

PD-AAY-946
59182

AN INTERDISCIPLINARY APPROACH TO OPTIMUM FOOD UTILITY
OF PEANUTS IN SAT AFRICA

GRANT AID/DSAN-G-0247 AAMU/FT/S

July, 1982 - April, 1985

Principal Investigator: B. Singh, Professor

Co-Investigators:

G. C. Wheelock, Professor
H. Jones, Assistant Professor
D. R. Rao, Professor
J. C. Anderson, Associate Professor
V. Caples, Professor,
Associate Dean, Division of Home Economics

Host Country: Sudan

Institution: Alabama A & M University
Units: Office of International Programs
Department of Food Science & Animal Industries
Department of Agribusiness Education
Division of Home Economics
Normal, Alabama



TABLE OF CONTENTS

1. Progress - An Outline
2. Proposal
3. Memorandum of Understanding (MOU) and Plan of Work
4. Trip Reports
5. Annual Reports - 1983, 1984
6. Survey Instruments
7. Budgets

An Interdisciplinary Approach to Optimum Food Utility
of Peanut in SAT Africa
(B. Singh)

Introduction: Scope of the Project - Project objectives
Justification of the project in the Sudan

Project Organization:
°Alabama A&M University
°Sudan
°MOU
°Plan of Work

Trips: 1. Planning 1982
2. Organization of the Survey 1983
3. Survey 1983
4. Research plans - implementation 1984

Benefits: To Sudan
°Institutional development
°Professional development
°Research involvement leading towards improved
products and better handling and storage

To AAMU
°Peanut research involvement
°Faculty - professional development
°Initiation of research on aflatoxin (state-wide)
and product development
°Involvement of students on data processing

Interest of the Institution:

°Departmental interest (High)
°School of Agriculture - overall
interest in peanut research
°Capability to serve international students improved

Accomplishments: °Lab capabilities at the FRC
°Research accomplishments
°Survey completed on consumption and post-harvest
handling
°Data on consumption of peanuts-almost completed
°Product development activities-research on
peanut paste
°Information on post-harvest handling (new
research planned)
°Significant results based on survey

Current Research Activities:

(1) Survey data analyses
(2) Plan of research on peanut paste.

Trips Planned: August, 1985 to work with collaborators

Trips Planned for Dr. H. Ishag and Dr. E. Bashir

Training: °Two Sudanese students arriving in June, 1985
°Three students from the US working on the Peanut CRSP related problems
a. aflatoxin - 1
b. product development - 1
c. data processing and interpretations - 1

Cooperators: Scientists are cooperating well on the project on every phase of the program (planning and implementation)

Administrative support:

Very good at AAMU
Very good at FRC

Problems: Shipping of equipment and materials (delays)

Mission assistance:

Very good support.

EQUIPMENT
(Shipped)

1. Apple IIe with printer (Epson, System Saver and other accessories)
2. Centrifuge - Table top type
3. Fat extractor - LabConco Goldfish
4. Fiber extractor
5. Kjeldahl Digestion & Distillation Unit
6. Water bath - Fisher
7. Air-oven-Precision general purpose
8. Fluorometer (Turner)
9. Soxhlet extraction system - 6 unit heating mantles, soxlet condenser
10. Spectroline - longwave lamp
11. Wiley mill
12. Condensers
13. Velasco flurotoxin meter
14. Multi-wrist flask shaker
15. TLC System-spreader, tank, plates
16. Chromatography columns (20 x 400 mm)

An Interdisciplinary Approach to Optimum Food Utilization of Peanuts in SAT Africa

Introduction

This project was initiated in July, 1982 to address the constraint on peanut utilization in SAT Africa. It was recognized during the planning of the Peanut CRSP that even though peanut is produced in developing countries, it is not considered as a primary food source. In addition, reliable information from most developing countries on the percentage of the peanut crop which is eaten directly as food is not available. Estimates from the Sudan, for example, range from 26 - 60%. The project objectives were developed to determine the current and potential dietary role of existing peanut products. Also, a survey was proposed to assess post-harvest practices that impact the supply of peanuts, including storage techniques and management techniques. An understanding of the environmental and socioeconomic constraints, as well as those of food preservation technology is needed if a sufficient cost effective, tasty, nutritious, and aflatoxin-free peanut is to be made available.

Host Country

The host country selected for this project was the Sudan based on the following considerations:

(1) The Sudan is the fourth leading country in peanut production after India, China, and the United States. Peanut is an important cash crop in the Sudan. It provides seven percent of the GNP and employs 12% of the population.

(2) Project objectives were discussed with the Sudanese scientists at the Food Research Centre (FRC). Sudanese scientists were interested in the project.

(3) Training and capabilities of the Sudanese scientists were adequate.

(4) Facilities at the FRC were adequate but needed additional equipment and materials.

(5) The FRC scientists had experience with a similar CRSP project on sorghum/millet.

(6) The project had a potential to enhance overall national research on groundnuts.

Project Organization

An interdisciplinary team of investigators was organized at Alabama A&M University. A similar team has been organized at the Food Research Centre. Even though the members of the team belong to three different units of the School of Agriculture at Alabama A&M, they have cooperated very well in development of the objectives and in preparation of the survey documents, research plan, field trips, and data analysis. Each has communicated and interacted well with the counterparts in the Sudan during their visits. At Alabama A&M, the team members have met once a week to review the progress since the implementation of the project.

Memorandum of Understanding (MOU)

The MOU and the research plan were approved and signed by the authorities since June, 1983.

Trips

The following trips have been made to the Sudan and FAO:

(1) Planning Trip - February, 1982) Just after the planning phase was completed, a trip was made to the Sudan by Dr. B. Singh to discuss objectives of the research and to make plans for implementation of the project. The major accomplishment of the trip was the assessment of the

needs to implement the research plan. During this trip, it was realized that, in addition to the work on product development and post-harvest handling, aflatoxin research needed to be included in the project.

On the return trip a stop was also made at the FAO, Rome, to consult and to collect information on the Sudan. Members of the Food and Nutrition Group provided information on aflatoxin work and on several consumption surveys in the SAT Africa.

(2) Planning of the Survey (May - June, 1983) The team included Drs. B. Singh, G. C. Wheelock, H. Jones, and Virginia Caples. The team members planned the strategy to survey three locations to collect information on consumption and post-harvest handling of peanuts with the Sudanese scientists. The survey instruments were discussed with the Sudanese counterparts.

The team also visited the FAO, Rome to consult and to collect additional information.

(3) Trip to Conduct Survey (Jan, 1984) This trip was made to conduct survey at three locations. The team members included were Drs. B. Singh, G. C. Wheelock, H. Jones, and Virginia Caples. The team members, along with Sudanese counterparts, completed the survey. Also, they carried with them computer equipment and various analytical instruments and materials for research.

(4) Trip to Assist in Data Analysis and Laboratory Establishment (August, 1984) Drs. B. Singh, G. C. Wheelock, and J. C. Anderson travelled to the Sudan in August, 1984. They completed set-up of computer equipment and assisted in data analysis. Also, research was planned for product improvement and innovations for storage and post-harvest handling.

Future Trips A trip is being planned to visit the Sudan in August, 1985.

Collaborator Visits to the USA Drs. H. Ishag and B. Bashir will be visiting the U.S. in the Summer of 1985.

Benefits to the Sudan

The project has developed interest in the peanut research at the FRC. The Sudanese scientists have been involved in planning and in research at all phases of the project.

The FRC is developing capability to process data on computers, to conduct research on aflatoxins, to conduct survey and assess needs for research on peanuts, to conduct research on product development and improvement of storage and post-harvest handling of peanuts.

Benefits to Alabama A&M University

Since the implementation of the project, Alabama A&M University has developed research projects on aflatoxin in peanuts, product development from peanuts, and survey data analysis.

Faculty members from the School of Agriculture have enhanced their experience by the visits and their direct involvements in the host country programs.

The Departments of Food Science, Agribusiness, and Home Economics have benefited from the project in many ways. The Department Chairpersons have taken keen interest in the project and they consider that the project has directly contributed to the professional development of the faculty members.

Accomplishments

- (1) Lab capabilities at the FRC have been improved (Ref. list of equipment and materials).

- (2) The survey has been completed at three sites (Ref. Annual Report-1983).
- (3) The product development work has been started. It was concluded from the survey data that the peanut paste is utilized by most substantial portion of Sudanese; however, it needs to be improved in many respects. A plan of research has been proposed.
- (4) Further research has been planned to collect additional information on post-harvest handling of peanuts.
- (5) Significant results (See Tables 1 - 6).

Current Research Activities

- (1) Survey data analyses
- (2) Plan of research on peanut paste
- (3) Plan of research on post-harvest handling of peanuts

Training

Two Sudanese students will be arriving in June, 1985.

Three students from the U.S. are working on the Peanut CRSP related project:

- (a) Aflatoxin - (1) (B. Singh, Adviser)
- (b) Product Development - (1) (B. O. Okezie, Adviser)
- (c) Data Processing & Interpretations - (1)(G.C.Wheelock, Adviser)

Collaborations - Scientists are cooperating well on every phase of the project.

Administrative Support

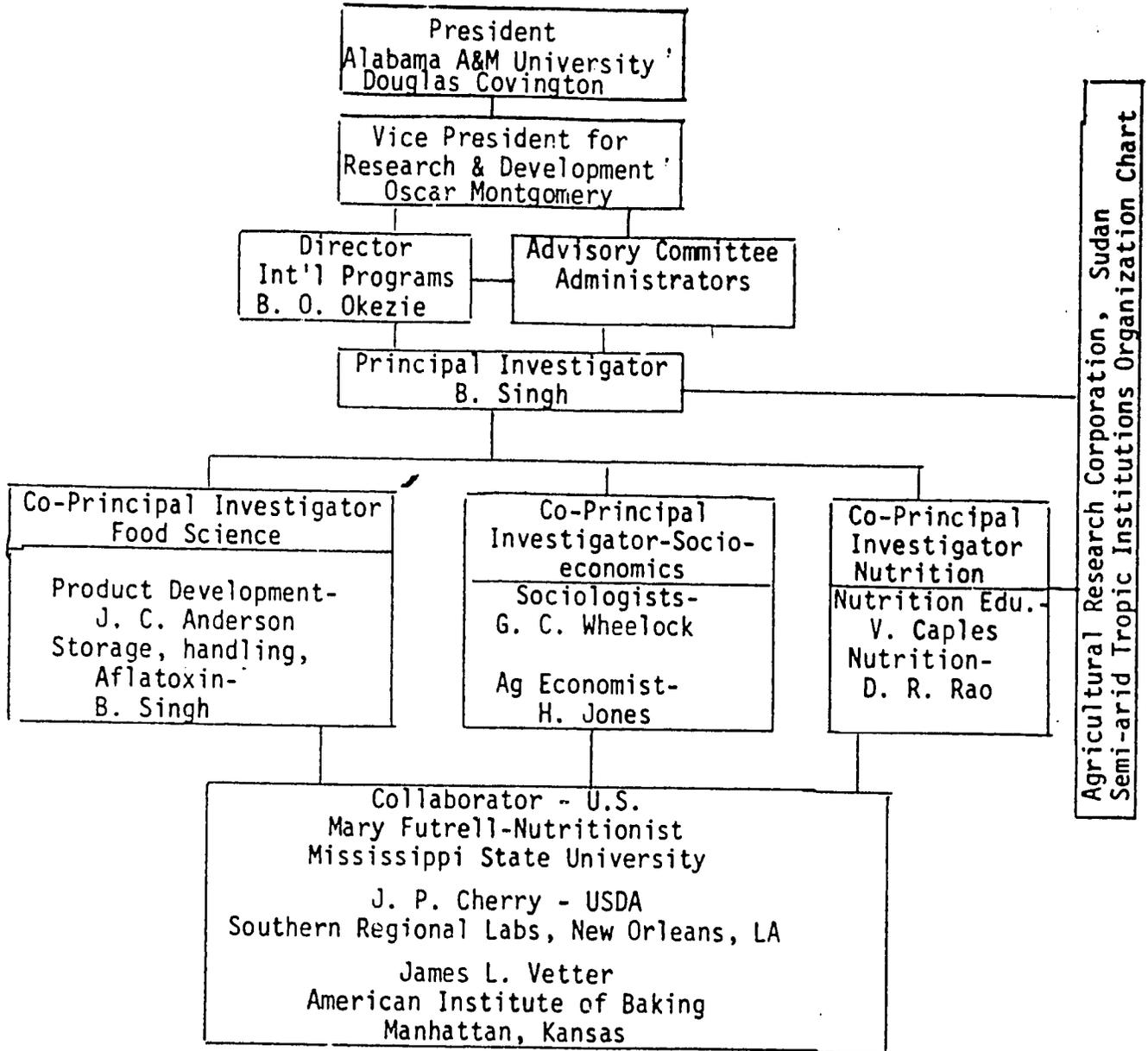
There has been very good support from the administration at Alabama A&M University, the Food Research Centre, and from the USAID Mission in Khartoum.

TITLE: AN INTERDISCIPLINARY APPROACH TO OPTIMUM FOOD
UTILITY
OF PEANUT IN SAT AFRICA

HOST COUNTRY: DEMOCRATIC REPUBLIC OF THE SUDAN
FOOD RESEARCH CENTRE
AGRICULTURAL RESEARCH CORPORATION

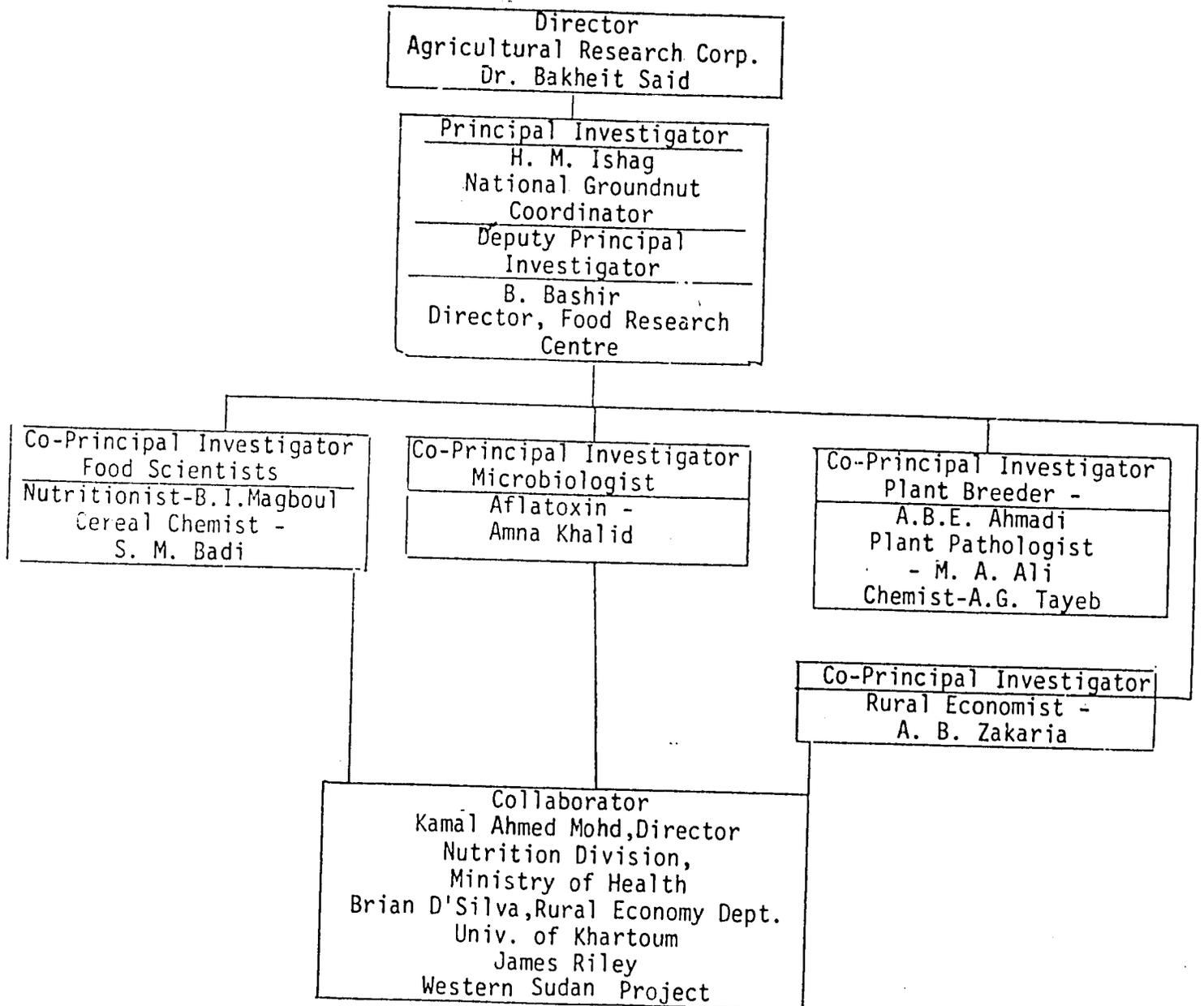
Alabama A & M University
Peanut CRSP

Organizational Chart



Agricultural Research Corporation, Sudan
Peanut CRSP

Organizational Chart



CO-INVESTIGATORS

DR. JOHN C. ANDERSON, FOOD SCIENTIST

DR. D. R. RAO, FOOD SCIENTIST

DR. G. C. WHEELLOCK, AGRIBUSINESS

DR. H. S. JONES, AGRIBUSINESS

DR. VIRGINIA CAPLES, HOME ECONOMICS

- .Peanut is an important cash crop in the Sudan.
 - .It provides 7% of the GNP and employs 12% of the population.
 - .Sudan is the fourth leading country in peanut production after India, China, and the U. S.
 - .60% of the peanut is converted to peanut oil.
 - .Peanut meal is exported.
-

OBJECTIVES

- A. Description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies.
 - B. Analysis of the current and potential dietary role of existing peanut products.
 - C. Research on the improvement of existing peanut products and the development of new products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.
 - D. Ensurance of safety of the products with particular reference to mycotoxins in raw and finished products, and
 - E. Exchange of peanut germplasm for breeding resistant varieties to aflatoxin.
-

SIGNIFICANT OUTCOMES

1. LINKAGES BETWEEN ALABAMA A & M UNIVERSITY AND LDC RESEARCH PROGRAMS WILL BE ESTABLISHED THAT WILL LEAD TO LONG-TERM COLLABORATIVE STUDIES, RESEARCH AND DEVELOPMENT OF PEANUT-BASED FOOD PRODUCTS.
2. CONDITIONS TO STORAGE, PRESERVATION AND UTILIZATION OF PEANUT TO PROMOTE IMPROVED NUTRITION IN RURAL POPULATIONS WILL BE DEFINED.
3. IMPROVED AND INNOVATIVE MEANS OF STORAGE, PRESERVATION AND PREPARATION FOR CONSUMPTION OF PEANUTS MAY BE INTRODUCED.
4. THE MOST VULNERABLE POPULATIONS MAY HAVE INCREASED AND PROLONGED OPPORTUNITIES TO BENEFIT FROM PEANUT CONSUMPTION.
5. IMPROVED AND INNOVATIVE PEANUT PROCESSING TECHNOLOGIES TO ALLOW INCREASED EFFICIENCY OF WOMEN IN FAMILY FOOD PREPARATION AND/OR ALTERNATIVE INCOME GENERATING ACTIVITIES WILL BE IDENTIFIED, E.G., PEANUT-BASED FOODS AS A COTTAGE INDUSTRY PRODUCT FOR SALE.
6. PUBLISHED RESULTS OF THE PROJECT BY RESEARCH PERSONNEL IN ALL COUNTRIES INVOLVED CAN BE USED IN DEVELOPING PROJECTS IN OTHER COUNTRIES WITH SIMILAR PEANUT CONSUMPTION PATTERNS.
7. MEMBERS OF COUNTERPARTS IN THE LDCs WILL HAVE AN ADDITIONAL OPPORTUNITY TO IMPROVE SKILLS IN ALL AREAS OF THE PROJECT

EXPERIMENTAL PLAN

A. LINKAGE: ALABAMA A & M UNIVERSITY
UNIVERSITY OF SUDAN & ARC

B. SELECTION OF AREAS:

THREE SAMPLE POPULATIONS

- I) AN URBAN SAMPLE
- II) A REMOTE BUT MODERATE RAINFALL VILLAGE
- III) AN ACCESSIBLE BUT LOW RAINFALL VILLAGE

C. DATA COLLECTION:

1. SOCIOECONOMIC AND NUTRITION

A MINIMUM OF 80-100 HOUSEHOLDS PER VILLAGE

- SOME PARAMETERS: AMOUNTS AND KINDS OF FOODS CONSUMED
- : AMOUNTS AND TYPES OF PEANUT FOODS
CONSUMED DAILY/WEEKLY/MONTHLY/SEASONALLY
 - : INTRAFAMILY CONSUMPTION PATTERNS
 - : IMPACT OF THE ROLE OF WOMEN ON THE
PEANUT INTAKE
 - : COST AND PREFERENCE CONSTRAINTS
 - : SOURCE OF PEANUTS FOR FAMILY
 - : TYPES OF FATS CONSUMED
 - : AMOUNT OF OIL CONSUMED
 - : FOOD PREPARATION METHODS

PEANUT AND PEANUT PRODUCT SURVEY AND ANALYSIS

AT HARVEST TIME THE FOLLOWING DATA WILL BE COLLECTED:

A. INITIAL QUALITY EVALUATION

- I) DEGREE OF MATURITY
- II) MOLD CONTAMINATION
- III) RESIDUE OF INSECTS AND INSECT FRAGMENTS
- IV) OTHER RELEVANT INFORMATION

B. PROTEIN AND CALORIES EVALUATION

- . CRUDE PROTEIN
- . CARBOHYDRATES
- . CALORIES

C. AFLATOXIN - LEVEL OF CONTAMINATION WILL BE
DETERMINED

IMPROVEMENT/MODIFICATION IN PROCESSING OF PEANUTS

1. SHELLING OF PEANUTS
2. STORAGE FACILITIES
3. PROCESSING
4. UTILIZATION OF PEANUT PROTEIN FOR FORTIFICATION
5. PRODUCTION OF NEW ACCEPTABLE FOODS

.Consumption survey document includes questions:

- {a} Amount and type of peanut food consumed;
 - {b} Intra-family consumption patterns;
 - {c} Impact of the role of women on peanut intake;
 - {d} Cost and preference constraints;
 - {e} Source of peanut for family;
 - {f} Amount of peanut oil consumed;
 - {g} Food preparation methods.
-

POST-HARVEST SURVEY

- .Degree of maturity at the time of harvest;
 - .Post-harvest handling: harvesting, transportation, storage;
 - .Mold contamination;
 - .Residue of insects or insect fragments.
-

URBAN POPULATIONS WERE STRATIFIED
 INTO LOW INCOME, MIDDLE INCOME,
 AND HIGH INCOME

	<u>Khartoum North</u>	<u>Omdurman</u>	<u>Khartoum</u>
Low Income	Shambat	Al Kabbagab	Fallata
Middle Income	Al Shaabbia North	Hai Nubbawi	Al Hilla, Al Saggana
High Income	Al Shabbia South	Hai Al	Al Ammarat Mollazmean

.Peanut samples collected from each household from the rural area and from the market.

.In the urban areas.

.Proximate compositions.

.Aflatoxins.

Survey Sites

Khartoum - Urban

El Obeid - Urban

El Obeid - Rural

Wad Medani - Rural

Sample Size: A minimum of 100 households.

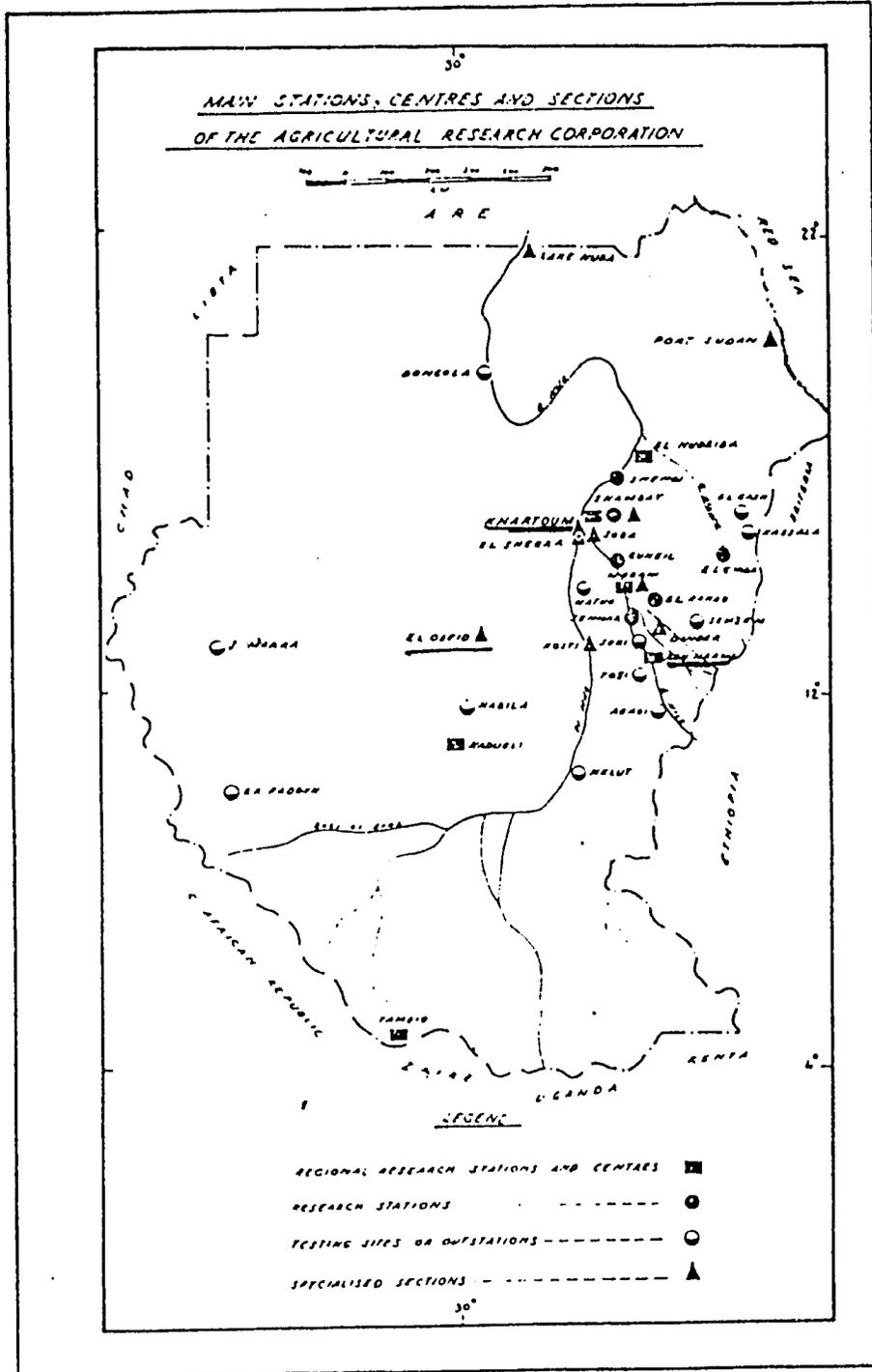


Figure 1.

