rural areas. A counterpart field study in the highlands of Cameroon's Northwest Province, carried out by Miriam Goheen-Fjellman, Lisa Matt, and Richard Rice, examines how access to marketing opportunities can affect farmers' food consumption patterns.

The methodology section in Part II develops a general framework to integrate food consumption decisions into a standard farm planning model. The suggested procedure constitutes a major improvement over similar attempts at such integration found in the recent literature on the economics of farm households. Neither of the country studies, however, constitutes a full-scale application of the methodology. This is unfortunate but unavoidable, since work on the methodology proceeded concurrently with the field research in West Africa.

Moreover the total duration of field research, analysis, and reporting was limited purposely to 6 months by AID in order to determine what could be done in a rather short period. Thus, the country surveys may be viewed as tests of alternative field research techniques to obtain the types of data needed to carry out the analytical methodology. For example, in order to determine crop patterns in a region, a rapid technique to get farm plot measurements and on-site area computations was developed at CRED and was successfully used in both Senegal and Cameroon. The application of such a technique in future farm surveys would considerably reduce survey time and improve accuracy of results. The feasibility of doing food consumption surveys in a farm setting through direct recording of ingredients, and using local enumerators, was also thoroughly demonstrated, and the results are highly satisfactory in both countries.

Furthermore, in Senegal a comparison of nutritional assessment using both a dietary survey and anthropometric measurements was made; the two procedures yielded inconsistent results, thus pointing out the limitations of anthropometry in identifying correctly short run food consumption deficiencies. In Cameroon, the sampling design was modified to take advantage of price differences among villages located at varying distances with respect to the major regional market and the single road. This permitted the simultaneous evaluation of price and income elasticities of food consumption from cross-sectional data.

Not all the techniques tried in our country surveys were as successful but the efforts were instructive. The main disappointment was in our attempt to obtain quantitative estimates of labor requirements for several crop season yielded unsatisfactory results. Without these labor profiles it is not possible to make confident judgements about crop trade-offs and potential supply responses of farmers. Clearly, better procedures to obtain such information are needed, otherwise the lengthy but well-tested method of direct recording of labor utilization throughout a complete crop season must be followed. Our efforts in Cameroon to perform some preliminary data analysis (using a microcomputer) concurrently with the data collection were also unsuccessful. Although the potential for in-country data analysis seems highly favorable, present limitations in software availability and programming capabilities severely restrict this option.

In order to provide a realistic illustration of the general methodology, secondary data sources were used to generate a farm planning model for a typical peasant family in the Casamance region of Senegal. The exercise included in Part

II not only demonstrates the applicability of the method to actual situations; it also gives a clear idea of the type of agronomic and economic iformation required, how it is all integrated into a consistent model, and the usefulness of the model in analyzing the nutritional effects of possible interventions in the farm sector.

Other methodolgical papers cover various specific subjects that were explored in the course of this research project. A particularly useful one describes the procedure used for on-site field measurements; others provide computational procedures to estimate changes in consumption patterns, and their corresponding nutritional consequences, resulting from changes in farm prices. These methodology papers should serve as guidelines to future researchers pursuing the subject.

Each country report acknowledges the contribution of the numerous individuals in Cameroon and Senegal who participated in the field research. Mention is made here only of persons involved in the development of the overall project and the preparation of the report. Special recognition should be made of the continuous interest and support provided by Roberta van Haeften, leader of the Nutrition Economics Group and two of her collaborators, Michael Goldman and Patricia Rader, who helped for months to coordinate the work of the CRED teams with the country USAID Missions in Dakar and Yaounde.

At the University of Michigan, Professor Kenneth Shapiro was a major contributor in developing the research methodology. He also reviewed and edited preliminary drafts of each report. The final report is greatly improved thanks to his critical but positive comments. Professors Robin Barlow (CRED Director) and Richard Porter provided helpful advice at various stages of the project. Dr. Frances Larkin of the School of Public Health contributed essential expertise in human nutrition. The administrative skills of Sherry Cogswell were fully needed to keep the multiple and difficult parts of this project under control. Jane McCormick's talents with figures are evident in the report's illustrations, and in keeping the project accounts straight. Patricia Johnson, assisted by Barbara Timmins-Monahan, processed the numerous draft versions of the report with admirable good cheer, while Carol Wilson labored to improve its readability. French translation of the project report was undertaken jointly by Henri Josserand, Nicole Roger-Hogan and Karin Lindgren.

Ann Arbor, Michigan
August 1982

Edgar J. Ariza-Niño
Project Director

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

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CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART I.

COUNTRY REPORTS:
CAMEROON AND SENEGAL CASE STUDIES

Center for Research on Economic Development
University of Michigan
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CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES: CAMEROON CASE STUDY

by

Edgar Ariza-Niño

Miriam Goheen-Fjellman

Lisa Matt

Richard Rice

Center for Research on Economic Development

University of Michigan

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ABSTRACT

The geographical proximity of the Northwest Province of Cameroon to the booming markets of southern Nigeria led many to anticipate a profitable market for agricultural products from the Province, if only the official proscriptions against such traders were eliminated. The main subject of this study was to foretell the effects of opening the Nigerian border upon the food consumption of Northwest Province farmers.

Only farmers in the highland zone of the Northwest Province were included in this study, for the mountainous terrain and ecological diversity of the Province severely limits coverage. Most of the Province population is concentrated in those highlands. Corn, beans, and potatoes are the main food crops in the zone, while arabica coffee provides the principal source of cash revenue to farmers.

There are no roads linking the Northwest Province highlands directly with Nigeria. A couple of mountain trails passable by all-terrain vehicles in good weather provide the only direct routes from the highlands to Gembu in the Mambila Plateau of Gongola State in Nigeria. Lack of transport facilities, rather than effective enforcement of trade restrictions is responsible for the low volume of exports to Nigeria. Current exports consist mainly of bags of beans, corn, and rice taken back across the border into Nigeria, without official objection, in vehicles that bring auto parts and electronic items into Cameroon.

Road infrastructure in the Northwest Province serves mainly to evacuate produce from the area towards the southern coastal markets centered around Douala. A good paved road from Bamenda to Douala has opened attractive marketing opportunities from farmers in the southernmost areas of the Province, as exemplified by the expansion of the vegetable growing industry in Santa and Bamenda. The rapid growth of Douala and surrounding zone will offer an attractive and expanding market for food crops from the Northwest highlands. Demand from these southern markets, rather than from Nigeria, is viewed as the main marketing impetus affecting highland farmers over the coming years.

Increased demand for food in the coastal zone coupled with improvements in the road infrastructure will translate into higher prices for the Northwest Province highland farmers. The effect of higher prices on food consumption of highland farmers is examined. A survey of 72 households in eight highland villages was conducted for that purpose, i.e., in order to relate farm production and food consumption with the set of prices faced in the locality.

Household food consumption was found to cover adequately, on the average, the nutritional requirements in both energy and protein in all eight villages. Some families, however, about one in five, do not adequately satisfy recommended levels of per capita calorie intake. Protein intake is considered adequate throughout the sample. Nutrient intake was derived from three-day observation and measurement of foods passing through the family kitchen. The survey was conducted at the soudure period of highest nutritional stress; intake levels will likely be more favorable at other times of the year.

Price and income elasticities for the three main staples taken together, corn, beans, and potatoes, were estimated using the survey data. Values derived were statistically significant, correctly signed and of reasonable absolute magnitudes: -1.2 and +.2 for price and income elasticities, respectively.

The short run effect of higher food prices upon food consumption of farmers is negative. That is, in the absence of appropriate gains in food production, higher food prices will induce highland farmers to sell more and consume less. In the longer run, however, farmers can and do adjust the level and pattern of crop production, and substitute some foods for others in their diets. It is important therefore to explore measures to stimulate food crop production if rural nutrition is not to suffer from the rapid growth in demand from coastal markets. Fortunately, the main staple crops from the highlands -- corn, beans, and potatoes -- have favorable agronomic potential for increasing yields through the application of off-farm inputs.

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CHAPTER 1

INTRODUCTION

This study forms a part of the larger body of research that the Office of Nutrition, Bureau for Science and Technology, U.S. Agency for International Development is financing in Africa and Latin America under a program of research on the "Consumption Effects of Agricultural Policies." The Center for Research on Economic Development at the University of Michigan has responsibility for two country studies in francophone West Africa, namely Cameroon and Senegal. Other institutions are concurrently working in East Africa and Latin America.

In both Cameroon and Senegal the research focussed on tracing the chain of effects linking the nutritional well-being of farmers in a particular region with government policies affecting production and trade in farm products. The Northwest Province of Cameroon had earlier been identified by AID as having particular interest for its geographical proximity to Nigeria. Relaxation of restrictions on farm product exports toward Nigeria was initially postulated as having potential effects on the Province's farmers. It became apparent, however, that the prospects for such trade with Nigeria are minor in comparison to the rapid growth in demand in Cameroon's own coastal area. The terms of reference were therefore modified to also take into account the effects from increasing domestic demand for the Northwest Province's food products.

Objectives

Main Objectives

This country study's central objective is to determine the probable effects on the nutritional status of farmers in the Northwest Province from a possible liberalization of trade with Nigeria and improvements in the road infrastructure.

Secondly, the project will attempt to formulate a simple methodology, capable of fulfilling the first objective quickly and without recourse to collecting large amounts of primary data.

Subsidiary Objectives

Fulfillment of these objectives can be better assured by breaking them down into more specific, detailed goals that give a clear idea of the operational requirements of this project. Among the more identifiable aims, one may cite:

1. To evaluate to what extent agricultural exports from the Northwest Province to Nigeria might be accelerated by the removal of trade restrictions and improvements in the road infrastructure.

2. To identify which agricultural products would most likely benefit from the more favorable export conditions.

3. To foretell possible changes of food item prices in the Northwest Province in response to the expanded export opportunities.

4. To estimate the probable adjustments in household consumption of key food items in response to a new structure of food prices.

5. To anticipate the likely response of farmers to more favorable product prices, especially concerning changes in their crop production and marketing patterns.

6. To determine how gains in a household's cash income might affect the intake of key ingredients in the diet of farmers.

7. To relate household consumption patterns to incidence of malnutrition among farmer families. More specifically, to identify critical items in the diet of these groups, and to derive estimates of caloric and protein intakes.

Working Hypotheses

a) The nutritional impact of an increase in agricultural trade with Nigeria, can be largely derived from its effect on food consumption levels and the composition of the diet.

b) Differences in food consumption patterns among the population of the Northwest Province can be largely attributed to household income variations and relative prices of food items (in addition to seasonal factors).

c) Price differentials between markets in the Northwest region largely reflect locational factors such as transport and other distribution costs.

d) The flows of agricultural produce in and out of the region reflect price differences with the outside, after making allowances for marketing costs and institutional constraints.

e) The prevalence of subsistence farming in the Northwest Province reflects the limited marketing opportunities available to producers; this, in turn, is mainly a consequence of the deficiencies in the transport network.

f) Beyond family subsistence requirements, the pattern of crops sold by farmers corresponds with their respective profitabilities.

g) Improvements in the road to Nigeria and relaxation of trade restrictions would have a significant impact on the structure of agricultural production, consumption and trade of the Northwest Province. The relative price structure of agricultural products would shift accordingly to reflect the changing conditions.

h) Expanded trade opportunities might divert to Nigeria a portion of the food flows currently going south to Cameroonian markets.

Analytical Framework

A thorough analysis of the problem presented would require -- under ordinary circumstances -- detailed information on a wide range of subjects. For example, data would be needed on food prices in Nigeria, transport costs, farming systems in the region, income distribution, demand and supply schedules for the main food items, dietary patterns and incidence of malnutrition, seasonality factors and much more.

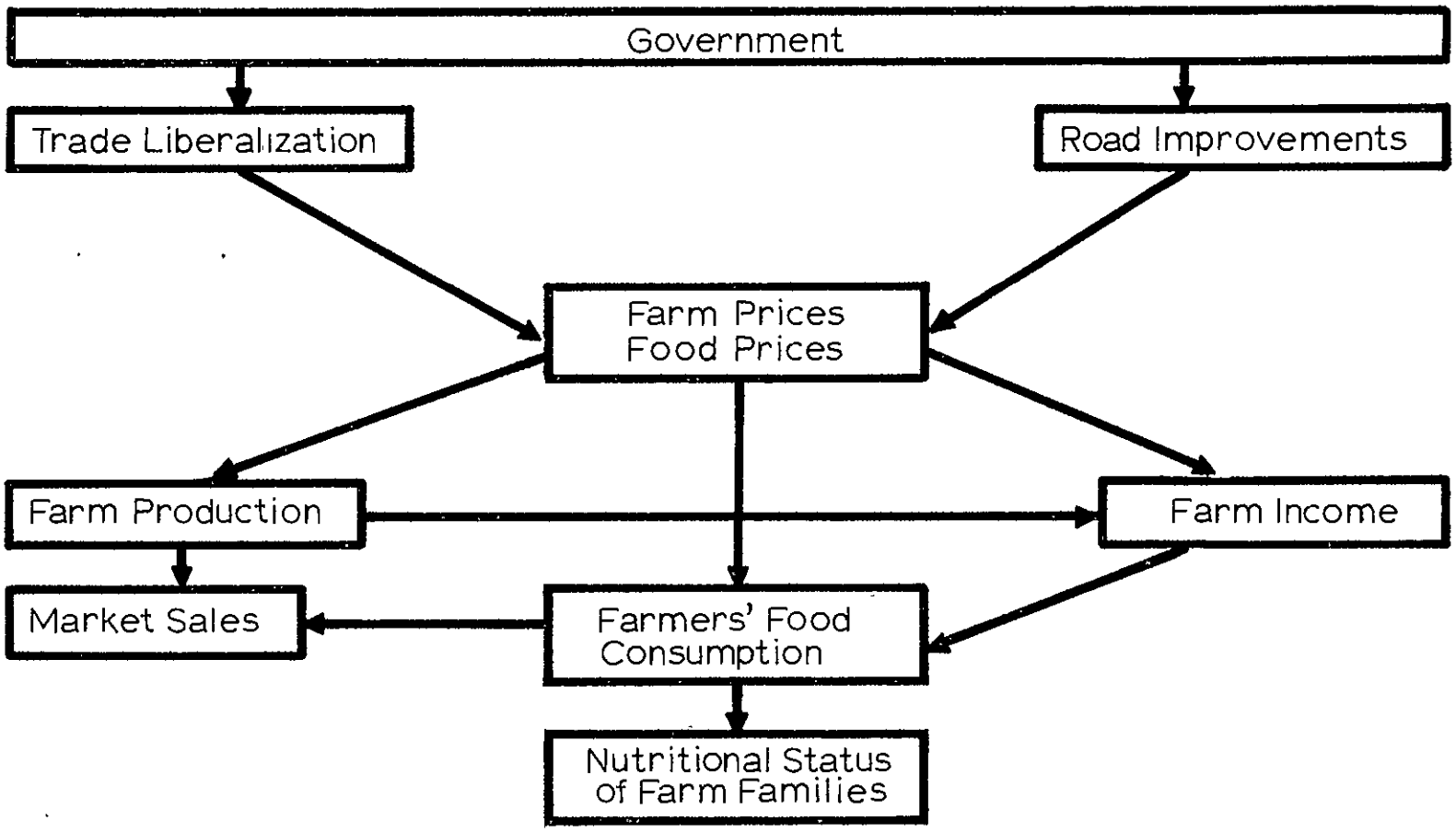
Clearly, in the short span of six months, it is not possible to assemble and digest such a vast amount of information. The major challenge of this study is how to devise ways of reducing to a bare minimum, the types and quantity of data to be collected. This requires taking advantage of secondary information sources such as the experience of professionals in the region, previous research and mission reports, and informal interviews with farmers, traders, and consumers. It is equally necessary to have a conceptual framework to assemble this information into a coherent body -- one that enables us to extract reasonable conclusions about the nutritional impact of the external disturbances being considered. Finally, it requires staffing the research team with persons well-acquainted with the Northwest Province and with the written material on the problem, who are also well-versed on matters of agricultural policy in Cameroon, statistical methodology, and economic analysis.

The attached flow diagram (Figure 1.1) illustrates the structure of relationships linking the principal factors involved. The diagram attempts to represent the household economy of Northwest Province farmers, where the system of food and crop prices interact in a way that results in a balance of farmers production, consumption, and marketed output.

The two policies under consideration in this study -- liberalized trade with Nigeria and road improvements -- appear at the top of the diagram. The nutritional status of farmers appear at the bottom. One may then trace the nutritional impact of these policies by following the paths connecting these boxes.

FIGURE 1.1

FLOW DIAGRAM OF AGRICULTURAL POLICY EFFECTS ON FARMERS' NUTRITION



For example, an improvement in the Douala road will help reduce transport and marketing costs for all goods traded in that route. As a result, the prices of foods imported into the province, as well as the prices of farm inputs such as fertilizers, may be reduced. Taking the latter case first, farmers will take advantage of lower fertilizer costs by using more fertilizer, thereby increasing crop production. Farmers' income will increase from both the resulting prices and the increase in marketed farm output. Income gains by farmers will translate into greater food consumption by farmers, both from the farm and from outside the farm. The nutritional status of farmers as a whole, is likely to improve.

Obviously, there are multiple paths linking the policy instruments and nutritional considerations. Some of them may have positive, others negative, effects on the nutritional status of target groups. To arrive at the net effect, each path must be evaluated and weighed appropriately. Moreover, the paths do not always lead forward but may loop back on themselves, thus leading to a circular chain of effects.

This is, of course, a very simplistic outline of the forces at work. More detailed discussions of the system and its functioning will appear in this case study and Part II (Methodology).

Data Requirements

The above framework is merely a logical structure; qualitative reasoning alone, however, does not suffice in getting concrete answers to food consumption effects of agricultural policies. To translate the conceptual framework into an operational tool, it is necessary to put numbers into the different relations. We set out to do that by obtaining information on the following:

Household Food Consumption

At the center of the problem is the relationship between food consumption, and family income and food prices. The price mechanism signals both consumers and farmers to the changes taking place in the system. Consumers respond to price changes by increasing or reducing food consumption and changing the composition of their diets. Income gains generally lead to a higher consumption of most foods, but there may be some foods whose consumption declines as family income increases. The diet also varies according to the seasons, but given the short duration of the study, this aspect will not be considered in depth.

A brief household food consumption survey was carried out with special attention being given to the following determinants:

a) Income -- Household sampling in several income categories will allow us to relate income changes with consumption levels of each major food. Reliable information about household income is, in general, very hard to obtain; especially if there are several earners in the family. Total for rural families' crop production and off-farm income will be used instead as proxies for household income.

b) Prices -- Observing food consumption over alternative price ranges poses a problem, since market prices do not normally vary from family to family. To overcome this, we will take advantage of the price differentials between markets along the "ring road" connecting the principal towns in the province. Transport and marketing costs would dictate that foods produced in rural areas and flowing into Bamenda, would be cheaper as one gets away from Bamenda. Conversely, foods imported from outside the region would be cheaper in Bamenda and increase in price as one gets farther along the "ring road."

The household consumption survey will, therefore, sample several villages along the "ring road." In order to interview a sufficient number of families, only three days of observation will be made per household.

Whenever possible, data from previous studies will be used to complement or substitute the household survey. The 1978 National Nutrition Survey included a food consumption component; unfortunately, the amounts of each food were not recorded, nor were they related to prices or incomes. It covered only households with children younger than five years old, and only foods eaten by the child and the child's keeper were noted.

Farming Systems

A good understanding of the present farming systems in the Northwest region is essential to anticipating the farmers' response to changing economic conditions. Their adjustments in crop patterns as a response to prices of agricultural products and farm inputs, is an essential part of this study. Unfortunately, it is quite beyond the scope of a project with a short duration, to attempt a thorough farm management study. The conditions affecting farmers' economic behavior are very specific to a location. Given the ecological diversity of the Northwest Province, several such studies might be needed to represent the different zones. Furthermore, the timing of agricultural activities for the different crops has been found paramount in explaining the relative

distribution of crops in a region. Studies in other parts of Africa have indicated that labor shortages at critical periods in the growing season, are the major constraints in expanding agricultural production. Finally, the schedule for this project's fieldwork is not propitious for doing a farm management survey, since it ended at the beginning of the growing season.

In the absence of a full-grown farm management survey, this project attempts to identify a representative farm profile for the highland zones of the region. This entailed assemblying of data concerning crop areas, agronomic techniques, yields, calendar of operations, and labor requirements. Other factors that may affect crop patterns, such as proximity to markets, price of farm inputs, credit availability, subsistence needs of the family, fallow and rotational land requirements, were also taken into account.

Supporting Surveys

Three smaller components are planned as part of this project to complement the information from the household food consumption survey and the farming system profile:

a) Market Prices -- A record of food prices in the sample villages and other towns was kept. These prices help verify responses from both farmers and consumers, and also permit rough estimates of marketing and transport costs. The fact that most rural markets meet on different days over an 8-day cycle, facilitated collecting price data with a minimum use of manpower. Whenever possible, actual food purchases by local consumers were used to compute prices, but if needed, actual purchases were made.

b) Trade Flows -- This project is primarily concerned with the potential effect of agricultural exports toward Nigeria from the Northwest Province. We need, therefore, to understand which products are more likely to be exported, and in which areas of the Northwest Province they are likely to be produced. The precise quantities of foods being traded are not as essential as their relative magnitudes, origins, and destinations.

Potatoes, beans, corn, and green vegetables are among the main export products from the area. Coffee and cattle, however, are already far more important exports in value, but the marketing arrangements followed for these are different from other agricultural products. The significance of the Nigerian market, in the case of cattle and coffee, is not explored here.

There is little information about the supposedly profitable market existing across the border in Nigeria, and the transport and marketing costs involved. As part of this project, we obtained information on prices of prospective exportable commodities in some border markets, as well as on road transport costs.

Organization of the Country Report

This country report consists of seven chapters, including the current introductory information. Chapter 2 presents an overall description of the physical geography of the Northwest Province and the highland regions, followed by a detailed description of the agricultural production patterns among sample villages. Chapter 3 gives an overview of the marketing system for the principal agricultural products from the Northwest Province, followed by a discussion in Chapter 4 of the demand prospects for food crops in the coming years, from both Nigeria and the coastal zones of Cameroon. Food consumption and nutrition is covered in two chapters (5 and 6), the first looks at the composition of the diet in the sample villages, and the structure of the sample households; the latter examines the nutritional adequacy of the diet in terms of energy and protein. Short-term estimates of price effects on the average per capita caloric intake end Chapter 6. The final chapter summarizes the main findings regarding the impact of prospective growth in demand upon the diet in the Northwest Province highlands.

In addition to these chapters which comprise the Cameroon country report, Part II of the project report contains separate papers on the analytical techniques as well as the survey methodology developed and used for the Cameroon study.

CHAPTER 2

AGRICULTURAL PRODUCTION

The Northwest Province

Ecology and Physical Features

The Northwest Province is part of an ecological zone known as the western highlands, an area diverse in ecological niches providing an environment in which both a temperate zone exists and tropical crops can be grown.[1] We can divide the Province essentially into two primary zones: a "corn" zone in which corn is the primary staple food produced, concentrated in the east and northern highlands, and a "cocoyam" zone in which cocoyams provide the primary staple food, concentrated in the lower lying areas in the southern and western parts of the Province. Diverse ecological features in both zones provide pockets within these two areas where cropping patterns are reversed, thus providing a varied choice of food products throughout the Province. The Province is extremely rich in agricultural production and potential. A schematic outline of the Northwest Province's major food crop area features is shown in Figure 2.1.

The Province itself covers an area of 1,730,000 hectares or approximately 3.8 percent of the total area in the United Republic of Cameroon. In addition to the richness of its agricultural production, the area offers considerable potential for livestock and small animal production due to its high elevation and relatively cool climate which largely prevent fly-carried trypanosomiasis and other animal diseases.

The Province is a high lava plateau surrounded by successively lower plains and valleys, often broken by volcanic peaks. The Mentchum Valley in the west and the Donga Plain along the border to the north are the lowest areas in the Province, lying below 300 meters in altitude. Intermediate plateaus, including the Ndop and Mbaw Plains, are in the 1000-1300 meter zone, above which are the high plateaus around Bamenda and Kumbo, at 1400-1700 meters. The highest mountain in the Province is Mt. Oku, at 3008 meters above sea level. The plateaus are frequently quite hilly, traversed by mountains with steep slopes often cut by deep valleys.

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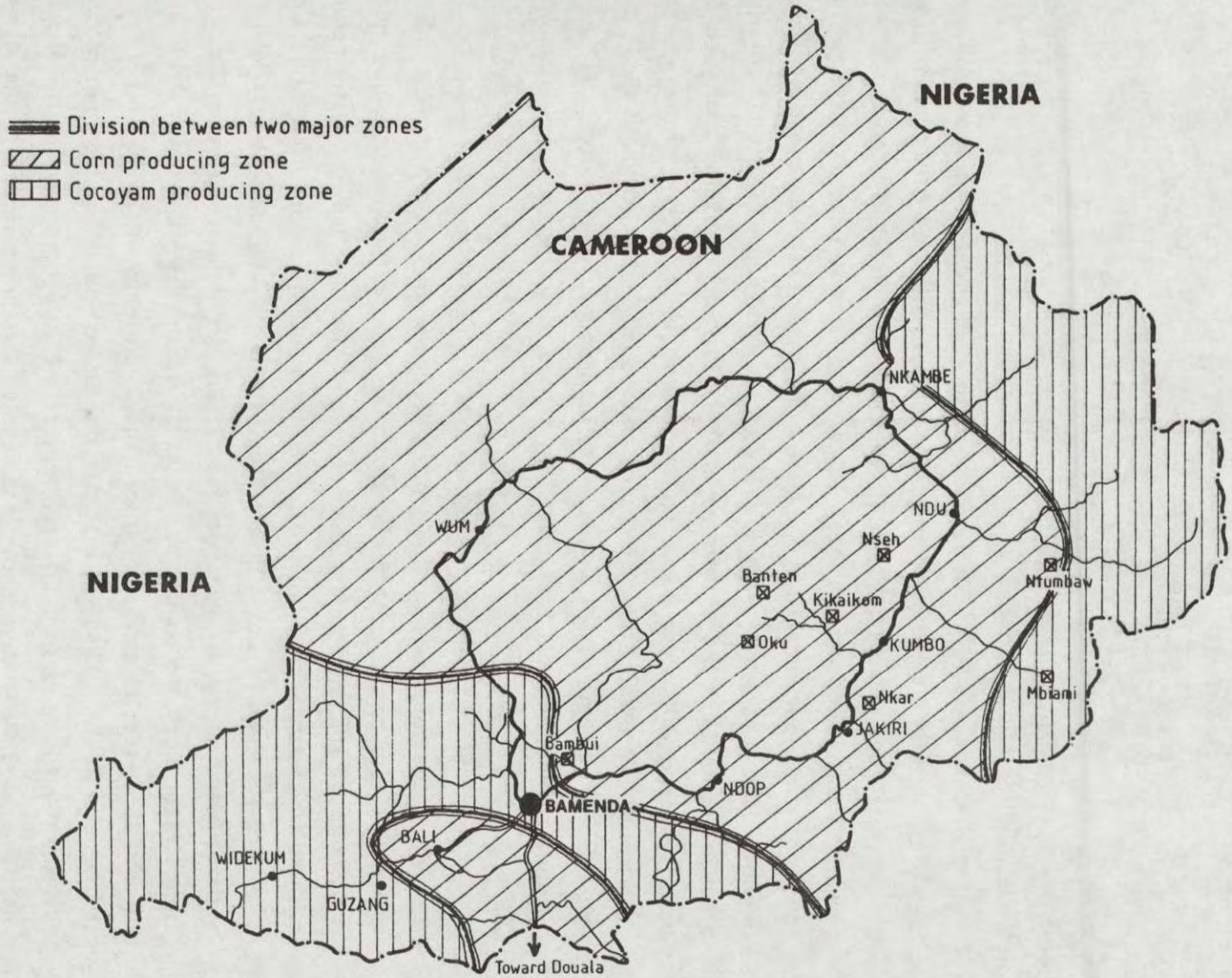
[1]Much of the following background information is summarized from the Agricultural Marketing in the Northwest Province, Executive Summary, 1980.

FIGURE 2.1 MAJOR CROP ZONES, NORTHWEST PROVINCE



Largely as a function of altitude, temperature and rainfall vary widely. The high mountain regions receive over 3000 millimeters of rainfall annually, while lower regions average between 1000-2000 mm of rain. Temperatures range from an annual average maximum of 16.7-18.9C^{o} (62-66 F^{o}) and a minimum of 8.9-10.6^{o}C (48-51 F^{o}) in high altitude zones, to an annual average maximum of 28.5-35.3C^{o} (83.8-95.5 F^{o}) and minimum of 14.6-22.2C^{o} (58.3-72.0 F^{o}) in the lowest zones. In their 1965 study of the ecology of West Cameroon, Hawkins and Brunt identify ten distinctive climatic zones in the Northwest Province, ranging from "Cold, cloudy, and misty," to "Hot, very humid and extremely wet." Seasons may vary considerably from one area to another, but generally there is a six to seven month rainy season from mid-March to October, a cool dry season from October to December, and a hot dry season from January to March.

Transport and Communications

Transport Infrastructure

The major transport artery within the province is the "ring road," some 368 km long, laterite-surfaced, and relatively well-maintained throughout the year. The "ring road" provides the major evacuation route for agricultural produce. The road starts at Bamenda, the provincial capital, extending northwards in a circular pattern through Ndop, Kumbo, Ndu, Nkambe and back southwards through Wum to Bamenda. Between Nkambe and Wum -- a relatively low population area -- the road is less well-maintained. There are a number of feeder and secondary roads extending out from the "ring road" to smaller villages; these routes are often poorly constructed and maintained. Many if not the majority of these roads become virtually impassable during the rainy season, and many villages can then be reached only in 4-wheel drive vehicles, if at all. A considerable amount of agricultural commodities spoil because of lack of adequate evacuation facilities.

On the plains, roads may remain inundated for long periods of time. Due to poor drainage, surface water erosion along steeper gradients is one of the major causes of damage to roads. Poor quality of construction, low design standards and inadequate maintenance all contribute to the poor quality of the transport infrastructure. The institution of a series of rain gates along the "ring road," at which large trucks are required to stop for four hours after rains cease, has helped to keep the road passable during rainy season, although this system increases the already high cost of transport in the Province.

A paved coal tar road from Bamenda to Bafoussam in the West Province provides the major channel for external transport. Other roads leading out of the Northwest Province include a rather poorly maintained road through Widekum to Mamfe in the Southwest Province, and a fairly well-maintained road from Jakiri to Foumban in the West Province.

Communications

Aside from the transport network, there are few means of communication in the Northwest Province, either internally or externally. Bamenda and Kumbo have telephone systems; however, this communication channel is often unreliable and it can be difficult to call out from these areas. The telephone network from Kumbo is often more reliable than the Bamenda system, but at times it is impossible to call out of the Province or between Kumbo and Bamenda at all. This makes it difficult for information regarding demand and prices in major markets outside of the Province to disseminate quickly. Although traders keep each other fairly well-informed of current price and demand in major cities, these can vary considerably from one week to the next. Since virtually all people listen to the radio, it might be feasible to broadcast prices and projected demands from the major cities.

The Highlands

This region is of particular interest due to the type of crops grown and the amount of uncultivated land available in outlying areas. Corn, beans and Irish potatoes -- all highlands crops -- appear to have the greatest potential for export. In addition, the area provides an environment in which garden vegetables can do well, although due to low demand, perishability and inability to compete with the West Province for outside markets, at the present time these are not cultivated extensively in this area. (Most garden vegetables exported to Douala and marketed in the Province come from Santa in Mezam Division.)

In the eastern highland area, the Fon is the symbolic or titular owner of all land which is administered and allocated through a system of landlords from whom people "beg" land. Land for food crop production is viewed on one level as "free land." However, as the area becomes more commercially-oriented, landlords are increasingly reluctant to give out land to people outside their own lineages, especially for a tree crop such as coffee which essentially results in private permanent tenure for the farmer. Problems of land tenure in this region will be discussed more thoroughly in

the following chapters, as will farmer-grazier problems which are considerable and a real constraint to increasing both agricultural and livestock production at this time.

Nseh, Oku, Mbiami and Nkar all have their own Fons who are responsible to the Fon of Nso, but who enjoy control over lands and people under their jurisdiction. Banten, Kikaikom and Ntumbah have village chiefs or quarterheads; Banten and Kikaikom are directly under Nso, while the Chief in Ntumbaw is responsible to the Fon of Ndu.

In all of these villages traditional councils composed of the Fon or village chief as head (along with quarterheads or other notables such as landlords) judge land, marriage, and farmer-grazier problems. If these cases cannot be resolved by the traditional council, they are taken to the local council responsible for the respective village. Local councils here are also responsible for building and maintaining certain roads and water systems.

Bambui was picked as a primary data point as a village with good transport and market access due to close proximity to Bamenda, the provincial capital. Although at one time the Fon here had considerable power over local matters, unlike many of the Fons in the eastern highlands today, his authority has been substantially eroded. This may be due to increased commercialization of the area, especially of land, and to increasingly urban-oriented values of the local population.

The authority of the Fon in Bambui has largely been replaced by the Tubah council and the traditional council. The Tubah councils are made up of one man and one woman selected from each of the seven villages in the area. This council is responsible for certain local roads, markets and water supplies, and also controls some land for the government.

The traditional council -- made up of the Fon as symbolic head, an elected chairman and eleven members elected by the village as a whole -- is responsible for trying land and marriage cases. Any criminal cases are referred to the magistrate court. There are few farmer-grazier problems around Bambui. Land in and around Bambui, with the exception of some council-controlled government land, is all essentially commercialized or under individual tenure. A 100 by 50 meter plot for buildings costs at least 100,000 FCFA; land for coffee and/or food crop production costs approximately 200,000 per acre. Land for growing food crops rents for approximately 2000 FCFA/year for one-fourth or less of a hectare.

Agricultural Production

Land Use and Soils

Land use in the Northwest Province is closely related to the widely varying quality of soils. Champaud (1973) identifies three major types of soils: ferralitic, hydromorphic, and weakly-developed. The most fertile farmland is in a humic, ferralitic soil region extending in a crescent from Bamenda to Nkambe, and south from Bamenda toward Bafoussam. This area corresponds roughly to the highland region above 1200 meters altitude, selected for this study. A larger section covered less fertile ferralitic soils occupying the central and northern parts of the Province where much of the grazing land is. Both Ndop and Mbaw Plains have hydromorphic soils of varying degrees of fertility and low drainage capacity in some areas. This often causes heavy seasonal flooding, impeding transport during the season of heavy rains. Around Mt. Oku and in the Wum area, the soils are weakly-developed, and, although quite fertile, their capacity to hold water is low. Crops around Oku at the time of the survey, May 1981, were not doing well because the rains started relatively late.

Land use estimates for the Northwest Province according to the 1976 National Agricultural Census are as follows:

Cultivated land	10.6%
Developed agricultural land	11.0%
Forest reserves	7.0%
Grazing land	59.1%
Other	12.3%

The difference between cultivated and developed agricultural land lies in both the intensity of cultivation and type of crops. Land with permanent and cash crop production is considered more developed than land with annual food crops. These two categories take into account land left fallow. The percentage of fallow land, especially around more populated areas, is steadily decreasing. Most of the farm land in Mezam Division and around towns such as Kumbo is now under continuous cultivation.

Principal Crops

Agriculture accounts for over 65 percent of the total provincial gross domestic product. The estimated value of agricultural production in the Province is

approximately 32 billion FCFA with gross domestic product estimated at over 50 billion FCFA. The Province contributes an important proportion of the country's food crop production, accounting for over 18 percent of the value of agricultural production in the national economy (valued at 174.4 billion FCFA in 1976/77). Agricultural census statistics indicate that the Province produces high percentages of the nation's production of the following crops: beans, 29.3 percent; corn (maize), 27.4 percent; Irish potatoes, 20.4 percent; sweet potatoes, 19.8 percent; yams, 18.2 percent. Over 30 percent of the national Arabica coffee hectarage is in the Northwest Province, as well as 64.6 percent of the national tea hectarage. Cassava, cocoyam, groundnuts, plantains and tomatoes are also important crops cultivated in the Province.

Table 2.1 presents 1979/80 figures on agricultural areas under various crops in the Northwest Province. These are preliminary figures from the Provincial Delegation of Agriculture, and must therefore be viewed with the proper caution. The highland areas of greatest interest in this study are included mainly in three divisions -- Bui, Donga/Matung, and Mezam. These divisions produce the bulk of corn, beans, and (Irish) potatoes, the predominant crops among the surveyed households. Together with coffee, these three crops account for almost the entire agricultural export trade from the Province.

Although palm oil statistics do not appear in Table 2.1, the Northwest Province produces about 40 percent of its own needs, and Momo division is the main source. Cocoyams and cassava are widely-grown in the warmer climate of the lowlands, but they are marketed to only a limited extent within the Province. Exports of cocoyams and cassava outside the Province are precluded by their low value-to-weight ratio as well as the lack of access routes to the producing areas. As noted earlier, although prices for tubers have risen dramatically in Nigeria the past few years, we do not view these crops as having a great export potential for the same reasons cited above.

Crop distribution patterns in the households can be observed in Table 2.2. The figures reflect the dominant role of corn in all sample villages, and to a lesser extent that of beans, potatoes, and coffee. These percentages however, are far from accurate estimates of areas under each crop, since no account is being taken here of field areas. Instead, for each cultivated field of the households, the crops in place were recorded. When two or three crops were simultaneously present each crop was given one-half or one-third weight, respectively. Percentages in Table 2.2 therefore reflect the relative frequency of crops rather than relative areas. Arabica coffee trees cultivated around the house, for example, were counted as separate fields, even

TABLE 2.1

CAMEROON NORTHWEST PROVINCE. AREA CULTIVATED IN SELECTED CROPS, BY DIVISION. 1979/80. (hectares)

Crop	DIVISION					Total Province
	Mezam	Bui	Menchum	Donga/ Matung	Momo	
Coffee Arabica	13,305	2,039	5,014	4,038	390	32,000
Coffee Robusta	330	-	-	269	1,306	1,906
Palm Oil ..	-	-	-	-	-	-
Cocoa ..	-	-	-	-	60	60
Tea ..	-	-	-	578	-	578
Maize ..	25,430	29,500	40,000	64,275	2,600	161,805
Rice ..	1,906	496	1,800	604	300	5,147
Guinea Corn	-	10	200	30	-	240
Groundnuts	8,500	2,000	6,000	2,286	408	19,244
Bambara Gnuts	140	20	700	10	11	881
Beans ..	15,720	23,000	9,500	32,554	1,025	81,799
Cocoyams ..	15,720	60	5,000	142	25,000	45,922
Colocasia ..	21,005	870	3,500	233	9,560	35,468
Cassava ..	11,103	605	3,500	6,506	1,700	23,414
Potatoes (Sweet)	312	20	1,500	61	400	2,293
Potatoes (Irish)	515	8,300	20	23	2	8,860
Yams ..	11,500	410	700	1,365	12,400	26,375
Plantains ..	16,620	1,410	4,500	1,846	1,760	26,136
Bananas ..	14,005	205	2,500	278	250	17,238
Onions ..	5	-	-	-	-	5
Sugar Cane ..	202	32	45	243	28	551
Pineapples ..	143	5	9	15	45	217
Tomatoes ..	156	11	15	21	30	233

SOURCE: Provincial Delegation of Agriculture, preliminary figures.

TABLE 2.2

CAMEROON NORTHWEST PROVINCE. APPROXIMATE CROP DISTRIBUTION IN HIGHLAND SAMPLE VILLAGES 1981. (percentage)[a]

Crop	Nseh	Oku	Mbiami	Ntumbaw	Kikaikom	Banten	Nkar	Mbiami	All Villages
Corn (maize)	32	31	26	30	26	28	29	23	28
Beans	27	22	19	27	21	19	15	8	19
Potatoes	22	12	22	6	15	18	4	3	12
Cassava			2	2	2		3	1	1
Cocoyams	1	3		3	1	1		18	3
Yams	1				2		1	4	1
Vegetables			1			2	1	1	1
Groundnuts		7		2	1	2	7	6	3
Plantains		2	1			1	9	11	3
Palm Oil								1	-.-[b]
Cocoa trees				1					-.-
Coffee trees	5	16	19	13	20	17	20	12	16
Bananas	5	1	2	1	7	7	7	2	4
Raffia Palms		1		1			1	3	1
Cabbages								1	-.-
Tomatoes								1	-.-
Pears (Avocados)	3		1	3	2	3		1	1
Pineapples								1	-.-
Papayas (Paw-Paw)								1	-.-
Equssi								1	-.-
Kolanuts	1	5	6	7	2	2	2	1	3
Plums								2	-.-
Oranges					3	1	2		1
Rice				5					1
Sugarcane	3			1					-.-

SOURCE: Survey data.

NOTES: (a) Percentages computed based on frequency of mentions of crops in household fields.
(b) Negligible amounts.

though often there are only a few trees; as a result, coffee seems over-represented vis-à-vis the main crops. Percentage values for bananas and plantains, interplanted among the coffee trees to provide shade, may also exceed their proportion of cultivated area. By contrast, values for corn, beans, and potatoes may in fact underestimate their actual percentage of area since they are grown in larger fields than coffee and are always interplanted with each other or with other crops.

Mbiami shows a significantly different crop production pattern from that of other highland villages. Corn is less important, and potatoes virtually dissappear. Cocoyam and plantains, on the other hand, are grown in many more fields than in other villages. Mbiami also produces an extraordinary diversity of garden vegetables and fruits. These differences may be ascribed in part to the lower altitude, and to its closer distance from Bamenda, hence the presence of better marketing possibilities.

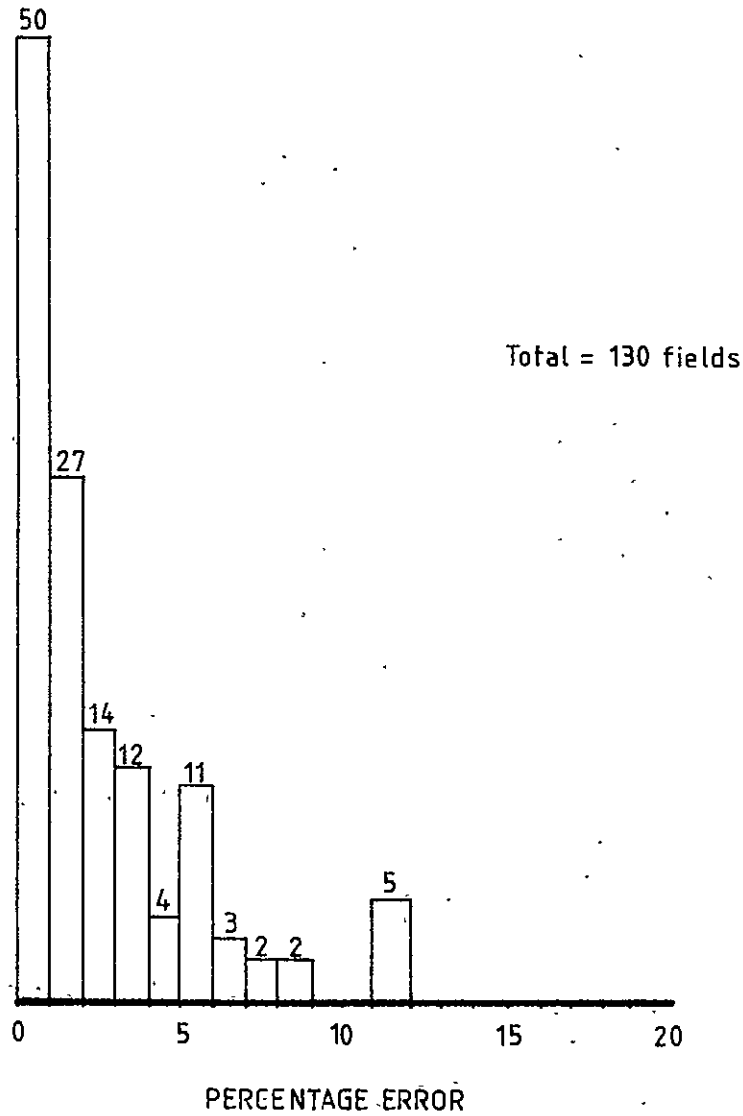
Farm Types

In the highland area most farms range from moderate slope to almost vertical planting on hillsides. Most farmers practice contour farming, creating horizontal ridges on the hillsides. This practice is fairly effective in preventing soil erosion. Corn, beans, and Irish potatoes are intercropped along these ridges. Cocoyams, where grown, are usually planted separately, although they may be planted in coffee farms or intercropped with other tubers such as yams. Corn production predominates in both Bui and Donga/Mantung Divisions, while tubers are the most common crops around Bambui. In Bui Division, Irish potatoes are the second most important crop, while in Donga/Mantung Division, beans rank second to corn.

Farm plot areas were obtained for a subsample of 130 plots out of the 300 plots among the 72 highland households. For each family a couple of fields with food crops were measured with a compass and string. A portable calculator was programmed to compute the plot area and measurement errors in the field itself. This effort was made to demonstrate the feasibility of getting reasonably accurate field areas rapidly in the course of a rural survey. The results were very encouraging as can be seen in the distribution of closing errors in Figure 2.2. Seventy percent of fields were measured with closing errors under three percent, a remarkably low figure compared to similar efforts elsewhere. The success of the procedure can be attributed mainly to the choice of equipment -- a Topochaix compass, a Topofil lost-thread odometer, and an HP-41C calculator -- and the ability to remeasure fields when errors were too large. Unfortunately, time did not permit all fields to be measured. Consequently, it is not possible to arrive at direct estimates of farm size for each household.

FIGURE 2.2

CAMEROON NORTHWEST PROVINCE. FREQUENCY DISTRIBUTION OF FIELD MEASUREMENT CLOSING ERRORS IN HIGHLAND SAMPLE VILLAGES. 1981 (percent)



SOURCE: Survey data.

Most farmers in the survey have between two and seven plots, with the average for the sample at 4.2. Plot sizes vary from 0.01 hectare to 2.2 hectares, with an average of 0.45 ha. (See Table 2.3) This gives an overall average of 1.88 hectares, slightly higher than the reported provincial average of 1.21 ha. Differences of average farm size between divisions are fairly substantial. Among the sample villages average plot size ranged from a low of 0.29 ha in Nkar to 0.70 ha in Banten, while most averages were within 0.35 and 0.55 ha. Figure 2.3 shows the frequency distribution of plot size among the subsample of measured plots.

According to national statistics, there is a wide range of farm sizes in the Northwest Province, where small farms predominate: 26 percent of farms are below 0.5 ha and 53 percent are below 1.0 ha; on the other hand, the 10.5 percent larger farms in the province are over 2.4 ha. The latter category constitutes approximately 32 percent of area cultivated.

We surmise from these figures that there is a category of approximately 10 percent of farms devoted substantially to production for the market, a large middle category of around 36 percent engaged in both commercial and subsistence production, and the major proportion of farmers producing primarily for household consumption. The first category might be largely concentrated around Santa, while the second category is more characteristic of Mezam Division as a whole. The last category, farmers producing foodstuff mainly for household consumption with marginal food crop production for the market, is characteristic of the majority of the households in our sample. If coffee is included, however, as it should, a larger percentage of these households would belong in the second category, farmers engaged in both commercial and subsistence production, since coffee is the only fully commercialized crop in the highland sample area.

The distribution of farm size according to both our sample and national statistics is somewhat skewed. From the survey data on Table 2.3, we see that three villages -- Mbiami, Oku and Bambui -- have higher standard deviations than means, indicating that plot sizes vary within as well as between villages. One must therefore think, not in terms of average farm size, but rather in terms of a range of variation in farm size from one household to another.

We must note here that although corn, beans and Irish potatoes predominate in the highlands (Bui and Donga/Mantung Divisions) the zone grows a variety of other crops primarily for household consumption. These include pumpkins (egussi), pepe, sugarcane, a variety of leafy vegetables (especially njamajama), garden eggs, cowpeas,

TABLE 2.3

CAMEROON NORTHWEST PROVINCE. AREA OF SELECTED FOODCROP FIELDS IN HIGHLAND SAMPLE VILLAGES. (hectares[a])

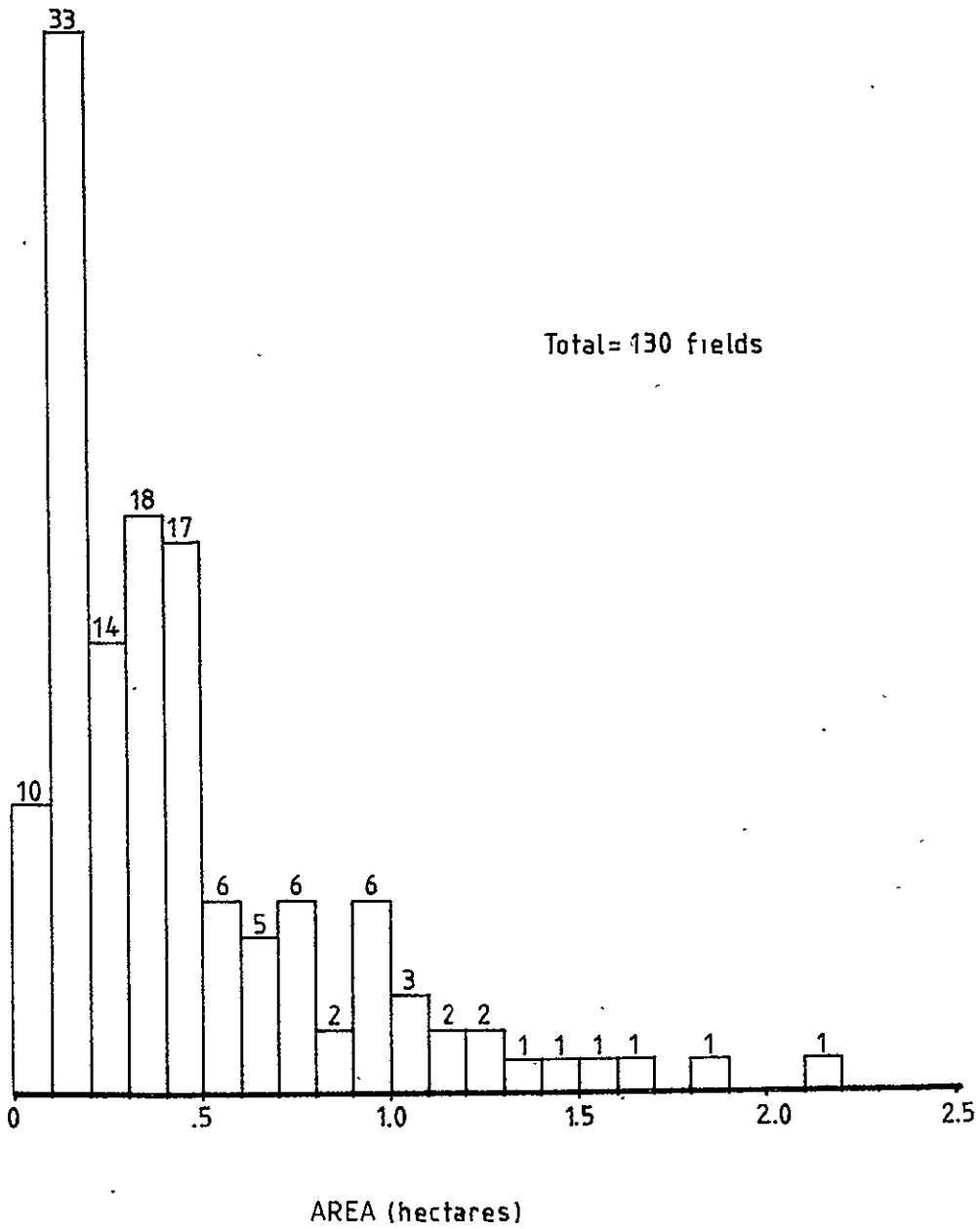
Village	Number of Fields	Area			
		Minimum	Maximum	Mean	Std. Deviation
Nseh	17	.155	1.27	.55	.31
Oku	10	.012	1.03	.35	.37
Mbiami	17	.048	2.19	.48	.50
Ntumbaw	17	.073	.93	.31	.26
Kikaikom	19	.079	1.04	.37	.30
Banten	18	.079	1.60	.70	.48
Nkar	15	.079	.61	.29	.16
Bambui	17	.095	1.82	.52	.55
All Villages	130	.012	2.19	.45	.40

SOURCE: Survey data.

NOTE: (a) 1 hectare = 10,000 square meters = 2.47 acreas.

FIGURE 2.3

CAMEROON NORTHWEST PROVINCE. FREQUENCY DISTRIBUTION OF MEASURED CROP FIELDS IN HIGHLAND SAMPLE VILLAGES. 1981



yams, sweet potatoes, cabbages, okra, tomatoes and pineapples where ecological conditions are suitable. In addition, a variety of tree crops are cultivated, including kola nuts, avocados (pear), plantains, bananas, papayas, mangoes, oranges, and raffia. The majority of these tree crops, especially plantain and banana, are interspersed with coffee. With the exception of rice, onions, ocean fish, salt and palm oil, the Northwest Province is largely self-sufficient in basic foodstuff production.

Division of Labor

Women traditionally perform the majority of labor required in food crop production. The main involvement of men is in the initial clearing, usually involving less than one week per year. Some men help with planting. The corn harvest is usually carried to storage by young men, friends or relatives of the husband, who are then given food and wine in return for their labor. Most often 10-30 young men participate, rotating from farm to farm, helping in turn on their mother's or other relative's farms. A household's total corn harvest can be accomplished rather quickly, as women also group together to help each other with the harvest.

Tasks performed by women include tilling, planting, weeding and harvesting, which are ongoing tasks requiring almost daily attention. The sexual division of labor, while still rather rigid, seems to be loosening somewhat. Many younger men are now working along with their wives in the fields, although not many men even now will use a hoe which carries symbolic connotations as a woman's possession. The calendar of labor activities in the highlands is fairly clear-cut, but varies from one region to another depending on climatic and ecological conditions. Generally, clearing takes place immediately after the coffee harvest, usually in January. The soil is then tilled from January to mid-March. Planting of corn, beans and potatoes occurs as soon as the first heavy rains begin. Fields are often weeded two times beginning in mid-April and continuing through July. Beans and potatoes are harvested first, usually from mid-July through the beginning of August. Corn harvest starts in some areas in late July and continues in various parts of the Province until September. Tubers follow the same basic pattern with the exception of harvesting which occurs during several parts of the year: January-March and October-December.

The range of labor time involved for specific plots and yields varies too widely to make any definitive statement at this point. We estimate that women spend an average of over 200 days per year working food crops, although the length of the day will vary substantially given seasonal labor requirements. The heaviest labor times are

during tilling and weeding. Women usually work together in cooperative labor groups ranging from 5-20 members. This helps alleviate heavy seasonal labor constraints. Children have traditionally been an important source of labor to the household. Although their contribution to farming has somewhat diminished as school enrollment increases, children still perform a significant amount of farm labor.

Men are somewhat more involved in working coffee plots, although women till and harvest the majority of coffee plots. Labor is hired almost exclusively for "men's" work-clearing and working coffee plots. Some men with food crop fields will hire labor for other tasks, while a few women hire help on their own farms. Hired labor forms a very small -- almost insignificant -- proportion of labor for households in our sample.

While women would like to increase their production, their subsistence and domestic labor obligations, which stem from their duty to grow and prepare the family food, actually leave them little time to do so. Although virtually all women farm, few sell more than 10-15 percent of their produce. Women's own labor appears to be stretched to individual capacity at this point.

Recently, more men have become interested in growing food crops. In response to the question "If you had more land, what would you grow?", 50.67 percent of men as opposed to 5.5 percent of women interviewed said they would grow cash crops, i.e. coffee; 12 percent of men as opposed to 5.5 percent of women said they would grow food crops to sell only; 32 percent of men said they would grow food crops to eat and sell, while 70.8 percent of women declared they would do so. Only 5.33 percent of men interviewed claimed they would grow food to eat as opposed to 18.05 percent of the women. Of the men who said they would grow cash crops, 22.7 percent claimed they would also grow food crops to sell. Overall, 72 percent of the men in the survey claimed they would grow food crops to one degree or another if they had the means to do so. Their orientation towards food crop production, however, is basically commercial.

Land Tenure

When we speak of customary land tenure systems in the Northwest highlands area, we should disregard ideas of absolute ownership of land as a commodity which can be bought or sold by individuals at will, and instead think of control over land as a bundle of rights vested in different individuals at various levels of society. Out of the many rights which can be identified, two stand out clearly. First, there is the right to own land. This right is not vested in individual persons, but rather in the group to

which they belong, symbolically represented by the Chief or Fon's symbolic or titular control over all land within his domain. This land is administered and allocated through a system of "landlords" in any given village. Theoretically, land for food crops is free; the only payment involved has historically been a symbolic payment of a fowl and a calabash of raffia wine ("white mimbo"). Women "begging" land from individual landlords are usually required to work on the landlord's farm several days per year, and often give him a tin of corn from their own harvest.

Aside from the right to allocate and manage land, there is the right to use land--often in perpetuity--and this right is vested in the individuals within the group. With few exceptions the occupation and use of land has been individual, and a person enjoyed a security of tenure as long as he occupied the land and abided by customary law and the decisions of customary authority. However, these individual rights have been to the product of the land: to its use and inheritance of its use rather than to the land itself. Food crop land has not been viewed as a commodity which can be alienated by individual owners.

The underlying contradiction in this system of land tenure lies in the fact that the ideology stresses the supremacy of the group over its individual members, and yet these individuals possess pieces of land as long as they identify themselves with the group. While at the level of facts it would appear as if individuals own land, at the level of ideas it is the group that owns the land. The contradiction becomes more apparent as land begins to take on a market value of its own and begins to be treated as a commodity which can be bought or sold.

With a movement towards an increased separation of economic from non-economic activities, there is a relaxation of traditional or customary tenure constraints. This is further reinforced by the 1974 Land Tenure and State Lands Ordinances issued by the Cameroonian Government. These ordinances were viewed as a land reform law intended to protect the small farmer, assure him a permanency of tenure, and encourage development in rural areas. While there is a movement towards a relaxation of customary tenure constraints, at the same time there is a contradictory attempt to maintain the dominance of traditional values over developing land laws and activities, to defend the integrity of the customary pattern.

Several factors have led to an increasing amount of land coming under individual tenure or ownership. These include the introduction of coffee as a cash crop, population growth, urbanization, and the national land ordinances which give the government de jure rights over land while de facto control in most rural villages remains for the most part in the hands of the Fons and the landlords. Coffee, like

other tree crops, is considered a permanent crop which cannot be reclaimed by the landlord. Food crop land, on the other hand, can be reclaimed upon proper notice. Landlords have become increasingly reluctant to give out land to people outside their own lineages, especially for coffee production. Even food crop land now often requires an unofficial and often substantial payment to the landlord who still maintains rights of control over the land.

The land ordinances of 1974, while initiated to help the small farmer, have actually helped the wealthier farmers, especially those who are educated and aware of the laws, and who have the capital resources and access to the bureaucracy required to file for land allocation certificates. In order to file for land allocation, a man must first show he has the means to develop the land requested. While some fairly small allocations (3-6 hectares) have been approved, in Bui Division alone approximately 100 applications have been approved for over 50 hectares, primarily in Mbaw Plain. Small village farmers, on the other hand, find it difficult to file and do not see the need for land allocation certificates or title to their land. Although for the majority of these farmers at this time, tenure is relatively secure, new land is difficult to obtain, especially without capital to do so. Thirty persons--16.9 percent of people interviewed--claimed it would be difficult or impossible to obtain any more land. Several women reported that they have had some portion of their land reclaimed by the landlord.

Traditional values have thus far persisted so that families with little land have been absorbed and accomodated into traditional society, although sometimes unequally. These latent inequalities are beginning to come to the surface. Although new land is still available in the lowlands, without the resources for filing for that land, for transporting goods and for hiring labor it has become difficult to obtain and exploit these lands, most of which lie some distance from towns and villages.

Capital and Credit

Household labor appears from our survey to be exploited to a maximum extent at this time, especially given the traditional sexual division of labor which is still fairly rigid. Labor may well remain a, if not the, major constraint to increased production if more men do not become involved in food crop production. A large percentage (61 percent) of people surveyed indicated they would have to hire labor in order to farm more land. To date, virtually all labor is direct human labor, with few technological inputs. Hoes, machetes and cutlasses constitute the major farm implements.

Recently, oxen have been introduced through the Nso Cooperative Union. So far, these animals have been used primarily for wheat cultivation on a fairly small scale. Wheat is a newly-introduced crop and it is too early to tell whether it will be incorporated substantially into the local diet or will be able to compete with imported varieties both locally and in larger urban centers. Nso Union is aggressively pursuing markets for wheat in conjunction with the oxen program. Oxen might prove useful in some areas and could help to involve men further in food production. There are, however, serious shortcomings that will make it difficult to utilize animal traction. These include extremely steep hills as well as the existence of trypanosomiasis in the low-lying plains.

Potential for mechanized agriculture does not appear promising at this point, although new developments in appropriate technology might be explored further. Most farms are hilly and steep, making the use of tractors difficult if not impossible. Tractors might be utilized in low-lying plains. Even here, use of tractors may be somewhat limited given road access and machine maintenance problems. Rototillers may be more appropriate for these areas, although these remain prohibitively expensive for farmers at this time and are also subject to maintenance problems. There are several avenues open to farmers for credit, although these are somewhat unevenly distributed. Government-financed credit, apart from young farmer resettlement programs, is provided primarily through FONADER. FONADER has sponsored some specific credit programs, and provides credit to small farmers channelled through the Cooperative Unions. Up until now, credit to small farmers has been quite limited. Very few farmers in our survey have received FONADER loans. Loans to small farmers often are not substantial enough to allow any real increase in productive inputs. The amount loaned to any given farmer is based on his coffee production and thus perceived ability to repay the loan. Larger farmers often obtain loans from FONADER and utilize them for capital-expanding investments such as urban properties, taxes and trading rather than for farming. We might note here that since a farmer has to grow rice or coffee to belong to a cooperative, and loans are channelled through the cooperatives, it is virtually impossible for women to use this credit source. Women's cooperatives are mainly consumer cooperatives for distribution of palm oil and other basic household necessities. FONADER is in the process of reorganization, trying to make it easier for smaller farmers to receive loans. They are also trying to supervise more closely the use of loan funds.

Credit is also available through a system of credit unions whose apex organization, the Cameroon Credit Union Leaque (CamCCUL) is based in Bamenda.

There are currently over 112 credit unions operating in the Northwest Province, with approximately 18,000 members and 346 million FCFA in savings. Out of our sample, 33 percent of the men and 18 percent of the women belong to credit unions. However, few if any of these people use the credit unions as a source of agricultural credit. Most loans are used for school fees, medical expenses and family emergencies.

The primary source of credit remains the traditional savings and loan associations or njangis. Virtually all men and most women in our sample belong to at least one njangi. Men and some business women belong to credit njangis where substantial amounts are loaned and saved. Most women belong to savings njangis whose primary purpose is saving small amounts of money weekly with distribution of savings taking place once a year, usually around Christmas. These groups also lend small amounts of money. Interest rates, however, are extremely high. These groups also buy some household items -- i.e., soap -- at wholesale prices for distribution to members.

Very few people qualify for bank loans. Only two men in our sample have obtained loans through banks. Considerable capital is required in order to file for bank loans. Some men will use their FONADER loans as collateral to obtain bank loans.

Capital acts as a major constraint on production. Many if not the majority of households either hire or would have to hire labor to farm more land. Land has increasingly taken on a substantial cash value. It is also costly to file for land allocation and to exploit and develop large portions of land without sufficient capital for labor, land, transport and technological inputs.

New Lands

Land in the highlands is already so intensely used that slopes as high as 60 degrees are under continuous cultivation. Soil erosion is partly controlled through the widespread practice of contour farming. Intercropping also helps by protecting the surface from direct exposure to wind and rainfall; high humus content in the soil also contributes to good water retention qualities. Only the hilltops with very poor soils and little water are left uncultivated but are instead used to graze the few remaining livestock. Hardly any cattle are raised in the highlands now, and fresh milk is unknown in the diet of the surveyed households. As noted earlier, it is becoming increasingly difficult to obtain farming land even close to small villages; around major towns like Kumbo and Ndu it is practically impossible and very expensive.

It seems incongruous therefore to learn that there are nearby several nearby areas of unexploited land with high agricultural potential. These are are located below

800 meters above sea level but may in fact be fairly close to densely-populated highland villages. Examples of these areas are Nkuf and Lip, near Kumbo (see Map 2.1). Nkuf and Lip are now being farmed primarily by town people who commute long distances on foot, often living in temporary huts for several weeks during heavy labor periods. There is virtually no passable road to Nkuf, and the road to Lip becomes impassable for the larger part of the year.

Approximately 450 families are now farming in Nkuf where land was first brought under substantial cultivation in 1975. At that time, harvests were poor and land was hard to obtain. The Fon of Nso opened up Nkuf--formerly his personal hunting ground--to the people of Nso. The average farm in Nkuf is approximately 2 hectares, although some are under one and others as large as 3-4 hectares. We have no real estimates on the amount of unexploited hectarage in Nkuf but according to local farmers there is still substantial land available in the area. During dry season there are some farmer-grazier problems, but these are not acute at this time.

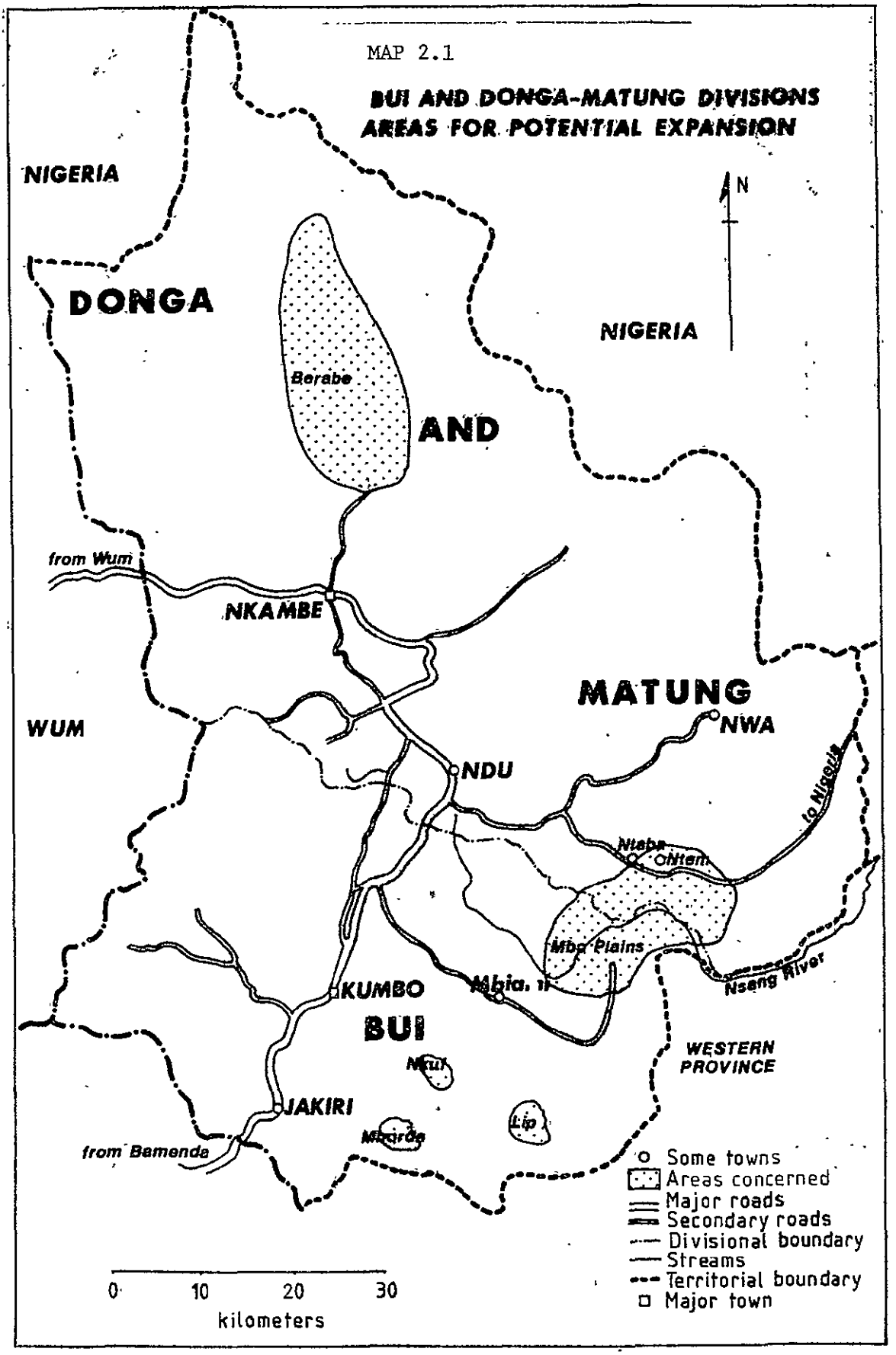
The major constraint to increased production and occupation of the area is lack of transport. Nkuf is an arduous, often steep trek of 4-5 hours from Kumbo. Local farmers have constructed by hand some 10 miles of road which is passable halfway down the valley during dry season. The road has to be rebuilt after each rainy season. Transport costs out are prohibitive--1700 FCFA for one bag (donkey load) and 250 FCFA for a headload or tin. Most food is headloaded out. A considerable amount of food spoils before it can be evacuated. Major crops are corn, beans, cassava, plantains and groundnuts. At this point, virtually all farming is subsistence or household-oriented. However, the soil is loamy and rich, and reported yields are quite high. Many farmers in Nkuf would like to increase production and commercialization of their farms. Due to difficulties with transport most farmers have had little incentive to produce for the market. Nkuf is also one of the few areas where men have become substantially involved in food crop production.

The Mbaw Plain is the largest area of potential expansion, covering portions of Donga/Mantung and Bui Divisions in the Northwest Province, and Bamoun in the West Province. According to local authorities the Government is instituting programs promoting rice, soya bean, Robusta coffee and oil palm as well as other food crop production including garden vegetables.

A small part of the Plain is under traditional control. The majority of the land is controlled by the Government to be allocated for appropriate development. There is no permanent land ownership in most of the Plain at this point. If a farmer wants a piece of land he must apply for an amount equal to his ability to develop it properly. If

MAP 2.1

BUI AND DONGA-MATUNG DIVISIONS AREAS FOR POTENTIAL EXPANSION



he does not do so, the land can be reclaimed and reallocated. Permanent residence in the area is not required as long as the land is farmed. Transport here has been a major constraint. Although there are roads to the Plain both from Donga and from Bui, these roads become impassable during rainy season, making crop evacuation difficult. Most of the rice cultivated in the Mbaw Plain is currently exported to Nigeria.

Young farmer settlement programs have been instituted in Mbaw Plain both by the Catholic Mission and by the Government. The Catholic Mission has settled 52 young farmers, providing credit for 3 hectares of cash crops and 3 hectares of food crops along with agricultural inputs. There are several restrictions on these young farmers. They must live permanently in the area, must pay back their loans and marry within three to five years.

The Government program is aimed primarily at young men between 17 and 25 years, and is not confined specifically to Mbaw. Any young man who can obtain at least three hectares of land can theoretically qualify for this program. They are given a loan of 360,000 FCFA, part of which is in kind, and are required to pay back only 160,000. If land is not worked properly the Government can confiscate it in lieu of repayment. Government agents are supposed to supervise production programs. There is no definite time limit for repayment of these loans, since production progress varies according to crops cultivated. In Kumbo subdivision, 36 young people, including two women have been included in the young farmer resettlement program. Women are at a disadvantage in applying for this program. Local authorities feel no man would want to move to a farm owned by his wife, and this program is aimed at young families in order to stem rural-urban migration.

Farmer-Herder Conflicts

Expansion of farmland is complicated by problems between farmers and herders. Herders for the most part are Fulani,although for local farmers cattle have become a desirable investment as well. As noted earlier, 59 percent of the land in the Province is designated as grazing land. This figure was established at a time when the Province was less densely-populated. The Northwest Province with a current population of over 1 million is now one of the most densely-populated areas in the country, with an average of 53 inhabitants per sq km. Approximately 85 percent of the population lives in rural areas, compared to an average of 72 percent nationwide. The livestock population has also grown rapidly with a total cattle population of 373,000 head, and as many sheep, goats and pigs.

Farmer-herder problems constitute the vast majority of land disputes in the highlands area. There are basically two types of disputes. The most common are over compensation for destroyed crops. Here goats as well as cattle are prime culprits. Farmers are not allowed to hurt animals caught destroying their crops. Instead, they must catch the animal in order to identify the owner. Needless to say, this is often difficult and ownership is usually hard to determine. In addition, many farmers claim herders are in a better position to win disputes which are usually costly to bring to court. These problems constitute approximately 55 percent of all land disputes. We should add here that although most cattle are owned by Fulani, local farmers owning cattle are more reluctant to pay compensation for destroyed crops while the Fulani, if convinced their animals are in fact guilty, will do so.

The second, and perhaps more serious, kind of farmer-herder disputes involve the allocation of what was formerly considered grazing land to farmers. This has been further exacerbated by the growth of rice in what were formerly dry season grazing areas. These cases constitute approximatley 25 percent of land conflicts. Many times these cases cannot be resolved by traditional authority or local councils and are more apt to end up before the district officer or even in magistrate court. Conflicts of this sort are especially common in the north and northeastern areas of the Province where programs for opening up new lands are being initiated.

CHAPTER 3

MARKETING OF AGRICULTURAL PRODUCTS

Relations with the Cameroonian Economy

The relative isolation of the Northwest Province has been both an advantage and a liability to market development and to production of foodstuff for export outside the Province. Although the Province has a relatively healthy climate and diverse ecozones, the infrastructure is much more weakly-developed than that of the West Province which shares basically the same ecozones. Thus it is difficult for Northwest farmers to compete effectively with farmers in the West Province for major markets in Yaounde and Douala, due primarily to differential transport costs and a more aggressive and better organized trading sector in the West Province.

Figures from the provincial delegates in Bafoussam (in West Province) and Bamenda (in Northwest Province) show that the quantity of marketed produce (both inside and outside the Provinces) were as follows for 1980:

TABLE 3.1

CAMEROON NORTHWEST PROVINCE. QUANTITY OF MARKETED PRODUCE, 1980

	Northwest Province (tons)	West Province (tons)
Irish Potatoes	8,000	30,000
Beans	21,000	25,000
Tomatoes	250	11,000
Cabbages	250	4,000

SOURCE: Scott, W.E. "Development in the Western Highlands," USAID report, Yaounde, 1980, p. 37.

Transport costs to Douala are 3-5 FCFA/kg higher from Bamenda than Bafoussam. Transport costs to Douala from our primary survey area are considerably higher due to the lack of an all-weather road to Bamenda from these areas. Cost per bag increases 50 percent from Kumbo-Douala (as compared to Bamenda) for transport cost alone.

As one of two anglophone provinces in what is essentially a francophone-oriented country, there are historical and cultural reasons for the relative isolation and more poorly-developed infrastructure in the Northwest Province. The fact that the Province, along with Nigeria, was under British rather than French colonial rule explains the development of many socio-cultural and economic ties of the Province to Nigeria. Southern Cameroon (now the Northwest and Southwest Provinces) was administered as a separate Nigerian Province for more than 25 years. Consequently, this part of Cameroon developed many important links with Nigeria. Despite the advantages of the Nigerian connection, "Cameroonian politicians always felt that the British Cameroons was being administered as an appendage of Nigeria, and that it did not receive the direct attention of the administering authority as required by its distinct status...There was very little government expenditure, either on the social services or on public works and the economy remained centered on the (Southwest) plantations which the Germans had developed" (Eyongetah and Brain, pp. 100-101). Therefore, it was not remarkable that the 1961 plebiscite unified the country politically but not economically, with the Northwest and Southwest Provinces (Southern Cameroon) choosing to unite with French Cameroon, while at the same time retaining economic ties with Nigeria.

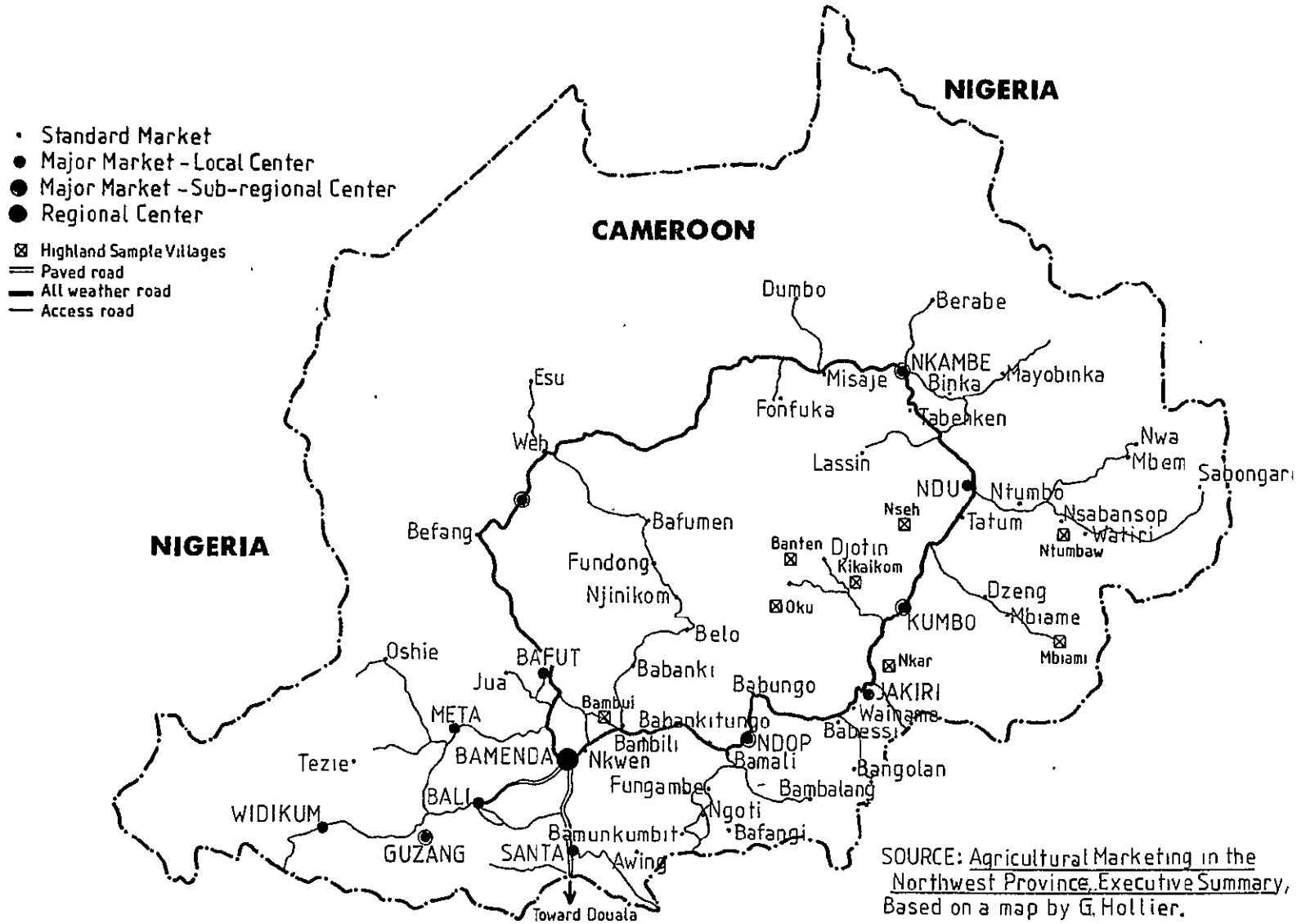
Intraprovincial Marketing

There is relatively little flow of staple crops from rural to rural markets. This is due to a low value-to-weight ratio for these crops, and low demand since rural areas are primarily self-sufficient in staple foodcrop production. Figure 3.1 presents a map of agricultural markets in the Province. The only items exchanged among rural markets appear to be lake fish and palm oil which are in high demand and which have a high value-to-weight ratio. At least 44 percent of all palm oil consumed in the Northwest Province is imported from the Southwest Province.

From rural areas close to Bamenda -- i.e., Bambui, Bali, Guzang, Mbengwi, Bambili and Meta -- market produce flows more directly to supply the provincial capital, with little going directly outside the Northwest Province. Ocean fish and rice are the major food imports to rural areas from outside the Province, which is otherwise self-sufficient in all other primary food items consumed (see Table 3.2).

Thus, although the ecological diversity within the Province has encouraged the production of a wide range of crops, there is little exchange of subregional specialities between rural areas and relatively low exchange with other regions.

FIGURE 3.1 MARKETS OF THE NORTHWEST PROVINCE



SOURCE: Agricultural Marketing in the Northwest Province, Executive Summary, 1980. Based on a map by G. Hollier.

TABLE 3.2

CAMEROON NORTHWEST PROVINCE. PERCENTAGE FLOWS OF MAJOR CROPS BY MARKET CATEGORIES

	Rural to Rural	Bamenda to Rural	External to Rural	Rural to Bamenda	Rural to External	Bamenda to External	External to Bemenda	Weekly Flow Total (100%) (T)
Cocoyams	00	00	00	90	10	00	00	29.9
Maize	11	00	00	56	25	03	00	10.1
Gari	09	00	00	70	05	15	00	19.0
Plantains	00	00	05	50	00	00	45	13.3
Potatoes	1	00	00	18	65	17	00	83.2
Rice	00	100	00	a	a	a	a	2.4
Palm Oil	17	02	1	35	01	00	44	41.3
Beans	04	03	00	18	69	06	00	31.3
Tomatoes	00	06	00	33	00	00	61	3.3
Cabbages	00	00	00	22	88	00	00	1.8
Lake Fish	100	00	00	a	a	00	00	1.5
Ocean Fish	00	100	00	00	00	00	a	2.0

SOURCE: Schwimmer, Brian. "The Structure and Performance of Agricultural Marketing in the Northwest Province, Cameroon" in Agricultural Marketing in the NW Province, USAID Report, 1979, p. 133.

