PN-AAS-089-38651

NUTRITIONAL STRATEGIES AND FARMING SYSTEMS RESEARCH IN SOUTHERN HONDURAS: THE INTERNATIONAL SORGHUM AND MILLET PROJECT (INTSORMIL)

Kathleen M. DeWalt (1,2)

In this paper I wish to address several issues concerning the inclusion of dietary and nutritional studies in Farming Systems Research. I will talk in general terms about the problems such research should address and the kinds of information which contributes to the understanding of farming systems. I also wish to discuss briefly the methodological approach to the study of diet and nutrition that we have used in research in Southern Honduras sponsored by the International Sorghum and Millet project (INTSORMIL) a Collaborative Research Support Project funded by the Agency for International Development.

Southern Honduras was selected as a research site because it is an area in which sorghum has been incorporated into farming systems for at least 100 years. Furthermore, it is one of the few areas in the Western Hemisphere in which sorghum is used as a human food as well as feed for animals. In addition, the climate of Southern Honduras is such that periodic droughts adversely affect the production of maize in many years in which the more drought tolerant sorghum continues to yield well. Finally, Honduras is the second poorest country in the Western Hemisphere. National surveys of nutritional status estimate that over 70% of children suffer from undernutrition (SAPLAN 1981). When average diets were compared for 1966 and 1979 the overall availability of energy, iron and Vitamins A and C in the Honduran diet had declined slightly. Food balance data from the nation as a whole indicate trends seen in other Third World countries experiencing declines in nutritional well-being. The country continues to use much of its best cropland to produce commodities desired by the developed countries. In addition to exporting bananas and other tropical fruits, in recent years Honduras has been converting more of its land into pasture to raise beef cattle for export. While beef production rose by 230% between 1960 and 1979, per capita consumption of beef actually declined by 20% (DeWalt 1983). During this same time period, imports of basic grains rose by almost 2000% for corn, 330% for rice, and 200% for beans.

Best Available Document

Why Include Nutrition in Farming Systems Research?

Hulse (1982) has recently argued that a failure to pay careful attention to the nutritional impact of food production and processing technology on the poor in less developed countries results in the formulation and implementation of food policy with little or no evidence to predict its consequences for nutritional status. Hulse was addressing the area of food science and postharvest processing specifically, but the argument applies to production policies as well. It seems clear that the introduction of technologies designed to improve the productivity of small farmers is not nutritionally neutral. Unfortunately, evidence suggests that it has frequently not been nutritionally positive at least in terms of the nutritional status of the small farm family. Fleuret and Flueret (1980) in a review of nutrition,consumption and agricultural development, conclude that few programs to improve the productivity of small farmers have had a positive impact on the nutritional status of their families. Some have even contributed to a decline in nutritional status.

Changing crop choice and techniques of cultivation contribute to changes in food availability and nutritional status in several ways. Perhaps the most controversial question is the effect of replacing subsistence crops with cash crops with the assumption that increases in income will enable the producer to purchase displaced foods. This assumption is not clearly supported. Elsewhere, I have argued that increasing income results in a different diet but not necessarily a better diet (DeWalt, K. M., n.d.). The application of some technologies to the production of subsistence crops results in a decline in crop diversity and consequently dietary diversity. A related problem is the elimination of unplanted food producing crops such as the edible wild plants which grow in the disturbed soils between rows of cultivated crops. Displaced minor crops and uncultivated plants are often overlooked because they do not provide the bulk of energy as other crops do, but may be major sources of micronutrients (Messer 1972, 1977; DeWalt, K. M. 1983). Fleuret and Fleuret (1980) also point out that technologies requiring reallocation of labor may have dramatic effects on the nutritional status of family members.

The nutritional impact of the introduction of alternating production technologies is an issue which has not received the attention it requires.

The other side of the coin is that small farmers producing crops for consumption within the household understand the need to protect family diets and evaluate new varieties of seed and technologies of production on the basis of their impact on the acceptability of the product as food. Numerous accounts exist of the rejection of new varieties of seed because their organoleptic qualities were unacceptable.

