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Social Science and Food Science Research in the Peanut CRSP

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The Peanut CRSP was initiated with a planning grant from USAID and BIFAD to the University of Georgia in August 1980. In February 1981, Alabama A&M University (AAMU) was selected from among several proposals from 1890 land grant institutions to assist in planning. A technical advisory committee (TAC) was also assembled to represent global peanut research interests. The TAC included USDA and land grant university plant, food, and social scientists, the peanut program coordinator from the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), and representatives from the African Groundnut Council, the Research Institute for Oils and Oilseeds (IRHO), Latin American and Caribbean research organizations (e.g., CARDI), and the World Bank. Later, U.S. producer interests were represented through the Peanut Council.

During the planning phase, in order to identify key researchable constraints to peanut production and utilization and to develop a global research plan, fact-finding trips were made to international peanut meetings at ICRISAT and to research sites in peanut-producing countries, where scientists from 20 nations were interviewed. Interviewees included several food scientists, but no social scientists studying peanut farming systems or utilization were identified within any national or university research organizations. However, at ICRISAT, the Economics Group provided some important insights into farming systems constraints on peanut production.

Most of these constraints centered on the greater labor demands planting and weeding peanuts relative to other crops. Planting corresponds with the onset of the rains. Because peanut seed stocks are more valuable than other crops, farmers are less likely to plant peanuts before sufficient rain has fallen. Weeding is equally critical to protect the farmer's investment in peanut seed. Consequently, more is at risk if drought occurs once peanuts are planted. More focused farming systems and market price–policy analysis appeared to be needed to understand peanut production and domestic market potential.

Peanuts are important both as a foreign-exchange earner and as a source

of vegetable oil in the semi-arid tropics (SAT). Yet, in the countries surveyed, very little has been documented about peanuts as a foodstuff except for their wide use as a snack. Economists generally believed that peanut consumption would not normally vary among income groups since peanuts appeared to be eaten by nearly everyone, but only in small quantities. It was therefore decided that more information on market demand and home consumption patterns would be needed in order to better design product development research. (Cummins and Jackson 1982, Wheelock 1982).

Research proposals were solicited from U.S. institutions in the areas of: advanced line, variety testing and cultural practices; breeding and cultural practices; mycotoxin management; weeds, insects, diseases, and nematode control; food technology; physiology and soil microbiology; and socioeconomics. The TAC then matched identified country-level researchable constraints with the most relevant proposals. The result was the "Peanut CRSP Planning Report" (Jackson and Cummins 1981).

Socioeconomic proposals were few in number, especially from peanut-producing states. Furthermore, those submitted did not demonstrate potentially strong links with peanut scientists in the United States or social scientists in collaborating countries – a particularly important consideration for this tightly focused and budgeted single-commodity CRSP. Most proposals were broad-based food system or sociostructural studies of the niche occupied by peanut producers and users. At the time, it was believed that basic FSR on peanuts was already under way, and that specialized cash-crop and foreign-exchange issues, plus the high weather/price risk of peanut production, were the main concerns of collaborating country scientists. The TAC therefore recommended that none of the broader socioeconomic proposals be funded. However, several members of the committee concurred with the TAC's World Bank representative that, if socioeconomic studies were excluded in the global plan, a strong case could be made that there should not even be a Peanut CRSP!

A twofold compromise on socioeconomic issues was reached. First, it called for special economic analyses to be conducted by a social scientist currently studying markets and farming systems in Peanut CRSP countries. Evaluation of the potential impact of higher-yielding, lower-risk (drought- and aflatoxin-resistant) varieties on poorer farm families' diets and incomes was to be a major focus of this analysis. While shorter-season strains and more vigorous taproot growth of the young peanut plant have received some research attention in SAT national research centers, the primary thrust to increase food security has been toward other shorter-season legumes (e.g., chick pea and pigeon pea) and improved sorghums and millets. Breeding work on these less frequently traded commodities has also been more favored by international research projects. Perhaps the central but unstated issue of the entire Peanut CRSP is whether the dearth of research support for lower-risk

peanut varieties for SATs is related to a true lack of genetic potential for peanuts in such climates, or whether it is due to protectionist policies of donor countries competing for the international peanut market.