NOTE: (a) Substantial flows are present but not indicated in survey. Table indicates pattern of rural distribution only.

Interprovincial Marketing

Primary crops exported from the survey area outside the Province are, in order of importance: Irish potatoes, beans and corn. Table 3.3 shows produce and destination for foodstuff exported in 1979-80 from Kumbo Market, which is the primary assembly point for exports and the second most important market in the province.

The major external markets for highlands produce are Douala and markets in the Southwest Province -- Kumbo, Tiko, Victoria. Some potatoes are sent directly to Yaounde, although spoilage risks and transport costs inhibit competition with the West Province. A considerable but undetermined amount of agricultural commodities goes directly to Nigeria (Gembu). Kola is the only product for which we have Nigerian trade figures; many traders say the figure of 1500 bags of kola obtained from the transport syndicate is considerably underestimated given the fact that many traders avoid the syndicate and go directly to Nigeria. Some traders estimate that close to 3000 bags of kola go out from the Kumbo area to Nigeria yearly.

Ndu syndicate records were not available. However, interviews with traders and syndicate personnel in Ndu indicate that produce from that area goes primarily to the Southwest Province, especially corn which is often marketed to poultry farmers and institutions such as schools and missions. Other important markets from Ndu include the West Province and Bamenda. Traders from these areas come to Ndu or send agents to buy produce for reassemblage out to Douala and Yaounde. Nigeria is also an important market for produce coming out of Ndu, in particular rice and beans.

We were also unable to obtain data from smaller secondary markets where records are poorly kept, if at all. Mbiami is an important market for potatoes going out to the West Province and Bamenda. The rest of the markets send very little produce directly outside the Province.

Relatively little information is available to measure price differences between markets at a single point in time or over a longer period of time. Although we conducted market surveys in each village, the span from April-August includes the time of corn, bean and Irish potato harvests in many areas, causing prices to change drastically from one week and one point to the next due to harvest gluts, especially for potatoes. We do know that potato prices at the beginning of harvest were 250 FCFA/tin (16.8 kg) in Mbiami, 400 FCFA/tin in Nseh and 800 FCFA/tin in Kumbo markets, indicating widely-varying prices depending on harvest, transport costs and marketing opportunities. Prices in rural markets are primarily determined by local

TABLE 3.3

CAMEROON NORTHWEST PROVINCE
EXPORTS FROM KUMBO MARKET (1979-80)

Produce	Bags (100 kgs.)	Destination
Potatoes	8,250	Douala
Corn	112	"
Beans	196	"
Potatoes	1,702	Southwest Province
Corn[a]	241	" "
Beans	5,869	" "
Pepe	250	" "
Potatoes[b]	1,471	West Province
Corn	237	" "
Beans	28	" "
Potatoes[c]	1,022	Bamenda
Corn	0	"
Beans	651	"
Potatoes[d]	4	Nigeria
Corn	184	"
Beans	26	"
Kola	1,500	"
Potatoes	320	Yaounde

SOURCES: Kumbo Syndicate Records and interviews with traders.

NOTES: (a) A large percentage of produce going out from Kumbo market is grown in outlying villages (especially those without actual markets) where various traders from Kumbo or other urban areas send agents to buy produce at lower prices in real bush markets. Kumbo is the primary assembly point for produce going out of the division. Many villages such as Mbiami, Djotin, Banten and Dzeng bypass Kumbo market and ship their produce directly, primarily to the West Province to be reassembled for major urban markets outside of the Province.

(b) Most corn going to the South West Province goes from Ndu where it is sold primarily to poultry farms and some institutions (i.e. schools). Ndu syndicate records were not available but the amount going out is considerably according to local traders. Produce from Ndu also goes out to the Western Province through traders from Foumban and Baffoussam.

(c) The produce exported to Bamenda and the West Province are usually purchased by traders from these areas for shipment to major urban markets in Douala, Yaounde and the South West Province.

(d) Most produce exported to Nigeria goes from Ndu rather than Banso market. See section on Nigerian trade and projected demand.

supply and demand conditions, transport costs, and the strength of urban demand, which is sometimes indicated to rural producers by the number of outside traders present in bush markets.

In the most remote markets poorly-served by the transport network, only a few outside traders may attend, often coming on an irregular basis. This puts the trader at an advantage since if producers want to sell their produce, they must sell at the price the few traders present are willing to pay. This is especially true for Irish potatoes which are highly perishable and hard to store and which are also harvested during rainy season when more remote markets become almost impossible to reach even in 4-wheel drive vehicles. However, it should be pointed out that traders coming to these markets are themselves taking a risk. In general, trading margins do not appear to be excessive. (See Agricultural Marketing in the Northwest Province, Executive Summary, 1980, p. 46 for estimated trader margins.) The table below indicates that over 60 percent of agricultural production in value terms enters the market system, with the internal Northwest market carrying almost 50 percent of the total production in value terms, and over 75 percent of the total marketed production.

TABLE 3.4

CAMEROON NORTHWEST PROVINCE. PROPORTION OF AGRICULTURAL PRODUCTION MARKETED, 1980

	Value (million FCFA)	Percentage of Total
Total Agricultural Production	32,208	100.0
Total Marketed Production	20,479	63.6
Total Marketed in NWP	15,531	48.2
Total Exported	4,669	15.4

SOURCE: Agricultural Marketing in the Northwest Province, Executive Summary, 1980.

Hence, commercial participation in the market would seem to be widespread among farmers in the Northwest Province. Based on our own findings, the above figures seem somewhat overestimated in terms of value of crops marketed or underestimated in terms of crops not marketed. Most farmers interviewed marketed a very small

percentage of foodstuff produced aside from coffee, rice, kola and palm oil. On the other hand, there may be more large commercially-oriented farmers than we suspect who account for the major portion of value of crops marketed, although we feel the latter to be somewhat doubtful.

Coffee Marketing

Coffee marketing in the Northwest Province is carried out by the cooperative system, headed by the Northwest Cooperative Association (NWCA). This organization is responsible for the collection, processing, and shipping of coffee. The NWCA must market coffee through the National Produce Marketing Board (NPMB), which acts as the selling agent for international markets. The NPMB sets the buying allowance given to the cooperative for operating costs including cost of collection, bags, contribution to overhead, insurance, commission, bank interest and stamp duty. The NPMB also assists specific cooperatives with grants and is responsible for setting the price paid to producers each year. In the 1960's, farmers were receiving on average approximately 65-70 percent of the world price of coffee (approximately 250 FCFA/kg). However, when the price of coffee on the international market began to rise in the1970's to over 1,000 FCFA/kg in 1976, farmers received a smaller percentage of the world price -- approximately 35 percent -- during the years 1976-1979. The difference between the international price and the costs of marketing goes to the NPMB, which acts as a marketing board with the objective of stabilizing prices to the farmer. World Bank price projections suggest that coffee prices will decline in the first part of the 1980's and then begin to rise again. Coffee prices paid to the producer have risen considerably in recent years, but it would appear that the present marketing structure of coffee is a means of rather heavily taxing the agricultural sector.

Recently, the NWCA has been beset by a number of problems, the foremost of which has been the inability to pass local farmers. Farmers in many areas this year have not been paid for their coffee. This has become a real disincentive for many rural farmers to increase or upgrade their coffee production.

Rice Marketing

The marketing of the other primary cash crop in the area, rice, has been beset by a series of problems. Over the last three years a number of development organizations involved in rice production have been able to sell only relatively small amounts of their harvest, and large stocks have built up. The UNVDA has some 3,000 tons of stored

paddy rice; Nso Cooperative Union, which buys rice from farmers working the Mbaw Plain, has over 800 tons in stock. Farmers are paid 42.5 FCFA for a kilogram of paddy, which equals a price of approximately 65 FCFA/kg when converted into clean rice. When transport and other costs are added in, the cost of production of a clean kilogram of white rice is almost 100 FCFA/kg. The UNVDA reports similar costs of production and processing. A wholesale price is set by the government, and it has been set between 100-110 FCFA/kg for the past several years. When transport costs and wholesale and retail margins are added, the local rice sells at around 115-120 FCFA per kilogram, depending on location. The marketing problem comes from the competition with imported rice. When the price of imported rice is low, as it has been over the past few years at 50-60 FCFA/kg, wholesalers prefer to import rice, which they can sell on the market for the price declared by the government for local rice, plus transport and margins. Due to foreign exchange rates, local rice has become more competitive with imported rice, although there are still substantial marketing problems.

To import rice, merchants must obtain a license, for which they must agree to purchase a certain amount of Cameroonian rice under a system of jumelage (consignment marketing). Unfortunately for local producers, rice merchants can often afford to not even pick up the local rice because they have made such large profits importing rice. The consumers do not benefit from this system because they must pay the price of locally produced rice when they might be paying the lower prices of the world market. The rice producer does not ultimately gain from this system, because although the development agencies have continued to purchase all of the paddy rice produced by the farmers, their donors will not likely continue to provide the funds necessary to finance such large stocks of rice in the long run. More efficient systems of processing such as parboiling and imported hulling machinery have been explored, especially by Nso Union. More aggressive marketing techniques would be an asset. Improving trade with Nigeria, currently the largest market for rice from the area, would greatly reduce current rice stocks and encourage production of local rice. A change in rice import policy will most likely be necessary to resolve the problem fully. Until a more satisfactory solution is found, it is difficult to recommend new rice production projects.[1]

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[1]For a more complete analysis of the above-mentioned problems, see the following publications: Fotzo, Pascal Tagne. Resource Productivity and Returns in Rice Production under Alternative Farming Systems: A Comparative Study on the Northwest Province in Cameroon, Master's Thesis, University of Ibadan, October 1977. Franzel, Steven. "A Statistical Study of Rice Production in the Northwest Province," Provincial Delegation of Agriculture, Northwest Province, 1975. UNVDA Annual Reports, WARDA Annual Reports.

Marketing of Other Crops

The marketing of all other crops in the province is accomplished through a loosely organized system of traders. Most purchases are made directly from the producer either in secondary markets or, through smaller traders or agents in rural villages. This system appears to work reasonably well. Large flows of agricultural commodities are moved through the system. Average seasonal price fluctuations generally correspond to seasonal availabilities. There is no real evidence of restrictive trading practices. Trader margin which on average are between 10-30 percent seem reasonable, especially given the risks involved. (For a thorough analysis of the marketing system in the Northwest Province, see Agricultural Marketing in the Northwest Province, 1979, especially "The Structure and Performance of Agricultural Marketing in the Northwest Province, Cameroon," by Brian Schwimmer.)

CHAPTER 4

DEMAND PROSPECTS

Major Urban Markets in Cameroon

There is relatively little information available at this point on projected demands in major urban centers of the country. According to Plan Alimentaire A Long Terme (February 1981) current population in Douala is between 616,000-623,000 while population in Yaounde is between 420,000-427,000. Other urban population centers with the exception of the North Province are estimated at between 1,232,000-1,394,000. Population is estimated to triple in Douala and Yaounde by the year 2000. Growth projections for other urban areas are somewhat lower at approximately 175 percent increase. Unless production increases, substantial deficits are expected to arise in major urban areas. Figures show projected surplus and deficit of national production, given different levels of rural migration. Average annual increase in demand for urban centers excluding the North to 1985 are projected as follows, cereals: 6.7 percent; feculants: 4.4 percent; legumes: 7 percent; other vegetable products: 6.4 percent.

These figures would indicate there is a real need for increased production and demand for Northwest Province crops. However, it should be kept in mind that, given the poor transport infrastructure and low commercialization of food crop marketing for the majority of the farmers in the province, along with a relatively poorly organized trading and marketing network for exported food crops at this point outside of Mezam Division, outlying areas will have trouble competing with Mezam and the West Province for major urban markets unless steps are taken to alleviate these problems.

Demand Prospects in Nigeria

There has been no official trade agreement between Cameroon and Nigeria since 1968. Foodstuff imports in Nigeria are tightly controlled by the Federal Government. However, in the case of some imported foodstuff, i.e., rice, the state rather than Federal Government in Nigeria has control over imports. There is a great deal of informal exchange between the two countries, with foodstuff from Cameroon going to Nigeria, and vehicle parts, small electronic equipment and other manufactures coming into Cameroon.

According to Nigerian Embassy estimates in Yaounde, with the current growth rate of overall food demand of 3.5 percent per annum and the current annual production growth rate of 1 percent, about 2.6 million tons of grain equivalents are being imported. Assuming that the demand and production growth rates remain constant over the Nigerian Plan Period 1981-85, a deficit of 5.5 million tons of grain equivalents would be expected by 1985. (See Figures 4.1, 4.2, 4.3, 4.4, 4.5 and 4.6.)

Prices for foodstuffs in Nigeria have increased substantially since May 1981 according to an investigation carried out by the "Consumer Affairs" in Kaduna and Calabar -- cities in the north and south, respectively -- and published by the "Daily Times of Nigeria," Lagos on May 26, 1981. In Kaduna, capital of Kaduna State, food prices have increased by between 50-120 percent.

Rice, the popular "Uncle Ben's" formerly sold at 368 FCFA per "mudu" (tassa), now sells between 735-917 FCFA. Gari formerly sold at 183 FCFA/tassa, now is sold at 550 FCFA, while a tassa of beans rose from 258 FCFA to between 478-550 FCFA. Although food prices varied from one market to another, the investigation showed that there was slight difference in all the markets.

At the Central Market in Kaduna a tassa of rice costs 918 FCFA. There are 16 tassas in a tin and for a large family requiring a tin of rice, it would cost about 14,705 FCFA every two weeks. A yam formerly sold at 90 FCFA now sells at 368 FCFA. A fowl now sells at 1,470-2,205 as opposed to the former price of 735 FCFA. A loaf of bread worth 175 FCFA which could formerly feed a family of four, now feeds only two people according to this investigation.

In Calabar, capital of Cross River State, prices of foodstuffs have gone up by as much as 50 percent. The area where consumers have been worst hit has been the increase in the price of gari -- the staple food. A cigarette cup of gari now sells for 175 FCFA. The smallest bag of semovita (corn flour) which used to cost 550 FCFA now sells for 735 FCFA, while the biggest bag which formerly sold for less than 1,838 now costs approximately 4,795 FCFA.

Here rice, another popular food, also increased in price from 110 FCFA a cup to 183 FCFA per cup, while beans rose from 90 FCFA to 128 FCFA. A small piece of yam just enough to feed three people in one meal now sells for 1,288 FCFA. Four instead of six plantains cost 368 FCFA. The price of meat has also gone up by fifty percent.

Prices for soup ingredients have also gone up, as okra, pepe, and tomatoes (fresh vegetables) are now sold in units of 73 FCFA as opposed to the former price of 38

FIGURE 4.1

PROJECTED SURPLUS AND DEFICIT OF NATIONAL PRODUCTION, GIVEN DIFFERENT LEVELS OF RURAL MIGRATION: MILLET-SORGHUM & WHEAT

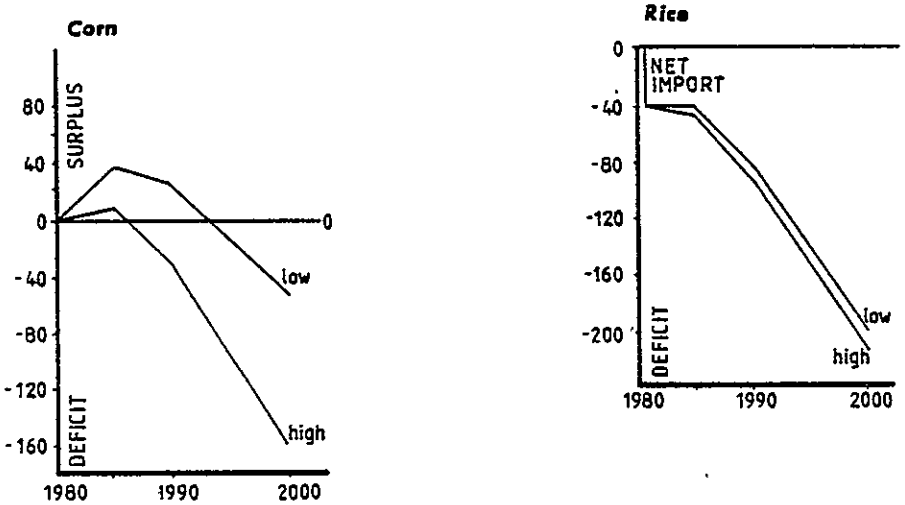
(million tons)

SOURCE: Plan Alimentaire à Long Terme 1981

FIGURE 4.2

PROJECTED SURPLUS AND DEFICIT OF NATIONAL PRODUCTION, GIVEN DIFFERENT LEVELS OF RURAL MIGRATION: CORN & RICE

(million tons)

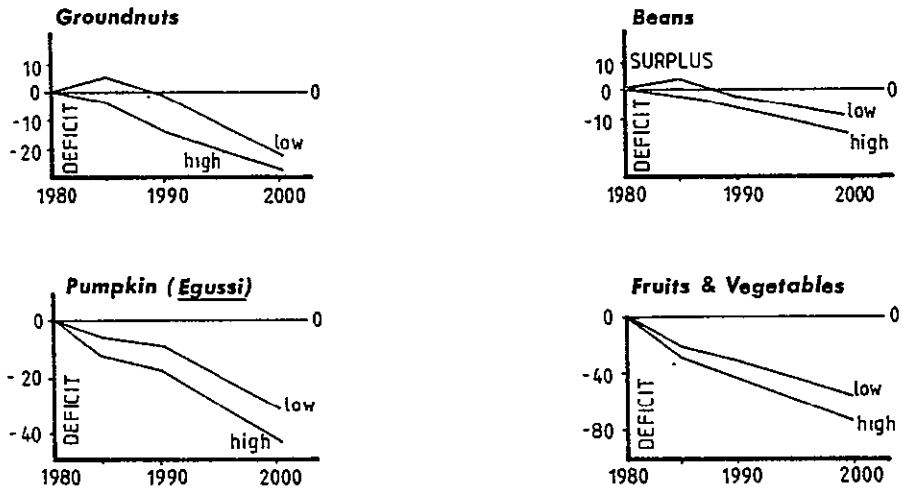


SOURCE: Ministere de l'Economie et du Plan, Note de Synthese du Plan Alimentaire à Long Term, March 1981.

FIGURE 4.3

PROJECTED SURPLUS AND DEFICIT OF NATIONAL PRODUCTION, GIVEN LEVELS OF RURAL MIGRATION: LEGUMES & VEGETABLES

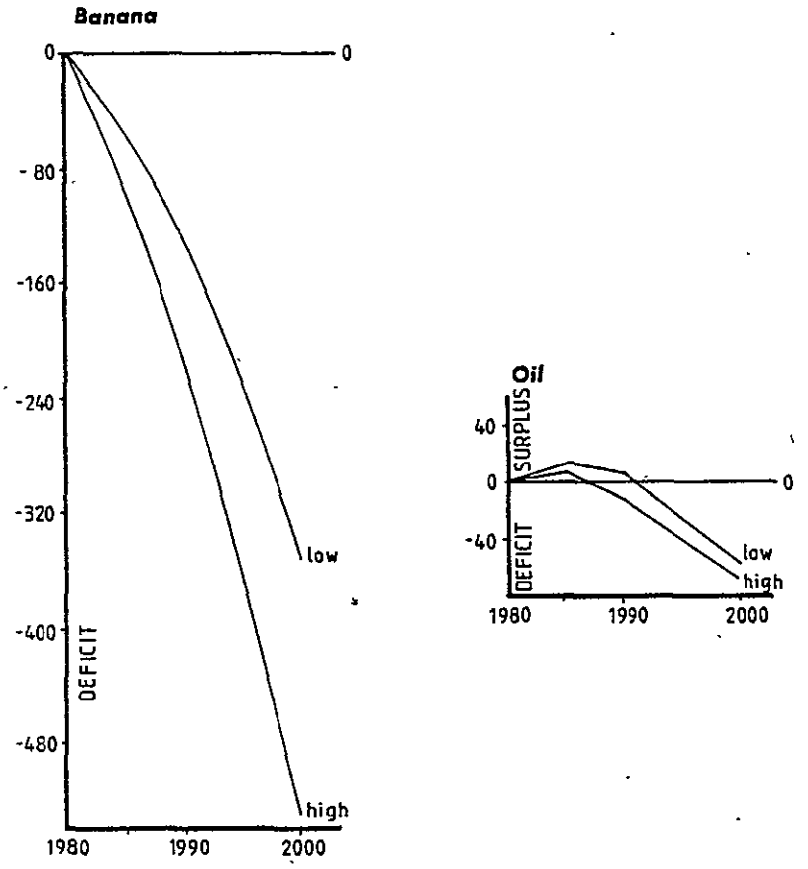
(million tons)



SOURCE: Plan Alimentaire à Long Terme. 1981

FIGURE 4.4

PROJECTED SURPLUS AND DEFICIT OF NATIONAL PRODUCTION, GIVEN DIFFERENT LEVELS OF RURAL MIGRATION: BANANAS & PALM OIL *(million tons)*

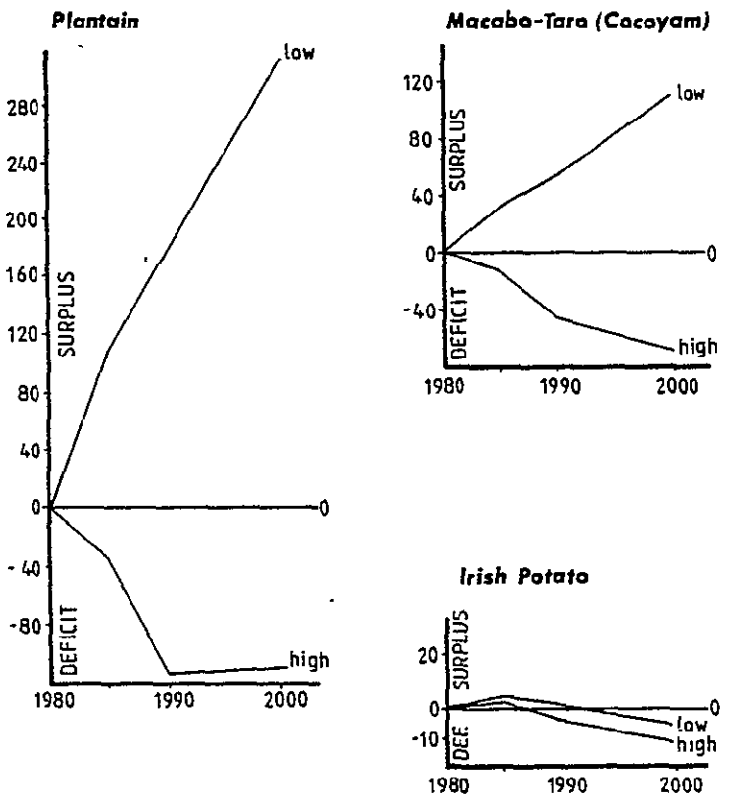


SOURCE: Ministere de l'Economie et du Plan, "Note de Synthese du Plan Alimentaire à Long Term," March 1981.

FIGURE 4.5

PROJECTED SURPLUS AND DEFICIT OF NATIONAL PRODUCTION GIVEN DIFFERENT LEVELS OF RURAL MIGRATION: STARCHY FOODS

(million tons)

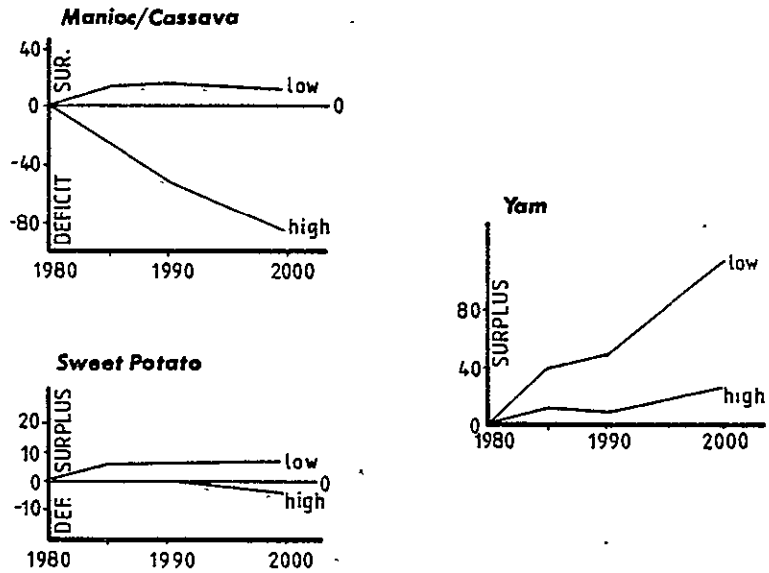


SOURCE: Plan Alimentaire à Long Term.

FIGURE 4.6

PROJECTED SURPLUS AND DEFICIT OF NATIONAL PRODUCTION, GIVEN DIFFERENT LEVELS OF RURAL MIGRATION: STARCHY FOODS

(million tons)



SOURCE: Ministere de l'Economie et du Plan, "Note de Synthese du Plan Alimentaire à Long Term," March 1981.

FCFA. The largest size of a tin of Bournvita (beverage) has gone up in price from 1,655 FCFA to 1,832 FCFA. A tin of peak milk now sells for 73 FCFA, while a packet of sugar has gone up to 183 FCFA. It should be noted that the prices in FCFA are approximations, as the exchange rate varies periodically.

Given the above data, it would appear Nigeria could be a potentially attractive market for produce coming out of the Northwest Province. However, aside from transport difficulties -- which are substantial, and which will be discussed further in the following section -- there are other problems involved in marketing foodstuff from Cameroon to Nigeria. Firstly, it is not clear Cameroon can compete on a world market price basis for the major coastal and urban markets of Nigeria, especially in the case of corn. Secondly, the political situation may inhibit any real substantial exchange between the two countries. Finally, price policies would have to be instituted to ensure enough food to supply major urban centers within Cameroon.

Even with all of the above problems, opening up markets with and improving transport infrastructure to Nigeria could substantially benefit Northwest Province farmers. Although they may not be able to compete effectively for major coastal markets, the Northwest Province is in a position to supply the outlying areas of Nigeria (i.e., Gongola State) more effectively and cheaply than produce coming into these areas from major distribution centers in Nigeria.

Current Trade with Nigeria

A substantial amount of produce from the northeast section of the Northwest Province currently goes to Nigeria, especially rice and beans, but also corn in smaller amounts. It is estimated by cooperative officials that 80 percent of Ndu and Nkambe Union rice sales are sold to Nigerian traders. Although this trade is "informal" or "unofficial" in that few export or import formalities are observed, there appears to be little problem with border crossing. This trade, however, is marked by severe problems at this time, most importantly the lack of roads suitable for vehicle traffic. There are several trails leading across the border into Gongola state in Nigeria, but the most commonly-used goes from Ndu to Gembu, in the Mambila Plateau. The distance is only 160 kilometers (100 miles), but the road goes from treacherous to nonexistent as it passes through very mountainous terrain. This route is suitable only for land rovers and similar all-terrain vehicles; during the dry season a vehicle can make two trips per week, but in the rainy season only one journey per week can be accomplished. Vehicles are bought in Nigeria where the cost is half that in Cameroon; maintaining Nigerian

registrations is possible, to avoid custom duties on the vehicle, provided that no more than five days are spent in Cameroonian territory at a time.

Once in Gembu, the road infrastructure in Nigeria is in much better condition, but the distances involved are considerable. There are one thousand kilometers of road between Gembu and Port Harcourt, of which less than one-half is paved. Enugu, the nearest large city to Gembu is 750 kilometers away, on the same road to Port Harcourt. The Mambila Plateau is among the least accessible areas of Nigeria, and the road passes through a region among the least-populated of the country.

Given the poor road conditions to Gembu, overall transport costs, including vehicle depreciation and maintenance, are extremely high. A vehicle travelling this route on a regular basis has a life expectancy of only one year, with maintenance costs estimated by traders at an average of 50,000 FCFA per month. A trader operating a US $25,000 four-wheel drive vehicle would require 6.85 million FCFA per year in vehicle depreciation and maintenance alone (US $1 = 250 FCFA in May 1981). This figure needs to be kept in mind when considering the seemingly high profit prospects from trading in agricultural products. For rice, for example, a trader can pay 11,000 FCFA per bag in the Northwest Province and sell it for 32,000 CFA francs in Gembu, a 200 percent margin. Similarly, bags of beans can be purchased for 5,400 CFA francs and sold in Nigeria for the equivalent of 16,800 CFA francs. As seen in Table 4.1 and 4.2 the profit on ten bags of rice, the capacity of a land rover, from Ndu to Gembu could be as high as 155,000 CFA francs, while for ten bags of beans net profit can reach 61,000 CFA francs. During one year of trade consisting of 75 trips with a profit of 100,000 CFA francs per trip, the trader's net revenue over operating costs is 7.5 million CFA francs, just enough to cover the 6.85 million in vehicle costs. The remaining 650,000 CFA francs (equivalent to US $2,600) is renumeration for a year's work and interest on invested capital, hardly a profitable business at first sight.

The real profit in the Nigeria trade is to be made not in the export of food to Nigeria, but in the imports of manufactured goods into Cameroon. Electronic equipment, automotive parts and accessories, small domestic appliances, and similar high-value manufactures are profitable to smuggle to avoid prevailing high import duties in Cameroon. Taking bags of rice and beans in the trip back to Nigeria not only helps to stabilize the vehicle, but also constitutes a way of converting some of the proceeds from the trade in manufactures into Nairas, thus bypassing the strict foreign currency exchange regulations in Nigeria.

We have concentrated on those food crops currently being exported to Nigeria from the northeastern highland areas of the Northwest Province, which in our view,

TABLE 4.1

ESTIMATED COSTS AND RETURN TO RICE TRADE
FROM NDU TO GEMBU (NIGERIA) JUNE 1981

Cost Item	Total Cost	Cost/Bag	% Total Cost
1. Cost of buying ten bags of rice (full capacity of landrover)	110,000	11,000	66.47
2. Syndicate fees	2,000	200	1.21
3. Handling charges (Ndu)	500	50	.30
4. Transport (Ndu-Nigeria)	40,000	4,000	24.17
5. Handling-Nigeria	750	75	.45
6. Storage-Nigeria	1,000	100	.60
7. Return transport-Ndu	4,000	400	2.42
8. Trader lodging and meals in Nigeria	5,000	500	3.02
9. Cost of capital (total cost).(.20).(.011)	242	24	.15
10. Border charges	2,000	200	1.21
Total Costs	165,492	16,549	100.00
Return from sale of 10 bags of rice in Gembu @ 32.000 FCFA per bag	320,000		
Net return to Trader	154,508 (per trip)	15,451 (per bag)	

SOURCE: Calculations based on interviews with traders.

TABLE 4.2

ESTIMATED COSTS AND RETURN TO TRADE
IN BEANS FROM NDU TO GEMBU (NIGERIA) JUNE 1982

Cost Item	Total Cost	Cost/Bag	% Total Cost
1. Cost of buying 10 bags of beans	54,000	5,400	50.28
2. Syndicate fees	2,000	200	1.86
3. Handling charges	500	50	.47
4. Transport (Ndu-Nigeria)	40,000	4,000	37.26
5. Handling-Nigeria	750	75	.70
6. Storage-Nigeria	1,000	100	.93
7. Return transport-Nigeria	4,000	400	3.73
8. Trader lodging and meals in Nigeria	5,000	500	4.66
9. Border charges	0	0	0
10. Cost of capital (total cost) (.20).(.011)	118	12	.11
Total Costs	107,368	10,737	100.00
Return from sale of 10 bags of beans in Gembu @ 16.800 FCFA per bag	168,000	16,800	
Net Return to Trader	60,632 (per trip)	6,063 (per bag)	

SOURCE: Calculations based on interviews with traders.

also have the highest potential for export expansion. However, high and fast-rising prices for tubers and other starchy products in Nigeria, especially in the oil-rich coastal areas of the eastern states, might also offer a potential market for these crops. Cocoyams, yams, cassava and plantains are produced in surplus in the low-lying areas in the southwestern divisions of the Northwest Province. There is at the moment no record that such products are being exported to Nigeria despite the presence of the Bamenda-Mamfe road. For several years that road has been in a bad state of disrepair and is now barely passable for truck traffic. Considerable improvements in that Bamenda-Mamfe road, as well as the Nigeria-Mamfe segment, would be necessary before the potential trade from those areas to Nigeria becomes possible. At the moment there are no plans for upgrading those roads. At any rate, prospects for long-distance movement of tubers and other starchy staples are severly limited by their low value-to-weight ratio. It is unlikely that products with such high water content and low prices can be transported at a profit beyond a couple of hundred kilometers. Depending on the route, the distance from Bamenda to Port Harcourt can range from 500 to 700 kilometers. The prospects would seem more favorable for shipments to Douala, located only some 300 kilometers to the south on a good paved road. Even then, however, with the exception of potatoes from the highlands, only small quantities of other tubers are being sent from the Northwest Province to Douala. Given the present conditions of the road network, and the rapid growth in the Litoral region. The Douala market will be likely to attract exports of tubers from the Northwest Province lowlands, before exports to Nigeria become viable.

In summary, despite the extraordinarily high price differentials between the Northwest Province and Gembu in Nigeria, the costs of moving farm produce across the border are prohibitive. Existing trade is justified mainly as a by-product of the thriving market for smuggled electronic and manufactured articles coming from Nigeria and found openly in shops in Bamenda.

CHAPTER 5

FARMER'S FOOD CONSUMPTION

The central focus of this country report is to study the effect of prices and other factors upon farmer's nutrition in the Northwest Province. We have covered in previous chapters the overall agricultural production of the zone, the marketing system for the principal commodities, and the prospects for increased demand in southern Cameroon markets. We now examine the pattern of food consumption among highland farmers in these final chapters. Chapter 5 contains two main segments; one describes the age, sex, and occupational structure of the hosueholds in the survey; the second presents results of the food consumption survey in terms of quantities of individual ingredients. Chapter 6 transforms food intakes into their corresponding energy and protein equivalents.

Sample Household Demographics

Sex and Age Distribution

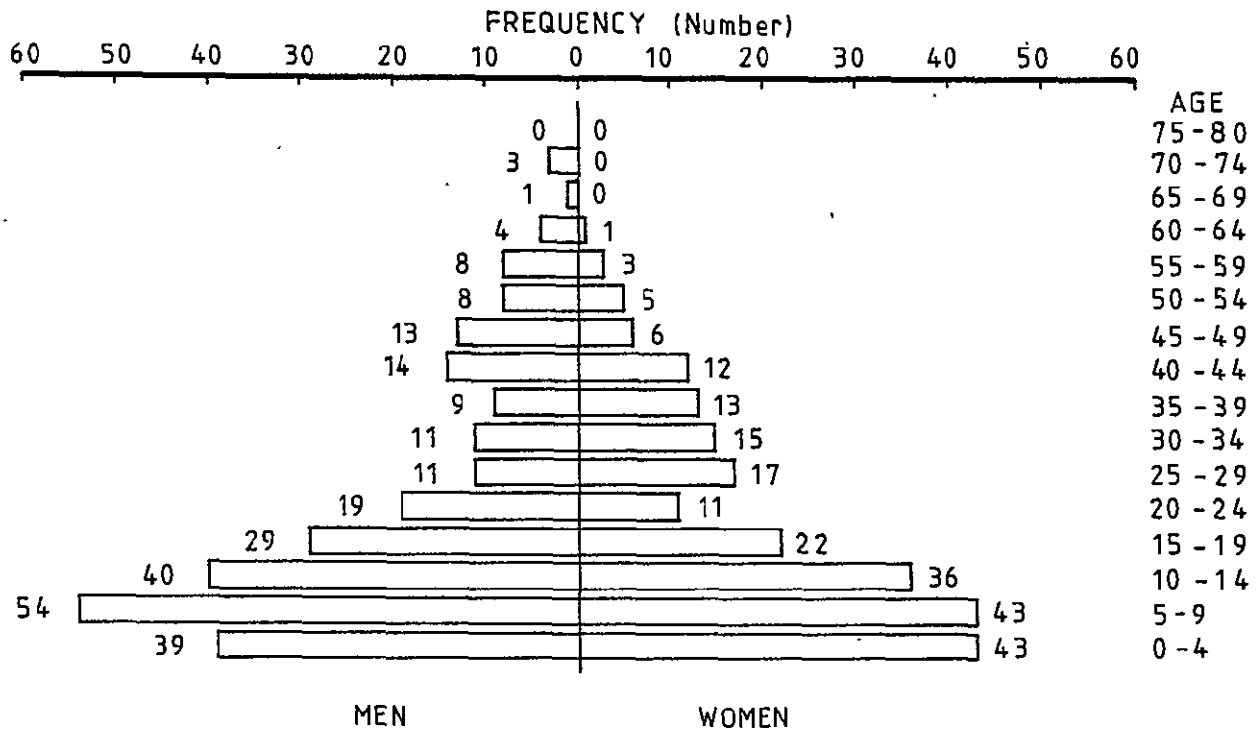
For each household in the eight highland villages a questionnaire to collect demographic information was completed. Members of the family living in the household at the time of the interview were, of course, of greatest interest, but information was also asked about members temporarily away.

The demographic information was obtained to gather data on the consumption needs of the family as well as on the availability of labor for farming. We are therefore mainly concerned here with the sex and age structure of resident family members.

Figure 5.1 presents the age pyramid for the highland farms sample. Each bar represents a 5-year interval; the high and low ages are given to identify each interval since only whole years were recorded. Several items are illustrated by that age pyramid:

(a) There are more men than women present on the farms. A total of 264 males were living in the households, as opposed to 229 women. The higher number of adult men may in part be attributed to the way the sampling treated polygamous families. In such cases, only one wife and her household was included in the sample; the husband was considered the head of that household.

FIGURE 5.1 CAMEROON NORTHWEST PROVINCE AGE DISTRIBUTION IN NORTHWEST HIGHLANDS SAMPLE FARMS



(b) Only 9 of the 229 women are over 50 years old, compared to 24 of 264 men. The oldest woman is in the 60-64 years group, while 3 men are 70-74 years. It must be kept in mind, though, that this is a small sample of the total population.

(c) There is a noticeable absence of men in their 20's and 30's. While 24 percent of women fall into those age categories, only 19 percent of men do. More strikingly, the number of men in their 40's exceeds those in their 30's and late 20's. Migration away from the village is the obvious explanation for the scarcity of men. The migration appears temporary since the number of men over age 40 regains a high level, and in fact exceeds the number of women over age 40. On the other hand, the high number of men over age 40 may reflect fewer migration opportunities earlier, when they were in their 20's.

(d) The age distribution of women does not exhibit a similar impact of migration. Their numbers decline gradually and consistently with the exception of the 15-19 and 20-24 age categories, where the figures seem remarkably low. These groups, of course, correspond to the marriageable age when daughters leave the household. Our sampling procedure may have underrepresented these recent households. For instance, in polygamous families, the older wife was selected over the younger ones.

e) The number of infants less than five years of age is noticeably smaller than it should be expected. Given the overall pattern of the age pyramid and high infant mortality rates prevalent in Africa, the age group 0-4 years should be much larger than the next group of 5-9 year olds. Instead, girls in the former equal those in the latter, and for boys the 5-9 age group actually exceeds the 0-4 age group, 54 to 39. This result could be merely a statistical fluke in a small sample population, although the same pattern is observed in over half of the separate village age histograms.

Dependency Ratios

Average household size in highland villages ranges from a high of 8.44 in Kikaikom to a low of 5.11 in Bambui, for an overall average of 6.85 members per family. These figures include only members currently living in the household (See Tables 5.1 and 5.2).

The age structure of the highland villages indicates a heavy load of dependents to working-age members in the family. In the overall sample of 493 persons living in the households, only 230 (or 47 percent) were in the working-age group of 15 to 60 years.

TABLE 5.1

CAMEROON NORTHWEST PROVINCE. SEX AND AGE DISTRIBUTION IN HIGHLAND SAMPLE VILLAGES, 1981

(Number per village)[a]

Village \ Age (Years)	Men				Women				Total by Age			Total Head
	0-14	15-60	61-80	Total	0-14	15-60	61-80	Total	0-14	15-60	61-80	
1. Nseh	22	16	0	38	16	14	0	30	38	30	0	68
2. Oku	18	14	2	34	13	13	0	26	31	27	2	60
3. Mbiami	14	14	2	30	13	18	0	31	27	32	2	61
4. Ntumbaw	16	19	0	35	18	11	0	29	34	30	0	64
7. Kikaikom	12	22	1	35	26	15	0	41	38	37	1	76
8. Banten	15	12	0	27	11	10	0	21	26	22	0	48
9. Nkar	23	17	0	40	16	14	0	30	39	31	0	70
10. Bambui	14	11	0	25	11	10	0	21	25	21	0	46
All Villages	134	125	5	264	124	105	0	229	258	230	5	493

NOTES: (a) Nine households per village
SOURCE: Survey data.

TABLE 5.2

CAMEROON NORTHWEST PROVINCE. SEX AND AGE DISTRIBUTION IN HIGHLAND SAMPLE VILLAGES, 1981

(Average Number per Household)

Village \ Age (Years)	Men				Women				Total by Age			Total
	0-14	15-60	61-80	Total	0-14	15-60	61-80	Total	0-14	15-60	61-80	Head
1. Nseh	2.44	1.78	0.00	4.22	1.78	1.56	0.00	3.33	4.22	3.33	0.00	7.56
2. Oku	2.00	1.56	0.22	3.78	1.44	1.44	0.00	2.89	3.44	3.00	0.22	6.67
3. Mbiami	1.56	1.56	0.22	3.33	1.44	2.00	0.00	3.44	3.00	3.56	0.22	6.78
4. Ntumbaw	1.78	2.11	0.00	3.89	2.00	1.22	0.00	3.22	3.78	3.33	0.00	7.11
7. Kikaikom	1.33	2.44	0.11	3.89	2.89	1.67	0.00	4.56	4.22	4.11	0.11	8.44
8. Banten	1.67	1.33	0.00	3.00	1.22	1.11	0.00	2.33	2.89	2.44	0.00	5.33
9. Nkar	2.56	1.89	0.00	4.44	1.78	1.56	0.00	3.33	4.33	3.44	0.00	7.78
10. Bambui	1.56	1.22	0.00	2.78	1.22	1.11	0.00	2.33	2.78	2.33	0.00	5.11
All Villages	1.86	1.74	0.07	3.67	1.72	1.46	0.00	3.18	3.58	3.19	0.07	6.85

SOURCE: Survey data.

Of the remaining, 52 percent consists of youths less than 15 years of age and one percent of persons over 60 years. It is however common to have children helping their parents doing fieldwork and domestic tasks. Excluding children less than 15 years as nonworking members is obviously arbitrary; it merely reflects their lower productivity.

In the average highland household of the 6.85 members, only 3.19 fall in the working-age interval. Of these, 1.74 are men and 1.46 are women. The ratio of dependents to working-age adults is fairly uniform throughout the villages.

Average age for husbands in the 72 highland households was 45 years, with a minimum of 25 years and a maximum of 70 years. Their age frequency distribution is bell-shaped with a standard deviation of 11.4 years; indeed 59 percent of husbands fell between 35 and 54 years of age, and 82 percent between 30 and 59.

Wives also exhibit a fairly normal age distribution with a mean of 35 years and 8.8 years standard deviation. The youngest and oldest wives were 20 and 58 years old, respectively. Three out of every four wives are between the ages of 25 and 44 years.

Information about years of schooling of both husbands and wives was requested, but for most of the households their data are missing. For the 32 husbands who did respond, the mean was 7.6 years of schooling; the minimum of 3 years was reported for 4 husbands; 15 and 16 years of schooling were recorded for 3 husbands. Twenty of the 32 had between 6 and 8 years of education. For the wives, only 21 of the 72 recorded schooling, and for them the minimum was 1 year and the maximum 13 years. Eighteen of the 21 wives however had between 3 and 7 years of education, with a mean of 5.4 years.

It is likely that the large number of husbands and wives for whom no education information was recorded had no schooling at all, but to what extent this is true is not known.

Occupations

The sample of 72 households from eight highland villages consists predominantly of farmers. For each household member the survey recorded their stated principal occupation. Sixty-one of the 71 husbands, i.e., 86 percent of the total, declared farming as their main activity, but there were also three teachers, five craftsmen, and one small trader. Among the wives, farming is almost exclusively their main occupation: 69 of the 72, or 96 percent of all wives, were farmers. The three exceptions included one teacher and two housewives. One household was headed by a woman, hence there is one less husband.

These figures reflect the large participation of women in farming activities. Food crop production in the Northwest highlands is traditionally considered a female responsibility. Men are mostly concerned with commercial crops such as coffee, but also help women with arduous operations on food crops. In other parts of the Northwest Province this reluctance of men toward food production is reportedly weaker, but women still contribute most of the labor needed in producing food for household consumption. The avoidance of farming activities by men apparently hinges on whether the product is for household consumption or to sell in the market, rather than on the kind of crop itself. It is thus acceptable for men to produce rice, or wheat, or coffee since these are not for immediate family consumption.

Given this tendency against men engaging in food production, it is in fact unexpected that so many of them declare farming as their main occupation. However, there is a significant proportion -- one out of every seven -- with nonfarming activities such as crafts and teaching. Table 5.3 provides a breakdown by occupation of the principal kinship categories of persons living in the household, as well as those living away from home.

Family Members Away from Home

In addition to the 493 household members living at home, there were 62 family members reported living temporarily away. These two groups combined add up to a total of 555 persons in the 72 highland households surveyed. Thus, eleven percent of the household members are living away from home.

Thirty-three of the 62 persons living away were men, and the other 29 were women. They are for the most part young men and women. Only one man and two women are over 30 years old. Two-thirds of the men are between 15 and 24 years of age. Twenty of the 29 women are less than twenty years old. On the other hand, no boys under 10 years were reported away, but six girls under 10 were living outside the household.

For the purpose of this study it is worthwhile to determine whether these family members away from home are dependent on the household for their support, or whether they contribute resources to the family. A breakdown by occupation reveals that among the men, 20 out of 31 responses were students; similarly, 18 out of 27 women living away from home were students. Other major occupations represented were 4 male drivers, 4 craftsmen, and 3 women farmers. There were also a male laborer, a male teacher, and a female nurse. One must consequently view family

TABLE 5.3

CAMEROON NORTHWEST PROVINCE. PRINCIPAL OCCUPATION

OF HOUSEHOLD MEMBERS

Activity	Living at Home					Living Away	
	Husband	Wife	Son/Daughter	Other Rel.	No Relation	Men	Women
Farming	61	69	23	12			3
Teacher	3	1	1			1	
Office Work				1			
Craftsman	5		4	1		4	
Laborer				1		1	
Driver			3			4	
Petty trade			5				
Small trade	1		1				
Nurse				1			1
Housewife		2					
Student			136	25	1	20	18
Unemployed			1	2			1
Child			64	8			4
Other			3			1	
Total	71	72	241	51	1	31	27
No data			49	7	1	2	2

SOURCE: Survey data.

members living away from home, mostly as additional dependents on the household. Only a small proportion of them are engaged in remunerative activities that will permit them to contribute financially to the upkeep of the household.

The Food Supply

The western highlands of Cameroon are blessed with a remarkable variety of foods, thanks mostly to climatic diversity. Although the list of important foods may be reduced to a dozen or so, many other items were frequently present, which led to the unexpectedly long list of individual ingredients found in Table 5.4.

Several ingredients in the table may represent different forms of the same basic food; for example, cassava may be consumed fresh or as gari (flour). Similarly, corn is mostly consumed as fufu (cornmeal), but fresh corn is also reported as immature corn. Separate entries are needed to account for differences in water and nutrient contents. The scientific names of most vegetables are entered along with the popular names for most common items. The English denomination was retained when it is commonly understood, since in this area Pidgin English is the lingua franca.

Most foods consumed have local origin, that is, they are produced locally instead of being imported from outside the area. The principal foods have a distinctive American flavor since corn, beans, potatoes, and cassava originated in the Western Hemisphere. The prevalence of these food crops in the area should dispel any doubts about the adaptability of African farmers to exploit new opportunities or the unchangeable nature of their diets. Over eighty individual food items were identified in the Northwest Province diet, even though many of them do not appear recorded in the highland consumption survey. Some foods may be out of season, or they may be consumed predominantely in the lowlands or other areas of the province. Other foods, however, such as beer, corn beer, and palm wine are frequently consumed by the highland families, but were not recorded in the questionnaire. Their omission results from the survey focusing on the foods that pass through the kitchen, while these beverages are consumed mostly on social occasions outside the households. Some information was obtained on foods consumed outside the home, but in view of their irregularity and lack of quantitative data, the subsequent analysis is limited to foods consumed or prepared at home. Table 5.4 also provides average daily intakes per person for each one of the foods coded, as well as their corresponding contributions to calorie and protein daily intakes. Cornmeal or fufu stands out as the principal

TABLE 5.4

CAMEROON NORTHWEST PROVINCE. ALPHABETICAL LIST OF MAIN FOODS IN HIGHLAND VILLAGES DIET, WITH ENERGY AND PROTEIN CONTENT, AND AVERAGE DAILY INTAKE PER CAPITA. MAY-JULY 1981

Food Code	Food Description and Scientific Name	Energy kcal/100g	Protein g/100g	Average Daily Intake		
				Weight (g)	Calories	Protein (g)
85	Achu (cocoyam/banana paste)	85	1.5	23.3	19.7	.35
70	Acra (groundnuts)	282	3.0	1.5	4.2	.04
47	Antelope	150	30.4	-.-	-.-	-.-
37	Avocado (Pear) (Persea gratissima)	121	1.4	20.3	24.6	.28
11	Banana (Musa paradisiaca)	88	1.5	23.7	20.8	.35
10	Beans (dry) (Phaseolus vulgaris)	343	25.5	83.3	285.8	21.25
48	Beef	237	18.2	20.5	48.5	3.72
29	Beer	36	.3	-.-	-.-	-.-
73	Bitterleaf (Veronica amygdalina)	52	5.3	4.9	2.6	.26
6	Bread (European type)	261	7.7	9.2	24.0	.71
33	Cabbage (Brassica oleracea)	26	1.7	13.5	3.5	.23
13	Cassava (fresh) (Manihot utilissima)	149	1.2	6.2	9.2	.07
50	Chicken (see also Fowl)	146	20.5	-.-	-.-	-.-
26	Cocoyam leaves	31	2.4	1.5	.5	.04
67	Cocoyam (Colocasia)	102	1.8	89.4	91.2	1.61

TABLE 5.4 (continued)

Food Code	Food Description and Scientific Name	Energy Kcal/100g	Protein g/100g	Average Daily Intake		
				Weight (g)	Calories	Protein (g)
27	Cola nuts	148	2.2	-.-	-.-	-.-
61	Coconuts	388	3.6	-.-	-.-	-.-
67	Colocasia (see Cocoyam)					
58	Corn Beer	33	.6	-.-	-.-	-.-
72	Cowpeas (Vigna unguiculata spp)	338	22.5	-.-	-.-	-.-
21	Cowpea leaves	34	4.2	.4	.1	.02
30	Crayfish (nyanga)	329	57.5	.7	2.3	.39
76	Dry beef	250	55.4	.7	1.7	.37
56	Dry milk	498	26.3	.2	1.2	.07
78	Dry mushrooms (Agaricus spp)	262	10.4	...	.1	...
83	Dry okra (Hibiscus esculentus)	283	10.8	-.-	-.-	-.-
08	Corn (roasting, boiling). (see Maize)					
53	Eggs	140	11.4	.6	.9	.07
16	Egussi (Citrullus lanatus)	567	25.8	1.9	10.6	.48
57	Evaporated Milk	140	7.1	.8	1.1	.06
54	Fish (raw)	103	18.8	4.9	5.0	.92
55	Fish (dry)	269	49.0	-.-	-.-	-.-
49	Foot (cow)	202	16.9	.7	1.4	.11
69	Fowl	146	20.5	3.4	4.9	.69
1	Fufu (corn meal)	353	9.3	400.0	1,412.1	37.20

TABLE 5.4 (continued)

Food Code	Food Description and Scientific Name	Energy kcal/100g	Protein g/100g	Average Daily Intake		
				Weight (g)	Calories	Protein (g)
31	Garden Eggs (Solanum macrocarpou)	29	1.2	5.5	1.6	.07
34	Garlic (Allium sativum)	131	5.2	...	...	...
12	Gari (Groundcassava)	351	1.0	8.7	30.5	.09
75	Ginger Root (Zingiber officinale)	301	7.6	...	.1	...
88	Goat	123	14.0	-.-	-.-	-.-
22	Groundnuts (roasted) (Arachis hypogaea)	595	23.2	4.9	29.0	1.13
23	Groundnuts (boiled)	235	16.8	-.-	-.-	-.-
87	Groundnuts (fresh)	580	25.6	.4	2.4	.11
65	Groundnut oil	897	0.0	.1	1.1	.00
43	Honey	311	.4	-.-	-.-	-.-
80	Immature Maize (koki corn)	152	5.0	23.3	35.4	1.16
4	Irish Potatoes (Solanum tuberosum)	82	1.7	191.4	157.0	3.25
79	Koki beans (dry) (Vigna unguiculata spp)	343	25.5	.7	2.4	.18
99	Leftovers from previous meal	0	0.0	-.-	-.-	-.-
51	Liver (beef)	143	19.0	-.-	-.-	-.-
63	Locust (fried)	N.A.	30.0	-.-	-.-	-.-
18	Macaroni	379	11.8	-.-	-.-	-.-
8	Maize (mature) (Zea Mays)	364	10.0	70.4	256.3	7.04
66	Maggi (cubes)	122	20.3	.2	.2	.03
39	Mango (Mangifera indica)	60	.6	-.-	-.-	-.-
48	Meat (see Beef)					

TABLE 5.4 (continued)

Food Code	Food Description and Scientific Name	Energy kcal/100g	Protein g/100g	Average Daily Intake		
				Weight (g)	Calories	Protein (g)
82	Ngansa (condiment)	558	22.8	.1	.3	.01
2	Njamajama/Vegetable (Rumex acetosa)	52	5.3	148.0	77.0	7.84
32	Okra (Hibiscus esculentus)	36	2.1	3.4	1.2	.07
35	Onion (Allium cepa)	41	1.2	7.7	3.2	.09
40	Orange (Citrus sinensis)	43	.6	-.-	-.-	-.-
68	Palm Oil (Elaeis guineensis)	875	.0	43.3	379.0	.0
60	Palm Wine	34	.4	-.-	-.-	-.-
44	Pap (corn porridge)	76	1.8	.6	.5	.01
41	Papaya (Carica papaya)	32	.4	-.-	-.-	-.-
38	Pepe (Capsicum spp.)	42	1.1	.3	.1	...
42	Pineapple (Ananas sativa)	47	.4	-.-	-.-	-.-
14	Plantain (Musa spp)	135	1.2	57.4	77.5	.69
84	Plum (Pachulobus edulis)	100	.1	-.-	-.-	-.-
4	Potatoes (see Irish Potatoes)					
52	Pork	418	12.4	-.-	-.-	-.-
17	Pumpkin	23	1.0	.6	.1	.01
25	Pumpkin leaves	27	4.0	3.9	1.0	.15
81	Puff Puff (fried cakes)	312	4.1	-.-	-.-	-.-
95	Pepper (Capsicum spp)	...	...	...	...	...
74	Raffia	34	0.4	-.-	-.-	-.-

TABLE 5.4 (continued)

Food Code	Food Description and Scientific Name	Energy kcal/100g	Protein g/100g	Average Daily Intake		
				Weight (g)	Calories	Protein (g)
28	Raffia wine(Raphia spp.)	326	7.8	-.-	-.-	-.-
5	Rice (imported) (Oryza sativa)	365	7.2	20.0	73.1	1.44
90	Salt	.0	.0	...	.0	.00
46	Sugar	392	.0	.2	.9	.00
45	Sugarcane (Saccharum officinarum)	62	.6	...	...	...
15	Sweet Potatoes (Ipomoea batatas)	121	1.6	-.-	-.-	-.-
62	Sweet Potatoe Leaves (Ipomoea batatas)	42	3.2	-.-	-.-	-.-
59	Tea	0	.0	...	.0	.00
64	Termites	542	31.8	.1	.4	.02
77	Tin Tomatoes	82	3.4	.9	.7	.03
36	Tomatoes (Lycopersicum esculentum)	21	1.0	12.5	2.6	.13
19	Yam (Dioscorea spp)	339	3.4	...	...	...
2	Vegetable (see Njamajama)					

Notes:
N.A. = Not available.
-.- = Not present in diet.
... = Present but in insignificant amount.

Sources:
Survey data.
FAO and U.S. Public Health Service. Food Composition Tables for Use in Africa. U.S. Printing Office, Washington, 1968.
Warrack-Goldman, Heather. The Nutrition of Children in a Coastal African (Liberia Food Economy). PhD thesis. Cornell University, 1979.

ORANA. (see orginal).

ingredient in highland diet, with 400 grams consumed per day per head, thus recording an average of 1,412 kilocalories and 37 grams of protein. By comparison, next in importance by weight are Irish potatoes and njamajama with 191 and 148 grams per day, respectively; their calorie and protein contributions, however, is much lower due to their high water content. Potatoes only provide an average of 157 kcal and 32 grams of protein per day, while for njamajama these values are 77 kcal and 78 grams. Dry beans and cocoyams follow in terms of weight with 83 and 89 grams per day. Beans provide, however, a considerable share of daily protein intake, 21 grams, and a significant portion of calories, 286 kcal. Cocoyams, by contrast only provide 91 kcal and less than 2 grams of protein per day. Whole corn or mature maize futher enhances the role of corn, by contributing 256 additional kilocalories and 7 grams more of protein.

Plantains and palm oil enter the diet in minor amounts, 57 and 43 grams per day, respectively, but this small amount of palm oil represents 379 kilocalories; it provides no protein though. Plantains, on the other hand, adds only 77 kcal and less than one gram of protein per day. Finally, rice (imported) is consumed in much lower amounts than expected, only 20 grams per day on the average, equivalent to 73 kilocalories and 14 grams of protein. Beef, bananas, and avocadoés are also consumed in about the same quantities, but except for beef's contribution of 37 grams of protein, their nutritional contributions are rather negligible.

Fluid milk was not consumed by the sample members, but a negligible amount of powder milk was recorded. Similarily, eggs are barely present at less than 1 gram per day. Fresh milk is reportedly consumed only by the few Fulani herder families living in the area.

Data on nutrient composition for each food item are also presented in Table 5.4 in the conventional form of kilocalories and grams of protein per 100 grams of the food as it normally enters in the meal. These data were assembled from several sources, but mainly from the Food Composition Tables for Use in Africa published by the Food and Agricultural Organization, and the U.S. Public Health Service.

Meals.

Three distinct meals were observed in the Northwest highlands at the time of the survey, May through July 1981. The morning and evening meals are the most important in all respects -- weight, calories, and protein intakes. Lunch is a light meal, often skipped by the adult members of the household. Table 5.5 presents the average contributions of each meal to the daily diet. Breakfast and dinner are roughly

TABLE 5.5

CAMEROON NORTHWEST PROVINCE
HIGHLAND VILLAGES AVERAGE DAILY INTAKE OF
FOOD, CALORIES AND PROTEIN, BY MEAL, PER PERSON,
MAY-JULY 1981

Meal	Weight(g)	Calories (kcal)	Protein(g)
Morning	566.6	1,345.0	41.4
Afternoon	198.5	443.8	13.7
Evening	557.6	1,320.9	37.8
Day's Total	1,322.7	3,109.6	92.9

equivalent in weight, energy and protein; between the two they account for 85 percent of the day's food intake, 86 percent of calories, and 85 percent of protein.

Heavy labor demands to care for the field crops at the time of the survey may explain in part the small portion of food prepared at lunch time. The survey started shortly after the planting season and covered a period of weeding and cultivation when the crops were getting established. Moreover, women perform most of the normal labor needed in food crops. Hence, women had less time available for meal preparation, and the noon meal was sacrificed to work in the fields. It is not clear whether during other seasons the same pattern of meals persists.

Lunch was also the only meal when significant amounts of leftovers were recorded. Nevertheless, only a note was made of it, and no weight, calories, or protein were attributed to leftovers to avoid double counting. In times of high field labor demands such as the period of the survey, a portion of the morning meal is taken to the fields and consumed later on in the day. As a result, the figures in Table 5.5 understate the actual amount of food intake in the afternoon meal, and overstate the morning consumption. The table should then be taken to reflect food preparation rather than actual food intakes.

Morning and evening meals are prepared in the kitchen and consumed right away. No leftovers from the evening meal are kept overnight for consumption at breakfast. Kitchens are usually separate structures from the living quarters of the family. Cooking is done on a three-stone firehole dug in the dirt floor. Women and children eat their meals in the kitchen, while men and guests eat in the man's quarter or, in more modern households, in the living room of the main house. No attempt was made in the survey to measure intrafamily distribution of food. Men are ordinarily served larger portions than women and children, and they are the main consumers of purchased specialty items such as meat, bread, tea, sugar, and milk, if these are served at all.

Meal Composition

Corn or maize, the predominant ingredient in the highland diet, is consumed mainly as fufu or cornmeal, but also roasted fresh, as pap for children, and as corn beer (sha). It constitutes about 40 percent of the morning and evening meals in weight, but only 16 percent in the afternoon meal (see Table 5.6). In terms of calories, corn contributes about 60 percent in the morning and evening but only 27 percent in the afternoon. More potatoes than corn are prepared in the afternoon meal, but the latter still provides more calories and protein than potatoes.

TABLE 5.6

CAMEROON NORTHWEST PROVINCE. PERCENTAGES OF WEIGHT, CALORIES AND PROTEIN CONTRIBUTED BY TWELVE SELECTED FOODS IN THE HIGHLAND VILLAGES DIET, PER DAY AND PER MEAL, MAY-JULY 1981.

FOOD	WEIGHT			CALORIES			PROTEIN			DAILY SHARES		
	Morning	Afternoon	Evening	Morning	Afternoon	Evening	Morning	Afternoon	Evening	Weight	Calories	Protein
Corn	39.5	16.5	42.6	56.3	26.6	62.8	48.9	23.2	58.2	37.4	54.8	48.9
Beans	7.9	9.9	3.4	11.5	15.2	4.9	27.7	36.5	12.7	6.3	9.2	22.9
Cocoyam	8.8	6.8	9.1	3.5	2.9	3.9	2.1	1.7	2.4	8.6	3.6	2.1
Potatoes	11.2	22.2	15.0	3.9	8.1	5.2	2.6	5.5	3.8	14.5	5.0	3.5
Palm Oil	3.2	4.2	3.1	11.7	16.4	11.3	0.0	0.0	0.0	3.3	12.2	0.0
Plantain	4.4	11.4	1.8	2.5	6.9	1.0	0.7	2.0	0.3	4.3	2.5	0.7
Rice	0.8	3.4	1.5	1.3	5.5	2.4	0.8	3.5	1.6	1.5	2.3	1.6
Groundnuts	0.3	1.9	0.3	0.4	5.0	0.7	0.1	6.5	0.9	0.5	1.2	1.4
Cassava	1.1	3.0	0.5	1.0	3.8	0.7	0.2	0.5	0.1	1.1	1.3	0.2
Meats	0.7	3.3	2.1	0.7	3.4	2.1	1.7	10.4	5.6	1.7	1.7	4.6
Fish	0.4	0.4	0.4	0.2	0.4	0.2	1.3	2.1	1.4	0.4	0.2	1.4
Njamajama	12.3	3.2	12.9	2.7	0.7	2.8	8.9	2.5	10.1	11.2	2.5	8.4
Total of Above	90.6	86.2	92.7	95.7	94.9	98.0	95.0	94.4	97.1	90.8	96.5	95.7
Other Foods	9.4	13.8	7.3	4.3	5.1	2.0	5.0	5.6	2.9	9.2	3.5	4.3

SOURCE: Survey data.

Morning and evening meals are remarkably similar in composition: about 40 percent corn, 12 percent njamajama; 12 percent potatoes, 9 percent cocoyam, 3 percent palm oil. These two meals differ only in a few items. Beans and plantains are eaten more in the morning while rice and meats are consumed mostly in the evening meals.

Fufu is served commonly with a sauce of palm oil and green vegetables. Njamajama is by far the preferred vegetable and accounts for about one-eighth of the morning and evening meals in weight, but other leafy vegetables were also recorded, including bitterleaf, cocoyam leaves, and pumpkin leaves, Like corn, njamajama is mostly consumed in the morning and evening but is nearly absent at lunch time. Other source ingredients include onions and tomatoes, both fresh and from tin cans. Ground pumpkin seeds (egussi), ginger, bouillion stock (Maggi) cubes, crayfish, okra, garden eggs and garlic are less often used.

Most women do not prepare special foods for their young children. Infants are given samples of solid foods beginning at about six months of age, but actual weaning doesn't usually take place until between 2 and 3 years. Gari and pap (corn porridge) are fed often to weaning children, but fufu and cocoyams are preferred, for these are easily digestible everyday foods that require no special preparation. Beans, meats, and other foods are seldom given to children for fear of digestive reactions.

Outside Meals

Fruits, groundnuts, sugarcane, and avocadoes are frequently eaten between meals, the first three primarily by children and young people. In addition, men sometimes eat meals outside the household either as substitute or as an additional meal; women eat less often outside the household. In social occassions such as meetings of men's secret societies and njangis (saving clubs), meat is often served along perhaps with rice and beverages. These events are more likely to happen in larger towns and on Sundays. To the extent that this survey covered mostly farmers in small villages during weekdays, the effects of there outside meals on estimating total food consumption are understated.

Another possible source of bias is the occasional sharing of food by women of different households who alternate working together on their fields. Such sharing arrangements may account for some exceptionally high levels of food consumption recorded at certain meals, but unfortunately, it is not known how common are these arrangements. Cooked food is sometimes exchanged between women in the same or

adjacent compounds, but no record of these exchanges was made in the course of this survey. More important is the frequent sharing of meals with children from neighboring households, especially at lunchtime during the high labor season. The latter effect was controlled by recording the number of men, women, and children partaking of each meal.

Raffia and palm wines are reportedly consumed almost daily by most village men at gatherings in mimbo houses. Their consumption goes down during the heavy rainy season when the wines are of poorer quality and not as plentiful. Bottled beer is consumed more often in towns than in small villages, where few men can afford this relatively expensive drink (U.S. $ .75 to 2.00 per liter). Women can seldom afford to buy bottled beer; instead, they consume corn beer or sha, especially on market days, Sundays, and at meetings of women njangis. Sha is also drunk by young men, but in comparatively smaller amounts than palm or raffia wines.

Diet Variation Among Villages

Although villages were chosen to reflect the ecology of the cold highlands with relatively homogeneous crop production and food consumption patterns, great diversity is still observed in the composition of diets among villages. The relative importance of the twelve selected foods in each village can be gauged by inspecting the three accompanying tables giving the percentage weight, calories, and protein contributed by each major food in each village. (See Tables 5.7, 5.8, and 5.9).

Corn is by far the most important item in the diet in terms of weight, calories, and protein. Corn provides as much as 69 percent of calories in Ntumbaw and Nkar; the lowest calorie contribution were observed in Kikaikom (39 percent) and Bambui (43 percent). In six of the eight highland villages corn provides over half of all calories intake during the survey period. Corn also provides over 40 percent of the protein intake in all but one village, Kikaikom. In Nkar and Ntumbaw over 60 percent of protein intake comes from corn. Only in Kikaikom does another food, beans, contribute more protein than corn to the local diet; in terms of energy no other food approaches the importance of corn.

There is great variation in the relative energy and protein shares among the other selected foods. Beans were especially important in Nseh, Kikaikom, and Banten in terms of calorie content, but in the other villages less than 7 percent of calories were attributed to beans. Of course, the protein contributions of beans is more significant in all villages, with the notable exception of Ntumbaw. For example, beans

TABLE 5.7

CAMEROON NORTHWEST PROVINCE. PERCENTAGE SHARES OF SELECTED FOODS IN HIGHLAND VILLAGES DIET BY WEIGHT, MAY-JULY 1981

Village \ Food	Corn	Beans	Cocoyams	Potatoes	Palm Oil	Plantain	Rice	Groundnuts	Cassava	Meat	Fish	Njamajama
Nseh	45.8	12.0	5.9	0.0	3.7	2.8	0.0	0.0	0.0	0.0	0.0	22.4
Oku	38.2	3.5	13.5	2.4	2.5	7.4	0.3	0.0	2.6	0.1	0.0	22.9
Mbiami	32.7	3.2	2.6	21.7	3.2	1.6	2.3	0.0	4.2	4.4	0.0	9.4
Nfumbaw	48.5	0.8	2.5	5.9	3.4	1.2	2.0	1.2	0.0	2.0	0.0	19.8
Kikaikom	26.4	11.9	0.0	30.5	4.9	3.0	3.1	0.0	0.9	2.8	0.2	6.3
Bauten	30.5	10.2	0.0	36.1	3.3	0.0	0.0	0.0	0.0	1.5	0.0	9.9
Nkar	52.8	5.2	0.0	18.3	2.0	3.7	1.2	2.8	1.3	0.4	1.6	6.0
Bambui	29.9	3.0	32.1	4.6	3.1	10.3	2.4	0.2	0.3	2.3	1.0	1.9

SOURCE: Survey data.

TABLE 5.8

CAMEROON NORTHWEST PROVINCE. PERCENTAGE SHARES OF SELECTED FOODS IN HIGHLAND VILLAGES
DIET BY CALORIES, MAY-JULY 1981

Village \ Food	Corn	Beans	Cocoyams	Potatoes	Palm Oil	Plantain	Rice	Groundnuts	Cassava	Meat	Fish	Njamajama
Nseh	61.1	15.6	2.3	0.0	12.1	1.4	0.0	0.0	0.0	0.0	0.0	4.0
Oku	62.1	5.6	6.2	0.9	10.0	4.6	0.5	0.0	2.7	0.1	0.0	5.5
Mbiami	50.9	4.9	1.2	7.9	12.5	0.9	3.7	0.0	4.2	4.5	0.1	2.2
Ntumbaw	68.6	1.1	1.0	2.0	12.1	0.6	2.9	1.4	0.0	1.9	0.0	4.1
Kikaikom	38.6	16.9	0.0	10.4	17.8	1.7	4.8	0.0	1.3	2.8	0.3	1.4
Banten	50.3	16.4	0.0	13.8	13.3	0.0	0.0	0.0	0.0	1.6	0.0	2.4
Nkar	68.1	6.5	0.0	5.4	6.3	1.8	1.6	6.0	1.6	0.3	0.6	1.1
Bambui	43.1	5.0	15.2	1.9	13.5	6.9	4.3	0.7	0.6	2.6	0.5	0.5

SOURCE: Survey data .

TABLE 5.9

CAMEROON NORTHWEST PROVINCE. PERCENTAGE SHARE OF SELECTED FOODS IN HIGHLAND VILLAGES DIET BY PROTEIN, MAY-JULY 1981

Villages \ Food	Corn	Beans	Cocoyams	Potatoes	Palm Oil	Plantain	Rice	Groundnuts	Cassava	Meat	Fish	Njamajama
Nseh	48.4	34.8	1.2	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	12.3
Oku	57.4	14.6	3.9	0.7	0.0	1.4	0.3	0.0	0.5	0.2	0.3	19.6
Mbiami	48.4	13.2	0.7	5.9	0.0	0.3	2.6	0.0	0.8	12.6	0.4	8.0
Ntumbaw	65.1	2.9	0.6	1.5	0.0	0.2	2.1	0.5	0.0	5.2	0.0	15.2
Kikaikom	32.3	39.8	0.0	6.8	0.0	0.5	3.0	0.0	0.1	6.8	1.4	4.4
Banten	40.3	37.1	0.0	8.7	0.0	0.0	0.0	0.0	0.0	3.8	0.2	7.4
Nkar	60.8	16.0	0.0	3.7	0.0	0.5	1.0	7.8	0.2	0.9	3.7	3.8
Bambui	44.7	13.8	10.0	1.4	0.0	2.3	3.2	0.8	0.1	9.4	3.7	1.9

SOURCE: Survey data.

provide 40 percent of protein in Kikaikom, 35 percent in Nseh, and 37 percent in Banten. In Oku, Mbiami, Nkar, and Bambui beans contribute between 13 and 16 percent of the protein.

Potatoes appear in large volumes in four villages only, namely Mbiami, Kikaikom, Banten and Nkar; only small amounts are reported in three other villages, and in Nseh, no potatoes were consumed at the time of this survey. In terms of calories, potatoes contribute a maximum of 14 percent in Banten, followed by 10 percent in Kikaikom, and 8 percent in Mbiami. The share of potatoes in protein intake in those three villages were 9, 7, and 6 percent, respectively; for other villages only minor values were recorded.

The Northwest Province has been referred to as consisting of a cocoyam zone and a corn zone, the former occupying the western lowlands, and the latter the eastern highlands of the Province. The distinction, however, is not strict, since corn is also grown and consumed in low altitude areas, and cocoyams are known even above the 1200 meters altitude. In this sample, this distinction seems validated by the high cocoyam consumption observed in Bambui, the lowest altitude and westernmost village in the survey. Cocoyams contributes 32 percent of the weight, 15 percent of calories and 10 percent of protein in Bambui. But Bambui is rather exceptional in having this high level of cocoyams consumption: in three villages there was no consumption at all; in three others its calorie contribution was between 1.0 and 2.5 percent; but in Oku, cocoyams did contribute 6.2 percent of calories. Overall, potatoes are more generally consumed in the survey villages than cocoyams, and contribute more significantly to protein and calorie intake.

Palm oil is an item with notable regularity in consumption, although much less than corn. In terms of weight, palm oil consumption varied from a low of 2 percent in Nkar to a high of 5 percent in Kikaikom, while most villages record about 3 percent. However in terms of calories, palm oil contributes significantly to the diet. As much as 18 percent of calories came from palm oil in Kikaikom, with most villages ranging between 10 and 13 percent. Only in Nkar was the energy share below 10 percent. There is no protein associated with palm oil, but its importance to the nutritional well-being of the area should also take into account its high content of vitamins and other nutrients.

Plantains play a small but significant role in the highland villages diet. Only in Banten was no consumption of plantains recorded, and in most villages it is less than 4 percent in weight. In Bambui and Oku, however, plantains accounted for 10 and 7.4 percent of food consumption, by weight. The high water content of plantains reduces

its energy and protein contributions to smaller levels. Only in Bambui and Oku does the percent of protein attributed to plantains exceed 1 percent. Similarly, in these two villages plantain provides 7 and 5 percent of calories, respectively, but in all other villages it was less than 2 percent.

Rice is another small ingredient in the highland diet in terms of weight, but with a significant participation in the calorie and protein intake. The highest weight share was 3.1 in Kikaikom, followed by 2.4 and 2.3 in Bambui and Mbiami; in two villages, Nseh and Banten it wasn't eaten at all. Nevertheless, rice did provide 4.8 and 4.3 percent of calories in Kikaikom and Bambui, respectively, and slightly lower percentages in Mbiami and Ntumbaw. A similar picture emerges for protein: over 2 percent of it was attributed to rice in four villages, Ntumbaw, Mbiami, Kikaikom and Bambui, with a maximum of 3.2 in the latter. In the other four villages the protein contribution was much less or nil.

Groundnuts and cassava are found sporadically in the diet of the highland areas. Only in two villages, Nkar and Ntumbaw were groundnuts consumed in any significant amount. Cassava consumption is slightly more widespread, but only in Mbiami and Oku did it reach over 2 percent. In Nkar, groundnuts provide significant shares of calories and protein, 6 and 8 percent respectively, but this seems an exceptional situation.

Meat and fish also enter the diet in the highland region, but only in small proportions. Fish wasn't consumed at all in five of the eight villages, and only in Nkar and Bambui did fish reach one percent or more of total food weight. Nowhere did fish provide more than one percent of calories, but in terms of protein it did contribute 3.7 percent in Nkar and Bambui, and 1.4 percent in Kikaikom. Meat consumption is more widespread; only in Nseh was there no record of consumption. Mbiami show the highest level of meat consumed, 4.4 percent by weight, which provided also 4.5 percent of calories and 11.6 of protein. Only half as much is reported in Ntumbaw, Kikaikom, Banten and Bambui, and only negligible constributions in the remaining villages.

Njamajama is a vegetable of remarkable importance in highland diet. It's botanical name is *Rumex acetosa*, but little information is found on this vegetable. In three villages, Oku, Nseh, and Ntumbaw, consumption of njamajama was 20 percent or more of total food weight, and in four other villages it represented 6 to 10 percent of food intake, by weight. Only in Mbiami was consumption as little as 2 percent. This vegetable is notably rich in protein; in Oku 20 percent of protein intake came from njamajama, and in Ntumbaw and Nseh 15 and 12 percent were attributed to it. For all other villages their percentages are lower but nevertheless all are 2 or above. Njamajama's contribution is less important for calories than for protein, but

nevertheless significant: 5.5 percent in Oku, 4 percent in Nseh and Ntumbaw, and above 11 percent in the rest of the villages, except for Mbiami.

CHAPTER 6

PRICE EFFECTS AND NUTRIENT BALANCES

Nutrient Requirements

Energy and Protein

A thorough nutritional analysis requires the consideration of many essential nutrients in the diet; in this study attention is given to only the two basic categories: energy and protein. Other nutrients such as calcium, iron, fats, vitamins, essential amino acids, and trace minerals, are also nutritionally important under particular circumstances. Ordinarily however, these nutrients are present in sufficient amounts when the diet contains adequate levels of calories and protein, and a variety of foods is consumed. The diversity of ingredients in the Northwest Province highland diet will almost assure that these other nutrients are adequately supplied.

Increasing understanding of human protein metabolism and availability in diets has led to a diminished emphasis in the last decade on the problem of protein intake and protein consumption. Adequate intake of most cereals to cover energy requirements also provides sufficient protein to cover minimum needs of moderately active adults. Young people and nursing women, however, may need supplementary protein sources. In this chapter energy balances will be given the most attention, but protein balance will be covered as well.

Nutritional Requirements

The commonly accepted standards of nutritional requirements for use in developing countries are those put forward by the Food and Agricultural Organization (FAO) in their Handbook on Human Nutritional Requirements. Table 6.1 presents the FAO requirements for men and women for different ages. These nutritional estimates will be used here to derive estimates of household nutrient requirements. A measure of nutritional well-being could then be obtained by comparing estimates of nutritional intake from the diet survey with estimates of nutrient requirements.

Several researchers have recently cautioned against using these comparisons of nutrient intakes and requirements to support statements about the extent of malnutrition in a community. Warnings against such use by FAO itself include: "The recommended intakes are not an adequate yardstick for assessing health because . . .

TABLE 6.1

RECOMMENDED INTAKES OF ENERGY AND PROTEIN PER DAY

	Age (Years)	Body Weight (kg)	Energy (kilocalories)	Protein (grams)
Children	Less than 1	7.3	820	14
	1 - 3	13.4	1,360	16
	4 - 6	20.2	1,830	20
	7 - 9	28.1	2,190	25
Male Adolescents	10 - 12	36.9	2,600	30
	13 - 15	51.3	2,900	37
	16 - 19	62.9	3,070	38
Female Adolescents	10 - 12	38.0	2,350	29
	13 - 15	49.9	2,490	31
	16 - 19	54.4	2,310	30
Adult Man (moderately active)		65.0	3,000	37
Adult Woman (moderately active)		55.0	2,200	29
Pregnancy (later half)			+ 350	38
Lactation (first 6 months)			+ 550	46

SOURCE: FAO, Handbook on Nutritional Requirements, Rome, 1974, p. 68-69.

each figure represents an average requirement augmented by a factor that takes into account interindividual variability. The recommended intakes are therefore the amounts considered sufficient for maintenance of health in nearly all people" (FAO, Handbook on Nutritional Requirements, 1974, p. 2).

Similarly, another nutrition researcher cautions that " . . . procedures for assessing nutritional status, by classifying individuals in a population as malnourished who have intakes below a single average norm for the population as a whole, thereby ignoring intra- and interindividual variance in intakes and requirements, will misclassify individuals (i.e. adequately nourished as malnourished and vice versa) to varying degrees. This misclassification bias need not cancel out for the population as a whole and there is a danger in overestimating the proportion of truly malnourished" (T.N. Srinivasan, "Malnutrition, Some Measurements and Policy Issues", Journal of Development Economics, 8(1981), pp. 3-19).

Household Per Capita Requirements

So far, nutrient requirements have been specified for individuals of particular sex and age. Food consumption, however, was not recorded per individual, but for the entire household. It is of interest therefore to calculate the average per capita nutrient requirement for the family as a whole. This was done by adding all the individual requirements of household members and dividing by household size, for each of the 72 households.