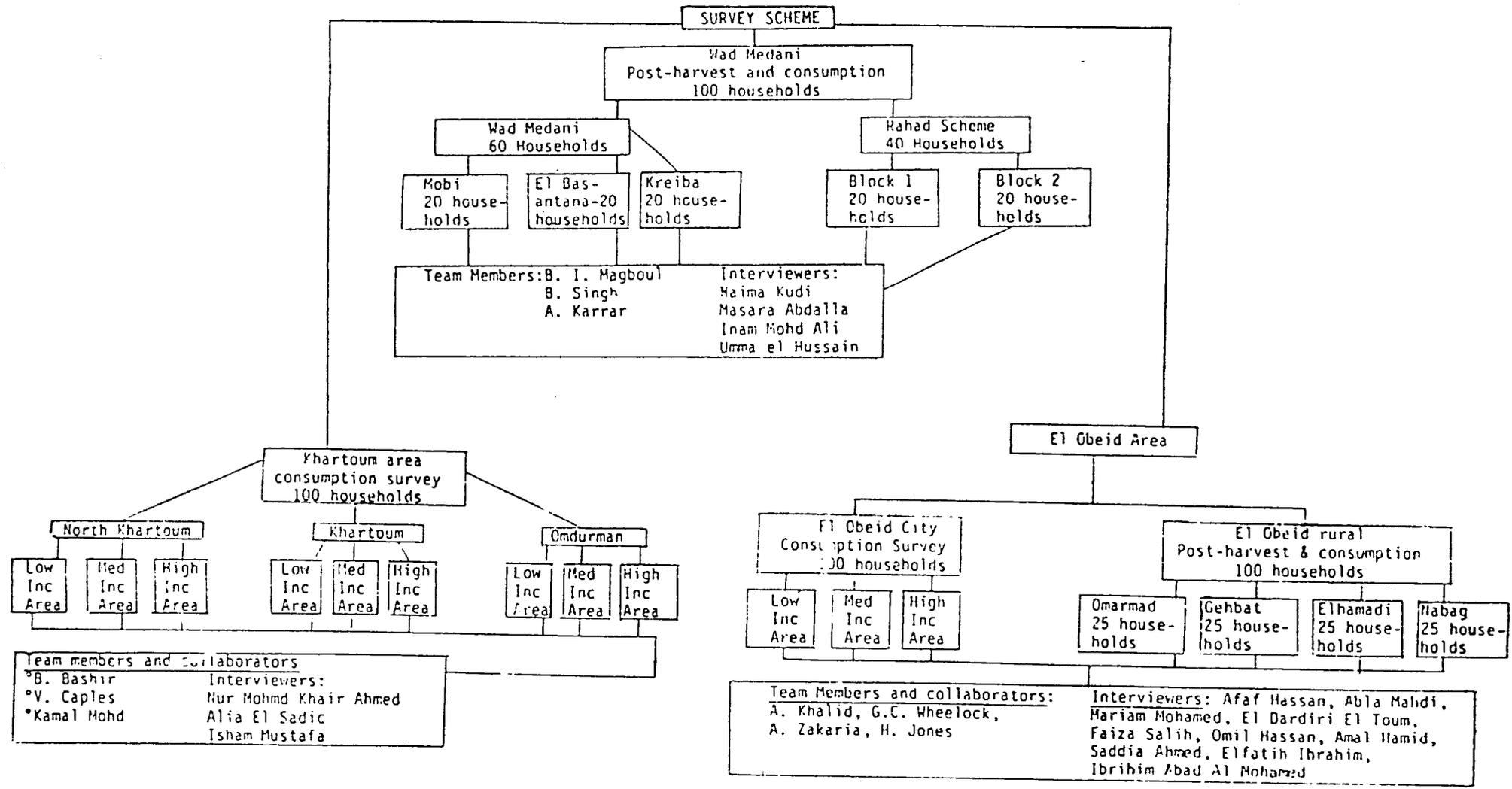


Figure 1. Scheme of survey of post-harvest handling, storage, and consumption of peanuts in the Sudan

.Peanut samples collected from each household from the rural area and from the market.

.In the urban areas.

.Proximate compositions.

.Aflatoxins.

Forms of Peanut Products Used

1. Roasted;
 2. Ground or paste;
 3. Peanut Oil;
 4. Raw;
 5. Boiled.
-

Table HOUSEHOLD CHARACTERISTICS - KHARTOUM AND WAD MEDANI

SAMPLE STATISTICS	FAMILY SIZE	AGE OF HEAD	YRS. OF EDUCATION		GROSS INCOME
			MALE	FEMALE	LS.
MEAN:					
KHARTOUM	8	48	8	5	7085
WAD MEDANI	6	49	2	0	1414
MEDIAN:					
KHARTOUM	8	49	6	4	5700
WAD MEDANI	6	50	0	0	850
MINIMUM:					
KHARTOUM	2	20	0	0	900
WAD MEDANI	2	20	0	0	40
MAXIMUM:					
KHARTOUM	17	95	16	16	48000
WAD MEDANI	13	97	12	4	8500
NUMBER:					
KHARTOUM	66	66	66	66	66
WAD MEDANI	98	97	94	9	97

TABLE 1. PROPORTION OF HOUSEHOLDS USING PEANUTS
IN VARIOUS FORMS

FORM	KHARTOUM (N=100) (%)	WAD MEDANI (N=99) (%)	EL OBEID (N=100) (%)	EL OBEID (N=100) (%)
1. ROASTED	71	71	86	84
2. GROUND OR PASTE	52	84	75	57
3. PEANUT OIL	31	92	-*	-*
4. RAW	11	10	34	44
5. BOILED	5	59	31	69

* DATA NOT AVAILABLE.

TABLE 2. HEDONIC RATINGS OF PEANUT PRODUCTS RANKED FIRST PREFERENCE.

PRODUCT	RATINGS									
	9 - 10		7 - 8		5 - 6		3 - 4		1 - 2	
	N	%	N	%	N	%	N	%	N	%
RAW	0	0	2	2	0	0	1	2	2	8
BOILED	6	5	9	10	9	10	7	16	0	0
ROASTED	8	7	19	21	29	33	5	12	6	25
FRIED	2	2	0	0	0	0	0	0	0	0
GROUND	53	44	22	24	27	30	18	42	9	38
PEANUT BUTTER	19	16	0	0	0	0	0	0	0	0
CANDY	1	1	2	2	1	1	0	0	3	13
INGREDIENTS	19	16	30	34	22	25	11	26	4	17
PEANUT OIL	1	1	3	3	1	1	0	0	0	0
OTHER	12	10	2	2	0	0	1	2	0	0
TOTAL*	121	33	89	24	89	24	43	12	24	7

*TOTAL CASES = 366; MISSING CASES = 34.

SIGNIFICANT POINTS

1. ROASTED PEANUTS ARE USED MOST COMMONLY IN BOTH RURAL AND URBAN POPULATIONS OF THE SUDAN. OF COURSE, MORE ROASTED PEANUTS ARE USED IN THE EL OBEID AREA THAN EITHER WAD MEDANI OR KHARTOUM.
2. MORE PEANUT OIL IS USED IN THE WAD MEDANI AREA THAN IN THE KHARTOUM AREA.
3. GROUND PASTE IS COMMONLY USED, HOWEVER, IN THE WAD MEDANI AREA. IT IS USED MORE COMMONLY THAN IN THE EL OBEID AREA.
4. BOILED PEANUTS ARE USED MORE IN THE RURAL AREA THAN IN THE URBAN AREA.

Table . PREFERRED PEANUT PRODUCTS FREQUENCY OF
 CONSUMPTION AND RANK AMONG ALL FOODS
 (CENTRAL TENDENCY AND RANGES)

	NUMBER OF TIMES/MONTH PEANUTS EATEN IN PREFERRED FORM		RANK AMONG ALL FOODS	
	KHARTOUM	WAD MEDANI	KHARTOUM	WAD MEDANI
MEAN	10	10	6	7
MEDIAN	8	8	7	8
MODE	8	10	5	10
n	65	80	65	89
MINIMUM	0	1	0	1
MAXIMUM	30	30	10	10

REASONS FOR NOT CONSUMING MORE PEANUTS

REASON	N*	(%)
Enough (I think I consume enough)	58	21
Costly (Can't afford more)	63	23
Habits (Never get around to using)	17	6
Health (Allergy & other concerns)	51	19
Dislike (Just don't like)	33	12
Sleepy/Climate	2	1
Digestion problems specific	13	5
Other-Response indicated but not Available	22	8
Like With Other Foods	12	4
Supply (Not available)	3	1

*Total 274 cases, 126 did not respond.

MONTHLY ACQUISITION OF PEANUT PRODUCTS
IN KHARTOUM (N=100)

Product	Quantity	Frequency
Roasted Peanuts	0.01 - 2 Kg	26
	2.01 - 4	16
	4.01 - 8	16
	8.01 - 15	2
	None or not responded	40
Peanut Paste	0.01 - 2 Kg	10
	2.01 - 8	10
	8.01 - 30	6
	None or not responded	71
Peanut Oil	0.01 - 10 bottle	23
	10.01 - 20	21
	20.01 - 30	5
	30.01 - 40	5
	None or not responded	46
Peanut Butter	0.01 - 10	15
	10.01 - 60	2
	None or not responded	83

POST-HARVEST SURVEY RESULTS (WAD MEDANI)

1. Planting dates - Based on 90 responses, most farmers planted peanuts in June (71%). However, the planting date generally varied from May until July.
2. Area planted ranged from 0.5 to 12 feddans with 5 feddans both mode and median.
3. The yield of peanuts is not significantly affected by the planting date. The yield varied from 1 - 42 sacks/feddan. The mode was 9 sacks/feddan.
4. The seeding rate (amount of seeds/area) affects the yield: low seeding rates resulted in lower yield. Moderate seeding rates resulted in moderate to higher yields.
5. Rahad Scheme farmers received seeds from the government; however, they did not obtain higher yields. Other farmers generally used their own seeds or other private suppliers.
6. Rotation did not seem to have significant effect on the yield of peanuts.
7. Intercropping did not have significant effect on the yield.
- 8.(a) Weeding - Weeding was practiced.
(b) First weeding - generally completed within 4 weeks after planting (mode is 3rd week).
Second weeding- 4-8 weeks after planting (mode is 4-5th week).
Third weeding - 6-12 weeks after planting (mode is 7-9th week).
(c) Time until the first weeding did not seem to influence the yield.
Second weeding earlier than 4-7th weeks resulted in lower yields.
Third weeding before the 12th week resulted in moderate to high yields of peanuts.
9. The harvest dates did not influence the yield.
10. The area harvested when limited to 6 or less feddans was correlated to higher yields. Areas greater than 6 feddans seemed to yield lower amounts of peanuts.
11. Larger amounts of peanuts sold correlate to higher prices received.
12. Storage problems:
(a) No effect of harvest date was recognized.
(b) Problems of storage: Most were not aware of the problems (59%). 3% reported insects as the problem, and 28% reported rodents as the problem.
(c) None reported problems due to mold contamination or aflatoxin.

<R> VAR.# TO BE DISTRIBUTED 4
 IS #2A CODED WITH MISSING DATA VALUES (Y/N)Y
 <R> MISSING DATA CODE-99
 MIN = .5 MAX = 12
 <R> NUMBER OF INTERVALS <=40 13
 ENCODE #2A WITH INTEGER INTERVALS (Y/N)Y

 HISTOGRAM OF VARIABLE #2A: AREA PLANTED



X AXIS BAR WIDTH = 1

 FREQUENCY DISTRIBUTION OF #2A

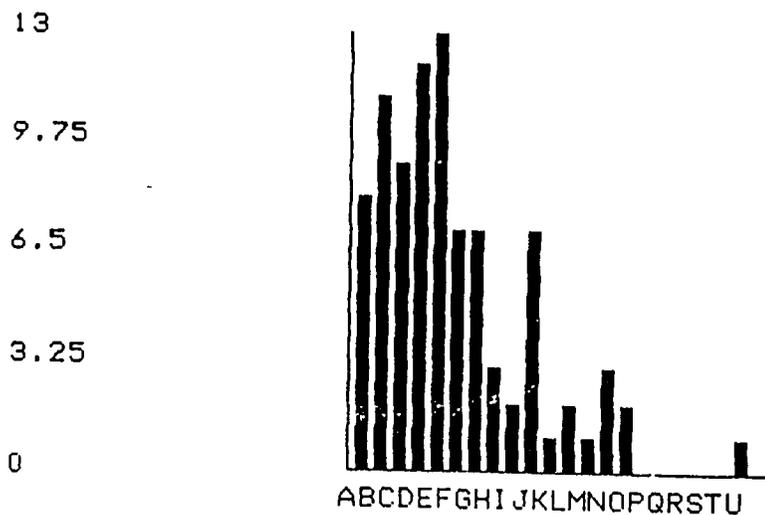
MIN = .5 MAX = 12

INTERVAL	FREQUENCY	RELATIVE %
A=: 0 -> .99	1	1
B=: 1 -> 1.99	7	7.6
C=: 2 -> 2.99	20	21.9
D=: 3 -> 3.99	5	5.4
E=: 4 -> 4.99	2	2.1
F=: 5 -> 5.99	45	49.4
G=: 6 -> 6.99	2	2.1
H=: 7 -> 7.99	1	1
I=: 8 -> 8.99	0	0
J=: 9 -> 9.99	0	0
K=: 10 -> 10.99	4	4.3
L=: 11 -> 11.99	1	1
M=: 12 -> 12.99	3	3.2

TOTAL MISSING = 0

% OF TOTAL CASES MISSING = 0

HISTOGRAM OF VARIABLE 7N/A (YIELD: SACKS/FEDDAN)



X AXIS BAR WIDTH = 2

FREQUENCY DISTRIBUTION OF 7N/A

MIN = 1 MAX = 42

INTERVAL	FREQUENCY	RELATIVE %
A=: 1 -> 2.99	8	8.8
B=: 3 -> 4.99	11	12.1
C=: 5 -> 6.99	9	9.9
D=: 7 -> 8.99	12	13.2
E=: 9 -> 10.99	13	14.3
F=: 11 -> 12.99	7	7.7
G=: 13 -> 14.99	7	7.7
H=: 15 -> 16.99	3	3.3
I=: 17 -> 18.99	2	2.2
J=: 19 -> 20.99	7	7.7
K=: 21 -> 22.99	1	1.1
L=: 23 -> 24.99	2	2.2
M=: 25 -> 26.99	1	1.1
N=: 27 -> 28.99	3	3.3
O=: 29 -> 30.99	2	2.2
P=: 31 -> 32.99	0	0
Q=: 33 -> 34.99	0	0
R=: 35 -> 36.99	0	0
S=: 37 -> 38.99	0	0
T=: 39 -> 40.99	0	0
U=: 41 -> 43	1	1.1

TOTAL MISSING = 2

% OF TOTAL CASES MISSING = 2.1

QUANTITY OF PEANUTS IN STORAGE ON FARM
WAD MEDANI (N=91)

Quantity per farm	Frequency (%)
.01 - 10 sacks	44
10.01 - 20 sacks	18
20.01 - 40 sacks	10
40.01 - 70 sacks	11
70.01 - 120 sacks	4
None	12

TABLE DISTRIBUTION OF SURVEYED HOUSEHOLDS ACCORDING TO INTENDED
DISPOSITION OF STORED PEANUTS (WAD MEDANI).
PURPOSE FOR WHICH PEANUTS ARE STORED

	Home		
	Consumption	Sale	Seed
Number of Households	72	82	81
Percent of Households	73	83	82
Minimum Sacks (100 lbs)	0	0	0
Maximum Sacks	25	140	28
Average	3.34	37.65	4.17
Standard Deviation	4.50	28.84	3.89

Plans for 1984

1. Analysis and interpretation of survey data.
2. Analysis of peanut and peanut products for aflatoxin contamination.
3. Analysis of peanut and peanut products for major nutrients in samples collected from the Wad Medani area and the El Obeid area.
4. Initiations of research on improvement of storage and handling of peanut during post harvest periods.
5. Initiation of research on improvement of existing food products.
 - (a) The existing method of processing for peanut pastes will be studied, and efforts will be made to improve the quality of the peanut paste.
 - (b) The product will be analyzed for nutrient content and also for contaminants such as extraneous matter (sand, silica, insect fragments), and protease inhibitors.
 - (c) The feasibility of developing a suitable packaging for the peanut paste will be studied.
 - (d) Acceptability of the improved peanut pastes will be determined.
 - (e) The socio-economic considerations of the improvement of the peanut paste production will be determined.
6. Initiation of research on development of new food products.

The objectives 4, 5, and 6 will be carried through 1985, 1986, and 1987. Further modifications will be made on the basis of progress in 1984-1985.

TRAINING PLAN

- . GRADUATE STUDENTS FROM SUDAN IN FOOD SCIENCE AND AGRIBUSINESS
- . VISIT AND SHORT COURSES IN PROCESSING

PEANUT COLLABORATIVE RESEARCH SUPPORT PROGRAM
(Peanut CRSP) AT ALABAMA A&M UNIVERSITY

The Peanut CRSP program is funded through "Title XII - Famine Prevention and Freedom from Hunger" under the International Development and Food Assistance Act of 1975, and the participating U. S. and host country institutions. In a USAID survey, peanut research in developing countries was rated highest priority, along with small ruminants, sorghum and millet, and bean/cowpea to improve the well-being of the small farmer in developing countries.

The Peanut CRSP was implemented July 1, 1982. Alabama A&M University is one of the four universities to participate in the Peanut CRSP activities. The other universities are: The University of Georgia, North Carolina State University, and Texas A&M University. The University of Georgia and Alabama A&M University were involved in planning the program through a planning grant awarded to the University of Georgia in August, 1980.

The purpose of the Peanut CRSP is to bring together the resources of LDC and U. S. institutions into a long-term collaborative research program to relieve constraints that would enable an increase in production and utilization of peanuts in the LDCs. Alabama A&M University was awarded the project related to the constraints affecting the utilization of peanuts for human consumption. The major objectives of the project are to determine the role of peanuts in the food supply and development of improved and new products. There are two projects at Alabama A&M:

(1) An Interdisciplinary Approach to Optimum Food Utility of Peanuts in SAT Africa: The host country for this project is The Democratic Republic of the Sudan. The total AID funds allotted for this project are \$668,228 for the period 1982 to 1986.

(2) Peanut Utilization in Food Systems in Developing Countries: The host countries for this project are Caribbean countries (through CARDI). The total AID funds allotted for this project are \$527,547 for the period 1983 to 1986. The University of Florida has been named as a subgrantee on this project.

The program at Alabama A&M University is administered through the Office of International Programs. Alabama A&M University is represented on the Board of Directors by Dr. B. Onuma Okezie, Director, Office of International Programs, and on the Technical Committee of the Peanut CRSP by Dr. B. Singh, Professor, Food Science.

The team of investigators is made up of personnel from the Departments of Food Science, Agribusiness, and Home Economics. They include:

Dr. B. Singh, Principal Investigator, Department of Food Science;

Dr. G. C. Wheelock, Agribusiness Education Department

Dr. H. Jones, Agribusiness Education Department

Dr. D. R. Rao, Food Science Department

Dr. J. C. Anderson, Food Science Department

Dr. V. Caples, Division of Home Economics

A team of investigators from Alabama A&M University has visited Sudan four times to develop a linkage with Food Research Centre in Khartoum, to plan research with the host country scientists, to participate in the survey, and to establish a laboratory to conduct food research. The data has been collected on consumption of peanuts in Sudan and has been analyzed to determine the area of research on peanuts. Two students from the Sudan will be attending Alabama A&M University to pursue graduate studies leading to an M.S. degree in Food Science from June 1, 1985. Materials and equipment to conduct research have been sent through the project to Sudan.

The linkage between Alabama A&M University and Caribbean countries has been finalized. A team of investigators from Alabama A&M has completed the

survey in Jamaica, Trinidad, and St. Vincent on the utility of peanuts. Further, research has been planned in collaboration with Alabama A&M, University of Florida, and the Caribbean countries.

AN INTERDISCIPLINARY APPROACH TO
OPTIMUM FOOD UTILITY OF PEANUTS
IN SAT AFRICA

Alabama A & M University

Research Proposal Submitted
to the
Peanut Collaborative Research Support Program

Title An Interdisciplinary Approach to Optimum Food Utility of Peanuts in SAT Africa

Proposed amount: \$122,534 (1982)

Proposed duration: 5 years

Bharat Singh
Principal Investigator (PI)

Alabama A & M University
Submitting Institution

Address of Principal Investigator:

Department of Food Science & Animal Industries
Alabama A & M University
Normal, Alabama 35762

Address of Submitting Institution:

Alabama A & M University
Normal, Alabama 35762

Name(s) of Co-Principal Investigator(s)
(U. S. Colleagues)

1. Name: Gerald C. Wheelock
Dept: Agribusiness
2. Name: John C. Anderson
Dept: Food Science

3. Name: D. R. Rao
Dept: Food Science
4. Name: Virginia Caples
Dept: Home Economics
5. Name: Hezekiah S. Jones
Dept: Agribusiness

Make grant to: Alabama A & M University
Name of Institution or Organization to which funding should be made.

IRS Number: 63-6001097

Congressional District No.: 5

Endorsement:

Principal Investigator

Name B. Singh
Title Professor
Phone No. (205) 859-7454

Date 7-1-81
Signature B. Singh

Institutional Administrative Official

R. D. Morrison
President
(205) 859-7222

R. D. Morrison 7/1/81

Dept. Head, Director, or other

Name Onuma Okezie
Title Director, International Programs
Phone No. (205) 859-7377

Date
Signature Onuma Okezie 7/1/81

C. A. Williams
Executive Vice President
(205) 859-7407

C. A. Williams 7/1/81

PROPOSAL SOURCE DOCUMENT

Principal Investigator(s) PI

First

Middle

Last

PI#1 Bharat Singh

PI#2 Gerald C. Wheelock

PI#3 John C. Anderson

Proposal No. (CRSP Use)

PI#1 Normal Al 35762 Department of Food Science
City State ZIP Department or street address

PI#1 (205) 859-7454 \$89,290 International Programs
Phone + area code Total requested Institute or subdivision of
(Direct & indirect) performing organization

PI#1 Alabama A & M University
Name of performing organization

Institutional Administrative Official

R. D. Morrison
First Name Middle Last Name

(205) 859-3771 President, Alabama A & M University
Phone + area code Department or Organizational Unit

Normal Al 35762
City State ZIP

Alabama A & M University
Date received Grantee organization
(CRSP Use)

An Interdisciplinary Approach to Optimum Food Utility of Peanuts in SAT Africa
Title of Proposal

Special Considerations

Check Appropriate statements. Supply additional information when necessary.

- X "This project does not involve human subjects."
- "This project involves human subjects. It was approved by the Institutional Review Board on _____. (is scheduled for review by the Institutional Review Board on _____. See DHEW regulations regarding the use of human subjects, appearing in Title 45, Code of Federal Regulations, Part 46, Subtitle A.
- X "This project does not involve recombinant DNA research."
- "This project involves recombinant DNA research. It was approved by the institutional Committee on _____. (Supply appropriate documents as required by "NIH Guide for Grants and Contracts," Vol. 6, No. 19, October 17, 1977 or subsequent revision thereto)."

Principal Investigator Assurance

"The undersigned agrees to accept responsibility for the scientific and technical conduct of the research project and for provision of required progress reports if a grant is awarded as the result of this proposal."

6.30.81
Date

B. Karabish
Principal Investigator

Certification and Acceptance

(To be signed by Authorized Official of Submitting Organization)

"The undersigned certifies that, if a grant is awarded, the above-listed organization will make available the necessary facilities, equipment, services, and personnel to conduct the project substantially as outlined in the proposal or such modifications of as may be mutually agreed and accepts the obligation to comply with the Guidelines of the Joint Research Committee (JRC) of the Board of International Food and Agricultural Development (BIFAD)

R. D. Morrison
(Signature)

R. D. Morrison, President
(Typed Name and Title)

7/1/81
(Date)

TABLE OF CONTENTS

TITLE PAGE i
PROPOSAL SOURCE DOCUMENT ii
SPECIAL CONSIDERATIONS iii
PROPOSAL SUMMARY iv
PROJECT DESCRIPTION
 I. Location of Proposed Activity 1
 II. Introduction. 2
 III. Rationale and Significance. 6
 IV. Experimental Plan 8
 V. Training Plan 13
 VI. Facilities and Equipment. 14
REFERENCES FOR PROJECT DESCRIPTION 16
ORGANIZATIONAL CHART 19
TIME TABLE 20
BUDGET 21
VITAE AND PUBLICATION LISTS

Brief description of personnel and activities they will perform in the LDC's

Peanut storage, processing, product improvement and development:

B. Singh
J. C. Anderson
B. Auclair
B. O. Okezie

Nutrient intake survey:

D. R. Rao
V. Caples
B. Auclair

Family Peanut supplies, economic and social determinants:

G. C. Wheelock
H. Jones

Resource Personnel:

Mary Futrell	-	Nutrition/Home Economics
J. P. Cherry	-	Protein Chemist, USDA, Southern Regional Laboratory, New Orleans, Louisiana
J. L. Vetter	-	Research Director, American Institute of Baking, Manhattan, Kansas
J. M. Aguilera	-	Food Engineer, Protein Food Research and Development Center, Texas A & M University, College Station, Texas

Additional ongoing activities of the principal investigator(s) and/or institution that may be of interest to collaborating LDC scientists or institutions.