Second, the compromise called for a multidisciplinary model, including social scientists and food scientists, to conduct utilization studies of food science constraints. In the first year of the Peanut CRSP, one such proposal was funded for Sudan. The Food Research Center of Sudan's Agricultural Research Corporation (FRC/ARC) and AAMU were named as host country and U.S. lead institutions, respectively. The principal objectives were to determine the role of peanuts in the diet and food budgets of Sudanese households and to explore the potential for improved or new peanut products and increased consumption. An initial survey phase would provide guidance in planning for the latter objective. Similar multidisciplinary projects were included in the second-year plan for Thailand and the Philippines, with the University of Georgia serving as U.S. lead institution.

Although it was the largest peanut-producing country in the CRSP, Sudan was not included in the program's agronomic plan. Sudanese scientists had expressed specific interest in drought tolerance and aflatoxin resistance as breeding objectives. However, as noted earlier, these constraints were not addressed in the proposals received from U.S. scientists. The TAC concluded that U.S. agronomists had little to offer their Sudanese counterparts at that time, but if such possibilities should develop in the future, agronomists from other collaborating African Peanut CRSPs at North Carolina State University, University of Georgia, and Texas A&M could then join food scientists already in Sudan. Coincidently or not, this strategy provided a convenient answer when, in 1982, U.S. peanut growers challenged USAID as to why a program was being funded that would help our major competitors in the world market. The answers were that the CRSP hoped to enhance peanut utilization around the world; the Sudan project was entirely utilization-oriented; all project countries involved were poor and their food balances showed deficits in carbohydrates and protein; and Senegal, an exporting country as was Sudan, was a convenient ally with whom to initiate collaborative research (with Texas A&M CRSP scientists) on health hazards from mycotoxins, the findings from which could be of great significance to U.S. peanut interests.

SOCIAL SCIENCE AND FOOD SCIENCE ON THE PEANUT CRSP IN SUDAN

The Food Science Peanut CRSP in Sudan is primarily a research service project focused on the role of peanuts in national food security. It was conceived as a multidisciplinary effort in terms of team composition,

objectives, and implementation. It called for the establishment of laboratory and computer facilities in FRC/ARC, standardization and validation of basic measurement procedures, and corresponding services from each Sudanese and U.S. scientist on the team. Agricultural economists and sociologists from FRC/ARC and AAMU were responsible for establishing a computer facility that would enable comparable data analysis at both locations. They were also responsible for constructing survey instruments and coordinating input from the food scientists. Two instruments were needed initially: one to estimate demand for various peanut products, both in producing areas and in urban markets stratified by income levels; and one to evaluate the role of peanuts in food security at the farm level, vis-à-vis postharvest peanut storage, handling, utilization, marketing practices, and aflatoxin contamination levels.

The food scientists cooperated in the surveys, but they also worked to establish an aflatoxin determination lab and to rehabilitate other laboratory facilities. Tasks such as getting ethyl ether and other volatile chemicals into Khartoum (which proved very nearly impossible), installing and maintaining equipment, and standardizing and validating measurement procedures new to FRC, if not its scientists, were basic services provided by the project.[1]

U.S. social science input in Sudan has been 30%–40% of one scientist year for the first three years of the project. This time has been split between the rural sociologist (Wheelock) and the agricultural economist (Jones). In FRC/ARC, two agricultural economists have also worked on the project, but only one at a time at about 20%. Below, the findings and contributions of social scientists, as well as their recommendations for the multidisciplinary food science project of the Sudan Peanut CRSP, are described. These outcomes are then expanded by comparison with results from the more recently established Caribbean Peanut CRSP.

Peanuts and Foreign Exchange in Sudan

One of the first tasks for the social sciences was to examine the overarching and interrelated roles of peanuts as a cash and food crop in both international and domestic socioeconomic contexts. Over the last decade, the volume and value of Sudan's peanut exports have declined absolutely and relative to total exports. From 1974 to 1978, peanuts averaged about 16% of the nation's foreign-exchange earnings. Total peanut exports peaked at 280,000 tons in 1976 (Riley 1981). From 1979 to 1983, peanut exports dropped to less than 7% of average yearly earnings. That average was buoyed up by extraordinary exports of about 80,000 tons in 1980–1981 (Riley 1981), when drought cut U.S. peanut production by more than a third, and U.S. imports increased more than tenfold to 3.6 million pounds (USDA 1984:121). The percentage share of Sudan's total value of exports to the United States more than tripled, from 2.4% to 8% in 1980–1981, then returned to 2.6% the next year (Bank

of Sudan 1983:45). U.S. farmers suddenly became very aware of Sudan's potential comparative advantage in peanut production. Sudanese farm prices were then somewhere below 50% of the world price, and one-sixth of the quota price of 27.5 cents per pound received by U.S. farmers (Bashir and Idris 1983). The Peanut CRSP was just being established, and U.S. grower interests had to be assured that peanut-exporting countries were not being helped to become even more competitive in the world market. However, subsequent events have replaced this concern with one of food security in Sudan and in Africa generally.