A third area of concern is the interaction of food production, food processing techniques, and nutrition. Sorghum, for example, is a staple

that raises these kinds of questions. Research with sorghum suggests that it is poorly digested by humans. At the same time in many areas of the world it is a dietary staple which is subjected to special processing. The nutritional impact of improving sorghum production may then need to be evaluated in light of post harvest processing techniques used to prepare it as food.

In small farm families engaged at least in part in farming to meet subsistence needs, all of these issues become especially crucial. Also, in these families the production and consumption units come together. Farming Systems Research, with its farm family focus, provides a logical model for the inclusion of a focus on the nutritional implications of technology transfere for the producing family. Tripp writes: "...nutrition planning and the data developed by on-farm research are in fact complimentary. Any effort to use agricultural change as a vehicle for nutritional improvement must take into account of farmer's production interests and the technical and economic realities of small farm management. Agricultural change programs, on the other hand, must assure that they are consistent with farmers' consumption preferences and offer real opportunities to improve farm families' welfare (1982:2)."

The inclusion of dietary and nutritional research has been a major component of the farming systems research we have undertaken as part of INTSORMIL in Southern Honduras. We had three objectives for the incorporation of dietary and nutritional data in this research. The first was to provide information on the uses and methods of preparation of basic food stuffs, with an emphasis on sorghum in order to provide information on the characteristics of sorghum which make it an acceptable food in this area. This has been crucial as the overall goal of INTSORMIL is to improve the production of sorghum and millet as human foods. The second was to assess the impact of lternative farming strategies already being followed on the diets and nutritional status of farm families. Such information is important in predicting the probable impact of agricultural innovation on diet and nutritional status. A final objective of our research approach has been to provide baseline data on both diet and nutritional status in order to allow for a basis for evaluation of the effects of agricultural innovation on the nutritional status of small farm families in the future. Data necessary for the evaluation of such projects has been sadly lacking in the past leaving no basis for comparison of the quality of life after innovations have been introduced.

Agriculture in Southern Honduras spans several ecological zones, and sorghum production is important in most of them. In the highland areas, production of basic grains such as maize and sorghum, and cattle production are the major forms of agriculture. While land tenure varies from area to area, for the most part there are a few farms of 40-100 manzanas and a much larger number of smaller land holdings. A large number of landless agriculturalists are able to rent land or sharecrop on the unused lands of larger holders. Agriculture is mostly slash and burn with land returning to fallow after two to three years of

cultivation. The major subsistence crops, maize and sorghum, are intercropped in the same field. Secondary crops include squash, a small amount of beans, watermelon, sweet manioc, camote and a small amount of dry land rice. The area is also known for its mango production.

Cultivation is on hillsides with little or no mechanization (Dewalt,B.R. and K.M. DeWalt 1982). Chemical fertilizers are infrequently used although herbicides are frequently used and serve as a major labor saving device Increasingly, land formerly available to renters and sharecroppers for the production of subsistence grains is being turned to pasturage for beef cattle. The production of beef requires little labor and both land for subsistence agriculture and wage labor opportunities are becoming increasingly scarce in these areas (B. R. DeWalt 1983).

In the lowland coastal area subsistence crops and cattle are joined by a number of cash crops produced for distant internal markets and export. These include cotton, sugar, and melons. Large landowners predominate in the flat, open areas characteristic of this zone. The cash crops produced are only partially mechanized and require relatively large amounts of labor providing a much greater need for agricultural labor. The result is more capitalistic relations of production in which large numbers of landless workers make their living working in cotton and sugar. Relatively little sharecropping and land rental take place and these subsistence farms are also characterized by intercropping of maize and sorghum. In addition, the area is one in which the limited agrarian reform begun in the 1970's has had some effect. A number of agrarian reform communities (asentamientos) exist in the area, including two communities included in our survey. The asentamientos follow a numberof strategies for production. The ones we have surveyed produce cotton cooperatively and allocate two manzanas of land to each family on which subsistence crops, maize, sorghum, beans, squash, and melons are grown. Asentamiento members may also continue to work for plantation owners as well.