Principal investigator, Dr. B. Singh, is involved in all phases of research on processing of cereals and legumes. Additionally, he is engaged in research on utilization of agricultural residues, toxic constituents of plant foods; and development of ingredients for improvements of cereal foods, especially sorghum-based diets. Dr. J. C. Anderson is working on engineered food products from cereals and legumes. Dr. D. R. Rao has programs on nutritional research especially effects of fermented foods on nutritional status. Dr. V. Caples has extensive experience in nutrition education. Dr. G. C. Wheelock is engaged in a five-year Southern Regional Research project on Income Inequality and resource utilization of rural residences (RR1). Dr. H. Jones is initiating a regional project on small farm management in the southeast. Dr. B. O. Okezie, Director of the International Programs, is involved in research on food proteins.

Summary of Proposal
for the
Peanut Collaborative Research Support Program

Principal Investigator and Department

Bharat Singh, Food Science & Animal Industries

Institution and Location

Alabama A & M University, Normal, Alabama

Co-Principal Investigator(s) and Department

Gerald C. Wheelock, Agribusiness

John C. Anderson, Food Science & Animal Industries

Summary

The project proposes to initiate a collaborative interdisciplinary research and development program on peanut utilization for human consumption between Alabama A & M University and LDC scientists serving peanut producing and consuming populations of the SAT regions of Africa, especially Nigeria and Sudan. Initial steps will involve development of linkages between LDC institutions and Alabama A & M University. Alabama A & M University's team will consist of food scientists, a rural sociologist, nutritionists and an agricultural economist and will derive its strength on previous experiences with small farmers domestically, as well as in LDC's. Dr. Mary Futrell of Mississippi State University, who spent two years at Ahmadu Bello University, will be assisting the project as a consultant. Additional resource persons who have expressed willingness to collaborate are from the USDA, American Institute of Baking and other universities.

The objectives of the project include: a) description and understanding of variations in environment, socioeconomics and food technologies as they constrain the preservation and utilization of peanut supplies; b) analysis of the current and potential dietary role of existing peanut products; and c) research on the improvement of existing peanut products and the development of new peanut products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost. In proposing these objectives, it is assumed that LDC scientists and participants will fully participate in coordination, implementation, and evaluation of the research. Implied in the proposal is the realization that to LDC populations, the change most desired in food consumption is a reliable and adequate supply of the traditional diet. This emphasis will effect development of research capabilities sensitive to research needs of the region, specifically research on optimizing food utility of the peanut.

PROJECT DESCRIPTION

AN INTERDISCIPLINARY APPROACH TO OPTIMUM FOOD UTILITY OF PEANUTS IN SAT AFRICA

I. LOCATION OF PROPOSED ACTIVITY

We propose to focus our activity in Semi-Arid Tropical areas of Nigeria and Sudan where peanuts are traditionally produced. Ahmadu Bello University, located in the peanut basin of Nigeria, will be approached to collaborate for the initial food intake and community survey to assess peanut food utilization. Subsequently, we anticipate to obtain parallel information from selected communities in Sudan through appropriate collaboration with the University of Sudan (facilities in Khartoum and Western Sudan). Following the data collection, research in peanut storage and product processing will be pursued with either the University of Ife or the University of Ibadan in Nigeria which have Food Science Research capabilities and facilities.

Through recent site visits and communications, Dr. Nathaniel O. Ejiga and Dr. Olukasi and Mrs. Abigail Olantunde were identified as possible collaborating scientists with a keen interest and awareness of peanut utilization. Dr. Banigo of the University of Ibadan and Dr. Oneyemi of the University of Ife are identified as potential collaborators in food science. Also Dr. Joseph Alao, Chairman of the Department of Rural Sociology and Extension Education, University of Ife, will be a Visiting Professor at Alabama A & M University during the 1981-82 academic year and will be consulting with the Peanut CRSP scientists. Dr. Mary Futrell of the Mississippi State University has agreed to serve as a consultant having spent two (2) years at Ahmadu Bello University helping set up the Home Economics Department. She also is currently involved in the Grain Sorghum/Pearl Millet CRSP.

In Sudan, collaboration will be sought with the University of Hartom and with the Agricultural Research Corporation, Food Research Centre, and the University of Kentucky faculty involved in the Sorghum/Millet CRSP in the Western Sudan.

While this proposal unit stands on its own merit, linkage points for collaborative work with other proposal units are obvious. In particular, this food science proposal unit for the semi-arid tropics of Africa anticipates linkage with the mycotoxin proposal unit and the socioeconomic proposal unit. Also, inter-regional linkages between this proposal unit, the Southeast Asian (Thailand-Philippines) proposal units, and the CARICOM proposal units are also anticipated. It is understood that the details of these linkages are to be worked out through the management entity in the implementation phase of the Peanut CRSP.

II. INTRODUCTION

A. Statement of the Problem:

Inequality in the distribution of balanced diets in most LDCs is quite evident. This is not only because of unequal availability of calories and proteins due to maldistribution of production resources, but also as a result of inequalities in annual income, losses in storage, lack of efficient distribution systems, and poor nutrition education. Peanuts are grown extensively in Nigeria, Sudan and other African countries (Misari et al., 1980; Ishag et al., 1980; Bolton, 1980) and are considered an important and economical source of protein and calories. It has been demonstrated that aflatoxin-free peanuts and peanut products can easily be incorporated into daily diets for improvement of protein and calories in underdeveloped countries (Parpia, 1969). However, peanut utilization in common dishes of Nigeria and Sudan have been limited by various constraints including those listed above.

56

There are some distinct advantages in utilizing peanuts over other major oilseeds (Lusas, 1979). It can be prepared in many food forms with only simple roasting and grinding processes. Peanut products are pleasantly flavored and do not require severe refining (Lusas, 1979). With peanuts, it is not necessary to first extract and purify protein, oil and carbohydrates for later recombination into compounded foods. However, about 60% of peanuts harvested outside the United States are crushed for oil, while 70% of the U.S. crop is used for food purposes (Woodruff, 1966; USDA Foreign Agricultural Service Report, 1977). Tolman et al. (1981) observed that fats from peanut oil are more readily absorbed than from whole peanuts or peanut butter. Peanut protein by itself may be better digested as well. Before recommending changes in peanut consumption habits, food science research should examine the utility of existing practices. Oyenuga (1968) has discussed the various possible uses of peanuts and its by-products in Nigeria. Most are crushed for oil and the residual cake is rich in protein and provides valuable human and livestock food. Peanut flour can be made by milling the cake and this can be used as an ingredient in soups, stews, sauces, sweets, confectionaries, puddings and bakery products. The most valuable product is edible oil which is used for cooking, especially in Northern Nigeria. Other uses are for lighting, a basis of pomade, soaps and cosmetics, salad oil, and in the manufacture of margarine.

In spite of considerable technical knowledge about the preservation of peanut supplies, the decline in peanut production in Nigeria is greatly amplified by losses incurred at and after harvest, especially in storage (Misari et al., 1980). It has been pointed out that a peanut producer experiences 5-35% storage losses to his crop annually from insect pest attacks in Nigeria. Losses due to inadequate handling and adverse storage conditions have not yet been estimated in most LDCs. Peanuts are considered

to be semi-perishable (Woodruff, 1966). They may be held for five years under optimum conditions, but under unsuitable storage conditions they become inedible within a month due to mold, insects, discoloration, absorption of foreign flavors, staleness, or rancidity. In the United States, methods of storage and handling are well-defined. Woodruff and Heaten (1969) determined that peanuts placed in refrigerated storage as soon as properly cured were much more suitable for long term storage than those held at variable temperatures during the winter and placed in refrigerated warehouses in spring. Other conditions for better shelf-life include: 1) initial high quality, i.e., free of mold, insects, rancidity, and off-flavors; b) degree of maturity; c) time and temperature of curing and method of cleaning; d) the temperature in storage area; e) relative humidity; f) the contaminants in the storage area (insects, molds, odors, and g) packaging methods. Not all of these conditions are readily optimized in LDCs. There is a need to document the present methods of handling and storage and develop techniques to modify the present method to extend shelf-life of peanuts in rural areas. Participants of the Conference on Women and Food in 1978 at Tucson, Arizona cautioned that research efforts should not be purely technical, but that social, political and economic consequences must be assessed (Fisher, 1978).

Much is also known about commercial technology to process protein from peanut (Rhee, et al., 1976; Ahmed and Schmidt, 1979). The successful utilization of peanut proteins as ingredients of manufactured foods depends largely on such functional properties as solubility, foaming capacity, foam stability, emulsification capacity, whipability, binding ability, gelation, viscosity, water holding capacity and fat absorption. Considering all these qualities, peanut protein has been found to have very desirable properties. Beneficial functional properties of peanut protein ingre-

dients in the marketplace include: white color, bland flavor, high solubility, low viscosity, heat stability, aerating ability and compatibility with other ingredients (Jungman, 1978). These qualities seem to be poorly exploited in many LDCs.

Parpia (1969) outlined steps in processing peanuts and incorporating them as an ingredient in infant formulas. However, an observation of the situation in India clearly indicates that this technology has not yet been made quite acceptable to rural India. If such a product is truly desirable in LDCs, a more intensive marketing effort and a program of consumer education may increase cost-effective production and utilization of these products. However, Cloud (1973) pointed out that for people in the LDCs, the change most desired in food consumption is a reliable and adequate supply of the traditional diet.

In 1973, a workshop was organized to consider the impact of changing food consumption patterns on food production and marketing in SAT Africa, and to consider a systematic approach to food utilization based on nutrition, economics, aesthetic values, and production technology. There was an expressed concern to increase the use of local food to overcome regional shortages and achieve self-sufficiency. Another concern was the lack of knowledge of consumer preferences to hasten policy for development of local food processing industries, and to aid in the selection of the variety of grains to be grown.

In Senegal, domestic peanut supplies usually exceed 50 kilograms per capita per year but no study of the impact of peanuts upon the diet or health of the population is available (Wheelock, 1981).

Peanuts in combination with sorghum and millet are key food crops for many people of the semi-arid world. In Nigeria, over one million tons of peanuts were once produced for oil extraction and export. Now production is

not sufficient for consumption and Nigeria is a net importer of peanuts (U.S. Dept. of State, 1980).

B. General Goal:

To foster interdisciplinary (nutrition, food science, social and economic) institutional-based linkages between U.S. and LDC scientists serving major peanut producing and consuming populations of the Sahel region of Africa for the purpose of optimizing the food utility of the peanut.

C. Objective: Food Science Constraints:

Design and implement a research program to determine the food utility of the peanut for the semi-arid tropics (SAT) of Africa via:

1. description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies;
2. analysis of the current and potential dietary role of existing peanut products; and
3. research on the improvement of existing peanut products and the development of new peanut products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.

III. RATIONALE AND SIGNIFICANCE

- A. The goals and objectives of this proposal are consistent with the overall goals and objectives of the Peanut CRSP. Further support is found in the recommendations of the Conference on Women and Food (1978). In particular, it is recommended that "national food centers be established in developing countries using a multidisciplinary and fully participatory approach, to: coordinate, and if necessary, conduct research and continuing evaluation of all aspects of production, distribution, consumption, storage and preservation, household management, and community services (water supply, market facilities) with particular emphasis on women; advice on

nutritional policy and national food systems; and collect accurate vital statistics (morbidity/mortality)."

B. Three specific goals of this proposal may be justified as follows:

1. As demonstrated by past levels of production, the potential of adequate supplies of peanuts in SAT cultures is clear. Further understanding of the environmental and socioeconomic constraints, as well as those of food preservation and preparation technology, are needed if sufficient cost-effective, tasty, nutritious and aflatoxin-free supplies of peanuts are to be made available.

In addition to production technology, cultural practices which impact the supply of peanuts include storage techniques and inventory management systems. Increasing evidence of variation in technical efficiency are accumulating (Matlon and Newman, 1978 and Newman et al., 1979). If some families exhibit more efficient preservation of inventories and preparation of foods than others, documentation and understanding of their procedures would be useful to food scientists as well as extension programmers involved in upgrading household resource management.

2. The extent to which peanut supply actually constrains peanut consumption has not been fully documented. In northern Nigeria, Abalu and D'Silva (1979) report that analysis of nutritional balances on farms of 5 acres or larger are more than sufficient to meet minimum nutritional constraints. However, they have not compared actual balances with the computed balances. They say actual balances should be studied, particularly in the face of observations that some of the most serious debilitating diseases peak during the planting and growing season when food inventories are low (Longhurst, 1978).
3. Emphasis at the survey stage will be on the identification of existing efficient and more appealing products and procedures. Newer alternatives developed in the urban communities may represent acceptable improvements against the traditional or village processes. To quote the Summary Report of the Conference on Women and Food, development programs should allow "--local units to assess traditional technologies used locally, and improve these if appropriate, rather than bring in inappropriate exogenous technologies". Finally, given the possibility of significant breakthroughs in the supply of peanuts, research on new product development for larger urban markets will be indicated.

Again, the Conference on Women and Food speaks to this point: "--in recognition that one of the major barriers to improving the status of women and basic nutrition is absolute and increasing poverty of women, all appropriate development projects should be designed to increase women's access to improved income, preferably using traditional and indigenous means of production".

In sum, new food products should be designed to utilize and reward women's indigenous means of production if the research is to impact favorably the status of women and basic nutrition.

C. Significant outcomes of the proposed project:

1. Linkages between Alabama A & M University and LDC research programs will be established that will lead to long-term collaborative studies, research and development of peanut-based food products.
2. Conditions to storage, preservation and utilization of peanut to promote improved nutrition in rural populations will be defined.
3. Improved and innovative means of storage, preservation and preparation for consumption of peanuts may be introduced.
4. The most vulnerable populations may have increased and prolonged opportunities to benefit from peanut consumption.
5. Improved and innovative peanut processing technologies to allow increased efficiency of women in family food preparation and/or alternative income generating activities will be identified, e.g., peanut-based foods as a cottage industry product for sale.
6. Published results of the project by research personnel in all countries involved can be used in developing projects in other countries with similar peanut consumption patterns.
7. Members of counterparts in the LDCs will have an additional opportunity to improve skills in all areas of the project activities.
8. The project will enable Alabama A & M University as a minority institution to further strengthen programs in international food and agriculture.

IV. EXPERIMENTAL PLAN

A. Linkage:

A first step will be to establish collaborative research agreements with counterpart scientists in LDCs. The consultancy with Dr. Futrell will give us a chance for better coordination between Grain Sorghum/Pearl Millet CRSP and Peanut CRSP. Since the expected outcome of the peanut supply and intake data collection is a knowledge of social, economic and dietary determinants of peanut consumption, the team from Alabama A & M University will involve a cluster consisting of food scientists,

62

nutritionists, a sociologist, and an economist. Representatives of A & M's team will visit with the collaborators in the LDCs to work out detailed procedures.

B. Selection of areas:

Three sample populations are proposed for the peanut basins of both Sudan and Nigeria: an urban sample, a remote but moderate rainfall village and an accessible but low rainfall village. These samples should offer the opportunity of testing actual impacts and estimating potential impacts of peanuts and relatively high levels of consumption upon the diets of a large proportion of the population of SAT Africa.

C. Data Collection:

1. Socioeconomic and nutrition:

A minimum of 80-100 households per village randomly selected will be necessary to adequately represent three to five income levels. Interview schedules will be developed to include among other things; a) amounts and kinds of foods consumed daily; b) amounts and types of peanut foods consumed daily/weekly/monthly/seasonally; c) intrafamily consumption patterns; d) impact of the role of women on the peanut intake; e) cost and preference constraints; f) source of peanuts for family; g) types of fats (oils) consumed; h) amount of peanut oil consumed; and i) food preparation methods. Nutrient analysis of the peanut products may be necessary where the information is not available. The survey will be done twice for each community. One survey will be done at the end of the dry season, around March, and one survey at the end of the rainy season about September at which time there is an abundant supply of peanuts. A 24-hour recall method may be adequate for the daily food consumption pattern data. However, recall of longer periods (week/month/season) may be necessary for gathering data on peanut-consumption.

2. Peanut and peanut product survey and analysis:

At harvest time the following data will be collected to identify efficient existing methods, or to diagnose needed modification or development of a new system.

a. Initial quality evaluation:

i. Degree of maturity:

The data will be collected on the method of separating the nuts of different maturity stages.

ii. Mold contamination:

Evidence of mold may be determined visually but in cases of lesser levels of contamination other appropriate tools will be used to verify.

iii. Residue of insects and insect fragment:

It is desirable to assess the degree of possible infestation, presence of insect parts in pods and presence of insects in pods.

b. Sampling for analysis of protein and calories:

Samples will be collected to determine the amount of crude protein, carbohydrates and calories. This data will be of significance in two ways. First, to determine per acre yield of protein and calories. Secondly, it is desirable to have the data on variations in protein due to location and other variables to formulate suitable recipes. At the initial stage, it may be desirable to analyze these samples in the United States to obtain baseline data. However, if adequate facilities are available at the collaborating institutions, methods of determination should be adequately monitored. A graduate student in Food Science may perform these analyses as a part of his/her thesis problem using standard AOAC method (1975).

c. Aflatoxin:

One of the major constraints of peanut utilization is aflatoxin. Samples will be collected and the level of aflatoxin will be determined.

The samples will be derived from the freshly harvested peanuts, shelled peanuts, peanuts stored in traditional storage facilities and foods derived from peanuts. It is proposed that a simplified procedure using solvent extraction and thin-layer chromatography will be introduced. Currently available methods of monitoring aflatoxins in the USA could easily be adopted in LDCs.

d. Storage:

The data on temperature, humidity, method of packaging, during transportation and storage is necessary. Samples will be taken to assess the losses during handling and storage. Data on losses of protein and calories during storage will be collected. Identification of economically and technically efficient storage will be useful in recommending modification of the storage facilities and storage practices.

D. Analysis and Prescription:

In the study of current and potential dietary role of peanuts, analysis of variation in nutritional intake with respect to socioeconomic and food preservation and food processing determinants will be addressed. In effect this will be an attempt to diagnose the relative order of magnitude of the constraints to peanut consumption.

Specifically, the impact of household peanut production upon peanut consumption will be estimated. Similarly, the impact of household inventory, management, storage technology, food technology, and household income upon peanut consumption will be estimated. To the extent households that have developed more cost-effective or otherwise preferred technologies also consume more peanuts, the potential consumption impact of wide adoption of these existing farm-level technologies may be estimated. Based on the outcome, the following alternatives may be indicated:

1. If there are no supply or food technology effects on peanut intakes, consumption may be near saturation already. Then,

the potential for non-farm and non-peanut-basin markets and new product development should be evaluated.

2. However, if there are supply and food technology effects independent of income levels, then research on improvement and wider scale adoption of existing practice is a particularly appropriate strategy.
3. Finally, if wealth levels and larger scale technologies appear to effect higher consumption, then research on the divisibility and ways and means of sharing these cost-effective technologies with the poor majority appears to be indicated.

The methodologies implied are standard dummy-variable regression techniques and may be interpreted similar to income elasticities of demand for food (Mellor, 1966). As much of this analysis as possible will be done at Ahmadu Bello University or the University of Sudan. Graduate students or research counterparts may also come to Alabama A & M University to collaborate on analysis.

E. Improvement/modification in processing of peanuts:

1. Shelling of peanuts:

Currently peanuts are generally shelled by hand for commercial sales and home consumption. Attempts will be made to design simple devices that could be made accessible to small village entrepreneurs particularly in surplus peanut areas. This will help provide additional time to the housewife for other useful and more productive activities.

2. Storage facilities:

Innovations will be sought to improve peanut storage practices and facilities. A variety of appropriate structures will be considered and evaluated. If possible, efforts will be made to establish common cold storage facilities, probably on a cooperative basis, or by a small entrepreneur.

3. Processing:

It may be desirable to establish mills to produce edible grade peanut flour. The suitability of such operations may be tested on

research models. In India, there are several plants which can produce edible grade peanut flour (Parpia, 1969). Similar models can be introduced in SAT regions of Africa.

4. Research on incorporation of peanut flour or peanut protein in existing dishes:

Recipes will be developed to incorporate peanut flour and peanut proteins preparations in commonly eaten foods such as Kulikuli or fufu. These food preparation alternatives will be evaluated by "model families" in the regions to determine their efficiency of preparation and acceptability.

5. Research on production of new acceptable foods:

It is desirable to produce foods where shelf life is considerably increased. However, it should resemble local products and should not contain unusual flavor or taste. For example, lactic cultures or other fermentation processes may be used with peanut products to improve shelf life. Initial findings indicate this may also lead to inactivation of aflatoxin (Marth and Doyle, 1981). It is proposed that a considerable effort will be made to produce economical, acceptable and marketable products. Any concept using technology which can be easily transferable to village economies will be explored, e.g. village texturizer (MFM-VITA, 1977). Promotion of any of these product and processing concepts will be suggested only if the approaches are deemed acceptable and technologically and economically advantageous after trials with "model families" who will be engaged to aid the evaluation of the developments.

V. TRAINING PLAN

The proposed project is based on the expertise of several persons within different disciplines on the campus of Alabama A & M University. Members of the faculty in Food Science, Home Economics and Agribusiness

will be available for required training of the participants from LDCs. Graduate students recruited from the participating LDC countries will be working under the supervision of the project members. Facilities and equipment in the department of Food Science are adequate to provide graduate and undergraduate training relevant to the proposed project. Additionally, the facilities and expertise in the departments of Natural Resource, Biology and Chemistry are also available to supplement the training for research. The program in Food Science is accredited by the Institute of Food Technologists.

It is proposed that key project personnel from LDCs will visit Alabama A & M University to make them familiar with the techniques of nutrient analyses, aflatoxin analyses and monitoring, survey methodology for nutritional studies, and data handling and processing. They will also visit commercial facilities for post-harvest handling, processing and management in Alabama, Georgia, Florida, North Carolina and Texas.

It is proposed that project personnel from Alabama A & M University and the LDC institutions will jointly participate in training the interviewers in methods of data collection from sample villages while maintaining contacts with traditional leaders.

VI. FACILITIES AND EQUIPMENT

Facilities and equipment available in the department of Food Science & Animal Industries, and School of Agriculture will be available for research and training related to this project. The department is located in a newly completed annex to Carver Complex and has laboratory and pilot plant space of 8,000 square feet. It includes laboratory and pilot plant facilities for dairy products, meat products, and cereal and legumes processing. Unit operations include dehydration equipment, freeze-dehydrates, milling operations and canning operations. Facilities for

growing, harvesting and cleaning cereals and legumes samples are available in the School of Agriculture. Cold room, controlled atmosphere rooms and other facilities are adequate for the storage of samples.

Equipment in laboratories include:

- Baking facilities
- Village type texturizer
- Rotary ovens
- Fermentation cabinets
- Automatic moulders
- Mixers
- Volume meter
- Mills (Quadramat Junior Mill, Wiley Mills, UDY simple cyclone mills, Lee Household flour mill, Fitzpatrick Homoloid mill)
- High Speed Centrifuge (IEC Model)
- Beckman Ultracentrifuge
- Bausch-Lomb UV-Visible Spectrophotometer
- Turner Fluorometer
- pH Meters with Expanded Scale
- Warburg Apparatus
- Autoclave
- Tracer MT-22 Gas Liquid Chromatograph
- Beckman Amino Acid Analyzer
- Facilities for Thin-Layer Chromatography
- Scanning Electron Microscope
- Microtome
- Tissue-Tek Apparatus
- Electrophoretic Equipment
- Light Microscopes
- Darkroom Facilities
- Distillation Apparatus
- Fat Extractor
- Liquid Chromatograph
- Small Animal Room - For Raising Rabbits, Mice and Rats
- Technician Autanalysis System
- Perkin-Elmer Model 460 Atomic Absorption Spectrometer
- Farm Facilities to Raise Rabbits, Chickens, Turkey, Beef, Cattle, and Swine

REFERENCES

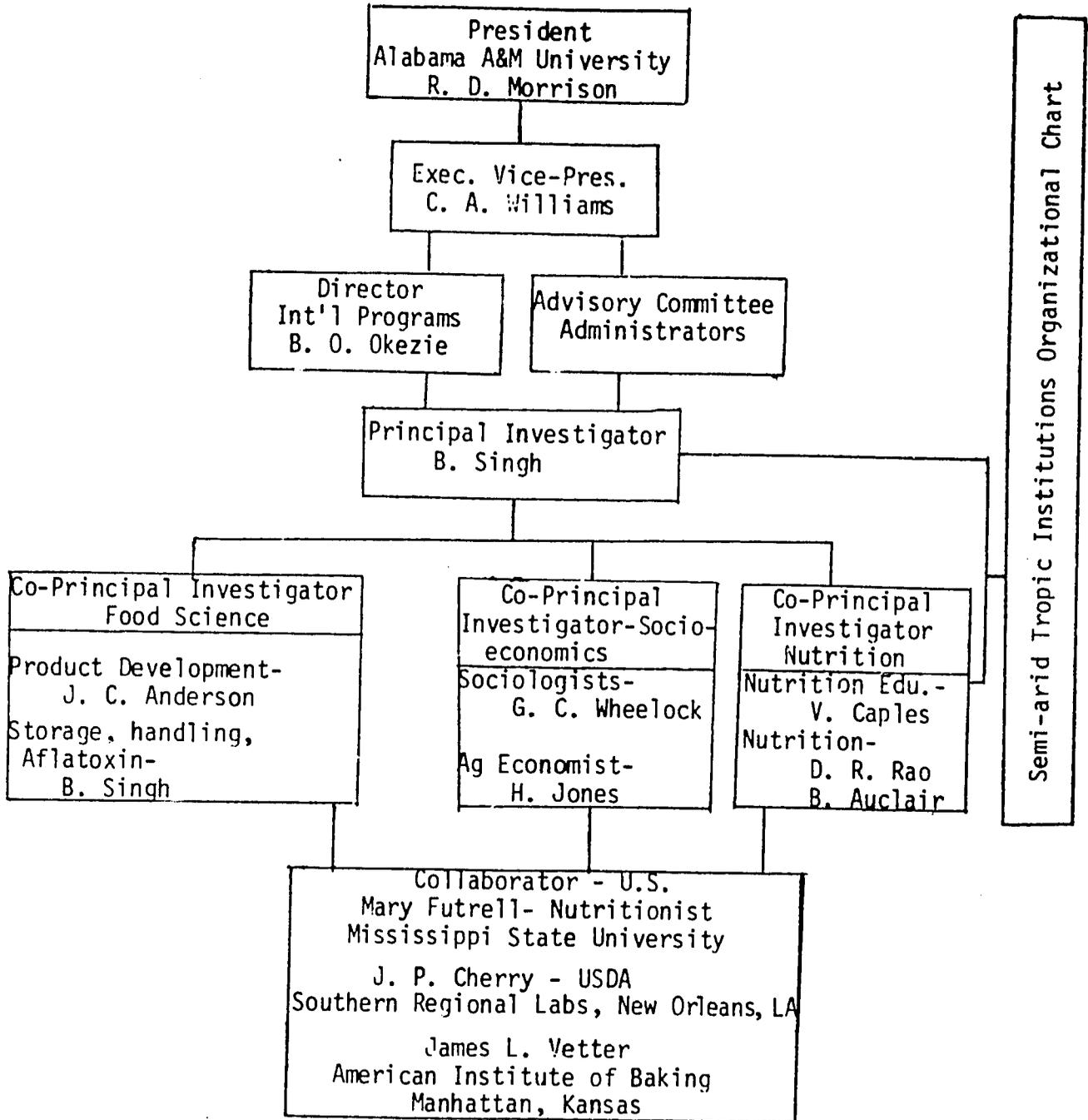
- Abalu, G. O. I., 1978. An economic analysis of groundnut production in the northern Nigeria. Proceedings of the National Seminar on Groundnut Production, Kano, Nigeria. pp. 83-90.
- Abalu, G. O. I. and B. D'Silva, 1979. Socioeconomic Analysis of Existing Farming Systems and Practices in Northern Nigeria. J. G. E. Ryan, Editor, Socioeconomic Constraints to Development of Semi-Arid Tropical Agriculture. ICRISAT, Hyderabad, India, pp. 3-10.
- Ahmed, E. M. and R. H. Schmidt. 1979. Functional properties of peanut and soybean proteins as influenced by processing method. Peanut Sci. 6:1-6.
- Bolton, A., 1980. Groundnut production, utilization, research problems and further research needs in Tanzania. Proceedings of the International Workshop on Groundnuts. ICRISAT Center, Patancheru, India. October, 13-17.
- Cloud, Kathleen, 1978. Sex Roles in Food Production and Distribution Systems in the Sahel. John Fisher, Editor, Summary Report on the Conference on Women and Food. January 9-11, 1978 at Tucson, Arizona.
- Fisher, John L., 1978. Summary Report on the Conference on Women and Food, January 9-11, 1978, Tucson, Arizona. University of Arizona.
- Futrell, M., 1981. Peanut consumption in Nigeria. Personal Communication.
- IDRC, 1973. Consumer Food Utilization in the Semi-Arid Tropics of Africa: Report of an Interdisciplinary Workshop at Ahmadu Bello University, Zaria, Nigeria. April 30-May 5, 1973. International Development Research Center, Ottawa, Canada.
- Ishag, H. M., M. A. Ali, and A. B. Ahmadi, 1980. Groundnut production and research problems in the Sudan. Proceedings of the International Workshop on Groundnuts. ICRISAT Center, Patancheru, India. October 13-17.
- Jungman, F. M., 1977. An analysis of the market potential of peanut protein ingredients in food processing. Ph.D. Dissertaion, Texas A & M University, College Station, Texas.
- Longhurst, R., 1978. Review of Conference on Seasonal Dimensions to Rural Poverty. July 3-6, 1978. Institute of Development Studies and Ross School of Tropical Hygiene, University of Sussex, Brighton, U. K.