Increased domestic demand, combined with poor growing conditions for peanuts and related aflatoxin contamination problems, resulted in declining Sudanese exports in 1982 and 1983, and essentially no exports in 1984 and 1985. Domestic demand for peanut oil in cooking was boosted both by population growth and by diversion of all cotton seed oil to the domestic soap industry. Peanut cake production increased as a by-product of the oil industry, but its export market faltered when aflatoxin detections proved excessive for European livestock feed markets. Finally, drought in western Sudan reduced peanut production in favor of more drought-resistant food and export crops such as sesame, sorghum, millet, rosette, and gum arabic. Sesame and sorghum comprised 30% of exports in 1982 compared with 6.9% for peanuts (Table 10.1). In 1983, incentives for cotton farmers were substantially increased, resulting in a doubling of cotton's share of exports to 49%, while sesame and sorghum comprised 17% and peanuts only 2%.

Sudanese export declines have been followed by drops in peanut production from the 1977 peak of 1,027,000 metric tons (Table 10.2). Both area and yield have declined as labor shifted from rainfed agriculture to more drought-tolerant crops in western Sudan, to irrigated schemes in central Sudan, and to labor markets in Saudi Arabia and other Middle Eastern countries. Area planted has fallen from more than 2.6 million feddans (one feddan = 0.95 acres) in 1977 to less than a million in 1984. Most of the decline has been in semi-arid regions where rains were not sufficient for planting. The rains returned in 1985 and 1986, but peanut production in western Sudan was slow to recover. Priority has been given to sorghum. Few farmers in the western region had any peanut seed left, and labor supplies had been diverted by the drought. Peanut exports were curtailed even further by aflatoxin restrictions in the European Common Market. In sum, it appears that peanut production and prices will depend increasingly upon growth in domestic demand and decreasingly upon exports.

With several key variables in Sudan's peanut industry and agriculture changing dramatically from year to year, the challenge for socioeconomic analyses pertinent to FRC/ARC research plans and policy is great. A comparative advantage in peanut production for the world market probably still exists—if rainfall returns to normal in the rainfed peanut-producing areas

TABLE 10.1. PEANUT, COTTON, SESAME, AND SORGHUM EXPORTS AS A PERCENTAGE OF TOTAL MONEY VALUE OF EXPORTS IN SUDAN (1974-1983)

Year	Peanuts	Cotton	Sesame	Cake & Meal	Sorghum (dura)	Exports (Ls.million)
1974	14.9	35.5	13.5	-	-	-
1975	22.6	46.0	7.8	-	-	-
1976	20.2	59.7	9.0	-	-	-
1977	12.5	57.2	7.9	-	-	-
1978	10.2	51.8	9.5	3.3	1.3	202
1979	4.3	65.0	2.7	3.2	5.8	233
1980	2.2	42.5	9.2	5.0	15.8	271
1981	18.6	19.2	9.0	4.1	12.0	357
1982	6.9	25.1	7.9	3.0	22.2	483
1983	2.0	48.8	8.7	3.0	8.2	811

Source: Bank of Sudan 1981, 1983.

of western Sudan, if trade and foreign exchange policy continues to encourage exports, and if the area's labor supply stabilizes. Sudan could probably expand its trade with China, Japan, Saudi Arabia, Egypt, and other peanut and peanut-oil markets. If production and trade of peanuts were to resume, policymakers could further encourage production by calculating and announcing expected minimum prices before planting time in western Sudan (Sattar 1982; Wheelock and Jones 1983).

FRC/ARC can do nothing about the weather, international labor markets, or internal political problems affecting migration of labor. However, the institution's role in monitoring aflatoxin and researching its control is important to the development of Sudan's domestic market, with or without recovery in foreign markets. Also, assessment of current and potential supply and demand for peanut products relative to other domestic products is crucial to FRC/ARC's own planning process, as well as to its effectiveness in intragovernmental planning and policy (Wheelock 1985).