Communities chosen for study in Southern Honduras included villages in both the ecological settings of interest. A series of three communities in the highland municipio of Pespire where subsistence production of basic grains and the production of cattle are the major agricultural pursuits were surveyed in 1981. Two agrarian reform communities in the coastal plain where cotton production is important, along with subsistence production of grains and cattle production were surveyed in 1982. Asentamiento members have and continue to participate as wage labors on the land of neighboring latifundias.

Nutritional Strategies Approach

In other studies (K. M. DeWalt, 1981, n.d.), we have argued that participation in subsistence agriculture puts families in a complicated relationship with respect to alternative food resources. The problem of agricultural development and nutrition has been approached relatively

simplistically, as though it were essentially a problem of income, however. Thus, development of cash-producing crops is frequently seen as a means of producing an increased income which is assumed to translate into ability to improve diet through the purchase of foods. As our earlier studies in Mexico (DeWalt, 1983) have demonstrated, the relationship between diet and income can be much more complex in agrarian communities. The framework we have found to approach the complex nature of diet in agrarian communities is one which recognizes the various alternative food resources available and examines the situations and conditions under which families use alternative resources to meet their nutritional needs. We have called these alternatives, "Nutritional Strategies" and have viewed the decision-making process among alternatives as an adaptive one (DeWalt 1981).

The nutritional strategies approach addresses two methodological and theoretical problems in dietary research in agrarian communities. The first is the problem of looking at individual variations in diet within a system of shared dietary norms. The second is the difficulty of organizing the collection and analysis of dietary and other data so that the varying effects of alternative economic and agricultural strategies can be addressed. We expect different patterns and strategies in different ecological settings so that we are looking for both inter- and intra-community differences.

The approach draws on both ethnographic and survey research skills. The first step in the research strategy is the description of potential nutritional resources or pathways through which food enters households (DeWalt, 1981) including, but not limited to, home-produced foods, purchased foods, foods shared among family members or social and religious organizations, donated foods, etc. The next step is to identify characteristics of households which might positively or negatively affect the households' ability to exploit alternative pathways. These include methods of farming and crop choice; methods of income generation and economic standing; family structure and patterns of task allocation; participation in ritual life; location and ecological surroundings of the households; beliefs about food and definitions of appropriate foods. The final step is to operationalize these factors and indicators of dietary and nutritional well-being to test the relative importance of potential factors in particular communities.

We have applied this approach to our study of diet in Southern Honduras within the context of the INTSORMIL project. The results of our preliminary analyses have provided some insights into the nutritional system of several communities in different ecological zones. In this paper we will be reporting on research in three communities in the highland region of Southern Honduras in which there remains a strong (albeit shifting) emphasis on subsistence agriculture focused on the production of basic grains by small independent farmers.

Research Methods

Our data come from several sources. Using ethnographic methodology we set about the task of describing household consumption patterns in research communities. An interview schedule was constructed and administered to male and female head sample of households. Male household heads responded to a detailed questionnaire concerning agricultural practices and economic strategies. Female household heads in those households responded to questions concerning household composition, economic strategies, food resources, diet, and health-related practices and beliefs. Dietary data were collected through the use of 24-hour recall of family meals and a "market basket" interview which included foods entering the household in the preceeding week, the amounts and their sources.

The nutritional strategies approach focuses on alternative pathways along which food enters households and the factors which facilitate and constrain exploitation of various food resources. In other words, it is a diet-focused approach. Therefore, there is at the same time, a need for independent evaluation of nutritional status. We have chosen to do this through anthropometrical evaluations of children under six years of age. We collected height, weight, and mid-arm circumference on all children in this age group in sample households. All dietary and nutritional status measures were collected at least twice for each family at two distinct times of the year.

Sorghum in Nutritional Strategies in Southern Honduras

Our data show that food enters these households through a variety of pathways, including home production, gathering, hunting, fishing, gifts, purchase, and sometimes through a German-Honduran "food for work" program. Corn and sorghum provide the bulk of the calories in almost every household, but a wide variety of other foodstuffs are also consumed. Meals recorded in the 24-hour recalls that we conducted usually included rice and beans, often contained cheese and other dairy products, occasionally contained vegetables and gathered freshwater shrimp and crayfish. Purchased foods such as salt, sugar, coffee, and cooking fat were quite common (Thompson, K. DeWalt, and Fordhamm 1982:52-63).