- Lusas, E. W., 1979. Food uses of Peanut Protein. Proceedings-World Conference on vegetable food proteins. J. Amer. Oil, Chemists Soc. 56:421-430.
- Marth, E. H. and M. P. Doyle, 1981. Chemical, physical, biological and biochemical degradation of mycotoxins in foods and agricultural commodities. Proc. Symp. on mycotoxins. Annual Meetings of the Institute of Food Technologists. Atlanta, GA. June, 7010.
- Mellor, John W., 1966. The Economics of Agricultural Development. Cornell University Press, Ithaca, New York.
- MFM-VITA, 1977. The Village Texturizer. A VITA publication. Mt. Rainier, Maryland.
- Misari, S. M., C. Harness, and A. M. Fowler, 1980. Groundnut production, utilization, research problems and further research needs in Nigeria. Proceedings of the International Workshop on Groundnuts. ICRISAT Center, Patancheru, India. October 13-17.
- Matlon, P. and M. Newman, 1978. Production efficiency and income distribution among farmers in the north of Nigeria. Michigan State University, East Lansing, Michigan, USA. (Mimeographed).
- Newman, M., I. Ouedroogo, and D. Norman, 1979. Farm-level studies in the semi-arid tropic of west Africa. J. G. Ryan, Editor, Socioeconomic Constraints to Development of Semi-Arid Tropical Agriculture. ICRISAT, Hyderabad, India. pp. 241-261.
- Okezie, B. O., 1981. Trip Report of Peanut CRSP: Site visit to Nigeria and Sudan. February, 1981.
- Olayide, S. O. *et al.*, 1972. A quantitative analysis of food requirements, supplies and demands in Nigeria, 1968-1985. Federal Department of Agriculture, Lagos, Nigeria.
- Oyenugu, V. A., 1968. Nigerian Feed and Feed Stuffs. Their Chemistry and Nutritive Value. Ibadan University, Press, p. 99. Ibadan, Nigeria.
- Parpia, H. A. B, 1969. Protein foods in India based on cereals, legumes, and oilseed meals. Protein enriched cereal foods for world needs. Ed. Max Milner, American Association of Cereal Chemists, St. Paul, Minnesota.
- Rhee, K. C., C. M. Center, and K. F. Matil, 1972. Simultaneous recovery of protein and oil from raw peanuts in an aqueous system. J. Food Sci. 37:90-93.
- Tolman, R. R., J. D. Miller A. S. Levine, and S. E. Silvis, 1981. Absorption of peanuts: Correspondence. New England Journal of Medicine. 304: 359. February 5, 1981

- United States Department of Agriculture (USDA), Foreign Agriculture Service, Foreign Agriculture Circular: Oilseeds and products. FOP. October, 1977. pp. 19-17.
- United States Department of State, 1980. Bureau of Public Affairs. Background Notes: Nigeria. May, 1980.
- Vincent, A., 1972. A Cookery Book for the Tropics. Allen and Unwin Ltd. London.
- Wheelock, G. C., 1981. Trip Report of Peanut CRSP: Site visit to Senegal, Malawi and Thailand. February, 1981.
- Woodruff, J. G., 1973. Peanuts, Production, Processing, Products. AVI Publishing Co., Westport, Connecticut.
- Woodruff, J. G. and E. K. Heaton, 1961. Peanuts for processing. Georgia Agricultural Experiment Station, Bull. NS. 80.
- Zalla, Tom, 1979. The relative importance of money and subsistence incomes in explaining dietary intake in Kilimanjaro--some preliminary results. Michigan State University. East Lansing, Michigan. (Mimeographed).

Alabama A & M University
Peanut CRSP

Organizational Chart



*Agreed to collaborate on consultancy basis

72

PROPOSED TIME TABLE OF ACTIVITIES
BY QUARTERS

ACTIVITIES	Year 1				Year 2				Year 3				Year 4				Year 5			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Collaborative Research Agreements	1 →																			
2. Design data collection strategy in Nigeria	2 →																			
3. Data Collection: Post harvest handling and nutrition intake survey					3 →															
4. Survey data analysis					4 →															
5. Peanut and peanut product analysis					5 →															
6. Data Collection: Nutrition Intake and Peanut Inventory Survey					6 →															
7. Analysis and reporting of first year supply and intake data									7 →											
8. Peanut utilization research													8 →							
9. Peanut product acceptability trial (multiple efforts)													9 →							
10. Evaluation - Final Report																	10 →			

U. S. Institution
Proposed Total Yearly Funding for Proposal

Organization and Address Alabama A & M University, Normal, AL 35762 Proposal No. _____
Assigned by Planning Office

Principal Investigator(s) (PI) B. Singh

	No.	Time % on CRSP	Proposed Budget			Assigned By CRSP Planning
			Total for CRSP	From Your Instit.	From Title XII	
A. Salaries and Wages						
1. Senior Personnel						
a. (Co) PI(s)	<u>6</u>	<u>1.3</u>	<u>\$39,000</u>	<u>\$ 9,000</u>	<u>\$30,000</u>	<u>\$</u>
b. Senior Assoc.	<u>---</u>	<u>---</u>	<u>\$</u>	<u>\$</u>	<u>\$</u>	<u>\$</u>
2. Other Personnel (Non-Faculty)						
a. Graduate Students	<u>2</u>	<u>1.0</u>	<u>\$ 9,600</u>	<u>\$ 9,600</u>	<u>\$</u>	<u>\$</u>
b. Secretarial-Clerical	<u>1</u>	<u>.5</u>	<u>\$ 5,000</u>	<u>\$</u>	<u>\$ 5,000</u>	<u>\$</u>
<u>TOTAL SALARIES AND WAGES</u>			<u>\$53,600</u>	<u>\$18,600</u>	<u>\$35,000</u>	<u>\$</u>
B. Fringe Benefits (24%)			<u>\$10,560</u>	<u>\$ 2,160</u>	<u>\$ 8,400</u>	<u>\$</u>
C. Total Salaries, Wages, and Fringe Benefits (A + B)			<u>\$64,160</u>	<u>\$20,760</u>	<u>\$43,400</u>	<u>\$</u>
D. Equipment	Word Processor, Upgrade 2000, Maintenance Contract Share 500					
Total Equipment			<u>\$ 2,500</u>	<u>\$</u>	<u>\$ 2,500</u>	<u>\$</u>
E. Materials and Supplies	Office and Laboratory					
Total Materials and Supplies			<u>\$ 2,500</u>	<u>\$</u>	<u>\$ 2,500</u>	<u>\$</u>
F. Travel--1. Domestic (Including Canada)			<u>\$ 3,000</u>	<u>\$</u>	<u>\$ 3,000</u>	<u>\$</u>
2. Foreign 4-six week trips			<u>\$10,000</u>	<u>\$</u>	<u>\$10,000</u>	<u>\$</u>
Zaria, Nigeria			<u>\$10,000</u>	<u>\$</u>	<u>\$10,000</u>	<u>\$</u>
Western Sudan			<u>\$</u>	<u>\$</u>	<u>\$</u>	<u>\$</u>
G. All other Direct Costs - Consultants			<u>\$ 4,000</u>	<u>\$</u>	<u>\$ 4,000</u>	<u>\$</u>
H. Total Direct Costs			<u>\$</u>	<u>\$</u>	<u>\$</u>	<u>\$</u>
I. Indirect Cost						
Off campus 14,000 @ 15.3%			<u>\$ 2,142</u>	<u>\$</u>	<u>\$ 2,142</u>	<u>\$</u>
On campus 39,600 @ 55.5%			<u>\$21,978</u>	<u>\$10,230</u>	<u>\$11,748</u>	<u>\$</u>
J. Total Direct & Indirect Costs			<u>\$120,280</u>	<u>\$30,990</u>	<u>\$89,290</u>	<u>\$</u>

Note: Signatures Required Only for Revised Budget. This is Revision No. _____

Sign. of Principal Investigator Bharat Singh Date of Sign. 7.1.81 Typed or Printed Name and Title B. Singh, Professor

Sign. of Auth. Organizational Rep. R. D. Morrison Date of Sign. 7/1/81 Typed or Printed Name and Title R.D. Morrison, President

R E S U M E'

I. PERSONAL DATA

Bharat Singh, PROFESSOR
CEREAL CHEMISTRY and PLANT PRODUCTS
Department of Food Science and Animal
Industries
Alabama A. & M. University
Normal, Alabama 35762

II. EDUCATION

B.S. - 1958 Banaras Hindu University, Varansasi, India
M.S. - 1961 Ranchi University, Ranchi, India
Ph.D. - 1968 University of British Columbia, Vancouver, Canada

III. PROFESSIONAL WORK EXPERIENCE (Relevant to the project)

6/72 to present Dr. Bharat Singh is currently employed at Alabama A. & M. University as a Professor in Food Chemistry. He is involved in research on handling, storage, nutrient analyses, functional characteristics and processing of cereals, legumes and other plant products. He organized a cereal quality laboratory at Alabama A. & M. University with excellent facilities to do research and product development from cereal grains and legumes. He has worked on the effects of protein isolates from peanut on rheological and functional characteristics of triticale and wheat flours. Dr. Singh has supervised work of more than 20 graduate students working on various aspects of cereals, legumes. Starchy staple vegetable products and by-products. He has just completed a work on production and characterization of plaintain flour for development of improved products acceptable to native populations in Ivory Coast. Earlier, he has worked on modification of conditions in storage to extend the shelf-life of various fruits and vegetables. He has completed several projects funded by USDA, NIH, NSF, and U.S. Department of Energy and U.S. Army.

Dr. Singh teaches graduate courses in Food Toxicology, Advanced topics in cereals and legumes and undergraduate courses in food chemistry, analysis and fruits, vegetable and cereal products. He has published more than 50 papers in various national and international journals and presented more than 40 papers in professional meetings and symposiums.

III. PROFESSIONAL WORK EXPERIENCE (cont'd)

Dr. Singh received Morrison-Evans outstanding Scientist Award in 1980 for meritorius achievement in research. He organized and served as a chairman of the symposium on Biochemistry and functional characteristics of triticale at the IFT meetings in 1974. He is organizing and serving as a chairman of the symposium on progress in triticale research at the 7th World Cereal and Bread Congress in Prague, Czechoslovakia in June, 1982. In addition to his teaching and research responsibilities, Dr. Singh has provided consultation to various food and feed processing companies in the State of Alabama and through Southeast U.S.A.

IV. SELECTED PUBLICATIONS AND REPORTS

Singh, B., S. Ogutu, E.M. Ahmed. Effect of protein isolates from peanut and soybean on rheological and functional characteristics of triticale and wheat flours. Annual meeting of the American Association of Cereal Chemists, Washington, D.C., November, 1979.

Agbo N'zi, Georges and B. Singh. Physico chemical and structural characteristics of plaintain (Musa paradisiaca) flour with a special reference to "future" preparation. Annual meeting of the Institute of Food Technologists. New Orleans, LA. June, 1980.

Singh, B., J. Adeyeye and J.M. Reddy. Evaluation of cookie baking characteristics of triticales. Annual Meeting of the American Association of Cereal Chemists, Chicago, Illinois, September, 1980.

Singh, B., A.A. Akinsanya and S.O. Ogutu. Saccharification of cottonseed hulls by microorganisms and cellulose. Bio-Energy '80. World Congress and Exposition. Atlanta, GA., April, 1980.

Singh, B. and R. Katragadda. 1980. Proteolytic activity and its relationship to other biochemical characteristics and bread quality of triticale. Lebensm-Wiss. U. Technol. 13:23-242.

Singh, B., N.A. Littlefield, and D.K. Salunkhe. 1972. The accumulation of amino acids and organic acids in the fruits of apples and pears under controlled atmosphere storage conditions and certain associated changes in metabolic processes. Indian J. Hort. Sci. 28:245-251.

Singh, B., and S.G. Reddy. 1973. Triticale utilization studies as food and feed at Alabama A. & M. University. Proc. International Symposium on Triticale, Lubbock, Texas (September, 1973).

- Singh, B. 1978. Triticale: A new cereal grain. In: *Encyclopedia of Food Science*. AVI Publications, Westport, Conn. 759-771.
- Singh, B. 1976. Amylograph and farinograph studies on triticale. *Baker's Digest*. 50:26-30.
- Singh, B. and N.R. Reddy. 1977. Phytic acid and mineral compositions of triticales. *J. Food Sci.* 42:1077-1083.
- Singh, B. and Prisca Mugwira. 1977. Effect of dough conditioners on baking quality and nutrient composition of triticale breads. *Food Sci. and Technology* 10:89-93.
- Singh, B. and L.M. Dodda. 1979. Studies on preparation and nutrient composition of bulgur from triticale. *J. Food Sci.* 44:449-452.
- Singh, B., Shah, M.O. and Hughes, J.L. 1978. Interrelationships between certain rheological and biochemical characteristics of triticale flours. Proc. 6th International Cereal and Bread Congress, Winnepeg, Canada. September 16-22.
- Singh, B., C.C. Yang, D.K. Salunkhe, and A.R. Rahman. 1972. Controlled atmosphere storage of lettuce. I. Effects on quality and the respiration rate of lettuce heads. *J. Food Sci.* 37:52-55.
- Singh, B., W.F. Campbell, and D.K. Salunkhe. 1972. Effects of S-triazines on protein and ultrastructure of *Phaseolus cotyledons*. *Am. J. Bot.* 59:568-572.
- Singh, B., O.P. Vadhawa, M.T. Wu, and D.K. Salunkhe. 1972. Effects of foliar application of S-triazines on protein, amino acids, carbohydrates and mineral composition of pea and sweet corn seeds, bush bean pods, and spinach leaves. *J. Agr. Fd. Chemistry* 20:1256-1259.
- Singh, B., M.T. Wu, and D.K. Salunkhe. The use of chemicals to increase leaf protein of certain crops. *Technical group meeting of Leaf Protein, International Biological Program*. Sri Avanashilingam Home Science College, Coimbatore, India, November 25-27, 1970
- Singh, B., M.T. Wu, and D.K. Salunkhe. 1971. The use of chemicals to increase leaf and seed proteins of certain crops. *Plant Foods for Human Nutrition* 2:171-184.
- Wu, M.T., B. Singh, J.C. Theurer, and D.K. Salunkhe. 1970. Control of sugar loss in sugar beets during storage by chemicals and modified atmosphere and certain associated physiological changes. *J. Am. Soc. Sugar Beet Technology*. 16:117-127.
- Singh, B., N.A. Littlefield, and D.K. Salunkhe. 1970. Effects of controlled atmosphere (CA) storage on amino acids, organic acids, sugars, and rate of respiration of "Lambert" sweet cherry fruit. *J. Am. Soc. Hort. Sci.* 95:458-461.

R E S U M E'

I. PERSONAL DATA

Gerald Calvin Wheelock, PROFESSOR
RURAL SOCIOLOGY
Box 12
Alabama A. & M. University
Normal, Alabama 35762

II. EDUCATION

B.S. - 1962 Animal Science, Iowa State University
M.S. - 1963 Rural Sociology, Iowa State University
Ph.D. - 1972 Development Sociology, Cornell University

III. PROFESSIONAL WORK EXPERIENCE

1979 - present Assistant CRSPP Director, Integrated Crop
Protection Planning Grant, Purdue University
and the Socio-Economics and Biology of Peanut
Production and Utilization, University of
Georgia.
1976 - 1979 Center Associate, Education Needs Projection
and Rural Development Network, Alabama A. &
M. University and Southern Rural Development
Center Cooperating.
1972 - present Associate to Professor of Rural Sociology,
Department of Agribusiness Education, Alabama
A. & M. University, Normal, Alabama.
1966 - 1972 Graduate Assistant to Research Associate at
Cornell University and the College of Agri-
culture, University of the Philippines at
Los Banos.
1966 Agriculture Development Organization, Vientiane
Provincial Liaison Officer, US/AID/Laos. Co-
ordinated with Laos Ministry of Agriculture
on rice seed multiplication and seed distri-
bution program.
1963 - 1965 U.S. Peace Corps Volunteer, Sabah, Malaysia.
Instructor, Sabah Agricultural Training Center,
Tuaran.
1961 International Farm Youth Exchange (IFYE) from
Iowa to Belgium.

IV. PRESENT RESEARCH

Dr. Wheelock is presently involved in a Regional Research Project on resource utilization of families in low income rural counties of 10 Southern states. He is involved in secondary data analysis of the 1970 and 1980 census and well as the sample survey of 2400 households. He has provided leadership on sample design, data management, and data analysis subcommittees for this 5 year project. He has taught and done research at the University of the Philippines at Los Banos. The studies were of agricultural credit insti-

IV. PRESENT RESEARCH (cont'd)

tutions and systems in rice program priority provinces. More recently, he has been involved in the evaluation of the Bicol River Basin integrated area development program in the Philippines and Title XII CRSP Planning Grant on Integrated Crop Protection and Peanuts. Activities involved site visits to Sudan, Senegal, Malawi, Egypt, Tunisia and ICRISAT (India). Related papers follow.

- 1980 Sharma, G.C., C. Stevens, and G.C. Wheelock. State of the art document (SOTA): Integrated crop protection for diseases and nematodes. Alabama A. & M. University, p. 75.
- 1980 Wheelock, G.C., et al. Wages and migration of the Southern labor force: A dual panel Study - 1960 and 1970. Rural Sociology in the South: 1980. W. Frese, editor, Mississippi State, Mississippi. p. 12.
- 1980 Wheelock, G.C., et al. Development context and wage share gains by minorities and females. A paper presented at the Annual Meeting of the Rural Sociological Society in Ithaca, New York, August 20-23, 1980. p. 14.
- 1980 Abawi, G.S., G.A. Schaefers, and G.C. Wheelock. Planning study for integrated crop protection in Egypt, Sudan and Tunisia: Collaborative research support planning grant site visit, April 23 - May 23, 1980. p. 82.
- 1979 Weaver, T.T., G.C. Wheelock, J.A. Roumasset, G.T. Castillo, J.P. Cortez III, R. Tungpalan, and D. Alcantara. Bicol biennial evaluation: Bicol river basin development program. GOP/USAID, Manila, Philippines. p. 43.
- 1978 Wheelock, G.C. Synthesis: Educational needs projection and rural development. Rural development series No. 7, Southern Rural Development Center, Mississippi State, Mississippi. p. 83.
- 1978 Wheelock, G.C. and Pushpa Sapra. Educational needs projection and rural development. Rural Development Bibliography Series No. 7, Mississippi State: Southern Rural Development. p. 161.
- 1978 Wheelock, G.C. Changing community structure and income distribution: A structural equation model. Paper presented at the Annual Meeting of the Rural Sociological Society in San Francisco, September 1978. Alabama A. & M. University, ERIC/CRESS ED 158 912. p. 28.

- 1978 Wheelock, Gerald C. and Ann Preyer Warren. Community social structures and school free lunch participation. School Food Service Research Review, pp. 92-97. Also in Rural Research in USDA, Hearings before the Subcommittee on Agricultural Research and General Legislation. pp. 182-192.
- 1974 Wheelock, G.C. Predicting the distribution of a rural credit institution in the Philippines. Journal of Developing Areas, 9:1:69-86.
- 1973 Wheelock, G.C. and Frank W. Young. Macrosocial accounting for municipalities in the Philippines: Rural banks and credit cooperatives. Cornell University International Agricultural Development Bulletin No. 26. p. 64.
- 1972 Wheelock, G.C. Structural differentiation and agricultural productivity: A cross-national study. Mimeographed research paper being prepared for publication. Abstract in L.D. Wilcox's et al., Social Indicators and Social Monitoring: An Annotated Bibliography. San Francisco: Jossey-Bass, Inc.

R E S U M E'

I. PERSONAL DATA

John C. Anderson, ASSOCIATE PROFESSOR
FOOD PROCESSING and ENGINEERING
Department of Food Science and Animal
Industries
Alabama A. & M. University
Normal, Alabama 35762

II. EDUCATION

B.S. - 1964 Dairy Industries, University of Minnesota
M.S. - 1970 Mechanical Engineering, University of
Minnesota
Ph.D. - 1975 Food Science, University of Minnesota

III. PROFESSIONAL WORK EXPERIENCE

1/80 - present Associate Professor, Department of Food Science
and Animal Industries, Alabama A. & M. University,
Normal, Alabama. Responsible for classroom in-
struction in food processing and engineering,
also teaching dairy technology, proteins in food
and nutrition and food processing and nutrients.
Advise graduate and undergraduate students and
perform limited research, pending development
of research program. Involved in development of
instructional materials for computer assisted
instruction of food processing and engineering
subjects.

1976 - 1979 Food Technologist/Engineer for Meals for Millions/
Freedom From Hunger Foundation, Santa Monica, CA.
Responsible for transfer of technology efforts
which sought to introduce appropriate food
processing technologies into less developed coun-
tries. Participated in training programs for
international participants and participated with
other members of the staff in various program
planning and decision efforts.

1974 - 1976 Product Development Scientist, The Pillsbury
Company, Minneapolis, Minnesota. Product Develop-
ment work for the Grocery Products division.

1970 - 1974 Various positions as Teaching Associate, Graduate
Research Teaching Assistant in the Department of
Food Science and Nutrition, also Research Fellow
and Research Specialist in the Department of
Agriculture and Applied Economics, University of
Minnesota, St. Paul, Minnesota.

502

J. Anderson
(cont'd)

III. PROFESSIONAL WORK EXPERIENCE (cont'd)

1965 - 1967 Peace Corps Volunteer in the Republic of the Philippines. Assisted in community development programs and rice production efforts.

IV. OTHER RELEVANT SKILLS AND EXPERIENCES

Publications

Patterson, G.W., Anderson, J.C., and Bray W.J., 1980. The Puffing Gun - A simple processing devise for rapid cooking of cereals and other grains. Appropriate Technology, 7(3) 29-31.

The Village Texturizer, 1977. John C. Anderson, a contributing author. A VITA publication, Volunteers in Technical Assistance, Mt. Rainer, Maryland.

Languages

French through informal instruction and tutoring developing proficiency, not fluent.

Previous contact with Spanish and Philippine languages but no longer fluent.

PROFESSIONAL GOALS

Related to the peanut food science CRSP - to develop food technology/processing skills by analysis of constraints and applying engineering and food development efforts that can be effectively used through subsequent extension programs.

R E S U M E

I. PERSONAL DATA

Hezekiah S. Jones, ASSISTANT PROFESSOR/AGRICULTURAL ECONOMIST
Department of Agribusiness Education
Alabama A. & M. University
Normal, Alabama 35762
(205) 859-7471/7472

II. EDUCATION

B.S. - 1974 Agribusiness Management, North Carolina A & T
State University
M.S. - 1976 Agricultural Economics, University of Illinois
Major: Farm Management and Production Economics
M.S. Thesis: Economies of Size on Illinois
Grain Farms
University of Illinois
Ph.D. - 1979 Agribusiness Economics, University of Illinois
Major: Farm Management and Production Economics
Minor: Agricultural Finance
Ph.D. Thesis: Solar Energy as an Alternative to
Fossil Fuel for Drying Corn in East Central
Illinois

III. PROFESSIONAL EXPERIENCE

1/79 - present Assistant Professor, Alabama A. & M. University
9/76 - 12/76 Teaching Assistant, University of Illinois,
Champaign-Urbana, Illinois
1/77 - 1/79 Graduate Research Assistant, University of
Illinois, Champaign-Urbana, Illinois
8/74 - 8/76 Graduate Research Assistant, University of
Illinois, Champaign-Urbana, Illinois
1/74 - 8/74 Research Assistant, North Carolina A & T State
University, Greensboro, North Carolina
1967 - 1972 Farm Overseer, Inswood Sugar Estate, Ltd.,
Spanish Town, Jamaica
1965 - 1967 Field Supervisor, Inswood Estate Ltd., Jamaica
1962 - 1965 Field Assessor, Banana Industry Insurance Board,
Kingston 4, Jamaica, W.I.