Peanuts and Food Energy Supplies in Sudan

When the source of Sudan's food energy supply was scrutinized, the relatively narrow objectives of the Sudan Peanut CRSP were further justified. Estimates for the country for 1979 to 1981 by FAO (1984) indicated a per

TABLE 10.2. AREA PLANTED, YIELD PER FEDDAN,[a] AND TOTAL PRODUCTION OF PEANUTS IN SUDAN (1971-1982)

Year	Feddans Planted (000)	(change)	Yield (kg)	Feddan (change)	Total Production (000)	(change)
1971	1511	-	256	-	387	-
1972	1614	6.8%	348	35.9%	568	46.8%
1973	1748	8.3%	317	-8.9%	554	-2.5%
1974	1792	2.5%	517	63.1%	928	67.5%
1975	2321	29.5%	343	-33.7%	796	-14.2%
1976	1880	-19.0%	393	14.6%	738	-7.3%
1977	2661	41.5%	386	-1.8%	1027	39.2%
1978	2328	-12.5%	342	-11.4%	798	-22.3%
1979	2352	1.0%	362	5.8%	852	6.8%
1980	2129	-9.5%	332	-8.3%	707	-17.0%
1981	2346	10.2%	306	-7.8%	721	2.0%
1982	1853	-21.0%	270	-11.8%	497	-31.1%

Source: Bashier and Idris 1983, Bank of Sudan 1981, 1983.

[a]One feddan = 0.39 hectares = 0.95 acres.

capita availability of 2,291 calories (cal) per day excluding alcohol (23 cal); by comparison, this figure is 3,455 for the United States. However, Sudan's averages did not indicate the considerable caloric inequality that must be present in one of Africa's largest and most climatically diverse countries. Comparison with neighboring nations was therefore helpful. The irrigated areas of the Nile and central Sudan have more in common with Egypt than with the rainfed semi-arid tropics of western Sudan or the savanna and tropical rain forests of the south. Hence, the latter regions should be compared with other countries in the Sahel and to the south. Egypt was estimated to have 3,174 cal per capita per day compared with only 1,691 and 2,079 in Uganda and Central African Republic, respectively. Central Sudan's supplies may have been within 500 cal of Egypt's average, but supplies in western and southern Sudan – which contain about one-third of the country's population (18,378,000 in 1980) – would have been closer to the 2,000 cal average of its neighbors to the south and west between 1979 and 1981.

Like most SAT countries of Africa, Sudan depends heavily upon the peanut as a source of dietary oils and calories. FAO food balance sheets for

1979–1981 estimate that 43.2% of Sudan's fat supply and 12% of its per capita caloric supply (net of exports, feed, seed, and waste) came from peanuts and peanut products. Of Sudan's daily per capita supply of 2,291 cal, 220 were from peanut oil and 55 from peanuts. In 1983 and 1984, because of the peanut's intolerance for drought, fat and calorie supplies most certainly dropped dramatically, particularly in rainfed peanut-producing areas of western Sudan.

During good years in Sudan, substantial groundnut cake (a by-product of the oil presses) is available for export or domestic use as livestock feed. Between 1979 and 1981, for example, 180,000 mt per year were produced, but no products from peanut cake were included in the food balances. In this form, however, the groundnut is a prolific medium for *Aspergillis flavus* and mycotoxin by-products, including B1 aflatoxin. If groundnut cake is to be exported or used for animal or human consumption domestically, the production of this most potent of all carcinogens must be controlled.

Sample Survey of Peanut Producers and Consumers in Sudan and the Caribbean

Coinvestigators from the food and social sciences agreed upon survey objectives, instruments, and analytic procedures to coordinate core components of CRSP-wide questionnaire research across program sites in Sudan and the Caribbean. Prior to the initial survey in Sudan, rigorous field survey techniques and quantitative methods of demand analysis were new to the AAMU and FRC/ARC food scientists. At the same time, nutritional subject matters were new to the social scientists. Overcoming the lack of experience in each other's disciplines was taken seriously by all concerned, and there was considerable give and take in defining objectives and procedures. The social scientists took leadership responsibility for survey objectives, sampling design (for both households and peanuts), questionnaire construction, and interview strategies. With the whole team's participation, these issues were thoroughly worked out to fit within budgetary and personnel constraints.

Two major multidisciplinary field survey objectives were identified to fill knowledge gaps on demand for various peanut products and to understand the food security role of peanuts at the household level. First, for estimating income elasticities of demand and other purposes, purchases of peanuts in various forms (raw, roasted, paste, or peanut butter) were documented in urban samples. To ensure that all income levels were sufficiently represented, the sample was stratified by low-, middle-, and high-income subdivisions. A second survey of producers was aimed at understanding the importance of peanuts as a cash crop and documenting variation in peanut cultural practices (pre- and postharvest) that might be associated with aflatoxin contamination

of farm-stored peanuts. Peanut samples for laboratory analysis were also collected from the farmers interviewed.