Although corn is the preferred grain for the making of tortillas, the basic dietary staple, sorghum, is widely used and is well-accepted. It is processed in a manner similar to corn. First, it is subjected to an alkali treatment, either with lime or wood ashes. The pericarp is removed and the grain is ground wet and formed into tortillas. Sometimes tortillas are made with a mixture of sorghum and corn, but the most typical pattern in the communities we studied was to use one or theother grain exclusively.

Data obtained from a market basket survey for the week preceding the interviews indicate that corn, sorghum, or both grains were used in every household surveyed. Because it is our impression that landowners have more resources under their control than do those who rent or borrow

land, we have separated the households into categories of owners and non-owners. In a comparison of one week's grain usage, we find that 71% of the landowners' households used corn exclusively. This was true for only 46% of the renters' households. Among renters, slightly more households used sorghum rather than using corn exclusively. Households headed by single females, or those that did not farm, were much more likely to use sorghum than to use corn alone (see Table 1). This pattern of sorghum usage reflects the more limited resources available to non-owners and the fact that sorghum was only two-thirds the price of corn.

Sorghum is also incorporated into the diets of children. In a survey of foods served to children under the age of four years, 11 children ate sorghum tortillas and 14 ate corn tortillas. Sorghum tortillas are considered equivalent to corn tortillas for children.

In looking at the relative importance of corn and sorghum throughout the year, sorghum is an important food stuff for all groups. Only 20% of the households surveyed reported using corn exclusively throughout the entire year. The rest of the households reported using sorghum (either alone or mixed with corn) during certain months of the year. Of the people who use sorghum, we found that it was used an average of seven months by renters, 5.1 months by landowners, and 10.4 months by cultivators.

Interestingly, one of our findings is that, among the land renters, the greater portion of those who use sorghum are also purchasing sorghum. This is understandable in light of the fact that renters usually have access to only a manzana or less or land, which is insufficient to meet their subsistence needs. Of the landowners who purchased sorghum, we suspect that their land holdings are also quite small.

The staple grains of corn and sorghum represent a large percentage of the energy requirements for people of the area. It appears that land renters rely more heavily upon staple grains for energy, with the average of nearly 2000 calories coming from sorghum. Although further analysis is necessary, the differences between landowners and non-owners in grain consumption indicate a relatively more monotonous diet for renters. They rely more heavily on basic grains, while owners supplement grain diets with a wider variety of goods.

No one with whom we talked preferred sorghum tortillas to those made from corn. Sorghum is a grain that serves as insurance. People eat corn when they can, but switch to sorghum when corn is in scarce supply or is too expensive to buy. People do not like the fact that sorghum tortillas are generally darker than those made from corn. In addition, they report that the sorghum tortillas have a blander taste. People also told us that, although sorghum tortillas sit very heavily in the stomach, it takes more of them to feel full. A commonly encountered formula was that it was necessary to eat five sorghum tortillas to feel as full as one might from eating four corn tortillas. It is not yet clear to us whether this belief has a cultural origin, reflecting a

cultural acceptance of corn as amore satisfying food, or if there is a physiological basis for the decreased feeling of satisfaction. The food chemists involved in the INTSORMIL project cannot see an obvious physiological basis for it, but this is an area we wish to pursue more fully.

Although because of the community focus of INTSORMIL we have devoted much attention to the role of alternative grains in the diet it is important to view the diet as a whole. Although the use of grains is highly correlated with dietary aequacy foods high in protein in general (and dairy products in particular) are also highly correlated with meeting energy and protein needs (Table 2).

The relationships between cattle production and production of subsistence grains in the highland communities is a complex one and nas been discussed elsewhere (B. R. DeWalt 1983). Cattle ownership itself is a marker of wealth and cattle compete with the landless for access to land. At the same time, community members are dependent on milk and milk productss as important dietary staples. Even poor families without cattle use significant amounts of milk products especially fresh curdn when they are available, and complain when they are not.