IV. PRESENT RESEARCH AND RELEVANT SKILLS

Dr. Jones is the Agricultural Economist for this proposed research team, and is a researcher who will be directly involved in the food consumption and expenditure surveys, data summary, data analysis and the interpretation of findings. His training provides him with the expertise necessary to undertake this phase of the project.

H. Jones
(cont'd)

He has taught courses in general agricultural economics, farm management, agricultural marketing, agricultural finance and rural development. He is experienced in working with various mathematical and econometric models, including Linear Programming, Quadratic Programming and Regression. In addition, he has had much experience working with small farmers in Jamaica, and this should enhance his ability to carry out the proposed tasks successfully.

His present research interest includes the following:

- o A study of factors influencing the use of government services by limited resource farmers in the black belt counties of Alabama. (Approved for funding by the Alabama Center for Higher Education.)
- o A study of the levels of knowledge and utilization of services of the Farmers Home Administration by rural residents in Northern Alabama. (Being considered for funding by U.S.D.A. - ESS.)
- o "Alternative Agricultural Enterprises for Small Farmers in South Alabama".
- o The Regional Small Farm Project - RR II

RESUME'

PERSONAL DATA

Virginia Caples, ASSOCIATE DEAN
Division of Home Economics
Alabama A. & M. University
Normal, Alabama 35762
(205) 859-7215

II. EDUCATION

B.S. - 1967 Home Economics Education, Alcorn State University
M.S. - 1970 Home Economics Education, Iowa State University
Ph.D. - 1973 Home Economics Education, Iowa State University

III. PROFESSIONAL WORK EXPERIENCE

9/77 - present Associate Dean, School of Agriculture, Environmental Science, and Home Economics. Supervise and coordinate activities for three departments: Home Economics Education, Early Childhood Education, and Food and Nutrition. Activities involve; personnel evaluation and development, curriculum update and expansion, and research development and administration.

Teaching: Teach graduate classes in Home Economics Education, Curriculum, Supervision and Evaluation.

Other: Advisor for master thesis students. Serve on various university and school committees.

4/73 - 8/77 Chairperson, Department of Home Economics, Alcorn State University, Lorman, MS. Supervised and coordinated activities for the department to include; supervision and evaluation of staff and faculty, program development; graduate and undergraduate classes in home economics education. Conducted research.

Organized and hosted a five minute daily consumer affairs program.

6/67 - 8/69 Assistant County Supervisor, Home Economics, USDA-Farmers Home Administration, Riverhead, Long Island, New York. Taught adult education classes in food and clothing, coordinated all home economics activities, and loan procession.

IV. PUBLICATIONS/PAPERS

1975 Caples, Virginia "Nutritional Status of Low-Income Families In Southwest Mississippi", Proceedings of The Federation of American Societies for Experimental Biology: 34:897, Atlantic City, N.J.

IV. PUBLICATIONS/PAPERS (cont'd)

- 1976 Koh, Eunsook
Caples, Virginia "Dietary Patterns of Low-Income Families In Southwest Mississippi", (Abstract Accepted for the Federation of American Societies for Experimental Biology) Anahiem, CA., April, 1976.
- 1976 Koh, Eunsook
Caples, Virginia "Dietary Patterns of Households In Southwest Mississippi", Paper presented at the American Home Economics Association Annual Meeting, Minneapolis, MN., June, 1976.
- 1977 Koh, Eunsook
Caples, Virginia Nutrition Survey of Black Families In Claiborne County of Southwest Mississippi: Food Practices and Dietary Intake 1973 - 1974, Research Bulletin #5, Alcorn State University, 1977, Lorman, MS.
- 1979 Koh, Eunsook
Caples, Virginia Frequency of Selection of Food Groups By Low-Income Families In Southwestern Mississippi, Journal of the American Dietetic Association, Volume 74, No. 6, June, 1979.

R E S U M E'

I. PERSONAL DATA

D. Ramkishan Rao, PROFESSOR
NUTRITION and BIOCHEMISTRY
Department of Food Science
and Animal Industries
Alabama A. & M. University
Normal, Alabama 35762

II. EDUCATION

B.V.Sc. - 1965 Veterinary Science, A.P. Agricultural
University, India
M.S. - 1970 Nutrition and Biochemistry, Auburn University
Ph.D. - 1972 Nutrition and Biochemistry, Auburn University

III. PROFESSIONAL WORK EXPERIENCE

Sixteen (16) years of teaching and research experience in the areas of nutrition and biochemistry. About 30 papers published in referred journals. Over 25 papers presented at scientific meetings. Presented papers at national and local symposia. Most of these publications are related to nutrition. Taught nutrition and biochemistry courses at undergraduate and graduate levels. Directed several graduate students a good number of whom are from African countries. Member of the American Institute of Nutrition, Institute of Food Technologists and New York Academy of Science.

IV. EXPERIENCE AND TRAINING RELEVANT TO THE PROPOSED PROJECT

Attended a short course on the Methods of Nutritional Status Assessment at the University of Alabama-Birmingham.

Attended a summer short course in International Nutrition at MIT.

Invited speaker at the Episcopalian World Hunger Conference, Birmingham, Alabama.

Lectured on World Hunger at local church gatherings.

Participated in writing the sub-contractor grant from the University of Georgia on planning a global strategy for peanut production and utilization.

Visited ICRISAT, Patancheru, India in connection with the planning grant on peanut CRSP.

Interviewed the scientists at ICRISAT and gathered information on peanut utilization status.

D. Rao
(cont'd)

Currently involved in writing the SOTA on peanut production and utilization in the world. Peanut production background in the family and experience in the utilization aspects of peanuts in LDCs.

V. PUBLICATIONS RELEVANT TO THE PROJECT

Rao and Pulusani, 1981. Effect of cultural conditions and media on antimicrobial activity of streptococcus thermophilus. J. Food Sci. 46:630 (this paper involves preparation and fermentation of peanut milk).

Rao, et al., 1980. Comparison of protein quality of triticale, wheat, and corn. Nutr. Rep. Intl. 21:923.

Rao and Chawan, 1980. Nutritive value of rabbit meat. In proceedings of symposium on Domestic Rabbits. Ed. P.R. Cheeke, Oregon State University Press.

R E S U M E'

I. PERSONAL DATA

B. Onuma Okezie, ASSOCIATE PROFESSOR/
DIRECTOR OF INTERNATIONAL PROGRAMS
Office of International Programs
Alabama A. & M. University
Normal, Alabama 35762
(205) 859-7377

II. EDUCATION

B.S. - 1966 Animal Husbandry, University of California,
Davis
M.S. - 1966 Animal Nutrition, University of California,
Davis
Ph.D. - 1975 Food Science (International) with minor in
Human Nutrition, Cornell University

III. PROFESSIONAL WORK EXPERIENCE

10/79 - present Director, Office of International Programs,
Alabama A. & M. University.
10/75 - 10/79 Associate Professor, Food Science Technology,
Alabama A. & M. University
1/75 - 10/75 Assistant Professor, International Food Science
and Nutrition. Program in International Studies,
School of Human Ecology, Howard University,
Washington, D.C.
10/74 - 1/75 Research Associate, Department of Food Science,
Cornell University.
8/71 - 9/74 Teaching/Research Assistant, Department of Food
Science, Cornell University.
7/70 - 6/71 Executive Advisor on Nutrition, International
Union for Child Welfare, Geneva, Switzerland.
2/70 - 6/71 Research Fellow, Department of Animal Science,
University of Ife, Nigeria. Research related
to leaf proteins.
1968 - 1970 Advisor on Nutrition, Biafran Rehabilitation
Commission. Organization and supervision of
feeding centres, orphanages and refugee nutrition.
1967 - 1968 Scientific Officer, Biafran Ministry of Animal
Health and Forestry. Organization and supervision
of research in animal protein production.

IV. RELEVANT PROFESSIONAL EXPERIENCE

Dr. Okezie has been in the present position as Director of International Programs since October 1979, being responsible for planning, developing, implementing and management of A. & M. University's international activities. He is the university's alternate trustee to the board of the Southeast Consortium for

IV. RELEVANT PROFESSIONAL EXPERIENCE (cont'd)

International Development (SECID) and a member of its program Development Community Assistant Planning Director of the Peanut CRSP. He has also been an associate professor to Food Science and Nutrition in the Department of Food Science and Animal Industries since 1975. He has been involved in curriculum development; teaching of various food science and nutrition courses including food processing, food engineering, food product development and nutritional aspects of raw and processed foods; and research dealing with proteins and their functionality, new product applications with cereals and oil seeds, nutritional quality evaluation of new products, food application studies of underutilized plants, and effects of processing on nutrient quality and availability. He has been Thesis Advisor to many graduate students and serves in many university and national professional committees.

Previously, Dr. Okezie served as an assistant professor at Howard University in Washington, D.C., where he helped to develop a program in International Studies in human ecology in addition to teaching undergraduate and graduate courses in international nutrition. He served as research associate and teaching assistant in the department of Food Science at Cornell University. Primary activities included research on high protein food development, single cell protein production and application and teaching of high protein food technology and international food development. He still participates as a visiting professor on International Food Development at Cornell University. Other relevant experiences included his serving as the Executive Advisor on nutrition to the International Union for Child Welfare in Switzerland, a research fellow at the University of IFE, Nigeria, advisor on nutrition to the Rehabilitation Commission, Biafra and scientific officer for the Ministry of Animal Health and Forestry, Biafra.

SELECTED PUBLICATIONS

- Okezie, B. Onuma, 1969. Nutritional Needs of Refugees in Biafra. Biafra Rehabilitation Commission Bulletin.
- Okezie, B. Onuma, 1975. Improved food uses of cassava (Manihot utilisima): Advanced in research. Ph.D. Thesis, Cornell University, Ithaca, N.Y.
- Okezie, B. Onuma, 1975. International Dimensions in Human Ecology. Howard University, School of Human Ecology Series.
- Dobo, S.B. and Okezie, B. Onuma, 1980. Baking and organoleptic quality of composite flour bread with winged bean, triticale and wheat. Bakers Digest, 54(6): 22-35.
- Okezie, B. Onuma and Kosikowski, F.U., 1979. Extractability and functionality of proteins from yeast cells grown on cassava hydrolysate (accepted for publication J. Food Chem).

PUBLICATIONS (cont'd)

- Okezie, B. Onuma and Martin, F., 1980. Chemical composition of dry seeds and fresh leaves of winged bean varieties grown in the U.S. and Puerto Rico, J. Food Science, 45: 1045-1051.
- Okezie, B. Onuma and Dobo, S.B., 1980. Rheological characteristics of winged bean (Psophocarpus tetragonolobus) (L)(DC) composite flour. Bakers Digest, 54(1): 35-41.

R E S U M E'

I. PERSONAL DATA

Barbara Auclair, INSTRUCTOR
FOOD and NUTRITION
Division of Home Economics
Alabama A. & M. University
Normal, Alabama 35762

II. EDUCATION

B.S. - 1966 Foods and Nutrition, Auburn University
M.S. - 1968 Nutritional Science, University of Wisconsin
Further Study McGill University, Montreal, Canada
Further Study Alabama A. & M. University

III. PROFESSIONAL WORK EXPERIENCE

9/77 - present Instructor, Alabama A. & M. University,
Division of Home Economics. Responsible
for teaching 6 to 8 courses a year which
have included: Basic Nutrition, Quantity
Cookery, Food Preparation, Food Management,
Meal Management, Community Nutrition, Infant
& Child Nutrition and Consumer Nutrition.

10/75 - 6/76 Director of small animal laboratory, Uni-
versity of Florida, Gainesville, Florida.
Conducted limited research, teaching,
laboratory courses, reorganizing this
facility, and reorganized two courses in
nutrition given in this department.

10/73 - 5/75 Senior Research Assistant, McGill University,
Montreal, Canada. Senior Research Assistant
working in tumor immunology, in both animal
and human. Responsibilities ranged from
tissues culture to animal surgery. Setup
and maintained extremely large experiments
(up to 800). Familiar with radioactive
isotopes and fluorescent techniques as well as
handling a range of administrative duties.

9/71 - 1/73 Research technician, Lady Davis Institute for
Medical Research, Montreal, Canada. Duties
involved all aspects of a complement immu-
nology laboratory. Main responsibility was
management of animal stocks, and maintaining
the general operation of the laboratory.

8/68 - 8/69 Research technician, University of Missouri,
Columbia. Developed diets for guinea pigs to
determine their amino acid requirements.
Handled other administrative duties. Also,
conducted protein research.

B. Auclair
(cont'd)

- 9/66 - 6/68 Traineeship, University of Wisconsin, Madison. While obtaining my MSC degree under a National Institute of Health Traineeship, my research was on the vitamin B₁₂ folate relationship in germfree rats.
- 1/66 - 8/66 Auburn University, Auburn, Alabama. Under a National Science Foundation grant, learned methods of synthesis of metabolic analogues and enzyme analysis.

IV. RELEVANT PUBLICATIONS

Elson, C.E., B. Auclair, and J.J. Vitale, 1970. "Rat Liver Glutamate Formiminotransferase Activity in B₁₂ Deprivation and Germ-free Conditions," Amer. J. Clin. Nut. 23:390-394.

Proctor, J.W., B. Auclair, and M.G. Lewis, 1976. "The Effect of BCG on B16 Mouse Melanoma: A Comparison of Routes of Administration on Tumor Growth at Different Anatomical Sites," Europ J Cancer, 12:203-210.

Proctor, J.W., B. Auclair, and C.M. Rudenstam, 1976. "The Distribution and Fate of Blood Borne 125 IUdR-Labelled Tumor Cells in Immune Syngeneic Rats," Inter J Cancer, 18:255-262.

Proctor, J.W., B. Auclair, and L. Stokowski, 1976. "Brief Communication: Endocrine Factors and the Growth and Spread of B16 Melanoma," J. Natl. Cancer Inst., 57:1197-1198.

SUMMARY INFORMATION

Over ten (10) years of diversified experience in nutrition activities including research, administration, and teaching. Translate nutrition into usable information for community education. Possess a fair to good knowledge of French that can be easily improved.

R E S U M E'

I. PERSONAL DATA

Mary Feltner Futrell, PROFESSOR
NUTRITION/HOME ECONOMICS
P.O. Drawer HE
Mississippi State University
Mississippi State, Mississippi 39762

II. EDUCATION

B.S. - 1944 Home Economics, Austin Peay State University
M.S. - 1949 Nutrition, University of Wisconsin
Ph.D. - 1952 Nutrition and Biochemistry, University of
Wisconsin

III. PROFESSIONAL EXPERIENCE

1978-present Professor of Home Economics, Mississippi State
University, Mississippi State, Mississippi
1967 - 1978 Associate Professor of Home Economics, Mississippi
State University, Mississippi State, Mississippi
1964 - 1966 Lecturer, Home Economics, Ahmadu Bello University,
Zaria, Nigeria
1952 - 1954 Assistant Professor, Home Economics, Texas A. & M.
University, College Station, Texas
1948 - 1952 Research Assistant, University of Wisconsin,
Madison, Wisconsin
1947 - 1948 Teacher, Vocational Home Economics, Alvaton High
School, Alvaton, Kentucky
1944 - 1946 Teacher, Chemistry, Springville High School,
Springville, Tennessee
1942 - 1943 Teacher, Fort Henry Grade School, Fort Henry,
Tennessee

CONSULTATION EXPERIENCE

Nutrition Consultant, Marvel Iglesias Baptist Hospital, Ailigandi,
San Blas, Panama (December 25, 1971 - January 10, 1972)

Nutrition Consultant, Agricultural Missions Foundation, Feeding
Center, Ailigandi, San Blas, Panama (July 1, 1974 - July 16, 1974)

Nutrition Consultant, Agricultural Missions Foundation, Feeding
Center, Ailigandi, San Blas, Panama (May 14, 1975 - May 31, 1975)

Nutrition Consultant, Bangalore Baptist Hospital, Bangalore, India,
(May 14, 1976 - June 26, 1976), Foreign Mission Board, Southern
Baptist Convention

Nutrition Consultant, Haiti, Agricultural Missions Foundation
(May 21-26, 1979)

Nutrition Consultant, Mainland China, International Home Economist
(July 20 - August 5, 1980)

IV. PRESENT RESEARCH

Title XII Project, An Interdisciplinary Approach to Nutrition Improvement of People Consuming Grain Sorghum and Pearl Millet as the Staple Food (India, Sudan, Upper Volta, Haiti, Honduras, and Ecuador).

Dr. Futrell is presently involved in a nutritional status study of 4 to 5 year old black children in Mississippi. She is involved in all aspects of the research, such as dietary consumption, anthropometric, biochemical and clinical methods. This project has been active for 10 years. She taught Foods and Nutrition for two years at Ahmadu Bello University and while there, did research on acceptability of new products made from different varieties of grain sorghum. Their cultural and food practices were also studied. Dr. Futrell has been active in setting up feeding centers for children in Panama where she devised weaning foods. In the summer of 1976, she was the nutritionist on a Community Health Team to India. There she conducted a nutritional status study, and developed a weaning food from millet, chick peas, and peanuts. A feeding center was setup in a village and a rehabilitation (mother craft) center was setup in connection with a hospital in Bangalore, India. Training programs for local nutritionists were initiated. Related papers follow:

RELEVANT PUBLICATIONS

- M.F. Futrell, L. Kilgore, and F. Windham, 1971: Nutritional Status of Negro Preschool Children in Mississippi: Evaluation of HOP index. J. Amer. Diet. Ass. 59:3.
- M.F. Futrell, L. Kilgore, and F. Windham, 1971: Nutritional Status of Negro Preschool Children in Mississippi: Impact of Education and Income. J. Amer. Diet. Ass. 59:3.
- C.C. Johnson and Mary F. Futrell, 1974. Anemia in Black Preschool Children in Mississippi. J. Amer. Diet. Ass. 65:536.
- M.F. Futrell, L. Kilgore, and F. Windham, 1974. Nutritional Status of Black Preschool Children in Mississippi: Influence of Income Education of Parent and Food Programs. J. Amer. Diet Ass. 66:22.
- M.F. Futrell, F. Windham, and L. Kilgore, 1975. Hydroxyproline index: An indicator of nutritional status. J. Amer. Diet. Ass. 67:125.

PLAN OF WORK
Under The Subgrant
Between the
University of Georgia Management Entity
and
Alabama A & M University (AAMU)
to Implement a
Research Project under the
Peanut Collaborative Research Support Program (CRSP)

This agreement is entered into between the University of Georgia referred to hereafter as the "MANAGEMENT ENTITY", and the Alabama A & M University referred to hereafter as the "PARTICIPATING INSTITUTION".

I. Purpose

This Plan of Work describes the Peanut CRSP research project "An Interdisciplinary Approach to Optimum Food Utility of Peanuts in SAT Africa" (AAMU/FT/S), under the Subgrant between the "MANAGEMENT ENTITY and the PARTICIPATING INSTITUTION.

The research project attached as Appendix I to this document defines in detail goals, objectives, procedures, individual obligations, and expected accomplishments; and serves as the overall guide for the planned research.

II. Goal.

The major goal of this research project is to develop means for greater utilization of peanuts as a direct food through determining the role of peanuts as food items in diets, improvement of existing peanut food products, and development of new peanut food products. Research will be conducted collaboratively between Alabama A & M University and the Agricultural Research Corporation, Food Research Center, (ARC,FRC) Khartoum, Sudan.

III. Objectives.

The overall objectives are:

- A. Description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies.
- B. Analysis of the current and potential dietary role of existing peanut products; and,
- C. Research on the improvement of existing peanut products and the development of new peanut products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.

IV. Cooperating Personnel

AAMU

Dr. Bharat Singh
Dr. Gerald Wheelock
Dr. John C. Anderson
Dr. D. R. Rao
Dr. Virginia Caples
Dr. Hezekiah S. Jones

ARC, FRC

Dr. B. I. Magboul
Dr. B. Bashir
Dr. A. K. Ahmed
Dr. A. S. Khalid
Dr. S. M. Badi
Mr. A. B. Zakaria

V. General Procedures for Accomplishing Research

The U. S. Principal Investigators plan to spend at least two accumulative months each year at ARC, FRC in research planning, supervision, and research. Selected ARC, FRC Principal Investigators will make training visits to the U.S.. Both AAMU and ARC, FRC Principal Investigators will independently spend time fulfilling the objectives of the project.

VI. Research Training

The U. S. Principal Investigators will provide on-site training for ARC, FRC scientists and technicians, short term training for selected ARC, FRC in the U. S., and provide graduate training for selected Sudanese students. Qualified researchers and individuals with baccalaureate degrees may apply for admission to graduate programs at AAMU to conduct thesis research (including classwork) on the proposed research that will lead to MS or PhD. degrees. U. S. Principal Investigators will participate in the selection of trainees. ARC, FRC should facilitate in clearance, approval, and to the extent feasible, financial support for students forwarding records and admission requirements for students in advance of arrival.

VII. Budget

Funds obligated for this project are \$83,733 for the period from date of final signature to April 30, 1983.

The tentative 5-year budget for this project is presented in Appendix II. This budget will be used as the basis for total annual allocations, and could change due to availability of funds from A.I.D. and deliberations of the Board of Directors and Technical Committee.

Based on consultations between U. S. and Sudanese collaborators in February 1982, the following year 1 plan for fund utilization was developed.

<u>Item</u>	<u>AAMU</u>	<u>ARC/FRC</u>
	<u>Year 1</u>	<u>Year 1</u>
	U. S. Dollars	
Salaries	\$18,064	9,650
Fringe Benefits	4,335	0
Equipment	1,290	14,000
Supplies	1,291	4,000
Travel	11,870	5,000
Other Direct Costs	2,064	1,913
Indirect Costs	7,169	3,087
TOTAL	<u>\$46,083</u>	<u>\$ 37,650</u>

A detailed annual budget plan will be submitted to the Management Entity by the Principal Investigator.

III. Duration

This project should run concurrent to the Prime Grant, subject to termination in accordance with Section II of the subgrant. This Plan of Work may be reviewed and/or revised annually as mutually agreed upon.

IX. Order of Precedence

The Prime A.I.D. Grant document and the Standard Provisions to the University of Georgia as Management Entity, and the Subgrant Agreement to Alabama A & M University as a Participating Institution take precedence over this document in any case of omission, or inconsistency that may occur between this and the above documents.

PLAN OF WORK - HOST COUNTRY
UNDER
MEMORANDUM OF UNDERSTANDING
Between
Alabama A & M University (AAMU)
and
Agricultural Research Corporation, (GRS,ARC)
Wad Medani, Sudan
to Conduct a
Research Project under the
Peanut Collaborative Research Support Program

I. Purpose

This Plan of Work implements the research project, "An Interdisciplinary Approach to Optimum Food Utility of Peanuts in SAT Africa" (AAM/FT/S), (Appendix I) under the Memorandum of Understanding establishing a Collaborative Research relationship.

II. Goal.

The major goal of this research project is to develop means for greater utilization of peanuts as a direct food through determining the role of peanuts as food items in diets, improvement of existing peanut food products, and development of new peanut food products.

III. Objectives.

The overall objectives are:

- A. Description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies.
- B. Analysis of the current and potential dietary role of existing peanut products; and,
- C. Research on the improvement of existing peanut products and the development of new peanut products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.
- D. Ensurance of safety of the products with particular reference to mycotoxins in raw and finished products; and
- E. Exchange of peanut germplasm for breeding resistant varieties to aflatoxin.

IV. Cooperating Personnel

AAMU Dr. Bharat Singh
Dr. Gerald Wheelock
Dr. John C. Anderson
Dr. D. R. Rao
Dr. Virginia Caples
Dr. Hezekiah S. Jones

ARC, FRC Dr. H.M. Ishag, National Coordinator,
Groundnuts Research.
Dr. B.I. Magboul, Nutritionist
Dr. B. Bashir, Director FRC
Dr. A.B. El Ahmadi, Breeder
Dr. A. S. Khalid, Microbiologist
Dr. S. M. Badi, Cereals Chemist
Mr. A. B. Zakaria, Economist.
Dr. M.A. Ali, Plant Pathologist
Dr. A.G. El Taveb, Chemist

V. General Procedures for Accomplishing Research

The U. S. Principal Investigators plan to spend at least two accumulative months each year at ARC in research planning, supervision, and research. Selected ARC researchers will make training visits to the U. S. Both AAMU and ARC researchers will independently spend time fulfilling the objectives of the project.

VI. Research Training

The U. S. Principal Investigators will provide on-site training for ARC scientists and technicians, short term training for selected ARC in the U. S., and provide graduate training for selected Sudanese students.

Qualified researchers and individuals with baccalaureate degrees may apply for admission to graduate programs at AAMU to conduct thesis research (including classwork) on the proposed research that will lead to MS or PhD. degrees. U. S. Principal Investigators will participate in the selection of trainees. ARC should facilitate in clearance, approval, and to the extent feasible, financial support for students forwarding records and admission requirements for students in advance of arrival.

VII. Budget

A. Pending fund availability each year through the Prime A.I.D. Grant for the Peanut CRSP, the following Year 1 budget is proposed for use by or for ARC in conducting this research project. The budget is subject to annual review and possible revision.

<u>Item</u>	<u>Year 1</u> U. S. Dollars
Salaries	\$ 9,650
Equipment	14,000
Supplies	4,000
Travel	5,000
Other Direct Cost	1,913
TOTAL	<u>\$34,563</u>

B. ARC shall submit, at least quarterly but not more frequently than monthly, to Alabama A & M University, a voucher identifying expenditures of claimed allowable costs by major categories and individual items within major categories. Copies of receipts or vouchers supporting these expenditures shall be attached.

Procedures to reimburse expenditures will be mutually agreed upon by ARC and AAMU in compliance with Item II. A. of Memorandum of Understanding between AAMU and ARC to Establish a Collaborative Research Relationship.