In Sudan, the urban study was conducted in Khartoum, the capital. Two farm samples were selected to represent major peanut-growing areas: one was drawn from four irrigation-scheme communities in central Sudan; the other included five rainfed agricultural villages in western Sudan (Singh 1984, 1985a, 1986a). On the more recently established Caribbean Peanut CRSP, similar procedures were used to interview urban samples in Trinidad, Jamaica, and St. Vincent, plus farm samples in the latter two countries (Okezie 1984; Singh 1985b and 1986b). The next sections briefly outline some of the major socioeconomic and other findings of these surveys.

Sources of New Demand for Peanuts and Peanut Products

To estimate growth in aggregate demand for peanuts and to document differences in markets for various peanut products, the Sudan and Caribbean utilization surveys collected data on quantities and values of peanut and peanut product purchases. These surveys sought to provide input for planning more useful product development research on peanuts and/or for redirecting research toward more promising commodities. At the same time, survey research skills would be enhanced within the respective food research centers.

To estimate potential growth in aggregate demand for peanuts in the domestic markets of CRSP countries, a standard model was elaborated based on growth in population and—to the extent that consumption increases with income—upon growth in income. Assuming domestic requirements would grow in proportion to the population and that income elasticities of demand for peanuts and peanut products, including oil, would average 0.5% (Mellor 1966:66), demand in Sudan and the Caribbean would be expected to increase about 3% and 2% per year, respectively. Population growth estimates in the two areas range around 2.9% and 1.8%. In Sudan, income is stagnant, but supplies are produced domestically. In Trinidad, the income effect may be negative since peanuts are imported and incomes have fallen. Therefore, price has probably increased and quantity purchased declined. Still, to the extent that domestically produced food is more available than imports (food and nonfood), more peanut and peanut oil may be consumed.

It would be expected that high-income households would purchase peanut products different from those bought by low-income households. Products requiring more value-added processing would generally be preferred by higher-income households, while those with little or no such processing or sorting would be more frequently purchased by lower-income households. Domestically roasted or parched peanuts are more likely to be purchased from street vendors and consumed as snacks, while peanut paste, butter, and oil are more likely to be consumed at home. Accordingly, the former products may

be more frequently consumed by low-income households, and the latter by high-income ones. Boiled peanuts are more frequently consumed in rural peanut-producing areas. Since peanut butter and oil are more likely to be used to complement a variety of foods (in soups and salads, on bread, or in cakes and candies), higher-income households with more diverse diets may be more likely to consume these products. Similarly, fancy imported and canned nuts would not figure in low-income household diets.

Thus far, social scientists' analysis of the available survey data has contributed to the existing research policy and planning dialogue within collaborating food research centers. Farmers' interest in growing peanuts relative to interest in alternate crops was directly communicated to food scientists, as were consumer preferences. Less directly examined were more macrolevel questions as to how declining export surpluses affect domestic utilization in Sudan or how domestic production and supplies would respond to import controls in Caribbean countries.

Country-by-country comparisons of the survey data on demand elasticities for peanut products have helped target some of these issues. Extrapolations from 1-month estimates derived from the survey of urban households in Khartoum yield estimated purchases of nearly 15 lbs of shelled or processed peanuts (excluding oil) per person per year in households with double the average sample food purchase budget, but only 6.2 lbs for persons in households with half the average food budget (Table 10.3). In the Caribbean, these estimates range from a low of 5.1 lbs for all budget levels in Jamaica, where imports have recently been prohibited, to 11.9 lbs in urban St. Vincent, where growing conditions permit two crops per year. Those with 50% of average incomes purchased 9.1 lbs per capita, while those with double the average purchased 17.5 lbs. In Trinidad, where all peanuts are imported, the urban household survey yielded an estimated range of 7.8–15.5 lbs per capita (Table 10.3).

Household samples were drawn from three strata of residential subdivisions (high, middle, and low income) to ensure sufficient variation to estimate income elasticities of demand for the various products. Therefore, these per capita estimates are not comparable to the UN/FAO food balance sheet (FBS) estimates discussed earlier. However, it is obvious that in all countries sampled, the stratified urban samples report more peanut purchases than their share of FBS estimated supplies. This would support the hypothesis of a positive income elasticity of demand for peanuts.