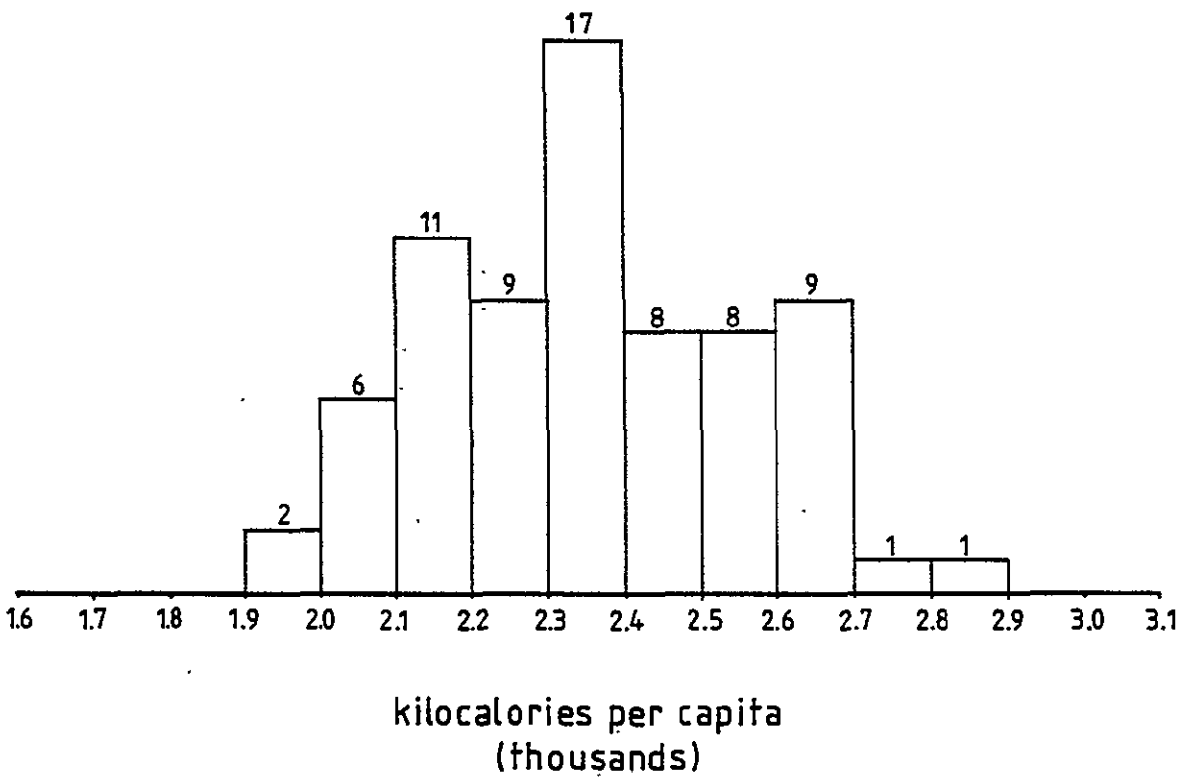
The degree of variation in per capita energy requirements among household was remarkable. A low requirement of 1,952 kilocalories was estimated for a family in Bambui, and a high of 2,881 kcal for a family in Ntumbaw; the mean per capita calorie requirement was 2,351 kcal with a standard deviation of 203 kcal. Figure 6.1 shows the frequency distribution of these estimates.

A parallel procedure followed for protein yielded a mean of 29.7 grams (g) per capita per day with a standard deviation of 2.6 g; the lowest per capita protein requirements was 24.7 g, and the highest was 37.3 g.

This large variation in per capita requirements for energy and protein among families raises some concern about using a single per capita level to judge the nutritional well-being of all families in the sample.

FIGURE 6.1

CAMEROON NORTHWEST PROVINCE. DISTRIBUTION OF PER CAPITA ENERGY REQUIREMENTS AMONG 72 HIGHLAND VILLAGES SAMPLE HOUSEHOLDS



Nutrient Intake

Nutrient Composition of Foods

In order to transform the foods consumed during meals in terms of energy and protein, standard tables of nutrient composition of foods for use in Africa have been used. These tables were published in 1968 by FAO and the U.S. Public Health Service. In some instances, some more recent data on certain foods were available; in those cases the latter were adopted. Table 5.4 provides the energy and protein equivalents for every ingredient found in the highland diet. Energy is expressed in kilocalories per 100 grams. Calories were used in keeping with the usual convention, rather than the more recent standard using joules as the energy unit. Protein is expressed in grams of protein per 100 grams of food.

Energy Intake

Results of calculations of energy intake in the sample households are presented in Table 6.2 for each highland village and for the entire sample. For the sample as a whole average per capita energy intake is 2,774 kcal with a standard deviation of 986 kcal. The village mean energy intakes range between a low of 2,336 in Banten, and a high of 3,365 in Nkar, but most fall near the overall sample mean. Standard deviations, however, are large in relation to the means, and vary greatly among villages. This indicates that although the sample and village means might be adequate, there is great variation among households in energy consumption.

Figure 6.2 shows the frequency distribution diagram of energy consumption among highland households. The distribution is bell-shaped but slightly skewed to the right. The lowest energy intake recorded for a family was 1,085 kcal per person per day in Oku, while the highest of 6,357 was found in Nkar. Eighteen families had energy intakes below 2,000 per head but above 1,000 kcal; 29 families had intakes between 2,000 kcal and 3,000 kcal; 16 families between 3,000 and 4,000 kcal; and nine families had intakes above 4,000 kcal.

Energy Balance

The ratio of per capita intake to requirements can be used to assess how well food consumption satisfies nutrient needs in a household. Values above 1.0 indicate positive energy balances, while values below 1.0 signal an energy deficit. Thus, in a

TABLE 6.2

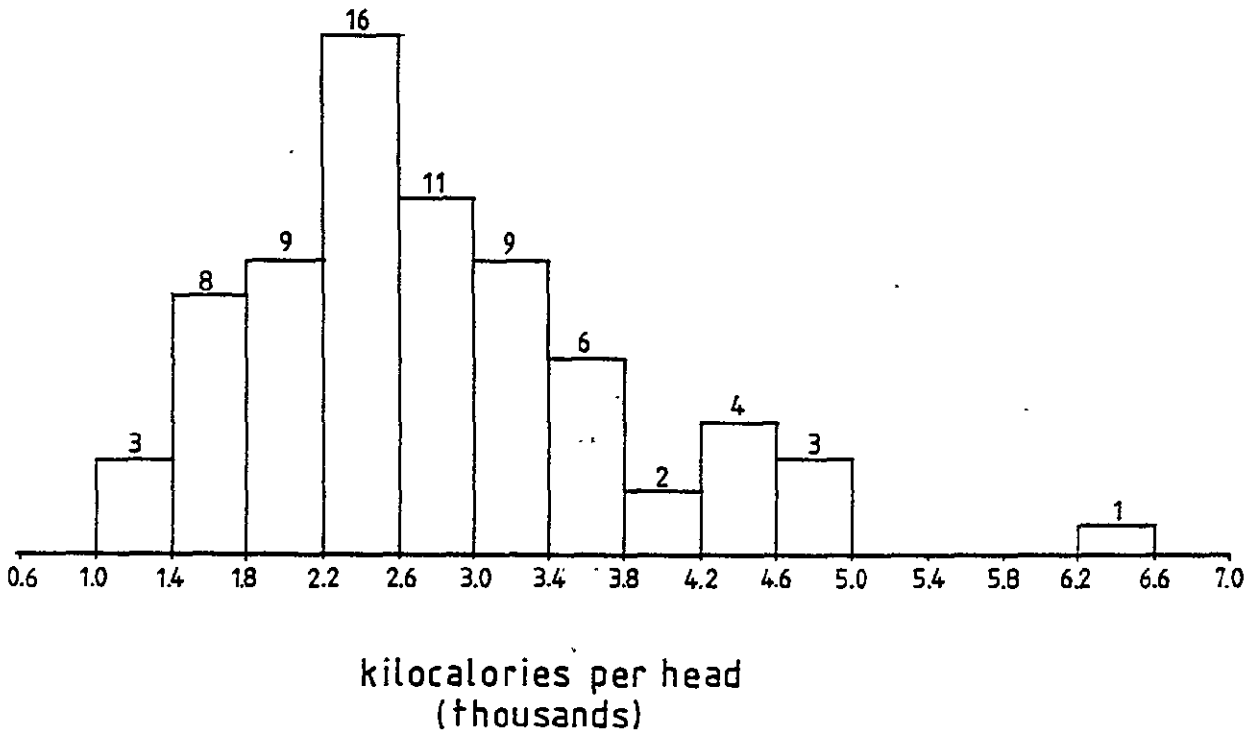
CAMEROON NORTHWEST PROVINCE. AVERAGE PER CAPITA ENERGY INTAKES AND REQUIREMENTS AMONG 72 HIGHLAND HOUSEHOLDS, BY VILLAGE. (kilocalories per Head)

Village	Households	Energy Intakes				Energy Requirements	
		Minimum	Maximum	Mean	Standard Deviation	Mean	Standard Deviation
Nseh	9	2,112	4,320	2,992	783	2,382	190
Oku	9	1,085	4,919	2,976	1,291	2,446	197
Mbiami	9	1,902	3,849	2,641	578	2,334	171
Ntumbaw	9	1,398	3,522	2,350	840	2,333	231
Kikaikom	9	1,642	4,753	2,694	939	2,381	191
Banten	9	1,483	3,457	2,336	574	2,359	154
Nkar	9	1,680	6,357	3,365	1,450	2,264	223
Bambui	9	1,193	4,409	3,018	1,019	2,312	271
All Villages	72	1,085	6,357	2,774	986	2,351	203

SOURCE: Survey data.

FIGURE 6.2

CAMEROON NORTHWEST PROVINCE. DISTRIBUTION OF PER CAPITA ENERGY INTAKE AMONG 72 HIGHLAND SAMPLE HOUSEHOLDS



household with an energy balance ratio of 1.20, average calorie intake exceeds calorie requirements by 20 percent; conversely, a ratio of 0.80 indicates a calorie consumption level 20 percent short of average per capita requirements.

Table 6.3 provides descriptive statistics for the energy balance ratio by village and for the sample as a whole. Figure 6.3 gives the frequency distribution of those ratios for the 72 households. For the average household, calorie intake during the survey period exceeded calorie requirements by 18 percent. Nevertheless, household energy ratios show a wide range of variation. A family in Oku satisfied only 51 percent of its energy requirements, while a family in Nkar consumed two-and-a-half times its energy needs. In all villages there were households whose energy intakes were below requirements, even though the means in all villages were greater than or equal to one. Banten and Ntumbaw have the lowest average energy balance ratios, while Nkar and Bambui have the most favorable. This illustrates clearly that satisfactory averages of energy availability in a village or region might hide the existence of a considerable portion of the population with insufficient energy intakes.

Figure 6.3 makes it easy to visualize what proportion of the population is afflicted by energy insufficiency. Fully 26 families out of 72, i.e. 36 percent, have energy balance ratios below 1.0. Even after allowances are made for the safety margins built in the FAO energy requirements, significant segments of the sample households are likely to suffer from calorie deficiency. Twenty familes -- 28 percent of the sample -- have intakes at least 10 percent below recommended levels; 13 families -- 18 percent of the sample -- have deficits greater than 20 percent. The critical cases are those 3 families with caloric intakes below 60 percent of requirements, followed by 4 families between 60 and 70 percent of recommended levels.

Comparable evidence about the incidence of energy deficiency can be obtained by analyzing energy intake on a per man-equivalent basis. It may be recalled that these estimates were obtained for each meal by assigning weights to women and children sharing the meals, in proportion to their energy requirements vis-a-vis men. Average energy consumption per man-equivalent over the three-day period was computed for each household; summaries of these values are given in Table 6.4 and graphically in Figure 6.4. FAO energy requirement tables specify 3000 kcal per reference adult man; this value is taken here as the norm: values above that indicate a household with energy surplus and vice versa.

Forty-nine households had energy intakes equal to or above the man-equivalent requirement; the remaining 23 households -- 32 percent of the sample -- had

TABLE 6.3

CAMEROON NORTHWEST PROVINCE. ENERGY BALANCE RATIOS OF HIGHLAND HOUSEHOLDS, BY VILLAGE (a)

Village	Households	Minimum	Maximum	Mean	Standard Deviation
Nseh	9	.87	1.75	1.26	.31
Oku	9	.51	2.12	1.16	.58
Mbiami	9	.87	1.52	1.13	.19
Ntumbaw	9	.63	1.69	1.02	.39
Kikaikom	9	.70	2.01	1.14	.40
Banten	9	.58	1.46	1.00	.27
Nkar	9	.79	2.54	1.48	.61
Bambui	9	.59	1.80	1.30	.40
All Villages	72		2.54	1.18	.42

SOURCE: Survey data

NOTES: (a) Energy balance ratios are defined as average per capita calorie intake divided by average per capita calorie requirement.

FIGURE 6.3

CAMEROON NORTHWEST PROVINCE. FREQUENCY DISTRIBUTION OF ENERGY BALANCE RATIOS OF 72 HIGHLAND HOUSEHOLDS

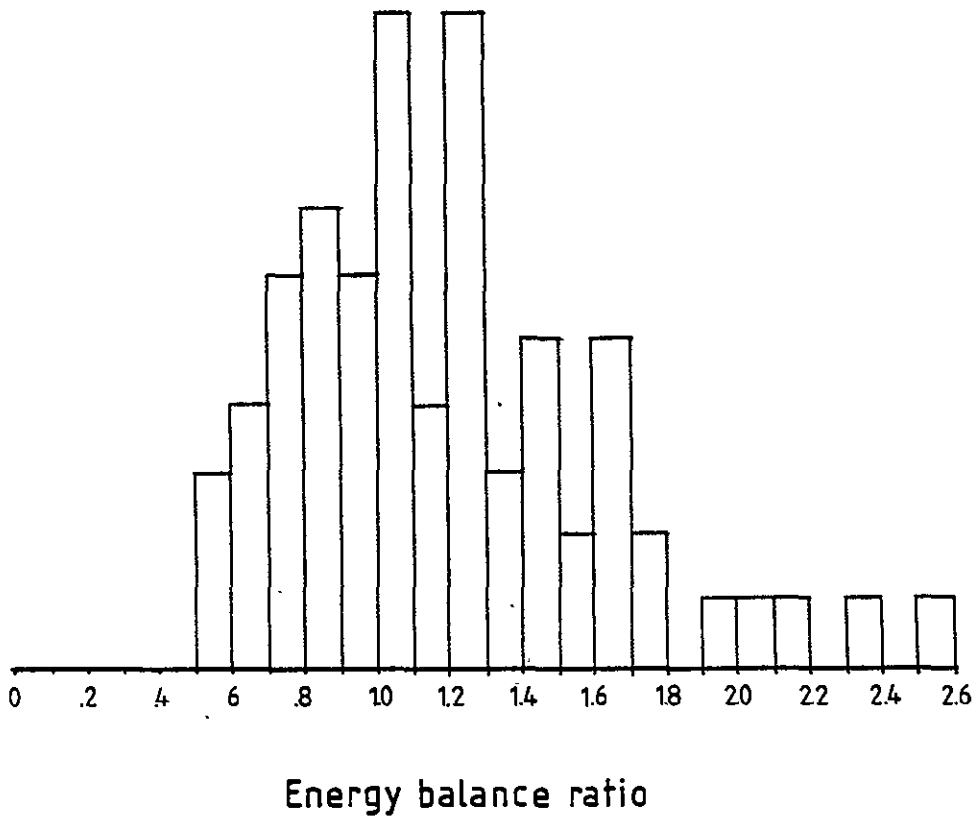


TABLE 6.4

CAMEROON NORTHWEST PROVINCE. ENERGY INTAKE PER MAN-EQUIVALENT AMONG HIGHLAND HOUSEHOLDS. (kilocalories per man)[a]

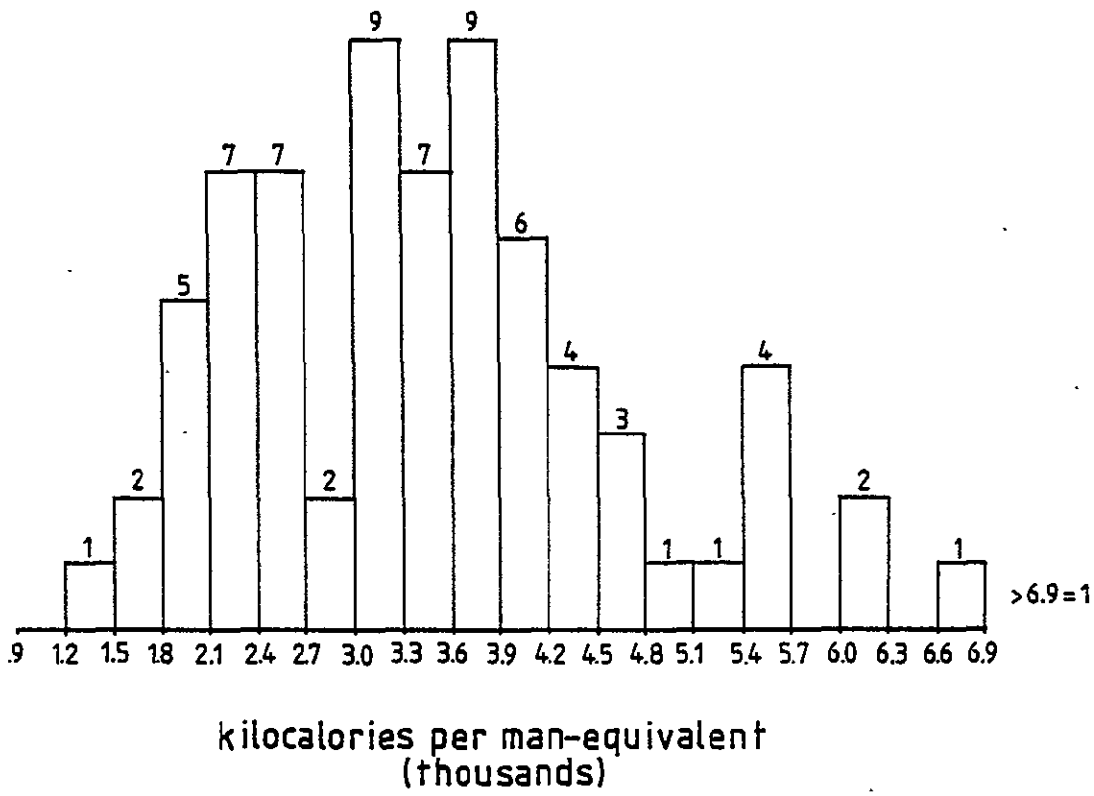
Village	Households	Minimum	Maximum	Mean	Standard Deviation
Nseh	9	2543	5424	3782	1021
Oku	9	1460	6642	3661	1825
Mbiami	9	2438	4456	3362	632
Ntumbaw	9	1787	4349	2974	1053
Kikaikom	9	2103	5523	3391	1114
Banten	9	1812	4119	2922	707
Nkar	9	1883	8501	4361	2017
Bambui	9	1598	5404	3903	1264
All Villages	72	1460	8501	3544	1305

SOURCES: Survey data.

NOTE: (a) Women and children weighted at .90 and .667 man-equivalent units.

FIGURE 6.4

CAMEROON NORTHWEST PROVINCE. FREQUENCY DISTRIBUTION OF ENERGY INTAKE PER MAN-EQUIVALENT AMONG 72 HIGHLAND HOUSEHOLDS



insufficient energy intakes. In two villages, Banten and Ntumbaw, the average intake per man-equivalent was below the recommended 3000 kcal, but only slightly so. The averages for Nkar and Bambui, as before, were the highest among the eight highland villages. The column of minimum values shows that in all villages there are households with energy intakes below requirements. Further analysis of the distribution of energy intake per man-equivalent yields nearly identical findings to those obtained previously using energy balance ratios. In fact, the correlation between these two variables is 0.9663, indicating a very close correspondence between them. Assessments of the nutritional adequacy of the diet with respect to requirements may be carried out by either method, i.e. in per capita or man-equivalent basis. Both procedures were used here because there was concern that variation observed in meal participation might lead to substantially different results. Fortunately, the results here are basically equivalent.

Protein Intake and Balance

Computation of protein intake per head reveals a general picture of adequate protein consumption in the Northwest Province highlands. No distinction was made here on whether the protein came from animal or vegetable sources, but the latter is overwhelmingly the case. The overall average protein intake was 82.9 grams per head per day, i.e., more than double the level required for a reference adult male. The lowest level of intake recorded was 27.4 grams for a family in Oku, while the highest was 189.1 grams in Nkar, By contrast, household per capita requirements ranged from a minimum of 24.7 grams to a maxiumum of 37.7 grams, with a mean of 29.8 grams.

All sample villages in the highlands have more than sufficient average levels of protein intake; the lowest village mean was 64.9 grams obtained in Ntumbaw, and the highest, 99.4 grams, occured in Nkar. Despite relatively high standard deviations with respect to the means (39 percent of the overall mean), those means are sufficiently high to insure adequate protein intake by nearly all the population. Taking for example a normal distribution with the mean and standard deviation of the overall sample, theoretically only five percent of households would have intakes below 30 grams of protein per head per day. In this food consumption survey, no household had mean protein intake below its per head requirement. In one case, intake and requirement matched exactly, but on the average, household protein intake was 2.8 times their requirements. See Table 6.5 and Figure 6.5 for more quantitative details.

TABLE 6.5

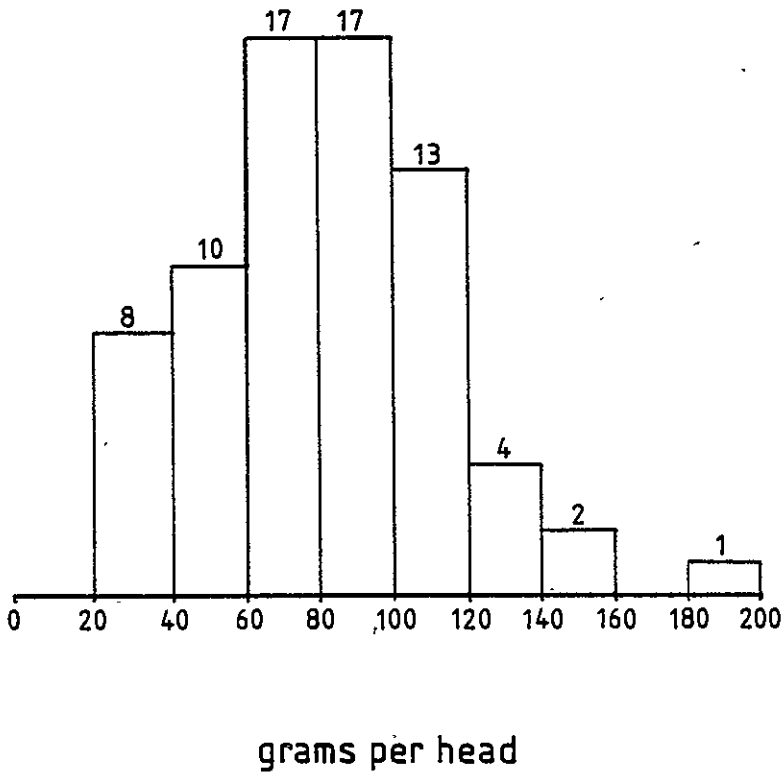
CAMEROON NORTHWEST PROVINCE. AVERAGE PER CAPITA PROTEIN INTAKES AND REQUIREMENTS AMONG 72 HIGHLAND HOUSEHOLDS, BY VILLAGE. (grams per head)

		Protein Intakes				Protein Requirements	
Village	Households	Minimum	Maximum	Mean	Standard Deviation	Mean	Standard Deviation
Nseh	9	68.6	158.0	97.8	27.8	29.8	2.1
Oku	9	27.4	139.6	78.7	38.8	31.2	3.1
Mbiami	9	37.4	124.4	70.7	24.0	29.4	2.5
Ntumbaw	9	29.7	95.8	64.9	29.0	29.6	2.8
Kikaikom	9	42.3	152.3	91.9	33.1	29.8	2.7
Banten	9	38.1	115.0	77.0	22.2	30.2	2.5
Nkar	9	44.6	189.1	99.4	45.7	28.9	2.8
Bambui	9	35.9	121.5	82.5	29.4	29.3	3.0
All Villages	72	27.4	189.1	82.9	32.7	29.8	2.6

SOURCE: Survey data.

FIGURE 6.5

CAMEROON NORTHWEST PROVINCE. DISTRIBUTION OF PER CAPITA PROTEIN INTAKE AMONG 72 HIGHLAND SAMPLE HOUSEHOLDS



Cameroon National Nutrition Survey

To summarize the survey results, the average nutritional intake of calories and protein of the Northwest Province highland population appears adequate overall. Nevertheless, about one in four households may have insufficient energy intakes. The proportion ranges from 18 to 28 percent depending on whether the cutoff point is set at 20 or 10 percent below the recommended allowance. For protein, intake was found adequate among all families.

The survey estimates match closely the results from the Cameroon National Nutrition Survey that took place from October 1977 through April 1978 under the auspices of the Government of Cameroon and USAID. The Nutrition Survey reports 24.2 percent of the population in the Northwest Province as suffering from chronic undernourishment.(See Table 6.6)

Agreement between these two estimates of the extent of malnutrition seems all the more remarkable in view of the different methodological approaches followed by the two surveys. The Cameroon National Nutrition Survey bases its conclusions about malnutrition on anthropometric data, basically on the relation of height-for-age and weight-for-height ratios vis-a-vis median values of a standard reference population. We did not make use of anthropometric measurements in this survey, instead we looked directly at food consumption.

In order to use anthropometric data to diagnose the extent of malnutrition it is necessary to adopt a standard or reference against which the population under survey is to be measured. Since no reference information was available for Cameroon at the time of the National Nutrition Survey, reference data were adopted from studies recently completed in the United States. The reference populations included children up to 24 months from middle to upper socioeconomic status families, and those aged 2-6 years from a nationwide survey in the U.S.A. (Cameroon National Nutrition Survey, pages 49-55).

Reference median values for body measurements are used to represent normal growth. A child measuring less than 90 percent of his expected height-for-age ratio will be classified as chronically undernourished, and the proportion of children so classified gives the estimate of the prevalence of chronic undernutrition in a population. Acute undernutrition is estimated as the proportion of children with weight-for-height ratios below 80 percent of the reference median values (Cameroon National Nutrition Survey, pages 49-55).

Table 6.6 presents the prevalence of chronic undernutrition for Cameroon and by province as reported by the Cameroon National Nutrition Survey. In the Northwest Province 24.2 percent was considered chronically undernourished, compared to 21.0 percent for Cameroon as a whole, but considerably less than in the West Province, for example, where 31 percent of the population was classified as suffering from chronic undernutrition. Excluding Yaounde and Douala, the percent of chronic undernutrition for all provinces was 22.1.

Prevalence of acute undernutrition in Cameroon provinces (defined as weight-for-height ratio under 80 percent of the reference median) was found to affect one percent of the country's population. Only in Northern Cameroon does acute malnutrition exceed 1.0 percent; in the Northwest Province the figure was 0.7 percent.

Results from the Cameroon National Nutrition Survey indicate that children in the Northwest Province are of smaller stature than children of the same age in the United States, but that their weight should be considered normal for their height. In other words, one could classify Northwest Province children as adequately nourished judging by their physical appearance alone, but when their age is taken into account they are not growing as fast as their American counterparts.

Despite the concordance between the Cameroon National Nutrition Survey and the nutritional analysis from this food consumption survey, it is not straightforward to conclude that the smaller stature of children in the Northwest Province is caused by deficiencies in calorie intake. Such a conclusion might be justifiable were children being raised in a similar environment to that of the reference population. However, given the vast environmental differences between the reference population in the United States and rural villages in the Northwest Province, attributing slower growth solely to food consumption deficiencies seems questionable. Equally likely factors for the slower growth are differences in sanitation, health care, degree of food processing, and genetic makeup between the two communities.

Impact of Price Changes on Food Consumption and Nutrition

Major Sources of Household Nutrition and Income

In order to project the likely nutritional impacts of higher food crop prices, it was necessary to select a specific crop or group of crops for which consumption elasticities should be estimated. Our primary concern of course was to identify those crops which were most important to the nutrition of households included in the sample.

TABLE 6.6

CAMEROON. PREVALENCE OF CHRONIC UNDERNUTRITION, BY AREA.
(HEIGHT-FOR-AGE UNDER 90 PERCENT OF REFERENCE MEDIAN. CHILDREN 3-59 MONTHS)

Province	Percent (weighed)	Sample Size
Central South[a]	18.8	899
East	26.7	899
North	21.1	1,199
Northwest	24.2	466
West	31.0	447
Southwest	20.1	504
Littoral[a]	24.0	389
Total Provinces[a]	22.1	4,783
Yaounde, Douala	11.8	897
Urban Cameroon[a]	19.4	840
Rural Cameroon	22.4	3,943
Total	21.0	5,681

SOURCE: Cameroon National Nutrition Survey, AID, 1978, p. 87.

NOTE: (a) Excluding Yaounde, Douala.

In addition, however, we were clearly interested only in crops produced for sale as well as for home consumption.

Table 6.7 summarizes the major findings of the previous chapters with regard to the relative contribution of different crops to the diet of households surveyed. As shown, a large percentage of the per capita daily intake of calories and protein is accounted for by a relatively small group of crops. Indeed, the first seven items listed in the table account for approximately 90 percent of all calories and protein consumed by our sample on a daily basis. Moreover, 49 percent of the per capita daily intake of protein and 55 percent of the per capita daily intake of calories was obtained from the consumption of corn alone.

An increase in the prices farmers receive for their crops, however, is not likely to affect similarly the nutritional contribution of all of the items listed in Table 6.7. Some of the items, palm oil and fish, for example, are not produced within our study area, while others are produced almost entirely for home consumption. In fact, as shown, in Table 6.8, only half of the major contributors to per capita daily calorie and protein intake (i.e. corn, Irish potatoes, beans, rice, plantains and groundnuts) made any significant contribution to household farm income, including income from marketing and the imputed value of home consumption. Moreover, the individual contributions of rice, plantains and groundnuts to household farm income were relatively small. In particular, although both groundnuts and plantains are produced in all eight of the villages surveyed, they accounted for an average of more than 1 percent of household farm income in only four villages (for groundnuts) and two villages (for plantains). Rice, on the other hand, is not produced in any of the villages surveyed. Nonetheless, it accounted for an average of 2.5 percent of household farm income in three of the villages in which a number of the cultivators own property in the rice producing areas of Mbo-Nso Plain -- twenty kilometers and over 1000 meters down from the nearest highlands village.

The remaining three crops (i.e. corn, beans and Irish potatoes) are clearly among the most important crops grown in our study area both in terms of their contribution to household nutrition and farm income. Indeed, as shown in Table 6.9, together they account for nearly 70 percent of all calories and over 75 percent of all protein consumed by the sample households. Table 6.9 shows that their importance to household nutrition is even greater in terms of their contribution to the per capita attainment of calorie and protein minimum daily requirements (MDR's).

Similarly, corn, beans and Irish potatoes accounted for nearly one-half of household farm income derived from the production of all crops (including nonfood

TABLE 6.7

CAMEROON NORTHWEST PROVINCE. RELATIVE CONTRIBUTION OF SELECTED FOOD ITEMS TO PER CAPITA DAILY INTAKE OF CALORIES AND PROTEIN

	Calories %	Protein %
Corn	54.8	48.9
Palm Oil	12.2	0.0
Beans	9.2	22.9
Irish Potatoes	5.0	3.5
Cocoyams	3.6	2.1
Njamajama	2.5	8.4
Meat[a]	1.7	4.6
Plantain	2.5	0.7
Rice	2.3	1.6
Cassava	1.3	0.2
Groundnuts	1.2	1.4
Fish	0.2	1.4
Total	96.5	95.7

NOTE: (a) Includes meat from cattle, goats, chickens and wild game (i.e. antelope, cutting grass, etc.).

TABLE 6.8

CAMEROON NORTHWEST PROVINCE. CONTRIBUTION OF SELECTED CROPS TO ANNUAL HOUSEHOLD FARM INCOME (%)

	Nseh	Oku	Mbiami	Ntumbaw	Kikaikom	Banten	Nkar	Bambui	Average
Corn	33.0	34.0	35.5	43.5	26.1	36.9	23.7	17.4	31.3
Coffee	30.0	42.2	11.1	26.8	34.7	22.0	42.2	23.0	29.0
Irish Potatoes	5.4	2.0	21.4	0.4	9.8	23.1	0.3	2.4	8.1
Beans	13.5	4.5	6.1	5.1	12.8	4.3	6.1	2.5	6.9
Cattle	0.0	0.0	8.2	6.9	0.0	0.0	0.0	10.3	3.8
Goats	4.9	3.2	0.0	0.0	0.8	4.3	1.0	5.9	2.5
Rice	1.9	0.0	6.1	11.9	0.0	0.0	0.0	0.0	2.5
Kola	0.0	3.3	8.7	0.1	2.6	1.8	2.0	1.1	2.5
Plantain	0.0	0.6	0.2	0.2	0.1	0.2	5.7	6.8	1.7
Rafia Wine	0.0	5.1	0.0	0.1	0.2	0.0	6.1	1.9	1.7
Groundnuts	0.0	1.5	0.1	3.1	0.0	0.0	2.7	5.0	1.6
Chickens	2.2	0.4	1.2	0.4	1.0	1.2	1.9	3.2	1.4
Eucalyptus	2.7	2.1	0.6	1.0	0.2	0.7	0.1	0.5	1.0
Pepe	4.4	0.5	0.0	0.0	0.9	0.4	0.0	0.0	0.8
Total	98.1	99.4	99.0	99.7	89.5	94.9	91.7	80.0	94.6

TABLE 6.9

CAMEROON NORTHWEST PROVINCE. RELATIVE CONTRIBUTION OF CORN, BEANS AND IRISH POTATOES TO SAMPLE NUTRITION

A. Sample Average Percent Daily Contribution of Corn, Beans and Irish Potatoes to Per Capita Intake of Calories and Protein

Corn		Beans		Irish Potatoes		Total	
Cal.	Prot.	Cal.	Prot.	Cal.	Prot.	Cal.	Prot.
54.8	48.9	9.2	22.9	5.0	3.5	69.0	75.3

B. Implied Sample Average Percent Contribution of Corn, Beans, and Irish Potatoes to Per Capita Attainment of Calorie and Protein Minimum Daily Requirements[a]

Corn		Beans		Irish Potatoes		Total	
Cal.	Prot.	Cal.	Prot.	Cal.	Prot.	Cal.	Prot.
64.7	135.9	10.9	63.7	5.9	9.7	81.5	209.3

NOTE: (a) Equals values listed in Part A above times 1.18 (for calories) and 2.78 (for protein), see Table 6.12.

cash crops) and approximately 75 percent of all household farm income associated with the production of food crops alone.

Given the above considerations, it was decided that an attempt should be made to estimate consumption elasticities for corn, beans and Irish potatoes taken together. As previously noted, Table 6.9 summarizes the relative importance of these three crops to household consumption, as well as to the per capita attainment of calorie and protein minimum daily requirements. The current distribution of household farm income derived from the marketing and home consumption of corn, beans and Irish potatoes is presented in Table 6.10. Finally, Table 6.11 summarizes the relative importance in our sample of farm income, its components, and off-farm income to total household income from all sources.

Farmers' Price and Income Elasticities

Elasticities calculated at the mean using the procedures discussed in Part II are presented in Table 6.12. Estimates of the marketing elasticities indicate that while the farmers' pure price response is to some degree offset by their response to real income changes induced by changes in the price, the net effect of higher prices will be an increase in marketing. The estimated consumption elasticities, on the other hand, indicate a net decrease in farm consumption as a result of higher prices for marketed food crops.

Farmers' Price Elasticities of Calorie and Protein Intake

A clearer picture of the nutritional implications of farmers' consumption response to higher food crop prices can be obtained by converting our estimated short run total price elasticity of home consumption into price elasticities of calorie and protein intake using the following equations:

$$\eta_{Cal} = c\,[\,\Sigma_{cp} + r\,\Sigma_{cy}]$$

$$\eta_{Prot} = pr\,[\,\Sigma_{cp} + r\,\Sigma_{cy}]$$

where: η_{cal} and η_{prot} are the total short run price elasticities of calorie and protein intake; c and pr are the relative contributions of corn, beans, and potatoes to the average per capita daily consumption of calories and protein, and Σ_{cp}, r and Σ_{cy} are the pure price and income elasticities of consumption; and r is the proportion of income from the three foods.

TABLE 6.10

CAMEROON NORTHWEST PROVINCE.

DISTRIBUTION OF THE VALUE OF CORN, BEANS AND IRISH POTATOES BETWEEN MARKET SALES AND HOME CONSUMPTION (%)

Village	-- Market Income --				-- Non-Market Income --			
	Corn	Beans	Irish Potatoes	Average	Corn	Beans	Irish Potatoes	Average
Nseh	17.8	42.7	28.8	29.8	82.2	57.3	71.2	70.2
Oku	3.2	41.5	10.1	18.3	96.8	58.5	89.9	81.7
Mbiame	3.0	43.5	42.4	29.6	97.0	56.5	57.6	70.4
Ntumbaw	2.4	29.0	25.0	18.8	97.6	71.0	75.0	81.2
Kikaikom	4.6	39.0	25.4	23.0	95.4	61.0	74.6	77.0
Banten	12.7	61.5	62.7	45.6	87.3	38.5	37.3	54.4
Nkar	5.5	73.4	0.0	26.3	94.5	26.6	100.0	73.7
Bambui	24.0	44.9	100.0	56.3	76.0	55.1	0.0	43.7
GRAND MEAN	9.2	46.9	36.8	31.0	90.9	53.1	63.2	69.0

TABLE 6.11

CAMEROON NORTHWEST PROVINCE. DISTRIBUTION OF ANNUAL HOUSEHOLD INCOME FROM DIFFERENT SOURCES[a] (%)

Village	Market Income	Non-Market Income	Farm Income	Off-Farm Income
Nseh	38.4	41.5	79.9	20.1
Oku	38.1	34.9	73.1	27.0
Mbiami	41.2	31.2	72.3	27.7
Ntumbaw	36.4	46.2	82.6	17.4
Kikaikom	37.9	37.6	75.5	24.5
Banten	43.2	36.8	80.0	20.0
Nkar	51.3	31.5	82.8	17.2
Bambui	50.8	27.1	78.0	22.1
GRAND MEAN	42.2	35.8	78.3	22.0

NOTE: (a) As noted on page 118 above, the various components of total household income are defined as follows: Market Income - value of marketed agricultural products; Non-Market Income - imputed value of crops not marketed; Farm Income - market income plus non-market income; Off-Farm Income - income from all non-farm sources.

TABLE 6.12

CAMEROON NORTHWEST PROVINCE. ESTIMATED VALUES OF PARAMETERS USED IN CONSTRUCTING TABLE 6.13

A. Estimated Price Elasticities of Calorie and Protein Intake

η_{Cal}	η_{Prot}
-0.773	-0.843

B. Sample Average Per Capita Attainment of Calorie and Protein Minimum Daily Requirements

Calories	Protein
1.18	2.78

Calculated elasticities can in turn be multiplied by sample average values of the per capita attainment of calorie and protein minimum daily requirements to yield expected net reductions in attainment of these MDR's for a variety of hypothetical price increases. Table 6.13 presents such a schedule of expected net reductions, with values of the parameters necessary for calculating the schedule listed in Table 6.12.

As illustrated in Table 6.12, the results of the nutrition surveys indicate that households are on average consuming 18 percent more calories and over 17.8 percent more protein than their minimum daily requirements. Combined with the estimated elasticities of calorie and protein intake listed in Table 6.12, this implies, again on average, that both the sample calorie and protein minimum daily requirements can be met even with an across the board increase of 18-19 percent in the price of corn, beans and Irish potatoes. Indeed, as reported in Table 6.13, it would require a substantially larger price increase to cause an average sample shortfall in attainment of the protein minimum daily requirement.

It should be emphasized, however, that the above estimates represent partial short run responses to changes in the price of food crops. In particular, no account has been taken of the long run consumption or production response to higher prices, nor of changes in the purchase of food items induced by income earned with increased marketings. Moreover, while on average the sample may safely sustain up to an 18 percent increase in the price of food crops, as shown in Table 6.14, a substantial percentage of individual sample households fail to meet their minimum daily requirement of calories even if no increase in the price is assumed. And given an increase of 18 percent, over half the sample can be expected to fall below 100 percent attainment.

Although data constraints have prevented calculation of the long run consumption elasticity, in view of the short run elasticities presented above, it is nearly certain that the long run response would indicate a similar decrease in consumption as a result of higher prices for marketed food crops.

With regard to the long run production elasticity, the fact that 80 percent of the cultivators when questioned responded that more land could be obtained for farming if it were needed, suggests the possibility at least of a positive long run production response to more favorable marketing opportunities.

Finally, there is little question that higher incomes would lead to an increase in purchased food items and presumably to improved household nutrition.

In the absence of more information, however, it is simply not possible to estimate the magnitude of these various unquantified factors, and hence to determine

TABLE 6.13

CAMEROON NORTHWEST PROVINCE.
ESTIMATED REDUCTIONS IN AVERAGE SAMPLE ATTAINMENT OF CALORIE AND PROTEIN MDR'S GIVEN VARIOUS HYPOTHETICAL PRICE INCREASES FOR MARKETED FOOD CROPS

Percentage Increase in Price of Corn, Beans & Irish Potatoes	Resulting Percentage Decrease in Consumption[a]		Resulting Percentage Decrease in MDR Attainment[b]	
	Cal.	Prot.	Cal.	Prot.
10	7.7	8.4	9.9	25.5
15	11.6	12.6	14.9	38.3
16	12.4	13.5	15.9	40.8
17	13.1	14.3	16.9	43.3
18	13.9	15.2	17.9	46.0
19	14.7	16.0	18.9	48.6
20	15.5	16.9	19.9	51.1

NOTES: (a) Equals percentage price increase times calorie and protein elasticities listed in Table 6.12.

(b) Equals percentage decrease in consumption times sample average MDR attainments listed in Table 6.12.

TABLE 6.14

CAMEROON NORTHWEST PROVINCE.
SAMPLE DISTRIBUTION OF ATTAINMENT OF CALORIE AND PROTEIN MDR's
GIVEN VARIOUS HYPOTHETICAL PRICE INCREASES FOR MARKETED FOOD CROPS

Percentage of Households Given Percentage of Minimum Daily Requirement for Calories and Protein[a]								
	Calorie MDR						Protein MDR	
Percentage Price Increase / Percentage MDR	0	10	15	18	19	20	0	20
100	34.9	44.4	50.8	52.4	54.0	60.3	1.6	15.9
90	25.4	31.7	36.5	42.9	42.9	47.6	0.0	12.7
80	12.7	22.2	25.4	33.3	33.3	34.9	0.0	9.5
70	4.8	7.9	14.3	17.5	19.0	19.0	0.0	4.8
60	1.6	3.2	4.8	6.3	7.9	7.9	0.0	4.8
50	0.0	1.6	1.6	1.6	1.6	1.6	0.0	0.0

NOTE: (a) Equals nutrition survey results for per capita attainment of MDR's times estimates of the expected percentage decrease in MDR attainment listed in Table 6.13.

the net long run nutritional impact of higher food crop prices. Further investigation, particularly with regard to possible constraints on increased output would, therefore, seem to be highly desirable before the initiation of any government program aimed specifically at increasing the demand for highland food crops.

Summary

Data collected in eight villages in the Northwest Province of Cameroon were used to estimate the short-run nutritional impact of policies that would lead to an increase in the demand for food crops in this area. Projected changes in the cultivators' nutritional status were based on estimates of their willingness to market more and consume less in response to higher prices along with estimates of their current nutritional well-being.

The price elasticity of demand for home consumption was calculated for three crops (corn, beans, and Irish potatoes) which were found to be major contributors to both household nutrition and farm income. Estimates of the consumption elasticity for the three crops considered together was -1.12.

A conversion of the estimated consumption elasticity to price elasticities of calorie and protein intake allowed a projection of likely short run changes in the per capita attainment of calorie and protein minimum daily requirements. The results of this procedure indicated that an 18 percent increase in the price of marketed food crops could be sustained without causing an average sample shortfall in attainment of either MDR.

The results of the nutrition surveys, however, indicated that a substantial percentage of individual sample households fail to meet their minimum daily requirement of calories even if no increase in the price is assumed. Furthermore, an increase of 18 percent was found to result in over half the individual households falling below 100 percent attainment for the calorie MDR.

Data constraints prevented calculation of various factors which would have permitted an estimation of the net long run nutritional impact of higher food crop prices. It is nearly certain, however, that the long run consumption elasticity would indicate a decrease in food intake similar to that of the estimated short run elasticity and further, that more food items would be purchased in response to higher incomes earned with increased marketings.

Perhaps the most critical unknown, however, is the magnitude of the cultivators' long run production response to higher prices. In this regard, although it was not

possible to census all available excess farmland within our study area, a survey of the cultivators themselves revealed overwhelming agreement that land would not be a constraint on the increased production of food crops. It is quite possible of course that other constraints, most notably labor, could prevent a sufficient increase in production despite available acreage.

In summary, although the nutrition of households included in our sample was in general found to be quite good, particularly with regard to protein consumption, an increase in the demand for food crops would likely result in a significant reduction in household consumption and a consequent lowering of the cultivators' nutritional well-being. It would therefore seem to be critically important that factors affecting the long run nutritional impact of higher food crop prices be investigated prior to the initiation of government policies likely to substantially increase the demand for highland food crops.

CHAPTER 7

SUMMARY AND CONCLUSIONS

Principal Findings

Infrastructure, Topography, Ecology

The mountainous geography of the Northwest Province, and the highland areas in particular, provides a favorable ecology to grow a great variety of food crops and a cool, healthy climate for human habitation. Unfortunately, it has also impeded the commercial integration of the Province with the rest of the Cameroonian economy. Transport infrastructure within the Province is barely adequate where it exists, and many areas are completely cut off during the rainy season. Long distances to the large markets of Douala and Yaounde has so far precluded the shipment of staple foods to those cities. The Western Province, situated farther to the south of the Northwest Province, has experienced in the past decade a remarkable expansion in agricultural production largely in response to the growth of the coastal market around Douala. So far however, the Northwest Province has shared little of that growing market primarily because of the deficiencies of the transport network. Only a few kilometers of paved road exist in the Province, on the road from Bamenda to Douala. It is illustrative that in Santa, a village south of Bamenda and on the paved road to Douala, a lively production of vegetables for export to Douala has developed in the past few years; these exports were made possible by the rapid access to refrigerated trucks provided by the paved highway.

Production Pattern

Farm production in the Northwest Province highlands has a very distinctive pattern: coffee trees mixed with banana or plantain trees are normally located around the household; food crop fields are located farther away and are scattered in several places. Three or four different crops are interplanted simultaneously in the same field; there is never a single crop per field. The most common crop mixture is maize, beans, and potatoes. The prevalence of crop interplanting makes it hard to arrive at independent estimates of input and yields for separate crops. It is therefore difficult to speculate about the potential production responses of farmers to changing market conditions, although the possibilities for crop substitution within the mixture are clearly good.

Sexual Division of Labor

Farm labor on food crops is performed almost exclusively by women; men help a little with the heavier activities, but work mostly with the cash crops such as coffee. The traditional exemption of men from engaging in farm work is slowly losing ground as food crops become more commercialized. The taboo is against production of food for home consumption, but production for the market is apparently accepted. This has occurred already in other areas of the Province, such as in Bambui, where similar patterns of sexual division of labor existed years ago but now men work openly in the fields.

Sources of Cash Income

Farm income originates mainly from the sale of coffee to the local cooperatives. Next in importance as sources of cash income are sales of corn, potatoes, and beans. Sales of fowl, small livestock, firewood and raffia wine also make substantial contributions to the family's cash income. Men receive the bulk of money income from farm sales, since women's income comes mainly from the sale of small amounts of food crops, i.e. corn, potatoes, and beans.

Composition of the Diet

Corn (maize) is the principal ingredient of the highland diet: it accounts for 55 percent of the calories and 49 percent of the protein. Following in importance are beans and potatoes which contribute 9 and 5 percent of calories and 23 and 35 percent of protein, respectively. Palm oil makes a considerable contribution -- 12 percent -- to calorie intake. Maize is consumed mainly as fufu or cornmeal, accompanied by a sauce of palm oil, vegetables, condiments, and some meat. Njamajama, a local vegetable, is an indispensable ingredient in the sauce and contributes substantially to both protein and calories in the local diet. Other important items in the highland farmers' diet are cocoyams and plantains, but they account for minor shares of energy and protein in comparison to corn. The diversity of the diet in the villages surveyed seems to insure adequate supplies of other nutrients.

Consumption from Own Production

Households produce almost all of the food they consume. The cropping pattern is dominated by the presence of corn, followed by beans and potatoes. Coffee is the

principal cash crop and source of farm money income. Food purchases are few and limited almost exclusively to palm oil, salt, sugar, meat, and condiments. None of the major staples are purchased in significant amounts by sample households. Specialty items such as powdered and condensed milk, bouillon cubes, tinned tomatoes, and wheat flour bread are of course purchased in the market, but the amounts are small, of little nutritional significance, and are consumed mostly by men or family guests. Bottled alcoholic beverages might constitute a significant share of food expenditures and calorie intake; unfortunately, the difficulties in recording beverage and food consumption outside the home precluded their analysis in this study.

Importance of Palm Oil

Palm oil is exceptional in being the main food purchased in the market with substantial nutritional value, since it provides 12 percent of energy intake. Consumption of imported rice constitutes a minor cash outlay, but the quantities consumed by farming households are fairly small, rice being considered a special food to be served at home only on exceptional occasions.

Seasonality

The consumption survey was scheduled to coincide with the period of greatest nutritional stress, corresponding to the months of April through July. Agricultural labor demand is highest at this time, while family food reserves from the previous harvest are at their minimum. Fieldwork also reduces the time wives can spend on meal preparation. It is expected that other seasons of the year would have more favorable nutritional balances.

Nutritional Adequacy

The diet of farming households in the Cameroon Northwest Province highlands is on the average nutritionally adequate in calories and protein. Per capita energy intake in the 72 household sample was 2,774 kilocalories, 18 percent above the average per capita requirement of 2,351 kcal. Average protein intake of 82.9 grams per capita is more than double the average requirement of 29.8 grams. Nevertheless, the distribution among households of caloric intake shows a number of households -- ranging from 18 to 28 percent -- with per capita intakes substantially below daily recommended allowances.

Conclusions

Trade Prospects with Nigeria

The prospects for expanded agricultural trade from the highlands of the Northwest Province toward Nigeria are of small consequence. Road transport from the area to the main coastal towns in Nigeria are almost nonexistent. The road through Mamfe has been in a bad state of disrepair for several years and it is not used as a major route to Nigeria. There are no known plans to improve that road. The only trade in farm produce from the highland areas to Nigeria takes place through the trails that connect Ndu with Gembu, on the Nigerian side, on the Mambila Plateau. Nigerian traders purchase small volumes of rice, beans, and corn for sale in Nigeria at substantially higher prices. Although the nominal profits seem high at first sight, they probably would not cover the depreciation of the land rovers over the maximum two-year life if one trip per week were made. The main reason for the land rovers to come into the Northwest Province from Nigeria through that route is to bring manufactured goods and equipment into Cameroon unofficially. Bamenda has in fact become a well-known and well-stocked market of electronics. The present small level of agricultural exports to Nigeria should be truly considered a by-product of this illicit traffic and subject to the uncertainties of that trade in the future.

Demand Prospects in Southern Cameroon

Of greater significance for the Northwest Province agricultural sector is the growth of demand anticipated in the urban centers of the coast. The rapid urbanization that Douala and surrounding towns exhibited during the 1970's may in fact accelerate as a result of the recent discovery of oil deposits. Population in Yaounde and other urban centers is also expected to grow in the 1980's at over 7 percent annually, exceeding the 6 percent growth in urban population since 1960. Population growth appears to have accelerated from about 2 percent per year between 1960 and 1975 to a current estimated rate of 2.56 percent. Rural-urban migration will further contribute to accelerated urban growth. These expected trends in urban growth and rural migration would result in alarming deficits of food production in Cameroon in all types of foods, from grain cereals to tubers, according to the Plan Alimentaire recently drafted by the Ministry of Planning (1981). The problem of providing adequate food supplies will be especially acute for the coastal areas around Douala.

Within the Northwest Province the main artery of commerce is the "ring road," a loop connecting Bamenda with the main provincial population centers, namely Ndop, Kumbo, Ndu, Nkambe, and Wum. Although the "ring road" itself can be travelled all through the year, the smaller access roads radiating from it into the highland villages are passable only in the dry season. Most produce from the more remote villages is headloaded into the larger market towns. Animals are not commonly used for transporting produce, except for the few donkeys used carrying raffia wine jugs. Under such circumstances it is not surprising that only a small percentage of produce is marketed. Until now coffee has constituted the main item exported from the highlands to the outside, thanks largely to its high value-to-weight ratio and that its harvest occurs after the heavy rains are over. Corn, beans, and potatoes are becoming increasingly commercialized and in some villages the share of potatoes marketed may actually exceed the share retained for home consumption.

It is evident from the above considerations that over the next few years highland farmers in the Northwest Province will see prices for their food crops increase at favorable rates. The two main reasons for the upward trend are the anticipated expansion of the coastal market for food produce and the likely improvement in the road infrastructure within the Province. During the past few years, as a result of increased attention by the Federal Government to the development of the Northwest Province, some progress has been made in the road system. Further work on the "ring road" and on feeder roads is expected in the near future. Reductions in the cost of transport will likely be reflected in higher farm-gate prices since the current trading system seems to work competitively, and improved transport facilities would lead to additional traders becoming interested in villages until now too remote to visit. The impact on farm prices from expansion of the market for agricultural products in the eastern states of Nigeria is heavily discounted here in view of the lack of routes leading to Nigeria, and the unlikely prospect that a Cameroonian government facing food deficits in Douala would contemplate facilitating the export of food to Nigeria.

Prices and Farmers' Food Consumption

The central topic of this study was therefore to trace the potential impact of these anticipated price increases on the food consumption of highland farmers in the Northwest Province. Two opposite types of economic effects on consumption can be postulated, a direct negative and a positive income effect from the higher revenues received. The direct negative price effect is the familiar response of consumers and

producers to higher prices, namely a decrease in the quantity consumed and an increase in the quantity sold, respectively. Urban consumers, for example, would reduce their consumption of potatoes as its price increases. Farmers could exhibit the same type of behavior even though they might not purchase the food in question; at higher prices farmers would try to sell more by sacrificing home consumption.

Farmers, however, in their role as producers and sellers of food products, would benefit from higher incomes as a result of more favorable prices; consequently farmers' consumption of food and other items would increase from this revenue effect. Substitutions of foods will undoubtedly occur; thus, a rise in the price of corn may lead to lower corn consumption but higher potato consumption. Farmers' incomes increase in two distinct manners. First, they receive more for the same quantity sold, and second, they are able to shift production to increase the quantity sold. In the short run only the former is observed, but in the long run adjustments in cropping patterns would result.

Food Consumption Elasticities

Data from the survey undertaken as part of this study were collected and processed with the aim of obtaining quantitative estimates of the negative price effect and the positive income effect on farmers' food consumption. The sample consisted of 72 households distributed over 8 separate highland villages, 9 households per village. Sufficient income variation was obtained by randomly selecting households within each village. Price variation was built into the sample by selecting the villages at varying distances from Bamenda and from the "ring road." The short duration of the survey could not provide enough price changes over time; instead, price differentials generated over space by the transportation system were postulated and observed. The "ring road" was conveniently well-suited for this purpose since it constitutes the main route of evacuation from the highland areas.

Results from the statistical procedures are highly encouraging. The observed relationships between food consumption, prices, and income are highly significant and conform to anticipated behavior. For the sake of simplicity in computation, the three main foods in the highland diet -- corn, beans, and potatoes -- were lumped together as a single food item; weighted average prices for the blend were also computed for each village. Equations to explain food consumption levels in terms of food prices and household income were fitted using least squares methods. Price elasticity of food consumption was thus estimated at -1.16, meaning that a 10 percent increase in food

prices will induce a reduction of 11.6 in food consumption. Income elasticity on the other hand was estimated at +0.17; in other words, an increase in income of 10 percent will result in 1.7 percent higher food consumption.

Negative Short Run Effect on Consumption

The net combined effect of higher food prices on farmer's food consumption is, in the short run, negative. That is, higher prices for farm produce lead to lower food consumption by farmers. Emphasis must be made that this result is the short run impact, before farmers have had time to adjust their production and sales patterns to the new prices. That is, these results assume production stays constant, a likely short run condition. Numerically the result can be derived quite simply: a 10 percent price increase lowers food consumption directly by 11.6 percent, and raises income by 3.0 percent since the three foods in question contribute 30 percent of income. The resulting increase in income induces a mere .5 percent increase in consumption, far from sufficient to compensate for the negative price effect. The net impact is a drop of 1.1 percent in food consumption. Calorie intake however is affected less drastically, since the three foods provide only 69 percent of energy intake. The 11 percent reduction in food consumption results in a 7.6 drop in calorie consumption. Protein loss is similarly calculated at 8.4 percent.

Uncertain Long Run Effects on Food Consumption

It bears repeating that the above result is only the short period impact of a rise in food prices. In the long run there is reason to believe that the negative impact will be considerably reduced and possibly transformed into a net positive effect. First, farmers will adjust their food consumption to increase the intake of items other than corn, beans, and potatoes, so that calories lost from the latter would in part be compensated from other sources. Second and most important, farmers would increase production and sales of those products with higher prices, even when that implies substituting for other less profitable crops. Increased production will result from higher yields per hectare as well as more land being used to produce the now more attractive crops. Thus increased production would result from more land being devoted to crops with higher prices. In addition, yields per acre can be expected to increase as higher output prices raise the profitability of using new inputs.

Need for Food Production Stimuli

Higher prices are necessary to increase the flow of foodstuff from the countryside to the coastal urban areas. If agricultural production is not increased accordingly, farmers' food consumption and nutritional status would suffer from the reallocation of the constant food stock. Serious deficits of calories in the diet of rural families might develop since one in five already fail to meet their recommended calorie levels. Food crop production must therefore increase if such a scenario is to be averted.

Highland farmers themselves are likely to invest part of their higher revenues in raising the productivity of their farms. Increasing levels of inputs will improve yields, and increased specialization will permit farmers to take further advantage of the market to satisfy their food consumption and other needs.

Fortunately, the agronomics of the crops grown in the Northwest highlands, -- corn, beans and potatoes -- are well-known in general, and offer very favorable prospects for increasing yields through the application of inputs and the use of improved varieties. Corn, especially, is likely to produce substantial yield responses when properly treated with fertilizers. This is however not the place to make specific agronomic recommendations to increase corn yields, or those of beans and potatoes. An experienced agronomist with familiarity with the area would be needed to do that. Fertilizers are currently seldom used on food crops, mainly because the local coffee cooperatives, who control the distribution and use fertilizers, make them available exclusively for coffee.

Government agricultural development efforts in the Northwest Province have concentrated until now on the promotion of cash crops, particularly coffee, but more recently also rice and wheat. There are several programs to produce rice under irrigation in the lower altitude flood plains to the east of the highland areas. Although these schemes take place in the same political divisions, highland farmers are touched by them only marginally. Only a few families have received land allocations in the irrigation areas, and fewer yet have settled there. Moreover, although rice production has proven feasible, marketing rice has become an intractable problem for the government. Local rice has not been able to compete pricewise with the cheaper and preferred imported rice from overseas. The government has so far purchased the output from farmers through rice cooperatives, but it is now faced with the problem of disposing of accumulated stocks.

We are suggesting therefore that agricultural development policy in the Northwest Province be reoriented toward the promotion of food crop production, a

sector which until now has been neglected. Interventions conductive to that goal may take many forms, ranging from the improvement of road infrastructure throughout the highland region to permit the evacuation of produce after harvest, to the delivery of agricultural inputs and tools through the existing network of farmer cooperatives. Interventions to alleviate land constraints should be given special attention. There is less urgency in introducing laborsaving techniques since in every household, there already exists a reservoir or underexploited male manpower. Land scarcity would be alleviated by expansion of the transport infrastructure to promising new areas, but also by providing land saving inputs such as fertilizers. Prospects for the introduction of mechanized techniques in highland farms are poor due to the extreme steepness of the terrain; fertilizers, on the other hand, could be made available to many farmers at the same time and would require fewer changes in the existing cultural practices. Provision of agricultural credit and extension services for food crops must be organized, keeping in mind that women are overwhelmingly responsible for food crop farming, and that those services should be especially oriented to reach them.

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES: SENEGAL CASE STUDY

by

Henri P. Josserand

Clark G. Ross

Center for Research on Economic Development

University of Michigan

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PREFACE

This study of rural food consumption and nutritional status for Senegal has been undertaken under USAID contract DSAN-C-0270 in conjunction with a similar study for Cameroon. This country report is being submitted along with a country report on Cameroon and a methodology section (Part II) applicable to both country studies. The research was carried out by the Center for Research on Economic Development (CRED) of the University of Michigan under the overall direction of Dr. Edgar Ariza-Niño. The principal researcher for the Senegal country report is Dr. Clark Ross of Davidson College; Mr. Henri Josserand of CRED was responsible for setting up the fieldwork in Senegal, for computer analysis, and for joint write-up of the final report. He also translated the report into French. The CRED team received valuable guidance from Dr. Kenneth Shapiro, CRED, and Dr. Frances Larkin, School of Public Health, University of Michigan. In addition, Mr. Tim Rosché helped supervise interviewers in the villages selected, and Ms. Susan Schiffman, a graduate student in the School of Natural Resources, worked as a research assistant both in Senegal and at the University of Michigan.

In Senegal, the CRED team benefited from the collaboration of counterpart national institutions. In particular, the Institut Sénégalais de Recherches Agricoles (ISRA), and its Centre National de Recherche Agricole (CNRA), especially through Mr. Moussa Fall, were primary contributors, both with considerable assistance, and with access to the extensive documentation on CNRA socioeconomic studies in the Peanut Basin.

The Office de la Recherche sur l'Alimentation et la Nutrition en Afrique (ORANA) provided assistance, advice and nutritional tables they have developed for Senegal. Other institutions which provided assistance or a willing discussion forum were the Institut Sénégalais de Technologie Alimentaire (ITA), especially Mr. Yamar Guaye, the Ecole Nationale d'Economie Appliquée (ENEA), and the Ministère du Plan et de la Coopération. We are also very grateful for the assistance offered by many members of the AID mission in Dakar, especially Linda Worthington, Sam Rea and Floyd Spears, and to Tonia Marek for a useful background paper. The graphics were done by Jane McCormick.

Finally, we wish to acknowledge the credit due to the six very competent enumerators who contributed so much to an essential part of the study:

Mr. Sacoura Badiane and Miss N'deye Guaye in Layabe;

Mr. Yankhoba Diouf and Miss Aminata Ly in Sessene;

Mr. Daouda N'diaye and Miss Ngosse Ly in Thienthie.

A complete listing of the team's contacts in Senegal is provided in Appendix III.

Naturally, these individuals and institutions bear no responsibility for any inaccuracies or omissions in the report.

Clark Ross and Henri Josserand
August 1982

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SUMMARY

The overall purpose of this study was the design and testing of a methodology allowing the integration of expected nutritional impact into the agricultural planning process. More specifically, the study aimed to assess the anticipated food consumption impact of agricultural policies on farming households on the basis of short-term fieldwork (3 months).

Agricultural policies influence farmers' choices of cash/food crop combinations and cultivation practices during the growing season, and thus the stock of food and monetary income available to the family. This in turn partly determines food consumption and nutritional status. To better understand and estimate the strength of these relationships, data on farm production, marketing, farm and nonfarm income, food consumption and physical condition of family members were collected for 72 households, through a village-level study combining elements of farming systems research, food consumption, and anthropometric surveys.

The main findings and policy implications are as follows:

(1) The distribution of total income (farm and nonfarm) was very uneven within each village, and among the three villages surveyed, with corresponding differences in food consumption per capita.

(2) There was no lack of protein consumption, but there was a serious deficiency in caloric intake, intra and intervillage differences closely following the income distribution pattern.

(3) Although food consumption was highly correlated with total income over a broad range of values, anthropometric measurements failed to highlight the same relationship. This suggests that dietary surveys may be much more revealing of the income/food consumption linkages than anthropometric measurements, at least in the short run.

(4) The surveyed villages are located in the same general area and face highly similar climatic conditions; the cash/food crop mix from one community to the next was also nearly equal. Productivity, however, varied greatly: Layabe families produced proportionally more than their Thienthie neighbors by placing the emphasis on labor-extending technologies (farm equipment), allowing them to cultivate more land per person. The most successful village (Sessene), however, achieved both higher yields and superior total production by applying very large quantities of cattle manure to their more limited acreage. This was made possible through a careful

integration of cattle into farming activities. This indicates that in many areas, an increase in productivity on both cash and food crops may be obtained without recourse to costly imported technology. At the same time, one must recognize that real obstacles lie in the path of more widespread mixed farming systems, just as there are constraints on the acceptance and use of nontraditional methods and techniques.

(5) Aside from being a typical urban staple, rice has become a very important source of food for rural families faced with a shortage of homegrown cereals because the quantity of millet other families are willing to sell is often limited. An increase in the price of rice would therefore raise the cost to farmers of not producing enough cereals, and thus quite possibly lead to a reallocation of inputs from peanuts to cereals. The government objective of maintaining the level of peanut oil export revenues therefore cannot be attained unless the domestic food supply is adequate. This leaves only two choices: continued rice imports (which the government opposes), or increased productivity in rural food production.

(6) In conclusion, Senegalese agricultural policy must aim to promote equally cash and food crops; this will require a further shift in emphasis (research, techniques, supply of inputs and prices) from traditional cash crops to traditional and introduced food crops.

(7) Finally, one must accept the possibility that nutritional considerations influence agricultural policy from the bottom as well as from the top. Planners may identify overall objectives or set guidelines partly with a view to their nutritional implications upon farmers. At the same time, the Senegal case strongly suggests that farmers' own perceptions of nutritional needs place limits on the range of policy options governments can realistically consider.

CHAPTER I
INTRODUCTION

1.1. Background and Basic Objectives

There is now broad agreement on the need to consider nutrition in the agricultural planning process to avoid harmful repercussions among populations already at risk. These populations are in rural and urban areas, but only the former were specified in the terms of work for this study. Issues that call for study include the sensitivity of rural food consumption to changes in rural incomes and food prices, and the nutritional implications of farmers cash/food crop choices. The resolution of these and other nutrition-related questions requires carefully designed field surveys to gather data in farmers' agricultural decision and household consumption.

This village-level study of food consumption in the Groundnut Basin of Senegal has three principal objectives. First, to provide an indication of current food consumption patterns and nutritional status for the three villages surveyed. Second, to assess the degree to which rural food consumption has been affected by Senegalese agricultural policy. Third, to assess the validity of a short survey (three months of fieldwork) compared to a longer term study.

The survey procedure designed to address these objectives has certain advantages. Questionnaires dealing with production, food consumption, marketing, and secondary economic activities were used. This broad range gives the research effort sufficient flexibility to consider a spectrum of related and interdependent topics. For instance, the dual role of producer-consumer is investigated. The importance to the consumer of food grain self-sufficiency is analyzed by considering his production and marketing decisions. The responsiveness of farmer production and consumption patterns to changing farm prices and income is also explored. Finally, having three villages in the survey permits an evaluation of intervillage differences with respect to the questions previously raised. As all three villages are located in the Groundnut Basin of Senegal, farmers in each village face similar production constraints and a similar economic environment. Differential behavior stemming from ethnic, religious, or land ownership variations can thus be observed.

1.2. Order of Work

To accomplish these objectives a team from the Center for Research on Economic Development (CRED) of the University of Michigan arrived in Dakar in late April 1981, survey questionnaires having already been designed and duplicated in Ann

Arbor (see Part II). During the first week, the team contacted personnel at USAID/Dakar and appropriate Senegalese agencies. The three main Senegalese organizations involved in the survey were the Institut Sénégalais de Recherches Agricoles (ISRA), the Office de la Recherche sur l'Alimentation et la Nutrition en Afrique (ORANA), and the Centre National de Recherche Agricole (CNRA). Without the full cooperation of these agencies the team's work would have been impossible. As indicated in Appendix III the team further benefited from contacts with a number of other official Senegalese sources and donor groups.

In early May the team, with the cooperation of CNRA-Bambey, chose the three villages for the survey and recruited six interviewers. A male and female interviewer were placed in each village. Concurrently, in Dakar, a team member contacted appropriate groups and documentation centers to collect supplementary information. The actual survey began during the week of May 18 and continued for twelve weeks until August 15, 1981. Data from the questionnaires were verified as collected by the team to correct inaccuracies and ambiguities. Following computer analysis of the data at Ann Arbor, Michigan, this country report was completed and translated into French.

1.3. Organization of the Country Report

This country report is organized into a summary, five chapters and four appendices which treat in detail the questions raised in this introduction. Chapter II is a brief description of Senegalese agricultural policy; it stresses the recent changes and reforms which have been introduced by the Diouf government. This information on agricultural policy will be used in the discussion of anticipated effects of agricultural policy on food consumption and nutritional status. The main findings, conclusions and policy implications related to the objectives of the study are reviewed in Chapter III.

Chapter IV provides a detailed description of agricultural production disposal, family income, and food purchases. Finally, Chapter V covers food consumption, nutrition, and their relationship to key economic variables. Special attention is given to the millet/rice issue, and to a comparison of findings from the dietary survey and anthropometric measurements.

The four appendices contain supporting material. Supplementary statistical findings and tables can be found in Appendix I. Appendix II is a bibliography of useful documents related to nutrition in Senegal, as well as other relevant source materials. The individuals and institutions contacted in the course of the survey are listed in Appendix III. Finally, Appendix IV provides a glossary of selected Wolof terms.

CHAPTER II

A REVIEW OF SENEGALESE AGRICULTURE AND AGRICULTURAL POLICY

This chapter presents background information on the main features of food and cash crop production in Senegal over the past two decades, as well as the recent chief objectives and evolution of the national agricultural policy.

2.1. Background and Principal Objectives of Agricultural Policy

The Senegalese population, distributed over the country's 200,000 km^2, was estimated at over 5.6 million for 1980, growing at an overall net annual rate of 2.7 percent. Seventy percent of the population live in the rural areas and engage primarily in agricultural activities, producing peanuts, millet/sorghum, rice, maize, and cotton, in decreasing order of importance (see Table 2.1.). With the exception of 1976/77, where the national acreage in peanuts reached 1.347 million hectares (ha), the area planted in peanuts has not markedly risen from the levels of the early sixties (around 1 to 1.1 million ha). Peanut yields, however, have been extremely sensitive to weather conditions, varying for example, from a 1975/76 high of 1,174 kilogram/hectare to 466 kg/ha two years later (see Table A13, Appendix I). Naturally, given nearly constant peanut acreage over time, peanut production -- and thus export earnings -- have been highly unstable.

Although the total area planted in millet did not increase between 1969 and 1977, production appears to have risen slowly over time; mean production being 488,000 tons in the 1960's, with a standard deviation of 100,000, and 546,600 tons in the 1970's, with a standard deviation of 146,000 (see Table A14, Appendix I). Even in the best years, however, Senegal's grain production falls short of satisfying domestic demand; up to the mid-1970's the government's strategy was to use part of its peanut export earnings to pay for rice imports. Within foreseeable ranges of peanut and rice prices ($350-650/ton and $150-350/ton, respectively), Senegal had a comparative advantage in trading peanuts for rice on the world market (see Ross, 1980). As Table 2.2. shows, however, net rice imports increased threefold from the early 1960's to the late 1970's, and some have stated that uncertainties in peanut and millet production may combine with world price fluctuations for peanuts and rice to make Senegal's comparative advantage in peanut production less clear cut in the eyes of risk-adverse policymakers (see Jabara & Thompson, 1980). To reduce costly rice imports, and minimize its

TABLE 2.1

PRODUCTION OF SELECTED CROPS, 1960/61-1980/81
(thousand metric tons)

	Peanuts	Millet	Rice	Rainfall Index[a]
1960/61	892	342	82	90
1961/62	995	407	84	95
1963	894	424	90	78
1964	952	478	106	87
1965	993	521	109	86
1966	1,122	554	125	106
1967	857	423	125	114
1968	1,005	655	135	102
1969	830	450	57	100
1970	789	625	141	55
1971	583	401	99	110
1972	989	583	108	73
1973	570	323	44	90
1974	675	609	64	55
1975	994	703	113	57
1976	1,412	621	115	80
1977	1,208	507	118	80
1978	519	420	63	65
1979	1,053	803	140	50
1980	650	496	121	90
1980/81	530	553	68	55

SOURCE: Senegal in Tables, Donald Brown, Axel Magnuson, USAID Mission to Senegal, 1981.

NOTE: (a) 1931-60 Average = 100.

TABLE 2.2.

NET RICE IMPORTS, 1960-1979
(thousands metric tons)

1960-64 Average	119
1965-69 Average	165
1970-74 Average	177.5
1975	101.8
1976	235
1977	276.8
1978	234
1979	352

SOURCES: FRI, Stanford, 1979. BCEAO, 1982.

dependence on external food sources, the Government of Senegal (GOS) has become publicly committed to increasing local production of foodgrains, so that the official objectives for the rural sector include the promotion of grain self-sufficiency in addition to increasing crop yields and rural incomes, and diversifying crop production. Nevertheless, greater food self-sufficiency has been hindered by the consumer's preference for rice, limiting the domestic demand for locally produced millet and maize. In turn, farmers have concentrated on more profitable groundnut production over millet and other foodgrains. Most government actions in the 1970-79 period tended to encourage this favoring of groundnut production over millet and other foodgrains (see Table A15, in Appendix I).

The last two agricultural campaigns (1979/80 and 1980/81) have been very unsuccessful due to the poor rains. From a 1978/79 level of 1,053,000 metric tons, groundnut production fell in the two successive campaigns to 650,000 and 530,000 tons respectively without significant changes in area cultivated. Similar decreases were observed for millet and rice. Realizing that strong governmental initiatives to improve performance in the rural sector were vital, the GOS began a series of policy changes and reforms. While maintaining the objectives of increased rural incomes and crop diversification, the GOS recognized two additional worthy priorities. These are increased efficiency in the management of the national economy and a decentralization of decision making, particularly in the agricultural sector. In principle, local residents will be granted a more meaningful role in the new cooperative structure and agencies involved in rural development will be given greater operating autonomy at the local level.

This new policy has become known as the Plan de Redressement. Key elements of this plan are still in a stage of evolution, complicating a full discussion of the intended reforms and changes. In late December 1979 the then Prime Minister Abdou Diouf described aspects of the Plan de Redressement to the National Assembly; subsequent portions of the Plan have since been released when Mr. Diouf assumed the Presidency of Senegal in January 1981. Essentially the plan calls for an initial stabilization of the economy (1980) followed by a period of growth (1981-1985). The second period roughly coincides with the Senegalese VI National Development Plan which covers the July 1, 1981 - June 30, 1985 period.

Many features of the plan relating to agriculture are still being discussed or formulated. Other aspects of the plan fall into the category of stabilization measures and are temporary. Thus, this description of Senegalese agricultural policy will contain references to the old policy, as well as to reforms associated with the Plan de

Redressement. It should be emphasized, however, that the principal objectives for the Senegalese rural sector--increasing rural incomes and promoting national food self-sufficiency--are being maintained by the GOS.

2.2. Organizations Active in the Rural Sector

This section describes the responsibilities of the principal organizations operating in the rural sector of Senegal.

2.2.1. Ministry of Rural Development

Overall coordination of agricultural policy and interventions into the rural sector are directed through the Ministry of Rural Development. This ministry must implement the decentralization of government activity called for in the Plan de Redressement, working closely with the regional development agencies.

2.2.2. Regional Development Agencies (RDAs)

For each major region of Senegal there exists a regional development agency which is responsible for agricultural extension in the region. To varying degrees the RDAs also assist in diffusing new farming techniques and aid in the delivery of inputs. Responding to criticism of the overall effectiveness of the RDAs, the GOS in the Plan de Redressement has mandated that each RDA, as with all parastatal organizations, sign a performance contract with the GOS. The specific objectives and costs of the RDAs program are to be stated in this contract.

The villages followed in this study are in the Diourbel Region and are covered by a RDA, the Société de Développement et Vulgarisation Agricole (SODEVA). RDAs generally receive external financial aid from the donor community; USAID is one of the sponsors of SODEVA. Other RDAs are operating in the Casamance (SOMIVAC), Fleuve (SAED), and Senegal Oriental (SODEFITEX) regions.

2.2.3. ONCAD and Cooperatives

As a result of its general inefficiency, bloated size, and financial irregularities, the Office National de la Coopération et de l'Assistance au Développement (ONCAD) was abolished in October 1980. ONCAD's various functions--directing the cooperative movement, providing inputs, collecting groundnuts, purchasing millet, and importing rice--have been transferred to other entities. The cooperative structure is in a stage of evolution. Previous cooperatives are greatly in debt due to nonrepayment for seed, fertilizer, and other inputs. The GOS does not simply want to replace the cooperative

of ONCAD with those of another organization. The reorganization may result in a dual structure system. At the village level, cooperatives managed by village residents, referred to as communautes rurales, could be successful in drawing on traditional social relations to build an efficient local system. These communautes rurales would be joined to form groupements, drawing together cooperatives from a specific geographic locality. The GOS realizes that organizing an effective system of cooperatives will be a very difficult and complicated task.

2.2.4. Société Nationale de l'Approvisionnement Rural (SONAR)

To assume ONCAD's role as provider of inputs to the rural sector, the GOS has created SONAR, with the delivery of agricultural inputs as its only responsibility. SONAR will continue to sell fertilizer at a subsidized price but sales of other agricultural inputs, particularly mechanical implements, will be greatly reduced. For the latter, sales will no longer be subsidized and will be made from the inherited inventory of ONCAD. Additional orders are not foreseen at this time, as an economy measure. Implements can, of course, be purchased through private dealers.

2.2.5. Peanut Oil Companies

In 1980 the GOS assumed a major equity role in the formerly private oil companies operating in Senegal. The final partitioning of the equity positions appears to be 49 percent GOS, 31 percent private Senegalese capital, and 20 percent private foreign capital (Le Soleil, August 25, 1980). The peanut oil processing facilities will be responsible for purchasing the groundnuts directly from the farmers using the old cooperative buildings of ONCAD. Each oil processing facility will purchase the groundnuts in its region. An agent from the oil company will go to the cooperative building and pay cash for the farmer's harvest. Financing of this operation will be done by the oil companies with credits received from the major banking groups in Senegal. Financing for a crop of 400,000 tons has been granted the oil processing companies for the 1981/82 campaign.

2.2.6. Caisse de Péréquation et de Stabilisation des Prix (CPSP)

The CPSP has assumed from ONCAD the role as the importer of rice. Wholesalers licensed by the Ministry of Finance will purchase the rice from the CPSP and make deliveries to the retail outlets. Rice prices are strictly controlled at each step of the distribution process. This is essentially the procedure previously followed by ONCAD.

In the past (1976-1979), the CPSP wholesale rice price exceeded the world market rice price, generating profit to the GOS. Currently, with the world market rice price rising above the controlled CPSP wholesale price, the GOS is effectively subsidizing rice.

2.2.7. Centres d'Expansion Rurale (CER)

Due to a lack of funding as well as organizational problems, the CER's have not been able to discharge effectively their role of training the local population. In each communaute rurale there should be agents specializing in agriculture, livestock, forestry, sanitation, and community development. This group is a natural vehicle to provide information and training to encourage better nutritional practices. Within the administrative structure of the GOS, the CER's are part of Promotion Humaine.

With respect to agricultural policy the above seven institutions are the most visible in Senegal. Decisions and policies of these groups are most likely to affect farmers.

2.3. Agricultural Policy in Practice

This section briefly summarizes the GOS's current policy towards seed distribution, fertilizer sales, producer prices, purchase of producer output, and the sale of imported rice.

2.3.1. Seed Distribution

The farmers followed in this study are involved in both groundnut and millet cultivation; thus, seed for these two crops is of primary importance. Farmers generally conserve from their millet harvest sufficient seed for the forthcoming agricultural campaign. Those farmers lacking millet seed can purchase millet either from a neighbor or on the local market. The GOS is not involved in providing millet seed to farmers, except through the RDA's occasional provision of experimental or improved seeds to selected farmers.

Until the demise of ONCAD, farmers purchased groundnut seed from their cooperative on a credit arrangement, with repayment at the harvest. This year (1981-82) farmers face a difficult situation with respect to groundnut seed. This is the first planting season following the replacement of ONCAD by SONAR and due to the poor 1980/81 harvest there is insufficient good quality groundnut seed in Senegal. The French government through its Caisse Centrale de Coopération Economique has made available 90,000 tons of groundnut seed. Local commisions comprised of representa-

tives from SONAR, SODEVA, CER, the communaute rurale, as well as the president of the cooperative, and the village chief are responsible for the distribution of this seed to the farmers. In early June, approximately 75 kilograms per man and 35 kilograms per woman were given to the households in the Diourbel Region. Farmers have expressed displeasure both with the quality and the quantity of seed provided. Often farmers received a poorer quality seed than they had sold at the previous harvest. Some seed spoiled in storage and better quality seed is distributed to more climatically-favorable regions. Some farmers have apparently surreptitiously maintained seed from last year's groundnut harvest to supplement that provided by the GOS. Legally, the entire groundnut crop minus family consumption should be sold to the appropriate government agency. Other farmers, however, will probably have to restrict their planting of groundnuts due to insufficient seed. These farmers will plant millet on fields which they otherwise would have used for groundnuts.

This year's seed arrangement is rather ad hoc. The GOS hopes to revamp the cooperative system and confine the task of groundnut seed distribution to that system. Ideally, there would be village seed banks in which the farmer would deposit seed following the harvest and then reclaim that same seed at planting time. This would give the farmer greater control over the quantity and quality of the groundnut seed at his disposal. Further, the costs of seed distribution would be reduced.

2.3.2. Fertilizer and Implements Distribution

Fertilizer was sold by ONCAD to the farmers through the cooperatives. Due to the expensive subsidy element involved in fertilizer sales and nonpayment of producer debt for the fertilizer, the GOS has concluded that it can no longer afford a fertilizer program of the magnitude funded in prior years. Nationwide the amount of subsidized fertilizer will be reduced from 100,000 tons (1980-81) to 50,000 tons for this year. In the Diourbel Region the respective reduction will be from 8,000 to 3,985 tons. SONAR will sell this reduced amount to farmers at the unchanged subsidized price of 25 CFA/kg (275-300 CFA/$). The full cost price of fertilizer produced in Senegal is between 58-60 CFA/kg. The GOS established a priority among farmers for the purchase of fertilizer. Those farmers involved in the multiplication of improved groundnut seed received first priority, followed by those farmers located in areas of favorable rainfall and growing conditions. Farmers located in the villages followed in this study received no subsidized fertilizer. Farmers can purchase fertilizer at the full cost price through the private market.

As previously discussed SONAR will continue to sell agricultural implements to farmers from the inherited ONCAD inventory. These implements will not be sold at a subsidized price but rather at the full cost price. In previous years the ONCAD program had distributed seeders and other small hand tools to many farmers in the Groundnut Basin; thus, the GOS does not feel that farmers will be adversely affected by the curtailment of the subsidized sale of farm implements.