The form attached as Appendix II will be used for reporting expenditures; and estimates of ARC contributions in terms of personnel, supplies, equipment, and facilities will be reported on the form attached as Appendix III.

VIII. Inventory and Property Management

Title to all equipment, material, and supplies purchased by or for ARC under this Plan of Work will be in the name of ARC. All such property shall be under the custody and control of the Participating U.S. Institution. When requested, the collaborating institution shall submit an inventory schedule covering all items of equipment which have not been consumed in performance of the research. Advice will be given by the Participating U. S. institution as to the disposition of property at the end of the Plan of Work.

IX Duration

This project should run concurrent to the Prime Grant, subject to termination in accordance with Section II.B. of the Memorandum of Understanding. This Plan of Work may be reviewed and/or revised annually as mutually agreed upon.

X. Attachments

The research project outline attached as Appendix 1 to this document further defines goals, objectives, procedures, individual obligations, and expected accomplishments; and serves as the overall guide for the planned research. As the project progresses, necessary changes may be made in the project upon approval of AAMU and ARC Principal Investigators, and the Management Entity (to include the Technical Committee and Board of Directors).

XI. Approvals

Having read this Memorandum of Understanding, the persons below have signed their names and shown their agency affiliation indicating their concurrence with the collaborative research relationships outlined therein. All parties involved agree to use their best efforts to perform the duties required to attain the objectives of this research project, and to resolve any problems that may arise as the work progresses. This Plan of Work becomes effective upon execution of this document, a copy of which will be filed with the A.I.D. Mission.

U. S. PARTICIPATING INSTITUTION

HOST COUNTRY INSTITUTION

Bharat Singh 10.20.82
Principal Investigator Date

J. M. Ishak 9/8/83
National Co-ordinator G'nut Date
Research. ARC.

D. M. M. M. M. 10/20/82
Director, International Programs. Date

B. B. B. B. Date
Director, Food Research
Centre, ARC.

A. M. M. M. 10/20/82
President Date

S. S. S. S. 9/8/83
Director General, ARC Date

104

Report of travel regarding the project entitled:
AN INTERDISCIPLINARY APPROACH TO OPTIMUM FOOD
UTILITY OF PEANUTS IN SAT AFRICA

to

Democratic Republic of the Sudan and FAO
February 19 to February 27, 1982

BHARAT SINGH, Ph.D., Professor
Principal Investigator

Department of Food Science
Alabama A & M University
Normal, Alabama 35762

An activity report from International Programs, Alabama A & M University
and Peanut CRSP Planning Unit of the University of Georgia.

Supported by Grant AID/DSA N-G-0247

105

1. Purpose of the travel: To review and discuss details of the project entitled: An interdisciplinary approach to optimum food utility of peanuts in SAT Africa and the nature of the collaborative research between Alabama A & M University and Food Research Centre (Agricultural Research Corporation).

2. Itinerary:

. Left (Huntsville to Atlanta), USA, February 19; arrived at Khartoum, Sudan on February 20, 1982.

. Breakfast meeting with Mr. Eric Witt, U.S. AID, Agricultural Development officer and Mr. A. E. Moneim, a USAID staff on February 21, 1982 at 9:00 a.m.

. Arrived in Wad Medani at 10:15 a.m., breakfast with Dr. Bakhaeit, director of Agricultural Research Cooperation, Sudan and his staff on February 21, 1982.

. Visited and met with Dr. Hassan M. Ishag, national coordinator for Groundnut Research in the Sudan, Dr. A. M. El. Ahmadi, groundnut breeder and head of the Plant Breeding Section, Professor M. A. Ali, national coordinator for Botany and Plant Pathology Research on February 21, 1982.

. Visited the laboratories and Mr. A. G. T. Babikar (biochemist) on February 21, 1982.

. Visited with Dr. Hassan, director, Soil Survey Administration on February 22, 1982.

. Visited Gezira Scheme Headquarters. Mr. Samuel Wageeh explained the program and also showed a film about Gezira Scheme on February 22, 1982.

. Returned to Khartoum and conferred with Mr. Witt.

. February 23, conference with Mr. Witt and Dr. James Riley of the Western Sudan Agricultural Project (Washington State University) during breakfast. Later, met with Dr. B. Bashir, director of Food Research Centre, Dr. A. K. Ahmed, food scientist (oilseed specialist), Dr. A. S. Khalid (food microbiologist, Microbial Toxins), Dr. Sitt M. Badi (cereal chemist), Dr. B. I. Magboul (nutritionist), and Mr. Ahmed Badani Zakaria (agricultural economist).

. February 24, visited the Food Research Centre; presented a seminar and then discussed the project with the group; Dr. Khalid visited and discussed the aflatoxin program in the evening.

. February 25, left the Sudan; arrived in Rome, Italy.

. February 26, visited FAO and discussed the project and the topics of mutual interest with Mr. R. K. Malik, Dr. K. O. Herz, Mr. M. Manni, Mr. G. D. Kouthon and others.

3.0 Acknowledgement: I am grateful to Dr. C. R. Jackson, associate director of CRSP, for providing useful briefings on the objectives of CRSP and on the Sudan prior to arrival in Khartoum. Furthermore, I would like to express my gratitude to Mr. Eric Witt and Mr. A. E. Moneim for making all the necessary arrangements in Khartoum, Wad Medani and Gezira. Dr. Bakhaeit, director of Agricultural Corporation, Wad Medani, made our trip very useful through his staff. I appreciate his hospitality during our overnight visit to Wad Medani. Thanks are also due to Dr. Babikar Bashir, director, Food Research Centre, and his associates for their useful discussion. Dr. James Riley was very helpful during our visit in many ways.

4.1 Meeting with Dr. C. R. Jackson: Dr. Jackson met at the Atlanta Airport. We had a very useful discussion at the airport and continued throughout. Dr. Jackson briefed me about the development in CRSP and also the objectives of the trip. Even though I was aware of the objectives, discussions were useful in developing an understanding so as we could deal as a team with our counterparts in the Sudan.

4.2 Meeting with Mr. Eric Witt: Mr. Witt, USAID agricultural development officer in the Sudan briefed us about our itinerary. Mr. Moneim, who is a Sudanese and employee of USAID, accompanied us throughout our trip. Mr. Witt pointed out, at his first meeting, that we may have to help ARC in the area of aflatoxin monitoring programs. I pointed out that our project is primarily a food science project. However, Dr. Jackson and I both have to agree later that we have to include aflatoxin assessment objectives in our projects.

Mr. Witt expressed a keen interest in our project and expressed that USAID may further assist us in establishing an aflatoxin assessment program in the Sudan. Later, we met Mr. Sherper of the USAID. He was very concerned about aflatoxin in peanuts.

4.3 Travel to Wad Medani: Wad Medani is about 100 miles southeast of Khartoum (parallel to the Blue Nile). Dr. Bakhaeit, director of ARC, met with us at the guest house at a breakfast. Dr. El Ahmadi, the peanut breeder; Dr. E. L. Tigani, entomologist and director of Gezira Research Station; Professor M. A. Ali, national coordinator for Groundnut Research, were also present. Dr. Bakhaeit briefly described the organization of ARC (Table 1, Fig. 1).

Later on, we had a conference with Professor Ishag and the group. Professor Ishag explained the organization of the peanut program. He also pointed out that the Sudan is a part of the African Groundnut Council and participates actively in various programs. Professor Ishag outlined the problems facing peanut production and research needs for the Sudan. The most urgent problem facing the Sudan in peanut production, utilization, and export, is aflatoxin contamination. At

Democratic Republic of the Sudan

Table 1.

Name of Institution	Locality with mailing Address	Designation of Head Administrator	Outreach or Substation Locality	Main Research Activities
Gezira Research Station	Wad Medani, P.O. Box 126 Cable : Research	Director	Maatug, Turabi, Hag Abdalla	Soils, Agronomy, Breeding, Protection. Crops : Cotton, Wheat, Groundnut, Rice, Sorghum, Soybean, etc.
Kenana Research Station	Abu Naama, Blue Nile Province, Sudan Cable : Research Abu Naama	Director	Tozi, Agadi Samsam	Agronomy, Breeding, Protection, Mechanization of Sorghum, Sesame, Kenaf, Sunflower, Soybean
Hudeiba Research Station	P.O. Box 31, Ed-Damer Cable : Research Ed-Damer	Director	Dongola, Nuri	Agronomy, Breeding, Protection of grain legumes (H. Beans, Broad Beans Lentils, gram) and Horticultural (Vegetables and Fruits).
Food Research Centre	Khartoum North, P.O. Box 312	Director		Activities cover Canning, Dehydration, Microbiology, Engineering, Chemistry, Fats and Oils, Meat Tech., Cereal Tech. and Post Harvest Physiology, Training and Extension.
Yambio Research Station	Yambio, Equatoria Province Cable : Research Yambio	Director		Limited work initiated on plantation crops, grain legumes, groundnuts, cotton and upland rice.
Guncid Sugar cane Research Station	Guncid Research Station, Guncid.	Head		Sugarcane husbandry, varietal trials and introduction, Fertility and water-requirements of cane, Diseases.
Fish Research Centre	El Shagara, Khartoum P.O. Box 1489	Head	Lake Nuba, Dongonab on Red Sea, Kosti.	Aquaculture, marine and Oyster culture.
Forestry Research Section	Soba, P.O. Box 658, Khartoum	Head	El Obeid, Gum Arabic Station Wad Medani, Dongola and Southern Kordofan	Research on Silviculture, Aridzone Wood Tech., Botany and Gum Arabic.
Wildlife Research Section	Khartoum, Zoological Garden P.O. Box 16, Murada, Omdurman	Head	Dinder National Park	Ecology of wildlife species, feeding habits migration trends, diseases etc.
Pasture Research Section	Shambat Research Station, Khartoum North, P.O. Box 30	Head	Gezira and Ghazala Gawazat	Research on irrigated and rainfed pasture. Local and introductions.
Shendi Research Station	Shendi	Head		Horticultural crops namely : Onion, Tomatoes, Peppers etc. and fruits, Citruses and Mangoes, Pulse crops, Broadbeans and Dry Beans.
New Halfa Res. Station	New Halfa Research Station New Oalfa	Head	Gash, Tokar	Wheat Breeding, Agronomy of cotton, Groundnuts, Wheat and sugar cane. Weed control, Diseases of Sugar, Wheat and Cotton, Horticulture.
Sennar Research Station	Sennar Research Station, Sennar P.O. Box 36, Sennar	Head	Suki	Groundnut Breeding, Sugar cane, Agronomy and insect control Horticulture mainly breeding activity of Tomato
Kadough Research Station	Kadough Agric. Res. Station Cable : Research	Head		Modernization of Traditional Farming, Crops : Dura, Cotton, Sesame Soybean.
Rahad Research Station	Jebel El Fau, Rahad Scheme HQ.	Head		Mechanization of cotton and groundnuts, Horticultural crops.
Shambat Research Station	Shambat, P.O. Box 30, Khartoum North ; Cable : Buzur.	Head	Soba	Horticultural crops, Forage crops and Management of Saline Alkaline Soils.

present, the laboratory at Wad Medani is not capable of analyzing quantitatively the concentration of aflatoxin. Dr. Ali, who visited the United States recently, wants to develop a screening and selection program. Dr. Jackson and I emphasized that our projects may not be able to be fully devoted to the aflatoxin problem. However, we may assist in establishing a laboratory in the Sudan which in turn may provide services and also training to various groups including plant breeders.

We visited Mr. A. G. T. Babikar, biochemist in the laboratory. He has only a few materials available for aflatoxin assays. We felt the need for providing assistance to his laboratory. A list of things needed for this laboratory includes; solvents, thin-layer materials, mini-columns, and explosion proof blender. Dr. Jackson and I both discussed and agreed that there is a need for better maintenance of the laboratory. We also realized that the laboratory personnel at Wad Medani need to develop a closer cooperation with scientists at the FRC, Shambat.

Professor Ishag expressed the need for mechanization of harvesting peanuts. There are equipments available, but not suitable for the cracking soils. He will also like to have equipments for determination of oil and protein contents, and leaf area measurements.

Dr. Jackson prepared a memo for Mr. Eric Witt and recommended to fund these projects through the mission in the Sudan.

4.4 Visit to the Soil Survey Administration: The Soil Survey Administration is located at Wad Medani. We visited laboratories. Dr. Hassan is the director of the administration. The laboratories were well maintained. The survey is utilizing remote sensing procedures for producing maps and soil survey data.

4.5 Visit to Gezira Scheme: Mr. Samuel Wageeh explained the Gezira-Mangil Scheme. We also saw a documentary film about the Scheme. The Gezira is a large, flat plain lying south of Khartoum between the Blue and White Niles. Approximately two million acres of the land is irrigated by gravity flow. It is organized a trifartite partnership with the Sudan Gezira Board (SGB), the tenants and government shares in management and policy making. The SGB and government share major responsibility for establishing cropping patterns, rotation and prices. Size of the 96,000 tenancies ranges between 40 feddans (approx. 40 acres) in the old section to 15 feddans in the newer Mangil extension.

The Scheme uses a rotation of cotton, wheat, sorghum, groundnuts and fallow. In this scheme, there are only two principal cotton varieties, only one peanut variety and only two wheat varieties. Mr. Wageeh explained that introduction of newer lines requires much more management and may create confusion among tenants. Cotton and peanuts are cash crops. The tenant has to deliver all his crops to the government. Wheat and sorghum crops can be handled by the tenants. The Gezira Scheme has several departments such as agriculture, engineering, social and welfare.

1057

4.6 Visit with D James Riley: Dr. James Riley, who is the coordinator of the Western Sudan Agricultural Project (Washington State University), met with us on February 23. Dr. Riley explained to us his program. He was also very helpful in providing few information about the El Obeid area of the Sudan. He accompanied us to the Food Research Centre and joined the discussion with the group.

4.7 Visit to the Food Research Centre: At the Food Research Centre, we met Dr. Babikar Bashir, director of the centre, Dr. A. K. Ahmed, food scientist, Dr. A. D. Khalid, microbiologist, Dr. Sitt M. Badi, cereal chemist, Dr. B. I. Magboul, nutritionist, and A. M. Zakaria, agricultural economist. The group expressed an urgent need for assistance in aflatoxin assessment in peanuts. I presented the objectives of the proposal and provided each member with a copy of the summary and the major points of the project. Dr. Bashir and the group expressed several doubts and emphasized a need for collaboration but more in areas of establishing laboratories and training personnel than in survey. I made a point that we need to have a baseline data so that we could develop programs for food research and product development. The group expressed the need for further study of the proposal and a meeting the next day.

4.7.1 Second visit to the Food Research Centre: We revisited the centre on February 24. I presented a seminar explaining several research and training programs at Alabama A & M University. I also emphasized that we have (at Alabama A & M University) a number of students from African nations and several other developing nations of the world. The faculty members understand the need of developing countries and are helpful in many ways. There were a number of questions and discussions about the proposed project. We discussed the project again for the benefit of new members in the audience.

Later, we resumed our discussions in the director's office. The director, Dr. Babikar Bashir, announced that the Food Research Centre had decided to participate in Peanut CRSP. The faculty and the director agreed that Dr. B. T. Magboul would serve as the coordinator of the project in the Sudan. Dr. Magboul serves as the deputy director of the Food Research Centre and collaborates with the Ministry of Health. Other members to be included in the project are: Dr. Sitt M. Badi (cereal chemist); Dr. Amna S. Khalid (food microbiologist); Dr. A. K. Ahmed (oilseed chemist); and Dr. A. B. Zakaria (agricultural economist).

Furthermore, Dr. Magboul suggested that personnel from the Ministry of Health will be helpful in the food consumption survey. Three possible locations for the survey were named: Port Sudan/or Khartoum, El Obeid, and Wad Medani. Port Sudan serves as a port for export of peanuts and peanut products (crushed peanuts and meal) and may serve as a good place for survey, however, I personally would prefer Khartoum to be included in the survey. El Obeid is a developing town. Sorghum/Millet CRSP is conducting survey in this area. It serves as a center for trading peanuts and represents a sizable number of rural population. It may serve as one of the ideal centers for survey. Khartoum may be taken as an urban center for survey. Wad Medani is the headquarters of ARC and has farming areas. We will have excellent

support from the staff of the ARC. The final approval of the sites will be after the second visit by Dr. Singh and Dr. Wheelock.

Since aflatoxin problems were considered as one of the most urgent needs in the Sudan, Dr. Jackson and I suggested to the director that the Peanut CRSP would assist in establishing a laboratory to monitor aflatoxins at the FRC. Dr. Khalid has the training in U.K. and in India. At CFTRI, Mysore, she learned the latest techniques in aflatoxin monitoring in peanuts. She was very enthusiastic, and further discussed the problems with me in the hotel.

We visited the facilities at the FRC. The laboratories included farinograph, amylograph, mixograph, and facilities for milling and baking. The centre serves other African nations in quality evaluations for sorghum and millet. There were procedures developed to evaluate indigenous products such as kisara (chapati like products). The centre bakes bread for the Sudan airways.

We concluded our discussion and indicated that I and possibly Socio-Economist, Dr. Wheelock, or Dr. B. O. Okezie, director, International Programs, will return to the Sudan to get memorandum of understanding signed. The director, Dr. Magboul and other participants were ready to enter with agreements, and expressed that there would be no problem in working cooperatively.

4.8 Briefing with Mr. Eric Witt and Mr. Sherper: We met with Mr. Witt and Mr. Sherper of the USAID Mission in the Sudan. Dr. Jackson suggested that USAID Mission should aid Wad Medani's program in establishing aflatoxin research in Wad Medani and also should aid in providing few additional equipment for the breeding program. Dr. Ali's breeding project in Wad Medani needs cooperation from the mycotoxin group of the CRSP. Additional consultation may be needed on the mechanization project. Mr. Witt was willing to assist through his office to Wad Medani's research program. He expressed the need for assistance from Alabama A & M University in more than one area. However, he would wait until we firmly established our program. Mr. Sherper further emphasized the need for a aflatoxin monitoring program. We left the Sudan the next morning.

It was emphasized by Mr. Witt that we may need to talk with the group at Washington State University Western Sudan Project and develop closer cooperation with Dr. Riley in the Sudan.

5.1 Visit to FAO: I arrived in Rome on February 25 and contacted Dr. R. K. Malik, senior food technologist at FAO, Food and Nutrition group. Dr. Malik was very enthusiastic and was interested in details of our project. Since FAO has a program on aflatoxin in peanuts throughout Africa, the group was very much interested in our program. After my briefing about the project, Dr. Malik suggested that Alabama A & M must develop a better relationship with FAO through peanut research and also many other programs. Dr. K. O. Herz might serve as a consultant on a project. There should be a cooperation with African Groundnut Council (AGC).

Dr. K. O. Kerz discussed the program "Control of aflatoxin in groundnuts and products in Senegal, Ghana, Nigeria, Benin, and Sudan." He pointed out that among the AGC members, Sudan is the largest exporter of hand-picked, selected (HPS) groundnuts (peanuts) and one of the major exporters of peanut cake.

Aflatoxin contamination of groundnuts in the field and in storage is a problem, but the levels do not approach those found in Senegal, at least as far as the commercial export sector is concerned. He emphasized, though, that the situation may well be more serious in the case of groundnuts grown on rainfed land under less favorable conditions. Some lots of groundnuts and products available for local consumption have high levels of aflatoxins. He indicated that FAO has supported a training program for Sudanese chemists in Kano, Nigeria, and training and equipments for others.

Members of the FAO who could be of assistance to Peanut CRSP include: Mr. M. Manni, Mr. G. D. Kouthon, Mr. K. Malik and Dr. K. O. Herz. Mr. Manni is the senior officer for agricultural industries. He explained the role of FAO in establishing various agricultural industries in underdeveloped nations.

Mr. Malik explained the role of FAO in developing food processing, preservation and nutritional assessment in various countries. Dr. Herz and Mr. Malik both explained briefly about FAO food consumption surveys. A document entitled "Food Consumption Surveys, 1977, Vol. 2: Africa, Latin America, Near East, and Far East" describes the objectives, parameters and data on nutritional status of various countries. We will review these documents and it seems to have useful information for the Alabama A & M Project. Mr. Malik expressed his willingness to cooperate with Alabama A & M and Peanut CRSP.

The document entitled "Mycotoxins," FAO Food and Nutrition Paper 2 summarizes the proceedings of the joint FAO/WHO/NNEP conference on mycotoxins. Mr. Malik explained to me that peanut programs on mycotoxin should review the existing program in AGC member countries and should develop complementary programs. The conference on mycotoxins was held in Nairobi, Kenya, from the 19th-27th of September, 1977. The conference dealt with such topics as: environmental aspects, health and toxicological aspects, trade and economic aspects, practical, technical, economic aspects of detoxification. It is worthwhile to note that AGC representative mentioned that the problem of mycotoxins is a real one in member nations and also it appears there is no easy solution. The delegation from Nigeria stated that successful intervention programs were dependent on availability of good methods of detection, sampling and quantitation. He emphasized that development of suitable methodologies for sampling and analyses should have high priority, perhaps the highest.

I met several other members at the FAO including Mr. G. D. Kouthon, nutrition officer, Food Safety and Additives. I concluded the visit with a note that we will be seeking assistance and cooperation of FAO in the Sudan and possibly in other countries. Mr. Malik expressed his willingness to cooperate with us.

6.1 Relevant Information on the Sudan:

The Sudan is the largest country in Africa -- just under one million square miles or nearly the size of the U.S., east of the Mississippi. The country contains many different climatic, vegetation and physical regions and includes people from very different ways of life, religion and cultures. The Arabic culture, language and religion dominates the entire country except for the extreme South.

The Nile River dominates the draining of the basin and consists of two major tributaries -- the White Nile, issuing from Lake Victoria in Uganda, and the Blue Nile, flowing from Lake Tana in Ethiopia. After leaving the lake, the river drops off the East African highlands in a series of lakes and waterfalls, but upon entering the basin, it creates a vast swamp called the Sudd, probably the largest swamp in the world. From Lake Tana in Ethiopia, the Blue Nile winds its way through the mountains before entering the basin. For centuries, the Nile has brought fresh, rich soil which makes the valley so incredibly fertile. Khartoum, the capital of the country, is located where the White and Blue Nile meet. Between the two rivers, near the junction, is the Gezira (Arabic for Island).

The government has developed tributaries for irrigation and hydro-electric power. The amount of water that the Sudan can take from the Nile River System is limited to 20 million cubic meters yearly as most of the water is reserved under international treaty for Egypt. Hence, there is a limit to the Sudan's development of farming by irrigation. The Nile continues northward cutting through the Nubian sandstone and limestone deposits and, in places, cuts into the crystalline rock. When this occurs, a series of rapids or cataracts result. The Nile has six cataracts -- the most famous of which is at Awan in Egypt, but four other cataracts are in the Sudan. All are barriers to transportation.

Overall, the climatic factor is not a positive one for the Sudan. The climatic regions of the Sudan includes desert, Red Sea Hills, sparse grazing, grazing and cropping clay plains, and forest at the extreme south (Fig. 2).

6.2 Population: It is important to know few facts about the population for the benefit of the Alabama A & M project. It is especially important from the point of view of the proposed survey. The first modern census in the Sudan was conducted in 1955-1956. At that time, total population was estimated to be 10.3 million (Table 2). The major concentrations of population were in the Blue Nile Province (2069 thousand), Kordofan (1761 thousand), and Darfur Province (1328 thousand). Estimates based on the 1973 population census indicated the total population has increased to 14.7 million. For the Sudan as a whole, the rate of population growth in the period of 1955-1973 is estimated at 2.2 percent per annum. A study by the USAID estimates the population growth at 3.1 percent per annum. The population has grown more rapidly in urban areas (7.4% annually) as contrasted with rural areas (1.5% annually). This has been achieved by a deliberate attempt to reduce, per capita expenditure, on the development. The population in the Sudan is mobile to a high degree. It is estimated that at least

TABLE 2. Population Growth by Province 1955-73

<i>Province</i>	<i>1955-6 Census</i>	<i>1973 Census</i>	<i>Annual growth rate</i>
Darfur	1,328,765	2,139,615	2.7
Kordofan	1,761,968	2,202,345	1.3
Khartoum	504,923	1,145,921	4.7
Blue Nile	2,069,646	3,740,405	3.2
Kassala and Red Sea	941,039	1,547,475	2.8
Northern	873,059	957,671	0.5
Equatoria	903,503	791,738	-0.7
Bahr el Gazal	991,022	1,396,913	2.0
Upper Nile	888,611	836,263	-0.4
Six northern provinces	7,479,400	11,733,432	2.7
Three southern provinces	2,783,136	3,024,914	0.5
Total	10,262,536	14,758,346	2.2

SOURCE 1955-6 Census of Population, and Department of Statistics, 1975. The 1973 census results are provisional and subject to revision.

one million men and women move every year. A high proportion of the mobile population move about from place to place in search of better income-earning opportunities. Second, Sudan has a large number of nomads who move with their cattle according to a seasonal pattern. This flow runs along a north-south axis and has the largest concentration in Kassala, Darfar and Kordofan Province. Third, there is a persistent drift of population toward urban centers, partly associated with better jobs. Fourth, there is a constant east-west flow of people through the Sudan in connection with the holy pilgrimage to Mecca. These individuals often take up temporary residence in the Sudan, sometimes for a period of several years, saving money for the next leg of the trip.

6.3 Areas that are major recipients of mobile Sudanese include: the urban centers and the modern farming schemes such as Gezira. Migration, based upon opportunities for seasonal work in agriculture, is of substantial magnitude. In 1973-1974, the Gezira Board alone employed 542,000 people in harvesting the cotton crop, of whom 336,000 were seasonal in-migrants from other provinces.

Data provided in the 1973 population census indicates that in the period of 1955-1973, urban population had grown annually at a rate of 7.4% reflecting a tripling of urban population in the Sudan. In 1973, approximately 35 percent of the urban population in the Sudan resided in the Three Towns area of Khartoum. Data indicate that over 3/4 of the migrants were working in agriculture prior to migrating to Khartoum. Main reasons for leaving their original provinces include: lack of job opportunities, lack of rain for good crops, and low incomes. Included in pull factors for Khartoum are higher average annual earnings, job availability, better education, and low cost of migration due to the friends and relatives who provide shelter and basic amenities.