To test that hypothesis, income elasticities were estimated directly from the survey data. For each sample, the natural logs of reported household purchases of peanut butter and total peanuts (including peanut butter) were regressed on natural logs of income or amount of total food expenditures (depending upon the quality of the data) and of household size. That is quantities of peanut purchases were taken as a function of income or food

TABLE 10.3. ELASTICITIES OF DEMAND FOR SELECTED PEANUT PRODUCTS[b]

	Khartoum		Jamaica		St. Vincent		Trinidad	
	Peanut butter	All peanuts	Roasted peanuts	All peanuts	Peanut butter	All peanuts	Peanut butter	All peanuts
Food purchases per week	1.03[a]	.63[a]	-.14	-.09	-	-	-	-
Gross family income	-	-	-	-	.47[a]	.41[a]	.29	.55[a]
Household size	.41	.22	.84[a]	.75[a]	.39[a]	.30	.66[a]	.44[a]

Source: Surveys conducted by FRC/ARC, CARDI, AAMU Food Technology Peanut CRSP (Okezie 1984, Singh 1984).

[a]Elasticity significant at the .05 level.

[b]See Table 10.4 for details.

expenditures and household size. When logical adjustments were made for country differences, the results were reasonably consistent across samples. In Sudan, the lowest-income country with the least diverse diet, particularly among vegetable oils and legumes, the food purchase elasticity (net of family size) for peanut paste was an elastic 1.03; for all peanuts, it was .63 (Table 10.3). Household size was not a significant factor. These income elasticities are consistent with the 0.8 reported by Mellor (1966:66) for Africa, but they are higher than the corresponding figure for pulses and nuts. Considering that all estimates reported here include the more highly processed peanut butter that is eaten as a complement to the salads, soups, bread, and confections more frequently consumed by middle- or higher-income households, these figures may not be unreasonable.

In Caribbean countries, household size was positive and significant in all equations, but income coefficients (net of household size) showed mixed results. In St. Vincent, where peanut surpluses are produced for export, the income elasticity of demand for peanut butter was .47 and .41 for all peanuts. Both figures are noteworthy in spite of significant net effects for household size (Table 10.3). In Trinidad, where most peanut products are imported from the United States, these figures were .29 and .55. Again, net of income effect, the household size effect was positive, particularly for peanut butter. For example, for each percentage increase in family size, peanut butter purchases increased .66% in the Trinidad sample. The higher income

TABLE 10.4. ELASTICITIES OF DEMAND AND DETAILS OF THE ORDINARY LEAST SQUARES ESTIMATES FOR PEANUT PRODUCTS

	Khartoum Jan 1984		Jamaica May 1984		St. Vincent May 1984		Trinidad May 1984	
Natural Logs[a]	Peanut butter	All peanuts	Roasted peanuts	All peanuts	Peanut butter	All peanuts	Peanut butter	All peanuts
Food purchase per week								
B	1.03*	.63*	-.14[b]	-.09				
SE	0.29	0.16	.10	.11				
Gross family income								
B					.47*	.41*	.29	.55*
SE					0.13	0.12	.16	.16
Household size								
B	.41	.22	.84[b]*	.75*	.39*	.30	.66*	.44*
SE	.45	0.25	.21	.23	0.16	0.17	.19	.18
Constant	-3.15	.79	1.46	2.07	.67	1.19	.25	.91
Number	99	99	137	137	210	210	179	179
F-value	7.4	9.0	8.1	5.3	11.4	10.0	9.6	11.2
DF	(2,96)	(2,96)	(2,134)	(2,134)	(2,207)	(2,207)	(2,176)	(2,176)
R-square	.13	.15	.11	.07	.10	.09	.10	.11

Source: Surveys conducted by FRC/ARC, CARDI, and the AAMU Food Technology Peanut CRSP (Okezie 1984, Singh 1984).

[a]When no peanut purchases were reported by a household, a small positive value (.001) was added to allow computation of natural logarithms.

[b]Little or no peanut butter was available in the area surveyed, therefore the coefficients are for roasted peanuts.

*Significant at the .05 level.

elasticity coefficient for all peanut products can be explained by quality and price differences.

Processed peanuts found in urban Trinidad grocery stores were fancy salted peanuts, vacuum-packed in the United States. These imports were seldom available in Jamaica or St. Vincent. Also, roasted peanuts sold as snacks to children or men by street vendors would not have been as uniformly reported as store-bought household purchases. Accordingly, roasted

peanut prices reported by Trinidad households were higher than in the other samples, but peanut butter on the average was reported to have cost less.