2.3.3. Producer Prices and Primary Purchase of Agricultural Products

The Plan de Redressement calls for a greater role for the private sector in the Senegalese economy. With respect to the purchase of agricultural products, the private sector will be given additional responsibility. There will still be official producer prices for the principal agricultural products. These prices are set by the Council of Ministers following the recommendation of the Comite des Grands Produits Agricoles, a committee comprised of representatives from various ministries and RDAs. This year the official prices were announced in April, before the planting season. Farmers had legitimately complained that in prior years the price declarations were generally made at the harvest with no price information available at planting time.

2.3.3.1. Millet Price

For the 1981/82 campaign the official producer price for millet has been raised from 40 CFA/kg to 50 CFA/kg. Farmers can sell millet to private traders who have been licensed by the Commerce Interieur division of the Ministry of Commerce. Sales to private traders are in principle at the official prices; however, the actual prices vary with market conditions. These traders will be financed by the Banque Nationale de Développement du Senegal (BNDS) with loans at competitive interest rates. The cooperatives will also purchase millet at the official producer price. The Commisariat à l'Aide Alimentaire (CAA) intends to constitute a national security stock of millet. The CAA will be responsible for this stock and will purchase millet in areas where surpluses exist. Financing for the CAA's activities will be from donor groups and from the National Solidarity Fund. All salaried workers are required to contribute the equivalent of one day's salary per month to this fund. It is unclear whether the CAA will succeed in purchasing a significant quantity of millet this year. First, the extent of their funding may not permit significant purchases. Second, enforcement of the official millet price on the private market is nearly impossible. If the millet crop is

relatively small the free market price of millet could exceed the official price of 50 CFA/kg in which case the CAA would not be competitive with the private traders. Directly after the harvest, however, the official price offered by the CAA could be quite attractive to farmers, in which case the CAA could purchase a significant quantity of millet.

2.3.3.2. Groundnut Price

The official groundnut price has been raised from 50 CFA/kg to 70 CFA/kg for the 1981/82 campaign. Of this amount 60 CFA/kg will be paid directly to the farmer at harvest with 8 CFA/kg retained for seed repayment and 2 CFA/kg retained for the fertilizer debt; in the 1980/81 campaign 4 CFA/kg had been retained. The producers' net revenue should increase from 46 CFA/kg to 60 CFA/kg. Some experts have questioned the wisdom of this sharp increase in the groundnut price. First, with a relatively soft world market price for groundnut oil, the full cost price of groundnut oil produced in Senegal could conceivably exceed the world market selling price. Second, the sharp increase in the groundnut price could lead to farmers' shifting additional land and labor to groundnut planting, away from millet planting. If this were to occur, the level of national food self-sufficiency would further fall, necessitating additional food grain imports. Reduced millet supply would increase the millet price, further stimulating demand for rice, the price of which is controlled and the supply of which is perfectly elastic at the controlled price. This scenario is tempered by the fact that good quality groundnut seed is relatively unavailable this year. Thus, farmers may be forced to plant more millet than they would otherwise prefer. The oil refineries will directly purchase the groundnuts from the farmers at official prices using the old cooperative buildings of ONCAD. In principle, the farmers will be paid in cash for their output. The Senegalese banking system is financing this operation at competitive interest rates with each major banking group participating in the operating expenses.

2.3.4. Imported Rice

The residents of Dakar and other urban communities are heavily dependent upon imported rice for their daily food intake. Increasingly, rice consumption has become important in the rural areas to supplement the millet-based diet and to compensate for inadequate farmer foodgrain production, particularly in years of inadequate rainfall. With the demise of ONCAD, the CPSP will be importing rice and selling it to the licensed traders. The official retail price of 80 CFA/kg has been maintained for the last seven years. While some profit had previously been generated at this price, the

GOS is currently subsidizing rice consumption, given recent world market increases in the rice price. Many have argued that the consumer rice price should be increased. First, a surcharge on imported rice could eliminate the subsidy element and conserve needed revenue for government development projects. Second, a higher rice price would limit consumption of imported rice and stimulate demand for locally produced grains--rice, millet and maize. Such greater food self-sufficiency is a primary goal of the GOS. Due to the politically disruptive potential that an increased rice price has, the GOS has resisted all suggestions to increase that price.

2.4. Effects of Agricultural Policy on the Farmers Sampled

One of the objectives of this study is to assess the extent to which agricultural policy affects the food consumption of the sample households. From the above discussion of agricultural policy in Senegal, certain working hypotheses can be advanced and evaluated.

2.4.1. Possible Effects of GOS Agricultural Policy

Some possible results of Senegalese agricultural policy are listed here in the form of questions which will be addressed in the empirical findings and discussed further in Chapter III.

First, has the price policy of the GOS favored the planting of groundnuts at the expense of traditional grain crops? This would lead to less millet produced by the farm family and a greater dependence on purchased food.

Second, to what extent has the availability of relatively low cost rice in the rural areas contributed to reduced millet planting with the same result as described for the first question? Essentially, these two questions assume that the producer groundnut price and the imported rice price are two key parameters in the decision-making process of the farmer.

Third, to what extent have the extension efforts of the RDAs, SODEVA for the Diourbel Region, increased crop yields per hectare? Such increases would generate additional income and food supplies for the family, contributing to a better quality diet.

Fourth, to what extent have the seed, fertilizer, and input policies of the GOS affected plantings, yields, and total output?

These are principal questions in the link between agricultural policy and food consumption.

2.4.2. Limitations of the Assessment of Agricultural Policy Effects

Certain factors will limit the extent to which the effects of agricultural policy can be assessed. First, as described in Section 2.1., the agricultural policy of Senegal is in a stage of evolution with certain changes and reforms occurring. To a large extent the empirical results of this study will capture the effects of past policies and not the effects of current ones. This problem is mitigated by the fact that the particularly key parameters affecting the producer have not really changed. The favorable groundnut price differential that has prevailed in past years still exists; the presence of relatively inexpensive imported rice still exists. While there have been some changes in seed, fertilizer, and input policy, a lack of variability in key parameters like prices limits the analysis of policy effects.

A second and more important limitation in identifying the linkage between policy and food consumption is methodological. Essentially this study captures a snapshot of food consumption in certain households at a given point in time. This observed result is a function of many independent influences: agricultural policy, prices, income, family composition, rainfall, soil conditions, and others. Thus, to attribute any result to agricultural policy without controlling for the independent effects of these other variables is not methodologically sound. Ideally, either a time-series analysis before and after policy changes is needed or a cross-sectional analysis between villages subject to a policy and those not subject to a policy is required. Nevertheless, certain useful inferences concerning the policy-food consumption linkage can be made and are pursued in this study.

CHAPTER III

SUMMARY OF FINDINGS, CONCLUSIONS AND POLICY IMPLICATIONS

3.1. Main Findings

The summarized findings are derived from twelve-week surveys executed concurrently in three villages of the Diourbel Region: a Serer community, Sessene, and two Wolof villages, Layabe and Thienthie. The total sample included 72 households and 720 respondents, about one-third of the entire survey population. During the survey, 452 fields were measured, 2,548 food items were weighed, and 608 food purchases were recorded. In addition, information was collected on 209 recalled farm sales, anthropometric measurements were taken on 711 respondents, and basic information was collected on 89 persons absent from the surveyed households.

3.1.1. Intervillage Comparisons

We first offer a summary of agricultural production for each village. Sessene families cultivated about 108 hectares in total, 56 percent being devoted to millet, while peanuts received about 44 percent. This village had by far the highest yields and highest total production. Although other factors probably contributed to the difference in production compared to other villages, we believe the strongest determinant was the presence of cattle and use of manure in this Serer community. The families surveyed in Sessene, therefore, produced much more millet than they would need for one year and a fair amount of peanuts. Total income in Sessene was the highest of all three villages and consisted mostly of farm income; nonfarm income earned through trades and crafts only accounted for a small proportion of the total. Farm income itself was made up of peanut and livestock sales (including fattened cattle); almost no millet was sold by Sessene families in spite of high grain production.

Layabe households had the highest total area planted, 138 hectares, equally divided between millet and peanuts. They were probably able to cultivate more land than other villages because of some advantage in access to agricultural implements. In spite of this advantage in area under cultivation, they had lower yields than Sessene families, and thus produced less overall, although enough for a year's millet consumption and a small grain surplus. Layabe families supplemented the value of agricultural production by the highest nonfarm income of all villages, putting them in second place in terms of receipts from all sources.

Thienthie families cultivated the least amount of land, about 69 hectares, with a strong emphasis on millet (71 percent) rather than peanuts (only 29 percent). The

smaller area of tilled land does not appear to be a temporary feature, since each family usually cultivates the same fields year after year and all fields were measured for each family, nor can this be ascribed to a difference in dependency ratios. The proportion of adult men and women in the entire population is not significantly different in Thienthie from that in Sessene and Layabe. Part of the answer may lie in the fact that soils in Thienthie are markedly different from those of the two other villages. The low amount of land under cultivation in Thienthie was compounded by very low yields, clearly making for deficit millet production among the surveyed families (an estimated one-third year's grain supply). Not surprisingly, there were no millet sales in Thienthie; peanut sales were limited as well, so the farm income consisted chiefly of small ruminants and other livestock sales. In fact, although small ruminants constituted a common source of farm income, during the past year a large number of horses were sold by Thienthie families, above and beyond the number one would expect to see sold off during a normal year. We emphasize, therefore, that part of what is considered farm income in Thienthie actually consisted of forced dis-saving or capital liquidation. The limited farm receipts realized in Thienthie were accompanied by very moderate nonfarm income, so the households surveyed in this village had the lowest overall receipts.

The general pattern of food purchases also shows significant differences among villages. In Sessene, the total quantity of food purchases was lowest, as was the proportion of total income devoted to food purchases. We note that rice purchases followed this general trend and were lowest in Sessene, the village with both highest grain stocks and total income.

Layabe families purchased more food, including rice, than their Serer neighbors; the proportion of total income spent on food was also higher. As for Thienthie, food purchases were highest, adding up to almost half of total monetary income. Interestingly, although Thienthie families consumed half as much total grain than people in Layabe, their proportion of rice in total grain was higher.

Intervillage differences also appeared in food intake, as measured by the weighted number of kilocalories per man-equivalent per day; food intake was significantly highest in Sessene, and higher in Layabe than in Thienthie. However, anthropometric measurements failed to show significant differences in the nutritional status of young children among the three villages, or even between the two extreme situations, Sessene and Thienthie.

3.2. Sample Overview

3.2.1. Agriculture

Several interesting findings apply to the whole survey sample in the domain of agricultural production, even though one allows for the fact that 1980-81 may not be considered as a 'normal year'. First, the proportion of total cultivated area planted in millet remained high compared to historical trends in the same area. After two very bad years, there appears to be an understandable concern for food self-sufficiency and the rebuilding of depleted family foodgrain stocks. Second, in view of the high nutritional value and equally high observed consumption of peanuts among the sample families (surprisingly high at this time of year and after two bad peanut campaigns), they should by no means be considered a pure cash crop. Even though the priority was clearly put on millet, as in Thienthie, peanut production had both monetary and food value. Third, considering fertilizer use statistics for the Diourbel Region, the amount of fertilizer used by surveyed families was very high, and was complemented by large amounts of manure, especially in Sessene, apparently with an excellent response. Farmers spent more time on each hectare of peanuts than on each hectare of millet. Finally one should keep in mind that all three villages are located in one of the very highest rural population density areas, so the additional land which could be brought under cultivation by sample families, even with more labor, is rather marginal.

In conclusion, we do not foresee a radical shift from peanuts to millet or vice versa; millet will continue to receive attention as the major, and almost unique, food staple, especially since its free market terms of trade with peanuts seem to have improved over the last few years. Farmers will also go on planting peanuts, not only for their cash value, but also for their nutritional value.

It also appears likely that demand for fertilizer will remain strong in this area; when one considers the high population density, a sufficient supply of chemical or organic fertilizer seems essential. Here again, a certain trade-off exists between chemical fertilizer and manure, so that the issue of mixed farming has potent policy implications.

3.2.2. Real Family Income

For all surveyed families, the concept of real family income was represented by the sum of several key indicators: value of total grain production, receipts from all farm sales during the year minus grain sales, and net nonfarm income earned through trades and crafts. Although the composite indicator is not precise in an absolute value

sense, it provides a useful ranking of all households from which one may infer income distribution within the sample. A possible problem with this measure is that in some cases farm receipts may be large due to dis-saving, such as emergency sales of animals. This might arise in some of the poorer households and thereby introduce some distortion into the income measure. The cumulative distribution of income for all families shows they are unequally distributed over a wide range of values:

TABLE 3.1.

CUMULATIVE DISTRIBUTION OF INCOME, ALL HOUSEHOLDS
(CFA FRANCS)

Probability	Quantile
.1	7,900
.2	16,100
.3	27,500
.4	39,950
.5	63,632
.6	114,450
.7	141,450
.8	211,200
.9	206,600

Although the arithmetic mean equals 120,030 CFA Francs per household, the distribution is sharply skewed toward lower values, so that the median is a much lower 63,632 CFA Francs per family yearly, implying that only half of all families earned or generated in value this much in 1980-81. Furthermore, although twenty percent of households earned less than 16,100 CFA Francs each, another twenty percent, at the other end of the range, earned or generated more than 211,200 CFA Francs each during the same period. Even when one adjusts for family size to obtain income on a per capita basis, wide disparities remain.

The large number of different renumerating activities observed throughout the survey: peanuts, cowpeas, vegetable gardens, poultry, small ruminants, cattle, steer-fattening, as well as many trades and crafts implies a good range of productive activities, and a certain flexibility in the choice some farmers have over the allocation of their labor or other resources. As one might expect, diversity in productive

activities is associated in the sample with higher family incomes. It seems that diversification would promote the situation of the lower income groups in similar rural communities.

3.2.3. Food Intake

Protein intake among the sample population was more than adequate; 95 percent of all households consumed more than the recommended level. Measured caloric intake, however, was definitely on the low side of FAO recommended levels for the entire population. Although one can hardly classify the whole sample as severely malnourished, both because of the average level of intake and unrecorded between meal food consumption by children and women, a significant proportion of families appeared to be obtaining two-thirds or less of the recommended caloric intake.

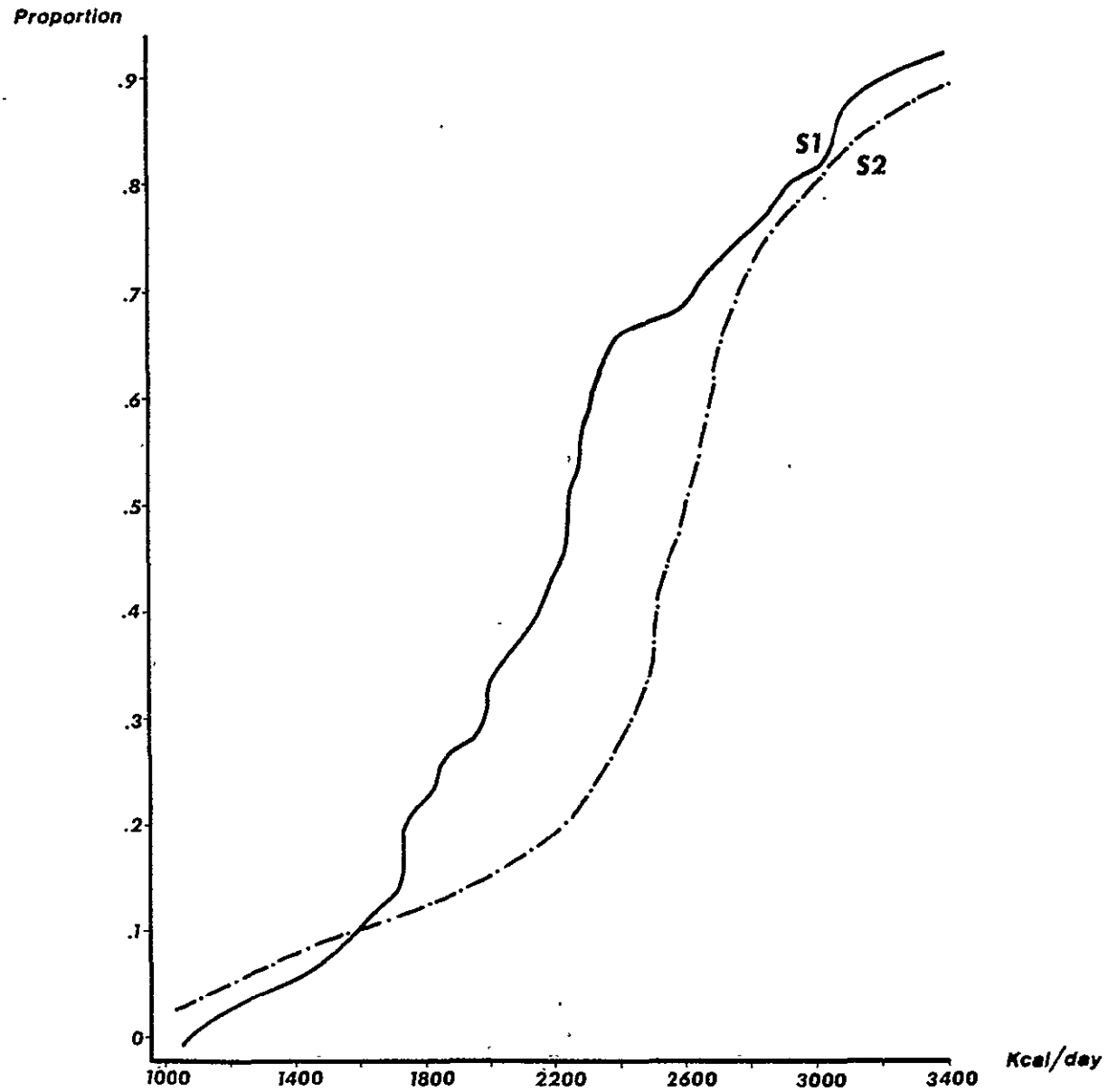
As is commonly the case, interfamily differences in caloric intake were much smaller than were differences in the income indicator, but it is still possible to identify two income strata on either side of the median with significantly different levels of caloric intake, as shown on Fig. 3.1.

For the sample as a whole, the bulk of food consumption was concentrated in rather few items: millet, rice, peanuts, curdled milk, smoked fish, and cooking oil. Cowpeas and vegetables were consumed in much smaller amounts, but almost no meat was eaten. Even if one allows for seasonal differences in food consumption patterns (especially with respect to meat and milk), certain conclusions emerge from the study.

First, we note that millet and imported rice appear as close substitutes under certain circumstances. Among farming communities in developing nations, demand for foodgrains induced by a shortfall in production is very inelastic with respect to price. Another widely observed pattern of behavior is that farmers build stocks in good years and deplete them in poor years. The combination of these two effects after a series of rather bad years typically leads to a situation where deficit farmers spend a very large share of their income on the minimum amount of grain purchases they need because surplus farmers tend to rebuild their own stocks rather than sell, especially if the latter have alternative ways of generating income. In theory, the price of grain would rise on the free market up to the point where surplus farmers would be induced to sell some grain rather than storing it all against future risk. As we know, the presence of a substitute, in the form of imported rice, somewhat changes the picture: deficit farmers buy millet up to a certain point, and then switch to rice for the remainder of their minimum foodgrain purchases. This is the pattern observed in Thienthie during the survey. The question then becomes: why don't people in Thienthie buy only millet, since millet is less expensive than rice?

FIGURE 3.1.

CALORIC INTAKE BY INCOME STRATUM, ALL HOUSEHOLDS



We can only hypothesize that at some point the advantage of buying rice rather than millet becomes marginally greater than the market price differential. The first reason involves transportation costs: while rice may be bought in Thienthie daily in small quantities, most millet purchases entail a more distant trip to a large weekly market. The second reason applies regardless of the place of purchase; rice is already milled, and requires only cleaning before cooking, while millet has to be pounded and sifted before it is steamed or otherwise prepared. Further, although the large amount of cooking oil required to prepare rice in the customary fashion raises its effective cost, oil itself is about as rich in calories as millet couscous.

Second, peanuts constitute another key food item; they provide by far the highest concentration of calories and protein, and surveyed families justly regard peanuts as a major source of nutrients. Even after several consecutive bad harvests, they occupy a very important place in food intake in all villages. Once again, we emphasize the value of peanuts as a food crop, and their potential usefulness as a relief food against localized caloric and protein deficiencies.

Finally, we note that curdled milk consumption is almost entirely limited to Sessene, another factor in favor of mixed farming.

3.2.4. Nutritional Status

Anthropometric measurements complemented the general dietary survey findings for the whole sample population, showing that nutritional status over the longer term had been on the low side of standards; as in the ORANA study of the Diourbel Region, we found 75 percent of the children under 5 years were at an adequate nutritional level (see Table A10, Appendix I). Anthropometric data, however, did not highlight significant differences among villages or between the two income strata for which caloric intake took on different values. The limited size of the sample cannot really be invoked to explain this, since it is large enough to show differences in caloric intake. However, this rather concurs with an ORANA finding (Ndiaye, et al., 1981) that no correlation has been established between income and anthropometrically estimated nutritional status in rural Africa.

This may be due to one or several of three reasons: (a) a generally uniform distribution of favorable and negative effects over time for the entire population, tending to smooth out differences in nutritional status over the long run; (b) a behavior tending to equalize nutritional status among the various groups of the population (different marginal propensities to purchase and consume food between low and high income families, for instance); and (c) anthropometric measurements yield information pertaining to specific age groups whose nutritional status are not influenced by the

same factors. For example, ORANA studies in Senegal have confirmed the general belief that the determinants of children's nutritional status are rather endogenous (condition of pregnancy, nursing, infections and diseases), while among adults the determinants of nutritional status are more likely to be exogenous, e.g. socioeconomic factors. This provides a further reason to combine a dietary survey and anthropometric or clinical measurements in studies of this type.

3.3. Policy Implications

We list again below, for reference, the general objectives of Senegalese agricultural policy:

- increased crop yields and rural incomes;
- diversification in production;
- foodgrain self-sufficiency;
- increased efficiency through decentralization.

Several facts brought to light or confirmed by this study should also be kept in mind from the onset: (a) one must recognize that there are wide disparities in income and food intake, even though no clear relationship between income and anthropometrically estimated nutritional status was discovered. This is important because agricultural policies often affect low and high income families in different ways; (b) policies influencing rural incomes are, in the short-term, more likely to have an impact on the nutritional status of adults, while more structural changes (e.g. variety of foods grown by the family, education, access to health care) are more likely to influence the nutritional status of children. In this respect, we note that according to the SONED study in the Diourbel Region, 78 percent of women interviewed thought their children were well or tolerably well-nourished, and 14 percent thought theirs were not eating adequately. On the other hand, 54 percent of the same respondents thought their children were in good or tolerably good health, while 37 percent saw their children as being in poor health (SONED, 1981, p.183). We also note that in such rural settings higher incomes would not in themselves guarantee access to the structural amenities listed above, such as education and health care.

We now turn to the several basic questions raised in section 2.4.1. First, has the price policy of the GOS favored the planting of groundnuts at the expense of traditional grain crops?

Holding farming technology constant, this would have led to lower aggregate millet production and increased dependence on purchased food, possibly with deleterious nutritional effects among some groups. This clearly did not happen in the

villages surveyed; the ratio of the area devoted to millet to that planted in peanuts did not decrease over the last four growing seasons. While millet has been given a slight priority in terms of acreage planted and amount of manure per hectare, the higher price paid for peanuts -- and their usually higher yield -- account for peanuts receiving both higher amounts of chemical fertilizer and labor per hectare. It appears the farmers' strategy over the past few years has been to allocate a constant proportion of land to both crops, with a slight advantage to millet in area cultivated, and to favor peanuts in chemical fertilizer and labor as a function of the price advantage of peanuts over millet.

This approach appears to have widely been followed in rural Senegal; the latest report on Senegalese agriculture as a whole (BCEAO, February 1982) states:

> "Indeed, for the first time in several years, more acreage has been allocated to foodgrains than to peanuts. It appears that farmers, learning from recent past drought years, put the highest priority on food self-sufficiency, which led to some reallocation of inputs in favor of food crops. This shift has actually been supported by public policy aiming to promote the efficient marketing of foodgrains." (translated by H. Josserand)

If our interpretation is correct, it means the families surveyed and other farmers have established a workable compromise between risk avoidance through food self-sufficiency and profit maximization through peanut sales. This allows us to make certain inferences as to their response to various policy changes, but only after several important facts have been emphasized. First, changes in the relative prices of foodgrains are quite often due to changes in production influenced by climatic factors. These may either offset or invalidate the official price change through differentials between official and parallel market prices. Second, the presence of carryover grain stocks will mute the free market price effect of a change in production. Finally, one must almost always consider price and input policies together; in the context of a fixed traditional technology, official price changes play at most a very limited role in increasing agricultural production (see Mellor, 1975).

Vast increases in millet production and income derived from millet sales are not likely to ensue from higher official millet prices: aggregate production of foodgrains tends to be relatively inelastic with respect to price (especially when family stocks are depleted), and in any case, the state's ability to buy and store millet is too limited to have any real nationwide impact. On the other hand, an increase in the price of peanuts relative to that of millet would probably not lead to a major change in the total area devoted to each crop, but the amount of additional inputs reserved for

peanut fields would increase, provided of course farmers had timely access to these inputs. Assuming for the time being that peanut prices had been increased relative to input prices as well, this would result in generally higher rural incomes, with the largest absolute increase accruing to larger (richer) producers, and the highest percentage increase accruing to poorer farmers. Finally, we note that an official price increase is sometimes necessary to help farmers overcome the risks associated with the adoption of a new technology; the coordination of the availability of new inputs with higher producer prices is then clearly essential.

The second question brought up in section 2.4.1. was: To what extent has the availability of relatively low cost imported rice in rural areas contributed to reduced millet planting?

The potential nutritional danger here was that farmers might substitute peanuts for millet on part of their land, and thus trade a dependable homegrown staple for dependence upon a less nutritional purchased grain. The evidence from this study shows that millet production has not been reduced by the availability of low cost imported rice. Rice is a welcome substitute for millet among families who can afford and desire diversity in their diet, as in Layabe, or among deficit families who cannot purchase as much millet as they might want to (Thienthie), but the behavior of Sessene families indicates that a rice-dominated diet does not necessarily follow from relatively high rural incomes. In terms of nutrition, the availability of low cost imported rice was a good thing overall.

The level at which the official consumer price is set, and the amount of yearly imports continue to be a major issue in Senegal. The usual argument is that a low rice price for urban consumers is viewed as a crucial condition for political stability. Another point in favor of low rice prices -- much less often quoted -- is that it constitutes a source of grain to rural families showing a deficit in millet production. However, the argument goes on to point out that low rice prices are inconsistent with the goal of greater domestic foodgrain production and self-sufficiency.

One must recognize that the factors opposing an increase in consumer rice prices go beyond urban discontent. In the first place, recent and current rice prices (which were markedly raised after the mid-1970's) involve very little or no element of subsidy with respect to world prices, so that there is no reason to increase them only on the basis of economic efficiency. Secondly -- and this is much more important -- a higher imported rice price in most rural areas would increase the potential cost to the farmer of not producing enough of his own grain. The conservative stance of Senegalese

farmers observed over the last few years implies that a higher rice price might very well induce them to become increasingly cautious and reallocate further inputs from peanuts to millet. This shift would be further encouraged by any urban shift from a more to a less expensive grain. Although the government officially advocates greater domestic grain production, one can hardly expect Senegalese policymakers will try to reach this objective at the cost of a decrease in vital peanut export earnings. In conclusion, the prices of imported foodgrains (rice and wheat, mostly) will almost certainly not be instrumental in increasing domestic foodcrop production; it seems that over the medium-term, cash and food crop outputs will have to rise together rather than separately.

The third question raised in section 2.4.1. was: To what extent have the extension efforts of SODEVA increased crop yields?

Even with the most detailed historical data -- not available in this case -- a clear answer would be difficult to obtain. Changes in production are strongly influenced by climatic conditions whose effects are hard to control for in comparative assessments. In terms of the nutritional implications of extension policies, we can, however, go beyond the trivial statement that overall yield increases would be beneficial. For example, the Government might want to consider the choice of helping farmers increase millet as opposed to peanut yields. Assuming both crops would respond to technological change in comparable proportions and a new technology was available to both small and large farmers, the greater nutritional benefit would certainly come from higher millet yields because the impact would be proportionally largest among small producers. This would reduce rural demand for imported rice (or other grain) by deficit families, and while higher peanut yields might well appear more attractive to the Government because of possible extra export earnings, the latter should be weighed against the decrease in grain import requirements consistent with higher domestic millet production. On the basis of comparisons between the three villages studied, there is room for improvement in millet yields, even without recourse to expensive technologies.

It seems that much could be gained by helping small farmers expand the scope of their agricultural activities; indeed, the Government appears to be moving in this direction. To consider the nutritional effects of this policy, one must bear in mind that the response will vary according to whether the farmers reached are going through a successful or a difficult period. The same type of proposed activity may also be taken up in various ways and with a different nutritional effect by successful and deficit farmers. For example, new opportunities are typically taken up first by richer

farmers, not because of better access to markets, but because they have greater access to credit and can bear greater risk.

There is but a short step from a discussion of agricultural extension to one of agricultural inputs policy, the fourth and final question brought up in section 2.4.1.: To what extent have the input policies of the GOS affected plantings, yields, and total output?

The information presented in Chapter IV shows significant intervillage differences in the use of agricultural inputs. In general, Layabe families had access to more agricultural implements than did farmers surveyed in the other two villages; it seems this enabled Layabe households to devote more time to nonfarm activities generating about half of total measured income. As stated above, the nutritional effect of additional farm and nonfarm activities will depend on the group involved and the activities concerned. Indeed, increases in labor productivity should not be confined to field work. We have seen that women in similar villages spend up to three-fourths of their time on household tasks: processing millet, drawing water, collecting wood, etc. Since women most often play a major role in secondary farm and nonfarm activities (cowpea fields, trades, poultry and small ruminants), the introduction of village mills, for instance, would have a positive effect on rural incomes, and indirectly, on nutritional status.

The issue of fertilizer use and pricing deserves to be considered by itself. The survey findings on the use of and response to chemical and organic fertilizers were quite striking. The average quantities of chemical fertilizer used in all villages (1980-1981) were 129 kg per hectare on peanuts, and 89 kg per hectare on millet, reflecting the price advantage of peanuts relative to millet. On the other hand, millet received much more manure than did peanuts; the vast yield advantage reported in Sessene eloquently illustrates the response of millet to manure applications. Chemical fertilizer prices are a crucial decision variable in farmers' planting decisions. Between 1970 and 1977, the subsidy share in fertilizer prices went up from 48 to 61 percent, and fertilizer use increased correspondingly. The current GOS policy, however, represents a departure from fertilizer price subsidies, prompted by a concern for economies and justified on the grounds of economic efficiency (also because farmers hardly need further encouragement to use chemical fertilizer when it is profitable to do so). What are the implications of a decrease availability of subsidized fertilizer?

Given the current level of peanut prices, the quantity of fertilizer purchased would fall, especially after a series of rather bad peanut years. There is no reason to believe farmers would jeopardize their millet supply by reallocating chemical fertilizer

from millet to peanuts -- this might occur only if a sharp rise in the fertilizer prices were accompanied by a much sharper rise in peanut price relative to millet, not a likely scenario. One can be reasonably confident, however, that a rise in chemical fertilizer price would have quite an impact on the value of manure, a ready substitute, especially in the short term. The question is, of course, how much of a decline in yields, total production and rural incomes would a decrease in fertilizer use entail? The answer depends on Senegal's current location on a curve showing the relationship between quantity of fertilizer used and yields per hectare. Other things being equal, the first applications of fertilizer are rewarded by large yield increases, but as additional quantities of fertilizer are used on the same fields, each successive increase in yields becomes smaller, until a point is reached where additional fertilizer results in no further increase in production. It seems doubtful that aggregate Senegalese fertilizer consumption is currently at such a high level that a decrease in its use would lead to only marginal reductions in yields and total production. Other things being equal, an increase in fertilizer prices will lead to a measurable decrease in peanut production, at least in the short run. Of course, other things may not be equal, and climatic factors could very easily offset or worsen this effect. The availability of manure will, therefore, become an increasingly cardinal determinant of rural production and incomes. Government funds saved by the reduction of fertilizer subsidies might well be used to promote mixed livestock/crop farming in the Peanut Basin. In mixed operations farmers may benefit from new cash income enterprises as well as from manure to substitute for chemical fertilizers. This hypothesis is worthy of further research.

Two more issues deserve attention in this far from exhaustive survey of agricultural policies: marketing and storage. As far as the marketing of peanuts is concerned, the GOS certainly seems on the way to increasingly efficient operations whose implications need not be spelled out. In the case of millet, there is no reason to retain the system under which ONCAD had an official monopoly in foodgrain purchases. Since the Government appears determined to pay at least the parallel market price for millet, private grain trading should be liberalized. For other farm products, all the evidence from the three villages surveyed conclusively shows that all households have access to a variety of marketing channels, and are thus not "at the mercy of monopsonistic traders".

The GOS may avail itself of extensive foodgrain storage space in various regions of Senegal, be it public storage areas formerly managed by ONCAD or warehouses leased from private traders. The build-up of public millet or sorghum stocks to smooth

out price fluctuations and supply relief grain to deficit areas constitutes a general policy objective, as described in section 2.3.3.1. The constitution of limited regional security stocks to remedy temporary emergency shortages is a worthwhile goal, but a major price stabilization program should not be attempted. In the Peanut Basin, storage losses incurred by farmers (up to 5 percent yearly) are much too small to justify grain transportation, storage and administration at public expense. Family carryover stocks, in the aggregate, cope with interannual price fluctuations at least as well as do public buffer reserves. Limited regional stocks however, would have a positive nutritional impact at an acceptable social cost by providing deficit families with an alternative to rice purchases, e.g. Thienthie case.

CHAPTER IV

THE AGRICULTURAL ECONOMY

Following a brief background section and presentation of demographic and occupational data, this chapter provides a detailed description of agricultural production and disposal, family income, and food purchases. The next chapter uses this information to analyze the relationship between economic variables and nutritional status.

Physical and Human Characteristics of the Survey Area

The three villages selected for this study are located in the Diourbel Region, which lies at the north central reaches of the Peanut Basin (see Map 4.1.). The Peanut Basin covers nearly 40 percent of the total area of Senegal, and contains about half of its population. It comprises, in decreasing order of importance for peanut production, the Sine-Saloum, Diourbel, Louga, Thies, and northern Casamance Regions. The respective importance of each region, in terms of area cultivated, production, and yields for the latest available year are presented in Table 4.1.

Livestock raising is a significant pursuit in the Diourbel Region, but most of the economic activity remains concentrated on traditional, although monetized, agriculture. Annual rainfall is scant and distributed over a short period of time. Yearly precipitation usually reaches 400 to 600 millimeters, spread over 30 to 40 days between July and October. Less than average rainfall during the previous two agricultural years, 1979-80 and 1980-81, has led to a sharp downfall in peanut and millet production.

In spite of climatic uncertainties, the Region is densely populated by a predominantly rural population; the density for the Region as a whole is 38 persons per square mile, with a high of 48 in the Diourbel area. As a consequence, land use is rather intensive, and there are many reported cases of serious soil exhaustion. Two crops account for the bulk of agricultural activity: peanuts and millet. Sorghum, cowpeas (niebe), and other produce are grown in very limited quantities. In a 'normal' year, total production in the Region is estimated to be 160,000 tons of peanuts, and 100,000 tons of millet (Ministère du Plan et de la Coopération, 1981). A note in passing that given the Region's population, the millet production of a 'normal' year just satisfies household consumption and seed requirements; a bad year, therefore, implies living off food and cash savings, capital liquidation, grain 'imports', or a combination of all three. This is precisely what seems to have been happening in the first half of 1981.

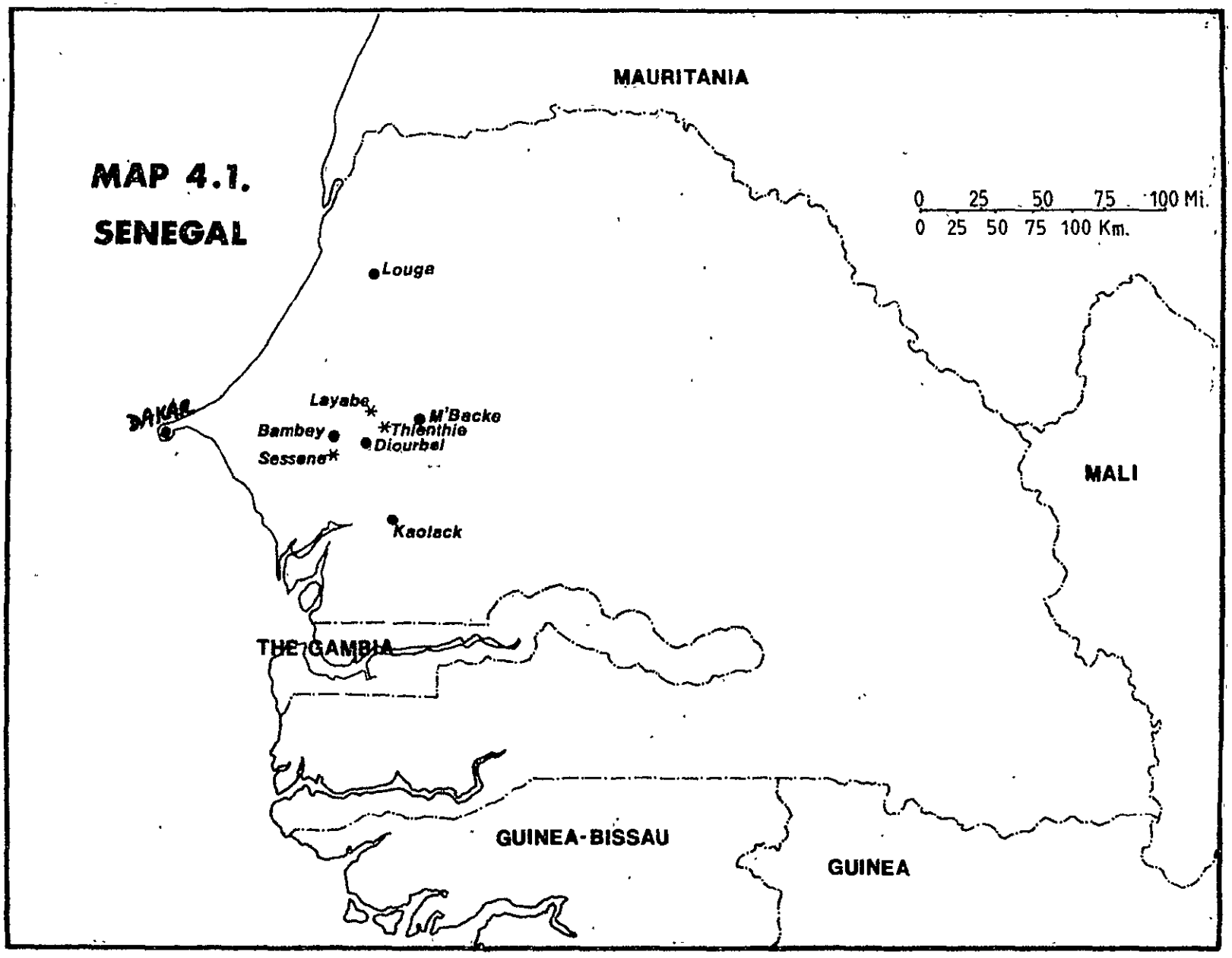

MAP 4.1.
SENEGAL
MAURITANIA
0 25 50 75 100 Mi.
0 25 50 75 100 Km.
Louga
DAKAR
Layabe
M'Backe
Thiénthie
Bambey
Diourbel
Sessene
Kaolack
MALI
THE GAMBIA
GUINEA-BISSAU
GUINEA

TABLE 4.1.

ACREAGE, PRODUCTION AND YIELDS, MAJOR PEANUT PRODUCING REGIONS
1977/78

Region	Acreage (ha)	%	Production (tons)	%	Yield (kg/ha)
Sine-Saloum	505,570	48.0	223,885	46.2	443
Diourbel	152,270	14.5	90,803	18.8	596
Iouga	150,981	14.4	49,283	10.2	326
Thies	135,000	13.0	33,926	7.0	251
N. Casamance	107,445	10.2	86,366	17.8	804
	1,051,266	100.0	484,263	100.0	2,420

SOURCE: Direction Generale de la Production Agricole, 1980.

The Diourbel Region lies within the traditional confines of the Wolof province historically known as the Baol, and to this day most of the population belongs to the Wolof ethnic group; others being mostly Serer, Fulani (Peuhl) and Toucouleur. Religion plays an important role in the Diourbel Region; the cities of Touba and Mbacke are regarded as holy by the "Murids," members of a Sufi Moslem brotherhood founded in the late 19th century by Amadou Bamba, and maintained in various sects by his followers. The nature and extent of Murid influence upon the villages surveyed are discussed further in this chapter.

4.1. Demographic and Occupational Data

The sample totalled 720 persons, drawn from 72 households and three villages. The sex and age distributions for the whole population, and for each village are summarized in Table 4.2. Figure 4.1. shows the age pyramid for the surveyed sample. The pronounced dent in the men's 15-30 age groups is likely due to out-migration. It must be emphasized that in addition to the 720 persons actually in residence, the 72 households surveyed provided information on a total of 89 migrants, bringing the total observed (and absent) to 809. This implies an 11 percent rate of out-migration, which might seem reasonable were it not for the fact that two-thirds of migrants are men in their late teens and early twenties.

Of all persons of both sexes for whom a migration purpose was recorded (n = 74), nearly two-thirds went away to seek some kind of employment, nearly 22 percent left for educational reasons; less than one percent were absent for trade purposes or unspecified "travel."

In all the villages, men's main occupation is obviously farming; the sexual division of labor in this region traditionally requires men to do most of the agricultural tasks, while women devote the larger part of their time to household chores. Copans estimated that in this area of the Diourbel Region, women can allocate only 14 to 23 percent of their time to agricultural tasks, while the rest of their working time is spent on food processing and cooking, drawing water, and collecting firewood and other fuel (Copans et al., 1972, p. 113). The arduousness of household tasks thus limits the contribution women can bring to common household food production, as well as the amount of personal income they may generate through their own peanut or cowpea fields. Their major current source of personal farm income consists of small ruminants and poultry. Women's contribution to agricultural production consists, by custom, of shelling peanuts for seed, winnowing and gleaning. Depending on household composition and growing conditions, they are also called upon to help with weeding and harvesting.

TABLE 4.2.

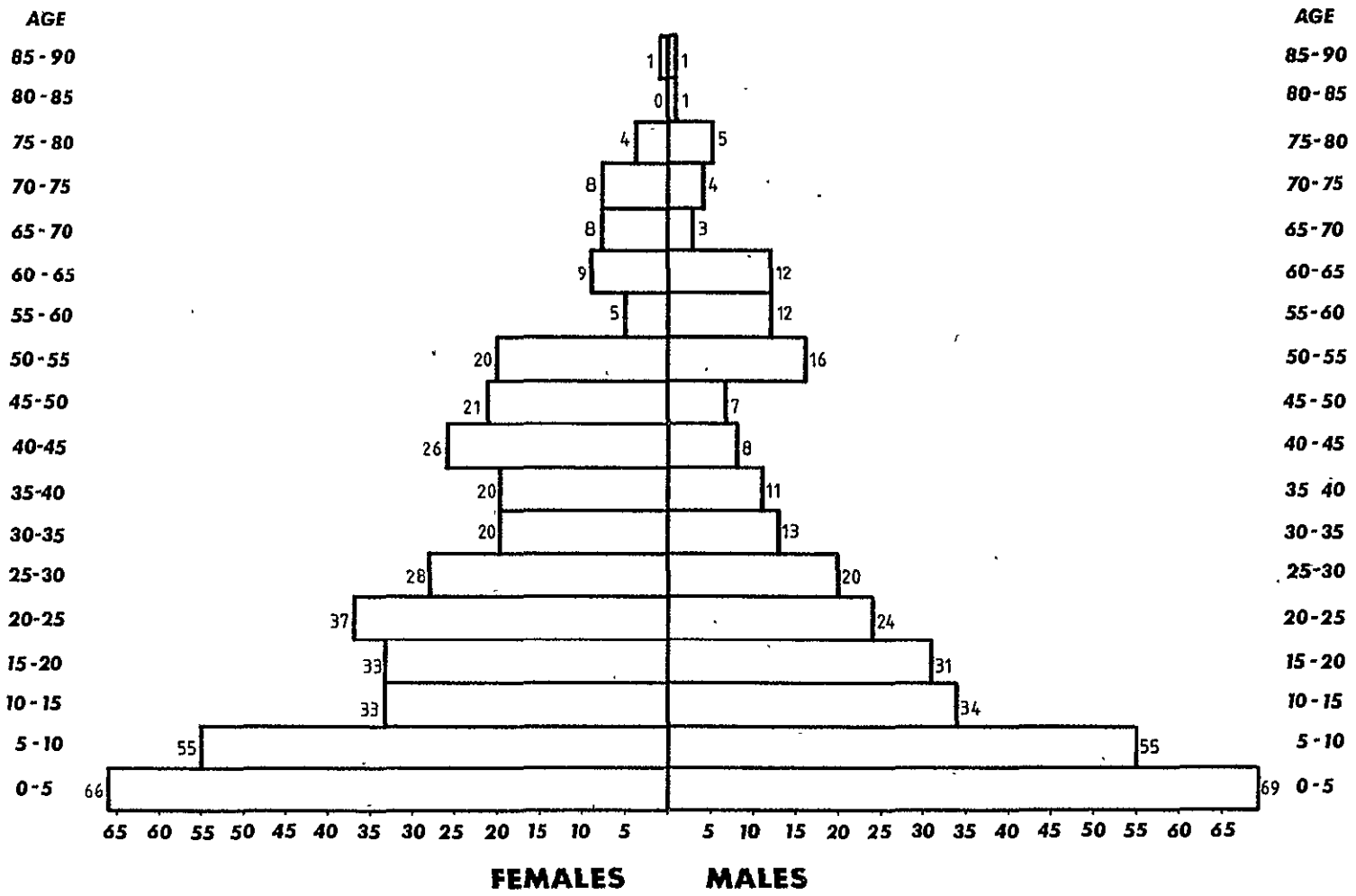
DEMOGRAPHIC PROFILE OF THE SURVEYED POPULATION

Village	Boys 0-15	Girls 0 -15	Men	Women[a]	Total
LAYABE	60	57	45	73	235
SESSENE	69	75	52	72	268
THIENTHIE	60	55	40	62	217
	189	187	137	207	720

NOTE: (a) Includes 11 pregnant and 44 nursing women.

FIGURE 4.1.

AGE PYRAMID OF SURVEYED POPULATION, ALL VILLAGES



Farming is the primary occupation, but many people have a secondary activity, especially after the last two very bad growing years: 73 persons (nearly one-fifth of all aged fifteen and over) have a significant secondary activity, an occupation they engage in on a regular, albeit often quite limited, basis. Sixty percent of these nonfarm income earners are men, and forty percent, women. Those for whom we have occupational data (n = 66) define themselves as artisans, stockmen, petty traders, etc. as below:

TABLE 4.3.

NONFARM ACTIVITIES: ALL HOUSEHOLDS

Activity	No. of Men	No. of Women
Artisan	12	13
Petty trader	5	9
Stockman (Sessene only)	12	1
Merchant	2	2
Shopkeeper	2	2
Tailor	2	0
Gov't Employee	4	0

A piece of information borrowed from Table 4.5. will add to the household profile which begins to emerge; the total area planted in the 1981/82 agricultural year (leaving out fallow fields) was 316 hectares for all three villages. The typical family has ten members present in the village and one away -- most likely a young man working or at school. Of the ten family members in the village, 4.5 are children under age 15, 2.2 are men and 3.2 are women. One of the adult family members has a significant nonfarm income generating activity. The household cultivates 4.4 hectares of peanuts and millet, about 2 hectares per adult man, (Copans et al. had a slightly lower estimate: 1.5 ha per man).

4.2. Production and Disposal of Farm Output

4.2.1. Agricultural Production

The information presented in this section is derived from data collected in 72 households through village interviews and measurement of 452 distinct fields. The customary cropping pattern is a regular annual rotation of peanuts and millet on the same fields; millet having been planted on 58 percent of total cultivated area, and 42

percent going to peanuts in 1980-81. Sorghum and cowpeas occasionally appear as crops, and there is a limited amount of fallow. Local farmers account for the unanimously followed peanut/millet combination by pointing out that such a system reduces risk both of total crop failure due to bad weather, and of soil exhaustion after successive peanut crops on the same field. These oft-stated reasons are not wholly persuasive; people grow millet partly to reduce risk, but also because it is a traditional staple to which they are not only accustomed, but also attached, in spite of a certain taste for rice. In reality, the strongest arguments in favor of growing both peanuts and millet, from the point of view of Diourbel Region farmers, are a real dependence on millet as a basic food, and the possibility of working more land by staggering peak labor requirements for the two crops, as outlined in Part II.

The distribution of land devoted to the various crops and to fallow by surveyed households over four agricultural years is shown on Table 4.4.; in most years people devoted significantly more land to millet than to peanuts.

Local farmers classify the area's soils according to the usual Wolof terminology of Dior, Dek and Dek-Dior types. Dior soils are light and sandy, while Dek soils, located in slight depressions, tend to be heavier, and retain moisture longer; Dek-Dior soils fall in between. Generally speaking, Dior soils are suitable for peanuts, while millet does better on Dek lands. Soil type information was collected and aggregated to the village level to check whether one might partially attribute differences in yields to soils found around the various villages (see Table A1, Appendix I). Although soils around Thienthie are almost entirely of the Dior type (93 percent), in Layabe and Sessene fields are similarly distributed over Dior (70 percent), Dek (10 percent) and Dek-Dior soils (20 percent). Layabe and Sessene, however, have very different yields per hectare both for peanuts and millet, as we see further, which cannot be accounted for by differences in soil types.

Table 4.5. presents a summary of area cultivated in 1981-82 and distance from the household. Layabe is clearly ahead of other villages for total area under cultivation, even for the same number of families, because they have more mechanized sowing and harvesting implements than do other villages. This naturally begs the question: why do they have more equipment? The factors which enable certain villages to have greater access to such inputs as seeds, fertilizer and implements are obviously not determined by national or regional agricultural policy. Rather, they are influenced by the political and religious stature of the chiefs, the extent to which the community is able to unite in the competition against other villages for limited government resources, and a multitude of other factors. In this case, the variations in

TABLE 4.4.

TOTAL AREA CULTIVATED BY CROP, 1978-81[a]

(in hectares)

YEAR	PEANUTS	MILLET	SORGHUM	COWPEAS	FALLOW
1981/82	129.0	169.0	0.0	2.0	23.4
1980/81	139.3	192.8	1.7	1.8	0.0
1979/80	166.7	143.0	0.0	0.4	16.0
1978/79	135.4	175.5	1.8	0.7	12.2

NOTE: (a) For surveyed households.

TABLE 4.5.

AREA CULTIVATED AND DISTANCE FROM THE HOUSEHOLD, BY VILLAGE

VILLAGE	TOTAL AREA INCLUDING FALLOW 1981 (ha)	TOTAL AREA PLANTED 1981 (ha)	AVERAGE AREA PLANTED PER HOUSEHOLD, 1981 (ha)	AVERAGE FIELD SIZE (ha)	AVERAGE DISTANCE FROM THE HOUSEHOLD (Kms)
LAYABE	146.9	138.0	5.75	0.864	1.7
SESSENE	108.4	108.4	4.52	0.686	0.1
THIENTHIE	83.8	69.3	2.57	0.676	1.7

NOTE: Fields surveyed N = 452

Households surveyed: Layabe: 24; Sessene: 24; Thienthie: 27.

access to resources between Layabe and Thienthie should be seen as part of the range which persists under a common public policy. With respect to the average distance between fields and household, note the sharp differences between the two clustered Wolof (Layabe and Thienthie), and the scattered Serer (Sessene) villages. The scattered pattern seems to give the Serer the advantage of having their fields around the household, while Wolof families' fields are around the village, much farther away.

Senegal stands out among west African states for the extent to which the horse has traditionally been and remains used in agriculture and transportation. In the area surveyed, the same practice avails: nearly 90 percent of households studied in Layabe use horses; the proportion was 87 percent in Thienthie, but only two-thirds in the Serer village.

The general calendar of agricultural tasks for both peanuts and millet, sketched in Table 4.6., applies equally well to all three villages. The amount of time spent by each household on each task, expressed in number of active man-days equivalent showed rather wide variations, which were to be expected, considering the differences among households in number of actively farming adults and number of fields cultivated. For instance, most households in Layabe cultivate five fields (87 percent), while most families in Sessene and Thienthie tend four fields each, but in each village, many households work eight to ten, or even twelve fields; complete histograms for the distribution of area worked by family are shown in Figure 4.2.

Ranges in active man-days equivalent for farming activities, by crop and season are listed in Tables A3 and A4, Appendix I; in Table 4.7. we reproduce the summary results.

During Nor (the dry, cool season early in the calendar year) agricultural work mostly consists of gleaning (if the harvest has been plentiful), or of gathering millet stalks, the major local material for walls and fences. Tioron (the dry, hot season) sees the beginning of earnest farm work: clearing of peanut and millet fields, shelling peanut seed, and sowing of early millet. Assuming six-day workweeks, Tioron has 52 working days, during that time the average household allocates about 16 days to each hectare of peanuts, and 9 days to each hectare of millet. Navet, the rainy season, stretches over 105 total possible workdays and is the most demanding time of the year, in terms of family labor. Surveyed households allocated 46.4 days to each hectare of peanuts, and almost 39 days to each hectare of millet, through sowing, radu (going over a freshly planted peanut field lightly), first, second and third weedings, harvest, etc. Lolly is the time when the harvest is stacked in the fields, dried, threshed and transported to the village for sale (peanuts usually) or storage (millet usually).

FIGURE 4.2.

DISTRIBUTION OF AREA CULTIVATED
BY HOUSEHOLDS, BY VILLAGE (hectares)

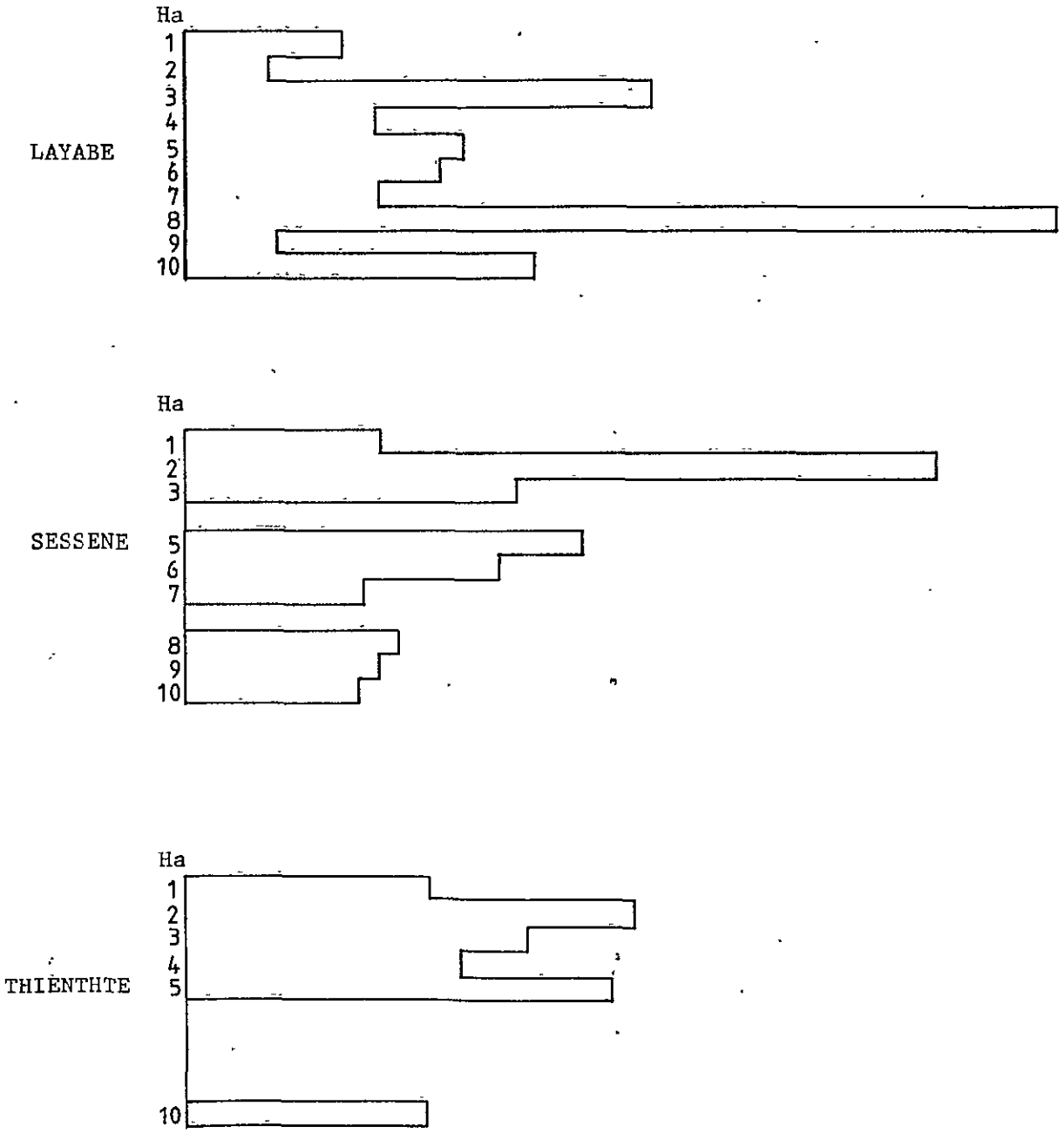


TABLE 4.6.

TIMING OF MAJOR AGRICULTURAL ACTIVITIES BY CROP

SEASON	MONTH	PEANUTS	MILLET
NOR	February	Gleaning	Collecting millet stalks
	March	Gleaning	
	April	Field manuring, clearing	Manuring, clearing
THIORON	May	Shelling for seed, clearing	Clearing
	June	Shelling for seed, clearing	Sowing
NAVET	July	Shelling Sowing	Sowing
	August	1st weeding	1st weeding
	September	2nd weeding 3rd weeding	2nd weeding 3rd weeding
	October	Lifting	Harvest
LOLLY	November	Stacking & threshing, transport	Transport
	December	Winnowing	Grain storage
	January	Threshing/winnowing	

SOURCES: Adapted from Copans et al, 1972; and 1981 survey.

TABLE 4.7.

TOTAL LABOR TIME ALLOCATION TO PEANUTS AND MILLET, BY TYPE OF LABOR AND SEASON, (adjusted man-days)

		PEANUTS	MILLET
		I. FAMILY LABOR	
I.	NOR	70.5	260.0
II.	TIORON	2,237.5	1,740.0
III.	NAVET	6,424.5	7,331.0
IV.	LOLLY	2,311.5	1,112.0
		11,044.0	10,443.0
		II. HIRED LABOR	
I.	NOR	0.0	0.0
II.	TIORON	23.0	16.0
III.	NAVET	43.5	118.0
IV.	LOLLY	28.5	11.6
		95.0	145.6
		III. COMMUNAL LABOR	
I.	NOR	0.0	0.0
II.	TIORON	0.0	0.0
III.	NAVET	0.0	23.0
IV.	LOLLY	10.3	164.0
		10.3	187.0
	TOTAL	11,149.3 (80 days/ha)	10,775.6 (56 days/ha)

The issue of the validity and usefulness of collecting such time allocation data on the basis of recall information versus year-long intensive surveys needs to be addressed. First, are the data presented in Table 4.7. realistic? There are two main ways of ascertaining this: (a) the labor allocation data may be checked for internal consistency, on the basis of what is known of the general agricultural calendar, and (b) the recall data may be checked against the findings of long-term studies in the same area. From the standpoint of consistency, time allocation data correspond to expectations, the respective weights for each season fit what is known of labor requirements throughout the year; the priority given to peanuts last year also appears consistently across households. The data seem reasonably accurate although slightly on the low side, because time spent on certain activities is almost surely understated, e.g., spreading manure and chemical fertilizer. Comparing recall data to full-fledged farm management studies does not actually settle the issue either, because year-long studies also have to contend with a wide variance among households, and because the amount of time spent by all households on the same total area every year is very much a function of the weather.

Most farmers in the Peanut Basin follow a strategy of sowing as much millet and peanuts as their stock allows; in years of very favorable rainfall, the amount of planted area they can handle throughout the growing season is determined by the maximum area they are able to weed. In bad years, on the other hand, the same total area planted may require much less total work; during the last two years, some fields have been given up as complete losses about halfway through Navet.

Considering the number of families surveyed and the total area planted in millet and peanuts in 1980-81 (193 ha and 139 ha, respectively), the average family spent 56 man-days on each hectare of millet, and 80 man-days on each hectare of peanuts. Various agronomic studies of labor time allocation in the same general area indicate that our estimates based on recall are in the right range. Pélissier (1966, p. 153), for instance, reports that in the Bambey area one hectare of peanuts requires 75 to 85 man-days of labor. Recall data thus do not provide the kind of precise information on absolute time allocation required, i.e. for complex linear programming models designed to assess the efficiency with which farmers allocate time among a set of activities, but they do provide, rapidly and at little cost, information on relative time allocation among production activities (i.e. millet and peanuts). The assumption that households understated time spent last year on various activities by the same general proportion appears justified. The conclusion then is that, in 1980-81, people devoted 40 percent more time to one hectare of peanuts than to one of millet. This is an interesting

finding, and one of real usefullness, but before one can gauge its policy implications, other types of crucial inputs must be examined, starting with chemical and organic fertilizers.

The quantity of fertilizer used by farmers in the Diourbel Region is said to be below optimal. For instance, the exhaustive 1981 SONED document reports applications of fertilizer may be as low as 27 kg per hectare on millet and 40 kg per hectare on peanuts. Farmers interviewed in Layabe, Sessene and Thienthie, however, were using much larger quantities of chemical fertilizer and manure on both millet and peanuts, as Table 4.9. shows. The general pattern there is one of putting more chemical fertilizer on peanuts than on millet; the following year, millet planted on the same field benefits from any residual chemical fertilizer, complemented by manure. This method is clearly followed by farmers in the two Wolof villages, Layabe and Thienthie. Sessene departs from the norm not so much in the method as in the quantity of manure used. Fields around the Serer households receive about the same amount of chemical fertilizer per hectare as fields near Layabe, but millet fields in Sessene are spread with three times more manure than those of Layabe and Thienthie. For peanuts, the factor is about ten.

To which factors can one ascribe the striking difference in the quantity of manure used by Wolof and Serer villages? The answer requires looking first at livestock ownership in the survey villages. Small ruminants are most common; the average household in the three villages owns one to three goats, and one to six sheep. Most families also keep chickens: one or two in Layabe and Thienthie, and usually more -- up to eight -- in Sessene. Horses, widely used for traction, are found in all villages. It is much more difficult to estimate the extent of cattle ownership; while small ruminants, poultry and horses are kept in or very close to the village, and thus can be observed by everyone, the family cattle are entrusted to relatives or hired herders. Cattle ownership data for our three villages may be summarized as follows:

TABLE 4.8.

CATTLE OWNERSHIP, ALL VILLAGES

Village	No. of Households Responding	Total No. Owned by all Households	No. per Household	Range of No. Owned
Layabe	12	5	.4	0-2
Sessene	19	226	12.0	0-73
Thienthie	22	12	.5	0-4

TABLE 4.9.

FERTILIZER USED BY TYPE, CROP AND VILLAGE, 1980-81
(kg and kg/ha)

I. CHEMICAL FERTILIZER

	MILLET		PEANUTS	
Village	Total kg	Average kg/ha	Total kg	Average kg/ha
LAYABE	7,350	87.5	7,550	125.0
SESSENE	6,550	117.6	5,000	97.6
THEINTHIE	3,250	61.0	4,550	164.0

II. MANURE

	MILLET		PEANUTS	
Village	Total kg	Average kg/ha	Total kg	Average kg/ha
LAYABE	8,000	95	1,104	18.3
SESSENE	15,496	278	9,000	176.0
THIENTHIE	4,300	80	400	14.4

Even allowing for the limited response and people's propensity to vagueness or deliberate understatement when it comes to cattle ownership, there is no denying the overwhelming Serer advantage in personal and common cattle stock. Before looking deeper into this issue, however, it may be well to assess its importance, in terms of peanut and millet yields.

4.2.2. Quantities Harvested and Yields

Data on the quantity of peanuts and millet harvested during the 1980-81 year were collected in two distinct fashions. At the beginning, we asked each head of household what had been the global quantity obtained from all peanut fields and all millet fields worked by the household (Form 2 of the questionnaire). Later on, as each individual family field was measured, the same person or an elder son was asked how much the field being surveyed had produced. Table 4.10. compares the global harvest data from responses pertaining to all fields, to the sum of the responses about individual fields. Farmers in Thienthie did not give very consistent answers, the whole being greater than the sum of the parts by well over twenty percent, but Layabe and Sessene farmers were quite consistent, demonstrating -- if there were any further need to do so -- a sharp awareness of input/output relationships for both peanuts and millet.

Before we proceed to compare yields per hectare, let us answer a question which has by now undoubtedly occurred to some: how did the farmers know the quantity harvested so precisely? Most of the peanut harvest is sold through the local co-operative where it is carefully weighed. Since he knows what general proportion of the total was sold and its weight, any farmer can easily infer the weight of total production. The method is different for millet, a major portion of which is stored in the family granaries after harvest. It has always been essential that the head of household be able to estimate total and disposable millet production; this allows him, given his knowledge of average daily family consumption, to see whether the year's production will allow for sales of surplus or implies purchases of grain before the following harvest. Millet farmers, in this area of Senegal at least, rely on two methods to estimate yearly grain production. The first one consists merely of keeping track of how many headloads, or cartloads, of millet panicles are brought in from the fields, each measure being given an assessed weight in kilograms. The second method estimates weight by way of volume stored. Traditional granaries are round, made of tightly woven osier-like rods, separated from the ground by a few boulders, and topped by a conical thatch roof. These granaries fall according to size into a few categories, on the basis of diameter and height. Some villagers offered information of the type:

TABLE 4.10.
COMPARISON OF TOTAL HARVEST DATA
BY CROP, BY VILLAGE, 1980-81 (Kg)

I. Derived by Summing Harvest on Individual Fields (n=446)

	MILLET	PEANUTS	COWPEAS
LAYABE	48,337	8,628	
SESSENE	61,741	21,949	
THIENTHIE	8,035	1,465	255

II. Derived by Responses by Crop for all Fields (section 2)

	MILLET	PEANUTS	COWPEAS
LAYABE	49,380 (+ 2%)	8,600 (- .3%)	
SESSENE	68,272 (+10%)	22,763 (+ 4.0%	
THIENTHIE	9,805 (+22%)	1,868 (+27.0%)	270 (+6%)

"if the granary is in diameter the length of twelve feet and so tall that a man's lifted hand can just touch the rim, then it will hold about 2.6 tons of machine-threshed grain and 2.8 tons of hand-threshed grain..." Others expressed it in terms of the time such a granary could support a family's grain needs. It was unfortunately not possible to check the accuracy and usefulness of these rules of thumb; this can only be done by weighing the millet stored by a sample of families at harvest time. However, even if the estimated weight in kilograms is not precise, people can clearly tell for how long they will live off the year's output, and compare quantities produced from year to year.

We now turn our attention back to yields. Table 4.11. shows the average yields by crop, by village for the 1980-81 campaign:

TABLE 4.11.

AVERAGE YIELDS BY CROP, BY VILLAGE
(Kg/Ha)

	Millet	Peanuts	Cowpeas
Layabe	575.4	142.8	-
Sessene	1,108.4	428.7	-
Thienthie	150.2	53	142

This table underscores two important facts: yields were higher for millet than for peanuts, and yields for both crops were much higher in Sessene than in the other two villages. The first fact constitutes a reversal of the usually reported pattern, and may be chiefly ascribed to very unfavorable weather conditions during 1980-81. Peanut yields did not reflect a lack of attention: farmers in the three villages surveyed spent more time per hectare on peanuts than on millet. It is likely that high chemical fertilizer and manure applications, and soil condition also played a role, but their respective effects cannot be separated without detailed information for several years. More importantly, Layabe and Thienthie clearly belie the generalizations often made about Wolof villages of the Peanut Basin, according to which farmers grow cash crops at the expense of food crops to generate money income. Both Layabe and Thienthie put in more millet than peanuts, and got out of each hectare more millet than peanuts. There have been, and may yet be, years during which peanuts are more important than millet in total area and yield, but farmers as a group are not locked into any given pattern of production.

The higher yields observed in Sessene cannot entirely be accounted for by differences in quantity and timing of rainfall. The distance between villages does not allow for the major change required, nor is there any reason to suppose the Serer spend more or less time on their fields than do the Wolof. We do know, however, the Serer apply three times more manure on millet fields and ten times more manure on peanut fields than the Wolof, most likely because they keep more cattle. Pélissier, among others, has described the Serer farming system in detail; the following quotation from his major work on Senegalese farmers is illustrative:

> "... The system of land use, the makeup of woody species, the location of trails, in short, all ways in which the environment is managed, stem from the fundamental requirement that cattle herds be maintained. The Serer, therefore, see their calling as an inseparable combination of cattle raising and millet growing. But cattle raising is not merely passive speculation. Although cattle may well constitute a primary traditional mode of investment, they also provide a much appreciated resource, milk, and above all represent the indispensable instrument of maintained soil fertility and long-term field use. The essential originality of this production system lies in its intimate integration of cattle raising and agriculture; far from running along parallel lines, these two activities are closely associated and complementary. As accomplished farmers, the Serer thus derive from the well-being of their cattle the surest token of productivity for their land." (Pélissier, 1966, p. 236, translated by H. Josserand)

Although the Serer clearly keep more cattle than the Wolof, the reasons why are less than evident, and require, even for a partial and simplified explanation, a short digression into the history of this region of Senegal.

4.2.3. Historical Context

Let us start by noting that Sessene, the Serer village, is located in an area long occupied by Serer farmers (several centuries). Layabe and Thienthie (especially the latter) lie in an area which, until late in the nineteenth century, formed the natural border between cultivated lands and the western reaches of the Ferlo, a large wooded, desertic region then occupied only by transhumant Fulani herdsmen.

The Wolof have long been in contact with Islam, and Moslem leaders (Cheikh and Serigne) played a political role, but as recently as a century ago, the mass of the people had not been converted to Islam. At the end of the nineteenth century, the increased process of French colonization precipitated the adoption of Islam by removing (among the Wolof) the old system of chieftains, paramount chiefs, etc. At the same time, two outstanding Wolof Moslem personalities emerged: El-Hadj Malick Sy, who gathered his followers into the Tidjan brotherhood, and Amadou Bamba, nephew of Lat-Dior, who founded the Wolof Murid brotherhood. The three major tenets of Amadou Bamba's philosophy may be summarized as:

- a pronounced mysticism, expressed though contemplation, asceticism, prayer;
- an exaltation on the virtue of work (mostly farm work);
- obedience and devotion of the Taalibe (disciple) to the Serigne, Cheikh and Khalife.

As far as we are concerned, it is important to note that Muridism between 1895 and 1945 found part of its expression through the settlement of pioneer communities established in new areas, east of the traditional croplands. This movement coincided with French interests in an expansion of peanut production and their building, much to this effect, the Diourbel-Tambacounda rail link in 1907. As a result, the western confines of the Ferlo were deforested, the Fulani forcibly removed (many times after bloody conflicts), and pioneer Murid settlements soon introduced peanuts to what is today the northeastern part of the Peanut Basin. It is essential to recognize that these new communities were mostly settled by people who did not have a long agricultural tradition and with a view to quick payoffs rather than the establishment of a long-term, balanced and sustainable system.

Some historians maintain that the Serer's advantage over the Wolof in cattle/millet association predates the rise of Islam in Senegal; if this is true, the violent conflicts (still vivid in many minds) between Wolof and Fulani in the western Ferlo, and the farming attitude of Murid pioneers, certainly did not contribute to the later integration of cattle and cereal in Wolof society. Should one wonder then why cattle raising projects in the area, such as embouche paysanne (on-farm cattle fattening), have found among the Serer a much more receptive audience?

By way of summary, let us recall here the salient points of the foregoing subsection:

(a) The Serer's higher yields are due in large part to a judicious integration of cattle raising and farming on the same lands;

(b) The Wolof do not integrate cattle into their production system, for historical reasons, some of which predate Islamization, while others are closely linked to the settlement of new lands in the early twentieth century.

One cannot tell to what extent the Wolof will adopt a more integrated and productive agricultural system because little is known of both their willingness and ability to do so. However, even if the Wolof wanted to emulate the Serer, they could not do it before making certain environmental adjustments, the most obvious being the multiplication of Acacia albida, trees ever-present and essential in Serer country for cattle maintenance, which would require a change in attitudes and many years of effort.

To close this brief overview of the Region's history in general and Muridism in specific, a few remarks on the Murid work ethic are in order. The Murid farmer is often depicted as a compulsive worker, slave to the local Moslem leaders, supporting by his sacrifices an enormously opulent group of dignitaries in Mbacke, Touba or Diourbel. This misunderstanding has been fed by the ardent devotion of early day Taalibes (disciples), who braved the wilderness and worked right through pest epidemics (1912); no doubt it has been influenced as well by such extreme or distorted forms of Muridism adhered to by M'Baye Fall, or Cheikh Anta followers.

Fortunately, decades of virtual neglect were interrupted in the 1960's and 1970's, when several major works on the brotherhood appeared (Dumont, Cheikh Tidjan Sy, Copans et al., Pélissier), dispelling a lot of the old myths. Certain findings are quite relevant to the purpose of this study: Murid farmers do not work differently, or significantly harder, than their non-Murid Wolof counterparts, and the share of their work devoted to the brotherhood is around ten percent (not unreasonable considering the value they place on what they receive in exchange).

4.2.4. Disposal of Farm Production

Now that we have a better interpretation of harvest and yield data for peanuts and millet in the survey villages, let us see how they compare to other marketed farm products. Table 4.12. shows the value of farm products actually sold in each village in 1980-81. Peanuts account for 3 percent of farm income in Thienthie, 17 percent in Sessene, and 34 percent in Layabe. The largest single contribution to income is brought in by cattle in Sessene (73 percent of total), which does not even include any milk sales. In Layabe and Thienthie, small ruminants and poultry play a major role, adding up to over one-third of total revenue in Layabe and two-thirds of the total in Thienthie! It is difficult, by looking at data for one year, to differentiate clearly between sales arising from surplus and dis-savings (sales arising out of duress whereby the farmer liquidates useful capital equipment). This seems to be happening in Thienthie; it appears hardly likely that in a normal year twenty-seven households would sell about ten horses. Not surprisingly, people in Thienthie reacted to poor millet and peanut yields by moving into other farm income-earning activities, and using up savings and capital.

The question is often raised as to whether farmers have ready access to markets for their various products, whether traders take advantage of villagers by buying items they are not willing or able to take to market themselves, etc. We attempted to shed some light on this issue by recording the location of each recalled sale for the year;

TABLE 4.12.

TOTAL FARM RECEIPTS, BY ACTIVITY/VILLAGE

1980/81 (CFA FRANCS)

ACTIVITY	LAYABE (24 households)	SESSENE (24 households)	THIENTHIE (27 households)
Peanuts	247,640 (34.6%)	456,780 (16.8%)	28,093 (3.0%)
Millet	127,230 (17.8%)	31,900 (1.2%)	
Cowpeas			14,000 (1.5%)
Chickens	33,850 (4.7%)	9,000 (.3%)	98,925 (10.4%)
Sheep	198,500 (27.8%)	217,900 (8.0%)	437,200 (46.0%)
Goats	27,800 (3.9%)	21,500 (.8%)	79,800 (8.4%)
Cattle		1,976,900 (72.8%)	81,000 (8.5%)
Horses	80,000 (11.2%)		207,000 (21.8%)
Donkeys		3,000 (.1%)	3,500 (.4%)
TOTAL	715,020 100.0%	2,716,980 100.0%	949,518 100.0%

NOTE: Overall cash income of three villages = 4,381,518.
No. of Sales: Layabe: 77; Sessene: 69; Thienthie: 63.

summary results are presented in Table 4.13. Peanuts are officially sold at the Co-op (people do not readily admit to other peanut sales), and millet sales are made at village shops, village markets and other markets by farmers, with traders handling 40 percent of total sales. Looking at poultry and small ruminants, we find that farmers handle sales themselves on a variety of markets, less than one-fourth of total in value going through intermediation. Finally, no cattle or horse sales are reportedly carried out with the assistance of traders.

This section ends with a few remarks on the seasonality of farm sales. Table 4.14. shows the seasonal distribution of sales throughout the year. The most active season is naturally Lolly, shortly after the harvest and at a time when livestock are in prime condition; over half of the year's transaction, in value, take place then. Nor and Tioron follow in decreasing order of importance, and only 5 percent of the year's sales take place in Navet, the time of highest farming activity.

4.3. Family Income

This section assesses the general level and origin of the average family income earned in the village through farm and nonfarm activities. Remittances from migrant workers and other sources are not included. Farm sales, as discussed recently, are usually complemented by some off-season pecuniary activity even in good years, for the growing cycle is such that Nor and the beginning of Tioron leave people with some free time. In harder times, such as 1981-82 which follows two very bad peanut years, there is all the more reason to take up a part-time occupation. As noted in Table 4.3., 73 persons worked as artisans, petty traders, shopkeepers, etc., the proportions between men and women being 60 and 40 percent, respectively. Although this ratio is not weighted by time worked or income generated, the proportion of women -- given their very busy household work schedule -- is quite high, suggesting a major effort is being made to shore up family resources through nonagricultural earnings. The first level of enquiry included the type of nonfarm occupation and seasonal variations in time devoted to the activity. Table 4.15. lists the 7 major types of occupations and the number of days (adjusted to full-time equivalent) worked in each season. In terms of total time spent, the types of work attracting most people were that of artisans, stockmen (Sessene only), and petty traders. The annual net income, by activity, season and village is shown in Table A11, Appendix I; it would be possible to draw up a table showing earnings by type of activity, but there is too much variation from one case to the next to make a reasonable ranking of activities by amount earned. The safest and probably most useful inference to be made from the data is that average yearly per

TABLE 4.13.

LOCATION OF FARM PRODUCT SALES
1980-81, BY PRODUCTS; ALL VILLAGES
(CFA FRANCS)

	Village Shop	Village Market	Other Market	Traders	Co-op
Peanuts		9,200			606,230
Millet	400	24,330	52,400	51,000	
Cowpeas			14,000		
Chickens		92,775	38,200	10,800	
Sheep	55,000	143,200	445,900	205,000	
Goats		49,700	33,300	46,100	
Cattle		21,000	1,990,400		
Horses		12,500	274,500		
Donkeys			6,500		
Percentage of Total Per Location	1.3%	8.4%	68.3%	7.5%	14.5%

NOTE: $\Sigma = 100\%$.

TABLE 4.14.

INCOME FROM FARM SALES, BY ITEM AND SEASON.

1980/81, ALL VILLAGES

(CFA FRANCS)

	I. NOR (Feb.-Apr.)	II. TIORON (May-June)	III. NAVET (July-Oct.)	IV. LOLLY (Nov.-Jan.)	TOTAL	(%)
Peanuts	26,400	21,000		610,110	741,510	16.9
Millet	68,000	7,640		39,990	159,130	3.6
Chickens	92,875	27,675	10,050	4,200	141,780	3.2
Sheep	176,400	192,200	47,000	403,000	853,600	19.4
Goats	69,600	7,800	30,700	21,000	129,100	2.9
Cattle	764,200	113,500	76,000	1,104,200	2,057,900	46.9
Horses	49,000	106,000	60,000	72,000	287,000	6.5
Donkeys					6,500	.2
Cowpeas				14,000	14,000	.3
Season %	29.5%	11.5%	5.3%	53.6%	4,390,520[a]	100.0%

NOTE: (a) The total is greater than the sum of items shown because seasonal information was not recorded in a few cases.

TABLE 4.15.

AVERAGE AND TOTAL DAYS OF NONFARM WORK

BY ACTIVITY/SEASON (days)

ACTIVITY AND NUMBER INVOLVED	AVERAGE				TOTAL		
	NOR	THIORON	NAVET	LOLLY	YEARLY TOTAL PER PERSON	YEARLY TOTAL ALL HOUSEHOLDS	% OF TOTAL IN EACH ACTIVITY
Shopkeepers (3)	58	58	52	52	220	660	4.6%
Petty Trader (10)	61	59	37	50	207	2,070	14.4
Tailor (2)	72	72	12	72	228	456	3.2
Stockman (12)	82	82	82	82	328	3,936	27.4
Artisan (23)	67	67	61	66	261	6,003	41.7
Civil Servant (4)	78	57	57	57	249	996	6.9
Merchant (4)	39	3	3	21	66	264	1.8
						14,385	100%

NOTE: Population surveyed = 720; N People with significant nonfarm activity = 73.

capita nonfarm net income is 64,000 CFA Francs in Layabe, and 43,000 CFA Francs in Sessene and Thienthie, for households surveyed.

We may now focus on the question of the proportion of total village income coming from agricultural and nonagricultural activities. To insure a more effective comparison, the total quantity of millet and peanuts sold and consumed by the family is imputed a monetary value: 46 Francs per kilo for peanuts, and 30 Francs per kilo for millet. The results are shown for each village in Table 4.16. Not surprisingly, we find the Sessene sample is ahead of other villages in total value of farm and nonfarm income, although the latter category contributes only 13 percent. Layabe's total income for surveyed families is almost equally divided between farm and nonfarm activities. The lowest total income is earned by the households studied in Thienthie, where nonfarm work brought a 25 percent contribution to the total.

The lesson we can draw from this simple comparison is that the successful Serer farming methods (on 107 hectares) yield the highest total income, requiring the smallest nonfarm contribution. The Layabe strategy involved labor-saving techniques enabling the surveyed families to cultivate much more land (146 hectares) and devote a lot of time to nonfarm work (bringing the highest value by far of all villages). Still, the total value of output is much lower than in Sessene, due to the latter's superior yields. Finally, Thienthie's lagging position can be ascribed to the lowest area planted (83 hectares), the lowest yields, and a limited contribution from nonfarm work.