The labor force participation rate is given in Table 4. It is apparent that boys start to work at an early age, that the great majority of men are economically active, that the females participate to a markedly lesser economic degree; and that for females, subsidiary occupations are more important by number employed than main occupations (see also Table 3).

6.4 Occupation: The general results of occupational analyses in the 1955-1956 census indicate: (1) agricultural activity dominates in both main and subsidiary occupations; (2) adult males outnumber adult females in main occupations by a ratio of 10 to 1; (3) adult females outnumber adult males in subsidiary occupations; (4) there is a great scarcity of professional, marginal, and skilled manufacturing workers; (5) the work force engaged in the manufacturing commerce and clerical categories is very small.

The data from the population census of 1973 indicate more or less a similar trend. The most significant point to note is that the agricultural activity continued to dominate as a source of employment, but now accounts for a somewhat lower percentage of over employment (Table 5).

6.5 Economy: According to the United Nations Survey, the Sudan is one of the 25 least developed countries. The Sudan shares the following economic and related characteristics with these countries: (a) Per capita Gross Domestic Product (GDP) of approximately \$100; (b) a share of manufacturing in GDP of 10 percent or less; (c) illiteracy of 75 percent or higher; and (d) a low per capita level of electric power consumption. Africa accounts for 16 of these 25 countries, and the Sudan is among the largest of all countries designated as least developed (Table 5). The economic development prospects of these countries are hampered by poor physical infrastructure, lack of trained manpower, and a shortage of resources for investment.

Sudan's economy is heavily dependent on agricultural production (40% of GDP in 1971), and exports of agricultural and primary products account for a substantial part of the GDP (25.4% in 1971). The Sudan suffers from a lack of well developed internal transportation facilities. As of 1972, approximately 1/4 of the population of the Sudan lived in the

modern sector, and 3/4 in the traditional sector. Approximately 85 percent of the population derived its livelihood from primary industry activity, including herding and cultivation of crops. A large part of the population engaged in primary industry activities follows a traditional pattern, and relies on hand-operated irrigation methods or scarce rainfall. By contrast, the modern sector has adopted power-operated or gravity-flow methods of irrigation and the use of mechanical implements.

While most of the population engaged in agricultural pursuits, produced primarily for their own subsistence, many market their surplus when the opportunity presents itself. Moreover, much of the agricultural output in the modern sector is used for subsistence. Some cultivators and herders that produce largely for their own use regularly sell products, such as gum arabic, sesame, or groundnuts, in the commercial markets to supplement their livelihood.

In the Sudan, the modern sector received its impetus with the introduction of cotton production in the irrigated areas in the 1920s. By the late 1960s, the modern sector accounted for half of the total output and provided 1/3 of the overall employment. The Gezira has been a core of the modern sector. However, most crops grown by the Gezira tenants (except cotton) are for subsistence. Moreover, a major export product, gum arabic, is produced within the traditional sector. The government has played an increasingly important role in the expansion of economic activity, and the development of new areas of employment and income-yielding opportunities. Data available on the growth of agricultural output (Table 7,8) in the Sudan suggest that in the two decade period ending in 1975, acreage and production increased nearly fourfold.

6.6 Agriculture: Agriculture is the major marketable commodity in the Sudan. It contributes approximately 40 percent of the Gross Domestic Product, generates over 90 percent of the Sudan's merchandise exports, provides the bulk of raw materials needed for local industries, and provides employment opportunities for over 3/4 of the work force.

116

Table 7. SUDAN PRODUCTION OF OILSEEDS - AND ITS SHARE IN WORLD
 PRODUCTION - 1974-1979 (estimated) QUANTITY IN "1000" M/TONS

SUDAN P R O D U C T I O N O F / Y E A R	1974	1975	1976	1977	1978 est	1979 est.
Groundnuts Inshell % Share in World Production	928 5.6%	878 4.8%	705 4.2%	852 5.2%	829 6.7%	650 5.3%
Sesameeds % Share in World Production	232 12.2%	212 11.3%	231 12.5%	284 14.9%	220 11.5%	210 10.9%
Castorseeds % Share in World Production	15 1.3%	16 2.2%	3 .4%	2 .3%	8 .9%	- -

Source: Sudan Oil Co., Ltd, Research Information and Public
 Relations Centre

Approximately 200 million feddans (approx. 1 feddan = 1 acre) is considered suitable for crop or pastoral farming. As of 1975, approximately 16 million feddans were under cultivation, and of this about 4 million acres were irrigated. Agricultural crops grown within Sudan include: cotton, grains, sesame, fruits and vegetables. A basic constraint on agricultural production is availability of water. For this reason, expansion of agricultural production has taken place along the Nile, its main tributaries and in the regions of the Sudan endowed with adequate rainfall.

There are three main types of agriculture practiced in the Sudan. These include irrigated agriculture, rainfed agriculture and traditional agriculture. Irrigated agriculture is limited mainly to the area lying between the Blue and White Nile, and smaller areas along the Atbara and Rahad Rivers. In these areas, long, staple cotton, groundnuts, wheat, and fruits and vegetables are cultivated. Rainfed agriculture is carried out mainly in the region east of the Blue Nile in the general area of Gedaref, and in the Southern Kordofan Province. A large part of this activity is mechanized and very extensive land areas are involved. Production is concentrated in sorghum, sesame, and short-staple cotton. In recent years, wheat, groundnuts, and sesame production has increased rapidly in these rainfed regions. Traditional agriculture is carried out in the central and western areas of the Sudan, as well as in all of the southern regions. Very little surplus product is available for market. Livestock production has remained organized along traditional lines and consequently limits the return accruing to the livestock producer.

6.6.1 In the Sudan, modern agriculture has been carried out largely under the authority of state corporations. In the irrigated areas, this has meant the formation of such agencies as the Gezira Board and Rahad Corporation. In the regions where dry farming (rainfed) has dominated, the Mechanized Farming Corporation has functioned as a central organization unit. In addition, several state enterprises have provided monopolistic purchasing, marketing, and distributing power over crops produced. In addition, the Ministry of Agriculture has established the Agriculture Research Corporation (ARC) with several substations (Figure 1).

The Food Research Centre, Sambat, a part of ARC was established in 1965 in the Sudan by the United Nations Development Programme (UNDP) as a joint undertaking with the Ministry of Agriculture and FAO. The purpose of the centre is to provide research, education, training and advisory services in the field of Food Science and Technology. It has the following departments and sections: (1) Post Harvest Physiology Department, (2) Fruits and Vegetable Technology Department, (3) Grain Technology Department, (4) Animal Products Technology Department, (5) Food Microbiology Department, (6) Chemistry, Oils, Fats and Oilseed Products Department, (7) Food Engineering Section, (8) Food Economics and Marketing Section. The centre possesses pilot plants, lecture rooms, a library, and a unit for information and documentation. It also has a 100 feddan farm at El Faki Hashim. It has a staff of 244 including 48 research scientists, 5 assistant research scientists, 45 technicians, 16 administrative staff and 130 skilled and unskilled workers.

115

Gezira Scheme: The Gezira is a large, flat plain lying south of Khartoum between the Blue and White Niles. The area is irrigated by gravity floatation. The Gezira is organized as a tripartite partnership with the Sudan Gezira Board (SGB), the tenants, and government sharing in management and policy making. The SGB is in the process of reallocating land cultivation. This involves a reduction in cotton acreage of 1/3, and increases in land area devoted to growing wheat and groundnuts. This has been done to alleviate the seasonal demand of farm labor, provide a greater self-sufficiency in food products, possibly improve the merchandise trade balance on agricultural goods and to improve the ability of SGB to mechanize harvesting (grains and groundnuts).

Rahad Scheme: The Rahad Scheme involves developing 300,000 feddan areas of irrigated land on the east bank of the Rahad River.

Livestock: The Sudan possesses animal wealth which contributes about 10 percent to GDP annually. It has been estimated that livestock totals in 1971-1972 were 12.9 million cattle, 10.9 million sheep, 7.8 million goats, and 2.5 million camels.

The forests of the Sudan represent, but as yet, a largely untapped resource.

6.7 Transport: The transport system of the Sudan consists of a network of 4757 kilometers of single track railways, 3500 km of river steamship and barge services, and approximately 18,000 km of road and track. The Sudan has 20 all-weather airfields plus the international airport at Khartoum. It has a single harbor facility at Port Sudan. The Sudan railways encompasses the largest line in Africa (Figure 4). The road and highway system is not well developed. The Sudan railways provide the main transportation system.

6.8 Information on Organizations Related to Peanuts: Agricultural Research Corporation (ARC), Wad Medani. The ARC is part of the Ministry of Agriculture. It works on peanuts and chiefly supports irrigated cultivation in the various large schemes (e.g. Gezira). Plant breeding for resistance to aflatoxin is an important regular activity of the ARC. Dr. El Ahmadi, head of the plant breeding section, had conducted research using resistant lines from the USA and ICRISAT. ARC has attempted to establish an aflatoxin testing laboratory.

Plant Propagation Administration, Sennar: FAO operates an oil-crops seed production project that has generated the necessary seed of two groundnut varieties for planting in the Gezira and other large-scale schemes.

National Health Laboratory, Ministry of Health, Khartoum: The contaminant laboratories are well staffed and equipped adequately.

Sudan Oil Co., Port Sudan: The HPS groundnut operation is well organized in 15 lines controlled by Sortex (electronic sorting) and manual inspection.

Sheikh Oil Mill Co., Ltd, Port Sudan: HPS groundnut processing is in 16 lines, Sortex basis. A statistical sampling plan is used to ensure that HPS lots test negative by aflatoxin analysis method sensitive to 5 ppb. The plant contains facilities for groundnuts and other oilseeds (e.g. cottonseed).

Walliab Oil Mills, Port Sudan: The crushing and solvent extraction plant for groundnuts.

7.1 Peanut Production and its Relationship to Economy in Sudan: Peanut is an important cash crop in the Sudan. It provides 7 percent of the GNP and employs 12 percent of the population. Sudan is the fourth leading country in groundnut production after India, China, and the United States (Tables 5-9). The production has increased about 320 percent since 1965. The three major regions of peanut production are Gezira and Mangil (42%), North Kordofan (17%), and South Darfur (14%).

The average pod yield is low, being 600 kg/ha in rainfed areas and 1440 kg/ha in irrigated areas. In sands of the western region of the Sudan, the early maturing variety, Barberton, is sown by hand when rains start. This variety matures in about 100 days. Plant population is low. No fertilizers are used and weeds are controlled by hand. Proper rotations are not followed and shifting cultivation is the normal practice. Crops grown with peanuts are sesame, roselle (Hibiscus sabdariffa, L) and millet.

Peanuts in irrigated areas are normally planted in June in a row spacing of 80 cm with about 300m between plant holes and with 1-2 seeds per hole. Different rotations are adopted; in Gezira, a four course rotation (cotton - wheat - groundnuts/sorghum - or rice fallow); in Mangil, a three-course (cotton - wheat - groundnut/sorghum), and in Suki and Rahad, a two-course cotton-groundnut watering is every two weeks, and a light watering is given seven days before harvest to facilitate pulling of groundnuts as the soils are heavy clay. Tenants normally delay harvest and this causes losses of pods in the soil.

Groundnut improvement by selection in the Sudan has received more attention recently and a full time breeder is now in charge of a program aimed at the development of high yielding, early maturing, spreading bunch types adapted to the irrigated Vertisols; selection of early maturing, drought tolerant cultivars for the rainfed sandy soils of Western Sudan; selection of large seeded Virginia types for production in Northern Sudan; development of genotype with increased resistance to infection by Aspergillus flavus and aflatoxin production; and development of genotypes with high oil content and high kernel yield. Breeding materials have been collected from the USA and ICRISAT.

There are several problems associated with peanuts including identification of pests and an extensive program in disease control.

The adverse climatic conditions in the Sahel have also affected the output in the Sudan. Yields have been low and quality of nuts not as good as in normal years. A large-scale shift to cultivation of groundnuts in large schemes on irrigated land has been underway for some time, and very substantial increases in production and exports of

groundnuts and products are foreseen in the current development plan of the Sudan. This shift is likely to entail a drastic decline in groundnut production as a cash crop for smaller farmers. In 1980-1981, harvest was considerably reduced from more than 600,000 tons which had been available for processing in earlier periods. A number of oil mills in the Khartoum and Port Sudan areas are idle or working only part of the time, due to lack of oilseeds, particularly peanuts and cottonseed. Processing of HPS groundnuts is given priority.

Aflatoxin contamination of groundnuts in the field and in storage is a problem, but the levels do not generally approach those found in Senegal, at least as far as the commercial export sector is concerned. The situation is more serious in rainfed areas. Some lots of groundnuts and products available for local consumption have high levels of aflatoxins. Aflatoxin analyses of 101 samples of groundnuts and products obtained in the metropolitan area revealed that occasionally very high levels are encountered (500-6000 ppb). Proper surveys are needed to elucidate the extent of the problem.

Storage constraints: Lack or inadequacy of storage at the farm or village level entails three serious problems for the farm family and the farm economy:

(i) Many subsistence-level families are forced to sell part of their crop for a low price at the harvest time and to buy grain at scarcity prices later in the year.

(ii) Spoilage is considerable -- said to average around 25 percent nationally and to go much higher locally.

(iii) Traditional farmers have an added disincentive for not producing for the market.

In many cases, simple improvements to and perhaps increase expansion of the traditional storage facilities, may be sufficient. The most common measure is the introduction of insecticides. However, storage insect pests have a high ability to develop resistance to these insecticides. One of the best systems that can be recommended for use by the farmer is some method of a sealed storage in airtight containers to reduce oxygen levels to the point where insects cannot survive. A separate problem is the storage of cropseed from one season to the next. Centralized village stores may require an effective protection process that can be applied regularly.

8.1 Collaborating Institutions and Scientists from the Sudan

Institution: Food Research Centre, Sambat

Scientists: Bahieldin Magboul, Ph.D., Food Scientist,
Nutritionist - Coordinator

Sitt Badi, Ph.D., Cereal Chemist

A. S. Khalid, Ph.D., Food Microbiologist

A. B. Zakaria, M. S., Agricultural Economist

A. W. K. Ahmed, Ph.D., Oilseed Chemist

Training and experience of the scientists at FRC is adequate. They have relevant experience.

REPORT OF TRAVEL REGARDING THE PROJECT ENTITLED:
AN INTERDISCIPLINARY APPROACH TO OPTIMUM FOOD UTILITY OF
PEANUTS IN SAT AFRICA

to

DEMOCRATIC REPUBLIC OF THE SUDAN AND FAO
May 26 to June 7, 1983

Bharat Singh, Ph.D, Professor
Principal Investigator
Department of Food Science
Alabama A & M University
Normal, Alabama 35762

An Activity Report from Peanut CRSP, International Programs,
Alabama A & M University supported by Grant AID/DSA N-G-0247

TABLE OF CONTENTS

- 1.0 Purpose of Study
- 2.0 Executive Summary
- 3.0 Itinerary
- 4.0 Acknowledgement
- 5.1 Meeting with Dr. David Cummins
- 5.2 Meeting with Dr. James Riley
- 5.3 Meeting with Dr. Brian D'Silva
- 5.4 Visit to the Food Reserach Centre
- 5.5.1 Visit to the Western Sudan Project Office (Dr. Riley)
- 5.5.2 Meeting with Eric Witt and Joyce Turk
- 5.6 Visit to Wad Medani and Meeting with Dr. Bakhaeit
- 5.7 Visit to Food Research Center and Ministry of Health
 - 5.7.1 Meeting with Dr. Kamal
 - 5.7.2 Revisit to the Ministry of Health
 - 5.7.3 Meeting with Investigators at the FRC
- 5.8 Visit to the Ministry of Agriculture
- 5.9 Agricultural Prices and Policy Conference
- 5.10 Meeting with Miss Joyce Truk
- 5.11 Meeting of the U. S. Team and Sudanese Collaborators
- 5.12 Pretest of the Survey Document
 - 5.12.1 Visit to the Western Sudan Project Office
 - 5.12.2 Visit to the FRC
 - 5.12.3 Meeting with Dr. Brian D'Silva
- 6.1 Visit to FAO, Rome
- 6.2 Meeting with Dr. Dawson

1.0 Purpose of Travel:

To finalize details of the project (including plans for consumption and post-harvest surveys, and aflatoxin monitoring programs) with counterparts at Agricultural Research Corporation and Food Research Centre.

2.0 Executive Summary:

Dr. B. Singh (Food Scientist and Principal Investigator), Dr. G. Wheelock (Rural Sociologist), Dr. V. Caples (Nutritionist) and Dr. H. Jones (Rural Economist) travelled to Kharatoum and Wad Medani in Sudan and FAO, Rome from May 26 - June 7, 1983. The purpose of this trip was to finalize details of the project outlined in the work plan. The Plan of Work, including survey instruments, implementation strategies, sites of the survey, and aflatoxin laboratory was discussed in detail with the host country Principal Investigator, Deputy Principal Investigator and Co-Investigators. Dr. M. Bakhaeit Said designated Dr. Hassan Ishag as the Principal Investigator and Dr. B. Basher as the Deputy Principal Investigator. We were successful in getting the work plan formally approved by the officials in the Ministry of Agriculture. With few exceptions, the survey instruments prepared at Alabama A & M University were found to be satisfactory.

3.0 Itinerary:

- May 26 - 27: o Left (Huntsville - Atlanta & New York) USA, May 26. Arrived at Khartoum, Sudan on May 27, 1983. Met Dr. David Cummins at Atlanta Airport. He brought germplasm for International groundnut aflatoxin resistance trials to be delivered to Dr. Ahmadi at ARC in Sudan.
- May 28: o Contacted Dr. James Riley at the U. S. Embassy (USAID Mission was closed). Dr. Riley took us to his office of the Western Sudan Agricultural Project and attempted to send message to Dr. M. Bakhaeit, Director of Agricultural Research Corporation.
- o Visited with Dr. Brian D'Silva who took us to the FRC, Shambat where we visited with Dr. B. Bashir, Director of FRC.
- May 29: o Visited U. S. Embassy, attempted to contact Mr. Eric Witt (holiday for U. S. personnel).
- o Visited Dr. Riley and planned for a trip to Wad Medani. Met Auburn University Fisheries team. Watched a film on the history of ARC.
- o Mr. Eric Witt and Ms. Joyce Turk visited with us in the evening at Araak Hotel.
- May 30: o Went by bus to Wad Medani (3½ hour ride from the bus stand).
- o Met Dr. M. Bakaeit Said, Director, who agreed to visit the Ministry of Agriculture to get the work plan approved.

- o Met Dr. Hassan Ishag, National Coordinator for Groundnut Research in the Sudan, and Dr. A. M. El Ahmadi, Groundnut Breeder and head of the Plant Breeding Section. Plan for a meeting with FRC and ARC collaborators in Khartoum.
- May 31:
- o Visited Dr. A. Khalid, Dr. B. I. Magboul, and Dr. B. Bashir and reviewed the project plan.
 - o Visited Dr. Kamal Ahmed Mohd, Director, Nutrition Division, Ministry of Health. He agreed to cooperate on the survey. We also met with Miss Aziza and arranged for a pretest of the survey instrument.
- June 1:
- o Visited Dr. Kamal at the Ministry of Health and made notes from previous surveys.
 - o Visited FRC again and met with Drs. Magboul, Bashir, Khalid and Badi and Mr. Zakaria. Discussed budget, sites of survey and related matters.
- June 2:
- o Dr. Bakhaeit came to the hotel and took us to the Ministry of Agriculture. The Director of Planning explained to us that the document was ready to be signed.
 - o Dr. Bakhaeit introduced us to Mr. Syed Zaki, Deputy Under Secretary, Finance and Planning, Sudan. He took us to the Friendship Hall to attend Agricultural Prices and Policy Conference.
 - o Visited Joyce Turk at the USAID Mission and briefed her on our activities in the Sudan.

- o In the evening we visited market place in Omdurman with Amna Khalid. She invited us into her home.
- June 3:
 - o Meeting with Drs. Ishag, Bashir, Magboul, Ahmadi, Mr. A. G. T. Babikar (Biochemist) and Mr. Zakaria. Dr. Riley was also present.
 - o Lunch at the Friendship Palace as guest of Dr. Bashir.
- June 4:
 - o Visited Nutrition Division, Ministry of Health. Met with Miss Aziza. Dr. Caples, Dr. Wheelock and I accompanied her to Omdurman for pretest of the survey document.
 - o Visited Dr. Riley in his office and briefed him.
 - o Visited Dr. Magboul and Dr. Bashir.
 - o Brian D'Silva visited us in the evening.
- June 5:
 - o Left the Sudan; arrived in Rome, Italy.
 - o Called Dr. Malik's house but he was gone to Geneva.
- June 6:
 - o Visited FAO. Contacted Dr. K. Herz.
 - o Contacted Dr. Bhattacharjee, Director of EST. He arranged meetings for Drs. Wheelock and Jones with Mr. Cortas and Dr. P. Poetiray, Mr. Pariboni.
 - o Visited Dr. J. Perisse, Dr. R. J. Dawon
- June 7:
 - o Left Rome, arrived Huntsville.

4.0 Acknowledgment:

I would like to express my gratitude to Dr. James Riley for his assistance during our visit. Mr. Eric Witt and Ms. Joyce Turk provided useful suggestions. I appreciate the hospitality extended by

Dr. B. Bashir, Dr. M. Bakhaeit and Dr. Hassan Ishag. Dr. Amna Khalid was very gracious in inviting us to her home and also for a trip to the market place. At FAO, we appreciate the assistance of Dr. Bhattacharjee and Dr. Richard Dawson in obtaining necessary information.

5.1 Meeting with Dr. David Cummins::

On May 26, Dr. Cummins met us at the Atlanta Airport and handed over the germplasm to be given to Dr. Ahmadi at ARC, Sudan. This is to implement part of the objectives outlined in the work plan to exchange peanut germplasm for breeding resistant varieties to aflatoxin.

5.2 Meeting with Dr. James Riley:

On May 28, Dr. James Riley told us that our planned visit was cancelled. Apparently, the telex did not reach us in time. It was indeed a surprise to us. He also told us that the work plan had not yet been approved by the Minister of Agriculture. I decided that we would visit Wad Medani. Dr. Riley attempted to send a letter to Professor Bakhaeit and explained to us that communication between Khartoum and Wad Medani is very difficult.

5.3 Meeting with Dr. Brian D'Silva::

Dr. Brian D'Silva from USDA, ERS is on an assignment to the Sudan. He is currently teaching Rural Economics in the Faculty of Agriculture, University of Khartoum and supervising research for several M.Sc. students. We briefed him about our project. Later, he went with us to FRC. Dr. D'Silva could serve as a resource person on our project. He is conducting a survey in the El Obeid area on farming systems. He provided some useful information on this area.

5.4 Visit to the Food Research Centre:

At the Food Research Centre, we met Dr. Babikar Bashir, Director of the Centre. He indicated that the work plan is yet not signed and he or other members at the centre cannot proceed on the project before the approval from Dr. Bakhaeit. He suggested that we should first contact Dr. Bakhaeit and then make plans. We discussed the progress of the events with Dr. Khalid (microbiologist) and Dr. Magboul (Nutritionist). Dr. Magboul discussed the plan of survey with the team and indicated that Dr. Kamal at the Ministry of Health is willing to cooperate with us. We left the copies of the survey document with Dr. Bashir and Dr. Magboul to review. We also indicated that before we left Sudan we would like to have the survey document pretested.

5.5.1 Visit to the Western Sudan Project Office (Dr. Riley):

May 29 was a holiday for U. S. Personnel. We went to the U.S. Embassy to contact Mr. Eric Witt. However, he could not be reached. We revisited Dr. Riley in his office and planned for a trip to Wad Medani. We met Auburn University team for fisheries.

5.5.2 Meeting with Eric Witt and Joyce Turk:

Contacted Mr. Eric Witt by phone. Later, he and Joyce Turk visited us in the evening at Araak Hotel. Mr. Witt suggested that we should visit Wad Medani. He also assured us that the USAID Mission in the Sudan will assist us in sending materials and communications. He, however, emphasized that the Mission may not directly get involved in monitoring the project. He also indicated that the Mission may be able to assist the breeding project of Dr. Ahmadi.

5.6 Visit to Wad Medani and Meeting with Dr. Bakhaeit:

We went to Wad Medani by bus and visited Dr. Bakhaeit, Director of the ARC. Dr. Bakhaeit expressed his concern and emphasized that he could not allow the project to start unless it is signed by the Minister of Agriculture. I requested him to accompany us to the Ministry so as we can present our problem. I wanted to point out that the project's first fiscal year will end by June 30, 1983 and further delay in implementation will lead to problems. Dr. Bakhaeit agreed to go to the Ministry.

He emphasized that the budget has to be handled by the ARC and the money should be channeled through the Office of the Director. Further, Professor Hassan Ishag will be the Principal Investigator and Dr. B. Bashir will act as Deputy Principal Investigator. Dr. Magboul, Dr. Khalid, Dr. Badi and Mr. Zakaria will be co-investigators. The work plan will include changes outlined in his earlier communications. The most important thing he wanted us to emphasize is that we should plan our trip well in advance. The lack of communication, especially phone, causes delays in response.

I assured Dr. Bakhaeit that we will not interfere in handling the ARC budget. However, the ARC needs to have (a) a separate account, (b) and should spend money only on the project related expenses, and (c) at the time of audit, records should be made available for auditing by ARC. Dr. Bakhaeit told us that Dr. Ishag has been handling similar projects from other agencies, such as IDARC and he is familiar with all the problems. The office of the Director at Wad Medani is capable of handling the accounts.

Later, we visited with Professor Ishag in his office. He treated us very nicely. We also visited Dr. Ahmadi and delivered the germplasm from Dr. Nixon. I requested for a meeting with all Peanut CRSP collaborators in Khartoum. Dr. Ishag proposed a meeting on Friday at 10:00 A.M. at the FRC. He wrote a letter to Dr. B. Bashir and invited him and other FRC members to the meeting. The team members were pleased with the progress of the events in Wad Medani.

5.7 Visit to Food Research Center and Ministry of Health:

On May 31, Dr. V. Caples and I revisited FRC. Dr. Wheelock and Dr. Jones went to see Mr. Hassan Wahbi, Manager of Research and Public Relations at Sudan Oil Seed Company. At the FRC, we visited Dr. Khalid, Dr. Magboul, Mr. Zakaria and Dr. B. Bashir.