In Jamaica, the income or food purchase elasticities of demand were not significant. However, purchases of both roasted peanuts (.84) and all peanut products (.75) increased roughly in proportion to household size (Table 10.3). In Jamaica, where imports have recently been stopped in order to encourage local production, commercial peanut butter processing is in its infancy. The lack of a positive income elasticity of demand for peanut products in Jamaica may simply reflect the absence of peanut products on the shelves of high-income suburban grocery stores. Local products may be more accessible to lower-income people, but their quality may not be acceptable to higher-income shoppers, who opt for other snacks or local meat and dairy products instead. Locally processed peanuts may thus be the more affordable protein snack for low-income, large-family households. The survey data suggest that local vendors buy direct from farmer middlemen and then roast, package, and sell their own products. In this instance, the import controls appear to be fostering grassroots entrepreneurship. Furthermore, they appear to be doing so without distorting consumer prices. While the average peanut butter price paid by the Jamaican urban sample was the highest of the three Caribbean samples, the average price for roasted peanuts was lower. Jamaican households reported purchasing less than half as much peanut butter; but, in spite of their lower average income and food budget, they purchased nearly the same amount of roasted nuts (Table 10.3). Of course, the survey data do not provide information on prices of locally produced peanuts before import restrictions. Since the survey was conducted soon after imposition of the new import controls, it is also possible that higher-income households have now found local suppliers and vendors, and prices may have been driven up accordingly.

To understand the effects of currency devaluation and import restrictions on the emergence of a domestic peanut industry, additional surveys are being planned with scientists of the Food Technology Institute in Kingston, Jamaica. At the time of the first survey, small producers and processors were participating in the newly stimulated domestic market, and low-income consumers were buying their products on a par with other consumers. How will small producers, processors, and consumers fare as the future unfolds? Is the production and processing technology sufficiently divisible that small producers and processors can meet domestic demand efficiently? And will low-income consumers still be able to buy the products? Comparison with St. Vincent, an exporter of surpluses, and Trinidad, strictly an importer of peanuts, provides an excellent opportunity to study indigenous entrepreneurship in food production and technology. Trinidad's recent currency devaluations are increasing economic pressures to internalize more value-added industry. Peanut processing may be a candidate.

To help guide their work, host country food scientists on the CRSP expressed a definite desire to institutionalize social science food-demand and food-policy analysis. A CRSP plan for long-term collaboration in these areas was well received by the cooperating scientists. Also, host country commitment was evidenced in Sudan by the reassignment of a PhD in economics within ARC to the FRC, plus support of PhD training for the original FRC/ARC economist. In addition, the Food Technology Institute in Jamaica is consulting with CRSP social scientists on the country's nascent peanut butter processing industry. Through continued collaboration among all Peanut CRSPs (including those of Thailand, the Philippines, and the University of Georgia), a large aim is to develop an internationally standard food demand analysis capability.

Along with income and food purchases, the impacts of family age and sex composition upon food product demand are now being evaluated (Huang and Raunikar 1985). Statistics can be calculated using computer capabilities at the various food research centers. Dialogue among Peanut CRSP collaborators is needed to ensure standardized use of statistical tools. To the extent that these results help food scientists differentiate growth markets for peanut products (and food products in general), consumers, producers, and processors will all benefit.

Moreover, these benefits could be extended to U.S. producers as well. In 1980, several factors combined to undermine U.S. peanut exports, including drought in the southern United States, peak petroleum prices that increased production costs, and the erosion of export markets caused by a strong dollar. However, U.S. peanut export markets have since expanded. Research to increase demand for peanuts in developing countries would therefore enhance the positive trend in post 1980 U.S. peanut exports. More important, it would help supply middle- and higher income markets in developing countries with more acceptable domestically produced peanut consumer goods. Improved domestic peanut products range from peanut butter and peanut drinks for human consumption to peanut cake safe for use in domestic livestock feed. In turn, producers and small- to medium-scale processors in developing nations could enhance their own food security with the increased cash income.

Incidences of Aflatoxin in Sudan and the Caribbean: Sociogenic or Biogenic Causes?