4.4. Food Purchases

From mid-May to mid-August, respondents in all three villages gave price and quantity information on 608 food items purchased. There is a clear inverse relationship between village food production and food purchases; Thienthie accounted for 46 percent of total purchases in value, Layabe for 34 percent, and Sessene for 19 percent, as Table 4.17. shows. Food purchases may also be expressed as a percentage of money income (see Table 4.18.). Money from farm and nonfarm income having been estimated for the year, the amount is prorated over three months, and compared to food expenditures for the same period. The underlying assumption that income is spent rather evenly throughout the year is evidently questionable, so that resulting estimates are best interpreted as rough orders of magnitude. Still, the figures are suggestive, by the standards of similar studies (e.g. SONED, 1981): a very low 7 percent of money income spent on food in Sessene, an average 14 percent in Layabe, and a very high 43 percent in Thienthie.

TABLE 4.16.

VALUE OF MAJOR TYPES OF ACTIVITIES BY VILLAGE, 1980/81
(CFA Francs)

	FARM INCOME EXCL. PEANUTS AND MILLET	VALUE OF PEANUTS AND MILLET PRODUCTION[a]	TOTAL VALUE OF FARM PRODUCTION	VALUE OF NONFARM ACTIVITIES	TOTAL
LAYABE	340,150	1,877,000	2,217,150 (48%)	2,422,008 (52%)	4,639,158 (100%)
SESSENE	2,228,300	3,084,200	5,312,500 (87%)	776,948 (13%)	6,089,448 (100%)
THIENTHIE	921,425	381,400	1,302,825 (75%)	437,760 (25%)	1,740,585 (100%)

NOTE: (a) Total production of peanuts x 46 francs per kilogram plus total millet production x 30 francs per kilogram.

TABLE 4.17.

TOTAL EXPENDITURES ON FOOD,

MAY-AUGUST 1981, BY VILLAGE

(CFA FRANCS)

	TOTAL	AVERAGE PER HOUSEHOLD	NO. OF RECORDED PURCHASES
LAYABE	111,640	4,652	283
SESSENE	61,271	2,553	174
THIENTHIE	149,230	5,527	151
TOTAL			608

TABLE 4.18

PERCENTAGE OF MONEY INCOME SPENT ON FOOD

MAY-AUGUST 1981

(CFA FRANCS)

	FARM[a] INCOME	NON-FARM[a] INCOME	TOTAL[a] INCOME	FOOD[b] PURCHASES	PERCENTAGE OF INCOME SPENT ON FOOD
LAYABE	178,755	605,502	784,257	111,640	14%
SESSENE	679,245	194,237	873,482	61,271	7%
THIENTHIE	237,379	109,440	346,819	149,230	43%

NOTES: (a) Averaged over 3 months from year's total.

(b) Recorded May 15 - August 15, 1981.

No. of Households: Layabe, 24; Sessene, 24; Thienthie, 27.

TABLE 4.19.

AMOUNT SPENT ON MAJOR FOOD ITEMS,
MAY 15 - AUGUST 15, 1981 BY VILLAGE (CFA FRANCS)

LAYABE		SESSENE		THIENTHIE	
Millet	17,400	Salt	18,300	Millet	57,190
Rice	16,535	Sugar	14,963	Rice	46,585
Cowpeas	12,545	Rice	5,030	Sugar	13,865
Oil	12,140	Smoked Fish	4,247	Oil	11,090
Sugar	11,508	Onions	3,789	Salt	10,660
Coffee	10,320	Hot Pepper	2,747	Smoked Fish	1,690
Salt	6,250	Beef	2,200	Fresh Tomatoes	1,395
Beef	2,870	Bread	1,925	Coffee	750
Smoked Fish	2,800	Oil	1,530	Tomato Paste	630
Bread	2,225	Fresh Fish	1,425	Onions	555
Chicken	2,100	Powder Milk	1,200	Hot Pepper	295
Tea	1,900	Tomato Paste	1,145	Maggi Cubes	180
Tomato Paste	1,850	Dried Fish	1,090	Dried Fish	120
Maggi Cubes	1,415	Tea	800	Diar	10
Onions	1,395	Cabbage	470		
Fresh Tomatoes	1,165	Cowpeas	250		
Fresh Fish	1,126	Maggi Cubes	80		
Diar	980	Black Pepper	25		
Hot Pepper	785	Fresh Tomatoes	25		
Fresh Milk	540				
Cabbage	475				
Lalo	450				
Guinea Sorrel	400				
Black Pepper	395				
Goatmeat	200				
Eggs	200				
Dried Fish	200				
Corn	170				
Powder Milk	125				

Comparisons of amounts spent on various foods by surveyed households in the three villages (Table 4.19.) are also quite instructive. As one might expect, there are no millet purchases in Sessene, even eight to ten months after harvest; condiments such as sugar, smoked fish, onions, etc. are prominent, but the amount of rice purchased, compared to the other villages, is quite low (three times lower than in Layabe and ten times lower than in Thienthie!). In Layabe and Thienthie, millet and rice are clearly at the top of the list; people spent nearly equal amounts on each, which means that given prevailing prices, they bought twice as much millet as rice. The high amount spent on both millet and rice in Thienthie, the village with the lowest production, farm and total income, strongly suggests the inflow of sizeable remittances, possibly complemented by serious capital liquidation.

Just as the case is occasionally made that villagers have little choice in the channel of disposal for their products, so is the argument sometimes proffered that they have little choice over which food items they can buy and the price they have to pay. It seems reasonable to infer the extent to which people actually have access to a variety of options (village shop, village market, and other, larger markets) through the proportion of reported purchases for each option. In this case, the value of purchases at each of the three possible locations for all surveyed households is as follows:

TABLE 4.20.

TOTAL VALUE OF FOOD PURCHASES, BY PLACE OF SALE, ALL HOUSEHOLDS, (CFA Francs)

Location	Amount Spent	Percentage
Village Shop	136,520	51.4%
Village Market	51,450	19.4%
Other Markets	77,657	29.2%

Although village shops handle about half of all purchases in value, they by no means have a monopoly on village trade. The high proportion of purchases outside the village (29 percent) attests to consumer mobility.

CHAPTER V

FOOD CONSUMPTION, NUTRITION, AND ECONOMIC STATUS

This chapter discusses food consumption, nutrition, and their relationship to key economic variables. Special attention is given to the millet/rice issue and to a comparison of findings from the dietary survey and anthropométric measurements.

This first section provides a general commentary on food consumption in the three villages surveyed including food taboos, the effect of Ramadan, and respondent bias in the dietary survey. Total food consumption and the millet/rice issue are then discussed; the results of the dietary survey, in terms of caloric and protein intake among various income groups, and the findings of the anthropometric study complete the discussion.

5.1. General Comments

Each sampled household was surveyed over three days according to the process described in Part II. By way of general introduction let us point out that the common fare is not plentiful; indeed some families are patently eating much less than the average, but overall, most households manage to consume a variety of nourishing foods. For the majority of families, breakfast consists of the previous night's dinner leftovers, most often millet couscous with sauce and sometimes cowpeas. A few affluent families occasionally have coffee spiced up with Diar (Xylopia aethiopica), and wheat bread. At any rate, breakfast is not a major meal.

Except during Ramadan, when only small children and some women eat lunch, the whole family gathers for a traditional millet or rice dish around midday. Common millet dishes consumed at lunch consist of steamed or cooked grain more or less finely ground and sifted according to whether millet is eaten as Tiere (fine flour for couscous), Lakh (millet semolina), or Sankhle (coarse porridge), complemented by a sauce made of peanuts, ground leaves and other condiments, sometimes with cowpeas. Lakh is also often served with curdled milk, occasionally with sugar as well. Rice dishes served at lunchtime are almost invariably made with fresh vegetables especially onions, smoked fish (ketiakh) and a lot of oil, about one liter for three to four kilograms of rice.

Dinner almost always consists of millet couscous and is eaten rather late, often after dusk. During Ramadan, people may have two late evening meals, one of which is naturally quite substantial. All surveyed households emphatically stated that the

lunchtime rice dish is never served at night, and offer two reasons for this. Firstly, they stated such rice dishes, although prized, are not so readily digestible as millet -- probably due to the high quantity of oil cooked with the rice. Secondly, the same rice dish does not keep so well overnight as millet, preempting the use of rice leftovers for breakfast.

In addition to the three principal meals, many people consume various foods during the day. The traditional, very strong tea consumed almost uniquely by men is taken with a lot of sugar. At the time of this survey, peanuts and mangoes were consumed in each village, mainly by women and children, respectively. Since the dietary survey included only food consumed at meals, its results must be viewed as being on the low side.

The issue of nutritional taboos also merits attention, especially as they are said to apply primarily to pregnant women and to children. Although this study did not include systematic direct enquiry into the question of taboos, both observation and information provided by some villagers did not reveal strong nutritional interdicts. In this respect, one should refer to the recent SONED (1981) report on twenty-four villages in the same area of the country. During their July 1979 survey, SONED researchers looking specifically into the question of nutritional taboos concluded there were few, and at any rate varied very much from one group or village to the next, adding up to quite contradictory evidence (SONED, pp. 115-116).

We conclude this subsection of general comments on food consumption by returning to two points previously mentioned: respondent bias, and the effect of Ramadan on food consumption.

Simple statistical analysis showed a very consistent trend across households and villages: the total amount of food prepared declined 10 percent from the first to the second day, and 10 percent again from the second to third day. There is thus little doubt that most households consumed nonrepresentative meals on the first two days of the survey. We can only assume that at this difficult time of year the bias had, on the average, disappeared by the third day. The possible advantage derived from spending more time with each family, however, would have been outweighed by: (a) the cost of losing data given the limited time available, and (b) the risk of introducing other biases into the survey.

In Part II, we broach the problems associated with measuring the nutritional impact of Ramadan. One must keep in mind that the results of this study only provide an assessment of the effect of Ramadan as it occurs in July among farming communities. In this case, there is no statistical evidence that people ate better or

worse during Ramadan. The total quantity of all foods consumed was greater during Ramadan, although not significantly greater in a statistical sense. Univariate, two-sample (t-test) checks were made to test the equality of mean consumption during and out of Ramadan for selected key food items such as millet, rice, sour milk, oil, sugar. Equality of variance was also tested (F-test) for the same items; again, this failed to provide statistical evidence of a difference in food consumption during Ramadan.

5.2. Dietary Survey

We now turn to the question of which food items are consumed by the surveyed population. Table 5.2. shows the relative importance of millet, rice, peanuts, oil, and other food items. Rice constitutes 13.3 percent of total grain consumed; note that peanuts play a major role, even after two bad years, and at a time when peanut seed is scarce. As many nutritionists have shown, peanuts, rich in vitamins and minerals, provide lysine, a limiting amino acid in both millet and rice (Warrack-Goldman, 1978). Sour milk, smoked fish and cowpeas add to the protein provided by peanuts, while the grains' calories are complemented by oil and sugar.

Other food items appear often, but in small quantities, and contribute vitamins and variety to the basic grain, peanut, milk, oil and smoked/dried fish diet (see Table 5.2.).

However interesting global information may be, one naturally wonders whether the intervillage differences in production patterns and agricultural output lead to differences in food consumption. As we look at key items we find that indeed, sharp differences exist:

TABLE 5.1.

TOTAL CONSUMPTION OF MAJOR FOOD ITEMS, BY VILLAGE
(in Kg)

	LAYABE	SESSENE	THIENTHIE
Millet	220	435	101
Rice	67	8	45
Peanuts	33	34	24
Curdled Milk	6	33.5	3.3
Oil	15	1	9.2
Smoked Fish	14	3.9	7.5

TABLE 5 2.

TOTAL QUANTITY OF FOOD ITEMS RECORDED DURING MEAL PREPARATION: ALL VILLAGES, MAY-AUGUST 1981 (in Kg)

Millet[a]	767.3
Rice	119.5
Peanuts	91.5
Curdled Milk	44.5
Smoked Fish	25.5
Peanut Oil	25.3
Salt	20.7
Sugar	17.3
Cowpeas	16.0
Onions	16.0
Fresh Tomatoes	6.6
Dried fish	5.6
Guinea Sorrel	4.6
Amaranth	4.5
Hot Pepper	3.5
Chicken	2.8
Peanut Cake	1.9
Tomato Paste	1.6
Cabbage	1.4
Wheat Flour	1.3
Beef	1.1
Fresh Fish	1.0
Baobab fruit	.9
Leptadenia	.9
Maggi Cubes	.8
Fresh Mango	.8
Black Pepper	.4
Fresh Milk	.4
Laurel	.6
Tamarin leaves	.3
Eggplant	.3
Sweet pepper	.2
Diar	.2

NOTE: (a) Millet:

Tiere	491.0 Kg
Lakh	216.6 Kg
Sankhle	59.7 Kg
	767.3 Kg

Not surprisingly, the ranking in quantity and nutritional value of food consumed by village corresponds to their respective rankings in food production and total (farm and nonfarm) village income. Sessene's considerable advantage in curdled milk consumption is due to the presence of cattle among Serer households, but rice purchases and consumption are lowest in Sessene, the village with the highest farm income (see Table 4.16.). Yet, rice is by no means an inferior good; conversely, one would expect the Thienthie cereal deficit to be made up by purchases with a higher rice/millet ratio than observed.

5.3. The Rice/Millet Issue

The observed differences in rice consumption and purchases among the three villages are at the crux of the important rice/millet issue in rural Senegal. In this case, the village with the highest total income bought and consumed the least amount of rice, while the poorest village consumed both the lowest total amount of grain (millet and rice), and the highest proportion of rice in total grain. Intravillage differences in millet production and rice consumption exist, but they are not so large as to invalidate the differences among villages. Before we examine these, however, let us summarize for convenience the major specific attributes of millet and rice.

Millet is produced locally, people are accustomed to it, and it is more nourishing than rice. Although it stores very well on the whole or split panicle (storage losses are estimated at 2-5 percent per year; see SONED, 1981), it does not keep as well as grain, and does not keep at all once it is ground into meal or flour. This requires that each day's supply be pounded by women or otherwise processed.

Rice, on the contrary, is not grown in the area and is less nourishing than millet; but it keeps well in grain form and does not require long and tiring processing before it is cooked. Furthermore, it provides variety to the diet. On the other hand, depending on the season, rice is two or three times as expensive as millet, and its cost is further increased by the large quantity of oil called for in the usual preparation. For instance, at 243 CFA francs per liter of oil, the effective cost of a kilogram of rice is brought from 90 francs up to about 150 CFA francs, compared to 50 CFA francs or so for millet. Finally, we note that rather small quantities of millet were found on rural markets, while rice was readily available.

Consider the selected data for the three villages summarized in Table 5.3.

TABLE 5.3.

MILLET/RICE SUMMARY STATISTICS, BY VILLAGE

	LAYABE (24 Households)	SESSENE (24 Households)	THIENTHIE (24 Households)
Millet Harvest (Fall 1980)	49 tons	68 tons	10 tons
Millet Sales (up to Survey)	4,240 kg	1,063 kg	-0-
Sales as % of Production	8.6%	1.5%	-0-
May 17-August 15,1981			
Total Millet Consumption, per Household	220 kg	435 kg	101 kg[a]
Total Rice Consumption, per Household	67 kg	8 kg	45 kg
Total Grain Consumption per Household	287 kg	461 kg	146 kg
Average Consumption Per Capita/Day:			
Millet	.312 kg	.54 kg	.155 kg
Rice	.095 kg	--	.07 kg
Total Grain	.407 kg	.55 kg	.224 kg

NOTE: (a) About half of which is purchased.

The households surveyed in Sessene produced more millet than they would normally use in a year (28 percent more than a year's supply, assuming 200 kg per person annually). Very little millet was sold, at least until mid-August; since Sessene families already had the highest total (farm and nonfarm) incomes, they had little need to sell any millet. Over the duration of the survey, almost no rice was either bought or consumed.

In Layabe, the millet harvested by 24 families, adding up to 235 persons, amounted to 49 tons. The amount sold by the various households amounted to about 4.24 tons, or nearly 9 percent of total harvested, leaving an average 191 kg per person for home consumption. We hypothesize that people in Layabe did not sell any more millet because other sources of income -- especially nonfarm income, highest of all three villages -- allowed them to conserve the main food staple. Per capita rice

consumption is highest in Layabe, though still less than one-third of millet consumption.

The 217 persons comprising the families surveyed in Thienthie harvested only ten tons of millet, barely enough to provide for one-third of a year's consumption. We have seen that people in Thienthie apparently reacted to this shortfall by a combination of outmigration for wage earning, and massive dis-saving (in no way can the sale of ten horses by twenty-four families in one year be regarded as typical). Nonfarm income did not improve the situation very much; it was the lowest of all three villages in absolute terms. As a consequence, total grain consumption was lowest in Thienthie: half of what it was in Layabe, and about one-third of the Sessene level. Considering that rice cost over twice as much as millet, one would expect that Thienthie's grain deficit would be made up almost entirely through millet purchases and yet, 45 percent of all grain consumed in Thienthie was rice. As far as we can see, Thienthie families would have liked to purchase more millet than they did but could not, and therefore shifted to readily available (though much more expensive) rice. The reason, in turn, why they cannot buy as much millet as they would like to is that: (a) Thienthie's own millet production did not allow for marketable surplus, and (b) after two bad years, even more successful villages are not keen on large millet sales. They can generate income through many other activities, e.g. peanuts, but also (and mostly) large and small ruminants, poultry, and all nonfarm activities.

The most instructive way of looking at the rice/millet issue is to find out how per capita rice, millet, and total grain consumption vary over the various levels of per capita real family income in the surveyed population.

Rice, millet and total grain consumption data are derived directly from the food consumption survey carried out in each sample family; grain consumption is expressed in terms of kg per capita per year. Real household income consists of the value of family millet and peanut production, farm sales, and nonfarm income. To translate everything to a per capita basis, a factor of 1 was given to men, .75 to women and .5 to children. Ordinary least-squares regression estimates of millet consumption as a function of real family income yielded the following equation:

$$\text{Millet consumption/cap.} = \underset{(3.5)}{63.25} + \underset{(8.16)}{.0064}\ \text{Income/cap.}$$

$R^2 = .6428$ $\qquad$ $F = 66.58$

t-values are in parentheses.

This equation indicates that millet consumption, expressed in kg per capita per year, increases linearly as income, in CFA Francs per annum, rises. In fact, per capita millet consumption is estimated to increase by 64 kg yearly for each 10,000 CFA per capita income rise.

At the overall arithmetic mean for income, 14,439 CFA/capita, the estimated per capita millet consumption reaches 155.6 kg/yr. High and low income strata means equal 25,896 and 5,277 CFA Francs, respectively, implying per capita millet consumption levels of 97 kg and 229 kg for each stratum. Finally, the elasticity of millet consumption with respect to income equals .594 at the overall mean income, implying that a 10 percent change in income would lead to a 6 percent change in millet consumption.

Rice consumption increases as income rises, but at a much slower rate than in the case of millet, over this range of per capita incomes:

$$\text{Rice consumption/cap.} = \underset{(7.55)}{37.5} + \underset{(4.22)}{.00091}\ \text{Income/cap.}$$

$R^2 = .3254$ $\qquad$ $F = 17.8$

Rice consumption per capita is estimated to increase by about 9 kg for each 10,000 CFA per capita income rise. At the income means defined above for the sample as a whole, and for low as well as high income strata, per capita rice consumption is estimated to be:

5,277 CFA	42.3 kg
14,439 CFA	50.6 kg
25,896 CFA	61.0 kg

The elasticity of rice consumption with respect to income at the mean level of per capita income is calculated as:

$$\frac{dR}{dy} \times \frac{y}{c} : (.00091) \times \frac{14{,}439}{50.6} = .26$$

A 10 percent change in income in the neighborhood of the mean would, therefore, lead to a 2.6 percent change in rice consumption.

Finally, the estimated total grain consumption (millet plus rice) as a function of real family income is expressed as:

$$\text{Total Grain consumption/cap.} = \underset{(5.3)}{100.76} + \underset{(8.96)}{.0073}\ \text{Income}$$

$R^2 = .6844$ $\qquad$ $F = 80.25$

Total grain consumption is, therefore, estimated to vary by 73 kg/yr for each 10,000 CFA change in per capita income. Estimated levels of total grain consumption at various levels of income are:

5,277 CFA	139.3 kg
14,439 CFA	206.2 kg
25,896 CFA	290.0 kg

An overview of grain consumption as a function of real family income, (which includes the value of millet production), is depicted in Figure 5.1. At the lowest income levels, rice makes up a very high proportion of total grain consumption, but since the rate of increase in millet consumption does not level off at the higher income levels observed, the proportion of rice in total grain falls consistently as income rises. This is representative of a situation where rice is a ready substitute for millet, and where both grains are still very much considered as essential goods at the levels of incomes concerned.

5.4. Caloric/Protein Intake

We now turn to the nutritional findings of the dietary survey. As briefly outlined in Part II, the food items consumed by each household were translated into calories and protein with the coefficients found in Table 5.5. Considering then the recommended daily intakes of nutrients in Africa (Table A7, Appendix I), the average requirement for three main groups, men, women and children, were calculated using age weights from the actual survey sample (see Table A8, Appendix I). The weighted daily requirements are summarized as follows:

TABLE 5.4.

SUMMARY OF WEIGHTED DAILY REQUIREMENTS

	Calories	Protein	Caloric Coefficient	Protein Coefficient
Men	3,000	31.0	1.00	1.00
Women	2,320	27.6	.77	.89
Children	1,941	22.6	.65	.73

For example, if a man, a woman and a child consume 7,261 kilocalories (kcal) in one day, the total number of kilocalories is divided by (1 + .77 + .65 = 2.42), yielding 3,000. Such a group of three exactly meets the daily standard requirement. This method is applied to each household for three days, allowing for change in the composition of the group sharing food from one meal to the next. The arithmetic mean of the three days for each family is taken as a final statistic, yielding a single figure representing the man-day equivalent of caloric and protein intake for direct interfamily comparisons.

FIGURE 5.1.

MILLET, RICE AND TOTAL GRAIN CONSUMPTION AS A FUNCTION OF INCOME

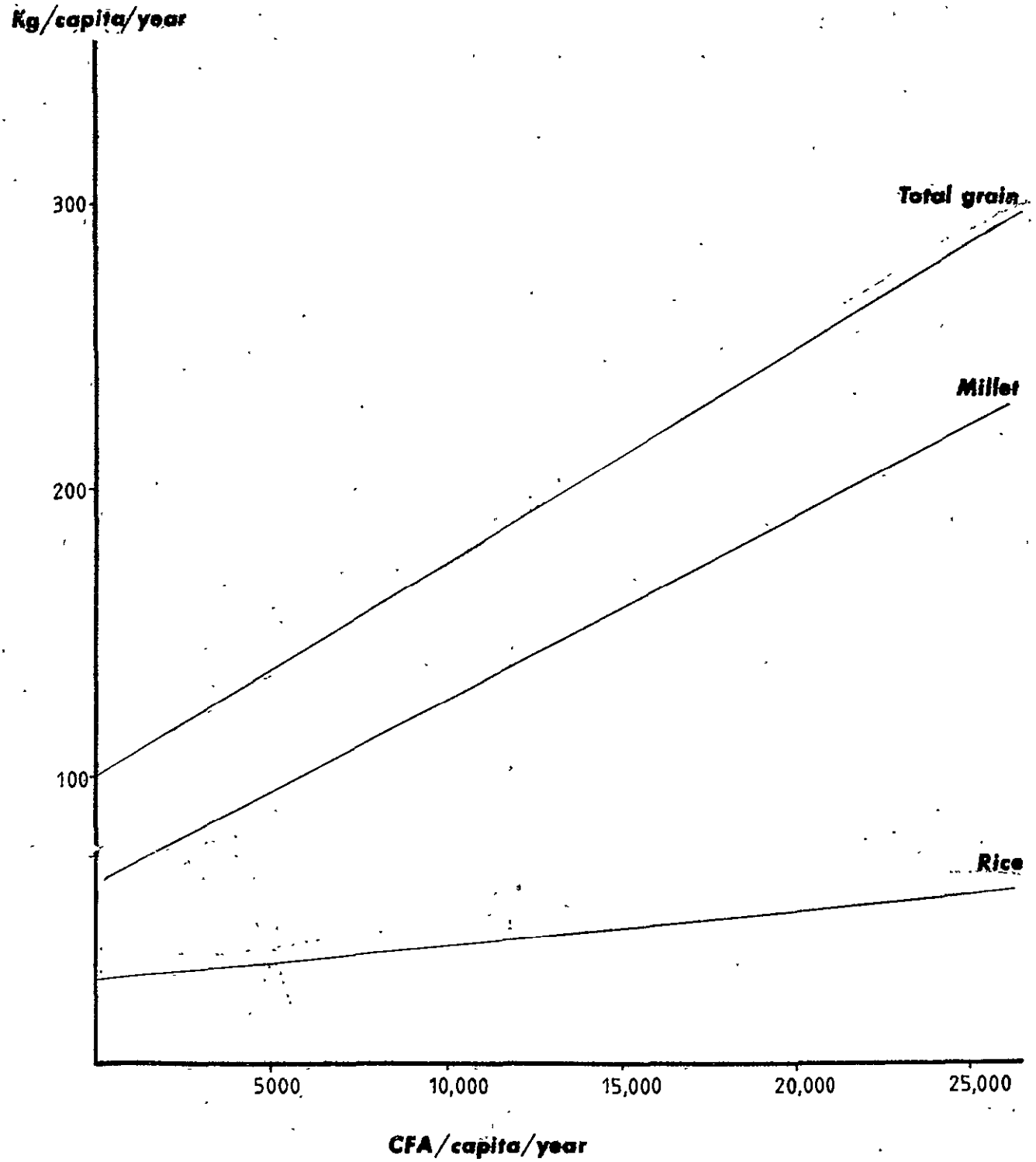


TABLE 5.5.

NUTRITIONAL VALUE OF COMMON FOOD ITEMS

	Kcal.	(per 100 grams) Gr. Protein
I. CEREALS		
Millet Semolina (Lakh)	320	6.7
Millet Couscous (Tiere)	226	5.7
Course Millet mush (Sangle)	320	6.7
Rice	370	6.6
Bread	252	7.9
II. VEGETABLE PROTEIN		
Peanuts & Peanut Cake	592	26.5
Cowpeas (Niebe)	346	23.3
III. ANIMAL PROTEIN		
Beef	122	20.6
Mutton	140	20.0
Goatmeat	140	20.0
Chicken	146	20.5
Eggs	140	11.8
Fresh Fish	100	20.0
Smoked Fish (Ketiakh)	361	63.4
Dried Fish (Guedj)	242	45.8
Fresh Milk	79	3.8
Curdled Milk (Sow)	69	3.8
IV. VEGETABLES AND LEAVES		
Cabbage	32	1.0
Onion	31	.7
Tomato	23	.7
Cherry Tomato	21	1.0
(Diakhatu) Nightshade Family	30	1.6
Guinea Sorrel (Bissap)	44	1.6
Baobab Leaves (Lalo)	279	12.5
Baobab Fruit	280	2.3
Leptadenia Lancifolia (Tiakhat)	55	5.0
Eggplant	32	1.0
Amaranth (Mboum)	30	4.0
Tamarin (Dakhare)	30	4.0
Laurel	30	4.0
Hot Pepper	74	3.3
V. FATS		
Refined Peanut Oil	884	--

TABLE 5.5. (cont.)

NUTRITIONAL VALUE OF COMMON FOOD ITEMS

	Kcal.	(per 100 grams) Gr. Protein
VI. FRUIT		
Mango	60	.7
Papaya	39	.6
Gingerbread Plum *Parinari Macrophylla* (Neou)	141	1.4
Cashew	53	1.0
VII. CONDIMENTS & SPICES		
Sugar	400	--
(Diar) *Xylopia aethiopica*		

NOTE: Latin species names are underlined; names in brackets are local Wolof names.

Let us first look at the general level of caloric and protein intake for the whole sample (Figures 5.2. and 5.3.). Table 5.6. is a distributional analysis interpreted as follows: for PROB = .5, the quantile is such that 50 percent of observations fall below it, and 50 percent above. For instance half of the households consume less than the equivalent of 2,374 kcal per man-day equivalent, while the other half consumes more. For PROB = .7, the implication is that 70 percent of households consume less than 2,697 kcal per man-day equivalent (90 percent of 3,000), while 30 percent of households exceed this level of intake. The confidence intervals for each quantile are calculated on the basis of a 90 percent confidence coefficient.

There seems to be no problem with protein intake; 80 percent of households consuming 155 percent of the required 31 grams. Caloric intake is not as high; half of the households consumed less than 80 percent of the requirement, and only a quarter of all families obtained over 93 percent of the standard. These results are, however, likely to be on the low side for two reasons. Firstly, the standard requirement selected is for a very active man (Latham, 1979, p. 250); any figure between 2,600 and 3,000 kcal could arguably be used. Secondly, the value of food eaten between meals is not included.

The rather good picture painted above for the entire sample does not hold if we look at individual villages. Tables 5.7. and 5.8. show the distributional analysis of caloric and protein intake by village and may be interpreted just as the previous one. For each probability level, the Layabe and Sessene quantiles are very close, but Thienthie's are consistently much lower; for instance, although the daily protein intake is above the minimum requirement, half of Thienthie families consume less than the equivalent of 1,821 kcal per man-day, and half consume more. Similarly, 75 percent of Thienthie households obtain less than the equivalent of 2,297 kcal per man-day, while only 25 percent obtain more. We conclude that the Layabe and Sessene populations cannot unequivocally be classified as undernourished, being rather on the borderline as a group. The families sampled in Thienthie were, on the average, clearly suffering from a serious caloric deficiency between mid-May and mid-August 1981.

However interesting intervillage differences may be, they hide intravillage disparities, and only allow for conclusions specific to Layabe, Sessene and Thienthie but it is possible to link food consumption to indicators applicable anywhere. The most logical choice is to start with indicators of economic well-being and to see how much these influence food consumption, but economic well-being itself is determined by several factors such as farm and nonfarm income, remittances, stocks of food and productive assets. In this study, two main indicators were used: (a) total cash income,

FIGURE 5.2.

CUMULATIVE SAMPLE DISTRIBUTION OF CALORIC INTAKE (Kcal/pers/day), ALL VILLAGES

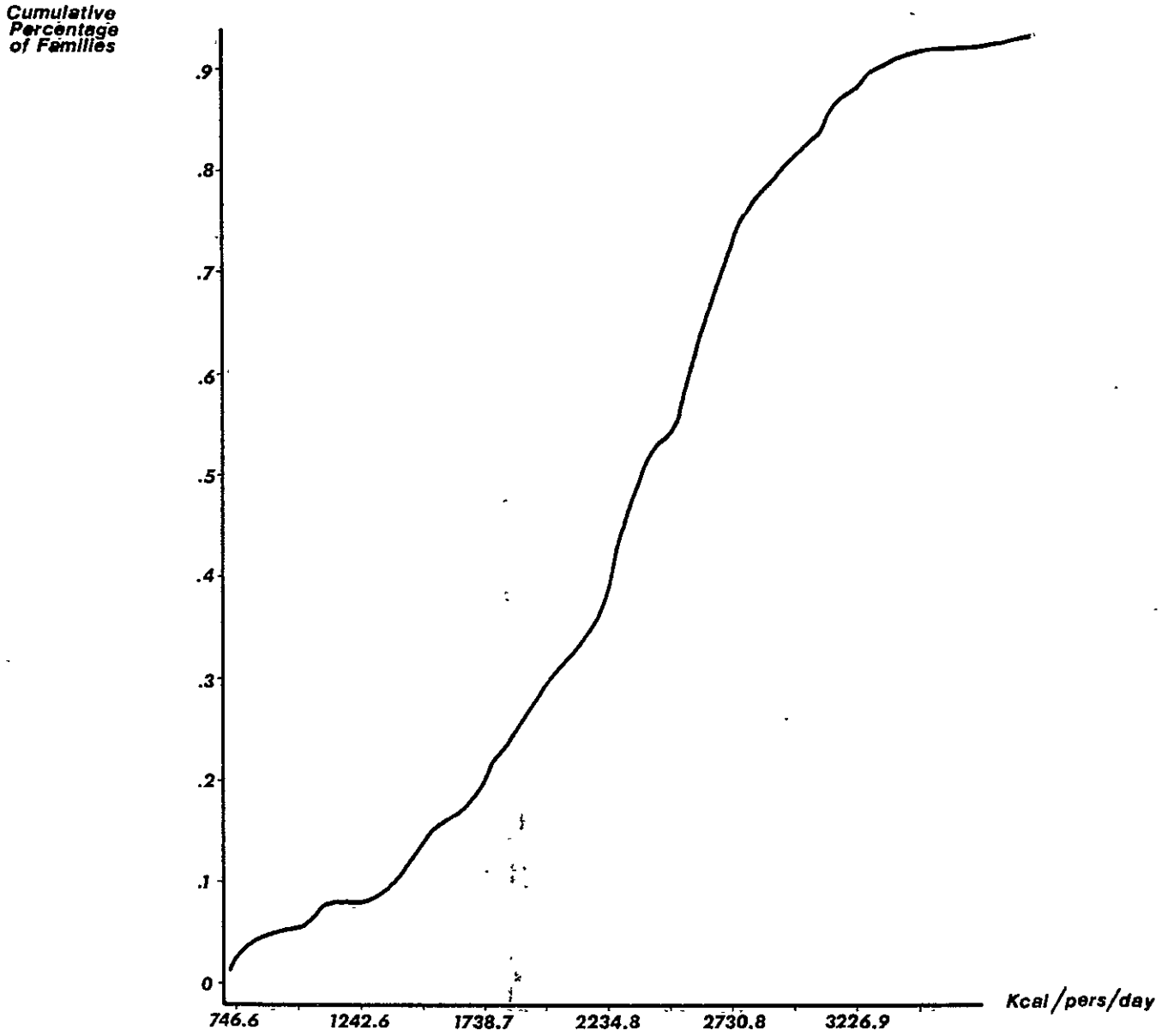


FIGURE 5.3.

CUMULATIVE SAMPLE DISTRIBUTION OF PROTEIN INTAKE (gr/pers/day), ALL VILLAGES

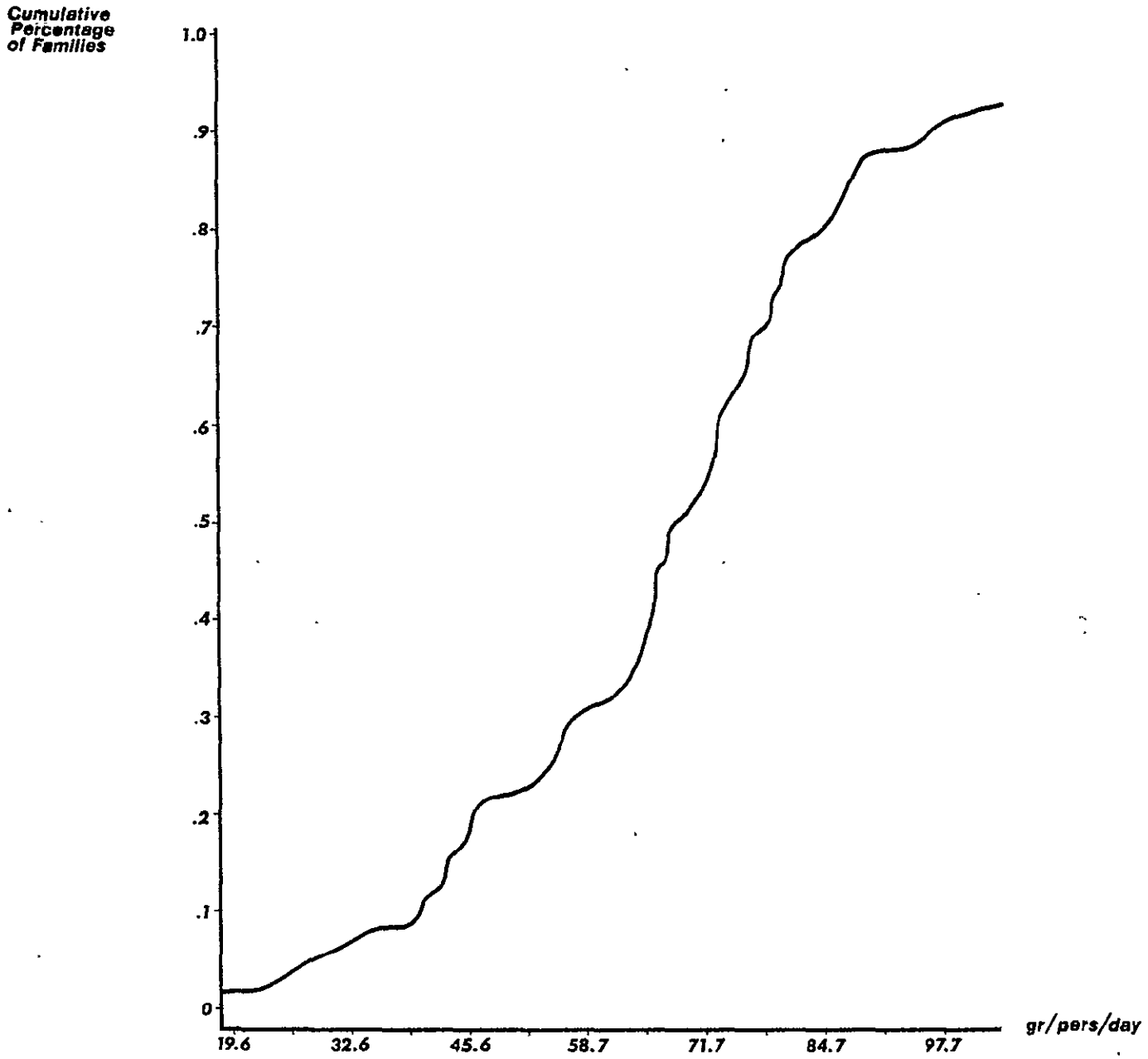


TABLE 5.6.

DISTRIBUTIONAL ANALYSIS OF AVERAGE DAILY CALORIC AND PROTEIN INTAKE, ALL HOUSEHOLDS

PROB	QUANTILE	CONFIDENCE	INTERVAL
I. CALORIES/MAN-EQUIVALENT			
.1000	1408.0	779.2	1656.1
.2000	1740.0	1448.7	1983.1
.3000	1989.0	1740.0	2230.4
.4000	2235.4	1989.0	2374.4
.5000	2374.4	2235.4	2553.1
.6000	2553.1	2374.4	2696.6
.7000	2696.6	2588.1	2926.6
.8000	2926.6	2712.2	3254.0
.9000	3269.0	3109.9	4298.2
II. PROTEIN, GR./MAN/DAY			
.0500	31.094	19.671	39.947
.1000	40.827	26.284	44.673
.1500	43.243	38.798	52.569
.2000	48.254	42.433	56.709
.2500	55.253	44.673	63.301

NOTE: Level of Confidence = .9.

TABLE 5.7.

DISTRIBUTIONAL ANALYSIS OF CALORIC INTAKE
BY VILLAGE

Village	Probability	Quantile (cal/per/day)	Confidence Interval
LAYABE	.25	2,110	1,886 - 2,428
SESSENE	.25	2,302	1,983 - 2,541
THIENTHIE	.25	1,408	1,066 - 1,736
LAYABE	.50	2,521	2,230 - 2,870
SESSENE	.50	2,588	2,374 - 2,748
THIENTHIE	.50	1,821	1,656 - 2,180
LAYABE	.75	3,022	2,712 - 3,716
SESSENE	.75	2,780	2,638 - 3,269
THIENTHIE	.75	2,297	1,989 - 2,922

NOTE: Level of Confidence = .9.

TABLE 5.8.

DISTRIBUTIONAL ANALYSIS OF PROTEIN INTAKE
BY VILLAGE

Village	Probability	Quantile (Gr/per/day)	Confidence Interval
LAYABE	.25	63.6	55.9 - 67.1
SESSENE	.25	63.3	52.6 - 67.0
THIENTHIE	.25	42.9	34.8 - 45.9

NOTE: Level of Confidence = .9.

from agricultural sales and off-farm earnings, and (b) real farm income, defined as the market value of total millet production, farm income (minus the value of millet sales to avoid double-counting), and nonfarm income. Not surprisingly, the two are closely linearly related (R = .9558). Both indicators are very unequally distributed over the survey population at large, as we see from Table 5.9.

TABLE 5.9.

DISTRIBUTION OF TOTAL CASH INCOME AND REAL FAMILY INCOME, ALL HOUSEHOLDS
(CFA Francs per annum)

PROBABILITY	QUANTILE	
	Cash Income	Real Farm Income
.1	4,500	7,900
.2	10,900	16,100
.3	16,100	27,500
.4	22,025	39,950
.5	29,500	63,632
.6	61,575	114,740
.7	99,800	141,450
.8	146,200	211,200
.9	225,760	306,600

Cash income and real family income are closely correlated, but the latter is more complete, and was therefore used to stratify the survey sample. Families from all villages were divided into two strata; those with a yearly real income below 100,000 CFA francs -- about 55 percent of all -- and those with a yearly real income above 100,000 CFA francs -- the remaining 45 percent. The effect of household production upon nutritional status may be seen through the differences in daily caloric intake per man-equivalent between the two strata. Figure 5.4. shows the cumulative distribution of caloric intake by stratum, stratum 1 representing the families with the lower real income, while stratum 2 represents households with higher real incomes. About 80 percent of all families from each stratum consumed less than the selected standard, nevertheless, for any but the lowest ten percent in each group, higher income stratum families consumed a greater amount of calories, up to 500 kilocalories per man-day in some cases (see also Table A9, Appendix I).

The significance of food intake differences between the two income strata (see Figure 3.1.), as measured in terms of caloric intake, can be statistically checked through the chi-square test, a particular form of analysis of variance. The test consists of first setting up several cells of equal size 1000-1499, 1500-1999, 2000-2499, and 2500-3999 kilocalories. With constant size cells, the distribution of the realizations of a stochastic process over the various cells should be rather constant through a sequence of independent trials. If, however, two successive trials represent significantly different processes (a low income vs. a high income group), the distribution of realizations of process 1 (i.e., high income) over the various cells should be significantly different from the distribution of realizations from process 2 (i.e., low income families) over the same cells. Table 5.10. shows the distribution of realizations for four levels of caloric intake (cells), and two income strata.

With 3 degrees of freedom, (r - 1) (c - 1), the chi-square value is significant at the 5 percent level, implying that the proportions of families in each cell vary significantly according to the income strata.

The fact that better-off families eat more than their less successful neighbors is not surprising, especially given the generally low level of food intake among the entire sample. It seems worth noting, however, that significant differences in caloric intake can be identified on the basis of a rather simple stratum variable -- real family income, in this instance -- and of a three-day dietary survey for each household.

We conclude this section by discussing the results of the anthropometric study of the sample population. Table 5.11. shows the distributional analysis of key anthropometric ratios for the most sensitive population group: children of both sexes, age one through fifty-nine months. As mentioned in Part II, anthropometric data are a way to estimate how well a population's growth in weight and length over time fit the growth pattern of a standard population. As such, they tend to reflect trends -- at least over a few years -- rather than temporary conditions.

In this case, the anthropometric data yield two main results: first, only about half of all households have children reaching 80 percent of the standard; and second, no significant difference among the three villages seems to exist. In particular, Thienthie children have overall the same physical characteristics as their counterparts of Layabe and Sessene, implying that over a number of years intervillage disparities in food consumption disappear or cancel out. By the same token, anthropometric measurements fail to highlight any differences among groups of the survey sample stratified by income or value of family production. Note, however, that the variance among families was greater for the lower income groups. This may be due to one or both of

FIGURE 5.4.

COMPARATIVE DISTRIBUTION OF CALORIC INTAKE (Kcal/pers/day), ALL VILLAGES

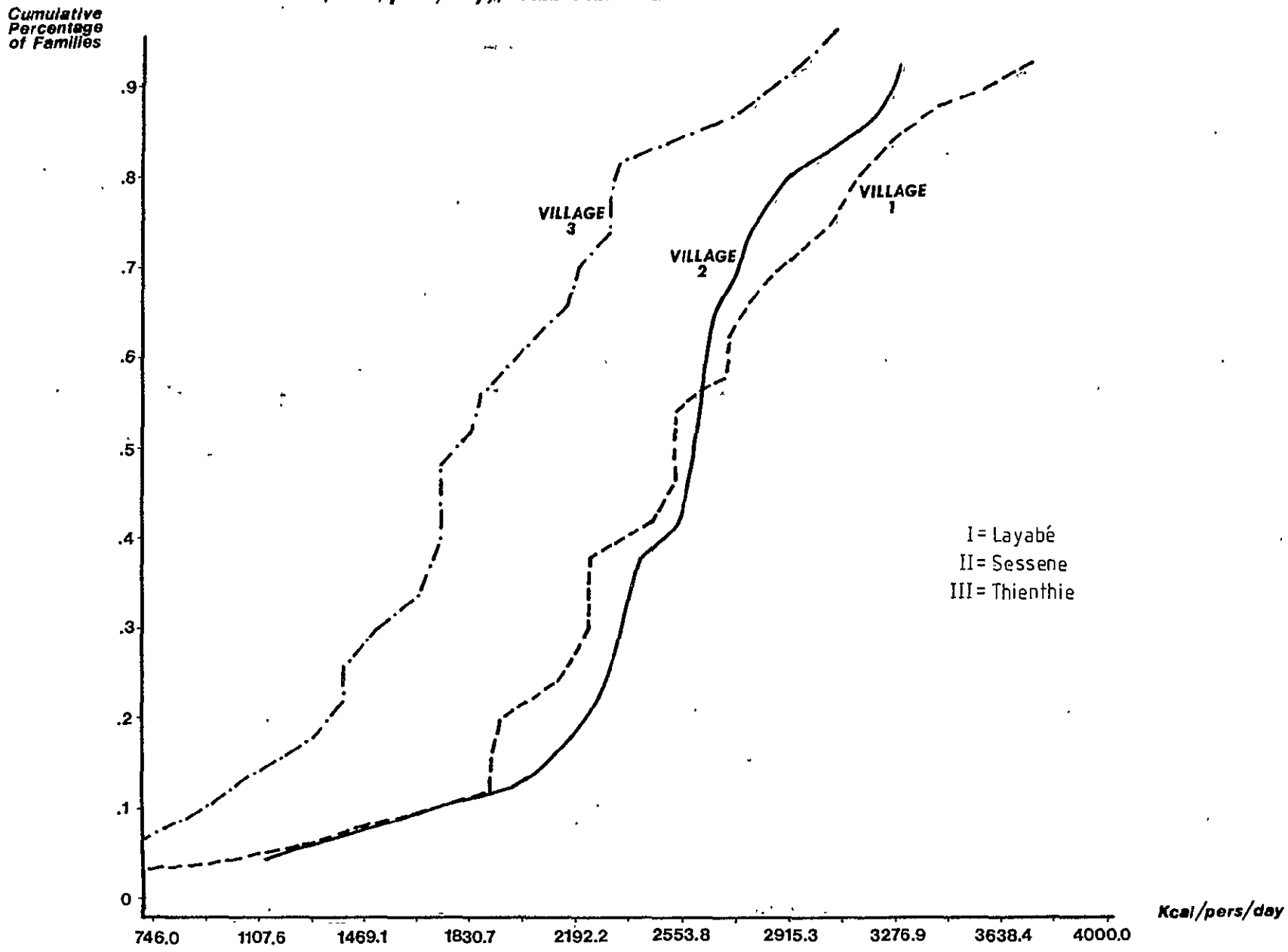


TABLE 5.10.

CHI-SQUARE ANALYSIS OF CALORIC INTAKE,

48 Households

Caloric Intake/Capita

Income Strata	1000-1499	1500-1999	2000-2499	2500-2999	Σ
High	2 (1.98)	2 (4.75)	3 (5.54)	12 (6.73)	19
Low	3 (3.02)	10 (7.25)	11 (8.46)	5 (10.27)	29
Σ	5	12	14	17	48

NOTE: Estimated expected value for all frequencies are in parentheses.

TABLE 5.11.

DISTRIBUTIONAL ANALYSIS OF WEIGHT FOR AGE, LENGTH FOR AGE AND WEIGHT FOR LENGTH, CHILDREN 1 TO 59 MONTHS OLD, BY VILLAGE

	PROB.	QUANTILE[a]	CONFIDENCE INTERVAL
		I. LAYABE	
WFA	.50	.73	
WFA	.80	.91	values > .73[b]
LFA	.50	.52	
LFA	.80	1.03	values > .52
		II. SESSENE	
WFA	.50	.82	.77 - .89
WFA	.80	1.02	.92 - 1.20
LFA	.50	.90	.87 - .95
LFA	.80	.99	.95 - 1.03
		III. THIENTHIE	
WFA	.50	.96	.83 - .89
WFA	.80	1.04	.89 - 1.23
LFA	.50	.90	.86 - .94
LFA	.80	.96	.94 - 1.06

NOTES: (a) A value of 1.0 implies the standard is met (100%).
WFA: Weight for age.
LFA: Length for age.

(b) Due to the limited number of degrees of freedom, there is no statistically significant upper bound on the confidence interval.

Level of confidence = .9.

SOURCE: Stuart and Stevenson, in Latham (1979).

two reasons: a (possible) lack of precision in measurements, or the lack of correlation between parameters determined over the long-term, such as anthropometric status, and a variable which may fluctuate widely from year to year, such as total income or value of family production.

APPENDICES

APPENDIX I. Additional Data
APPENDIX II. Sources and Bibliography
APPENDIX III. Individuals and Institutions Contacted
APPENDIX IV. Glossary of Selected Wolof Terms.

APPENDIX I

ADDITIONAL DATA

TABLE A1

TYPES OF SOILS FOUND IN FIELDS

OF SURVEYED HOUSEHOLDS, BY VILLAGE

(No. and percentage of total)

VILLAGE	SOIL TYPE:DIOR	DEK	DEK-DIOR
LAYABE	113 (72%)	14 (9%)	30 (19%)
SESSENE	97 (69)	16 (11)	28 (20)
THIENTHIE	115 (94)	1	7 (6)

NOTE: Σ No. fields = 421.

TABLE A2

TOTAL AREA DEVOTED TO VARIOUS CROPS,

BY TYPE OF SOIL; ALL VILLAGE

1978-81 (hectares)

1981/82	MILLET	PEANUTS	SORGHUM	COWPEAS	FALLOW
Dior	122.0	88.0			13.8
Dek	15.0	11.2			
Dek-Dior	18.1	21.5			8.4
1980/81					
Dior	136.7	98.5	.7	1.2	
Dek	13.8	12.7	1.3		
Dek-Dior	32.8	16.3		.7	
1979/80					
Dior	99.4	114.0		.4	15.8
Dek	15.0	12.0			
Dek-Dior	16.3	31.2			
1978/79					
Dior	125.6	95.0	.7		8.3
Dek	10.2	12.3	1.0	.6	2.9
Dek-Dior	30.2	16.3			1.0

NOTE : No. of fields in sample; 1981/82 = 396
1980/81 = 417
1979/80 = 405
1978/79 = 405

TABLE A3

LABOR TIME ALLOCATION TO MILLET

BY SEASON AND ACTIVITY, 1980-81

SEASON	ACTIVITY	RANGE OF MAN-DAYS	PERCENT OF HOUSEHOLDS FALLING WITHIN RANGE
NOR	Gathering stalks	1 to 6	66%
	Spreading manure	2	60%
TIORON	Field cleaning	1 to 18	86%
	Sowing	1 to 16	98%
NAVET	First weeding	1.5 to 12.5	78%
	Second weeding	4 to 24	93%
	Third weeding	3 to 17.5	98%
	Last weedings	10 to 23	80%
	Harvest	2 to 34	74%
LOLLY	Transport	.5 to 3.2	84%
	Threshing	0 to 2	75%
	Storage	1 to 8	94%

TABLE A4

LABOR TIME ALLOCATION TO PEANUTS,

BY SEASON AND ACTIVITY, 1980-81.

SEASON	ACTIVITY	RANGE OF MAN-DAYS	PERCENT OF HOUSEHOLDS FALLING WITHIN RANGE
NOR	--	--	--
TIORON	Field clearing	3 - 27	95%
	Seed shelling	15 - 20	50%
NAVET	Sowing	6 - 15	70%
	Radu[a]	6 - 12	83%
	First weeding	4 - 12	66%
	Second weeding	4 - 16	74%
	Third weeding	4 - 12	69%
	Last weedings	1.5 - 14	61%
	Harvest	22.5 - 40	75%
LOLLY	Transport	.5 - 2	72%
	Threshing	1 - 10	86%
	Winnowing	3 - 9	70%

NOTE: (a) Radu: going lightly over a peanut field about three days after sowing.

TABLE A5

SEASONAL ALLOCATION OF TOTAL LABOR

BY CROP (days)

Seasons		PEANUTS (Days)	days/ha	MILLET (Days)	days/ha
I.	NOR	70.5	(.5)	260.0	(1.3)
II.	TIORON	2,260.5	(16.2)	1,756.0	(9.1)
III.	NAVET	6,468.0	(46.4)	7,472.0	(38.7)
IV.	LOLLY	2,350.3	(16.9)	1,287.6	(6.7)
	TOTAL FOR YEAR	11,149.3	80.0 d/ha	10,775.6	55.8 d/ha

TABLE A6

AVERAGE RECORDED UNIT PRICES

FOR FOOD PURCHASES[a], ALL VILLAGES

(CFA FRANCS)

ITEM	PRICE	UNIT
Sugar	244	kg
Rice	90	kg
Smoked Fish (Ketiakh)	81	?
Salt	28	kg
Onions	80	kg
Oil	243	liter
Bread	68	loaf
Fresh Tomatoes	91	kg
Millet	52	kg
Coffee	560	kg
Maggi Cubes	11	unit
Tomato Paste	42	scoop
Dried Fish	113	unit
Niebe (cowpeas)	116	kg
Fresh Fish	283	kg
Beef	372	kg
Cabbage	76	kg
Lalo	500	kg (?)

NOTE: (a) Ranked in descending order of purchase frequency.

TABLE A7

RECOMMENDED DAILY INTAKES OF NUTRIENTS IN AFRICA

		Calories	Protein (gr)
Adult Men		3,000	31
Adult Women		2,200	24
Prégnant	(+350)	2,550	33
Lactating	(+550)	2,750	41
Children	0-1	820	14
	1-3	1,360	16
	4-6	1,830	20
	7-9	2,190	25
Boys	10-12	2,600	30
	13-15	2,450	30
Girls	10-12	2,350	29
	13-15	2,120	29

SOURCE: Latham, Human Nutrition in Africa, FAO, 1979.

TABLE A8

WEIGHTED AVERAGES OF DAILY NUTRITIONAL REQUIREMENTS

IN CALORIES AND PROTEIN

Women

Total Adult: 233
Pregnant 11 (4.7%)
Lactating 44 (18.9%)
Others 178 (76.4%)

Weighted Requirement (calories)
.764 x 2,200 + .189 x 2,750 + .047 x 2,550 = 2,320.4/day

Weighted Requirements (protein)
.764 x 24 + .189 x 41 + .047 x 33 = 27.6 gr/day

Ages 1-15: Children (calories)

.243 x 1,360 + .276 x 1,830 + .208 x 2,190 + .078 x 2,600 + .091 x 2,350 + .0617 x 2,450 + .039 x 2,120 = 1,941.5 cal/day

Children (protein)

.243 x 16 + .276 x 20 + .208 x 25 + .078 x 30 + .091 x 29 + .0617 x 30 + .039 x 29 = 22.57 gr/day

NOTE: Age groups are weighted according to the age distribution of the surveyed population; n = 720.

TABLE A9

CUMULATIVE DISTRIBUTION OF FAMILY
CALORIC INTAKE, BY STRATUM
ALL HOUSEHOLDS

PROB.	STRATUM 1 QUANTILE	STRATUM 2 (Richer) QUANTILE (Kcal/man/day)
.1000	1066.4	1885.8
.2000	1656.1	2235.4
.3000	1820.8	2513.5
.4000	1989.0	2532.2
.5000	2221.7	2588.1
.6000	2297.8	2677.1
.7000	2589.9	2780.1
.8000	2922.3	3109.9
.9000	3406.8	3269.0

NOTE: For instance, while 40 percent of families in Stratum 1 receive less than the equivalent of 1989 Kcal/man/day, and 60 percent receive more, 40 percent of families in Stratum 2 (richer) receive less than the equivalent of 2532 Kcal/man/day, while 60 percent received more.

TABLE A10

CUMULATIVE DISTRIBUTION OF SELECTED ANTHROPOMETRIC INDICATORS, ALL HOUSEHOLDS

PROBABILITY	WEIGHT FOR AGE QUANTILE	LENGTH FOR AGE QUANTILE	WEIGHT FOR LENGTH QUANTILE
.1	.60	.33	.71
.2	.68	.51	.78
.3	.76	.72	.81
.4	.79	.86	.86
.5	.83	.90	.88
.6	.87	.93	.92
.7	.91	.95	.96
.8	.96	.96	1.07
.9	1.00	.97	1.18

NOTE: A quantile of 1 implies the corresponding proportion of sampled children entirely satisfies the standard ratio.

TABLE A11

ANNUAL NONFARM NET INCOME
BY ACTIVITY/VILLAGE
(CFA FRANCS)

SEASON	ACTIVITY	LAYABE	SESSENE	THIENTHIE
I	Shopkeeper	10,452		91,080
II		10,452		91,080
III		10,452		90,000
IV		10,452		90,000
Total & No. Involved		41,808 (1)	(0)	362,160 (3)
I	Petty Trader	126,200	30,000	27,600
II		124,500	30,000	29,400
III		143,700	-0-	-0-
IV		235,800	30,000	1,200
Total & No. Involved		630,200 (9)	90,000 (1)	58,200 (4)
I	Tailor	52,800		
II		52,800		
III		52,800		
IV		52,800		
Total & No. Involved		211,200 (2)	(0)	(0)
I	Stockman		120,290	
II			120,290	
III			117,290	
IV			117,290	
Total & No. Involved		(0)	475,160 (13)	(0)
I	Artisan	351,200		-0-
II		448,800		3,000
III		260,400		-0-
IV		428,400		-0-
Total & No. Involved		1,488,800 (24)	(0)	3,000(1)
I	Employee (Gov't)		69,012	
II			47,592	
III			47,592	
IV			47,592	
Total & No. Involved		(0)	211,788 (4)	(0)
I	Merchant	12,000		7,200
II		12,000		-0-
III		12,000		
IV		14,000		7,200
Total & No. Involved		50,000 (2)	(0)	14,400 (2)
	TOTAL	2,422,008 (38)	776,948 (18)	437,760 (10)

TABLE A12

REGRESSION EQUATIONS

Least Squares Regression

ANALYSIS OF VARIANCE OF 25.KGMILCA N = 39 OUT OF 72

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	1	.51372 +6	.51372 +6	66.578	.0000
ERROR	37	.28549 +6	7716.0		
TOTAL	38	.79921 +6			
MULT R = .80174	R-SQR = .64278	SE = 87.841			

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		63.251	18.055	3.5032	.0012
INCAP	.80174	.63967 -2	.78395 -3	8.1596	.0000

Least Squares Regression

ANALYSIS OF VARIANCE OF 2613.KGRICAP N = 39 OUT OF 72

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	1	10415.	10415.	17.847	.0001
ERROR	37	21593.	583.58		
TOTAL	38	32008.			
MULT R = .57004	R-SQR = .32540	SE = 24.157			

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		37.512	4.9654	7.5547	.0000
INCAP	.57044	.91082 -3	.21560 -3	4.2246	.0001

Least Squares Regression

ANALYSIS OF VARIANCE OF 39.KGGRCAP N = 39 OUT OF 72

SOURCE	DF	SUM SQRS	MEAN SQR	F-STAT	SIGNIF
REGRESSION	1	.67043 +6	.67043 +6	80.247	.0000
ERROR	37	.30912 +6	8354.5		
TOTAL	38	.97955 +6			
MULT R = .82730	R-SQR = .68443	SE = 91.403			

VARIABLE	PARTIAL	COEFF	STD ERROR	T-STAT	SIGNIF
CONSTANT		100.76	18.787	5.3634	.0000
INCAP	.82730	.73075 -2	.81575 -3	8.9581	.0000

TABLE A13

PEANUT ACREAGE, PRODUCTION AND YIELDS
1960/61 - 1980/81

	Acreage (1000 ha)	Production (1000 tons)	Yield (kg/ha)
1960/61	977	892	913
1961/62	1,026	995	969
1963	1,015	914	900
1964	1,084	952	878
1965	1,055	1,019	966
1966	1,114	1,121	1,007
1967	1,114	857	769
1968	1,164	1,005	864
1969	1,191	830	697
1970	953	789	828
1971	1,049	583	556
1972	1,060	989	932
1973	1,071	570	532
1974	1,026	675	658
1975	1,052	980	932
1976	1,203	1,412	1,174
1977	1,347	1,208	897
1978	1,113	519	466
1979		1,053	
1979/80		650	
1980/81		530	

SOURCES: CRED, 1977 and BCEAO, 1982.

TABLE A14

ACREAGE FOR SELECTED CROPS
1968/69 - 1976/77
(1,000 hectares)

	Peanuts	Millet (Sorghum)	Rice	Maize	Cotton	Total
1968/69	1,191.0	1,053.7	77.5	36.3	6.7	2,365.2
1970	993.1	1,037.3	104.3	55.4	9.8	2,199.9
1971	1,000.0	972.2	93.3	50.6	13.9	2,130.0
1972	1,060.3	974.6	83.7	48.9	18.3	2.185.8
1973	1,071.4	936.3	50.3	32.3	20.4	2,110.7
1974	1,026.2	1,093.5	64.6	39.2	28.6	2,252.1
1975	1,152.1	1,155.1	85.6	48.6	38.6	2,480.0
1976	1,017.0	900.0	80.0	48.0	43.0	2,088.0
1976/77	1,330.0	952.0	81.2	47.4	43.8	2,454.4

SOURCES: BCEAO, 1981 and CRED, 1977.

TABLE A15

OFFICIAL PRODUCER PRICES
1960/82
(CFA/kg)

	Peanuts	Millet	Rice
1960/65 Average	21.0	15.6	19.0
1965/66	21.0	16.0	21.0
1966/67	21.0	17.0	21.0
1967/68	18.0	17.5	21.0
1968/69	18.0	17.5	21.0
1970	18.0	17.5	21.0
1971	19.0	17.5	21.0
1972	23.0	17.5	21.0
1973	23.0	17.5	25.0
1974	26.0	26.0	25.0
1975	41.5	30.0	41.5
1976	41.5	30.0	41.5
1977	41.5	35.0	41.5
1978	41.5	35/40	41.5
1979	41.5	40.0	41.5
1979/80	45.5	40.0	41.5
1980/81	50.0	40.0	41.5
1981/82	60.0	50.0	51.5

SOURCE: CRED, 1977; BCEAO, various years.

APPENDIX II

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APPENDIX III

INSTITUTIONS AND INDIVIDUALS CONTACTED

- Banque Nationale de Développement du Senegal (BNDS);
  Mr. Malick Fall.
- Commissariat à l'Aide Alimentaire (CAA);
  Mr. Ibrahima Sy.
- Centre National de Recherche Agricole (CNRA);
  Mr. Mbodj, Directeur,
  Mr. Moussa Fall, etudes socio-economiques,
  Mr. Diouf.
- Ecole Nationale d'Economie Appliquée (ENEA);
  Mr. Cheikh Tidjan Sy, Directeur.
- Institut Sénégalais de Recherches Agricoles (ISRA);
  Dr. P. Thiongane, Directeur-General.
- Institut de Technologie Alimentaire (ITA);
  Mme. Basse, Directrice,
  Mr. Yamar Guaye, technicien expert.
- Ministère du Plan;
  Mr. M. Sow, Directeur de Cabinet,
  Mr. Abdoulaye Mor Diaye.
- Office de la Recherche sur l'Alimentation et la Nutrition en Afrique (ORANA);
  Dr. Ndiaye, Directeur-General,
  Mr. Chevassus-Agnes, expert.
  Mr. Le Francois, chercheur.
- Société de Développement et de Vulgarisation Agricole (SODEVA);
  Mr. Ali Gueye, Directeur de l'Agence Diourbel,
  Mr. Mbaye N'Diaye.
- Société Nationale des Etudes de Développement (SONED);
  Mr. Thiaw, Directeur-General,
  Mr. Samba Gueye.
- Agency for International Development (USAID);
  Dr. David Shear, Director,
  Mr. Melvin McCaw, Deputy Director,

Mr. John Balis, Agriculture Officer

Mr. Donald Brown, Agriculture Officer

Mr. Sam Rea, Program Officer,

Mrs. Linda Worthington, Nutrition and Public Relations,

Dr. Michael White

- World Bank/Ministere de la Sante

  Ms. Tonia Marek

Documentation Centers Consulted

- ENEA, Dakar
- SONED, Dakar
- ORSTOM, Dakar
- ORANA, Dakar
- USAID, Dakar
- CNRA, Bambey

APPENDIX IV

GLOSSARY OF SELECTED WOLOF TERMS

Cheikh	Spiritual Moslem leader
Dek	Compact soil type
Diar	Xylopia Aethiopica
Dior	Light, sandy soil type
Firdu	Same as Navetane, from the Casamance Region
Khalife	Highest Moslem leaders, chiefs of brotherhoods or of important Moslem lineage
Lakh	Millet porridge
Lalo	Dried ground Baobab leaves
Lolly	Cold season, November - end January
Murid	Wolof Moslem brotherhood founded by Amadou Bamba
Nadante	(or Dimboli) Common work done on a reciprocal basis
Navet	Rainy season July - end October
Navetane	Worker hired for agricultural tasks during the rainy season
Nor	Cool season, February through April
Radu	Going lightly over a newly planted peanut field
Sankhle	Coarsely ground millet meal (also SANGLE)
Santaane	Common work done by convocation
Serigne	Moslem notable
Taalibe	Murid Disciple of a Cheikh
Tidjan	Moslem Wolof brotherhood founded by El Hadj Malick Sy
Tiere	Fine millet flour, steamed
Tioron	Dry hot season, end April - end June

CONSUMPTION EFFECTS ON AGRICULTURAL POLICIES

PART II.

ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

edited by
Edgar J. Ariza-Niño

Center for Research on Economic Development
University of Michigan
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CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES:
PART II. ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

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CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

CHAPTER 1
INTRODUCTION

by
Edgar J. Ariza-Niño

Center for Research on Economic Development
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CHAPTER 1

INTRODUCTION

Organization of Part II

Part II presents the analytical methods and field survey techniques developed in the course of this project. The field survey techniques were fully implemented and experience with them is discussed. Data gathered under this project was sufficient to implement some of the analytical methods presented here. Other methods are illustrated with relevant secondary data collected by others.

The first section (Chapters 2-6) present the analytical methods. Two alternative general methodological approaches were developed at CRED for this project, one based on a linear programming farm planning model, another using consumption and production elasticities to derive price effects on farmers' nutrient intakes. Each one of these methods is introduced with a practical illustration of how it is used, followed by a theoretical formulation of how it might be generalized to real life situations.

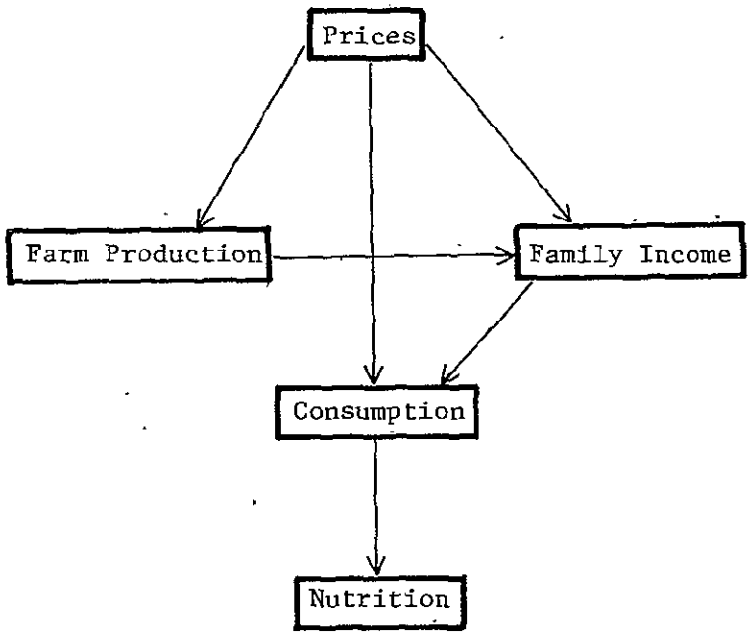
The second section (Chapters 7-9) describes in great detail the type of data collected, the procedures followed in the survey, and the special considerations encountered in the processing of food consumption data among farming households. Each country study is treated separately, in self-contained chapters, in order to maintain narrative continuity, but comparisons between the two can be readily made. Complete sets of questionnaires, designed for both Cameroon and Senegal studies, are also included in Appendix I and II, respectively. Finally, the procedure that made possible the measurement in place of farm plot areas is described step-by-step, including the hand-held calculator programs employed in area computation.

Functional Relationships

The flowchart in Figure 1A is designed to illustrate the interrelationships among the principal variables of interest. The overall aim is to represent how changes in prices of food or farm products affect food consumption and nutrition of farmers. Nutrition is defined here narrowly and entirely as the nutrient equivalent of food consumption, so that effects on nutrition are limited to those effects traceable through changes in food consumption. There are three different routes connecting prices with consumption and nutrition: first, a direct link between price and food

FIGURE 1A.

FUNCTIONAL RELATIONSHIPS BETWEEN PRICES AND NUTRITION FOR A FARMING HOUSEHOLD



consumption; second, an indirect route from prices to income and from income to food consumption; and third, a doubly indirect route from prices to production, from production to income, and from income to consumption. One may therefore identify three types of effects of prices on food consumption and nutrition, namely:

(a)	Direct Price Effect:	Pure price effect on consumption;
(b)	Income Effect:	Effect of price on income and income on consumption;
(c)	Production Effect:	Effect of price on output, output on income, and income on consumption.

Direct Price Effect

The direct or pure price effect on consumption is the familiar one exhibited by all consumers, urban or rural, whereby a rise in price of a commodity tends to reduce its own consumption and increase the consumption of competing goods.

Income Effect

Since farmers are producers and sellers of food in addition to being consumers, a rise in price will also increase the amount they receive for sales of that product. The additional income resulting from selling the same amount at a higher price will tend ordinarily to raise the level of consumption of food items. Thus the income effect is normally positive while the direct price effect is negative. In a given production year, when the level of production and stocks are given, a price movement changes the proportion of sales to home consumption.

Production Effect

Farmers have one additional element of flexibility in adjusting to price movements, namely, they can increase or decrease the level of output of the different commodities. Adjustments in the pattern of production will result in further changes in income, and the change in income will redound further in corresponding effects on consumption. Changes in cropping patterns cannot become effective, however, until at least the next growing season, and even then, adjustments are made progressively over a number of years. Thus, while price and income effects can be felt promptly after the price change, the production effect is mostly significant in the longer run.

Data Needs and Data Collection

In order to assess the ultimate impact of price changes on farmers' nutrition, it becomes necessary to decompose the problem into its three component effects. In other words, three separate types of relationships need to be established in order to trace the effect of a price change on farmers' consumption, namely. the relationship between farmers' income and their consumption, the relationship between food prices and farmers consumption, and the relationship between farm prices and levels of production. In order to accomplish that, it is necessary to collect information on the various elements: farm and food prices, farm production, farm income, and farmers' food consumption. In addition, nutrient composition tables are needed to transform food consumption levels into their nutritional equivalents.

It is not enough to obtain data on all these variables at a given moment. Sufficient variation must be observed to allow us to establish functional relationships between variables, i.e., how changes in one variable affect changes in others. This makes it especially difficult to obtain sufficient and adequate data on all relevant variables when the time allocated for fieldwork is very short. Prices, for example, might remain constant over the observation period and thus, defeat efforts to relate them with consumption levels. Both Cameroon and Senegal studies were designed to collect information on a sufficient number of households on prices, production, income, and consumption, while trying to capture the widest possible range of variation in them.

Consumption and Income

The relationship between consumption and household income was perhaps the one most adequately covered by the data collection effort in both Cameroon and Senegal. Despite early misgivings, it turned out to be relatively straightforward to collect consumption data among rural families, either by placing enumerators in the households or by daily visits and recall of ingredients used. Actual weighing of ingredients with portable scales was made in Senegal, while local measuring units were used in Cameroon, in both cases with good results. Overall, we consider the food consumption data over the three-day period to be highly reliable.

Income information is far more difficult to obtain. Only at the end of the interview period with each family, when enough rapport had been established with the researchers, was this type of data approached directly. The results in both Cameroon and Senegal were judged very satisfactory and encouraging. Some components of

household income can be arrived at separately. Farm production, for example, can be computed when field areas and yields are being collected for each plot that belongs to family members; the most delicate component of income to obtain is off-farm income, from either off-farm employment or remittances from relatives. Market sales are reported openly in terms of both prices and quantities, but questions about the precision of recall information remain.

Consumption levels for the major foods can be calculated independently from the dietary survey, and as a difference from output and market sales. The dietary survey has more accurate information, but adjustments for seasonal changes must be made to arrive at annual levels of consumption. Conversion of food consumption data into nutrient equivalents was relatively straightforward using international and national tables of nutrient composition of foods for Africa.

Prices and Consumption

Although food consumption is readily obtained, and price information can be gathered independently outside the family, there is normally not enough price variation in the short survey period to be able to establish price-consumption relationships. That was the case, for example, in Senegal. In Cameroon, however, distance to the main provincial market generates a considerable price differentials among villages; judicious selection of sample villages provides sufficient variation in prices for the purpose of estimating price-consumption relationships. It was, therefore, possible in Cameroon to simultaneously estimate the price and income relationships to consumption.

Production Response Relationships

This is perhaps the most difficult category of data to obtain in a short period since there is not enough time to observe variations in area cultivated in response to price changes; ideally time series would be suited to establish such a relationship, but obviously that would require several years of data collection.

An alternative way to obtain price responsiveness of farmers is to build representative farm models for the area and use these models to predict probable adjustments in crop areas for alternative price sets. This was the approach taken in this project, using a pattern already developed at CRED for building small-farm linear programming models in other parts of West Africa. From these earlier experiences, it has been found that the principal limiting factor for farm production is generally labor availability at critical periods in the growing season, such as first weeding and harvest time. An attempt was made in the project to gather labor input data through recall of

the previous year's activities in selected fields. Unfortunately, in neither country was the data on labor utilization considered reliable enough to build the appropriate farm models. An important lesson derived from this project must be the need to refine the procedures for the rapid collection of farm production and labor use data for the different crops.

Implementation: Real Effects

Figure 1B illustrates how the Cameroon and Senegal studies were able to cover the scope of relationships defined above. In Senegal the analysis encompasses mainly the income-consumption-nutrition relationships; prices were fairly uniform throughout the study region, so no price-consumption relationship was developed. In Cameroon both price and income relationships to consumption were traced, thanks to the price differentials observed along the single road in the region. The prosumer farmer model described below encompasses the entire system of relations.

Prosumer Farmer

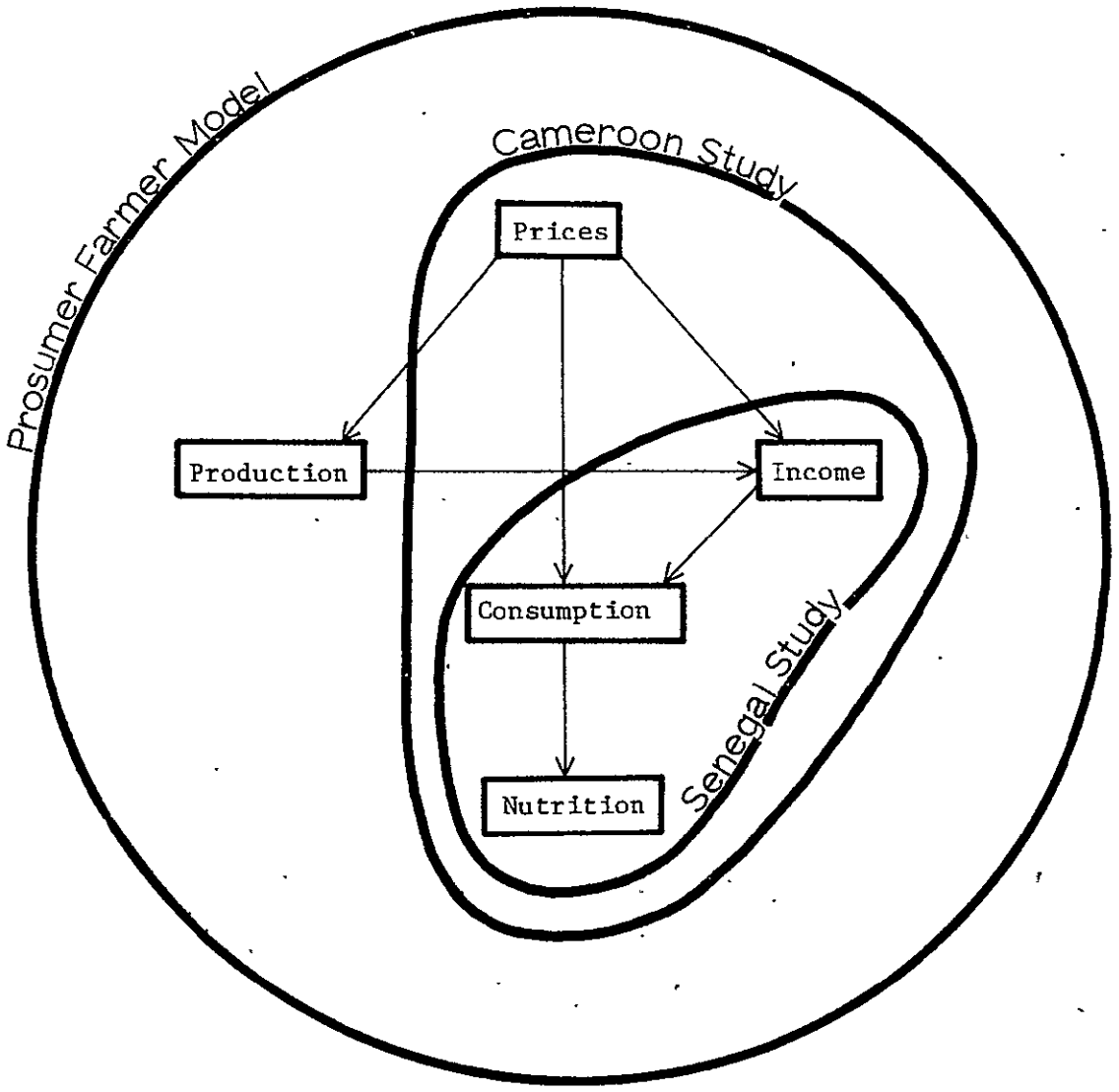
A major methodological contribution of this project is the development of a farm planning model structure able to integrate both production and consumption decisions. The well-known linear programming technique for representing small farms has been expanded to include price and income effects upon the family food consumption. The recommended optimal pattern of production and marketings takes into consideration as first priority the satisfaction of family food requirements. The model incorporates all the elements discussed above, namely prices, income, production, consumption and nutritional variables.

Full implementation of this model was not possible within the limitations of this project. Several reasons can be adduced, but the main one is that key data on farm production and labor utilization were not adequate for building the production component. Future research teams should be better trained to gather labor profiles for the main crops; the alternative is to record daily farm activities by the household over the entire agricultural year, as it has successfully been done in other CRED farming systems studies. The hope that such information can be obtained through recall after several months was not realized. Better methods are needed.

In the absence of an actual implementation of the prosumer farmer model, an illustration of its application and potential is presented in the next chapter. The illustration uses secondary data for the Casamance region of Senegal to construct the

FIGURE 1B.

COVERAGE OF FUNCTIONAL RELATIONS BY PROJECT COMPONENTS



farm planning model. Several types of interventions, including changes in prices, family size, and outside income are simulated, and the results are highly realistic and encouraging. The generalized form of the model is presented in a more rigorous manner in Chapter 3 of Part II, so that it might be adapted to other situations.

Implementation: Relative Effects

Oftentimes, judgements can be made on the basis of relative magnitudes, without the benefit of actual values. The concept of elasticities in economics, for example, defines relationships between variables in terms of relative changes in one variable resulting from relative changes in another, without taking into account the absolute magnitudes of the variables in question. It is possible, therefore, to estimate what percent increase in rice consumption, for example, can be expected from a given percent increase in income, provided we have an estimate of the income elasticity of rice consumption. Similarly, the output elasticity of millet with respect to its price expresses the percent change in production that would result from a given change in millet price; once again, the actual levels are not needed.

It is moreover possible to assess the effects of changes in farm or food prices upon the nutritional status of farm families by chaining the multiple effects of prices on production, income, and consumption. Figure 1C. gives a visual template of how elasticities might be used to such an end. In the very simplified case of one single food being produced and consumed, the elasticity of calorie intake with respect to the price of the one food is readily calculated by this formula using the individual elasticities in the figure:

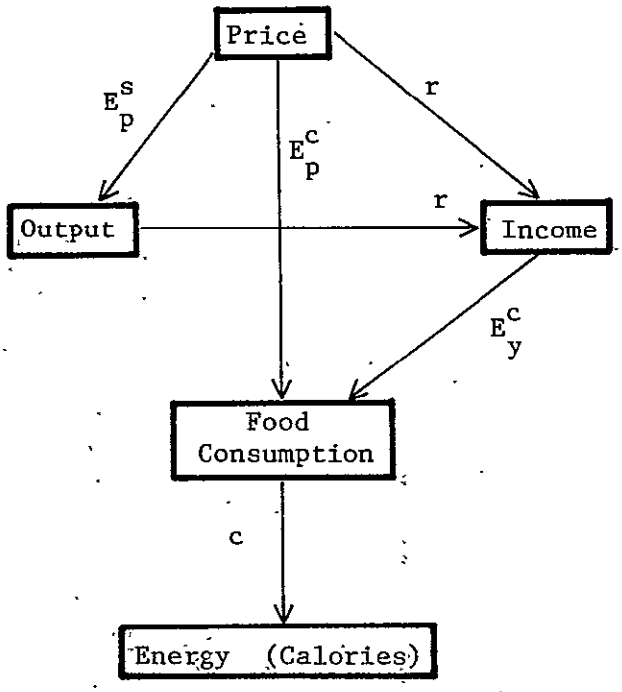
$$E_p^e = c[E_p^c + E_y^c (r + r E_p^s)]$$

When two or more foods or farm products enter the analysis the mathematical manipulations become considerably more cumbersome. Chapter 5 of Part II develops the computational steps to estimate the final outcome in terms of nutrients from multiple simultaneous price changes. Chapter 6 of Part II concentrates on the more manageable case of tracing the effects of changing a single product price on calorie intake.