Eggs from another important dietary staple and chicken is the only meat families are likely to eat on a regular basis. Eggs are singled out as an especially good food for children and the elderly. A major constraint to poultry keeping is the periodic epidemics of disease which move through the poultry populations of the community. It appears to us that control of poultry disease would have a major important on improving nutrition in these communities.

Conclusions

In the one or two centuries since the crop was introduced into Central America, Honduran farmers have engaged in selection practices that have produced acceptable food-quality sorghums. Because of its drought tolerance, the crop has become a much more productive part of the farming systems on the Honduran south coast than has corn. While people still prefer corn, sorghum is an important food crop. As we have shown, almost 50% of the individuals samples in 1981 ate sorghum at some time during the year. Furthermore, about 37% of the sorghum produced is consumed by people in the households that produce it. In poorer agricultural years, these percentages are even higher.

There are a number of issues surrounding sorghum use by humans that are being addressed by INTSORMIL scientists. Our data on cultural practices are quite important to these issues. Our major question concerns the nutritional value of sorghum as a human food. Preliminary studies of nutritional quality and protein availability in rats suggested that sorghum compared favorably with other grains. On the basis of these studies (Bressani 1978), a feeding trial with children was conducted. The results of this feeding trial were very poor

(McLean, et. al. 1981). The apparent digestibility of the proteins in sorghum was only about 46%, compared to over 70% corn. Children fed sorghum as their primary source of protein ceased to grow, or lost weight. Because of the ethical implications of this result, the experiment was terminated early.

These data raised serious questions concerning the nutritional effects of promoting sorghum consumption. The experiments conducted with sorghum, however, were based on a product prepared by mixing raw sorghum flour with water and cooking it into a porridge. In Africa, sorghum batter is frequently allowed to ferment before it is cooked. In Central America, as we have noted, sorghum is cooked in an alkali medium similar to the preparation of corn before being made into tortillas. No one has yet investigated the effects these preparation methods have on the availability of nutrients and the digestibility of proteins in sorghum. It is clear to us that traditional preparation techniques should be utilized whenever the nuritional value of sorghum as a human food is being estimated. Sorghum has been eaten for thousands of years in Africa without adverse effects on human populations. We doubt its nutritional value can be as poor as suggested by the work of McLean and his colleagues. We expect that processing techniques for making the nutrients available in sorghum are just as important as they have been found to be for corn (see Katz, Hediger, and Valleroy 1974).

A second and similar question is related to the interaction between sorghum and ascorbic acid. Research with animal model carried out by INTSORMIL scientists (Klopfenstein et.al. 1981, 1983) has suggested that in animal models sorghum based diets increase the need for ascorbic acid. Our research cannot address that question directly, but our approach to the study of diet emphasizing the study of all dietary components shows that there are awide range of cultivated and wild foods used that are rich sources of ascorbic acid any program to improve sorghum production would need to protect the availablity of these food. Also, as our work in Honduras suggests, there is no one who is depending solely on a diet consisting of sorghum or corn. The diets of the villagers contain a wide variety of food; the biggest problem is simply getting enough food. With enough food available, the complementary amino acids necessary to make sorghum or corn provide complete protein would not be a problem. Since beans and cowpeas are already an integral part of the cropping systems of these communities, we believe that directing attention to the improvement of the beans-sorghum-corn intercropping system is likely to be more beneficial than continuing attempts to develop high lysine sorghums.

NOTES

1. Assistant Professor of Behavioral Science, University of Kentucky, Lexington, KY 40536-0086, U.S.A.

2. The research reported here was supported by the U.S. Agency for International Development through the International Sorghum and Millet Project. (INTSORMIL) Contract No. AID/DSAW-G-0149.

REFERENCES CITED

Bressani, R.
1978 Evaluation of the Protein Quality of Four Selections of Sorghum Grain, Unpublished manuscript.

DeWalt, B.R.
1983 The Cattle Are Eating the Forest. Bulletin of the Atomic Scientists.

DeWalt, K.M.
1981 Diet as Adaptation: The Search for Nutritional Strategies. Federation Proceedings 40:64-68.