Small-farm production of peanuts involves a wide variety of cultural practices that may affect aflatoxin (B1) contamination. Several of these practices were monitored in the farm-level surveys, including planting and harvest date of last crop, kind of crop rotation and intercropping practiced, soil type and washing or cleaning of harvested nuts, gleaning of loose nuts from the field

after harvest, and storage practices. Peanut samples from the same farms were to be collected and analyzed for aflatoxin contamination.

Samples from Sudanese farms were very small (100 cc or less); in many cases, no peanuts were available because the entire crop had been sold. Aflatoxin analysis requires larger samples, so individual samples were pooled for larger areas. All pooled samples were analyzed at FRC/ARC, but none showed B1 aflatoxin contamination of 20 parts per billion (ppb) or more (Khalid et al. 1986). Insofar as international standardization tests have not been run on the newly installed equipment, these data must be considered preliminary.

In Jamaica and St. Vincent, only eight of 141 samples were found to be contaminated at levels of 20 ppb or greater. These tests were of international standard and are considered reliable. When these values were classified by cultural practices, seven of the eight contaminated samples (87.5%) were found to have been harvested during aflatoxin-prone months. Furthermore, it was discovered that the contaminated samples were grown on farms with several similar cultural practices, including growing peanuts in rotation after sweet potatoes, intercropping peanuts with corn, and post-harvest gleaning (Singh 1985b:279). When combined with harvest during aflatoxin-prone months, these practices were related to higher probabilities of contamination.

From these limited survey data, both biogenic and sociogenic hypotheses as to the causes of contamination can be formulated. Biologically, the indicated cultural practices in combination with aflatoxin-prone harvest months could have resulted in greater incidence of aflatoxin contamination in the peanut samples collected. Incidence of contamination increases when wet harvest weather, conducive to growth of *Aspergillus*, follows drought-induced defects in shell formation. However, an Israeli study of similar design reported no correlation between crop sequence and incidence of *Aspergillus flavus* (Ishag 1986; Joffe and Lisker 1969). But, this study included no root crops in the rotations. Regarding soil type and the practice of washing peanuts, total kernel mycoflora were constantly higher on medium and heavy soils than on other soils.

Alternately and sociologically, these contaminated samples may have been culls retained by small but thrifty, labor-intensive farm operators for emergency use as food, feed, or fertilizer. Sampling procedures may have simply resulted in more contaminated peanuts (culls) from these farms. Survey evidence supports this hypothesis: findings suggest that the 141 farmers providing peanut samples generally practiced more labor-intensive methods and were more likely to have gleaned peanuts from fields during the critical harvest month than were the 174 that did not provide samples. Similarly, they were more likely to have washed the peanuts harvested during the critical month. Chi-square tests of these findings are significant at the .05 level. In any event, it would seem important to determine whether the

probability of aflatoxin contamination is greatly increased when peanuts are grown in rotation with fleshy root crops, such as sweet potatoes. This would be particularly desirable before beginning any extension program to promote peanuts in home gardens.

CONCLUSIONS

Collaborative food science and social science research findings of the kind reported here should be of value to social, food, and agronomic scientists in making future research decisions about peanut production, storage, processing, and marketing, plus the relative importance of peanut-related research in future agricultural research budgets. Agronomic experiments suggested by the farm surveys of cultural practices conducive to aflatoxin growth lay beyond the scope of the Food Science project, but through the Peanut CRSP's management entity, the TAC, and host country collaborators, this and other cross-disciplinary issues are discussed and negotiated. Likewise, commodity research coordinators in each country meet and negotiate technical issues and research budgets domestically and with international donors. In this way, multidisciplinary research to optimize the role of peanuts in host country economies and diets should complement the role of other commodities in the overall effort to maximize the benefits to each country's population, especially the poor, from each nation's public research dollar, and commodity and human resource mix.

More specifically, within the CRSP's multidisciplinary collaborative research mode, students are trained, trained scientists are equipped, and participating scientists become better-informed teachers; research collaborations are forged between scientists and disciplines; methods and measurement procedures are developed and refined in accordance with international standards; alternative biogenic and sociogenic hypotheses are considered; improved technologies are designed and tested for use on small farms, in low-income homes, and in small cottage industries; research findings are debated and published for wider application or dialogue; and higher R&D payoffs or more refined research issues result.

NOTES

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1. While provision of these services could be taken for granted by many CRSP projects, this was not the case in Sudan. Basic cultivar selection projects in which all necessary information is contained within a few seeds

would be much easier to implement; but with Sudan's already considerable production potential and the lack of U.S. sources of drought-resistant genetic material, more complex utilization issues were identified as the constraints to be dealt with at this time.

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