As was the case with the prosumer farmer model, actual implementation of the elasticities structure was not possible in the limited span of time available for this project since work on these derivations was proceeding at the same time as the data collection and analysis. In the Cameroon study, however, an effort was made to

FIGURE 1C.

ESTIMATING NUTRITIONAL IMPACT USING ELASTICITIES



$$E_p^e = c\ [E_p^c + E_y^c\ (r + rE_p^s)]$$

where:

E_p^e = Energy intake elasticity with regard to price.

c = Relative share of caloric intake.

E_p^c = Pure price elasticity of consumption.

E_y^c = Income elasticity of consumption.

r = Relative share of income.

E_p^s = Output (supply) elasticity with regard to price.

estimate statistically the appropriate elasticities using the collected field data. These estimates were then used to project potential effects on calorie and protein intakes. Chapter 4 of Part II details such an effort, as far as it was carried out. Once more, lack of appropriate production response data prevented a more complete utilization of the above structure using elasticities. They are present here, nevertheless, in the interest of providing guidance to future researchers of the subject.

Adequacy of a Short Survey

These studies were deliberately designed to constrain research teams to a few weeks in the field. This was done in order to learn how much can and cannot be accomplished in a limited time with limited resources, a situation likely to be encountered in developing countries trying to do similar studies. The field survey in both country studies were designed for a 12-week period. Questions naturally arise about how adequate such a short survey is to gather the necessary data. Of course, given more time and funds, better quality and additional data can be obtained. The issue is rather one of determining when sufficient precision is attained for the specific purpose at hand.

Depending on the type of data, the degree of confidence in the survey results in Senegal and Cameroon ranged from highly satisfactory to simply useless. Data that can be obtained either by direct observation or actual measurement are no doubt more accurate than those which require subjective evaluation or recalling from memory. Field area measurements, for instance, are as accurate as the measurement procedure allows, and they can be made almost equally well throughout the year. Field yields on the other hand, can only be measured with some precision at harvest; other times one can only rely on the subjective recall of the household head or person responsible for the plot. The timing of the survey to cover harvest would be essential to get accurate yield estimates. On the other hand, those might not be the best months to obtain other kinds of information. There are, therefore, potential conflicts in timing the survey to improve the precision of alternative types of data.

Food consumption, for example, was expected to be most critical at the time immediately following the early rains. Both the Cameroon and Senegal field surveys were carried out at those times, in order to determine how adequate nutrient intakes were at that critical period, assuming that they would be more favorable in other seasons. That meant of course that the harvest period was not covered. In contrast to initial misgivings, the results from the rural food consumption survey show a pattern of

consistency indicative of a satisfactory level of confidence. Patient and detailed recording of food quantities used in the kitchen were definitely worthwhile. Three days of food recording are also deemed adequate despite the evident bias caused by the observation process itself; such an effect is sufficiently attenuated by the third day that it doesn't seem justified to increase the period of observation further to gain a minimal improvement in accuracy.

Unfortunately, farmers' food consumption varies systematically throughout the year according to the seasons. A short-term survey is therefore inadequate to represent the overall annual composition and adequacy of the diet. Efforts were made to find ways to generalize the results from the food consumption survey to the whole year by developing seasonal indices of consumption for each major food. A questionnaire was designed to obtain subjective values on such weights, but the preliminary results were so inconclusive that they were not used at all in the final analysis. Thus, a quick survey suffices to gather data on food consumption at a given time, but cannot portray seasonal movements in diet and the overall annual food intake.

Information on household income sources and levels is among the most difficult to assess accurately, particularly in a rural setting. Questions about income are ordinarily left for last, in the hope that the rapport established with the family over the three-day observation period leads to more reliable answers. To the extent that farm output constitutes the greater part of household income among village farmers, estimates of crop production can be used to estimate income. Data on off-farm employment and other income sources, however, are completely dependent on the willingness of the family to report such information. Although the field researchers in both Cameroon and Senegal feel confident that farmers were very frank about reporting market sales and off-farm earnings, a certain dose of caution is in order when analyzing that data. Memory lapses in recalling earnings and expenditures over one-year are far too common, as any taxpayer well knows. A longer survey period will of course allow more frequent recording of fresher information.

Labor utilization is unfortunately among the less reliable data obtained in the course of this survey. Several factors account for that: first, recall of activities that took place twelve months earlier are cloudy at best; second, field crop operations are done in spurts, with several-day intervals in-between so that the timing of activities is difficult to pinpoint from memory; third, each activity has different labor requirements so only approximate estimates are made; fourth, it is hard to keep separate recollections of work by field, by crop and by type of activity; fifth, many people work

in a field at the same time and their individual recollections may vary greatly. Without adequate data on labor patterns for alternative cropping activities, it is difficult to judge what crop production adjustments farmers might make in response to external factors such as price changes. Improved techniques to collect labor utilization data are obviously needed; in-depth farm surveys covering a one-year growing cycle have proved highly effective to monitor labor input flows over time, but their long duration and high cost restrict their application in practice. A brief separate farm survey limited to the growing season might prove a viable alternative even though it will require more than the 12 weeks alloted in these studies.

Seasonal dynamics also affect other important variables recorded in the course of the farm survey. Family composition may differ slightly during the dry season if young persons migrate outside the region for temporary employment, or if school age children live away while in school. This survey captured the family structure at planting and weeding time, a period of high labor demand in the fields. Anthropometric measurements are also affected by seasonal factors; weight losses and cessation of growth among children might occur in the last dry season months. Thus the timing of the survey may critically affect the values recorded and the interpretations made.

In summary, the brief field surveys carried out in both country studies were designed for and succeeded in capturing the food situation among village farmers at the most critical period of the year, the weeks following the arrival of the rains. Presumably food intake is more favorable throughout the rest of the year, but it was not possible to extrapolate from the data to estimate average annual food consumption levels. Complementary survey at other times of the year are needed to do that. Labor utilization data was inadequate to allow forecasts of potential crop supply response by farmers; a separate brief survey expressly designed for that purpose should be considered instead.

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

SECTION ONE
ANALYTICAL METHODS

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

CHAPTER 2
PROSUMER FARMER - A LINEAR MODEL OF PEASANT FARMING IN CASAMANCE, SENEGAL

by
Edgar J. Ariza-Niño

Center for Research on Economic Development
University of Michigan
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CHAPTER 2

PROSUMER FARMER - A LINEAR MODEL OF PEASANT FARMING IN CASAMANCE, SENEGAL

Introduction

This chapter reports on a promising technique for integrating family food consumption considerations into the production decision making model of a peasant farming family.

Linear farming models have a well-established presence in the analysis of agricultural production systems. In developing countries, however, their application to peasant farming conditions runs into multiple difficulties from several sources. One major shortcoming so far is the failure to structure the peasant farm in its dual role of a production enterprise, as well as a consumption unit. This limitation is well-acknowledged by development researchers who often find that projections from farm production models about crop distribution and response, fail to materialize. Farmers are severely limited in their production options by the food consumption needs of the family.

Efforts to introduce food consumption into standard linear models have taken several approaches. The most common one is to incorporate ad hoc restrictions until the results from the model reflect closer the real situation. Thus, foodgrains could be forced to appear in at least half of the cultivated area, for example, or a minimum quantity of grain is imposed on the system. Another approach suggested recently is to treat the family as livestock to be given certain nutrients at minimum cost. That would permit combining the least-cost ration procedures into the faming production model. Such a twin ration-feed production model has been used already in developed countries to represent the livestock enterprise production part of its own feeds. It is relatively simple, then, to adapt that model to introduce family nutritional considerations into the farm production system. Unfortunately, human diets, even among the rural poor, do not lend themselves to least-cost treatment. Food consumption patterns are influenced far more by factors other than nutrient composition of ingredients.

Applied food consumption analysis is of course a widespread field of work by agricultural and general economists, but empirical studies concentrate almost exclusively on the urban populations. Food consumption by farmers is either thought to be the same as the rest of the population, or to defy empirical economic analysis. In developing nations, however, farmers constitute the vast majority of the population, but also most of the food produced is consumed by the farmers themselves. Agricultural development policies, if they are to be effective, need to be based on some understanding of the determinants of farmers' food consumption.

A basic premise of this chapter is that rural families adjust their food consumption patterns in accordance to the same principles as other families do. Prices, income and taste preferences continually induce rural families to eat more of this item and less of that other. Moreover, these food consumption patterns are believed amenable to empirical investigation, despite the well-known problems of data measurement and collection.

In short, it is contended that food consumption by farming families can be satisfactorily represented by a system of linear demand equations embodying the effects of prices and income. The challenge for this chapter is to enter the pattern of food consumption derived by the system of demand functions into the linear farm mangement framework.

This challenge, it turns out, is a surprisingly easy one.

A few minor transformations permit the system of equations to be directly linked to the farm production model. The main difficulty is in converting the net farm output value obtained from the objective function, into the income variable affecting demand levels.

Casamance Farm Production

In order to explain the procedure, a simple model of a peasant farm in the Casamance region of Senegal was built Data for this example was gathered from various published sources. The Casamance region in southern Senegal differs substantially from the rest of the country. It has greater rainfall; transport and communications with Dakar are made difficult by the Gambia River. Rice production is possible in low-lying areas, while groundnuts, millet, sorghum, and maize are grown in fields not subject to flooding. Groundnuts is the principal cash crop, and it is sold exclusively to the state marketing monopoly, ONCAD. Rice is also sold in smaller

quantities, but the bulk of it is consumed domestically by the farmers' families. Millet and sorghum remain the basic staple of the population, but very little of it enters the market circuit. Maize is increasingly an important food crop but it shall be disregarded for lack of sufficient information. Table 2A. gives the input-output coefficients for the three crops considered in this example, namely groundnuts, rice, and millet/sorghum (taken together as a single crop). Thus, groundnuts require a total 100 days of labor per hectare (ha), most of it being spent in June, July, and August. Rice, on the other hand, requires a long season with high labor requirements throughout, even in December and January. Millet and sorghum, by contrast require half as much effort as rice, 85 days against 188 for rice, and all activities are finished by October.

Yields and prices for the three crops do not vary that much. Groundnuts are expected to produce one ton per hectare, compared to 1.1 tons for rice and .9 tons for millet/sorghum. Prices for groundnuts and rice are set by the government marketing agency, ONCAD, at 42 CFA/kg in 1976 for both products, while for millet/sorghum, it is reported at 35 CFA/kg. Rice provides the highest revenue per hectare -- 46,200 CFA, compared to 42,000 CFA for groundnuts and 31,500 CFA for millet/sorghum.

Table 2A. also includes a column with levels of land and labor resources for a typical peasant family in the Casamance, with 4.5 adult work-day equivalents contributed by 5 adult persons and 6 children. During months of high activity (June through December, except September and November), there will be 112 work-day equivalents. Only half as much labor is assumed available in the other months, the difference presumably taken by either temporary migration or social activities (Rigoulot, 1980, p. 28 and Appendix A).

Only waterlogged lands for swamp rice are considered scarce in the Casamance; each family is assumed to have access to slightly under 2.0 hectares of wetlands. Dryland for peanuts and cereal production is assumed less restrictive, for the Casamance has a relatively low population density; a maximum of 10 hectares per family seems a suitable limit (Rigoulot, 1980, Appendix A).

Casamance Farm Food Consumption

Millet/Sorghum

Food consumption by rural families has been researched in Senegal far more than in other West African countries. One finds, therefore, a substantial amount of

TABLE 2A.

INPUT-OUTPUT COEFFICIENTS FOR GROUNDNUTS, RICE, AND MILLET/SORGHUM (CASAMANCE, SENEGAL)

	Groundnuts (1 ha)	Rice (1 ha)	Millet/Sorghum (1 ha)	Typical Family Resources
Land:				
Dryland	1		1	10 ha
Wetland		1		2 ha
Labor: (days)				
May	4	10	10	56 days
June	30	23	21	112 days
July	24	28	21	112 days
August	16	28	14	112 days
September	3	18	3	56 days
October	16	10	14	112 days
November	2	16	2	56 days
December	5	35	--	112 days
January	--	20	--	56 days
Total days/ha	100	188	85	
Yield: kg/ha	1,000	1,100	900	
Price: FCFA/kg	42	42	35	
Revenue: FCFA/ha	42,000	46,200	31,500	

SOURCE: Rigoulot, J.P. An Analysis of Constraints on Expanding Rice Output in the Casamance Region of Senegal, 1980.

information on the patterns of food consumption. Unfortunately, with few exceptions, the economic determinants of those food patterns have not been analyzed. One recent exception is the thesis of Amadou D. Niane at Michigan State University (1980). Niane estimates statistically demand and supply functions for millet/sorghum in Senegal as a whole, using time-series data for 1960-1976.

Niane's ordinary least squares demand estimates exhibited a high degree of serial correlation. He, therefore, corrected for serial correlation using the Cochrane-Orcutt technique to arrive at the following function:

$$Qm = \underset{(3.87)}{302.191} - \underset{(-2.47)}{7.16}\,Pm + \underset{(8.49)}{2.92}\,Pr + \underset{(.20)}{0.00021}\,Y - \underset{(-.19)}{1.97}\,DV - \underset{(-4.69)}{2.69}\,T$$

with R^2 = .93 and F-statistic (5,10) = 26.14. Numbers in parenthesis are t-values.

The variables involved are:

Qm = Per consumption of millet/sorghum (kg/year).
Pm = Price of millet/sorghum in current year (FCFA/kg).
Pr = Price of imported rice in current year (FCFA/kg).
Y = Per capita income in year t (FCFA).
T = Time trend.
DV = Dummy variable for government policy in four years (1973-76).

Since the equation is estimated for Senegal as a whole, its direct application to rural families in the Casamance ought to be made cautiously but, in the absence of better empirical estimates, it is unavoidable.

The elasticities of millet/sorghum consumption implied by this question are:

- Own-price elasticity = -1.1.
- Cross-price elasticity with rice = +1.08.
- Income elasticity = +0.1.

At first glance the price elasticity estimates appear too high, while the income elasticity seems rather low. On the other hand, given that millet/sorghum constitutes the basic staple of the Senegalese diet, it should not be surprising that it has a low income elasticity. Some studies have even estimated negative values, indicating inferior-good status for millet/sorghum.

Rice

One is less fortunate in obtaining empirical estimates of rice demand in Casamance, even though it is a major food item in the diet. For Senegal as a whole, Jabara's thesis (1979) estimates rice is own-price elasticity at -.745, but the

coefficient was not statistically significant. She also uses SONED's estimate of +.4 income elasticity for rice consumption. Clark Ross, on the other hand, has estimated for the Casamance Region own-price elasticity for rice at -.85 and income elasticity at +1.3. We shall settle for the moment on -.8 as the own-price elasticity and +1.0 income elasticity. Moreover, the cross-price elasticity with millet/sorghum will be taken at +.20.

Given the above elasticity estimates, and the corresponding levels of prices, income, and rice consumption in 1976 (the year of reference used here), it is possible to derive a demand equation for per capita rice consumption. An average of 93 kg of rice paddy were consumed per person per year in the Casamance area, according to Jabara (1979, p. 82), in 1975/76. At the same time, producers' price for rice was 41.5 FCFA per kg and for millet/sorghum, 35 CFA per kg. Income per capita for Casamance in 1976 is assumed at 30,000 FCFA (U.S. $150).

The demand equation derived is:

$$Qr = 55.74 - 1.79\,Pr + 0.53\,Pm + 0.0031\,Y$$

where:

Qr = Capita rice consumption (kg).

Pr = Price of rice (FCFA/kg).

Pm = Price of millet/sorghum (FCFA/kg).

Y = Income per capita (FCFA).

Recapitulation

We have now two per capita consumption functions, one for millet/sorghum, another for rice, expressed in terms of income per capita and the prices of both types of cereals. Table 2B. summarizes these functions. The constant term in the millet/sorghum equation has changed to 259.2 to standardize all data to 1976. We now attempt to incorporate this rural farm consumption system into the standard linear farm production model.

Casamance Farm Modelling

Production Component

We shall begin by building a standard farm production model for a typical Casamance family; subsequently we shall introduce the food consumption system.

TABLE 2B.

PER CAPITA CONSUMPTION FUNCTIONS FOR MILLET/SORGHUM AND RICE FOR RURAL FAMILIES IN CASAMANCE, SENEGAL (1976)

Demand Function	Constant (kg)	Price Millet (FCFA/kg)	Price Rice (FCFA/kg)	Income (FCFA/head)
Coefficients				
Millet/sorghum	259.20	- 7.16	2.92	0.0002
Rice	55.74	0.53	- 1.79	0.0031
Elasticities				
Millet/sorghum		- 1.1	1.08	0.1
Rice		0.2	- 0.80	1.0

SOURCES: Amadou D. NIANE (MSU Thesis, 1980).
Cathy L. Jabara (Purdue Thesis, 1979).
Clark Ross (CRED Discussion Paper, 1980).

Table 2C. presents the farm production section as a revenue maximization problem.

The farmer faces three alternative production activities:

A-1: Production of groundnuts (ha);

A-2: Production of rice (ha);

A-3: Production of millet/sorghum (ha).

In the absence of consumption considerations, the farmers can sell the output of these activities at the market, hence:

A-4: Sale of groundnuts (kg);

A-5: Sale of rice (kg);

A-6: Sale of millet/sorghum (kg).

For future convenience one can define the resulting revenue as a separate activity (A-7) expressed in FCFA. These seven activities correspond to the columns in Table 2C.

The rows in the table correspond to the resource restrictions faced by the farmer, and a few other equations linking the various activities:

Row 1 is the objective function for the farm model. It merely states that the value of farm income (A-7) is to be maximized.

Row 2 defines the value of farm income as not exceeding the sum of sales of groundnuts, rice, and millet/sorghum multiplied by their respective prices, namely 42, 42, and 35 FCA/kg. Thus:

$$(A\text{-}7) \leq 42 * (A\text{-}4) + 42 * (A\text{-}5) + 35 * (A\text{-}6).$$

where * indicates multiplication.

Row 3 restrains the area cultivated in groundnuts and millet/rice to at most 10 ha of dryland available to the typical family.

Row 4 restrains rice area to a maximum of 2 ha of wetland.

Row 5 states that labor days required by groundnuts, rice and millet/sorghum must not exceed the 56 days that the family can dispose of that month.

Each hectare of groundnuts requires 4 workdays in May, while 10 are needed per hectare of rice and per hectare of millet/sorghum. Thus:

$$4 * (A\text{-}1) + 10 * (A\text{-}2) + 10 * (A\text{-}3) \leq 56.$$

Row 6 through Row 13 makes the equivalent restrictions of labor utilization for subsequent months, from June through January of the following year. Note that for most months the family has available a total of 112 days, but in September, November and January, only half as much labor is available.

TABLE 2C.

CASAMANCE FARM MODEL - WITHOUT CONSUMPTION COMPONENT (1976)

	A - 1	A - 2	A - 3	A - 4	A - 5	A - 6	A - 7			
Row	Production Groundnuts	Production Rice	Production Millet/Sorghum	Sales of Groundnuts	Sale of Rice	Sale of Millet/Sorghum	Farm Income	Restrictions		Comments
1							1		Maximize	Obj. Function
2				- 42	- 42	- 35	1	≤	0	Farm Income
3	1		1					≤	10	Dryland (ha)
4		1						≤	2	Wetland (ha)
5	4	10	10					≤	56	Days-May
6	30	23	21					≤	112	Days-June
7	24	28	21					≤	112	Days-July
8	16	28	14					≤	112	Days-August
9	3	18	3					≤	56	Days-September
10	16	10	14					≤	112	Days-October
11	2	16	2					≤	56	Days-November
12	5	35						≤	116	Days-December
13		20						≤	56	Days-January
14	- 1000			1				≤	0	Groundnuts
15		- 1100			1			≤	0	Rice
16			- 900			1		≤	0	Millet/Sorghum

Row 14 links groundnut production (A-1) with groundnut sales (A-4). It merely states that the farmer cannot sell more groundnuts than were produced. Since the expected yield is 1000 kg per hectare, the groundnuts balance can be expressed as:

$$(A\text{-}4) \leq 1000 * (A\text{-}1)$$

Or, as it appears in Table 2C.,

$$-1000 * (A\text{-}1) + 1 * (A\text{-}4) \leq 0.$$

Row 15 makes exactly the same balance for rice sales (A-5) and rice production (A-2):

$$(A\text{-}5) \leq 1100 * (A\text{-}2)$$

where 1100 is the yield per hectare of rice.

Row 16 balances sales (A-5) and production (A-3) of millet/sorghum:

$$(A\text{-}6) \leq 900 * (A\text{-}3)$$

where 900 kg/ha is the yield of millet/sorghum.

Food Consumption Component

In order to incorporate the per capita demand functions developed earlier for Casamance farming families, it is necessary to define several additional "activities":

A-8: Level of per capita income for the family (FCFA/head);

A-9: Price of rice at the producer level (FCFA/kg);

A-10: Price of millet/sorghum at the farm gate (FCFA/kg);

A-11: Level of per capita consumption of rice for the family in question, in kg/head;

A-12: Per capita consumption of millet/sorghum in kg/head;

A-13: Total annual family rice consumption, in kg;

A-14: Total annual family millet/sorghum consumption, in kg.

Table 2D. shows how food consumption may be arranged into a linear form suitable to include in the farm production model. The rows correspond to equations relating the different consumption activities.

Row 17 simply transforms total farm income into income per capita, by dividing in this case by 11, the number of heads in the family:

$$(A\text{-}8) = (A\text{-}7)/11$$

or

$$-0.0909\,(A\text{-}7) + (A\text{-}8) = 0.$$

Row 18 equates the price of rice, A-9, to 42 FCFA per kg.

Row 19 equates the price of millet/sorghum to 35 FCFA/kg.

TABLE 2D.

FOOD CONSUMPTION COMPONENTS OF CASAMANCE FARM MODEL (1976)

Row	A - 7	A - 8	A - 9	A - 10	A - 11	A - 12	A - 13	A - 14	Restrictions	Comments
17	-.0909	1							= 0	Income/head
18			1						= 42	Price Rice
19				1					= 35	Price Millet/Sorghum
20		-0.0031	1.79	-0.53	1				= 55.74	Rice/head
21		-0.0002	-2.92	7.16		1			= 259.2	Millet/head
22					-11		1		= 0	Rice-Family
23						-11		1	= 0	Millet-Family

Row 20 is simply the per capita demand function for rice as it appears in Table 2B., but with signs reversed for the coefficients, since they appear to the left of the equal sign. Rice consumption per head (A-11) is set equal to:

$$(A\text{-}11) = 52.74 + 0.0031\ (A\text{-}8) - 1.79\ (A\text{-}9) + 0.53\ (A\text{-}10).$$

Row 21 also computes millet/sorghum per head (A-12) as a function of per capita income (A-8), price of rice (A-9), and price of millet (A-10) according to the equation:

$$(A\text{-}12) = 259.2 + 0.0002\ (A\text{-}8) + 2.92\ (A\text{-}9) - 7.16\ (A\text{-}10).$$

Row 22 merely sets total family consumption of rice (A-13) equal to the product of per capita consumption of rice times the number of family members, 11:

$$(A\text{-}13) = 11 * (A\text{-}11).$$

Row 23 equates total family consumption of millet/sorghum (A-14) to consumption per head times the number of heads:

$$(A\text{-}14) = 11 * (A\text{-}12).$$

Production-Consumption Linkages

So far, the production and consumption components of the peasant farm have been developed independently. Only farm income (A-7) has appeared in both components: as the objective function in the production section, and as the source of income in the consumption section.

(a) New rice balance. -- It is now necessary to state explicitly that food produced at the farm should be available for family consumption, as well as for sale at the market. More precisely, the quantity of rice sold (A-5) plus the quantity of rice consumed by the family (A-13) must not exceed the rice produced at the farm (A-2). Thus:

$$(A\text{-}5) + (A\text{-}13) \quad 1100 * (A\text{-}2).$$

It is not necessary to enter this rice balance equation as a new row, since there was already a similar condition relating rice sales and production (see Row 15). It therefore sufficies to modify Row 15 by introducing the new coefficient (1.0) for activity (A-13). The new relation should appear as:

$$-1100 * (A\text{-}2) + 1.0 * (A\text{-}5) + 1 * (A\text{-}13) \quad 0.$$

(b) New millet/sorghum balance. -- In a similar fashion, we need to modify Row 16 which links millet/sorghum sales and production. The new relation states that the quantity of millet/sorghum sold and consumed must not exceed the yield from the hectares of millet/sorghum (A-3):

$$(A\text{-}6) + (A\text{-}14) \quad 900 * (A\text{-}3).$$

No adjustments are necessary in the balance relation for groundnuts (Row 14) since in this simplified example, it is assumed that all groundnuts are sold and none are consumed as food by the family. Small amounts of groundnuts are in fact consumed.

Food Purchases

(a) Rice. -- The production-consumption model of a peasant farm in the Casamance region is now complete, but it implicitly assumes that all rice and millet/sorghum consumed by the family originates at the farm itself. This is not necessarily the case. Rice pruchases by farmers are widely observed in other regions of Senegal, especially in the peanut basin where rice production is not possible. Casamance farmers sell rice not just to ONCAD but also in the parallel market for local processing, storage, and distribution -- other farmers in the region have the option, therefore, in obtaining their rice consumption from purchases at the local market. Of course, the price faced by a farmer as a consumer is higher than the price as a producer selling the product. For simplicity we shall assume a markup of 20 percent so the retail price for rice is taken at 50 CFA/kg.

A new activity (A-15) needs to be defined in the farm model, to indicate the amount of rice pruchased by the farmer. The new activity affects the farm model in two ways: it reduces farm income, and it increases the rice balance. Let's take the latter effect first. We must redefine the rice balance (Row 15) to state that rice outflows (sales, consumption) must not exceed rice inflows (production, purchases). Row 15 must then read:

$$(A\text{-}5) + (A\text{-}13) \quad 1100 * (A\text{-}2) + (A\text{-}15).$$

(b) Millet/Sorghum. -- A similar reasoning justifies the introduction of a millet/sorghum purchasing activity (A-16) into the farm model. Again, although relatively little of the millet/sorghum production enters the market circuit, farmers do in fact have the option to supplement their cereal consumption with millet/sorghum purchased outside the farm. The balance row for millet/sorghum grain (Row 16) is, therefore, expanded to include purchases (A-16):

millet/sorghum outflows millet sorghum inflows

$$(a\text{-}6) + (A\text{-}12) \quad 900 * (A\text{-}3) + (A\text{-}16).$$

As in the case of rice, a 20 percent markup is assumed over the producer price for millet/sorghum. A 42 FCFA/kg consumer price is faced by the farmer buying millet/sorghum, while he could only get 35 FCFA/kg when selling it.

Farm income must be now redefined as the net value of farm production minus purchases of food for family consumption. Row 2 therefore must be modified to reflect the inequality:

$$(A\text{-}7) \quad 42\,(A\text{-}4) + 42\,(A\text{-}5) + 35\,(A\text{-}6) - 50\,(A\text{-}15) - 42\,(A\text{-}16)$$

where the coefficients represent prices at producer and consumer levels for groundnuts, rice, and millet/sorghum in FCFA per kg.

Table 2E. represents the joint production-consumption farm model, complete with the appropriate linkages in food balances, and the purchasing activities for rice and millet/sorghum.

Sample Run of Casamance Family Farm Model

The contents of Table 2E. can now be entered as data in a linear programming format. In this case, the Mathematical Programming System (MPS) available at the University of Michigan was used. The initial results are highly encouraging.

All three crops are produced by the family (Table 2F.), but cereals production occupies two-thirds of the total area cultivated: rice is produced in 1.61 ha, millet/sorghum in 1.64 ha, and groundnuts in only 1.34 ha. Neither of the two types of land was fully used; only 3.0 ha of dryland were cultivated out of a possible 10, but rice on the other hand used 1.6 ha, leaving only 0.4 ha of wetland unused.

Labor requirements in June and July are the effective constraints on farm production, thus confirming one of A. Niane's own observations (Niane, 1980, pp. 28 and 59). Labor availability during the rest of the year exceeds labor requirements on the three crops.

The entire output of groundnuts is sold (1,345 kg); millet/sorghum on the other hand, is consumed completely within the family. Two-thirds of the rice (1,218 kg) is sold in the market while the remainder (557 kg) is consumed internally.

Farm revenue, including the imputed value of rice and millet/sorghum family consumption, reached 182,847 FCFA. For this family of 11 persons, this is equivalent to 16,621 CFA per head. Based on this income per head, and the given prices of rice and millet/sorghum, per capita consumptions of 51 and 135 kg per year were calculated for rice and millet/sorghum, respectively. The family as a whole consumes 557 kg of rice and 1,480 kg of millet/sorghum. It is worth noting that neither rice nor millet/sorghum were purchased by the family outside the farm.

TABLE 2E.

1976 PRODUCTION AND CONSUMPTION LINKAGES (CASAMANCE FARM MODEL)

	Activities																
Row	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	RHS
1							1										OBJ
2				- 42	- 42	- 35	1.0						- 42	- 35	50	42	≤ 0.00
3	1		1														≤ 10.00
4		1															≤ 2.00
5	4	10	10														≤ 56.00
6	30	23	21														≤ 112.00
7	24	28	21														≤ 112.00
8	16	28	14														≤ 112.00
9	3	18	3														≤ 56.00
10	16	10	14														≤ 112.00
11	2	16	2														≤ 56.00
12	5	35															≤ 112.00
13		20															≤ 0.00
14	-1000			1.0													≤ 0.00
15		-1100			1.0								1.0		- 1.0		≤ 0.00
16			- 900			1.0								1.0		- 1.0	≤ 0.00
17							-.0909	1.0									= 0.00
18									1.0								= 42.00
19										1.0							= 35.00
20								-.0031	1.79	-0.53	1.0						= 55.74
21								-.0002	- 2.92	7.16		1.0					= 259.20
22											-11		1.0				= 0.00
23												-11		1.0			= 0.00

TABLE 2F.

SAMPLE RESULTS WITH AND WITHOUT CONSUMPTION COMPONENT: (CASAMANCE FARM MODEL)

Activity	Results with Consumption Component	Results without Consumption Component
1. Groundnuts (ha)	1.34	1.67
2. Rice (ha)	1.61	2.00
3. Millet/sorghum (ha)	1.64	.76
4. Sale - groundnuts (kg)	1,345.00	1,667.00
5. Sale - rice (kg)	1,218.00	2,200.00
6. Sale - millet/sorghum (kg)	- 0 -	686.00
7. Farm income (CFA)	182,847.00	186,400.00
8. Income per head (CFA)	16,621.00	
9. Price of rice (CFA)	42.00	
10. Price of millet/sorghum (CFA)	35.00	
11. Consumption of rice per head (kg)	51.00	
12. Consumption of millet per head (kg)	135.00	
13. Consumption of rice per family (kg)	557.00	
14. Consumption of millet/sorghum per family (kg)	1,480.00	
15. Purchase of rice (kg)	- 0 -	
16. Purchase of millet/sorghum (kg)	- 0 -	

In addition to demonstrating the feasibility of the model, the results clearly show the rationale for farmers' persistence in producing millet/sorghum, despite the apparent higher profitability obtained from rice and groundnuts. Given the family's demand for millet/sorghum, the farmer finds it more advantageous to produce in-farm rather than acquiring it outside. The presence of millet/sorghum production does not reflect here any intrinsic conservatism or risk aversion on the part of peasant families; such a presence can be easily attributed to straightforward cost calculations of providing for family food consumption from the farm itself or from the market. Food consumption decisions are then an intrinsic element in the farm management process.

The above point is more clearly illustrated if one compares the initial results of the complete model, with those of the model incorporating only the farm production component, i.e. without taking into account family food consumption. Table 2F. presents both sets of results side by side.

In the production-only model, the recommended farm program consists almost exclusively of the two main cash crops, groundnuts and rice, 1.67 ha and 2.0 ha, respectively. Only .76 ha of millet/sorghum are included in the program. Naturally, farm revenue is slightly higher -- 186,400 FCFA -- than when consumption is introduced. As anticipated, the absence of the consumption component in the model leads to exaggerate the advantages of cash crops and implies that food crops production is a less than optimal arrangement. The combination of consumption and production components into the farm model leads to results more in accordance with observed patterns of crop areas and farmers' market behavior.

Simulations With the Farm Model

Once the basic structure of the Casamance family farm has been assembled, it becomes easy to derive simulated responses to hypothetical changes. By simply changing a number here and a number there, one may alter the model to reflect new situations. The new results would give an indication of the direction of adjustment in the various activities, as well as a rough idea of the order of magnitude. Given the tentative nature of this exercise, the actual figures should not be taken literally.

To illustrate the flexibility of the model for analysing the effects of policy or other changes, some simple examples follow.

Off-Farm Income

In our original model the family's income is tactily assumed to come only from the farm activities. Among farmers in the Casamance, it is very common for the young men, and sometimes women, to go to Dakar or the Peanut Basin to work during the slack season in the Casamance. Alternatively, farm families receive periodically remittances from members living elsewhere.

Let us suppose, for example, that the family receives 100,000 CFA per year from relatives in Dakar. This amount should enter as family income in making the consumption calculations. This is easily accomplished in the model by changing the right-hand side of Row 2 to 100,000 instead of the current zero. The results from this simple change are predictable (see Table 2G.).

Millet/sorghum consumption increases by only slightly, while rice consumption increases in proportion to income from 51 to 79 kg. Farm production remains basically unchanged but the amount of rice sold decreases as a consequence of higher family consumption. The new value for farm income reflects the remittances, hence it should rather be viewed as family income. Farm revenue from crops remains unchanged.

Changes in Family Composition

The relative proportion of working adults in a family has an obvious impact on what is produced, consumed, and sold at the farm. The composition of the family is reflected in the model both in the number of working days available, and in estimating the family consumption requirements. A simple example will suffice: instead of 6 children in the original family of 11, let us suppose that there are only 4; the number of adults remain the same, so family labor remains unchanged. To introduce this modification one has to change three coefficients in the original model of Table 2E.:

In Row 17, column 7, the value changes from -1/11 to -1/9;

In Rows 22 and 23, the - 11 is changed to - 9.

The potential impact of the removal of two children can be viewed in the new results from the model: income per head increases, which raises rice consumption per head. Total millet consumption by the family is lower, but rice consumption is slightly higher, which allows the farm to increase both rice and groundnuts production and sales, while reducing millet/sorghum production. Family revenue increases slightly because of the shift to more profitable cash crops.

TABLE 2G.

RESULTS FROM ALTERNATIVE SPECIFICATIONS: (CASAMANCE FARM MODEL)

Activities	Original	Off-Farm Income	Family of 9	Groundnuts at 50 CFA	Rice at 50 CFA
1. Groundnuts (ha)	1.34	1.34	1.45	1.67	0.64
2. Rice (ha)	1.61	1.60	1.74	2.00	2.00
3. Millet/sorghum (ha)	1.64	1.67	1.35	0.76	1.93
4. Sale - groundnuts (kg)	1,345	1,337	1,451	1,667	642
5. Sale - rice (kg)	1,218	897	1,353	1,608	1,754
6. Sale - millet/sorghum (kg)	- 0 -	- 0 -	- 0 -	- 0 -	- 0 -
7. Farm income (CFA)	182,847	282,758	184,020	194,156	197,849
8. Income per head (CFA)	16,621	25,703	20,445	17,649	17,984
9. Price of rice (CFA)	42	42	42	42	50
10. Price of millet/sorghum (CFA)	35	35	35	35	35
11. Rice per head (kg)	51	79	62	54	41
12. Millet/sorghum per head (kg)	135	136	135	135	158
13. Rice for family (kg)	557	867	562	592	446
14. Millet/sorghum for family (kg)	1,480	1,500	1,218	1,482	1,740
15. Purchase of rice (kg)	- 0 -	- 0 -	- 0 -	- 0 -	- 0 -
16. Purchase of millet/sorghum (kg)	- 0 -	- 0 -	- 0 -	797	- 0 -

Price Increases of Groundnuts

The Senegalese government has the power to affect the price for goundnuts paid to farmers; this is the key instrument of government agricultural policy, especially when ONCAD was a government monopoly charged with marketing and processing the groundnut crop. Can the effects of groundnut price changes be traced with the aid of the Casamance farm model just developed? The simulation of price policies was, of course, one of the main motivations for building the model. To accomplish this, all that is needed is to modify the appropriate coefficient in the model.

Since groundnut farm consumption as food has been assumed to be neglible, the price of groundnuts only enters in calculating the revenue from groundnut sales (see Row 2, column 4 in Table 2E.). Let us suppose, for example, that ONCAD had established the price for groundnuts at 50 CFA per kg instead of the original 42 CFA. The results of the model with the higher price appears in Table 2G., and they are highly interesting. First, hectares in groundnut production increases from 1.34 ha to 1.67 ha, a 25 percent increase in response to a 19 percent increase in price. Groundnut sales increase in proportion to the area cultivated. Second, hectares of rice also exhibit a surprising increase as a consequence of the higher groundnut price. This latter result was unexpected; rice increased from 1.61 ha (in the original model) to 2.00 ha, a 24 percent increase. Were it not for the limit of 2 hectares of wetland suitable for rice production faced by the farm, rice area would have expanded even further.

Millet/sorghum production, however, exhibits a drastic drop as a consequence of rising groundnut prices: from 1.64 ha, it went down to merely 0.76 ha, a precipitous 54 percent loss. Millet/sorghum consumption, however, remained unchanged at 135 kg per head; the deficit in millet/sorghum production is compensated by purchases in the market, on the order of 797 kilograms. Rice consumption rises to 54 kg per head, from 51 before the groundnut price increase; most of the additional rice production, therefore, finds its way to the market: 1.6 tons of rice are sold instead of 1.2 tons as previously.

The expected ramifications of the increase in groundnut prices are a logical result from the structure of the model and the data used in it. These results highlight the complex interrelations existing within a family farm enterprise, and the limitations of intuition to take them into account.

One can tentatively explain the shift away from millet/sorghum into groundnuts and rice as a reallocation of labor mandated by the relative crop prices. Under the

original set of prices, the farmer found it advantageous to produce his family's millet consumption in the farm. At the higher groundnut prices, other things staying the same, the farmer reduces millet/sorghum hectares in order to free labor for groundnut production. The critical months for labor are June and July. A smaller area of millet/sorghum releases equal amounts of labor in both months, while groundnuts require 30 workdays in June -- there is an obvious complementarity between groundnuts and rice in the use of June and July labor. Not surprisingly, increases in groundnut hectares carries along corresponding increases in rice hectares.

Moreover, under the new set of prices, the higher income from rice and groundnuts is sufficient to overcome the 20 percent markup charge on millet/sorghum; the farmer finds it then profitable to purchase part of his millet/sorghum needs at the market, but he continues to produce about half of his family's requirements.

Despite the diverse and significant changes in crop patterns resulting from the rise in groundnut prices, farm income increased only by 6 percent to 194,156 CFA, or 17,649 CFA per head. Hence the minor adjustments observed in cereals consumption. In short, consumption seems rather insensitive to the price of groundnuts, while crop production patterns are highly sensitive to it.

Price Increases of Rice

Unlike groundnuts which are treated here only as a cash crop, rice is both an important source of cash as well as a major ingredient of the diet in Casamance. Changes in the price of rice have a more complex chain of linkages than those of groundnuts. A higher price for rice will not only induce farmers to produce more rice, but will also discourage farmers from consuming it; hence we can expect a higher proportion of rice production to reach the market. On the other hand, increased revenues from rice will tend to raise consumption of both rice and millet/sorghum. Moreover, the demand for millet/sorghum is affected by the price of rice; an increase in the latter will also increase the former. The Casamance farm model will trace these conflicting influences to arrive at some net effects.

A comparable price increase for rice, from 42 CFA/kg to 50 CFA/kg, was chosen for illustration. Several coefficients in the model need changing to incorporate the new price. Rice sales and rice consumption (A-5 and A-13) must be valued at 50 CFA/kg in Row 2 that defines farm income. Rice purchases (A-15) now reduce farm income (Row 2) by 60 CFA/kg to allow a 20 percent markup charge. Finally (A-9) the price of rice used in calculating demand is set at 50 CFA/kg in the right-hand side column of Row 18.

Results from the model thus modified are given in Table 2G. Rice production increased to its limit (2.00 ha, from 1.61 ha). Groundnuts, on the other hand, suffered a major loss of acreage, from 1.34 ha to merely 0.64 ha. Millet/sorghum increased from 1.64 ha to 1.93 ha in response to higher demand within the family. Those results contrast sharply with those from an equivalent rise in groundnut prices. While rice production increases with higher groundnut prices, groundnuts production decreases at higher rice prices. This lack of symmetry in supply response is puzzling and unexpected. Millet/sorghum production is also affected in opposite directions: it declines sharply with higher groundnut prices, but increases significantly at higher rice prices. Under the new crop production schedule, June labor days cease to be a limiting factor. The July labor constraint becomes all the more critical, and the availability of wetland places a barrier on further expansion of rice production.

Family food consumption responds to the higher rice price by reducing rice consumption by 10 kg to 41 kg per head while increasing millet/sorghum consumption 23 kg to 158 kg per head. By contrast, the higher price for goundnuts left food consumption roughly unaffected. No recourse is made to the market to obtain the additional millet/sorghum, as had occurred in the groundnuts price case.

Farm income per family member increased eight percent to 17,983 CFA, a slight gain over the groundnut price case. Total farm revenue was 197,849 CFA against 182,847 CFA in the original model.

Assessment of Nutritional Status

A major motivation for this attempt at introducing food consumption considerations into a farm management framework, was to determine the impact of policy changes on the nutritional status of rural families.

The Casamance farm model here developed already provides information on per capita consumption of the two main types of cereal in the diet: millet/sorghum and rice. These items account for the bulk of nutrient intake in the Casamance. Additional items could be added to the model in a straightforward manner, but data considerations limit the expansion of the model in actual situations.

Nutritional adequacy of diets is evaluated on the basis of daily calorie and protein intakes per person. Other lesser nutrients are neglected in this illustrative exercise. In order to judge the food consumption pattern resulting from the farm model, we need to convert the actual quantities of rice and millet/sorghum per head, into corresponding daily calorie and protein equivalents. By introducing two additional equations, the farm model itself can be made to do the needed computations.

Daily calorie intake is just the sum of calories contained in rice and millet/sorghum, divided by 365 days a year. A new activity (A-17) is defined as:

$$(A\text{-}17) = \frac{3500}{365} \cdot (A\text{-}11) + \frac{3510}{365} \cdot (A\text{-}12)$$

where: (A-17): Daily calorie intake per person, in calories;

(A-11): Annual consumption of rice per person, in kilograms;

(A-12): Annual consumption of millet/sorghum per person, in kilograms.

The coefficients (3500 and 3510) are the number of calories in one kilogram of paddy rice and in one kilogram of whole millet grain, respectively. A new row (Row 24) can then be defined in the model to represent the equation:

$$(A\text{-}17) - 9.59\,(A\text{-}11) - 9.62\,(A\text{-}12) = 0.$$

In a parallel manner we can compute protein intake as:

$$(A\text{-}18) = \frac{63.3}{365} \cdot (A\text{-}11) + \frac{94.4}{365} \cdot (A\text{-}12).$$

where: (A-18): Daily protein intake per person, in grams;

(A-11): Annual consumption of rice per person, in kilograms;

(A-12): Annual consumption of millet/sorghum per person, in kilograms.

The numbers (63.3 and 94.4) are grams of protein per kilogram of paddy rice and whole millet grain, respectively. Data on calorie and protein content of rice and millet were obtained from the ORANA tables of nutrient composition of common foods in West Africa.

Row 25 can now be inserted to obtain protein intake:

$$(A\text{-}18) - 0.17\,(A\text{-}11) - 0.26\,(A\text{-}12) = 0.$$

Table 2H. provides the calorie and protein equivalents of the food consumption estimates obtained in the previous runs under alternative specifications. In the original version, average daily intakes of 1,780 calories and 44 grams of protein resulted from the consumption of 51 kg of rice and 135 kg of millet/sorghum per year. These values compare with the rule-of-thumb minimum recommended allowances of 2,200 calories and 30 grams of protein. However, since there are other ingredients of the diet besides those considered here, it is likely the small deficits will be covered or exceeded.

The impact of alternative specifications on the nutritional status of the family can be observed in the other columns on Table 2H. Allowing for 100,000 CFA in off-farm income induces a small but significant improvement in the diet: calorie intake rises to 2,068 calories and protein intake to 49 grams, as a result of the higher rice

TABLE 2H.

NUTRITIONAL STATUS UNDER ALTERNATIVE SPECIFICATIONS, 1976: (CASAMANCE FARM MODEL)

Variable	Original	100,000 CFA off-farm income	Family of 9	Groundnuts at 50 CFA	Rice at 50 CFA
A-11: Rice per head (kg/year)	51	79	62	54	41
A-12: Millet/sorghum per head (kg/year)	135	136	135	135	158
A-17: Calories per head (cal/day)	1,780	2,068	1,901	1,813	1,911
A-18: Protein per head (g/day)	44	49	46	44	48

consumption. A smaller but similar improvement in the diet is observed when family size is reduced to 9 persons instead of 11: calories increase to 1,901 and protein to 46 grams.

Price policy changes influence the Casamance diet differently, depending on whether it is groundnuts or rice whose price is being changed. Raising groundnuts prices to 50 CFA/kg adds a few calories to the diet -- 1,813 instead of 1,780 -- but leaves protein intake the same. The equivalent price increase in rice, however, increases both calories and protein intakes to 1,911 calories and 48 grams, respectively. The latter is the result of a large increase in millet/sorghum consumption accompanied by a drop in rice consumption.

The above results indicate a remarkable stability of nutrient intakes in the Casamance diet. Variations in food consumption do occur in relation to external changes, but the overall energy and protein intakes remain substantially unchanged. The 55 percent increase in family income from off-farm sources resulted in a 16 percent increase in calorie intake, and 11 percent in protein intake. Income elasticities of energy and protein intakes would roughly be about .3 and .2 respectively.

Similarly, when the price of groundnuts was raised by 19 percent, protein intake stayed the same, and calorie intake rose by a mere 2 percent. However, when the price of rice was raised by an equivalent amount, the resulting improvement in nutrient intakes were significant: seven percent in calories and nine percent in protein. The elasticities of calories with respect to the prices of groundnuts and rice can then be roughly estimated at .1 and .4 respectively. For protein, the estimates are .0 for groundnuts and .5 for rice.

One may conclude from the foregoing analysis that rice price policy is a more effective instrument than groundnuts price policy to influence the nutritional status of rural families in the Casamance: higher prices of rice lead to nutritional improvement; higher prices for groundnuts leave nutrient status roughly the same. The current emphasis of the Senegalese government to promote rice production through better prices and increase its self-sufficiency in rice, is expected to lead to an improvement in the Casamance diet.

Summary and Conclusions

1. Food consumption by rural families in Senegal is subject to the influence of economic factors such as family income, the prices of foodstuffs, and marketing changes.

2. Farmers' food consumption is amenable to statistical estimation and analysis through techniques similar to those used in urban consumption studies. However, substantial adaptations in survey methodology might be necessary. Rural families' food consumption can be represented by a set of linear demand equations on the various income and price factors.

3. Peasant farmers in the Casamance require a dual consideration in their roles as producers and consumers of agricultural products. Farm models limited to the production side alone, overestimate the potential for cash crop production, and underestimate the advantages of internal food production.

4. The set of consumption equations of a farm family can be integrated within the framework of a standard linear farm management model. A detailed explanation of the procedure was provided. The structure of the model imposes flexible requirements in the data. Production and consumption data already available from other sources can be adapted to satisfy the requirements of the model.

5. Results from the combined production-consumption farm model are highly satisfactory, and better reflect observed crop patterns in the Casamance than the production-alone farm model. Farmers choose to produce rather than purchase their millet/sorghum consumption needs, despite the apparent higher profitability of groundnuts and rice.

6. The model thus developed can be expanded to reflect more complicated real life situations. Alternative specifications of the model permit researchers and policy makers to approximate the likely impact of exogenous changes upon the crop pattern in the farm and food consumption patterns by the family.

7. Nutritional considerations can be built into the model, thus taking advantage of the information on per capita food consumption. The model was used to evaluate the potential effects of changes in the prices of groundnuts and rice on food consumption by the farm family. Higher prices for groundnuts have negligible effects upon the nutritional adequacy of the diet, while a higher rice price yields a substantial improvement in both calorie and protein intakes.

8. Although the relative proportions of rice and millet/sorghum in the Casamance diet varies greatly in response to outside changes in income and prices, the actual nutrient content of calories and protein was found remarkably stable. Small but positive effects in nutrient intakes were estimated for family income, and for the prices of groundnuts and rice.

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CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

CHAPTER 3
FOOD CONSUMPTION DECISIONS IN A FAMILY FARM PLANNING MODEL

by

Edgar J. Ariza-Niño

Center for Research on Economic Development
University of Michigan

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CHAPTER 3

FOOD CONSUMPTION DECISIONS IN A FAMILY FARM PLANNING MODEL

Introduction

Agricultural development professionals have regarded farmers primarily as producers of farm products; until recent years attention has not been focused on the dual role of the family farm as consumers of agricultural products. Interest in farm food consumption reflects in part increased concern about the nutritional status of the rural population, but also recognizes the fact that in developing countries the bulk of agricultural production is consumed by the farmers themselves.

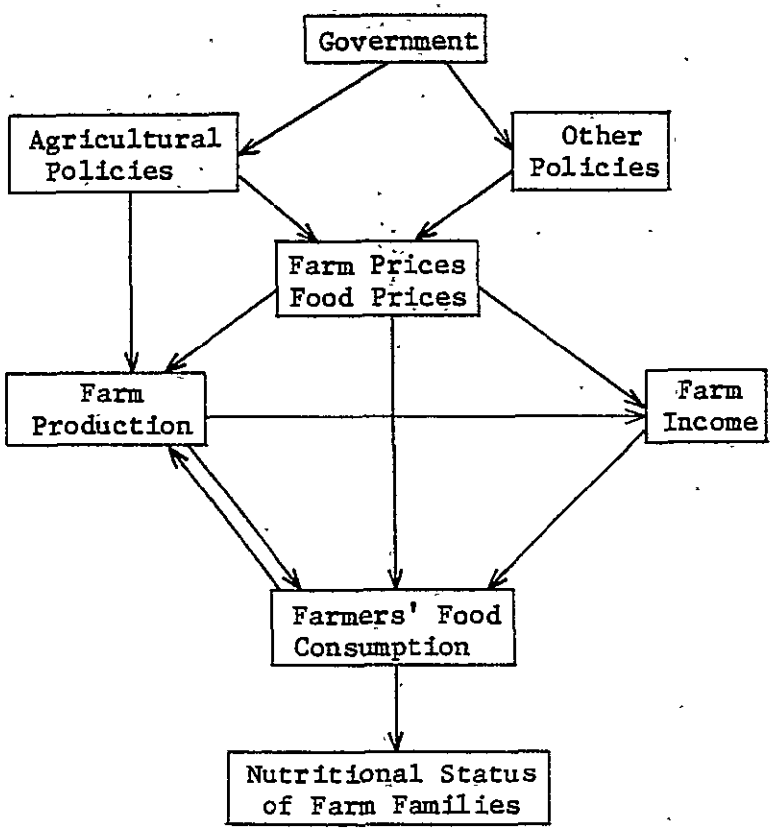
The Office of Nutrition of the Agency for International Development contracted with the Center for Research on Economic Development of the University of Michigan, to carry out studies in two West African countries, Senegal and Cameroon, to develop methodology and survey procedures to calculate the potential impact of agricultural policies on the nutritional status of farm families. This report outlines a farm planning model approach to this problem; the model integrates decisions about family food consumption within the general farm management linear programming (LP) framework.

There is great diversity in developing countries in the types of policies affecting the performance of the rural sector. Some policies are aimed directly at agriculture, but often, macroeconomic policies on foreign exchange, trade, credit, money, and other issues have substantial consequences on the farm sector. Farmers notice the effects of these policies mainly through the price mechanism, as prices for farm products and consumer goods purchased by farmers change in response to those policies. Of course, farmers also respond to direct interventions by state agencies in the provision of inputs such as seed, implements, credit and fertilizers, independently of price changes. The chain of effects of government policies on the nutritional status of farm families can be roughly traced in the diagram in Figure 3A.

Farmers' nutritional status is affected by many factors other than food consumption, such as water quality, sanitation infrastructure, medical and health care facilities. These other factors might have a crucial effect on the well-being of particularly susceptible groups such as children, pregnant women and the aged. Food consumption remains however the main determinant of nutritional adequacy, and serves here as the link between government policies and nutrition status of farmers.

FIGURE 3A.

EFFECTS OF GOVERNMENT POLICIES ON NUTRITIONAL STATUS



Food consumption in rural as well as in urban families is determined in large part by the income of the family, and the relative prices of different foods. The composition of the diet will vary considerably among income groups, and from one season to another in response to variations in the availability and prices of the different foods. The food requirements of the farming family may be satisfied either through market purchases or by production on the farm itself. Cash for food purchases originates mostly from the sales of farm produce, although off-farm employment and remittances from family members living away may also be important sources of income. The pattern of agricultural activities of a family is, therefore, not chosen independently of consumption; production decisions are made in the light of technical and price data, but also taking into consideration the provision of family food needs.

Consider for example the possible effects of an increase in the price of a grain staple, i.e. rice. First, consumption of rice will diminish since it becomes dearer vis-a-vis other grains. Farmers who produce rice, however, will receive higher incomes for their rice, hence their consumption of rice and other foods will rise somewhat. Furthermore, the higher price will induce farmers to produce more rice, and new farmers to engage in rice production; this shift in production patterns provides an additional impetus to the income effect on the rice consumption. The net effect of all these changes cannot be intuitively foreseen, and will depend on the relevant price and income elasticities.

Methodology

Standard LP Farm Model

The model developed here to incorporate this multitude of interactions among prices, production, income, and consumption, is an extension of farm models already widely used to analyse farmers' behavior in developing countries. Formulation of the standard linear programming (LP) farm model dictates the maximization of farm net revenue subject to the availability of resources to the household. To review:

Maximize

$$M = \Sigma_i r_i X_i - \Sigma_i c_i Z_i \qquad i = 1, \ldots, I$$

subject to

$$\Sigma_i \gamma_{ti} Z_i \leq \Gamma_t \qquad t = 1, \ldots, T$$

$$X_i \leq g_i Z_i \qquad i = 1, \ldots, I$$

$$Z_i, X_i \geq 0 \qquad i = 1, \ldots, I$$

where

M = Net farm monetary revenue.

i = Index subscript of the array of farm products and foods.

X_i = Sale of product i, in units of product i.

r_i = Revenue (price) per unit of product i.

Z_i = Production of i, in hectares.

c_i = Cost of production per hectare of Z_i.

g_i = Yield per hectare of Z_i, in units of product i.

t = Index subscript for the different farm resources.

γ_{ti} = Input-output coefficient: units of resource t used per hectare of Z_i.

Γ_t = Supply of resource t available to the household.

The resources indicated by Γ_t range from different soil types in the farm, to labor constraints during specific time periods in the agricultural cycle. Other resources commonly considered are the amount of seed or fertilizer available, or limits on access to credit and hired labor. Production activities, Z_i's, are typically cultivation of various crops, but livestock activities as well as processing activities could also be incorporated with minimal adjustments. The coefficients, c_i, only include monetary costs per unit of production activity, i.e. disregarding imputed values for own-land, own-labor, and management. Sales activities, X_i, are entered separately to permit in subsequent steps, independent decisions about production, consumption, sales, and purchases of a given product. The same index, i, is kept for both production and sales activities for the sake of simplicity in notation, even though sometimes one or the other might be missing. In such cases the missing activity may be omitted without loss of generality.

The analysis of peasant farming using linear programming model is now a well accepted and widely used technique. Nevertheless, when the above type of farm model is implemented for a given area, the solution often recommends cash crop production beyond the levels observed and contrariwise, it underestimates the levels of food crop production for house consumption. Researchers and advisors faced with this discrepancy between model recommendations and observed behaviors ordinarily attribute it to a safety-first strategy by the peasant family, that is that farmers produce first to feed the family and only then for the market. To incorporate this assumed behavior, additional restrictions are entered in the farm model to force the production of a minimum surface of grain crops, or a minimum level of grain production. Specifying rotation activities can accomplish the same purpose.

This ad hoc procedure is unsatisfactory to analyse the food consumption effects of changes in prices or resource levels faced by the farmer. First, the minimum food constraints are arbitrarily imposed by the researchers at some level deemed reasonable. Second, these minimum levels of food production are taken as being independent of the income of farmers, and relative commodity prices. Thus, agricultural policies that might affect farmers' prices and incomes are not likely to show an impact on farmers' food crop production, hence food consumption.

Farm Model with Least-cost Diet

An alternative approach to introduce family food consumption decisions into the farmers' management process is to incorporate a least-cost diet formulation within the standard linear programming farm model. In its original conception the joint farm management-least-cost diet model is designed to represent the situation of a livestock farm, where a given number of animals has to be fed certain levels of nutrients. The farmer can purchase the ingredients for the ration, produce them in the farm, or produce and sell some items, and purchase others. The general form of this combined diet and farm management problem is

Maximize

$$M = \Sigma r_i X_i - \Sigma c_i Z_i - \Sigma s_i W_i$$

Subject to resource constraints

$$\Sigma \gamma_{ti} Z_i \leq \Gamma_t \qquad t = 1, \ldots, T \quad i = 1, \ldots, I$$

product balances

$$X_i + V_i \leq g_i Z_i + W_i$$

and nutrient constraints

$$\Sigma \delta_{ni} V_i \geq \Delta_n \qquad n = 1, \ldots, N$$

plus the non-negative constraints

$$X_i,\ V_i,\ W_i,\ Z_i \geq 0$$

where, in addition to the symbols given previously,

W_i = purchase activity of product i, in units of i.

s_i = purchase price of product i.

V_i = farm consumption activity of product i, in units of i.

δ_{ni} = contents of nutrient n per unit of product i.

Δ_n = total requirements of nutrient n.

Although the problem is specified as one of maximization, the resulting values of V_i will provide a least-cost diet, since in order to maximize net revenue M, production and sale activities will be increased as much as possible while the values of consumption and purchase activities will be kept as low as possible, but insuring that they still satisfy the nutrient constraints. Since the number of animals is taken as given, revenue from their sale or the sale of their products is a constant value that need not be included in the objective function. Farm consumption activities, V_i, do not enter in the objective function because they do not generate any income by themselves, and their cost is already included in either the purchase or production activities.

Although the farm management cum least-cost diet formulation (when applied to the problem of feeding the farms' family) takes explicit account of nutritional considerations, its usefulness for assessing the nutritional impact of agricultural policies is very limited. First, it is questionable whether food consumption decisions of a family can be represented as a cost minimization problem to satisfy minimum nutrient requirements, since neither the requirements nor the composition of foods are known by the family. Second, the resulting least-cost diets will normally turn out unreasonably monotonous and unappetizing (Calkins, 1981). To improve the palatability for human consumption, the analyst can recur to ad hoc constraints to limit the levels of garlic or radishes, for example, but such after the fact restrictions always involve a measure of arbitrariness that precludes, to a great extent, the analysis of policy impacts. Third, the set of nutrient contraints is insensitive to both family income and prices; hence it is not possible to follow the effects of these on the nutritional status of the family. Changes in relative prices might affect the composition of the diet, but the levels of nutrients will remain roughly the same.

Food Consumption, Prices and Income

The fundamental criticism against the above two approaches to introduce food consumption considerations in farm planning, is their neglect of the economic nature of food consumption. Rural families, like their counterparts in urban centers, adjust their consumption in greater or lesser degree in response to changes in income and prices. Although food demand studies among farm families in developing countries are still rare, there is ample evidence of wide variations in diet composition and intakes between areas, among families, and within seasons. These variations can, to a great extent, reflect adjustments to spatial and temporal variations in prices, and the distribution of income within the population. Even among poor farmers in remote areas one finds a substantial portion of food consumed is purchased, and often imported from outside the region. Peasant farmers rely on the market for a considerable part of their food supply.

Per capita consumption of a given food product can be functionally represented by a simple linear demand equation of the form:

$$U_i = \alpha_i + \lambda_i Y + \beta_{i1} P_1 + \beta_{i2} P_2 + \dots + \beta_{iI} P_I$$

where

U_i = per capita consumption of food i, in kilograms per year.

α_i = constant in demand function for food i.

λ_i = income coefficient in demand functions for food i.

Y = income per capita.

P_i = price of food i.

β_{ij} = coefficient in demand function for food i for the price of food j.

Empirical estimation of a system of demand equations for the main foods in a region is a major undertaking in itself. Considerable amount of data and careful econometric methods would be required. In the absence of empirical estimates, the equations may be derived from a priori estimates of income and price elasticities and information about current consumption patterns. Setting aside the issues of estimating such demand functions, the problem at hand is how to integrate the food consumption behavior embodied in those equations into the farm planning framework.

Farm Model with Food Consumption Functions

It is possible to enter the above set of linear demand equations for food, in terms of income and prices, into the linear programming farm model. This can be accomplished through some small adjustments in the standard structure of such models. The proposed structure can be briefly stated as:

Maximize M

subject to

(a) $M \leq \sum_i r_i X_i - \sum_i c_i Z_i - \sum_i s_i W_i$

(b) $\sum \gamma_{ti} Z_i \leq \Gamma_t$ $\quad t = 1, \ldots, T$

(c) $X_i + V_i \leq g_i Z_i + W_i$ $\quad i = 1, \ldots, I$

(d) $Y_1 = M + \sum_i s_i V_i$

(e) $Y_2 = Y_1/\phi$

(f) $P_i = s_i$

(g) $U_i = \alpha_i + \lambda_i Y_2 + \beta_{i1} P_1 + \beta_{i2} P_2 + \ldots + \beta_{iI} P_I$

(h) $V_i = \phi \cdot U_i$

(i) $D_n = 365^{-1} \sum \delta_{ni} U_i$ $\quad n = 1, \ldots, N$

(j) $X_i, Z_i, V_i, W_i, U_i, P_i, \geq 0$ $\quad i = 1, \ldots, I$

$D_n \geq 0$ $\quad n = 1, \ldots, N$

$M, Y_1, Y_2 \geq 0$

where

M = Net Farm Revenue.

i = Farm product or food index.

X_i = Sale of product or food i in, say, kilograms.

r_i = Revenue per unit of i sold; i.e., producer price of i.

Z_i = Production of product or food i in, say, hectares.

c_i = Cost of production (money only) per unit of Z_i.

W_i = Purchase of product or food i in, say, kilograms.

s_i = Purchase price of product or food i.

Γ_t = Maximum supply of resource t available to the farm.

γ_{ti} = Amount of resource t required per unit of production Z_i.

g_i = Yield of product or food i per unit of production Z_i.

V_i = Amount of product or food i consumed in the farm, in a year.

Y_1 = Household income, included imputed value of home consumption.

Y_2 = Per capita income in household.

ϕ = Family size.

P_i = Consumer price of i.

U_i = Per capita consumption of food i, in kilograms.

α_i = Constant term in demand function for food i.

λ_i = Income coefficient in demand function for food i.

β_{ij} = Coefficient in demand function for food i, for price of food j.

D_n = Per capita daily intake of nutrient n, in appropriate units for each nutrient.

δ_{ni} = Contents of nutrient n per kilogram of food i.

Σ = Summation symbol; over i in all cases.

The objective function includes only one variable, farm net revenue M, which is explicitly defined in constraint (a) as the sum of all revenues from farm sales less costs of production and food purchases. One advantage of this type of specification is to allow the use of farm revenue later on in determining household income, hence food

consumption. The set of constraints in (b) correspond to the limits on production activities imposed by the resources available to the farm. Product balances are given in (c) to insure that outflows of a given product or food from sales or consumption do not exceed the inflows from production and purchases.

Household income, Y_1, is defined in (d) as farm net revenue plus the imputed value of home food consumption at purchase prices. In the next constraint, per capita income is defined as Y_1 divided by household size. The set of constraints in (f) are identities designed to define the prices of different foods as variables in the linear programming framework; this will permit later on in (g) to calculate per capita consumption U_i of each food i on the basis of information on income Y_2 and prices P_i. Per capita food intakes are converted to annual household consumption in the set of equations (h). Finally, daily per capita intakes of calories, protein and other nutrients denoted by D_n, are computed in (i) based on the per capita consumption of each food and their corresponding nutrient compositions. The nonnegativity constraints for all variables in the model are specified in (j).

Table 3A. presents a simplified example of the model structure in matrix form, for a farm family with only two food products (i.e. i = 1,2), three types of resources (t = 1,2,3), and two nutrients that matter (n = 1,2). It can be easily seen from the structure how the model could be expanded to accomodate more complex situations.

Advantages of the Proposed Modelling Scheme

The extended linear programming farm planning model postulates a farmer aiming to maximize the net revenue from the farm resources, but taking full account of the food consumption requirements of the farm household. The food needs of the family are not constant values but change in response to different levels of prices and household income. The consumption analysis is carried out in terms of individual foods or categories of foods. Nutrient intakes are, therefore, the outcome of food consumption decisions rather than the other way around. Income changes and price changes have effects on the nutritional status of farm households through their impact on the levels of consumption for each major food.

A general equilibrium model of the farm enterprise has been thus constructed, where decisions about production and consumption are intimately linked through household income. The latter variable is the outcome of the production and sale activities and a key input in determining consumption levels. Prices enter the model in two ways, as revenues in sale activities, and as costs in the food purchasing and consumption activities. For the same product, the price paid by the farmer as a consumer will probably be higher than the price he would receive as a producer. The

TABLE 3A.

MATRIX OUTLINE OF LINEAR PROGRAMMING FARM PLANNING MODEL WITH BUILT-IN FOOD CONSUMPTION EQUATIONS

VARIABLES

	M	Z_1	Z_2	X_1	X_2	W_1	W_2	V_1	V_2	Y_1	Y_2	P_1	P_2	U_1	U_2	D_1	D_2	Righthand side
Objective Function	1																	Maximize
Farm Net Revenue	1	c_1	c_2	$-r_1$	$-r_2$	s_1	s_2											< 0
Resource Constraints		γ_{11}	γ_{12}															$< \Gamma_1$
		γ_{21}	γ_{22}															$< \Gamma_2$
		γ_{31}	γ_{32}															$< \Gamma_3$
Product Balances		$-g_1$		1		-1		1										< 0
			$-g_2$		1		-1		1									< 0
Household Income	-1							$-s_1$	$-s_2$	1								< 0
Income per Head										$-\phi^{-1}$	1							$= 0$
Food Prices												1						$= s_1$
													1					$= s_2$
Food Consumption Equations											$-\lambda_1$	$-\beta_{11}$	$-\beta_{12}$	1				$= \alpha_1$
											$-\lambda_2$	$-\beta_{21}$	$-\beta_{22}$		1			$= \alpha_2$
Household Food Consumption								1						$-\phi$				$= 0$
									1						$-\phi$			$= 0$
Nutrient Intake per Head per day														$-\delta_{11}$	$-\delta_{12}$	365^{-1}		$= 0$
														$-\delta_{21}$	$-\delta_{22}$		365^{-1}	$= 0$

price differentials will reflect the relative efficiency of the marketings mechanism for different products. When the producer-consumer price differential for a major food is sufficiently large, the farmer may find advantageous to produce that food himself and reduce the production of another seemingly more profitable crop. This might partly explain why peasant farms often seem to have greater than optimal levels of food crop production.

The possibilities for simulation of policy impacts with the help of the proposed model go beyond the nutritional impact originally intended. As stated above, by explicitly incorporating food consumption decisions, this extension of the farm planning model will likely yield outcomes more in accordance with observed farmers' behavior in developing countries. It will also provide a vehicle to assess the nutritional impact of agricultural projects that change model parameters such as resource availability or yields. Family size and family structure enter the farm decision process in determining labor availability, and the per capita levels of income and food consumption. In sum, the proposed modelling scheme expands the usefulness of the standard linear programming farm model as instrument of policy evaluation, by introducing family food consumption decisions into the farm planning process.

Conclusions

Small farmers in developing countries ordinarily consume the greater part of their farm production. Models of peasant farms normally consider the farmer only in his role as producer and tacitly assume production for the market as the only motivating force. As a result, these models often prescribe unrealistic levels of production specialization and market sales, and underestimate the needs of farmers to produce their own foods. Development researchers amply recognize the desirability of introducing food consumption considerations into the standard farm management model, but the adaptations commonly tried are not entirely satisfactory, for they involve a measure of arbitrariness, or they prescribe food consumption as being insensitive to economic factors.

An expanded linear programming version of the farm planning model is proposed here to incorporate linear consumption functions for individual foods or categories, dependent on levels of income and the array of relative prices facing the farmer. The enlarged size of the model poses no difficulties, as current computer capabilities normally suffice to accomodate even very complex situations. The suggested model would likely improve the predictive power of standard linear programming farm models

under smallholder agriculture, and offers a ready-made instrument to assess the food consumption and nutritional impact of changes affecting the agricultural sector, brought about either by policy or other external factors.

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CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

CHAPTER 4
FARMERS' FOOD CONSUMPTION ELASTICITIES: ILLUSTRATION FROM CAMEROON

by
Richard Rice

Center for Research on Economic Development
University of Michigan
1982

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CHAPTER 4

FARMERS' FOOD CONSUMPTION ELASTICITIES: ILLUSTRATION FROM CAMEROON

The primary objective of the Cameroon study is to project the short run impact of certain government policies on the nutrition of farmers in the "ring road" area of the Cameroon's Northwest Province. Although attention has been focused on two specific government actions, i.e. trade liberalization with Nigeria and improvements in the road infrastructure between the two nations, the nutritional impacts discussed in this chapter could arise equally from any government policy or indeed, private market activity affecting the prices farmers receive for their crops.

Calculation of projected changes in the farmers' nutrition is based on an estimation of the price elasticity of demand for home consumption of marketed food crops. In addition, it was found to be convenient and enlightening to also estimate the farmers' total short run price elasticity of demand for marketings. Estimates of the consumption elasticity were combined with information gathered on household nutritional status to yield estimates of the cultivators' short run price elasticities of calorie and protein intake. These estimates in turn were applied to a schedule of hypothetical price increases to yield projected changes in the sample attainment of calorie and protein minimum daily requirements.

This chapter presents the methodology used in estimating farmers' marketing and consumption responsiveness to changes in the prices of marketed food crops. A brief description of data collected for use in this estimation procedure will then be given, with emphasis being placed on summarizing the major sources of income and nutrition of households included in the sample. Results obtained from this estimation procedure will also be presented along with a discussion of their broader policy implications.

Methodology

The basic model used in our analysis was originally developed by Bardhan in conjunction with a study of small farmers in India.[1] His research focused entirely

[1] K. Bardhan. "Price and Output Response of Marketed Surplus of Foodgrains: A Cross-Sectional Study of Some Northern Indian Villages," Am. J. Agr. Econ. 52 (1970): 51-61.

upon calculation of the short-run elasticity of marketed surplus. The model was later refined by Haessel to include estimation of both price and income elasticities of marketed surplus and home consumption.[2]

In view of the fact that it seemed to provide more information, and further, explicity addresses our concern with the farmers' consumption response to price changes, we chose to adopt Haessel's formulation of the model for use in our study.

Relevant portions of his 1975 article are presented below with differences introduced for the purposes of our analysis noted as necessary.

The Model

Haessel begins his presentation of the model with the following identity:

$$(1)\quad Q \equiv C + M.$$

That is, the total production of food crops (Q) is divided amongst consumption by the cultivators (C) and marketings (M).[3]

Of interest to us is the cultivators' short run (i.e. from one planting season to the next) decision to allocate (Q) between home consumption and sales. Consumption (C) is assumed to be a function of the price of marketed food crops (P) and the net income of farmers (Y):

$$(2)\quad C = C\,(P, Y).$$

Given that the allocation of (Q) between (C) and (M) involves only one decision, (M) can be viewed as a residual, or from equation (1):

$$(3)\quad M = Q - C\,(P, Y) = M\,(P, Y, Q).$$

Net farm income will depend upon the value of agricultural production, as well as income from other sources (Y°) and production costs. However, since it was not feasible to gather detailed cost information, income is defined as (Y°) plus income derived from agricultural production (including the imputed value of own consumption) or:

$$(4)\quad Y = PQ + Y^\circ.$$

Assuming a linear functional form, the consumption equation can be specified as:

$$(5)\quad C = \alpha_0 + \alpha_1 P + \alpha_2 Y + e,$$

where e is a normally distributed statistical error term with mean zero.

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[2] W. Haessel. "The Price and Income Elasticities of Home Consumption and Marketed Surplus of Foodgrains," Am. J. Agr. Econ. 56 (1975): 111-115.

[3] Both Haessel and Bardhan added a third term to this identity to account for all other disposals of food crops on the farm in payments in kind for rent, wages, etc. In view of the fact that such disposals tended for the most part to be small (ceremonial tributes within our study area rather than actual payments in kind), it was decided that this variable should not be included in our equation.

It should be noted that in the actual analysis, two specifications of the consumption equation were estimated. Data used in the above equation for consumption (C) and income (Y) were calculated on a per capita basis for each household, a form which conforms to the specifications used by Haessel and Bardhan. In an alternate specification, household totals were used for consumption (C') and income (Y'), with family size (F) added as a separate regressor:

$$(5a)\quad C' = \beta_0 + \beta_1 P + \beta_2 Y' + \beta_3 F + \lambda$$

where λ, again, is a normally distributed statistical error term.

Finally, by substituting equation (5) into equation (3), it can be seen that the estimating equation for marketings is:

$$M - Q = -C = -\alpha_0 - \alpha_1 P - \alpha_2 Y - e,$$

or simply the negative of the consumption equation. Hence, all results of interest from the model, including farmers' marketing response to price changes, can be derived from an estimation of the consumption equation.

Cultivators' Price and Income Elasticities

It can be shown that the short run total price elasticity of demand for home consumption is:

$$(6)\quad \eta_{Pc} = \frac{dC}{dP}\frac{P}{C} = \varepsilon_{cp} + r\varepsilon_{cy}$$

where: $\varepsilon_{cp} = \{\frac{P}{C}\frac{\partial C}{\partial P}\}$ is defined as the pure price elasticity of demand for home consumption (ignoring the income effect of a price change); $\varepsilon_{cy} = \{\frac{Y}{C}\frac{\partial C}{\partial Y}\}$ is defined as the pure income elasticity of demand for home consumption, and $r = \frac{PQ}{Y}$ is the proportion of total household income derived from the production of food crops.

In a similar manner, the total short run price elasticity of marketed surplus can be defined as:

$$(7)\quad \eta = \frac{dMP}{dPM} = \varepsilon_{mp} = r\varepsilon_{my}$$

where: $\varepsilon_{mp} = \{\frac{P}{M}\frac{\partial M}{\partial P}\}$ is the farmers' price elasticity of marketings; $\varepsilon_{my} = \{\frac{Y}{M}\frac{\partial M}{\partial Y}\}$ is the farmers' income elasticity of marketings, and $r = \frac{PQ}{Y}$.

Finally, given the short run condition that $\frac{dQ}{dP} = \frac{dQ}{dY} = 0$ (i.e. that neither price nor income changes will affect the quantity of food crops produced), it can be shown that (7) is identical to:

$$(8)\quad \eta_{Pm} = -b(\varepsilon_{cp} + r\varepsilon_{cy})$$

where: ε_{cp}, r and ε_{cy} are as defined for equation (6) and $-b = \frac{-C}{M}$ is the negative of the ratio of consumption to marketings.

The cultivators' total short run marketing and consumption elasticities are, therefore, actually a mixture of responses, each with a pure price and an induced income component. Moreover, as was noted above, all four components of the two elasticities can be derived from an estimation of equation (5).

Data

As discussed earlier, data were collected over a three-month period in eight villages located in three subdivisions in the Northwest Province:

Bui Subdivision	Donga/Mantung Subdivision
Banten	Ntumbaw
Kikaikom	
Mbiami	**Mezam Subdivision**
Nkar	Bambui
Nseh	
Oku	

Nine households were sampled in each village for a total of 72 households. Data for six households from a total of five villages were omitted from the analysis due to known or suspected sampling error.

Each household was surveyed over a three-day period during which time information was gathered relating to farm production, marketing, household nutritional status and some of the major economic factors which might influence these variables. All data used in the analysis are summarized in Tables 4A. and 4B.

Although most of our information was collected on a producer basis (i.e. husband or wife), each entry in Tables 4A. and 4B. represents data aggregated at the household level. The dependent and explanatory variables used in the analysis are defined as follows:

C': Household consumption of major food crops (corn, beans and Irish potatoes) in tins (1 tin ≈ 16.8 kilos) calculated as a residual equal to the total quantity harvested minus the total quantity marketed. Used as the dependent variable in equation (5a). The selection of corn, beans and Irish potatoes for use in constructing this variable is discussed in conjunction with sources of household income and nutrition below.

TABLE 4A.

FACTORS AFFECTING TOTAL HOUSEHOLD CONSUMPTION OF MARKETED FOOD CROPS IN EIGHT VILLAGES

Village	Household	Family Size	Food Crops Harvested (tins)	Food Crops Marketed (tins)	Food Crops Consumed (tins)	Total Household Income (CFA)	Weighted Village Average Price (CFA)
Nseh	1.0	5.0	64.0	12.0	52.0	84823.0	623.7
	2.0	8.0	223.0	90.0	133.0	235425.0	623.7
	3.0	8.0	186.0	21.0	165.0	234480.0	623.7
	4.0	4.0	167.0	93.0	74.0	245674.0	623.7
	5.0	6.0	153.0	45.0	108.0	765320.0	623.7
	6.0	12.0	202.0	54.0	148.0	318506.0	623.7
	8.0	9.0	148.0	21.0	127.0	154559.0	623.7
	9.0	8.0	102.0	10.0	92.0	514388.0	623.7
Oku	1.0	8.0	294.0	12.0	282.0	810528.0	718.3
	2.0	7.0	64.5	3.0	61.5	325261.0	718.3
	4.0	3.0	32.5	2.0	30.5	44592.5	718.3
	5.0	7.0	79.3	15.0	64.3	383285.3	718.3
	6.0	10.0	23.0	7.0	16.0	177960.0	718.3
	7.0	3.0	50.0	3.0	47.0	158836.0	718.3
	8.0	7.0	43.0	2.0	41.0	70155.0	718.3
	9.0	9.0	25.5	2.0	23.5	153325.0	718.3
Mbiami	1.0	6.0	439.0	267.0	172.0	339799.0	851.3
	2.0	6.0	163.0	59.0	104.0	259943.2	851.3
	3.0	9.0	124.0	30.0	94.0	204521.0	851.3
	4.0	4.0	38.0	5.0	33.0	317080.0	851.3
	5.0	9.0	105.0	4.0	101.0	116435.0	851.3
	7.0	7.0	133.0	23.0	110.0	153510.0	851.3
	9.0	8.0	101.0	6.0	95.0	432596.0	851.3
Ntumbaw	1.0	7.0	39.5	0.0	39.5	137321.5	801.7
	2.0	5.0	89.0	16.0	73.0	172418.0	801.7
	3.0	3.0	15.0	0.0	15.0	134371.0	801.7
	4.0	5.0	109.0	4.0	105.0	386014.5	801.7
	6.0	12.0	45.5	0.0	45.5	207505.5	801.7
	7.0	7.0	249.0	14.0	235.0	298117.0	801.7
	8.0	7.0	36.0	2.0	34.0	143424.0	801.7
	9.0	5.0	48.0	1.0	47.0	117682.0	801.7
Kikaikom	1.0	7.0	52.0	10.0	42.0	296090.0	907.3
	2.0	21.0	837.0	156.0	681.0	7198036.0	907.3
	3.0	10.0	67.0	8.0	59.0	109070.0	907.3
	4.0	6.0	33.0	0.0	33.0	575008.0	907.3
	5.0	8.0	126.0	31.0	95.0	162349.0	907.3
	6.0	5.0	84.0	22.0	62.0	181070.0	907.3
	7.0	7.0	169.0	82.0	87.0	261076.0	907.3
	8.0	7.0	157.0	14.0	143.0	239533.0	907.3
	9.0	5.0	32.5	8.0	24.5	145147.0	907.3
Banten	1.0	6.0	124.0	18.0	106.0	86668.0	487.3
	2.0	4.0	77.5	31.0	46.5	64026.2	487.3
	3.0	7.0	93.0	24.0	69.0	95463.6	487.3
	4.0	3.0	106.0	55.0	51.0	197044.2	487.3
	5.0	7.0	180.0	36.0	144.0	116340.6	487.3
	6.0	3.0	318.0	282.0	36.0	189175.6	487.3
	7.0	7.0	85.0	18.0	67.0	78903.6	487.3
	8.0	7.0	128.0	18.0	110.0	164433.8	487.3
	9.0	4.0	95.0	42.0	53.0	78657.0	487.3
Nkar	1.0	7.0	62.0	6.0	56.0	254843.0	840.7
	3.0	16.0	25.5	1.0	24.5	408848.4	840.7
	4.0	7.0	48.0	8.0	40.0	351151.0	840.7
	5.0	7.0	41.5	11.0	30.5	259891.8	840.7
	6.0	3.0	9.0	2.0	7.0	67397.5	840.7
	7.0	8.0	40.0	4.0	36.0	62588.5	840.7
	8.0	8.0	120.0	16.0	104.0	301264.0	840.7
	9.0	4.0	32.0	9.0	23.0	93224.0	840.7
Bambui	1.0	9.0	149.0	43.5	105.5	3855159.5	1025.3
	2.0	2.0	23.0	12.0	11.0	147537.0	1025.3
	3.0	10.0	582.0	541.3	40.8	1630524.8	1025.3
	4.0	5.0	14.0	1.0	13.0	145097.0	1025.3
	5.0	5.0	68.0	2.0	66.0	137424.0	1025.3
	6.0	5.0	18.0	4.0	14.0	141234.0	1025.3
	7.0	2.0	44.5	10.0	34.5	390891.5	1025.3
	8.0	3.0	31.5	3.0	28.5	379562.5	1025.3
	9.0	5.0	48.0	30.0	18.0	1507640.0	1025.3

TABLE 4B.