DeWalt, K.M., Thompson, K.S., and Fordham, M.
1982 Sorghum as Human Food in Southern Honduras. In Farming Systems Research in Southern Honduras. Kentucky INTSORMIL Technical Report #1 Lexington, Ky: University of Kentucky pp. 51-56.

DeWolt, K.M.
1983 Nutritional Strategies and Agricultural Change. Ann Arbor: UMI Research Press.

DeWalt, K. M.
n.d. Income and Dietary Adequacy in an Agricultural Community. Social Science and Medicine, in press.

Fleuret, P. and Fleuret, A.
1980 Nutrition, Consumption and Agricultural Change. Human Organization 39:259-260.

Hulse, J. H.
1982 Food Science and Nutrition: The Gulf Between Rich and Poor. Science 216:1291-1294.

Katz, S. H., Hediger, M. L. and Valleroy, L. A.
1974 Traditional Maize Processing Techniques in the New World. Science 184:765-773.

Klopfenstein, Carol F., Varriano-Marston, Elizabeth and Hosney, Carl
1981 Effects of Ascorbic Acid in Casein vs. Sorghum Grain Diets in Guinea Pigs. Nutriotion Reports International 24:1017-1028.

Klopfenstein, Carol, Hosney, Carl, and Varriano-Marston, Elizabeth
1983 Effects of Ascorbic Acid in Sorghum-, High Leucine-, and Casein-Fed Guinea Pigs. Nutrition Reports International 27: 121-129.

McLean, W. C. et. al.
1981 Protein Quality and Digestibility of Sorghum in Preschool Children: Balance Studies and Plasma Free Amino Acids. Journal of Nutrition 111:1928-1936.

Messer, E.
1977 The Ecology of a Vegetarian Diet in a Modernizing Mexican-Community. In Nutrition and Anthropology in Action. T. Fitzgerald, cd. pp. 117-124. Assen: VanGorcum.

Messer, E.
1972 Patterns of "Wild" Plant Consumption in Oaxaca, Mexico. Ecology of Food and Nutrition 1:325-332.

SAPLAN
1981 Analisis de la Situacion Alimentaria Nutricion Durante el Periodo 1972-1980. Tegucigalpa, Honduras. Consejo Superior de Planificacion Economica.

Tripp, R.
1982 Including Dietary Concerns in On-Farm Research: An Example From Imbabura, Ecuador. Economics program working paper No. 82/2. Mexico: CIMMYT.

TABLE 1. NUMBER OF HOUSEHOLDS USING SORGHUM AND CORN

	Landowners	Renters	All Others	Totals
Used Corn Exclusively	17 (71%)	12 (46%)	4 (27%)	33 (51%)
Used Sorghum	7 (29%)	14 (54%)	11 (73%)	32 (49%)
				N = 65
Children < 4				
Ate Corn *Tortillas* Only	8 (62%)	5 (63%)	1 (25%)	14 (56%)
Ate Some Sorghum *Tortillas*	5 (38%)	3 (37%)	3 (75%)	11 (44%)
				N = 25

Table 2

ZERO ORDER CORRELATIONS BETWEEN DEGREE TO WHICH PROTEIN AND ENERGY NEEDS ARE MET AND FOOD USE

Food Use	Energy	Protein
Corn	.47***[1]	.36**[1]
Sorghum	.01	-.11
Beans	.25*[1]	.49***[1,3]
Rice	.42***[1]	.40***[1]
Eggs	.21	.35**[1]
Milk	.48***[1,3]	.53***[1,3]
Cheese	.20*	.33**[3]
Cuajada	.25*[1,3]	.61***[1,3]
Grow Vegetables	.21	.35*
Buy Vegetables	-.04	-.04
Animal Products	.36**[3]	.39**[3]
Grains	.91***[1,3]	.55***[1,3]
Sweets	.53***[1,3]	.41**[1,3]
Protein Foods	.53***[1,3]	.85***[1,3]
Dairy	.44**[1,3]	.74***[1,3]
Diet Diversity	.20	.19 (.56)**[3]

N = 68

*p ≤ .05 — 1, relationship holds in Villages 1 & 2

**p ≤ .01 — 3, relationship holds in Villages 3

***p ≤ .001