FACTORS AFFECTING PER CAPITA CONSUMPTION OF MARKETED FOOD CROPS IN EIGHT VILLAGES

Village	Household	Family Size	Per Capita Values: Food Crops Harvested (tins)	Food Crops Marketed (tins)	Food Crops Consumed (tins)	Capita Household Income (CFA)	Weighted Village Average Price (CFA)
Nseh	1.0	5.0	12.8	2.4	10.4	16964.6	623.7
	2.0	8.0	27.9	11.3	16.6	29428.1	623.7
	3.0	8.0	23.3	2.6	20.6	29310.0	623.7
	4.0	4.0	41.8	23.3	18.5	61418.5	623.7
	5.0	6.0	25.5	7.5	18.0	127553.3	623.7
	6.0	12.0	16.8	4.5	12.3	26542.2	623.7
	8.0	9.0	16.4	2.3	14.1	17173.2	623.7
	9.0	8.0	12.8	1.3	11.5	64298.5	623.7
Oku	1.0	8.0	36.8	1.5	35.3	101316.0	718.3
	2.0	7.0	9.2	.4	8.8	46465.9	718.3
	4.0	3.0	10.8	.7	10.2	14864.2	718.3
	5.0	7.0	11.3	2.1	9.2	54755.0	718.3
	6.0	10.0	2.3	.7	1.6	17796.0	718.3
	7.0	3.0	16.7	1.0	15.7	52945.3	718.3
	8.0	7.0	6.1	.3	5.9	10022.1	718.3
	9.0	9.0	2.8	.2	2.6	17036.1	718.3
Mbiami	1.0	6.0	73.2	44.5	28.7	56633.2	851.3
	2.0	6.0	27.2	9.8	17.3	43323.9	851.3
	3.0	9.0	13.8	3.3	10.4	22724.6	851.3
	4.0	4.0	9.5	1.3	8.3	79270.0	851.3
	5.0	9.0	11.7	.4	11.2	12937.2	851.3
	7.0	7.0	19.0	3.3	15.7	21930.0	851.0
	9.0	8.0	12.6	.8	11.9	54074.5	851.0
Ntumbaw	1.0	7.0	5.6	0.0	5.6	19617.4	801.7
	2.0	5.0	17.8	3.2	14.6	34483.6	801.7
	3.0	3.0	5.0	0.0	5.0	44790.3	801.7
	4.0	5.0	21.8	.8	21.0	77202.9	801.7
	6.0	12.0	3.8	0.0	3.8	17292.1	801.7
	7.0	7.0	35.6	2.0	33.6	42588.1	801.7
	8.0	7.0	5.1	.3	4.9	20489.1	801.7
	9.0	5.0	9.6	.2	9.4	23536.4	801.7
Kikaikom	1.0	7.0	7.4	1.4	6.0	42298.6	907.3
	2.0	21.0	39.9	7.4	32.4	342763.6	907.3
	3.0	10.0	6.7	.8	5.9	10907.0	907.3
	4.0	6.0	5.5	0.0	5.5	95834.7	907.3
	5.0	8.0	15.8	3.9	11.9	20293.6	907.3
	6.0	5.0	16.8	4.4	12.4	36214.0	907.3
	7.0	7.0	24.1	11.7	12.4	37296.6	907.3
	8.0	7.0	22.4	2.0	20.4	34219.0	907.3
	9.0	5.0	6.5	1.6	4.9	29029.4	907.3
Banten	1.0	6.0	20.7	3.0	17.7	14444.7	487.3
	2.0	4.0	19.4	7.8	11.6	16006.5	487.3
	3.0	7.0	13.3	3.4	9.9	13637.7	487.3
	4.0	3.0	35.3	18.3	17.0	65681.4	487.3
	5.0	7.0	25.7	5.1	20.6	16620.1	487.3
	6.0	3.0	106.0	94.0	12.0	63058.5	487.3
	7.0	7.0	12.1	2.6	9.6	11271.9	487.3
	8.0	7.0	18.3	2.6	15.7	23490.5	487.3
	9.0	4.0	23.8	10.5	13.3	19664.2	487.3
Nkar	1.0	7.0	8.9	.9	8.0	36406.1	840.7
	3.0	16.0	1.6	.1	1.5	25553.0	840.7
	4.0	7.0	6.9	1.1	5.7	50164.4	840.7
	5.0	7.0	5.9	1.6	4.4	37127.4	840.7
	6.0	3.0	3.0	.7	2.3	22465.8	840.7
	7.0	8.0	5.0	.5	4.5	7823.6	840.7
	8.0	8.0	15.0	2.0	13.0	37658.0	840.7
	9.0	4.0	8.0	2.3	5.8	23306.0	840.7
Bambui	1.0	9.0	16.5	4.8	11.7	428351.1	1025.3
	2.0	2.0	11.5	6.0	5.5	73768.5	1025.3
	3.0	10.0	58.2	54.1	4.1	163052.5	1025.3
	4.0	5.0	2.8	.2	2.6	29019.4	1025.3
	5.0	5.0	13.6	.4	13.2	27484.8	1025.3
	6.0	5.0	3.6	.8	2.8	28246.8	1025.3
	7.0	2.0	22.3	5.0	17.3	195445.8	1025.3
	8.0	3.0	10.5	1.0	9.5	126520.8	1025.3
	9.0	5.0	9.6	6.0	3.6	301528.0	1025.3

C: Per capita household consumption of major food crops in tins. Defined as total household consumption of major food crops (C') divided by family size (F). Used as the dependent variable in estimating equation (5).

Y': Total annual household income from all sources expressed in thousands of FCFA (French West African Francs). Used as an explanatory variable in equation (5a). It should be noted that for the purposes of our analysis total household income is broken down into two major components: farm income and off-farm income. Off-farm income is simply income derived from nonfarm sources. Farm income is defined as market income, or the value of all marketed agricultural products, plus nonmarket income, or the imputed value of all crops retained for home consumption. The latter was calculated as the quantity of all crops harvested minus the quantity marketed times the weighted average village price for each crop.

Y: Per capita total annual household income expressed in thousands of FCFA. Defined as total annual household income (Y') divided by family size (F) and used as an explanatory variable in equation (5).

P: Village average price of marketed food crops weighted by the quantity of each crop sold. Averages were calculated using household data for marketed corn, beans and Irish potatoes and are expressed in thousands of FCFA per tin. Used as an explanatory variable in equations (5) and (5a).

F: Family size. Defined as the number of persons in each household living at home. Used as an explanatory variable in equation (5a).

Major Sources of Household Nutrition and Income

In order to project the likely nutritional impacts of higher food crop prices, it was necessary to select a specific crop or group of crops for which consumption elasticities should be estimated. Our primary concern of course was to identify those crops which were most important to the nutrition of households included in the sample. In addition, however, we were clearly interested only in crops produced for sale as well as for home consumption.

Table 4C. summarizes the major findings with regard to the relative contribution of different crops to the diet of households surveyed. As shown, a large percentage of the per capita daily intake of calories and protein is accounted for by a relatively small group of crops. Indeed, the first seven items listed in the table account for

TABLE 4C.

RELATIVE CONTRIBUTION OF SELECTED FOOD ITEMS TO PER CAPITA DAILY INTAKE OF CALORIES AND PROTEIN

	Calories %	Protein %
Corn	54.8	48.9
Palm Oil	12.2	0.0
Beans	9.2	22.9
Irish Potatoes	5.0	3.5
Cocoyams	3.6	2.1
Njamajama	2.5	8.4
Meat[a]	1.7	4.6
Plantains	2.5	0.7
Rice	2.3	1.6
Cassava	1.3	0.2
Groundnuts	1.2	1.4
Fish	0.2	1.4
Total	96.5	95.7

NOTE: (a) Includes meat from cattle, goats, chickens and wild game (i.e. antelope, cutting grass, etc.).

approximately 90 percent of all calories and protein consumed by our sample on a daily basis. Moreover, 49 percent of the per capita daily intake of protein and 55 percent of the per capita daily intake of calories was obtained from the consumption of corn alone.

An increase in the prices farmers receive for their crops, however, is not likely to affect similarly the nutritional contribution of all of the items listed in Table 4C. Some of the items (palm oil and fish, for example) are not produced within our study area, while others are produced almost entirely for home consumption. In fact, as shown in Table 4D., only half of the major contributors to per capita daily calorie and protein intake (i.e. corn, Irish potatoes, beans, rice, plantains and groundnuts) made any significant contribution to household farm income, including income from marketing and the imputed value of home consumption. Moreover, the individual contributions of rice, plantains and groundnuts to household farm income were relatively small. In particular, although both groundnuts and plantains are produced in all eight of the villages surveyed, they accounted for an average of more than 1 percent of household farm income in only four villages (for groundnuts) and two villages (for plantains). Rice, on the other hand, is not produced in any of the villages surveyed. Nonetheless, it accounted for an average of 2.5 percent of household farm income in three of the villages in which a number of the cultivators own property in the rice-producing areas of Mbo-Nso Plain -- twenty kilometers and over 1000 meters down from the nearest highlands village.

The remaining three crops (i.e. corn, beans and Irish potatoes) are clearly among the most important crops grown in our study area both in terms of their contribution to household nutrition and farm income. Indeed, as shown in Table 4E., together they account for nearly 70 percent of all calories and over 75 percent of all protein consumed by the sample households. Table 4E. shows that their importance to household nutrition is even greater in terms of their contribution to the per capita attainment of calorie and protein minimum daily requirements (MDR's).

Similarly, corn, beans and Irish potatoes accounted for nearly one-half of household farm income derived from the production of all crops (including nonfood cash crops) and approximately 75 percent of all household farm income associated with the production of food crops alone.

TABLE 4D.

CONTRIBUTION OF SELECTED CROPS TO
ANNUAL HOUSEHOLD FARM INCOME (%)

	Nseh	Oku	Mbiami	Ntumbaw	Kikaikom	Banten	Nkar	Bambui	Average
Corn	33.0	34.0	35.5	43.5	26.1	36.9	23.7	17.4	31.3
Coffee	30.0	42.2	11.1	26.8	34.7	22.0	42.2	23.0	29.0
Irish Potatoes	5.4	2.0	21.4	0.4	9.8	23.1	0.3	2.4	8.1
Beans	13.5	4.5	6.1	5.1	12.8	4.3	6.1	2.5	6.9
Cattle	0.0	0.0	8.2	6.9	0.0	0.0	0.0	10.3	3.8
Goats	4.9	3.2	0.0	0.0	0.8	4.3	1.0	5.9	2.5
Rice	1.9	0.0	6.1	11.9	0.0	0.0	0.0	0.0	2.5
Kola	0.0	3.3	8.7	0.1	2.6	1.8	2.0	1.1	2.5
Plantain	0.0	0.6	0.2	0.2	0.1	0.2	5.7	6.8	1.7
Rafia Wine	0.0	5.1	0.0	0.1	0.2	0.0	6.1	1.9	1.7
Groundnuts	0.0	1.5	0.1	3.1	0.0	0.0	2.7	5.0	1.6
Chickens	2.2	0.4	1.2	0.4	1.0	1.2	1.9	3.2	1.4
Eucalyptus	2.7	2.1	0.6	1.0	0.2	0.7	0.1	0.5	1.0
Pepe	4.4	0.5	0.0	0.0	0.9	0.4	0.0	0.0	0.8
Total	98.1	99.4	99.0	99.7	89.5	94.9	91.7	80.0	94.6

TABLE 4E.

RELATIVE CONTRIBUTION OF CORN, BEANS AND IRISH POTATOES TO SAMPLE NUTRITION

A. Sample Average Percent Daily Contribution of Corn, Beans and Irish Potatoes to Per Capita Intake of Calories and Protein

Corn		Beans		Irish Potatoes		Total	
Cal.	Prot.	Cal.	Prot.	Cal.	Prot.	Cal.	Prot.
54.8	48.9	9.2	22.9	5.0	3.5	69.0	75.3

B. Implied Sample Average Percent Contribution of Corn, Beans, and Irish Potatoes to Per Capita Attainment of Calorie and Protein Minimum Daily Requirements[a]

Corn		Beans		Irish Potatoes		Total	
Cal.	Prot.	Cal.	Prot.	Cal.	Prot.	Cal.	Prot.
64.7	135.9	10.9	63.7	5.9	9.7	81.5	209.3

NOTE: (a) Equals values listed in Part A above times 1.18 (for calories) and 2.78 (for protein), see Table 4J., Part B.

Given the above considerations, it was decided that an attempt should be made to estimate consumption elasticities for only corn, beans and Irish potatoes. As previously noted, Table 4E. summarizes the relative importance of these three crops to household consumption, as well as to the per capita attainment of calorie and protein minimum daily requirements. The current distribution of household farm income derived from the marketing and home consumption of corn, beans and Irish potatoes is presented in Table 4F. Finally, Table 4G. summarizes the relative importance in our sample of farm income, its components, and off-farm income to total household income from all sources.

Results and Discussion

Farmers' Price and Income Elasticities

Estimates of the two specifications of the consumption equation (5) and (5a) are presented in Table 4H. Although the general magnitude of the estimated coefficients on price and income do not vary appreciably between the two equations (given differences in the data used), the R^2 obtained for equation (5a) is considerably larger owing to the apparent importance of family size (F) in explaining overall variation within the sample. The estimated coefficients in both equations, however, are highly significant (at the 99 percent level and above) and the signs are in all cases in agreement with a priori expectations.

Elasticities calculated at the mean using the procedures discussed are presented in Table 4I. Again, little difference was noted between results obtained from the two specifications of the consumption equation.

Estimates of the marketing elasticities indicate that while the farmers' pure price response is, to some degree, offset by their response to real income changes induced by changes in the price, the net effect of higher prices will be an increase in marketings. The estimated consumption elasticities, on the other hand, indicate a net decrease in farm consumption as a result of higher prices for marketed food crops.

TABLE 4F.

DISTRIBUTION OF THE VALUE OF CORN, BEANS AND IRISH POTATOES BETWEEN MARKET SALES AND HOME CONSUMPTION (%)

Village	-- Market Income --				-- Non-Market Income --			
	Corn	Beans	Irish Potatoes	Average	Corn	Beans	Irish Potatoes	Average
Nseh	17.8	42.7	28.8	29.8	82.2	57.3	71.2	70.2
Oku	3.2	41.5	10.1	18.3	96.8	58.5	89.9	81.7
Mbiame	3.0	43.5	42.4	29.6	97.0	56.5	57.6	70.4
Ntumbaw	2.4	29.0	25.0	18.8	97.6	71.0	75.0	81.2
Kikaikom	4.6	39.0	25.4	23.0	95.4	61.0	74.6	77.0
Banten	12.7	61.5	62.7	45.6	87.3	38.5	37.3	54.4
Nkar	5.5	73.4	0.0	26.3	94.5	26.6	100.0	73.7
Bambui	24.0	44.9	100.0	56.3	76.0	55.1	0.0	43.7
GRAND MEAN	9.2	46.9	36.8	31.0	90.9	53.1	63.2	69.0

TABLE 4C.

DISTRIBUTION OF ANNUAL HOUSEHOLD INCOME
FROM DIFFERENT SOURCES[a] (%)

Village	Market Income	Non-Market Income	Farm Income	Off-Farm Income
Nseh	38.4	41.5	79.9	20.1
Oku	38.1	34.9	73.1	27.0
Mbiami	41.2	31.2	72.3	27.7
Ntumbaw	36.4	46.2	82.6	17.4
Kikaikom	37.9	37.6	75.5	24.5
Banten	43.2	36.8	80.0	20.0
Nkar	51.3	31.5	82.8	17.2
Bambui	50.8	27.1	78.0	22.1
GRAND MEAN	42.2	35.8	78.3	22.0

NOTE: (a) As noted in defining Y^1, the various components of total household income are defined as follows: Market Income: value of marketed agricultural products; Non-Market Income: imputed value of crops not marketed; Farm Income: market income plus non-market income; Off-Farm Income: income from all non-farm sources.

TABLE 4H.

LEAST-SQUARES ESTIMATES OF CONSUMPTION EQUATIONS (5) and (5a)

Equation	Dependent Variable	Intercept	Independent Variables			R^2	F Stat
			P	Y			
5	Per Capita Consumption	23.12 (4.3)	-17.23 (5.7)	0.035 (0.01)		0.164	6.20
			P	Y'	F		
5a	Household Consumption	110.9 (39.9)	-132.89 (44.1)	0.06 (0.009)	7.09 (2.8)	0.641	36.93

NOTE: Numbers in parentheses are estimated standard errors.

TABLE 4I.

ESTIMATES OF PRICE AND INCOME ELASTICITIES OF MARKETINGS AND CONSUMPTION[a]

	Marketings			Consumption		
Equation	ε_{mp}	ε_{my}	η_{Pm}	ε_{cp}	ε_{cy}	η_{Pc}
5	2.22	-0.326	2.14	-1.16	0.170	-1.12
5a	2.87	-0.723	2.73	-1.29	0.323	-1.22

NOTES: (a) The various elasticity measures are defined as follows: ε_{mp} = pure price elasticity of marketings; ε_{my} = pure income elasticity of marketings; η_{Pm} = total short run price elasticity of marketings; ε_{cp} = pure price elasticity of home consumption; ε_{cy} = pure income elasticity of home consumption; η_{Pc} = total short run price elasticity of home consumption.

The fact that estimates of the marketing elasticities are uniformly larger in absolute value than estimates of the consumption elasticities is, of course, a direct result of the sample distribution of production between sales and home consumption.[4]

Farmers' Price Elasticities of Calorie and Protein Intake

A clearer picture of the nutritional implications of farmers' consumption response to higher food crop prices can be obtained by converting our estimated short run total price elasticity of home consumption into price elasticities of calorie and protein intake using the following equations:

$$(9) \quad \eta_{Cal} = \sum_{i=1}^{A} c_i [\varepsilon_{cp_i} + r\varepsilon_{cy_i}]$$

$$(10) \quad \eta_{Prot} = \sum_{i=1}^{A} pr_i [\varepsilon_{cp_i} + r\varepsilon_{cy_i}]$$

where: η_{cal} and η_{prot} are the total short run price elasticities of calorie and protein intake; c_i and pr_i are the relative contributions of commodity i to the average per capita daily consumption of calories and protein, and ε_{cp}, r and ε_{cy} are as defined in equation (6) above.

Elasticities calculated using equations (9) and (10) can in turn be multiplied by sample average values of the per capita attainment of caloire and protein minimum daily requirements to yield expected net reductions in attainment of these MDR's for a

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[4]As noted in Table 4F. above, at the household level cultivators in our sample on average marketed 31 percent of all the corn, beans and Irish potatoes produced. Sixty-nine percent of the harvest, on the other hand, was on average retained for home consumption. If, for example, the price of these crops were to increase 10 percent and farmers responded with an increase in sales of 20 percent, the implied price elasticity of marketings would be: $\frac{\%\Delta M}{\%\Delta P} = \frac{20}{10} = 2.$

Given the above distribution of production between marketings and consumption, however, a 20 percent increase in sales will not lead to a 20 percent decrease in consumption, but rather 20 percent *69 percent or only 13.8 percent. The corresponding price elasticity of demand for home consumption would therefore be equal to: $\frac{\%\Delta C}{\%\Delta P} = \frac{13.8}{10.0} = 1.38.$

Hence, notwithstanding the fact that an extra tin marketed is exactly one less tin consumed, the consumption and marketing elasticities will only be equal if the percentage of crops marketed is the same as the percentage of crops consumed at home.

TABLE 4J.

ESTIMATED VALUES OF PARAMETERS USED IN CONSTRUCTING TABLE 4K.

A. Estimated Price Elasticities of Calorie and Protein Intake

Equation (5)		Equation (5a)	
η_{Cal}	η_{Prot}	η_{Cal}	η_{Prot}
-0.773	-0.843	-0.842	-0.919

B. Sample Average Per Capita Attainment of Calorie and Protein Minimum Daily Requirements

Calories	Protein
1.18	2.78

TABLE 4K.

ESTIMATED REDUCTIONS IN AVERAGE SAMPLE ATTAINMENT OF CALORIE AND PROTEIN MDR's GIVEN VARIOUS HYPOTHETICAL PRICE INCREASES FOR MARKETED FOOD CROPS

Percentage Increase in Price of Corn, Beans & Irish Potatoes	Resulting Percentage Decrease in Consumption[a]				Resulting Percentage Decrease in MDR Attainment[b]			
	Equation (5)		Equation (5a)		Equation (5)		Equation (5a)	
	Cal.	Prot.	Cal.	Prot.	Cal.	Prot.	Cal.	Prot.
10	7.7	8.4	8.4	9.2	9.9	25.5	9.1	23.4
15	11.6	12.6	12.6	13.8	14.9	38.3	13.7	35.2
16	12.4	13.5	13.5	14.7	15.9	40.8	14.6	37.5
17	13.1	14.3	14.3	15.6	16.9	43.3	15.5	39.8
18	13.9	15.2	15.2	16.5	17.9	46.0	16.5	42.3
19	14.7	16.0	16.0	17.5	18.9	48.6	17.4	44.6
20	15.5	16.9	16.8	18.4	19.9	51.1	18.3	46.9

NOTES: (a) Equals percentage price increase times calorie and protein elasticities listed in Table 4J.

(b) Equals percentage decrease in consumption times sample average MDR attainments listed in Table 4J.

TABLE 4L.

SAMPLE DISTRIBUTION OF ATTAINMENT OF CALORIE AND PROTEIN MDR's GIVEN VARIOUS HYPOTHETICAL PRICE INCREASES FOR MARKETED FOOD CROPS

Percentage of Households Given Percentage of Minimum Daily Requirement for Calories and Protein[a]								
	Calorie MDR						Protein MDR	
Percentage Price Increase / Percentage MDR	0	10	15	18	19	20	0	20
100	34.9	44.4	50.8	52.4	54.0	60.3	1.6	15.9
90	25.4	31.7	36.5	42.9	42.9	47.6	0.0	12.7
80	12.7	22.2	25.4	33.3	33.3	34.9	0.0	9.5
70	4.8	7.9	14.3	17.5	19.0	19.0	0.0	4.8
60	1.6	3.2	4.8	6.3	7.9	7.9	0.0	4.8
50	0.0	1.6	1.6	1.6	1.6	1.6	0.0	0.0

NOTE: (a) Equals nutrition survey results for per capita attainment of MRD's times estimates of the expected percentage decrease in MDR attainment (Eq. 5a) listed in Table 4K.

variety of hypothetical price increases. Table 4K. presents such a schedule of expected net reductions, with values of the parameters necessary for calculating the schedule listed in Table 4J.

As illustrated in Table 4J., the results of the nutrition surveys indicate that households are consuming an average 18 percent more calories and over 175 percent more protein than their minimum daily requirements. Combined with the estimated elasticities of calorie and protein intake listed in Table 4J., this implies, again on the average, that both the sample calorie and protein minimum daily requirements can be met even with an across the board increase of 18-19 percent in the price of corn, beans and Irish potatoes (depending upon which consumption equation is used). Indeed, as reported in Table 4K., it would require a substantially larger price increase to cause an average sample shortfall in attainment of the protein minimum daily requirement.

It should be emphasized, however, that the above estimates represent partial short run responses to changes in the price of food crops. In particular, no account has been taken of the long run consumption or production response to higher prices, nor of changes in the purchase of food items induced by income earned with increased marketings. Moreover, while on average the sample may safely sustain up to an 18 percent increase in the price of food crops, as shown in Table 4L., a substantial percentage of individual sample households fail to meet their minimum daily requirement of calories even if no increase in the price is assumed. Given an increase of 18 percent, over half the sample can be expected to fall below 100 percent attainment.

Although data constraints have prevented calculation of the long run consumption elasticity, in view of the short run elasticities presented, it is nearly certain that the long run response would indicate a similar decrease in consumption as a result of higher prices for marketed food crops.

With regard to the long run production elasticity, the fact that 80 percent of the cultivators when questioned responded that more land could be obtained for farming if it were needed, suggests the possibility at least of a positive long run production response to more favorable marketing opportunities.

Finally, there is little question that higher incomes would lead to an increase in purchased food items and presumably to improved household nutrition.

In the absence of more information, however, it is simply not possible to estimate the magnitude of these various unquantified factors, and hence to determine the net long run nutritional impact of higher food crop prices. Further investigation, particularly with regard to possible constraints on increased output would, therefore, seem to be highly desirable before the initiation of any government program aimed specifically at increasing the demand for highland food crops.

Summary

Data collected in eight villages in the Northwest Province of Cameroon were used to estimate the short run nutritional impact of policies that would lead to an increase in the demand for food crops in this area. Projected changes in the cultivators' nutritional status were based on estimates of their willingness to market more and consume less in response to higher prices along with estimates of their current nutritional well-being.

The price elasticity of demand for home consumption was calculated for three crops (i.e. corn, beans, and Irish potatoes) which were found to be major contributors to both household nutrition and farm income. Estimates of the consumption elasticity for the three crops considered together ranged from -1.12 to -1.22 depending upon the exact specification of the consumption equation.

A conversion of the estimated consumption elasticity to price elasticities of calorie and protein intake allowed a projection of likely short run changes in the per capita attainment of calorie and protein minimum daily requirements. The results of this procedure indicated that an 18 percent increase in the price of marketed food crops could be sustained without causing an average sample shortfall in attainment of either MDR.

The results of the nutrition surveys, however, indicated that a substantial percentage of individual sample households fail to meet their minimum daily requirement of calories even if no increase in the price is assumed. Furthermore, an increase of 18 percent was found to result in over half the individual households falling below 100 percent attainment for the calorie MDR.

Data constraints prevented calculation of various factors which would have permitted an estimation of the net long run nutritional impact of higher food crop prices. It is nearly certain, however, that the long run consumption elasticity would

indicate a decrease in food intake similar to that of the estimated short run elasticity and further, that more food items would be purchased in response to higher incomes earned with increased marketings.

Perhaps the most critical unknown, however, is the magnitude of the cultivators' long run production response to higher prices. In this regard, although it was not possible to census unused farmland within our study area, a survey of the cultivators themselves revealed overwhelming agreement that land would not be a constraint on the increased production of food crops. It is quite possible of course that other constraints, most notably labor, could prevent a sufficient increase in production despite available acreage.

In summary, although the nutrition of households included in our sample was generally found to be quite good, particularly with regard to protein consumption, an increase in the demand for food crops would likely result in a significant reduction in household consumption and a consequent lowering of the cultivators' nutritional well-being. It would therefore seem to be critically important that factors affecting the long run nutritional impact of higher food crop prices be investigated prior to the initiation of government policies likely to substantially increase the demand for highland food crops.

CONSUMPTION EFFECTS OF AGRICULTURAL PRODUCTS

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

CHAPTER 5
COMPUTING FARMERS' CALORIE INTAKE RESPONSE TO PRICE CHANGES

by

Edgar J. Ariza-Niño

Center for Research on Economic Development
University of Michigan

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CHAPTER 5

Computing Farmers' Calorie Intake Response to Price Changes

The nutritional impact in terms of calorie intake, upon a farming community from changes in the prices of farm products and foods can be readily assessed given the following information:

c_i = the proportion of calories contributed by product or food i

r_i = the proportion of farm income contributed by product i

E^c_{ij} = the elasticity of consumption of product or food i with respect to the price of product j

E^c_{iy} = the elasticity of consumption of product or food i with respect to income

E^s_{ij} = the elasticity of sales of product i with respect to the price of product j

Given a change in prices of one or several farm products or food prices, the following sequence of steps will provide the desired result in terms of expected change in calorie intake.

$$s_i = \Sigma_j E_{ij} P_j \qquad [1]$$

where s_i = expected relative changes in sales of product i,

p_j = relative change in the price of product j;

$$y = \Sigma_i r_i (p_i + s_i) \qquad [2]$$

where y = relative change in farm income resulting from the changes in product prices;

$$q_i = E^c_{iY} y + \Sigma_j E^c_{ij} p_i \qquad [3]$$

where q_i = relative changes in the consumption of food i resulting from changes in income and prices of products or foods;

$$k = \Sigma_i c_i q_i \qquad [4]$$

where k = relative change in calorie intake.

The rationale for these sequence of steps has been broken down into four separate postulates demonstrated independently below. Postulate I derives equation [4], Postulate II derives equation [3], Postulate III derives equation [2], and Postulate IV derives equation [1].

Postulate I

Let c_i stand for the relative contribution to total calorie intake provided by product or food i, q_i be the relative change in consumption of food i, resulting from say, a change in prices. Then

$$k = \Sigma_i c_i q_i \qquad \begin{array}{l} i = 1, \ldots, I \\ 0 \leq c_i \leq 1 \\ -\infty \leq q_i \leq \infty \end{array}$$

corresponds to the relative change in calorie intake resulting from the change in consumption.

Proof:

Total calorie intake is merely the aggregation of calorie contribution from each food item.

$$K = \Sigma_i \ \delta_i \ Q_i$$

where K = total calorie intake

Q_i = consumption of food i

δ_i = calories contained per unit of food i.

The total differential dK can be expressed as

$$dK = \Sigma_i \ \delta_i \ dQ_i$$

Dividing both sides by K we can obtain the relative change in K

$$\frac{dK}{K} = \Sigma \frac{1}{K} \ \delta_i \ dQ_i$$

Multiplying and dividing the right hand side elements of this expression by Q_i we get

$$\frac{dK}{K} = \Sigma \frac{\delta_i \ Q_i}{K} \cdot \frac{dQ_i}{Q_i}$$

if we let small letters stand for relative or proportional change

$$k = \frac{dK}{K} \quad q_i = \frac{dQ_i}{Q_i}$$

we can transform the above equation into

$$k = \Sigma \frac{\delta_i \ Q_i}{K} \ q_i$$

Note however that $\delta_i \ Q_i$ is simply the contribution of Q_i to total calories K. That can be expressed more briefly by

$$c_i = \frac{\delta_i Q_i}{K}$$

Hence the total expression collapses into

$$k = \Sigma_i c_i q_i$$

which was the demonstrandum.

Postulate II

Let p_i be the relative change in the price of product or food i,

y be the relative change in per capita income,

E^c_{iy} be the elasticity of consumption of product i with respect to income,

E^c_{ij} be the elasticity of consumption in product i with respect to the price of product j

then

$$q_i = E^c_{iY} \cdot y + \Sigma_j E^c_{ij} P_j \qquad \begin{array}{l} i = 1, \ldots, n \\ j = 1, \ldots, n \end{array}$$

represents the relative change in consumption of product i from changes in income and prices.

Proof:

Consumption of food i can be expressed as a function of income, the price of food i, and the prices of other goods j.

$$Q_i = Q_i \ (Y, P_1, P_2, \ldots, P_j \ldots, P_n)$$

where Q_i = Consumption of food i, and functional indicator

Y = Per capita income

P_j = Price of food j

By total differentiation

$$dQ_i = \frac{\delta Q_i}{\delta Y} \cdot dY + \Sigma_j \frac{\delta Q_i}{\delta P_j} \cdot dP_j$$

where dQ_i = differential of Q_i

dY = differential of Y

dP_j = differential of P_j

and the symbols indicate partial derivatives.

To obtain the relative change in consumption of food i we divide both sides of the above expression by Q_i

$$\frac{dQ_i}{Q_i} = \frac{1}{Q_i} \cdot \frac{\delta Q_i}{\delta Y} \cdot dY + \Sigma_j \frac{1}{Q_i} \cdot \frac{\delta Q_i}{\delta P_j} \cdot dP_j$$

Multiplying and dividing each term in the summation by P_j leaves the expression unchanged.

$$\frac{dQ_i}{Q_i} = \frac{1}{Q_i} \cdot \frac{\delta Q_i}{\delta Y} dY + \Sigma_j \frac{P_i}{Q_i} \frac{\delta Q_i}{\delta P_j} \frac{dP_j}{P_j}$$

Similarly, the first term in the right-hand side can be multiplied and divided by Y

$$\frac{dQ_i}{Q_i} = \frac{Y}{Q_i} \cdot \frac{\delta Q_i}{\delta Y} \cdot \frac{dY}{Y} + \Sigma_j \frac{P_j}{Q_i} \cdot \frac{\delta Q_i}{\delta P_j} \cdot \frac{dP_j}{P_j}$$

We may recall that demand elasticities with respect to income and prices are, by definition,

$$E^c_{iY} = \frac{\delta Q_i}{\delta Y} \cdot \frac{Y}{Q_i}$$

and

$$E^c_{ij} = \frac{\delta Q_i}{\delta P_j} \cdot \frac{P_j}{Q_i}$$

Substituting these two definitions of elasticity one can write

$$\frac{dQ_i}{Q_i} = E^c_{iY} \cdot \frac{dY}{Y} + \Sigma_j E^c_{ij} \frac{dP_j}{P_j}$$

Using small letters to indicate relative changes

$$qi = \frac{dQ_i}{Q_i} \qquad y = \frac{dY}{Y} \quad \text{and } p_j = \frac{dP_j}{P_j}$$

one can further simplify the expression to

$$q_i = E^c_{iY}\, y + \Sigma_j E^c_{ij}\, p_i$$

Q.E.D.

Postulate III

Let p_i be the relative change in the price of product or food i, and E^s_{ij} be the elasticity of sales of product i with respect to the price of product j. Then

$$s_i = \Sigma_j E^s_{ij}\, p_j$$

represents the relative change in the amount of product i sold in the market.

Proof:

The amount of product i sold can be considered a function of the set of prices for farm products and foods faced by the farmer.

$$S_i = S_i\ (P_1, P_2, \ldots, P_n)$$

where S_i = Sales of product i, and functional name

P_i = Price of product i

The total differential of S_i is given by

$$dS_i = \Sigma_j \frac{\delta S_i}{\delta P_j} \cdot dP_j$$

where dS_i = the differential of S_i

dP_j = the differential of P_j

and the δ symbol denotes partial derivation.

The relative change in S_i can be obtained by dividing both sides of the expression by S_i

$$\frac{dS_i}{S_i} = \Sigma_j \frac{1}{S_i} \cdot \frac{\delta S_i}{\delta P_j} \cdot dP_j$$

Multiplying and dividing each term in the summation by P_j we have

$$\frac{dS_i}{S_i} = \Sigma_j \frac{P_j}{S_i} \cdot \frac{\delta S_i}{\delta P_j} \cdot \frac{dP_j}{P_j}$$

Recall however that the definition of the sales elasticity of product i with respect to the price of product j is given by

$$E^s_{ij} = \frac{\delta S_i}{\delta P_j} \cdot \frac{P_j}{S_i}$$

Substituting the value of E^s_{ij} we get

$$\frac{dS_i}{S_i} = \Sigma_j \; E^s_{ij} \cdot \frac{dP_j}{P_j}$$

Using small letters to indicate relative changes, i.e.

$$s_i = \frac{dS_i}{S_i} \text{ and } P_j = \frac{dP_j}{P_j}$$

we can transform the above into

$$s_i = \Sigma_j \; E^s_{ij} \; P_j$$

Q.E.D.

Postulate IV

Let p_i be the relative change in the price of product i, s_i be the relative change in sales of product i resulting from a change in prices, and r_i be the proportion of farm income attributed to sales of product i. Then

$$y = \Sigma_i \; r_i \; (p_i + s_i)$$

represents the relative change in income resulting from changes in prices.

Proof:

Farm Income can be expressed as the sum of revenues from sale of farm products at their respective prices.

$$Y = \Sigma_i S_i P_i$$

where Y = farm income

S_i = Sales of product i

P_i = Price of product i

By total differentiation we have

$$dY = \Sigma_i \frac{\delta Y}{\delta S_i} \cdot dS_i + \Sigma_i \frac{\delta Y}{\delta P_i} dP_i$$

where dY = differential of Y

dS_i = differential of S_i

dP_i = differential of P_i

and the symbol denotes partial derivation.

Clearly,

$$\frac{\delta Y}{\delta S_i} = P_i \qquad \text{and} \qquad \frac{\delta Y}{\delta P_i} = S_i$$

then

$$dY = \Sigma_i P_i dS_i + \Sigma S_i dP_i$$

relative change in income can be obtained by dividing both sides by Y

$$\frac{dY}{Y} = \Sigma_i \frac{P_i}{Y} \cdot dS_i + \Sigma \frac{S_i}{Y} \cdot dP_i$$

Multiplying and dividing each term in the first summation by S_i, and each term in the second summation by P_i, doesn't alter the expression:

$$\frac{dY}{Y} = \Sigma_i \frac{P_i S_i}{Y} \frac{dS_i}{S_i} + \Sigma_i \frac{S_i P_i}{Y} \frac{dP_i}{P_i}$$

Letting small letters denote relative changes for Y, S_i, and P_i

$$y = \frac{dY}{Y} \qquad s_i = \frac{dS_i}{S_i} \qquad P_i = \frac{dP_i}{P_i}$$

we get

$$y = \Sigma_i \frac{P_i S_i}{Y} s_i + \Sigma_i \frac{S_i P_i}{Y} P_i$$

But $P_i S_i / Y$ is just the proportion of income contributed by product i; let r_i stand for that ratio.

$$r_i = \frac{S_i P_i}{Y}$$

then

$$y = \Sigma r_i s_i + \Sigma r_i p_i$$

Or, even better

$$y = \Sigma_i r_i (p_i + s_i)$$

which proves the postulate.

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

CHAPTER 6
COMPUTING FARMERS' ENERGY INTAKE PRICE ELASTICITY

by
Edgar J. Ariza-Niño

Center for Research on Economic Development
University of Michigan
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CHAPTER 6

Computing Farmers' Energy Intake Price Elasticity

It is possible to estimate the elasticity of farmers' calorie intake with respect to a change in a given farm product or food price by means of the formula

$$E^{E}_{Pk} = \Sigma_i \, c_i \, \{ E^{c}_{ik} + E^{c}_{iY} \, [r_k + \Sigma_j \, r_j \, E^{s}_{jk}]\} \qquad [1]$$

where

E^{E}_{Pk} = elasticity of calorie intake (Energy) with respect to the price of product k

c_i = relative contribution of product i to total calorie intake

E^{c}_{ik} = elasticity of consumption of product i with respect to the price of product k

E^{c}_{iy} = elasticity of consumption of product i with respect to income

r_k = relative contribution of product k to farm income $(0 \leq r_k \leq 1)$

r_j = relative contribution of product j to farm income $(0 \leq r_j \leq 1)$

E^{s}_{jk} = elasticity of sales of product j with respect to the price of product k and i, j = 1, ..., n.

Alternatively, the elasticity of caloric intake may be computed in three steps to arrive at the same result:

$$E^{Y}_{Pk} = r_k + \Sigma_j \, r_j \, E^{s}_{jk} \qquad j = 1, \ldots, n \qquad [2a]$$

$$E^{Q_i}_{Pk} = E^{c}_{ik} + E^{c}_{iY} \, E^{Y}_{Pk} \qquad i = 1, \ldots, n \qquad [2b]$$

$$E^{E}_{Pk} = \Sigma_i \, c_i \, E^{Q_i}_{Pk} \qquad c = 1, \ldots, n \qquad [2c]$$

where, in addition to the above notation,

E^{Y}_{Pk} = elasticity of farm income with respect to the price of product k

$E^{Q_i}_{Pk}$ = combined elasticity of consumption of product i with respect to the price of product k, including the effect through income changes brought about by changes in the price of product k. (i.e. incompensated price elasticity of i on k).

DERIVATION

Formulas 1-2c can be obtained as a special case of those generated in Chapter 5 of Part II.

In the latter work the combined impact of price changes in several products was computed by

$$e = \Sigma_i \, c_i \, q_i \qquad [3]$$

where

- e = relative change in calorie intake (energy) resulting from changes in farm product and food prices
- c_i = proportion of calories contributed by product i to the diet $(0 \leq c_i \leq 1)$
- q_i = relative change in consumption of product i as a result in changes in farm and food prices.

The elasticity of energy intake with respect to a change in price of a given product k can be defined as

$$E^E_{Pk} = \frac{e}{P_k} \qquad [4]$$

where p_k represents the relative change in the price of k, and e has been computed under the ceteris paribus assumption that all values of p_i are equal to zero except for p_k, the price of the product in question.

We need therefore to retrace the derivation of e, taking into account that

$$p_i = \begin{cases} 0 & i \neq k \\ p_i & i = k \end{cases}$$

The steps in deriving e were given by the equations

$$s_i = \Sigma_j \, E^s_{ij} \, p_j \qquad [5a]$$

$$y = \Sigma_i \, r_i \, (p_i + s_i) \qquad [5b]$$

$$q_i = E^c_{iY} \, y + \Sigma_j \, E^c_{ij} \, p_j \qquad i,j = 1, \ldots, n \qquad [5c]$$

$$e = \Sigma_i \, c_i \, q_i \qquad [5d]$$

where

- s_i = expected relative change in sales of product i,
- y = relative change in farm income,
- q_i = relative change in consumption of food i.

Equation [5a], for example, becomes much simpler once all values of p_j are zero, except p_k, namely

$$s_i = E^s_{ik} \cdot P_k \qquad i = 1, \ldots, n \qquad [6a]$$

When this value is replaced in [5b] we obtain

$$y = \Sigma_i r_i p_i + \Sigma_i r_i s_i \qquad [6b]$$

$$y = \Sigma_i r_i p_i + \Sigma_i r_i E^s_{ik} p_k$$

$$y = r_k p_k + p_k \Sigma_i r_i E^s_{ik}$$

$$y = p_k [r_k + \Sigma_i r_i E^s_{ik}]$$

The elasticity of farm income with respect to the price of product k can be defined by

$$E^Y_{Pk} = \frac{y}{P_k} = r_k + \Sigma_i r_i E^s_{ik} \qquad [7]$$

which corresponds to equation [2a].

Replacing the value of y in [6b] into [5c] a new expression for q_i is obtained:

$$q_i = E^c_{iY} p_k [r_k + \Sigma_j r_j E^s_{jk}] + \Sigma_j E^c_{ij} p_j \qquad [8]$$

$$q_i = E^c_{iY} p_k [r_k + \Sigma_j r_j E^s_{jk}] + E^c_{ik} p_k$$

$$q_i = p_k \{E^c_{ik} + E^c_{iY} [r_k + \Sigma_j r_j E^s_{jk}]\}$$

If we designate the elasticity of product i consumption with respect to the price of product k, by $E^{Q_i}_{Pk}$, then

$$E^{Q_i}_{Pk} = \frac{q_i}{P_k} = E^c_{ik} + E^c_{iY} [r_k + \Sigma_j r_j E^s_{jk}] \qquad [9]$$

which corresponds to equation [2b] of the three expressions to evaluate the energy intake elasticity.

Finally, entering the value of q_i from equation [8] into [5d] in order to evaluate the relative change in energy intake e, we have

$$e = \Sigma_i c_i q_i \qquad [10]$$

$$e = \Sigma_i c_i p_k \{E^c_{ik} + E^c_{iY} [r_k + \Sigma_j r_j E^s_{jk}]\}$$

$$e = p_k \Sigma_i c_i \{E^c_{ik} + E^c_{iY} [r_k + \Sigma_j r_j E^s_{jk}]\}$$

to obtain the value of e when only the price of product k has changed while other prices remained the same. The elasticity of energy intake with respect to the change in the price of k was defined in equation [4] as

$$E^{E}_{Pk} = \frac{e}{p_k} \qquad [11]$$

$$E^{E}_{Pk} = \Sigma_i \, c_i \{ E^{c}_{ik} + E^{c}_{iY} \, [r_k + \Sigma_j \, r_j \, E^{s}_{jk}] \}$$

which is exactly equation [1] originally suggested to calculate this elasticity. Or, using equation [9] this expression can be simplified to

$$E^{E}_{Pk} = \Sigma_i \, c_i \, E^{Q_i}_{Pk} \qquad [12]$$

corresponding to equation [2c] of these three-step method to calculate the same energy intake elasticity.

CONCLUSION

A method to evaluate numerically the relative impact of a change in the price of a given farm product or food upon the caloric (energy) intake of the farm family has been suggested. The mathematical derivation of the method has also been presented. The proposed evaluation technique is computationally simple and requires a minimal amount of data. These data consist of the relative shares of each product on calorie intake and farm income, and the income, price, and cross price elasticities of consumption and sales of each product vis-a-vis the price of the product in question.

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

SECTION TWO
FIELD SURVEY TECHNIQUES

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

CHAPTER 7
FIELD SURVEY AND DATA PROCEDURES: CAMEROON

by
Edgar J. Ariza-Niño
Miriam Goheen-Fjellman
Lisa Matt

Center for Research on Economic Development
University of Michigan
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CHAPTER 7

FIELD SURVEY AND DATA PROCEDURES: CAMEROON

The purpose of this chapter is to look at some of the operational considerations that arose in doing the food consumption and farm production survey in Cameroon as part of this project. Chapter 4 (Part II) illustrates how elements of the data collected were statistically manipulated to arrive at estimates of price change effects on rural food consumption in the Northwest Province highlands. Later in this chapter, special attention is given to the food consumption survey and how estimates of nutritional adequacy of the diet were computed. The first part of this chapter concerns more general issues that need addressing to define the survey area and the sample families.

Selection of Sample Area

The highland areas of the Northwest Province were selected by USAID at the outset of this case study. The western Cameroon Mountain range that crosses the Province generates such a diversity of zones, each with particular microclimate, population density, and degree of accessibility, that an overall study covering the entire Province was out of the question. A certain degree of homogeneity is needed to permit the aggregation of data on, for example, farm production. Farming in the lowlands is vastly different from the highlands in multiple respects, but it is primarily reflected in different sets of viable crops for different altitude levels. Arabica coffee and potatoes, for example, cannot be grown in the lowlands, and conversely, rice cannot be grown in the highlands. An arbitrary altitude of 1200 meters above sea level was set, and only villages above that level were included in the survey.

Food consumption patterns are closely related to crop production, and therefore differ between the high and low areas. The staple in the diet of high altitude areas is maize (corn), while in the low-lying areas cocoyams and yams predominate. The analysis of food consumption data is more meaningful for areas of roughly similar diets; averages over both corn and cocoyam diet zones would be representative of neither.

The highland areas of the Northwest Province (NWP) are the principal producers of the four main crop exports of the Province, namely Arabica coffee, beans, maize, and Irish potatoes. These four crops account for 96 percent of the value of agricultural exports from the Province as shown in Table 7A. Concerning other crops, the production of garden vegetables -- cabbages, green beans, tomatoes, etc. -- for the

TABLE 7A.

VALUE OF AGRICULTURAL EXPORTS FROM THE NORTHWEST PROVINCE, 1979/80

Crop	Million CFA Francs	Percentage of Total
1. Coffee (Arabica)	2,942	63
2. Beans	676	14
3. Maize (corn)	338	7
4. Potatoes	322	7
5. Groundnuts	215	5
Other		4
Total	4,669	100

SOURCE: Scott, W. and Mahaffey (Goheen-Fjellman), M. Agricultural Marketing in the Northwest Province, Executive Summary, USAID report. Yaounde, 1980, Table 16.

Douala market has expanded in recent years in a high altitude area around Santa, south of Bamenda on the paved road to Douala.

Market linkages are also better developed among highland than lowland farmers, thanks mainly to the role of Arabica coffee. Finally, most of the Province's population is concentrated in highland villages, attracted by the cool mountain climate and healthy conditions. Population density in the survey area is among the highest in the country, despite government efforts to encourage settlement in unexploited arable land available nearby in low-lying areas.

The survey was further limited to the highland areas of the eastern section in the Province, served by the eastern branch of the "ring road," and covering most of the Bui Division and the southern part of Donga-Matung. In addition, one village near Bamenda in the Mezam Division was included to observe the influence of proximity to the major provincial market center, and good trade and marketing opportunities as well as ample alternatives for obtaining off-farm income. The survey population therefore consists mostly of farmers living in highland villages in the eastern part of the NWP; it does not include farmers living in larger towns such as Kumbo, Ndu, and Bamenda.

At the specific request of the USAID Mission in Yaounde, two additional villages were surveyed in the Momo Division, outside the highland areas of interest in this case study. This particularly inaccessible division has been targeted by USAID for possible development, after many years of being neglected. Evaluation of potential projects is hampered, however, by lack of information on the farming system, infrastructure, and marketing opportunities. The survey procedures and questionnaires developed for this study were considered sufficiently appropriate to collect basic information about farms in that area. Although these two villages, Widekum and Teze, are not included in the data analysis of this case study, they could provide information about the nutritional adequacy in the cocoyam diet zone, since the latter, rather than corn, constitutes the primary staple and basis of meals throughout the year. Finally, the main source of cash income among Momo farmers is the sale of palm oil, a basic ingredient of the Northwest Province diet in both highland and lowland areas. Momo Division produces about 40 percent of the palm oil consumed in the Province.

Sample Villages

The main criteria in selecting villages within the highland areas was the need to observe a representative range of variation in farm gate prices, since they affect both food consumption and crop production. Because the survey was scheduled for only a

12-week period and most variations in farm prices follow seasonal patterns, little variation in prices was observed over time. To overcome this we took advantage of the expected price differentials over space, particularly those occurring in relation to the "ring road" that connects the area with Bamenda, the main outlet for goods flowing in and out of the Province. Transport and marketing costs would dictate that farm gate prices for produce flowing into Bamenda would be lower as distance to Bamenda increases.

Eight sample villages were thus selected at varying distances from Bamenda and other main markets. Although a large range of variation is observed within the sample there are villages which are much less accessible within the area and where prices, incomes, and expenditures are apt to be below the figures obtained from the sample. Although most sample villages are primarily farming areas, a few are also becoming more commercially oriented, and it is in those where the greatest opportunities lie for increased production and market participation (see Tables 7A. and 7B.). There are some additional areas of potentially high production that could not be included in the sample because the survey was conducted in the rainy season when access to them was impossible.

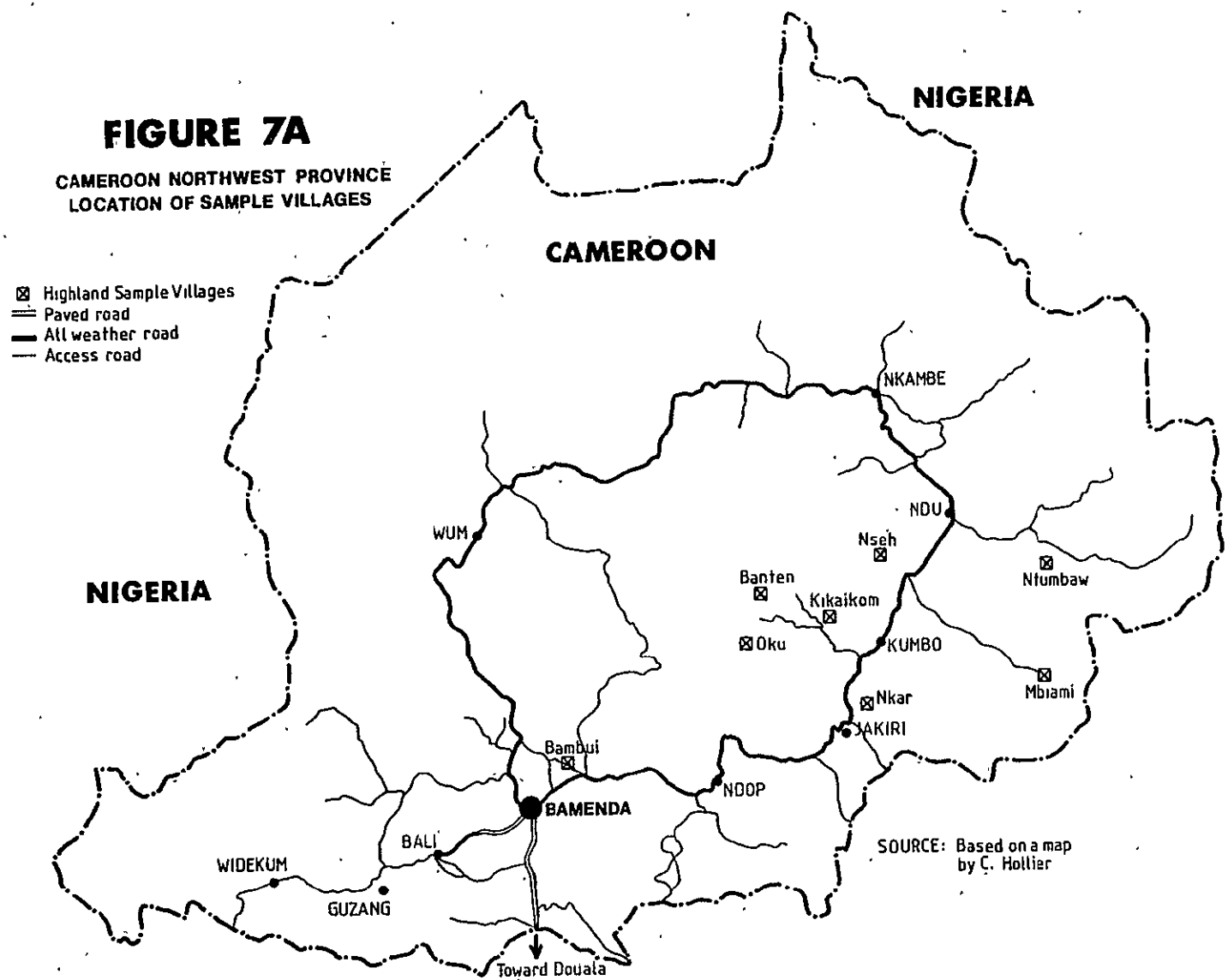
Figure 7A. presents the location of the eight highland villages on a map of the Northwest Province, together with the road network linking them to Bamenda and other major markets. The villages are, in the order surveyed: Nseh, Oku, Mbiami, Ntumbaw, Kikaikom, Banten, Nkar, and Bambui. Table 7B. gives the approximate distances and transport costs from each village to Bamenda and near markets. A summary of population and social services available in the sample villages appears in Table 7C.

Sample Households

One cannot just walk into an African village and expect people to answer a barrage of personal questions. We were required to go through the traditional authority structure to gain access to a sample of nine households in each village. In villages with Fons, chiefs or strong quarterheads, we went through traditional protocol to select three quarters located some distance apart and from each quarter, three households were selected. We also consulted with local agricultural extension and community development workers, where available, in order to pick as varied a sample as possible. In villages where town councils are the primary instrument of local government (Bambui, for example), the council head and other members were consulted, as well as agriculture and community development people, then followed the

FIGURE 7A

CAMEROON NORTHWEST PROVINCE
LOCATION OF SAMPLE VILLAGES



SOURCE: Based on a map by C. Hollier

TABLE 7B.

TRANSPORT AND MARKET ACCESS FOR HIGHLAND SAMPLE VILLAGES AND MAJOR MARKETS, 1981[a]

Town/Village	Distance to Bamenda (km)	Transport Cost/Bag (FCFA)	Nearest Major Market	Distance to Major Market (km)	Transport Cost/Bag (FCFA)	Transport Availability
Nseh	130	800	Kumbo	18	300	Poor
			Ndu	12	300	Poor
Oku	154	1000	Kumbo	39	500	Fair
Mbiami	142.5	1000	Kumbo	27.5	500	Poor
Ntumbaw	160	1300	Ndu	17	300	Fair
Kikaikom	118.5	700	Kumbo	3.5	200	Good
Banten	132	900	Kumbo	17	400	Poor
Nkar	98.7	500	Jakiri	3.7	100	Good
			Kumbo	16.3	300	Fair
Bambui	17	200	Bamenda	17	200	Good
Major Towns:						
Kumbo	115	500				Excellent
Ndu	150	700				Excellent
Mamfe	99	1500				Fair/Poor
Jakiri	95	500				Excellent

SOURCES: Kumbo Syndicate Records; interviews with transporters.

NOTE: (a) Transport prices given are Dry Season prices; during Rainy Season, prices usually go up by at least a third, depending on the condition of the road.

TABLE 7C.

POPULATION AND SOCIAL SERVICES IN HIGHLAND SAMPLE VILLAGES, 1981

Village	Altitude	Meridian	Parallel	Number of Households	Population	Quarters (Number)	Consumer Services	Health Facilities	Water Supply (piped)	Education Facilities	Electricity	Provision Stores	Non-Farm Employment Options	Local Marketing Options
Nseh	1660 m	10°44'	6°23'	556	1756	16	poor	1 maternity	none	3 primary	none	8	few	fair/poor
Oku[a]						26	fair	4 health care centers	yes	17 primary	none	36	fair	fair
Elak	1940 m	10°30'	6°14'	205	2030									
Jikijem	2060 m	10°27'	6°14'	149	1686									
Manchok	1580 m	10°32'	6°16'	n.a.	n.a.									
Mbiami	1880 m	10°51'	6°12'	593	1418	12	poor	1 maternity	none	12 primary	none	12		fair
Ntumbaw	2000 m	10°51'	6°21'	n.a.	n.a.	9	poor	1 health care post	none	3 primary	none	5	few	fair
Kikaikom	1740 m	10°40'	6°14'	768	4051	6	fair/good	none	none	4 primary	none	4	good	good
Banten	1800 m	10°35'	6°21'	n.a.	n.a.	8	poor	none	none	1 primary	none	3	none	poor
Nkar	1600 m	10°37'	6°37'	495	2265	18	good	none	yes	7 primary	none	18	few	fair/good
Bambui	1200 m	n.a.	n.a.	972	6688	9	good	1 health care center	none	4 primary 1 secondary 1 agric. college	none	15	good	good/excellent

SOURCES: 1976 National Census, unpublished data & Village Directories for Bui and Donga-Mantung Divisions for population, number of households, altitude, meridian and parallel.

NOTE: (a) Oku is comprised of 26 quarters and villages (some of which are considered quarters), all of which are considered part of Oku proper; all 26 are under the domain of the Fon of Oku. The three areas listed are those areas in which the survey was conducted.

same basic pattern of choosing three quarters and three households within each quarter. The reason for this combination is to enable one enumerator to cover three households simultaneously by having them clustered within walking distance of each other.

Two of the researchers had a combined total of seven years experience living in the highland area, working with local cooperatives, doing research on land tenure, marketing and labor allocation, and writing various reports for the Cameroon Government and USAID. There was therefore no difficulty in obtaining the full cooperation of village heads in selecting sample households. The sample is thought to be fairly representative of the highland farmers since it was selected in a reasonably random fashion. Nevertheless, there was one household in Kikaikom which was included for reasons of protocol. This homestead may be eliminated from the analysis if it skews results significantly. Since a total of 72 households were interviewed in the eight highland villages, some data attrition is permissible without undue loss of statistical significance.

Enumerators and Field-Workers

Enumerators and field-workers were selected on the basis of experience, education, ability to interact and communicate with local people, and personal knowledge and experience in the area. A balance is necessary in choosing between outside persons who may have education and experience in enumeration, and local persons with less training but with better capability to interact and communicate with village people. The latter was a far more important requirement for this project, especially since the researchers were able to supervise closely and participate in the interviews along with the enumerators and because considerable amount of in-field training of the enumerators was possible. We are confident of the reliability of the information collected by the enumerators, who joined the project with interest and enthusiasm.

Questionnaires

A set of nine questionnaires was designed at the Center for Research on Economic Development prior to departure of the field research team for Cameroon. This is ordinarily not an advisable strategy, but under the mandated time limitations, it was not possible to defer the design and duplication of questionnaires until arrival in the field. Fortunately, the previous experience of CRED researchers and others at the University of Michigan in similar rural surveys, combined with the extensive

experience of the principal researchers in the survey area, made it possible to advance the preparation of questionnaires. The research team arrived in Cameroon almost ready to proceed to the survey area. However, prior to starting actual data collection, each questionnaire was thoroughly reviewed with national and expatriate specialists in Yaounde. As a result, a few significant modifications were made; a new supplementary questionnaire (No. 10) was added, while one of the original set of nine (No. 6) was discarded in favor of more informal methods to obtain off-farm income information.

Appendix I (Part II) contains a complete set of the field questionnaires. The originals were color coded to facilitate identification and later processing. Their contents are:

1. Household demographic information
2. Daily food consumption
3. Market purchases in previous week
4. Seasonal variations in diet
5. Farm sales (crops marketed)
6. Off-farm income
7. Socioeconomic indicators
8. Individual crop field information
9. Calendar of crop activities in previous year
10. Supplementary questions

Data Collection

Six days were allocated for data collection in each village, during which time extensive interviews concerning production, income, expenditures, household possessions and features, demographics, and consumption were carried out. Data collection can be viewed essentially in three phases:

(a) Private interviews were conducted in the first and second day regarding demographics, income, and expenditures, as well as household possessions and features.

(b) Daily consumption was recorded nightly for three days in a row, each household being interviewed immediately preceding the evening meal preparation. Food for the evening meal was weighed and measured in standardized local measures (see Table 7D.). Consumption data for the rest of the day were obtained by recall from the person responsible for cooking, using standard local measures as proxies for amounts cooked.

TABLE 7D.

CONVERSION STANDARDS FOR LOCAL MEASUREMENTS USED IN HIGHLAND SAMPLE VILLAGES

Measures		Equivalent	
1	bag	100	kilograms
1	tin	16.8	kilograms
1	bag	6	tins
1	tin	16	tassas
1	tassa	6	cigarette cups
1	Nigerian Mudu	1	tassa
2	medium buckets	1	tin
4	small buckets	1	tin
1	small basin	1	tin
1	headpan	1	tin
1	large rubber bucket	1	tin
1½	baskets	1	tin
1	Banso canja	1	tin
1	Oku canja	1	tin
1	large basin	2	tins
1000	kola nuts	1	basket
6	bags unshelled corn	1	bag shelled corn
For Plantains and Bananas			
12	fingers	1	hand
8	hands	1	head
96	fingers	1	head

SOURCE: Survey data.

(c) Two food crop fields were measured for each household, for a total of 18 fields per village. Additional information was also collected for other fields concerning crops, yields, land costs, tenure arrangements, input use, labor time, etc. In the case of tree crops, fields were not measured, but information regarding yields or number of stems was obtained when possible.

Areas of fields were obtained by measuring direction and length of straight segments along the perimeter. A good compass (Topochaix model Broussarde) was used to obtain magnetic bearings, and side lengths were taken with either "topofils" (another Topochaix devise that uses a lost-thread method), or with optical range finders.

Data Processing

Some data processing was to be carried out in the field, concurrently with the data collection, but the statistical analysis for the sample as a whole was done at the University of Michigan. Enumerators were provided with pocket calculators to enable them to perform simple data transformations such as local measurements to gram equivalents. Programmable calculators with statistical capabilities were also on hand to perform intervillage comparisons and other operations.

A program developed at CRED for the HP-41C programmable calculator was used to compute field areas on-site, immediately after field measurements were taken. Whenever measurement errors occurred, as it is often the case, it was possible to measure again the field right away.

Efforts were made, at USAID's request, to enter field data on magnetic floppy disks and do some preliminary nutritional analysis for some villages, using an Apple II microcomputer available at the USAID Mission in Yaounde. Although some preliminary results were obtained, retrieving the data from the magnetic disks became a time-consuming process that eventually nullified the progress made in codification and keypunching. Microcomputers have real possibilities and advantages for in-country data analysis, but their use should be carefully planned ahead, and appropriate software must be ready to use. Our unfortunate experience in this can be attributed to lack of preparation, lack of software, and the myriad of incompatibility problems that arise when data from one microcomputer are to be transferred to another system.

Data codification, keypunching, and processing were done at the University of Michigan. Only the major features of the data are presented in this report because of time constraints imposed by the methodological objective of designing a scheme of rapid impact assessment. Further in-depth analysis of the survey data will be carried out independently by the researchers involved in the project.

The Food Consumption Survey

Timing of the Survey

The amount, quality, and composition of the diet in a peasant community ordinarily follows well-defined annual cycles corresponding to the climatic constraints on food production. In most of West Africa the cropping and harvest seasons are dictated by the pattern of rainfall. For the area under observation (the highlands of Cameroon Northwest Province), the rains begin in late March or early April and continue until the end of the year, with the highest precipitation recorded in July and August. Planting of crops begins as soon as the first rains occur, but harvesting does not begin until August and September for the main crops. Following harvest, food consumption is presumably more nutritionally adequate than at the end of the dry season. The greatest nutritional stress would be expected in the first few months of the cropping season, when long hours of farm work are required at the time when food reserves are at their lowest levels.

This food consumption survey was scheduled to take place during the months of April, May and June, but a delay in starting moved the coverage to May through July 1981. The survey was expected therefore to cover the period of greatest nutritional stress, as well as to maximize the observed variation in diets among income groups.

Staffing and Training

Three women enumerators were also recruited to do the actual dietary recording. They were recommended by and borrowed from one of the local agricultural cooperative organizations for the duration of the survey. The enumerators were fluent in the local languages and Pidgin English, while the principal researchers were fluent or conversant in the latter. One week of training was sufficient to acquaint the enumerators with the questionnaires and the data recording procedures.

Equipment and Supplies

Little specialized equipment was required for the food consumption survey. Two scales for weighing food were provided to each enumerator, one with capacity of up to 2 kilograms, another up to 5 kilograms. These were lightweight spring scales with a bowl on top. Unfortunately, the enumerators complained of having to carry the scales from house to house, and their use was discontinued. Instead, food inputs were recorded using the number of standard local units for that food, such as cups or

cooking spoons. Afterwards, average gram equivalents were obtained and used to convert these recordings to grams. Small pocket calculators with one-year batteries were provided to each enumerator to perform these calculations.

No data on height and weights of household members were collected in this survey; equipment for this purpose was therefore not needed. Ample office supplies to protect, fill, and store the questionnaires were, of course, made available.

The large number of villages to be covered in such a short time required high mobility by the entire team. A house was rented in Kumbo, the main town in the highland area, to serve as base for principal researchers. During the week, however the team spent the entire time in the survey villages. Appropriate clothing, cots, and other camping supplies were often needed. A four-wheel drive vehicle well-adapted to the conditions of the terrain, as well as an experienced driver, were assigned to the survey by the Ministry of Agriculture, Department of Studies and Projects.

Questionnaires

Most of the data recorded on food consumption were incorporated in Questionnaire No. 2 (see Appendix I, Part II), but other schedules also contain information pertinent to the analysis of food consumption. The demographic aspects of Questionnaire No. 1, in particular, provided basic facts about sex, age, and activities of each member of the household. Questionnaire No. 3 collected data on market purchases, of which most are food-related, and in Questionnaire No. 4 the seasonal relative variation in the composition of diets was recorded.

Three copies of Questionnaire No. 2 were completed for each household, one for each day of interview. Three consecutive days were considered the minimum necessary to obtain a reasonably accurate estimate of the nutritional adequacy of a family's diet. A single day interview has been found to overstate the real variation of food intake in a community, while more than three days would have severely reduced the number of families that could be interviewed in the three months of the survey.

Each day the enumerators requested information about the morning, afternoon and evening meals: names of main dishes, ingredients needed in preparation, quantities of each item and whether it was bought by the husband or wife. The number of men, women, and children partaking of the meals was also recorded, but not their identity. Finally, the questionnaire inquired about any meals taken outside the household.

Sampling

Sundays were not included in the food consumption survey, in order to avoid the problems of making allowances for special eating habits and presence or absence of

family members and guests. Moreover, this allowed the staff and assistants to take needed rests. Enough slack time was built into the schedule to permit additional time that might be needed for some families, and to allow one researcher to go a couple of days ahead of the team to make arrangements in the net village.

Polygamous families are not unusual in the survey regions; in fact, about a third of our sample households are part of polygamous families. In such cases, each wife ordinarily runs her own household relatively independently of the other wives. She has her own fields, food stock and sources of income, and she cares for her own children and cooks separately. Whenever the case of a polygamous family arose, the senior wife's household was chosen for the survey, even though this might have introduced a slight bias in the sample.

In a food consumption study, a basic unit of observation is the commensal unit, or group of people who eat together out of a common pot. This has been adopted as the reference group in this study. Nevertheless, there is wide variation in the number of people eating at each meal, and even between days. It was therefore necessary to record meal participation in addition to the census of family members.

Finally, it should be noted that no attempt was made at evaluating individual food consumption, or distribution of food within the family. Such approaches were deemed impractical.

Computing Per Capita Intakes

To arrive at estimates of per capita daily calorie intake is not as straightforward a calculation as it might appear at first sight. There are three sources of difficulties: first, variations occur in the number, sex and age of people eating at different meals and in different days; second, leftovers from one meal are sometimes consumed at another time; third, no record was kept of who took part in each meal, only of how many men, women and children.

To be sure, most meals are consumed by all members of the household. Variations in meal participation occur mainly because during this season, fieldwork prevents some women from cooking in the middle of the day. In many cases the afternoon meal was skipped altogether; alternatively, a portion of the breakfast may be taken to the fields to eat later, while another portion may be left at home for the children to eat in the afternoon. In addition, neighboring families may arrange to alternate preparing lunch for all the children in both households.

In view of these complications, it is difficult to design a calculating procedure that would be consistently appropriate for all situations. It is not entirely correct, for

example, to add up all the calories in one day and divide by the average number of participants, since lunch is often skipped by most adults of the family. Per head estimates of food intake could then be subject to great variations from seemingly small changes in meal participation. The procedure adopted here to alleviate this particular problem is to make separate estimates of per capita intake of food, calories and protein for each meal, according to the number of people eating; these per capita estimates were then added to arrive at per capita daily intake estimates. Three daily intake estimates were thus obtained for each family, one for every day of the interview. In the final analysis, only the averages over the three days were used.

Computing Man-Equivalent Intakes

Objections to per capita estimates of nutrient intake might be raised since these averages blur the distinctions in nutrient requirements among individuals of different age and sex. Families with different sex and age structures would have different levels of per capita nutrient requirements. In response to this concern, alternative estimates of food, energy and protein intakes were made on the basis of man-equivalents taking an adult male with a moderate level of activity as the unit; other meal participants were weighted in proportion to their average nutrient requirements. In the case of energy, for example, adult males were assigned a weight of 1.00 corresponding to a recommended allowance of 3,000 kcal per day; adult women were given a .90 weight, equivalent to 2,700 kcal per day, an allowance calculated to cover 2,200 kcal per day plus a 500 kcal margin for the extra labor activity in this season, plus pregnancy and lactation requirements. Children were given a weight of .667 man-equivalent, i.e., 2,000 kcal per day. This figure was computed as the average of energy requirements for children 14 years of age and younger, weighted by their relative presence in the sample population.

The same technique was used to arrive at per man-equivalent estimates of protein, but the weights for women and children were changed: adult women were counted as equal to 1.00 man-equivalent since allowances for both pregnancy and lactation raise their protein needs to those of men. Children were weighted at 0.63 man-equivalent.

Observation Biases

Observation biases are a serious concern in food consumption surveys. The presence of an enumerator in the kitchen may affect, consciously or unconsciously, the choice of foods and the quantities served. Depending on the particular circumstances,

TABLE 7E.

TOTAL FOOD, ENERGY, AND PROTEIN INTAKES IN THE FIRST, SECOND AND THIRD DAYS OF INTERVIEWS

Day	Food Weight (kg.)	Energy Mcal	Protein kg.
First	654.5	1,542	48.1
Second	653.0	1,533	44.8
Third	648.9	1,524	44.5

households may increase their food intake to make a good impression on the enumerator. Conversely, if there is an expectation that aid might be forthcoming if insufficient food is observed, households might consume less than average amounts of food. Most often, the presence of a strange person in the kitchen is likely to result in an overestimate of food intake. Prolonging the survey for several days permits the family to get accustomed to the enumerator, and after a couple of days, more representative food consumption may result.

In order to ascertain if food consumption is being affected by the survey process itself, the food weight, energy, and protein intakes for the first, second, and third days of interview were computed separately. Results appear in Table 7E. The pattern is evident: all measurements for the first day exceed those of the second day which in turn exceed those of the third day. But the relative differences are minor, since in weight and calories the discrepancy is merely one percent. In protein, however, the difference between first and third day is eight percent. It would appear that families consumed significantly more protein-rich foods such as meat and beans in the first day of the survey.

In sum, the data support the presumption of a slight upward observation bias in the food consumption survey. The bias affects most significantly the protein content of the diet.

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

CHAPTER 8
FIELD SURVEY METHODOLOGY: SENEGAL

by
Henri Josserand

Center for Research on Economic Development
University of Michigan
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CHAPTER 8

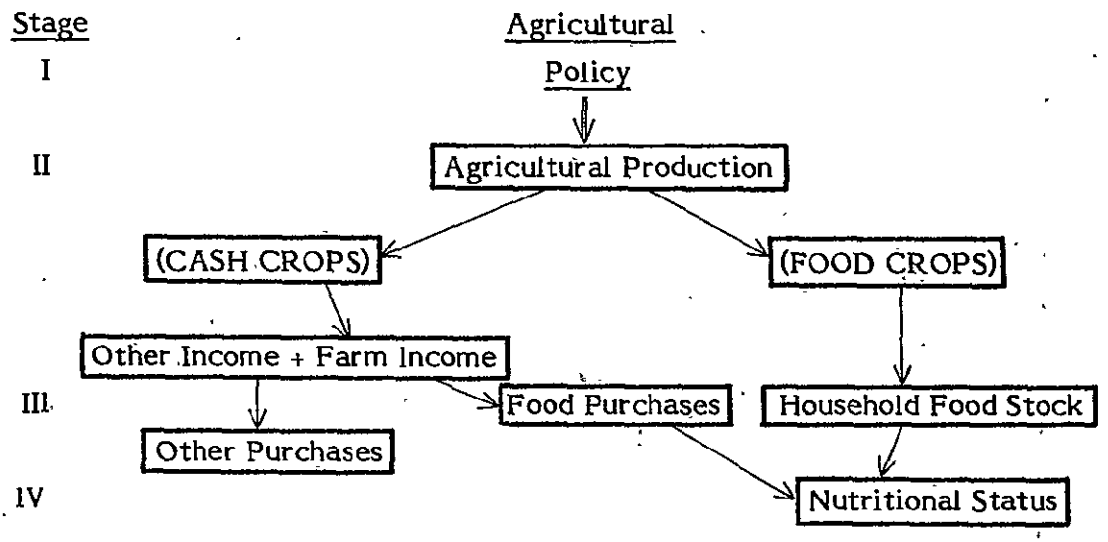
FIELD SURVEY METHODOLOGY IN SENEGAL

This chapter discusses the general methodology developed for the Senegal case study, provides a brief overview of the research area, and describes the survey process employed in the field. We also offer some comments on the design and implementation of data gathering, an evaluation of the completeness and precision of results obtained, and recommendations for the transferability to other cases and countries, including prerequisites and modifications.

8.1. Methodology

A major objective of this study was the design and testing of a rapid methodology enabling planners to estimate the eventual nutritional impact of agricultural policies. Let us address this part of the assigned task first. Essentially, we sought to identify the location and strength of the various linkages in the simplest logical chain connecting agricultural policy at one end, with rural nutritional status at the other. This logical chain may be represented as in the diagram below:

DIAGRAM 8A.



Agricultural policy in African economies is most likely to be expressed through producer prices for major cash crops, prices of inputs such as seeds and fertilizer, access to credit (which may be closely tied to the previous two), and extension or other technical assistance. Depending upon policies chosen and announced before planting time, a farmer may wish to alter his production pattern, either changing the mix and proportion of his crops, the techniques of production used, or both. Of course, the extent to which farmers react to changes in agricultural policies is strongly influenced by many other factors, not shown in this diagram. These include risk considerations, household cereal requirements, price expectations, and so forth.

Farmers' planting and cultivating decisions determine -- at least partly -- income from farm activities and the quantity of food grown by the household for family consumption. Clearly, all livestock sold by the family are considered as a cash crop while livestock consumed by the household fall in the food crop category. Unsold food crops and food purchased with farm plus nonfarm income constitute the total stock of food available to the family. The final step is to infer nutritional status from food availability. This is not as straightforward as it may first appear; the nutritional effect of food intake is influenced by the timing of food consumption over the year, the intrafamily distribution of food, and the general health status of family members.

Finding the links between the successive logical stages of Diagram 8A. calls for a combination of elements from farming systems research, household budget surveys, and nutritional studies for the same population. In view of the time and cost constraints specified, none of the areas of research listed above could be addressed in a way entirely fulfilling their more rigorous current standards. The widely accepted norm today for farming systems research requires over a year's fieldwork (a complete agricultural cycle). Household budget studies, because of the sensitivity of such issues as off-farm income and remittances from outside the village, also require much time in the field. Similarly, nutrition surveys at their best are based upon observation of food intake (at and between meals), careful examination of a population sample by physicians, blood tests, and anthropometric measurements. An attempt on our part to set our sights on the best state-of-the-art research methods in these areas, given about six months' time to do the work, would have been pointless. Instead, we have sought to select essential elements in each type of research area and to connect them to replicate the logical chain of Diagram 8A.

We also tried to follow a strategy in the testing of this new methodology enabling us to ascertain whether it could work at all, that is, under the most favorable

conditions. In this case, the most favorable conditions are such that linkages between the successive stages of Diagram 8A. are clear and strong, and the analysis is not complicated by a large number of cash and food crop production activities. We felt these requirements were best met in an area like the Diourbel Region, where there is only one main cash crop (peanuts) and one major food crop (millet). Among other similar areas, the Diourbel Region was also chosen because there are several recent studies on farming systems (e.g. ISRA/CNRA, various years), and rural nutrition (e.g. ORANA, SONED, 1981). We thought their findings would be helpful in testing the validity of our own downsized but rather holistic approach.

All the selected essential elements mentioned above were collected for each unit (household) of the basic survey sample, which consisted of 720 persons belonging to 72 households drawn from three villages. Note that the survey units selected made up a systematic random sample amounting to about a third of all households in each village. Data were collected on four very general topics: demography, agriculture, nutrition and income, over a continuous twelve-week period, May 17 through August 15, 1981. Two enumerators were installed in each village, a young man and woman from the Region, who worked under the supervision of Mr. Tim Rosché in Sessene and Mr. Henri Josserand in Layabe and Thienthie during the first phase of the study, and with Mr. Rosché's guidance only for the remainder of the field work.

8.1.1. Demographics

Basic demographic information collected on each surveyed household included data on members of the family generally present, for instance name, sex, age, relationship, schooling. Pregnant and lactating women were also identified. Information about members of the household generally absent (i.e. migrants), included age and sex, date of departure and reason for leaving (e.g. school attendance, work, trade).

8.1.2. Agriculture

Agricultural data were collected in several ways:

(a) Measurement of every household's fields, and recall information on last year's crop planted, fertilizer and manure used, harvest, etc. for each family field;

(b) Recall information for the full farm on such items as implements available, total quantity of fertilizer and manure applied to all fields, and total harvest by crop for the previous year;

(c) Data on time spent on agricultural activities over one agricultural year were also collected by recall. Again, we felt it was both worth trying and most likely to succeed

in the Diourbel Region if anywhere at all in Senegal. The method followed in this case required some understanding of the local agricultural calendar. This was gained by studying previous reports on agriculture in the area and through discussions with farmers. The first step consisted of identifying the name and span of the year's seasons, as known in the area, since people are used to weeks and months as time intervals, but can less clearly recall May or October, for example, in an annual cycle.

Farmers in the surveyed area use the four traditional Wolof seasons, which correspond to major climatic changes over the year:

- Nor, a cool season, from February through April;
- Tioron, a dry, hot season, from end of April to the end of June;
- Navet, the rainy season, from July to the end of October;
- Lolly, the "cold" season, from November to the end of January.

The general calendar of major agricultural activities summarized in Part I (Senegal, Table 4.5.) was then determined. Nearly twenty separate agricultural activities and their precise vernacular names were identified. The dominant (near-unique) pattern of cultivation in the area consists of sowing millet first, shortly before the rains, and then sowing peanuts at the first major rain. The work during the rest of the growing season is a sequence of activities where each task is applied first to millet, then to peanuts. This process staggers activities and peak labor time requirements over the growing season, which goes a long way in explaining the near-total acceptance and continuation of the peanut-millet association in the area. Once the basic system had been ascertained, the process of recall for labor requirements consisted of asking the head of household to "retrace his steps" in chronological (and thus to him, logical) order from one crop to the other and back over the year. A comparison of labor requirements estimated according to this method, and similar data obtained after year-long field observations was presented in Part I (Senegal, Chapter IV).

(d) Recall information was also gathered from heads of households on the amount and seasonality of farm product marketing during the past year, including peanuts, millet, cowpeas, livestock and poultry, as well as on the current stock of poultry, small ruminants and horses (used for traction).

8.1.3. Nutrition

Data on nutrition were collected on the following three separate but closely related levels: observed food intake during meals, weekly food purchases, and

anthropometric measurements of the sample population.

(a) Given daily random variation in diet, the type and quantity of food consumed by a family had to be estimated by taking the average of several days. There is an obvious trade-off between the number of days spent on each family and the total number of families surveyed during a fixed period of time. We decided to follow each family for three days, thereby aiming for a maximum of two families per village per week, and a total maximum of 72 families over the survey period. In food consumption studies there is always a definite risk that surveyed families will depart from the norm and more or less consciously prepare unrepresentative or 'nonrandom' meals; our check for the presence of such bias is discussed with the survey results in Part I (Senegal, Chapter V). At any rate, we sought to minimize the disturbance by having the woman enumerator live and eat regularly in the village chief's compound, so that she would come over to the family surveyed at meal preparation time, list and weigh all the food items before they were cooked, record how many men, women and children (including guests) were eating out of the dish(es), and go back to the chief's compound for her own meal.

Under certain circumstances, this approach might be rightly criticized on two counts. First, by not actually attending meals, the enumerator might miss important intrafamily differences in quantity and quality of food consumed. Secondly, the amount of food ingested might be overestimated since no allowance is made for leftovers thrown away or fed to animals. In the case of this study, however, intrafamily distribution could only have been very roughly estimated since people do not eat observable discrete portions, but eat out of one or several communal dishes. Men marginally eat more and better than the rest of the family, but the question of knowing how much more and better cannot be answered just by observing the meal, especially with the disruption careful observation is certain to cause. At any rate, even if food portions at breakfast and lunch had been observed, dinner might be another matter entirely, since the day's last meal most often takes place in near-complete darkness. Finally, at this time of year and after two bad harvests, the question of wasted leftovers does not arise. Our own concern about the validity of judging food intake from meals stems from the undeniable consumption of snacks -- in this case, mostly mangoes and peanuts -- between meals. This issue is taken up with the results of Part I (Senegal, Chapter V) as well.

The food items consumed by each household were translated into calories and grams of protein; for each meal, the total quantity of nutrients was divided by a "man-

equivalent" number of persons, on the basis of calories and protein requirements for the various sex or age groups. For men, calorie requirements were set at the very active level of 3000 kilocalories per day, and protein requirements at 31 grams per day. Other groups called for slightly more complex indexing, based on the observed demographics of the surveyed sample. For instance, 4.7 percent of women surveyed were pregnant and 18.9 percent were lactating, leaving 76.4 percent as being neither. On the basis of recommended levels listed in Latham (1979), standard caloric and protein intake for various groups were set at:

Pregnant women	2,550 kcal/day;	33 grams/day
Lactating mothers	2,750 kcal/day;	41 grams/day
Others	2,200 kcal/day;	24 grams/day

The weighted average daily caloric requirement for a woman drawn from this population was, therefore: .764 x 2,200 + .189 x 2,750 + .047 x 2,550 = 2,320.4 kilocalories/day. Similarly, the weighted average daily protein intake recommended was 27.6 grams per day.

The same type of calculation was applied to the population of children, broken down into seven age-groups for caloric and protein requirements; detailed calculations are presented in Part I (Senegal, Table A8. of Appendix I.). For each meal, the number of men, women and children observed eating was thus translated into a "man-equivalent" number for both calories and protein. For each day, the total amount of calories and protein consumed were then divided by these factors to derive daily calories and protein by "man-equivalent". Finally, the numbers actually used as single caloric and protein indicators are the arithmetic mean of the three days' values. This allowed us to represent the entire household by a single figure for calories, and a single figure for protein. A comparison of either level of nutritional intake among the various households then became possible, as well as an inquiry into several factors which might influence such interfamily disparities.

As it turned out this year, the annual month-long Ramadan, traditional Moslem period of fast, took place from July 4 to August 4, and was entirely included in the survey period. During Ramadan, observing Moslems do not eat between dawn and dusk, but pregnant and lactating women, as well as children, are excused from rigorous fast, and do eat during the day. There is no consensus of opinion over the nutritional impact of Ramadan upon rural populations. Some researchers hold that the effect is deleterious, while others claim on the contrary that people more than make up for the day's fast by consuming at night more and nutritionally better food than at other times. This lack of agreement mostly stems from the difficulty of measuring the

impact of an event occurring at a different time year after year. The impact of Ramadan on rural nutrition is not likely to be the same in January, a time of full granaries and little agricultural work, as in August, when stocks of food are low or exhausted and people spend all day in the fields. The fact that no single study can answer the question clearly for all times and places is no reason to ignore the issue altogether; we discuss this point in Part I (Senegal, Chapter V).

(b) Weekly food purchases are an interesting nutrition-related topic. We tried to estimate the extent to which village families depend on food items purchased at the village shop, village market, or other larger market. This information was collected by the women enumerators through conversations with those women mainly in charge of food preparation who were sure to know about the items, whether they had purchased them personally or not. The data thus gathered were adjusted to account for the fact that occasional purchases of grain, salt, etc. last for several weeks or months, so that the final product represented the adjusted weekly quantity of various food items, and their cost for each household. This allowed us to test for any correlation between the agricultural production pattern and food purchase requirements at the end of the dry season, to see if one village seemed advantaged by its location in terms of types and prices of foods available, etc. Finally, the type and value of food purchased by households, as economic status indicators, were compared to other possible measures of economic well-being.

(c) The last part of our nutritional status survey consisted of an anthropometric study of the whole survey sample. Anthropometric studies are said, in the relevant literature, to have several advantages over food intake surveys. First, food intake varies over time due to changes in food availability and income, so it is difficult to infer a long-term eating pattern from a few days' observation. On the contrary, "the body remembers", and the weight-for-age or similar ratio for a child shows how well, in general, the child ate over his/her lifetime. It is also easier to avoid bias in anthropometric studies; the family may well (and seems to, in this case) prepare more food while surveyed, but if all children are weighed and measured no such error is introduced. A comparison of results obtained through food intake estimates and anthropometric methods is set out in Part I (Senegal, Chapter V).

Anthropometric data consisted of the sex, age, weight, and length of each sample population member (n = 720). The ages for children five years or older, and for adults, were expressed in years, while the ages of children under five were expressed in months. To help ascertain the age of small children, we resorted to the tried and tested "Calendar of Events" method. This consists of identifying, for the last few

years, certain key events most people can locate in the recent past; for example, the construction of a well, a Moslem feast, national election, the death of a notable, etc. These points of reference in time help pinpoint the time of the child's birth.

Adults' weights were recorded with standard scales. For children, where greater accuracy is required, we used UNICEF sling-type scales.

8.1.4. Wealth and Income

The last topics of data collection concerned wealth and income. In traditional farming societies, what we usually think of as wealth and income, as concepts of economic well-being, must be expressed as an amalgam of valuable family-generated stocks and flows, plus the net balance of in-kind receipts and outlays, including labor time. For instance, in this study, we attempted to capture information on family stocks by recording the household's present active farming population, the usual area planted each year, the list of available agricultural implements including horses, standing livestock and poultry, and a variety of economic status indicators such as improved bedding, flashlights, etc. Flows were divided into two categories: farm income, and nonfarm income earned in the village. Farm income flows included the value of grain production, marketed nongrain crops, peanuts, cowpeas, livestock, and poultry. Village nonfarm income was the estimated net income, adjusted for seasonal variation, of family members working part or full-time as shopkeepers, petty traders, tailors, stockmen, artisans, etc.

Nonfarm income was estimated on the basis of interviews with each person engaged in one of the activities listed above. Using the same traditional seasons as for the agricultural census, Nor, Tioron, Navet, and Lolly, we asked respondents how many weeks they worked each season, and how many days per week. Days per week were translated into whole work days by estimating the average actual number of hours worked daily. We then asked people to give us an average weekly or monthly earnings figure for each season, explaining as well as possible the difference between gross and net income, since we wanted the latter. When profit margins were not obtained directly, two methods were used to reconstruct them: for some trades the profit on each unit was estimated and multiplied by the estimated number of sales; for others, the items purchased with profits for a known time period were listed, their total value being well known or closely estimated.

Income from outside the village, consisting of remittances to various households by family members working in towns and cities, constitutes a very important part of the whole rural income question. In this case, considering the team spent only three

days with each family, we decided not to bring up the matter of remittances; it is quite unlikely we could have obtained useful information by pursuing the matter, and we could avail ourselves of enough other elements to construct an income indicator or index for each family.

8.2. Brief Description of the Diourbel Region and Survey Area

No single area of Senegal can be proffered as a microcosm of the country's varied physical and human geography; furthermore, the character of the study itself and data availability influenced our choice of the general research area. Additional information on the Diourbel Region can be found in Part I (Senegal, Chapter IV). We see the Diourbel Region, however, as usefully representative of rural Senegalese conditions for the purposes of this study. These conditions are portrayed by such characteristics as:

- significant livestock raising but concentration on cash and food crops;
- clearly monetized but still essentially traditional methods of production and social system;
- ethnic and religious diversity, with one ethnic group and one religion clearly dominant;
- a pronounced tendency to outmigration among young adult males;
- a low level of school enrollment (less than 13 percent of 5-14 year old children).

Within the Diourbel Region, the selected villages were Layabe, Sessene, and Thienthie (Thienthie I, strictly speaking). The three villages are close enough to one another that similar climatic conditions may be reasonably assumed in the short-term, and taken for granted over the long-run. They are also roughly equal in population size, each claiming about 700 residents, a size typical of many rural communities in this and other regions. All are located at near-equal distances to a paved road and larger rural market towns, possibly with a slight advantage for Sessene in this regard. All three are made up of a variety of traditional castes; for the Wolof these include freemen (Ger), "slaves" (Dyam), blacksmiths (Tog), etc. On the other hand, they are dissimilar enough to reflect the variety of production and other socioeconomic systems observable in the area. For instance, Layabe and Thienthie are predominantly Wolof Murid villages, while Sessene is Serer and non-Moslem. Of the two Wolof villages, Layabe seems to have a more rigorous and fundamentalist Murid leadership, making Thienthie's customs and practices appear more permissive and "progressive" in comparison. The villages differ in several other important ways; Layabe and Thienthie like other Wolof communities in the area are spatially organized as a tight cluster of

households around a fairly well-defined central place, while Sessene consists of a scattered collection of individual households. Several studies of agricultural practices in the Diourbel Region (see Copans, et al., 1972), have pointed out a basic difference between Wolof and Serer communities in this part of Senegal; although both groups raise small ruminants, horses and poultry, the Serer raise many more cattle than the Wolof. The same pattern prevails in the three survey villages, influencing agricultural practices and output to a major extent. As always, each village has a unique character and "personality", not succinctly expressible, but very real nonetheless.

8.3. Survey Process

The questionnaires used in this study were designed and prepared at CRED along the methodological lines described in 8.1., on the basis of a survey of the literature about the area (see ISRA/CNRA; Copans et al). A sample sheet from each of the nine forms used is provided in Appendix II (Part II). Given a twelve-week expected data collection period, questionnaires were designed on a survey scale of three days per household with two enumerators working simultaneously on different aspects of the family's activities. To insure a large enough survey sample and some ethnic or other diversity, three villages were selected in the project area; more than three villages would have almost certainly overtaxed data collection supervision and logistics.

In the project area, the three survey villages were selected in consultation with the ISRA's Centre National de Recherche Agricole (CNRA) in Bambey, especially with Mr. Moussa Fall, who accompanied the field researchers and enumerators to the chosen villages several times to propose and explain the study to the local chiefs, elders, and population. The ISRA/CNRA also notified and arranged for interviews with suitable young men and women, so that out of the six candidates selected as enumerators, four had good experience with agricultural or socioeconomic research in Diourbel Region villages. This assistance was the most decisive factor making for an orderly and timely start-up of data collection in Layabe, Sessene and Thienthie. Finally, ISRA/CNRA's extensive agricultural research library proved quite useful at all stages of the study.

In each selected village the two enumerators and supervisor were accomodated in the village chief's compound. After a short period of training and questionnaire testing, data collection proceded regularly from mid-May to mid-August. Each village consists of several castes and socioeconomic groups often clustered in particular sections of the community. To avoid over and underrepresentation of certain groups, the households surveyed were picked according to a pattern starting from the village

center or near-center, and gradually spiraling outward to cover some households in each major section of the village.

As in 8.1., the main areas of inquiry may be summarized as demographics, agriculture, nutrition, and income. Demographic information was collected first, through interviews with the chief of household, most often in the presence of other family members; one or more No. 1 forms of the questionnaire were used for each compound. The information gathered on this form was used by itself to obtain a demographic profile of the survey sample and migrants from the same families, and in connection with or to prompt/check information on forms No. 9 and No. 10.

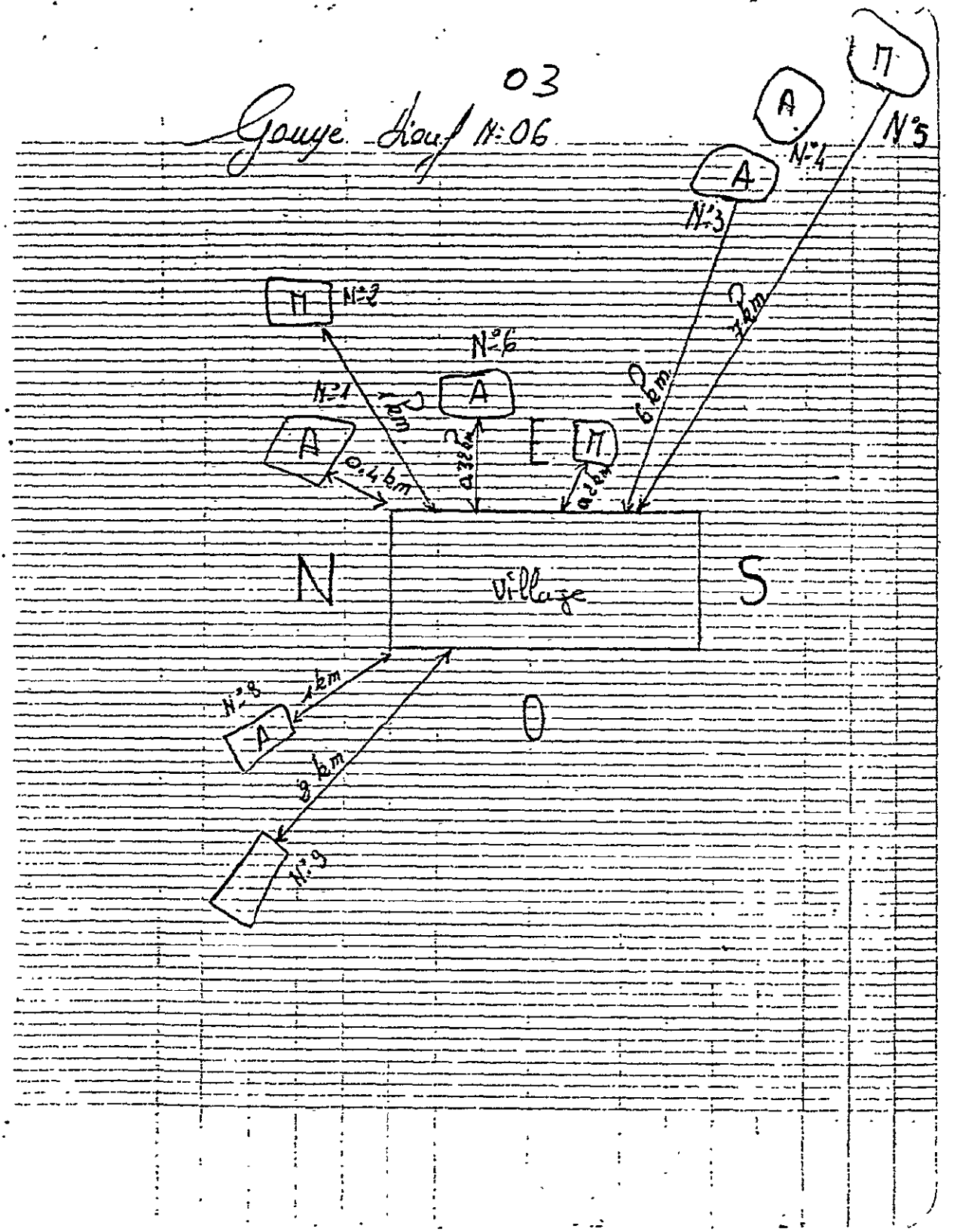
Agricultural information was then collected, through more personal interviews with the chiefs of households, sometimes in the presence of another active farming member of the family--an elder son, for instance. After explanations and agreement on terminology (seasons, specific vernacular names for agricultural tasks), the agricultural calendar was determined. Using one form No. 2 for each major crop for all fields taken together, labor time requirements over the past agricultural year were recalled, as well as the total quantity harvested on all fields.

Farmers in the project area occasionally hire workers under a variety of contractual arrangements; according to the type of contract, where they come from and their relationship with the family, such workers are called navetane or firdu. In the past few years, rainfall in the area has been so low that farmers have been able to meet labor requirements without recourse to hired workers; the navetane and firdu columns on form No. 2 were, therefore, used to gather information on reciprocal work arrangements common among farmers of the same village (Nadante, or Dimboli in Wolof; see Copans, et al.; Pelissier).

Once the general patterns of cropping and labor use were established, further general farming information was collected from the same respondents through form No. 5 of the questionnaire. These data concerned the type and quantity of agricultural implements, various inputs such as chemical fertilizer and manure, and the livestock held by the family.

The next step involved gathering data on every field cultivated by the family. Each family cultivates the same fields year after year, only rarely loaning a field to another household. A sketch of the various fields' location was first drawn, showing the direction and distance of all fields with respect to the village, and last year's crop for each field. This turned out to be a rather easy task, and one accurately handled by local farmers who thus demonstrated a very keen sense of spatial parameters. A typical sketch, drawn by an enumerator from such information is shown in Diagram 8B.

DIAGRAM 8B


03
Gouye Kouf N:06
A
N°4
M
N°5
A
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M
N°2
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A
N°1
A
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0.32 km
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M
0.2 km
6 km
7 km
N
Village
S
O
N°8
A
1 km
9 km
N°9

Note that the spatial distribution of fields in most directions is also typical; no family had fields concentrated in a single quadrant. This sketch also allowed the team to organize field measurement over several days to reduce the total distance traveled between village and all fields.

The survey team, accompanied by the chief of household or elder son, then collected data on each family field. Fields were measured for area calculation by breaking up the perimeter into straight segments, and measuring the azimuth and length of each segment (see form No. 4 of the questionnaire). While on the field itself, soil type, yield information for the previous year, and past cropping patterns were established and recorded. Many field area calculations were made by Ms. Susan Schiffman during the survey period to check the accuracy of the measurement process; the results were most satisfactory, most of the fields measured by enumerators with no previous surveying experience showed closing errors of only a few percentage points.

Nutritional information was obtained through a three-day dietary survey, an assessment of weekly food purchases and an anthropometric study of all family members. During introductory sessions with the general village populations, we had explained the survey process, emphasizing our wish to observe "normal" patterns of food consumption, requiring that enumerators not eat with the families being surveyed, thus departing from well-established custom. This was, it is believed, understood and accepted, so that no objections were raised when enumerators did not eat with the family. In each village, a woman enumerator did the dietary survey; shortly before each meal preparation, she was called over to the surveyed compound to list and weigh every item used, and the amount of time needed to prepare the food (from previously pounded grain). She would then stay just until the beginning of the meal to count the number of men, women and children eating, and return to the chief's compound; no family objected to the use of a scale to weigh food items. Form No. 6A in Appendix II (Part II) shows a typical meal chart for a family's lunch. The survey process was made more difficult, though not seriously disrupted, by the advent of Ramadan, when the total number of meals per day was occasionally greater than at other times.

During one or several of the dietary survey sessions, the enumerator asked the woman mainly in charge of meal preparation which food items had been purchased over the past week. Form No. 8 of the questionnaire was used to ask about some thirty-odd common items, the quantity bought, cost, place bought, etc. Here again, we observed no reluctance on the part of respondents. They may have tended to overstate purchases.

The final step of the nutritional status survey consisted of gathering the whole family to weigh and measure everyone, starting with the chief of household and elders, then proceeding to adolescents and children. Heights were obtained through the use of simple, locally-made apparatus; children's weights were recorded from UNICEF-type scales or regular portable scales. Adults were weighed with regular portable scales, occasionally checked against readings from village co-op "peanut scales". There was no objection to height measurements; weight measurements were readily accepted for stand-on scales, while sling-type scales for children were not so well received, and many children had to be put on less accurate stand-on scales. The "Calendar of Events" method described in 8.1. was used to a limited extent to ascertain the age of children; known age differences between children from the same family proved useful as well. Finally, demographic information from form No. 1 served to check whether all family members were present.

Information on family income was gathered through the administration of forms No. 7 and No. 10. Form No. 7 bears on the sale of farm products, including livestock and draft animals (in this case, horses). People were able and willing to provide good recall information on peanuts sold shortly after the harvest, and on livestock, including small ruminants and poultry. Sales of millet are much more difficult to recall because it is often sold in small quantities over most of the year. Furthermore, millet sales sometimes occur without the knowledge of the chief of household, the main respondent to this type of question. He is traditionally responsible for the management of the family's main staple food stock, but women do have some latitude, it appears, over the sale or barter of small quantities of millet.

It was thought that certain household items might serve as indicators of economic status; for instance flashlights, zinc roofs or fences, portable radio receivers, etc. A checklist for such items made up the first part of form No. 10; enumerators filled it out for each family through a combination of observation and direct questions. The second part of form No. 10 was devoted to the family members who had a significant nonfarm income. Data on time spent on nonfarm activities and earnings were collected through private interviews with each such family member in turn.

8.4. Comments on the Survey Methodology

8.4.1. Survey Design

At the risk of seeming over-repetitive, we must emphasize again that such short surveys can yield useful results only if certain conditions are met, without which the

effort probably should not be attempted. These necessary conditions are naturally not the same at the various stages of the study; they are therefore best reviewed by following the logical sequence of the study itself: design, site identification, data collection, analysis. As we assess each stage, important or essential prerequisites are examined.

Once the very broad outline of the research approach had been identified, as represented in Diagram 8A.; the actual survey process was designed to fit very specifically a given area of Senegal. This area itself had been selected because it met two basic conditions dictated by the short span of the study: a comparatively simple production system, and a good number of prior agricultural and socioeconomic studies. As explained previously, these allow for both complementing and gauging the validity of the shorter research work. Indeed, the usefulness of a short study is very much a function of existing data. For instance, good baseline information on agricultural production reinforce the descriptive, analytical and monitoring attributes of a short-term survey, while the existence of demand studies estimating, the price and income elasticities of basic food staples, for example, allow for the kind of linkages turning a short-term study into a forecasting tool.

Once the Diourbel Region of the Peanut Basin had been chosen, the questionnaire was designed in Ann Arbor both on the basis of previous experience in the area by various researchers, and on knowledge gained from the literature. Form No. 1, Demographics is quite general, but form No. 2, Agricultural Calendar, and others, required more specificity. The decision of surveying each family over three days for the dietary survey was tentatively taken in consultation with Dr. Frances Larkin, nutritionist in the School of Public Health, University of Michigan. As it turns out, the most directly comparable study of nutrition in Senegal (SONED, 1981), also surveyed each family for three days. At any rate, the questionnaire was entirely flexible in this respect, and the number of days could easily have been changed by the survey team.

At some point in the survey design, the question of determining nutritional status through either a dietary survey or an anthropometric study was briefly considered. With the benefit of hindsight we believe it is clearly best to do both for the same population.

Finally, the location and number of survey villages was an important methodological consideration. In this respect, we note that the Senegal and Cameroon studies differ. The number of communities in Cameroon (eight) was much higher because that study focused, in part, on the way distance from market and different prices affected farmers' production and consumption decisions. In retrospect there appears to have

been a trade-off between capturing significant variability in location and prices, as in Cameroon, and obtaining more accurate and complete data on agricultural production, especially areas and yields, as in Senegal.

8.4.2. Implementation

We will discuss the factors that we think contributed most to the timely collection of useful data. The same factors would also, we believe, be crucial in any similar study.

The major contributing factor was undoubtedly the assistance the survey team received from the ISRA's Centre National de Recherche Agricole (CNRA) in Bambey. Their participation involved visits in many villages, several sessions in each selected village during which Mr. Moussa Fall explained the purpose of the work, introduced team members, and otherwise facilitated the start of the survey. The CNRA also provided experienced enumerators, born in the Region, who were able to master the various tasks required in this study in a very short time, including such new ones as topographical work.

The wide range of topics covered during data collection and the time limit made for complex interviewing over a rather tight schedule. This required close supervision.

With the exception of one family, all villagers were extremely cooperative, but since interviews and field measurements could take over one day of each household's time, a small stipend was given each family surveyed. At the conclusion of the survey in August, each village received a communal pharmacy chest, as a token of appreciation for their help.

We conclude by noting that no preliminary analysis should be planned at the data collection stage; the necessary schedule of information gathering does not leave time for anything but a visual check of questionnaires. For this kind of study, the field reasearchers should concentrate exclusively on obtaining good data; preliminary analysis in the field constitutes a misallocation of scarce research time when total time available for data collection is so limited. This may not be the case when the field survey period extends over one year.

8.4.3. Completeness and Precision of Results

How complete and precise can a three-month field survey be? The first step of such an assessment consists of identifying the items for which a short survey yields as useful results as would a longer study. These turn out to be significant, including:

- demographic data (form No. 1 of the questionnaire);
- out-migration data (form No. 1);
- general Agricultural Calendar (form No. 2);
- area cultivated and crop rotation pattern (form No. 4);
- agricultural implements, (form No. 5);
- anthropometric measurements (form No. 9);
- economic status indicators (form No. 10).

For some other items there are fundamental differences between three-month and year-long surveys, for three main reasons: (a) seasonal variations, (b) relying on recall data as opposed to observations, and (c) length of recall required.

Seasonal variations in food consumption and food purchases could not be estimated in our case, making the analysis of the rural nutrition issue more difficult and less complete than it otherwise would have been. On the other hand, there are very few cases of year-long rural nutrition surveys. Reliance on recall rather than observation over time and the length of recall certainly affect data on labor time allocation to various crops, the marketing of farm products over the year, and nonfarm income. Both with respect to internal consistency and to the findings of longer studies, labor allocation data appear reasonably accurate; produce marketing and nonfarm income data also seem right, but we have less confidence in these because similar information from longer studies is either unavailable or too sketchy.

Several research topics could, in fact, possibly have been expanded upon or added to the survey without necessarily increasing its duration. For instance, if a similar research effort were repeated elsewhere, the team might try to collect data on credit and child mortality; with propitious timing the question of storage might be looked into as well, but in any case, these should only be explored once the more basic issues covered in the present report have adequately been addressed.

In the final analysis, the question is not whether better data can be generated through a longer study, but whether data collected over a short period of time are adequate for a specific purpose. For describing and basically understanding the production/consumption system, our answer is yes; for simple nutritional monitoring and surveillance purposes, yes also. As for providing a rather precise forecasting instrument, the answer has to be contingent upon the existence of demand studies (preferably several done over a number of years).

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

CHAPTER 9
ON-SITE COMPUTATION OF FARM PLOT AREAS

by
Edgar J. Ariza-Niño

Center for Research on Economic Development
University of Michigan
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CHAPTER 9

ON-SITE COMPUTATION OF FARM PLOT AREAS

Introduction

One of the major impediments in conducting rapid farm management surveys in developing countries has been the difficulty in obtaining accurate estimates of field areas in peasant farms. With the advent of pocket programmable calculators in the past few years, it is now possible to estimate the area of a piece of land on-site, with a minimum of effort. This paper describes one such procedure.*

Land measurements have until recently been thought the domain of topographers with highly specialized equipment; their services were therefore expensive and impractical to use except in special occasions such as for land transactions. Peasant farmers usually cultivate multiple scattered small plots. Farm management research under peasant agriculture requires area estimates of these plots to arrive at crop patterns, crop yields, and input-output relationships. A typical survey of farmers in several villages involves measuring close to a thousand plots; unless this can be done fast and easily enough, it becomes impractical and too expensive.

Several researchers in agricultural development have in recent years turned to less demanding procedures to measure farm plots, using compass bearings and length for each side of the plot. These recordings are then used to make a diagram of the field. If the diagram is done on plotting paper, the area can be estimated by merely counting the squares enclosed by the graph; otherwise, a topographer's instrument called a planimeter, can measure directly the area by tracing the outline of the field. Alternatively, field recordings of bearings and distances can be recorded and processed at the university computer back home.

Neither of these solutions is entirely satisfactory for quick surveys, even though area measurements are reasonably accurate. The length of time it takes between a field measurement and the area results is a serious drawback. Furthermore, field measurement procedures are not very accurate and recording mistakes are all too common. As a result, errors invariably occur, and when these are too large, it is

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*Henri Josserand, also at CRED, brought the problem to my attention and has contributed valuable suggestions to this paper.

necessary to remeasure the plot. Were field measurements exact, a person walking the indicated distances and angles should return precisely to the starting point. Any measurement or recording error will make the end point miss the starting point, and the plot would not "close". The gap between the two points is referred to here as closing error. Unfortunately, by the time the error is discovered, the researcher is back home in the States, or the survey team has moved to a different zone, or the farmer cannot recall which was the plot in question. Discarding plots with large errors can lead to serious data attrition, and depending on the nature of the survey, adjustments may or may not be possible.

The procedure described below is designed to estimate field area, with the aid of a calculator, directly in the field using bearing and lengths of plot sides, as well as to provide an estimate of closing error, in case the plot needs remeasurement.

Field Measurements

A farm plot can be approximated by an irregular polygon with a sufficient number of sides. For each side of the polygon, two measurements are needed: length and direction. Both measures are taken simultaneously as one moves along the perimeter of the field.

The procedure for measuring a field is quite simple, and can be executed by an interviewer, and a young helper with a minimum of training.

Two-Person Procedure

Step 1: Select a starting point along edge of field. Mark it clearly.

Step 2: Advance along edge of field. Select a new point so that a straight line between the points coincides closely with edge of field. Helper remains at old point.

Step 3: Record distance between points.

Step 4: Record compass bearing (direction) from new point to old point.

Step 5: Is new point the original starting point?

If yes, STOP.

If not, continue.

Step 6: Helper joins enumerator at new point. Now "new point" becomes "old point". Continue with Step 2.

Alternative Two-Person Procedure

Step 1: Select a starting point along edge of field. Mark it clearly.

Step 2: Have helper advance along edge of field. Select a new point so that a straight line between points coincides closely with edge of field. Helper stands at new point; enumerator stays at old point.

Step 3: Record distance between points.

Step 4: Record compass bearing (direction) from old point to new point.

Step 5: Is new point the original starting point?

If yes, STOP.

If not, continue.

Step 6: Enumerator joins helper at new point. Now "new point" becomes old point. Continue with Step 2.

Variations in the measuring procedure are possible without affecting the results. For example, in the alternative two-person procedure above, the positions of the helper and interviewer have been switched so that the interviewer, not the helper, selects the new spot. In that case the bearing records the reverse direction from the new to the old spot. The results are identical since it should not matter whether the field is measured clockwise or counterclockwise. But note that the two methods cannot be combined. Sequences of points must be either all clockwise or all counterclockwise. The first method has the advantage of allowing the enumerator, not the helper, to determine the location of each new point.

Equipment

Recording the length of each field side can be accomplished in many ways; the actual choice is a compromise between accuracy, convenience, and cost. The more accurate techniques require costly equipment, lots of setup time, and trained surveyors. At the other end, pacing is fast and cheap but accuracy may be less satisfactory. Measuring tapes are cumbersome in broken or bush terrain, are easily damaged, and require additional personnel. The most convenient way we have found in practice to measure lengths is with the lost-thread method: a thread is pulled as one walks along a side, and as it unrolls it turns a metering device. The method is as fast as walking and gives accuracy comparable to using tapes. The cost of the thread is small per field, but it can amount to substantial sums for many fields. It is sometimes

difficult to obtain thread bobbins locally, and one needs to carry several bobbins to the field. Farmers, on the other hand, usually collect the discarded thread for sewing. Optical range finders are very portable but more than one is required for short and long distances, and training interviewers to use them has proven difficult.

Measurement of angles for each plot side is a serious source of error. It is not necessary to measure internal angles between two sides. It suffices to establish the bearing with respect to the north, i.e., the azimuth, for each side. This is done with a compass, but depending on the type of compass it may involve greater or lesser difficulty. Only hand-held equipment is envisaged here since the emphasis is on rapid farm surveys. The use of tripods, levels, and staffs is cumbersome and time consuming. Needle compasses are best avoided, for they require simultaneously keeping the needle pointing north while keeping the marker in the line of sight. Hands tire fast and, after more than a few seconds, vibrations interfere with accurate readings. Rosette-type compasses with degrees marked around a disk that rotates automatically to keep a north orientation are best for the purpose in question since they require the operator only to keep line of sight while reading the bearing.

Rosette-disk compasses can be purchased from outdoor equipment stores for less than $10. One can obtain readings $\pm$ 5 degrees fairly fast, but they do require good sharp eyes and a steady hand. At the other end of the price range for hand-held rosette compasses are those with metal casings, sealed oil bath, automatic dampeners, magnifying adjustable prisms, and reverse markings to facilitate reading. Readings of $\pm$ ½ degree can be obtained effortlessly with these units and seem well worth the $150 price tag. Their solid construction recommends them for field use under extreme heat, dust, and humidity conditions. When using the reversed degree markings, the operator must remember that numbers increase from right to left, unlike the standard convention.

Method for Area Calculations

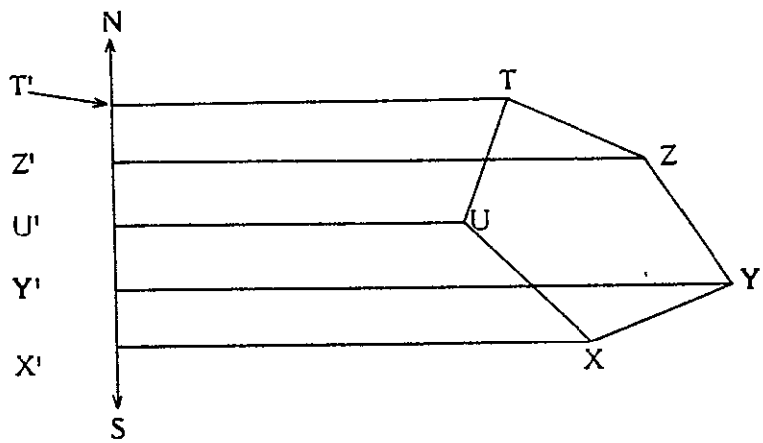
The key to the procedure lies in the idea that the area of a polygon can be represented as the algebraic sum of a series of rectangular trapezoids. This concept is easier to understand with the help of the diagram in Figure 9A.

The polygon we use as an example is given by the figure XYZTU. Suppose there is an arbitrary line NS running north-south one kilometer to the west of point X. We can draw perpendiculars to the NS axis from each one of the polygon vertices; these perpendiculars intersect the NS axis at X',Y'Z'T', and U', respectively.

The area of the polygon XYZTU can now be visualized as the algebraic sum of five trapezoids, namely:

$$XYY'X' + YZZ'Y' + ZTT'Z' - TUU'T' - UXX'U'$$

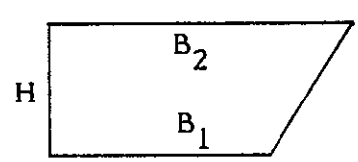
Figure 9A



Finding the area of the polygon can thus be reduced to the problem of obtaining the areas of five individual trapezoids, one for each side. Let us recall that the area of a trapezoid is equal to one half the product of the bases times the height:

Figure 9B

$$\text{Area} = \frac{B_1 + B_2}{2} H$$

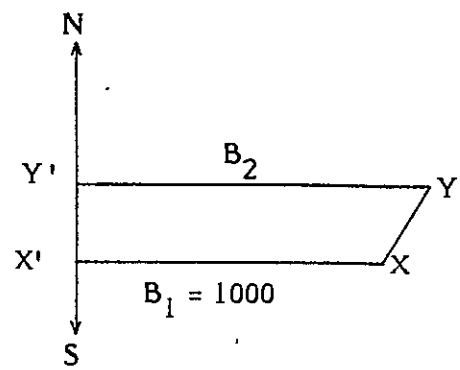


The first trapezoid XYY'X', shown in Figure 9C, is generated by the side XY and its projection on the NS axis. For the side XY we know its length, L_1, and its azimuth or bearing vis-a-vis the north, α. From these data we can derive:

Figure 9C

$$B_1 = XX' = 1000$$

$$B_2 = YY' = 1000 + L_1 \cdot \sin(\alpha_1)$$



Since B_1 and B_2 are parallel, the expression $L_1 \cdot \sin(\alpha_1)$ indicates how much farther point Y is from NS than point X. The height of the trapezoid is obviously given by the distance Y'X', or the projection of side XY on NS, thus

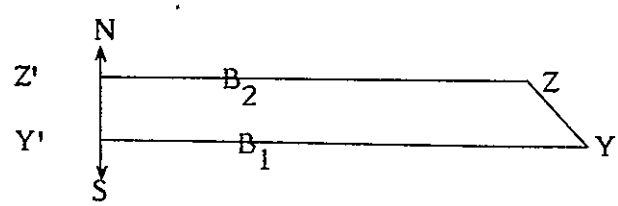
$$H_1 = L_1 \cdot \cos(\alpha_1)$$

With all these elements we can now compute the area of the trapezoid generated by the first XY side of the polygon:

$$\text{Area } XYY'X' = A_1 = \frac{B_1 + B_2}{2} H$$

We proceed to obtain the area of the second trapezoid determined by side YZ and its projection Y'Z'. See Figure 9D:

Figure 9D



Side YZ has length L_2 and azimuth α_2, measured clockwise from the North direction. First of all, we realize that the first base B_1 is given by $\overline{YY'}$, i.e., it is the same as the second base of the previous trapezoid; then

$$B_1 = \overline{YY'} = B_2 \text{ from previous trapezoid } XYY'X'.$$

This feature is very convenient since it allows us to chain the computation for successive trapezoids, and saves on computing one base per trapezoid.

The second base of trapezoid YZZ'Y' is given by $\overline{ZZ'}$ which can be derived:

$$B_2 = \overline{ZZ'} = \overline{YY'} + L_2 \cdot \sin(\alpha_2) = B_1 + L_2 \cdot \sin(\alpha_2)$$

Since the angle α_2 is greater than 180 degrees, its side has a negative sign, consequently, the expression $L_2 \cdot \sin(\alpha_2)$ indicates how much closer point Z is to the axis NS than point Y. It is remarkable that the same formula applies to calculate B_2, regardless of the direction of the side, provided the angle is measured clockwise from the north direction.

The height for the second trapezoid is obtained simply by:

$$H_2 = L_2 \cdot \cos(\alpha_2) = \overline{Y'Z'}$$

and the area by:

$$\text{Area } YZZ'Y' = A_2 = \frac{B_1 + B_2}{2} H_2$$

Calculating the area of the third trapezoid ZTT'Z' generated by the side ZT follows the same procedure as above.

The fourth trapezoid, however offers an interesting variation: whereas the previous three sides have followed generally northward directions, the fourth side has a southward direction, i.e., its azimuth is between 90 and 270 with respect to the north. The consequence of this direction will become apparent.

The bases for the fourth trapezoid TUU'T' are given by:

$$B_1 = \overline{TT'} = B_2 \text{ from previous trapezoid}$$

$$B_2 = \overline{TT'} + L_4 \cdot \sin(\alpha_4) = B_1 + L_4 \cdot \sin(\alpha_4).$$

The height for the fourth trapezoid is obtained by:

$$H_4 = \overline{T'U'} = L_4 \cdot \cos(\alpha_4)$$

However, since α_4 is between 90 and 270, its cosine is negative, and the calculated height H_4 will also be negative. Furthermore, the area of the trapezoid will also be negative since it is computed as:

$$\text{Area TUUT'T'} = A_4 = \frac{(B_1 + B_2)}{2} H_4$$

Although a trapezoid with negative area seems disturbing at first, it turns out a blessing in disguise, since in the computation of the polygon area (Equation 1), the area of the fourth trapezoid TUU'T' is to be subtracted. In other words, areas of trapezoids corresponding to northbound sides have positive signs, while areas for southbound sides have negative values.

The same negative result is obtained for the area of the fifth trapezoid UXX'U' corresponding to the last side UX of the polygon. Hence, when the areas of all five trapezoids are added up, taking care of their respective signs, the net result is the area of the desired polygon XYZTU.

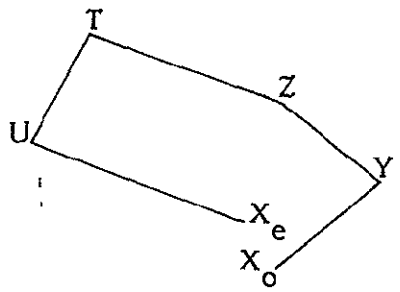
A disturbing thought arises at this point: if the field had been measured clockwise, rather than counterclockwise, the individual trapezoids would have had the same areas but with opposite signs! The area of the polygon would therefore be negative, but with the same value. Obviously, one must take the absolute value of the algebraic sum of trapezoid areas, to eliminate this sign problem.

Furthermore, the NS axis was first assumed at 1000 meters west of point X. It makes no difference at what distance it is assumed, since all trapezoids would be affected by the same length, and the net area would remain the same. In fact, it is just as well to place the north-south axis NS passing right through the first point X. This is equivalent to setting $B_1 = 0$ for the first trapezoid. This change would make Figure 9A slightly more messy but the algebra and the results would remain unchanged.

Closing Errors

Finally, there is the matter of closing errors. The combination of angle and distance measurements should ideally be such that the calculated final point coincides with the original point. In practice this does not occur, for measurements are never quite precise, and computations are often truncated or rounded. The calculated end point is usually some distance from the originating point. In such cases, the polygon needs to be closed in order to find its area. Figure 9E illustrates the problem, where X_o indicates the originating point and X_e the ending point.

Figure 9E



Closing the polygon requires adding a sixth side X_eX_o, and computing the area of the trapezoid it forms with the NS axis. The first base B_1 is equal to the second base B_2 of the previous trapezoid. The second base B_2 is just the original distance $\overline{XX'}$ which was arbitrarily set at 1000 meters at the beginning of the exercise. The height of the closing trapezoid is the projection of $\overline{X_eX_o}$ on the NS line but it can be found easier as the algebraic sum of all trapezoids heights. Thus, letting c stand as a subscript for the closing trapezoid,

$$B_1 = \overline{X_eX_e'} = B_2 \text{ of last trapezoid}$$

$$B_2 = 1000$$

$$H_c = \text{Sum of all previous heights}$$

$$A_c = \frac{B_1 + B_2}{2} \cdot H_c$$

The area of the closing trapezoid must also be added to the areas of the trapezoids to obtain the final result.

To sum up, the area of the polygon was obtained as the absolute value of the algebraic sum of all trapezoids, plus the area of the closing trapezoid, Ac:

$$\text{Area of polygon} = \left| \Sigma_i A_i + A_c \right|$$

Area Computation - Manual Procedure

The following step-by-step procedure to carry out the field area computation accompanies the attached worksheet, and does not require a programmable calculator.

Step 1: In the first three columns of the worksheet, enter side numbers (i's) and their corresponding angles (α_i's) and lengths (L_i's), as they were obtained during field measurements.

Step 2: Assign a value to the first base of the trapezoid. For the first side simply let $B_1 = 0$ but thereafter $B_1 = B_2$ from the previous trapezoid.

Step 3: Compute and enter the second base (B_2) of the i-th trapezoid by the following formula:

$$B_2 = B_1 + L_i \cdot \sin(\alpha_i)$$

Step 4: Compute and enter the height of the i-th trapezoid by the formula:

$$H_i = L_i \cdot \cos(\alpha_i)$$

Step 5: Compute and enter the Area of the i-th trapezoid by the formula:

$$A_i = \tfrac{1}{2}(B_1 + B_2) \cdot H_i$$

Step 6: Is this the last side?
If yes, go to Step 7.
If not, go to Step 2.

Step 7: Perform the following <u>algebraic</u> sums, observing carefully the appropriate signs.

(a) Sum of L_i's.
(b) Sum of H_i's.
(c) Sum of A_i's.

Step 8: Compute the following field parameters using these formulas:

(a) Perimeter = Sum of L_i's.

(b) Closing gap $= \sqrt{(\text{Last } B_2)^2 + (\text{Sum } H_i\text{'s})^2}$.

(c) Closing error (percent) = 100 x Gap/Perimeter.

(d) Plot Area = Absolute Value Sum A_i's + ½ (Last B_2) (Sum H_i's).

Step 9: If closing error is greater than 5%, recheck the computations or remeasure the field. Otherwise, STOP.

WORKSHEET FOR MANUAL AREA CALCULATIONS

Field Identification: _____

Field Measured by: _____

Area Calculations by: _____

Side i	Angle α_i	Length L_i	First Base B_1	Second Base $B_2 = B_1 + L_i \cdot \sin(\alpha_i)$	Height $H_i = L_i \cdot \cos(\alpha_i)$	Area $A_i = \frac{(B_1 + B_2) \cdot H_i}{2}$
1			0			
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
Sums		Sum L_i's			Sum H_i's	Sum A_i's

Perimeter = Sum L_i's =

Closing Gap = $\sqrt{(\text{Last } B_2)^2 + (\text{Sum } H_i\text{'s})^2}$ =

Closing Error (%) = 100 x Gap/Perimeter = %

Plot Area = Absolute Value Sum A_i's + ½ (Last B_2) (Sum H_i's) =

Area Computation With a Programmable Calculator

The advent of programmable calculators makes it possible to even further simplify the procedure to compute a field area. The repetitive nature of the procedure can be easily programmed as a sequence of steps to be executed every time data about a side are entered. The following program was developed to run in a Hewlett-Packard HP-41C calculator, and was successfully used during three months of fieldwork in the Northwest Province highlands of Cameroon. A comparable algorithm for the Texas Instrument TI-59 calculator was programmed by my colleague, Henri Josserand, and was used in Senegal with equally good results. A listing of the TI-59 program appears in Appendix 9A. The HP-41C is particularly well-suited for field use because it has continuous memory, so the program is keyed only once, it has one-year batteries rather than rechargeable, and it avoids the problems of using cards in dusty conditions. Once the program has been loaded into the calculator, the procedure to process the information for a field plot is quite simple:

Step 1: Turn calculator on.

Step 2: Press [XEQ] [ALPHA] [F] [I] [E] [L] [D] [ALPHA].

Step 3: The display will ask [SIDES?].
Enter the number of sides in the field and press [R/S].

Step 4: The display will ask [ANGLE?].
Enter the azimuth for the first side (in degrees) and press [R/S].

Step 5: The display will ask [LENGTH?].
Enter the length for the first side (in meters or steps) and press [R/S].

Step 6: Wait for the display to ask again [ANGLE?] then enter the azimuth for the next side, and press [R/S].

Step 7: The display will ask [LENGTH?].
Enter length for next side, and press [R/S].

Step 8: Keep going back through Steps 6 and 7 once for each remaining side of the polygon.

Step 9: A beep will sound after the last side has been entered. Don't do anything; just wait a few seconds.

Step 10: The display will read [GAP = ###. ###].
Write down the closing error (in meters, steps, or whatever unit was used).
Press [R/S] to continue.

Step 11: The display will read PERIM = ###. ##.
Write down the perimeter of the field (in meters or steps). Press R/S to continue.

Step 12: The display will read ERR % = ###. ##.
Write down the percentage closing error. Press R/S to continue.

Step 13: The display will read AREA = ####. ##.
Write down the area of the field, in square meters or square steps if steps were used. - That's it! -

Step 14: If the percentage closing error is greater than, say, 5%, recheck your work by repeating this procedure. To do that press R/S and go back to Step 3.

Step 15: If there is another field, press R/S and a new cycle will start at Step 3, with the display asking SIDES? for the number of sides in the new field.

FIELD AREA PROGRAM

(to run on a Hewlett-Packard HP-41C calculator)

```
01  LBL 'FIELD
02  CLRG
03  'SIDES?
04  PROMPT
05  STO 00
06  LBL 01
07  RCL 04
08  ENTER
09  'ANGLE?
10  PROMPT
11  'LENGTH?
12  PROMPT
13  ST + 08
14  P - R
15  ST - 06
16  RDN
17  +
18  STO 04
19  +
20  *
21  ST + 07
22  DSE 00
23  GTO 01
24  BEEP
25  RCL 04
26  RCL 06
27  R - P
28  'GAP =
29  ARCL X
30  AVIEW
31  STOP
32  RCL 08
33  'PERIM =
34  ARCL X
35  AVIEW
36  STOP
37  /
38  100.0
39  *
40  'ERR % =
41  ARCL X
42  AVIEW
43  STOP
44  RCL 07
45  RCL 04
46  RCL 06
47  *
48  +
49  ABS
50  2.0
51  /
52  'AREA =
53  ARCL X
54  AVIEW
55  END
```

Conclusions

1. It is possible to obtain on-site estimates of the areas of farm plots in the course of farm surveys. This can be accomplished with minimal equipment, consisting of measuring string, compass, and calculator.
2. Step-by-step procedures have been derived and outlined to carry out the field measurement and to compute the field perimeter, area, and closing error.
3. Field measurement requires only the length and compass bearing of each side of a polygon approximating the field boundaries. There are no restrictions on the number of sides or the shape of the polygon.
4. The basic idea behind the area computation procedure is decomposing the area of the polygon into a series of trapezoids, one for each side of the polygon. The algebraic sum of the trapezoids' areas add up to the field area.
5. There is no need to draw the field on graph paper. The procedure is completely algebraic.
6. Areas can be computed by hand with the help of a pocket calculator in less time than it takes to measure the field. The calculator must be able to provide sines and cosines of angles.
7. Pocket programmable calculators make the area computation in the field even easier, needing only to enter angle and length of each side. Programs for HP-41C and TI-59 calculators are available. Listings of FORTRAN and BASIC programs to run in small computers can also be obtained from the author.
8. The procedure also computes the closing error in absolute distance and in percent with respect to the perimeter. If the error exceeds a given limit, remeasurement of the field might be necessary.

APPENDIX 9A

FIELD AREA PROGRAM[a]

Texas Instruments 59 or 58-C

User Instructions

Step 1: Load program (by reading card on TI-59).

Step 2: Initialize: [E'].

Step 3: Enter bearing to next point, in degrees: .... [A].

Step 4: Enter distance to next point: .... [R/S].

Step 5: Go to Step 3 for all following points until the return to origin.

Step 6: Compute the area: [E].

Step 7: Compute the N/S error: [R/S].

Step 8: Compute the E/W error: [R/S].

Step 9: Compute the perimeter: [R/S].

For the next field, go to Step 2.

---

[a]Developed by Henri Josserand, CRED, 1979.

TI 59 (58-C) PROGRAM LISTING

00	76	LBL
01	10	E'
02	47	CMS
03	25	CLR
04	92	RTN
05	76	LBL
06	11	A
07	42	STO
08	06	06
09	91	R/S
10	42	STO
11	07	07
12	44	SUM
13	05	05
14	43	RCL
15	07	07
16	65	x
17	53	(
18	43	RCL
19	06	06
20	39	COS
21	54	)
22	95	=
23	42	STO
24	08	08
25	44	SUM
26	12	12
27	43	RCL
28	07	07
29	65	x
30	53	(
31	43	RCL
32	06	06
33	38	SIN
34	54	)
35	95	=
36	42	STO
37	09	09
38	44	SUM
39	13	13
40	43	RCL
41	01	01
42	85	+
43	43	RCL
44	09	09
45	95	=
46	42	STO
47	03	03
48	43	RCL
49	01	01
50	85	+
51	43	RCL
52	03	03
53	95	=
54	65	x
55	43	RCL
56	08	08
57	55	÷
58	02	2
59	95	=
60	44	SUM
61	11	11
62	43	RCL
63	03	03
64	42	STO
65	01	01
66	92	RTN
67	76	LBL
68	15	E
69	43	RCL
70	11	11
71	50	I x I
72	91	R/S
73	43	RCL
74	12	12
75	91	R/S
76	43	RCL
77	13	13
78	91	R/S
79	43	RCL
80	05	05
81	92	RTN
82	00	0

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

APPENDIX I
FIELD QUESTIONNAIRES: CAMEROON

Center for Research on Economic Development
University of Michigan
1982

DEMOGRAPHIC QUESTIONNAIRE

Questionnaire	Village	Household	Enumerator	Supervisor	Date	Day
01						

LIST ALL PERSONS USUALLY EATING TOGETHER:

NAME	RELATIONSHIP TO HEAD	CODE	M F SEX	AGE	S M D W MARITAL STATUS	PREG Y/N	NURSING Y/N	PRINCIPAL OCCUPATION	CODE	EDUCATION (YRS)	TYPE S,M,P	SCHOOL FEES PAID	PAID BY: H,W,O	OUTSIDER?
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														

LIST ALL MEMBERS OF THE HOUSEHOLD WHO DO NOT LIVE AT HOME AT THIS TIME:

11														
12														
13														

FOR ALL ABSENT MEMBERS LISTED ABOVE:

CODE # ABOVE	LIVING WHERE?	CODE	VISITED HOME PAST YEAR? Y N	DAYS SPENT AT HOME LAST	PREVIOUS	HELPS ON FARM? Y N	SENDS MONEY HOME? Y N	AMOUNT/YEAR	SEND FOOD TO HIM? Y N	FOOD SENT TO HIM (TINS): CORN	BEANS	POTATOES	OTHER	# FOWL SENT
11														
12														
13														

DAILY FOOD CONSUMPTION

Questionnaire	Village	Household	Enumerator	Supervisor	Date (M,dd)	(1of3) Day
02						

Were any leftovers from last dinner discarded? YES _____ NO_____

MEAL	DISH 1	DISH 2	DISH 3	Persons Eating		
				Men	Women	Children
Morning						
Afternoon						
Evening						
Other						

MEAL	FOOD	Prod. code	Measures		Grams/ unit	Total grams	Bought? Y/N	Bought by H. W. O.
			Units	Type				

MEALS OUTSIDE HOME

PERSON	Meal: M.A.E.O.	Where?	Beers? (#)	Meat Y/N	Wine Y/N	Other foods (name)
Husband						
Wife						
Other						

LAST WEEK MARKET PURCHASES

Questionnaire	Village	Household	Enumerator	Supervisor	Month	Day
03						

CODES	MARKET LIST
(01)	Oil
(02)	Salt
(03)	Kerosene
(04)	Soap: Laundry
(05)	Soap: Bathing
(06)	Rubbing Oil
(07)	Meat
(08)	Rice
(09)	Tinned Tomato
(10)	Maggi
(11)	Garlic
(12)	Ginger
(13)	Nido (Milk)
(14)	Tea
(15)	Sugar
(16)	Bread
(17)	Eggs
(18)	Onions
(19)	Tomatoes
(20)	Egussi
(21)	Gari
(22)	Corn
(23)	Other Staples

Item	Code	How much bought: Units	Type	Kg/unit	Total Kgs.	Price per: Unit	Kilo	Total Paid	Who paid: H, W, O	How long will last?

How much corn you milled	
This week:	tins
The week before:	tins

Is that normal?	
Yes	No
Yes	No

How long does it last?	
	days
	days

SEASONAL VARIATION AND FREQUENCY IN DIET

Questionnaire	Village	Household	Enumerator	Supervisor	Month	Day
04						

(Number of days food is served per week)

FOOD	JAN	APR	AUG	NOV
CORN				
BEANS				
IRISH POTATOES				
GREENS				
COCOYAM				
PLANTAIN				
CASSAVA (GARI)				
OTHER TUBERS				
OIL				
MEAT				
FRUITS				

CROPS MARKETED

Questionnaire	Village	Household	Enumerator	Supervisor	Month	Day
05						

CHECK CROPS SOLD DURING PAST YEAR

☐ Coffee	(01)	☐ Plantain	(06)	☐ Egussi	(11)	☐ Eggs	(16)
☐ Rice	(02)	☐ Groundnuts	(07)	☐ Pepe	(12)	☐ Fowl	(17)
☐ Corn	(03)	☐ Cabbage	(08)	☐ Eucalyptus	(13)	☐ Goats	(18)
☐ Beans	(04)	☐ Onions	(09)	☐ Raffia	(14)	☐ Cattle	(19)
☐ Irish Potatoes	(05)	☐ Tomatoes	(10)	☐ Kola	(15)		

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
01	02	03	04	05	06	07	08	09	10	11	12

CROP	code	Transport Method (Y/N)				Place sold (Y/N)		
		Head-load	Hired labor	Donkey	Motor Vehicle	On Farm	Local Market	Other (Specify)

MO.	To whom sold	How much sold				Price Per		Total Receipts
		Units	Type	kg/unit	Total kg	Unit	Kilo	

CROP	code	Transport Method (Y/N)				Place sold (Y/N)		
		Head-load	Hired labor	Donkey	Motor Vehicle	On Farm	Local Market	Other (Specify)

MO.	To whom sold	How much sold				Price Per		Total Receipts
		Units	Type	kg/unit	Total kg	Unit	Kilo	

CROP	code	Transport Method (Y/N)				Place sold (Y/N)		
		Head-load	Hired labor	Donkey	Motor Vehicle	On Farm	Local Market	Other (Specify)

MO.	To whom sold	How much sold				Price Per		Total Receipts
		Units	Type	kg/unit	Total kg	Unit	Kilo	

OFF-FARM INCOME

Questionnaire	Village	Household	Enumerator	Supervisor	Month	Day
06						

CODE:

01 FOODSTUFF TRADER
02 MANUFACTURED GOODS TRADER
03 DRIVER
04 SHOPKEEPER
05 CAPITAL INVESTMENTS (RENTAL PROP, VEHICLE OWNER)
06 TRADITIONAL OFFICE
07 CIVIL SERVANT
08 SCHOOL TEACHER
09 COOPERATIVE STAFF & OFFICIALS
10 COOPERATIVE-GENERAL LABOR
11 FARM LABOR
12 SKILLED LABOR (i.e. MECHANIC)
13 GENERAL LABOR (TAXI, ETC)
14 TEA ESTATE WORKER

IN THE PAST YEAR DID YOU WORK IN ONE OF THE ABOVE OCCUPATIONS? LIST:

NAME	AGE	SEX	JOB	CODE	EARNINGS IN CFA											
					JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

INDICATORS

Questionnaire	Village	Household	Enumerator	Supervisor	Date	Day
07						

AGRICULTURAL PRACTICES AND POSSESSIONS:	Y / N	NUMBER
1) DO YOU HAVE A HOE?		
2) DO YOU HAVE A CUTLASS?		
3) DO YOU HAVE A FARM KNIFE?		
4) DO YOU HAVE A SPRAYER?		
5) DO YOU HAVE A PRUNER?		
6) DO YOU HAVE A WHEELBARROW?		
7) DO YOU HAVE A SPRINKLING CAN?		
8) DID YOU USE FERTILIZER LAST YEAR OR THIS YEAR ON COFFEE?		X X
9) DID YOU USE FERTILIZER LAST YEAR OR THIS YEAR ON CORN?		X X
10) DID YOU USE FERTILIZER LAST YEAR OR THIS YEAR ON ANY OTHER CROP?		X X
11) DID YOU USE INSECTICIDE LAST YEAR OR THIS YEAR ON COFFEE?		X X
12) DID YOU USE INSECTICIDE LAST YEAR OR THIS YEAR ON CORN?		X X
13) DID YOU USE INSECTICIDE LAST YEAR OR THIS YEAR ON ANY OTHER CROP?		X X
14) DID YOU USE WEEVIL MEDICINE LAST YEAR OR THIS YEAR FOR STORAGE?		X X
15) DO YOU OWN ANY CATTLE?		
16) DO YOU OWN ANY SHEEP?		
17) DO YOU OWN ANY GOATS?		
18) DO YOU OWN ANY PIGS?		
19) DO YOU OWN ANY FOWL?		
20) DO YOU HAVE ANY FISH PONDS?		
21) DO YOU OWN ANY DONKEYS?		
22) DO YOU OWN ANY PETS? (CAT, DOG)		
23) DOES THE HOUSEHOLD HEAD BELONG TO A COOPERATIVE SOCIETY?		X X
24) DOES THE WIFE OF THE HOUSEHOLD HEAD BELONG TO A COOPERATIVE SOCIETY?		X X

FAMILY TRAVEL:		
25) HOUSEHOLD HEAD: DID YOU GO TO KUMBO IN THE LAST YEAR? (TIMES)		
26) DID YOU GO TO BAMENDA IN THE LAST YEAR? (TIMES)		
27) DID YOU GO TO DOUALA IN THE LAST YEAR? (TIMES)		
28) DID YOU GO TO NIGERIA IN THE LAST YEAR? (TIMES)		
29) SPOUSE: DID YOU GO TO KUMBO IN THE LAST YEAR? (TIMES)		
30) DID YOU GO TO BAMENDA IN THE LAST YEAR? (TIMES)		
31) DID YOU GO TO DOUALA IN THE LAST YEAR? (TIMES)		
32) DID YOU GO TO NIGERIA IN THE LAST YEAR? (TIMES)		

CREDIT ACCESS:		
33) HOUSEHOLD HEAD: DO YOU BELONG TO A CREDIT UNION?		X X
34) BORROWED MONEY FOR FARMING FROM CREDIT UNION?		X X
35) DO YOU BELONG TO AN NJANGI?		X X
36) IF YES, HOW MANY TIMES A MONTH DOES IT MEET?		
37) IF YES, IS IT A SAVINGS NJANGI?		X X

CREDIT ACCESS (con't.):

		Y / N	NUMBER
38)	IF YES, IS IT A CREDIT NJANGI?		X X
39)	HOW MUCH DO YOU PUT IN EACH MEETING?	X	
40)	HAVE YOU RECEIVED A LOAN FROM FONADER?		X X
41)	IF YES, WHAT WAS THE AMOUNT OF THE LOAN?	X	X X
42)	HAVE YOU RECEIVED A LOAN FROM A BANK?		X X
43)	IF YES, WHAT WAS THE AMOUNT OF THE LOAN?	X	X X
44)	SPOUSE: DO YOU BELONG TO A CREDIT UNION?		X X
45)	HAVE YOU BORROWED MONEY FROM THE CREDIT UNION?		X X
46)	DO YOU BELONG TO AN NJANGI?		X X
47)	IF YES, HOW MANY TIMES A MONTH DOES IT MEET?	X	
48)	IF YES, IS IT A SAVINGS NJANGI?		X X
49)	IF YES, IS IT A CREDIT NJANGI?		X X
50)	HOW MUCH DO YOU PUT IN EACH MEETING?	X	

OTHER COMPOUND OCCUPANTS:

51)	NUMBER OF OTHER ADULT FEMALES	X	
52)	NUMBER OF OTHER ADULT MALES	X	
53)	NUMBER OF OTHER CHILDREN (10 - 18)	X	
54)	NUMBER OF OTHER CHILDREN UNDER TEN YEARS	X	

HOUSEHOLD STRUCTURES:

55)	DO YOU HAVE A MUD BLOCK STRUCTURE WITH A THATCH ROOF?		
56)	DO YOU HAVE A MUD BLOCK STRUCTURE WITH A ZINC ROOF?		
57)	DO YOU HAVE A MUD BLOCK STRUCTURE WITH A ZINC ROOF AND CEMENT FLOOR?		
58)	DO YOU HAVE A CEMENT PLASTERED OVER MUD STRUCTURE WITH A CEMENT FLOOR?		
59)	DO YOU HAVE A CEMENT BLOCK STRUCTURE?		
60)	DO YOU HAVE A WASH PLACE?		
61)	DOES THE FAMILY SLEEP IN ONE HOUSE?		X X
62)	DOES THE FAMILY EAT TOGETHER IN ONE HOUSE?		X X
63)	DO YOU HAVE A LATRINE WITH A BAMBOO FLOOR? (NOT ENCLOSED)		
64)	DO YOU HAVE AN ENCLOSED LATRINE WITH A BAMBOO FLOOR?		
65)	DO YOU HAVE A LATRINE WITH A CEMENT FLOOR?		

HOUSEHOLD ITEMS:

66)	DO YOU HAVE A RADIO?		
67)	DO YOU HAVE A RADIO CASSETTE?		
68)	DO YOU HAVE A COAL POT?		
69)	DO YOU HAVE KEROSENE LAMPS?		
70)	DO YOU HAVE GAS LAMPS?		
71)	DO YOU HAVE A HEAVY FUFU POT?		
72)	DO YOU HAVE AN ENAMEL OR STAINLESS STEEL WASH BASIN?		
73)	DO YOU HAVE EATING UTENSILS? (FORKS, SPOONS)		
74)	DO YOU HAVE A MOTORCYCLE?		
75)	DO YOU HAVE SPRING/WOODEN FRAME BEDS?		
76)	DO YOU HAVE MATTRESSES?		
77)	DO YOU HAVE UPHOLSTERED FURNITURE?		
78)	DO YOU HAVE GLASS/CHINA DISHES?		

FIELD INFORMATION

Questionnaire	Village	Household	Plot	Enumerator	Supervisor	Month	Day
018							

Distance		Crops in Field			Meters /step	Area square meters
Kms	Mins	Main	Second	Third		

Side	Bearing	Length	Side	Bearing	Length	Side	Bearing	Length
1			9			17		
2			10			18		
3			11			19		
4			12			20		
5			13			Gap		
6			14			Perimeter		
7			15			Error (%)		
8			16			Area		

Years since last fallow? _____

Who works the plot? 1. Wife ☐ 2. Husband ☐ 3. Other ☐

Soil: 1. Bad ☐ 2. Normal ☐ 3. Good ☐ 4. Very Good ☐

Slope: 1. Steep ☐ 2. Moderate Slope ☐ 3. Flat ☐

Besides fowl and calabash, what else do you give for using the land?

Money (CFA) _____

Labor (days) _____

Kind: _____

How long has your family worked this plot? _____years

Is the landlord related to the family of:

1. the husband? ☐ 2. the wife? ☐ 3. Other? ☐

Do you own or rent this plot? 1. Own ☐ 2. Rent ☐ 3. Other ☐

Did you use fertilizer in this plot last year? Yes ☐ No ☐

How much fertilizer? (kg.): _____

What yields did you get from this plot last year:

		(crop code)	(kilos)
Main crop	(_____) : _____ of _____kg each		
Second crop	(_____) : _____ of _____kg each		
Third crop	(_____) : _____ of _____kg each		

Transport (Y/N) Head_____ Hired labor_____ Donkey_____ Vehicle_____

LAST YEAR CALENDAR OF CROP ACTIVITIES

Questionnaire	Village	Household	Plot	Enumerator	Supervisor	Month Day	Area (sm)
019							

Year	Crops in field - Rotations		
	Main	Second	Third
This year			
Last year			
2 years ago			
3 years ago			
4 years ago			

Rains Pattern	Month-Half	Activity	Code	Persons Working	Days Each	Total Days	Hired Labor Days
	JAN-1						
	JAN-2						
	FEB-1						
	FEB-2						
	MAR-1						
	MAR-2						
	APR-1						
	APR-2						
	MAY-1						
	MAY-2						
	JUN-1						
	JUN-2						
	JUL-1						
	JUL-2						
	AUG-1						
	AUG-2						
	SEP-1						
	SEP-2						
	OCT-1						
	OCT-2						
	NOV-1						
	NOV-2						
	DEC-1						
	DEC-2						

During the last two weeks what work has been done in this field?

Month-Half	Activity	Code	Persons Working	Days Each	Total Days	Hired Labor Days

CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

PART II: ANALYTICAL METHODS AND FIELD SURVEY TECHNIQUES

APPENDIX II
FIELD QUESTIONNAIRES: SENEGAL

Center for Research on Economic Development
University of Michigan
1982

Date 19/5/81
Village LAYABE
Chef de Carré SERIGNE Bara Léye
Enquêteur Lacoua, S.B.
Vu par HENRI P. JOSSERAND

1 | 0 1

INFORMATION DEMOGRAPHIQUE, (Section 1)

Personnes de la même famille (mangent ensemble)

	NOM	Parenté	Sexe M/F	Age	Etat Civil C,M,A	Femme Enceinte O/N	Allaite O/N	Activité principale	Activité Secondaire	Ecolier O/N	Années	Type* (1) (2) (3)
01	BARA LEYE	CHEF	M	78 ans	M	–	–	Agriculture		NON	07	1
02	Aïssatou Léye	épouse/cc	F	60 "	M	–	–					
3	Oumou Léye	fille (01 x 02)	F	45 "	M	–	–	ménagère				
4	Amy Sia	fille (03)	F	4 ans	C	–	–					
5	Abdou Ka	fils (03)	M	11 ans	e					oui	03	1
6	Faty Sylla	fille (03)	F	2 ans	e							
7	Bintou Léye	fille (01)	F	40 ans	A (veuve)			commerce				
8	Abibou Tall	fils (07)	M	10 ans	e					oui	02	
9	ANDY Léye	fils (01)	M	36 ans	M			Agriculture	commerce	NON	05	1
10	Sagar Sieng	épouse (09)	F	23 ans	M	–	–	ménagère				

*[Type: Coranique (1)
Etat (2)
mission (3)]

Religion du Chef de Carré: Musulmane(1), Animiste(2), Autre(3)

Lieu de naissance du Chef de Carré LAYABE 1 Region Louxbel 1

Quels membres de la famille ont quitté le village temporairement?

	NOM	Sexe M/F	Age	Raison: commerce(3) Ecole(1), travail(2)	Quand sont-ils Partis? (Saison, Année)	Codes Sexe	Age	R	Quand Partis
1	Ndoudou Léye	F	26 ans	malade mentale	1 mois (Avril 1981)				
2									
3									
4									

-457-

CALENDRIER AGRICOLE, (Section 2)

Date. 28/05/1981
Village. Thierthie I
Chef de Carré. Samba Diouf 0 3
Enquêteur LN
Vu par

BEST AVAILABLE

Questions sur tous les champs
ayant la même culture de . mil

Evenements Saisonniers	Mois	Activité	Code	par la famille		Jours de travail par Navetane	Jours de travail par Firdu
Lolly	Jan 1	ramassage et construction d'une meule de tiges de mil		4 j			
	Jan 2						
Noor	Fev 1						
	Fev 2	→ Kersage de palissade		8 j			
	Mar 1						
	Mar 2						
	Avr 1						
Thiaroye	Avr 2	→ 1 Débourrage		9 jours			
	Mai 1	→ 1 Jas bulles					
	Mai 2						
	Juin 1						
	Juin 2						
Navett	Juil 1						
	Juil 2						
	Aout 1	1 binage + bakhaw		16 j			
	Aout 2	Sarclage + démariage		30 j			
	Sep 1	2 binage		16 j			
	Sep 2						
	Oct 1						
	Oct 2	battage des poquets (manuel)		6 j			
Lolly	Nov 1	récolte		30 j			
	Nov 2	stockage avec chaulée		1,5 j			
	Dec 1	stockage dans le grenier		1,5 j			
	Dec 2						

Quelle quantité totale (tous les champs) de cette culture de ..... avez-vous récolté l'année dernière? 9 5 0 Kg.

Activitiés, Codes: Defrichage (1), labour (2), semis (3) Sarclage (4) (Plusieurs:) Récolte (5) Battage (6) Vannage (7).

CHAMP INDIVIDUEL, (Section 4)

Date . . . . . 12/06/1991 . . . . . .
Village. . . Thiantine . . . . . .
Chef de Carré. Samba Fatime Diouf . . .
Enquêteur. . . . . .
Vu par . . . . . .
Culture actuelle . mil . . . . . .
Ce champ est cultivé par Samba F. Diouf . .
(Nom et parenté) chef de carré et Coumba Faye sa 1ère ep. . . . . .

03
07

Champ N° 1

Distance à partir du village . . 1 Km ou une marche de . . . . min.

DIMENSIONS

Côté	Degrés	Distance	Côté	Degrés	Distance	Côté	Degres	Distance
1	191	14.7	8	284	23.8	15	82	69.7
2	269	8.3	9	317	97	16		
3	197	51.1	10	29	9.8	17		
4	222	15.6	11	120	41.3	18		
5	241	25.7	12	39	77.3	19		
6	235	46.7	13	84	38	20		
7	300	8.8	14	186	29.5	21		

m./pas	Superficie	Dev.N/S	Dev.E/W	Périmètre
	13099,0	-,85	-1,18	557,3

Area. . .

Nombre d'années depuis la dernière jachère? 99

Type de Sol: Dior (1) Dek (2) Dek-Dior (3) .....(4) 1

Mettez-vous de l'engrais sur ce champ? (O/N). . . oui

Ques genre? Chimique (1), Femure (2). 1

Quelle quantité? . . . . . Kg. 150

Combien avez-vous récolté sur ce champ l'année derniére?

. . . . . de Kg chacun = Kg.

Ou : quantité totale estimée pour ce champ . . . . . 000 Kg.

La récolte est transportée au village:

sur la tête (1), à dos d'âne (2) avec charrette (3) dans d'arachides . 3

Quelle culture y-avait-il sur ce champ l'année dernière?. arachides .

il y a deux ans? . mil . . . . . .

il y a trois ans?. arachides

Au cours des deux dernières semaines, quel travail avez-vous fait sur ce champ?

Date	Activités	Code	Jours de Travail pour la famille		Jours de Travail Navetane	Firdu
	Sébrouné		1,5 j.			

1-1

Date 08/06/78

Village Tabenkue 0 3

Chef de Carre Gouye Diay 0 6

Enquêteur J.N.

Vu par MB

AUTRES DONNEES AGRICOLES

(Section 5)

Materiel Agricole de la Famille

HENRI P. JOSSERAND

1. Utilisez-vous un attelage? (O/N) ...Non..... N

pour arachides(1), mil(2), sorgho(3), ou .....(4) 0

2. Utilisez-vous un cheval? (O/N) ...Oui.....

pour arachides(1), mil(2), sorgho(3), ou...niébe.....(4) N

3. Utilisez-vous Chameau néant

pour arachides(1), mil(2), sorgho(3), ou .....(4) N

4. Utilisez-vous Asiana néant.

pour arachides(1), mil(2), sorgho(3), ou .....(4)

Quelle quantité la famille utilise-t-elle d'engrais chimique

- sur arachides ..... 4 0 0 Kg
- sur le mil ..... 4 0 0 Kg achetés
- sur le sorgho..... 0 0 0 Kg

Quelle quantité la famille utilise-t-elle de fumure

- sur arachides ..... 0 0 0 Kg
- sur le mil ..... 0 0 0 Kg
- sur le sorgho ..... 0 0 0 Kg

Quelle quantité la famille utilise-t-elle d'insecticide

- sur les arachides ..... 0 0 0 Kg
- sur le mil..... 0 0 0 Kg
- sur le sorgho..... 0 0 0 Kg

Appartenez-vous à une Co-opérative? (O/N) ..Oui..... 0

Quantite vendue l'année dernière..... 0 0 0 Kg

Prix reçu de la co-op ..... 0 0 0 CFa

Matériel ou fournitures reçus de la Co-op 1 semoir arachides + 300 kg. engrais.....

Recevez-vous la visite d'agents d'encadrement agricole? (O/N) Non N

Si oui, de quelle agence .....

Combine de fois par an? .....

Que font-ils?.....

BETAIL La famille possède-t-elle

des vaches (O/N) oui	1
des chèvres (O/N) oui	7
des moutons (O/N) oui	3
des poulets (O/N)	oui
des pintades (O/N)	NON
chevaux	3
âne	0

Date 19/05/81

Village Loyalé. 01

Chef de carré. Banaly

Enquêteur Aloye Gaye

Vu par

ALIMENTATION (Section 6A)

Visite commencée à ..12....(heure)

Visite achevée à .....13.h...

REPAS: petit-déjeuner(1), déjeuner(2) diner(3)

Si petit-déjeuner: restes du diner de la veille? (O/N) .....

Pour tout repas: nombre de personnes qui mangent ce repas; Hommes..... 3

Femmes..... 8

enfants..... 6

Nom du plat principal(1). Riz au poisson ~~[illegible]~~ fumé.....

Nom du plat secondaire(2).....

Composition des Plats

Plat	Ingrédients	Code	Unités	Type	Grammes /unite.	Total Grammes	Acheté O/N	Payé par mari(1) femme(2
01	Riz	013				3000	oui	01
	Kétiakh	712				100	oui	01
	oignons	412				100	oui	01
	Piment	713				10	oui	01
	Poivre	719				20	oui	01
	cube Maggie	716				10	oui	01
	tomate (sauce)	718				50	oui	01
	sel	712				60	non	01
	huile	011				1340	oui	01
	Mielé	317				250	oui	01

Temps nécessaire (tout compris) pour préparer le repas?..... 1h30 min.

Combien de fois par semaine le plat principal est-il fait?

Combien de fois par semaine le plat secondaire est-il fait?

Certains ingrédients sont-ils parfois difficiles à obtenir?

Lesquels	Code	Pourquoi	Remplacés par:	Code

Date. 04/06/1981. . . .
Village Thienthie . . . .
Chef de Carré N'Ging. Diouf
Enquêteur . M. . . . . .
Vu par. . . . . .
HENRI P. JOSSERAND

0 3
0 5

MB

VENTE DES RECOLTES (Section 7)

Liste des Cultures commercialisées l'année dernière

Arachides de bouche (01)	Mais (06)	Mouton (11)
Arachides (02)	.....(07)	Chèvre (12)
Petit Mil (03)	.....(08)	Boeuf (13)
Mil (04)	Poulet (09)	.....(14)
Sorgho (05)	Oeufs (10)	.....(15)

CULTURE Mouton..... Code 11

Saison/	VENTES: Bout(1)	Marché Village(2)	Autre Marché(3)	Marchand Ambulant (4)	QUANTITE: No. d'unités	type	Kg/Unité	Total en Kg.	PRIX PAR: Unité	Kg	Recettes (CFA)	TRANSPORT: tête (1)	Ane (2)	Charette. (3) (coût)	Autre (4)
Nawitt		2			1				3000		3000				

CULTURE ~~Nou~~ Chèvre..... Code 12

Saison/	VENTES: Bout(1)	Marché Village(2)	Autre Marché(3)	Marchand Ambulant (4)	QUANTITE: No. d'unités	type	Kg/Unité	Total en Kg.	PRIX PAR: Unité	Kg	Recettes (CFA)	TRANSPORT: tête (1)	Ane (2)	Charette. (3) (coût)	Autre (4)
Nou		2			1				2600		2600				

Date..25/5/81....
Village...Ehrenthe I.....
Chef de carré...Mama Diouf.....
Enquêteur....N'Gom.....
Vu par HENRI P. JOUSSERAND

3 / 02 / W3

ACHATS DE LA SEMAINE (Section 8)

Liste des Produits

(01) Riz
(2) Mil
(3) Sorgho
(4) Maïs
(5) Huile
(6) Viande boeuf
(7) Viande mouton
(8) Poulet
(9) Oeufs
(10) Poisson frais
(11) " fumé/séché.
(12) Lait frais
(13) Lait en poudre
(14) Pain
(15) Sel
(16) Sucre
(17) Thé
(18) Oigons
(19) Choux
(20) Sauce tomate
(21) Cubes Maggi
(22) Café..
(23) [redacted]
(24) .....
(25) T.P.M...(fresh tomatoes)
(26) SAVON
(27) .....
(28) .....

PRODUIT	Code	ACHETE A: Bout (1)	Marché Local (2)	Autre Marché (3)	QUANTITE: No. d'Unités	Type	Kg/Unité	Total en Kg	PRIX PAR Unité	PRIX PAR Kg	Cout Total	Payé par (M/F)	Va durer x jours
Riz	01	1						40		90	3600	M	30
Mil	02	1						50		50	2500	M	30
huile	05	1			3	liter			260		780	M	7
Sucre	16	1						5		260	1300	M	30
Sel	15		2					1		10	10	M	7
tomate	25		2		7	kos			50		350	M	7
Savon	26	1						7		150	1050	M	30
poisson fumé	11		2		7 (tas)				25		175	M	7

Si vous aviez eu un peu plus d'argent, auriez-vous acheté davantage d'un des mêmes produits,

Ou bien auriez-vous acheté autre chose? oui

Quel même produit?..viande.....

Quel autre produit?..café.....

06 / 22

Date: 28-05-81
Village Sessene
Chef de carré Joseph Séne
Enquêteur Yaw Khoba Diouf
Vu par: . . . . . MB

2
C1

ETAT DE SANTE (Section 9)

Nom des enfants de 0 à 9 ans	Sexe M/F	Age (ans)	M.A.C. cm	Poids Kg	Taille cm	Age au Sevrage (mois)	L'enfant a-t-il eu la diarrhée pendant la dernière semaine? (O/N)
Josef Séne	M	62	✓	59,0	165	24	N
Rose Quinque	F	47	✓	54,0	159	24	N
Blaise Séne	M	30	✓		175	24	N
Ousmane Séne	M	40	✓	71,0	177	24	N
Aissatou Diouf	F	35	✓	51,0	160	24	N
Ousseynou Séne	M	13	✓	37,0	155	24	N
Ibra Séne	M	7	✓	25,0	129	24	N
Sarze Séne	F	5	✓	19,5	108	24	N
Amy Séne	F	18 mois	✓	18,0	82	24	O
Alioune Séne	M	3		14,0	96	24	N

Date 07/06/81

Village Thiénthe 03

Chef de Carré Yoyye Diouf 06

Enquêteur N'Gosé Ly

Vu par

HENRI P. JOSSERAND

MB

NIVEAU DE VIE ET

REVENU MONETAIRE

(Section 10)

-465-

Liste de certains Indicateurs du niveau de vie

(à recueillir par observation aussi bien que par questions)

	(O/N)		
Lampe à pétrole...oui...6...	O	Sol cimenté dans la maison...NON...	
Lampe à pétrole(pression).non	N	Maison en blocs ciment...NON.....	
Torche électrique...oui.....	O	Radio...oui.....	
Bassine en émail...oui.....	O	Meubles (p.e. chaise pliantes)....NON	0
Bicyclette.....NON.....	N	Lit et matelas éponge...oui.....	3
Toiture en zinc...oui.....	O	Radio-Cassette....NON.....	0
toiture en chaume...non...	N	Mobylette...NON.....	0
Charrette...oui...	O		

Liste des Personnes gagnant de l'argent

	Nom	Sexe (M/F)	Age	Etat-Civil (C,M,A)	Activité qui rapporte de l'argent
1	Diop Yoyye				vendeuse de savon et de huile
2	Kane Diouf				vendeuse de beignets
3					

Adressez les questions ci-dessous à chacune de ces personnes, tour à tour.

Combine de temps consacrez-vous à cette activite?

	Saison	Sally		NOOR		Thiorone		NAVET	
Nom (1) Diop Yoyye	No. semaines	1	2	1	2				
	jours/semaine								
Nom (2) Kane Diouf	No. semaines	1	2	1	2				
	jours/semaine								
Nom (3)	No. semaines								
	jours/semaine								

En général, combien peut-on gagner par semaine lorsqu'on soustrait les dépenses?

	Saison	Sally	NOOR	Thiorone	NAVET
CFA par semaine	1	1500	1500		
	2	700	700		
	3				

DIS
file
ARDA
1656 NS