Dr. Magboul reviewed the project objectives and discussed his scope of work. He explained his problems in conducting proximate analysis of samples. He pointed out that the capacity of the equipments in Dr. Badi's laboratory to handle analysis is not enough. We must add additional equipments and supplies. I suggested to him to prepare a list of equipments and supplies so as it can be included in the 1983-1984 budget. I also emphasized that a prior approval to buy equipments is necessary.

Dr. Amna Khalid presented her list of equipments and supplies to aflatoxin laboratory. I already had received her list and pointed out that her equipments and supplies will be purchased as soon as we receive approval of the Minister of Agriculture. She seemed to have made all preparations for implementing her objectives. She had a considerable amount of material obtained from various sources including Tropical Products Institute, London.

5.7.1 Meeting with Dr. Kamal:

Dr. Kamal Ahmed Mohd, Director of Nutrition Division, Ministry of Health, Khartoum, met with us and Dr. Magboul in his office. We also met Miss Aziza who has worked as an interviewer before. As a group, we went through the survey document and wanted comments from Dr. Kamnal and also from Dr. Magboul and Miss Aziza. They thought that the document is good enough and it does not need further modifications. It also does not need translation into Arabic. The interviewers are well-trained and will have no problem in translating in Arabic during the interview.

Dr. Kamnal assured us that he and his department will participate in the survey, however, we have to bear the cost of transportation.

Dr. Kamnal had data on nutritional intake, however, he did not allow us to remove and copy the documents. We made notes and planned to return next morning for further discussions.

We made a plan to return to Dr. Kamnal's office on Saturday and go for a pretest of the document. We requested Dr. Kamnal and Miss Aziza to review the survey document so as we can make necessary modifications if needed.

5.7.2 Revisit to the Ministry of Health:

On June 1, Dr. Caples and I revisited the Ministry of Health and had conference with Dr. Kamnal. He outlined some problems in the data on surveys made in the Sudan and suggested that interpretations and inferences should be drawn after a careful analysis of the data only.

5.7.3 Meeting with Investigators at the FRC:

The team met with the FRC group in Dr. Bashir's Office and discussed following topics as a group. Earlier, we met individually with Dr. Khalid, Dr. Magboul, and Mr. Zakaria. Dr. Badi joined the group for a brief period. The following topics were discussed: (1) Survey plan, (2) survey documents, (3) Cost of survey, (4) Survey sites, (5) problems associated with survey, (6) possible collaboration with sorghum/millet CRSP, Western Sudan Project, AID Mission; (B) (1) Sampling procedure for aflatoxin analysis and proximate analysis, (2) detailed list of equipments and supplies for the aflatoxin laboratory, (3) maintenance of the quality of analyses through check samples programs of the American Oil Chemists Society or other groups, (C) (1.) List of equipments and supplies for nutrient analyses (2.) technician time (D) Plan for the next year's budget, (E) collaborative nature of the project and need for a well-knit group to achieve the final objectives of the project; (F) (1) Membership to professional societies in the United States (2.) purchase of books and journals; (G) Student recruitments (admission requirements and screening for assistantships).

This meeting was very useful and helped us to prepare for a final meeting with Professor Ishag, Dr. Ahmadi and Mr. Babiker from the ARC, Wad Medani.

I had a detailed discussion with Dr. Khalid about aflatoxin tests. She has plans for comparing results obtained through fluorotoximeter with other available methods. I suggested that she needs to get her laboratory on the check sample program of the AOCS to maintain quality of her determinations. She must further maintain relationships with the

TPI, London, and other agencies. We also discussed the plan of sampling, storage of samples and time lag from the time of collection to the final determinations.

We had discussions with Dr. Magboul. Dr. Bashir emphasized that the laboratory equipments in Dr. Badi's cereal laboratory may not be adequate for our projects. We reviewed the list of equipments and supplies for Dr. Magboul and agreed to include in the next year's budget.

There were no specific suggestions on the survey document by Dr. Magboul. Mr. Zakaria suggested that we should include informations on inputs on the crop such as fertilizers, pesticides, etc. He also pointed out the transportation problems in the El Obeid area. We suggested to maintain a close relationship with Western Sudan Project. Dr. D'Silva may also be helpful in the survey.

I suggested that Dr. Bashir and possibly others should become members of the professional societies in the United States. It will allow them to receive journals and provide opportunities to attend meetings. The suggested list of societies (associations) are: Institute of Food Technologists, American Association of Cereal Chemists, American Oil Chemists Society, and American Peanut Research and Education Society. Dr. Bashir and the group were very much interested in becoming members. They also wanted to buy books such as: Methods of Analysis, AOAC, AOCS, and AACC. They expressed problems in obtaining journals and books. The Peanut CRSP should assist in this regard.

5.8 Visit to the Ministry of Agriculture:

On June 2, Dr. Bakhaeit took me and Dr. Wheelock to the Ministry of Agriculture. We met Dr. Hassan Sid Ahmed, Director of Planning and explained the situation of the project. He assured us that the work plan will be signed by Saturday and will be sent to Dr. Bakhaeit. Dr. Bakhaeit agreed to inform us by telegram.

Dr. Bakhaeit introduced us to Mr. Syed Zaki, Deputy Undersecretary of Finance and Planning. He took us to the Friendship Hall to attend a conference on Agricultural Prices and Policy Conference.

5.9 Agricultural Prices and Policy Conference:

The conference was arranged by the FAO and the government of Sudan. Dr. Wheelock and I attended the morning session on June 2 and all team members attended the wrap-up session in the evening. The chairman of the session, Mr. Zaki, introduced us to the conference. The conference dealt with the factors affecting the pricing of commodities in the Sudan. There were several recommendations pertaining to peanuts. The most significant from the project point of view is the occurrence of aflatoxins and acceptance of peanuts in foreign markets. This was singled out as one of the most important problems.

5.10 Meeting with Miss Joyce Turk:

On June 2, I visited AID Mission and briefed Miss Joyce Turk about the progress of the discussion. She wanted us to keep them informed about our visits and also send all relevant communications, so as the mission could assist the project in a much better way. She was

happy that we have been keeping them informed in the past. She was very cooperative. I also met Mr. Moneim. He is very interested in the project.

5.11 Meeting of the U.S. Team and Sudanese Collaborators:

On June 3, all team members and Sudanese counterparts met at the FRC. Dr. Hassan Ishag, Principal Investigator, Dr. B. Bashir, Deputy Principal Investigator, Dr. B. Magboul (Nutritionist), Dr. A. Khalid (microbiologist), A. Zakaria (Economist), Dr. Ahmadi (plant breeder), and Mr. A. G. T. Babikar (biochemist). Dr. Riley was also invited to attend the meeting.

We discussed the implementation of the project. I also emphasized that the project does not have enough money to start aflatoxin laboratory at two places. We discussed the role of each investigator on the project. Dr. Ishag went through the procedure to develop new budget and line items. He assured his full support of the project. The need for purchasing a microcomputer was also indicated.

The team was later invited to a luncheon at Friendship Palace as guest of Dr. Bashir. Later, Mr. Zakaria and Dr. Khalid escorted us to Dr. Khalid's home. She took us to the Omdurman dairy and cattle market. We expressed our appreciation to her.

5.12 Pretest of the Survey Document:

On June 4, Dr. Caples, Dr. Wheelock and I went to the Nutrition Division of the Ministry of Health and visited with Dr. Kamal, Dr. Magboul and Miss Aziza in the office of Dr. Kamal. Miss Aziza accompanied us to the test site in the Omdurman area of Khartoum. The test was conducted in two households. The first house appeared

to be of upper middle class type and the second house lower income type. This determination was based on the prior knowledge of Miss Aziza who seemed to be very familiar with the locality. Dr. Caples sat with the interviewer.

Apparently, there was no major problem in the interview. The female member (wife) offered pepsi to us and provided all informations. The interview took almost one hour. There was one major problem and that was the method of estimation of the quantity of peanuts. Next, we went to a house of lower income group.

It appeared that (a) the instrument was adequate, (b) the interviewer was well trained and had no problems, (c) and finally, the family members were willing to provide informations and seemed to be very friendly.

Miss Aziza related that peanuts are used in a variety of forms in the Sudan and also the lower income families use more peanuts compared to higher income groups.

5.12.1 Visit to the Western Sudan Project Office:

After pretesting, Dr. Wheelock and I visited Dr. Riley. I briefed Dr. Riley about the progress of our trip and sought his assistance in the future. He expressed his willingness to cooperate. He suggested that the WSARC has a plane which could be made available for trips to El Obeid. He also offered his assistance in sending informations from the United States to the Sudan.

5.12.2 Visit to the FRC:

I revisited the FRC for a final meeting with Dr. Bashir, Dr. Magboul and Dr. Khalid. Dr. Bashir assured me that he will send us

the telegram about the approval of the work plan. Dr. Magboul and Dr. Khalid assured me that they will get clearances for importing the equipments in the Sudan.

5.12.3 Meeting with Dr. Brian D'Silva

In the evening of June 4, the team met with Dr. Brian D'Silva. I requested Dr. D'Silva to serve as a resource person on the project. Dr. D'Silva has an assignment for one year in the Sudan in the Department of Rural Economics. He is supervising research there and conducting a survey in the El Obeid area on farming systems. He offered some useful suggestions for the post-harvest survey. We will be contacting Dr. D'Silva in the United States. He will be visiting the United States in July and August of 1983.

6.1 Visit to FAO, Rome:

We arrived in Rome on June 5 at 1:45 p.m. I attempted to contact Dr. Raj. Malik. He was gone to Geneva. The next morning, June 6, we visited FAO.

I contacted Dr. Bhattacharjee, Director of EST, FAO. He arranged a meeting with Dr. Cortas. Dr. Cortas later provided useful informations and arranged meetings with several scientists.

Dr. Caples and I visited Dr. Perrise. Dr. Perrise gave information on survey in Togo and also took us to the library for informations on the Sudan. There was a list of documents available on Sudan (see the list). We made copies of some of the documents.

6.2 Meeting with Dr. Dawson:

I met Dr. Dawson in the afternoon and briefed him about the project. He was very interested in the project especially on the

aflatoxin aspect. He also suggested that the FAO may be able to assist Sudan in the aflatoxin area if request comes from the Sudan. He pointed out that FAO/WHO jointly offers programs in maintaining quality of determinations of aflatoxins through check samples. In addition, FAO may provide funds for training or consultation. He cited examples of programs funded through FAO for India and Nepal. Dr. Dawson expressed interest in developing cooperation between FAO and the Peanut CRSP.

A report entitled: "Food Contamination Study for Asia and the Far East" provided program of aflatoxin laboratories in India and Nepal. The document entitled: "Summary and Assessment of Data Received from the FAO/WHO Collaborating Centres for Food Contamination Monitoring" prepared under joint sponsorship of the UN Environmental Programs, FAO and WHO provides data from several laboratories.

DOCUMENTS AVAILABLE AT FAO ON SUDAN (Statistics Library)

1. Salih, H. M.; Ostor, A.; Fruzzetti, L. M. Khartoum University (Sudan) Faculty of Economic and Social Studies. Development Studies and Research Centre.

Abyei Project; Main Report of the Socioeconomic Survey, Khartoum Sudan SRC 1978 (124 leaves)
2. Hassanein, Sidqui, M.: University of Gezira, Faculty of Economics and Rural Development (Sudan)

Food Consumption Patterns in the Gezira Mangil area, October 1979, University of Gezira, Wad Medani (Sudan) 1980. Discussion Paper No. 2.
3. Ministry of Health, Khartoum (Sudan) Nutrition Division, Food Consumption Survey in Sudan 1971-1974.

No. 1, Khartoum; No. 2 in Soba West Village, No. 3 in Iad Hussein Village, No. 4, Food Intake Survey at Karari area; No. 5, Hasir Extension Food Intake Survey; No. 6, Dietary Survey in Deim Abu Saad; No. 7, Dietary Study of the Preschool Children of El Hasnab Villages. Khartoum (Sudan) Ministry of Health, 1972-1975 (7 pamphlets).
4. Department of Statistics, Khartoum (Sudan) Omdurman (Republic of Sudan) Household Budget Survey, 1963. Khartoum (Sudan) Department of Statistics, 1965 (102 leaves).
5. Sudan (Republic) Department of Statistics. The household budget survey in the Gezir-Managil area. Khartoum 1965. 173 pp.
6. Department of Statistics, Khartoum (Sudan) Wadi Halfa (Sudan) Social and Economic Survey: Report on the Income and Expenditure Survey (including results of a livestock survey) August 1960 - May 1961 Khartoum (Sudan). Department of Statistics, 1963 (59 pages).
7. Department of Statistics, Khartoum (Sudan) Kadngli household budget Survey (Republic of Sudan). Khartoum (Sudan) Department of Statistics, 1966. 64 pp.
8. Sudan (Republic) Department of Statistics. Household Sample Survey in the Sudan 1967-1969 Pattern of Income and Expenditure, Khartoum 1970. 380 pp.

Report of Travel Regarding the Project Entitled:
An Interdisciplinary Approach to Optimum
Food Utility of Peanuts in
SAT Africa
to
Democratic Republic of the Sudan
January 3 - January 23, 1984

Bharat Singh, Food Scientist
Principal Investigator, Department of Food Science

Virginia Caples, Home Economist
Division of Home Economics

Hezekiah Jones, Agricultural Economist
Department of Agribusiness

Gerald C. Wheelock, Rural Sociologist
Department of Agribusiness

Alabama A & M University, Normal, Alabama 35762

An Activity Report from Peanut CRSP,
International Programs, Alabama A & M University
Supported by Grant USAID/DSA N-G-0247

TABLE OF CONTENTS

- 1.0 Purpose of Travel
- 2.0 Executive Summary
- 3.0 Itinerary
- 4.0 Acknowledgment
- 5.0 Arrival at Khartoum, Sudan
 - 5.1 Visit to the Food Research Centre: meeting with Dr. Hassan Ishag, Dr. Babiker Bashir, Dr. Bahi-el-din I. Magboul, Dr. Amna Khalid, and Mr. A. Zakaria
 - 5.2 Meeting with Dr. Kamal Mohd and finalization of the arrangements for survey in Khartoum
 - 5.3 Visit to USAID Mission: meeting with Mr. Eric Witt and Miss Elizabeth S.F. Martella
 - 5.4 Meeting with Dr. James Riley (Western Sudan Project)
 - 5.5 Visit to Dr. Mohammed Obeid Mubarak, Vice-Chancellor, University of Gezira
 - 5.6 Visit to USAID office and Eric Witt's residence
 - 5.7 Visit to Food Research Centre and activities during January 11-13
 - 5.8 Visit to D'Silva's office; computer familiarization with Mr. Zakaria
- 6.0 Activities in Wad Medani - B. Singh
 - 6.1 Visit with Dr. H. Ishag and to Dr. Ali Karrar
 - 6.2 Visit to Dr. M. Bakhaeit and ARC Scientists
 - 6.3 Survey in villages near Wad Medani
 - 6.3.1 Additional information related to the Project
 - 6.4 Survey in Rahad Scheme area
 - 6.5 Visit to the Market in Wad Medani and other activities
- 7.0 Activities in El Obeid - G. C. Wheelock and H. Jones
 - 7.1 Planning Survey Logistics with Provincial Government, ARC and Ministry of Agriculture
 - 7.2 Groundnut Auction Market and Briefing by Farmer Leader
 - 7.3 Interviewer Training and Utilization Survey in El Obeid
 - 7.4 Completion of Urban Sample and Logistics for Farm Sample
- 8.0 Khartoum Survey Activities - V. Caples
 - 8.1 Khartoum Data Collection - V. Caples
 - 8.2 General Observation Notes on Several Clusters
- 9.0 Return to Khartoum
 - 9.1 Visit to USAID, WSARP and FRC
 - 9.2 Revisit to FRC
 - 9.3 Meeting with Dr. Siddig Abdmageed Salih

1.0 Purpose of Travel

1. To initiate data collection on consumption and food utility aspects of peanuts and post-harvest practices of peanuts in the Sudan.
2. To plan analyses of data using mini-computer.
3. To plan analyses of samples collected during the surveys in rural and urban sites in the Sudan for aflatoxins and proximate compositions.

2.0 Executive Summary

B. Singh (Food Scientist and Principal Investigator), G. C. Wheelock (Rural Sociologist), Virginia Caples (Home Economist), and Hezekiah Jones (Agricultural Economist) travelled to Khartoum (capital city), Wad Medani (capital of central region), and El Obeid (capital of western region) of the Sudan from January 3 through January 21, 1984.

Initial preparations and planning were made at the Food Research Centre, Khartoum for surveys including review and coding of survey instruments; implementation strategies and available personnel. The survey in Khartoum started January 14 under the joint supervision of Dr. Babiker Bashir (Food Research Centre), Dr. Virginia Caples (Alabama A&M University) and Dr. Kamal Mohd (Ministry of Health). The survey included cities of Khartoum, North Khartoum and Omdurman. The survey in Wad Medani area was started on January 16 under the joint supervision of Dr. B. I. Magboul (Food Research Centre), Dr. Ali Karrar (Faculty of Medicine, University of Gezira), and Dr. B. Singh (Alabama A&M University). The survey included both consumption of peanuts and post-harvest handling of peanuts in four villages (2 near Wad Medani and 2 under Rahad Scheme). In the El Obeid area, the survey was conducted

in the City of El Obeid and also in rural populations near El Obeid. The survey in El Obeid was started on January 16 by Dr. A. Khalid, A. Zakaria, Dr. H. Jones, and Dr. G. C. Wheelock. A limited number of data has been brought to Alabama A&M for analysis. Further arrangements have been made to analyze data at the Food Research Centre using Apple IIe computer as soon as possible.

Instruments to analyze aflatoxins and relevant chemicals and materials, and computer and accessories have been installed at the Food Research Centre. There has been excellent cooperation from Dr. Hassan Ishag (Principal Investigator) and Dr. B. Bashir (Deputy Principal Investigator) through their active participation in the project. -

3.0 Itinerary

- Jan. 3 Left (Huntsville-Atlanta-New York) USA with 6 packages-
(in addition to personal packages) of equipments and
supplies to be delivered to the Food Research Centre in
Khartoum.
- Jan. 4 ° Stopped at Athens, Greece till 5:05 p.m.
° Arrived in Khartoum, Sudan Jan. 4 at 8:45 p.m. and met
with Dr. Amna Khalid, Dr. M. Dardin, Mr. Mustafa (US
Embassy). Our baggages did not arrive: Disappointed!
- Jan. 5 ° Visited Food Research Centre and met with Dr. Hassan
Ishag, Dr. B. Bashir, Dr. Amna Khalid, Dr. B. I.
Maqboul, and Mr. A. Zakaria.
° Dr. Brian D'Silva took us to his home.
- Jan. 6 ° Friday (Holiday)
° Visited Dr. Brian D'Silva
- Jan. 7 ° Visited Dr. Kamal Mohd in the Ministry of Health along
with Dr. Bashir, Dr. B. I. Magboul.
° Visited Food Research Centre and met with Dr. B.
Bashir, Dr. Amna Khalid, Dr. B. I. Magboul, and Ahmed
Zakaria.
- Jan. 8 ° Meeting with Dr. Kamal Mohd, Dr. B. Bashir and
interviewers: Isham Ahmed, Nur Maamed Khair Ahmed and
Alia Elsadic (Ishan Mustafa was not present)
° Went to Khartoum Airport to check baggages
° Visited with Mr. Eric Witt and Elizabeth Martella
° Went to KLM office to send telex about baggages
- Jan. 9 Visited Dr. James Riley at Western Sudan Agricultural
Research Project office
° Visited Food Research Centre
° Visited Dr. Mahammed Obeid Mubarak, Vice-Chancellor of
the University of Gezira, Wad Medani at the Guest House
along with Dr. Moawia Mohamed Dardiri
- Jan. 10 ° Visited Mr. Eric Witt at the USAID office to brief him
on our situation
° Evening: We were invited to a reception at Mr. Witt's
house and met with the U.S. Ambassador and Dr. John
Fischer, Director, Consortium for International
Development, Tuscon, Arizona; Dr. James Ozburn, Dean of
Agriculture, Washington State University, Pullman,
Washington; and Dr. James Henson and Dr. Jan Noel of
Washington State University
- Jan. 11 Visited Food Research Centre and worked with scientists

- Jan. 12 °Visited Food Research Centre and made plan to leave for Wad Medani (Singh), El Obeid (Jones and Wheelock), and start survey in Khartoum (V. Caples)
 °Visited Dr. Brian D'Silva and Mr. Zakaria at Department of Rural Economy, University of Khartoum and attempted to familiarize with computer
- Jan. 13 °Went to Food Research Centre and inspected Fluorotaximeter
 °Visited Dr. Brian D'Silva's home
 °Developed coding procedures for instruments
- Jan. 14 °Singh, Jan. 14-19 - Wad Medani
 °Left Khartoum with Dr. B. I. Magboul at 8 a.m. and arrived Wad Medani at 11:30 a.m.
 °Met with Dr. H. Ishag
 °Visited Dr. Ali Karrar, Faculty of Medicine, University of Gezira
- Jan. 15 °Visited Dr. G. A. Zorgani at Plant Protection Centre and Dr. H. Shimabukuro of the U. S. Department of Agriculture, Fargo, ND
 °Visited Ministry of Education, Nutrition Education Centre and met with interviewers
 °Later visited with Dr. M. G. Siriwardana, University of Gezira (Loan from France working with aflatoxins).
 °Returned to Nutrition Education Centre and reviewed the questionnaire with interviewers
- Jan. 16 °Visited Dr. Bakhaeit Said, Director General, ARC, Sudan
 °Proceeded to villages with interviewers after review of the questionnaires
 °Interviews started in three villages near Wad Medani
- Jan. 17 °Review of the problems and discussion with interviewers
 °Proceeded to the villages to complete questionnaire
 °Visited local market and collected samples of peanuts
 °Reception at Prof. Hassan Ishag's residence
 °Planned for a trip to Rahad Scheme area
- Jan. 18 °Went with interviewers to Rahad area and survey started
 °Met with block inspector
 °Returned to Wad Medani and visited with Dr. Ishag and Dr. Magboul to discuss next year's budget
- Jan. 19 °Returned to Khartoum
 °Visited USAID office and briefed Mrs. Elizabeth Martella about the progress
 °Visited Dr. James Riley
 °Visited Food Research Centre, Dr. B. Bashir

1977

- Jan. 14 Wheelock and Jones, Jan. 14 - 19, El Obeid Survey
 °Depart 8:00 a.m. via WSARP plane for El Obeid with Dr. Amna Khalid, microbiologist and Mr. Zakaria, Ag Economist both of FRC.
 °Met with Dr. El Hag H. Abulgasim, Director of El Obeid ARC Research Station; Abdul Rahman Khadir Osman, Peanut Breeder; and Hashim Mukhtor, Range Scientist to plan agenda.
 °Met with Kordofan Deputy Governor, Fadlla Ahmad and the Manager of General Affairs and Protocol Abdul Aziz Abdul Rahim Salah to seek logistical support for the survey.
 °Met with Minister of Agriculture Bashir El Tahir and Dr. Farcuk El Tagani, General Production Manager to arrange Survey logistical support.
- Jan. 15 °Met four interviewers and begin training.
 °Visited auction market official and peanut farmers at auction market.
- Jan. 16 °Met four additional interviewers for training.
 °Begin interviewing in high-income clusters of El Obeid.
- Jan. 17 °Surveyed 15 households.
 °Lunch with Dr. El Hag, ARC Station Director.
 °Surveyed 23 households with full team of 9 interviewers.
- Jan. 18 °Surveyed 44 households with full team.
- Jan. 19 °Wheelock and Jones returned to Khartoum.
 °Khalid and Zakaria remained to complete El Obeid city and rural samples.
 °Picked up Air Freight documents from Air France for Uninterruptable Power Supply.
 °Met with Lili Martella USAID Ag officer for debriefing and left Air Freight documents.
 °Met James Riley WSARP for debriefing.
 °Dr. DeFalla WSARPARC Director had not returned from drought survey trip to El Fashir.
- Jan. 14 Caples, Jan. 14-19 - Khartoum
 °Review of Research Data collection procedures with Dr. Bashir and enumerators
 °Collection of data for Cluster 11 (Shambat), 11 even households
 °Review of data collected with enumerators for consistency and general problems experienced
 °Editing construction of coding procedures
- Jan. 15 °Collection of data in Cluster 12 (Al Shaabbia).
 °Completion of 6 households (Transportation problems and only two enumerators) °Editing of data

- Jan. 16 °Completion of data collection in Cluster 12 of Al Shaabbia (5 households). Partial data collection in Cluster 13 of Al Shaabbia (4 households)
°Data editing and coding
- Jan. 17 °Data collection in cluster 21, Al Kabbgab, completion of 11 households
°Data editing
- Jan. 19 °No data collection due to lack of gasoline °Data coding °Filing of claim forms for missing equipment
- Jan. 20 °Data Coding
- Jan. 21 °Collection of data in Cluster 23, Al Mullazmean, 11 households.
°Data editing and coding
- Jan. 20 °Singh, Wheelock, Caples prepared plans for analysis
- Jan. 21 °Singh spent part of the morning with Sudan Airways and then returned to FRC to see Dr. Magboul and Dr. Bashir
°Wheelock discussed the plan of survey analysis with Dr. Magboul
°Caples went with survey team to Khartoum
°In the evening: Dr. Sadig Salih, Dr. Magboul and Dr. D'Silva visited and discussed the future plan of collaboration
- Jan. 22 Left Khartoum and arrived in London
- Jan. 23 Left London and arrived Huntsville

4.0 Acknowledgment

We would like to express our thanks to Mr. Eric Witt and Elizabeth Martella of USAID mission in Sudan for their assistance during our visit. We appreciate the hospitality extended by Dr. Brian D'Silva and his wife in Khartoum. We are thankful to Dr. B. Bashir, Dr. Amna Khalid, Dr. B. I. Magboul, M. A. Zakaria from the Food Research Centre, Shambat and Dr. Hassan Ishag and Dr. M. Bakhaeit from the ARC, Wad Medani for their excellent cooperation during the survey.

5.0 Arrival at Khartoum, Sudan

The team arrived at Khartoum airport on January 4. We met Dr. Amna Khalid, Dr. M. Dardiri and Mr. Mustafa. To our disappointment, our baggage did not arrive although Mr. Mustafa came prepared with all required paper for clearance. This certainly became a matter of concern and continued until the end of the trip (still not finally settled - we are still missing two packages containing parts of the computer and chemical supplies).

5.1 Visit to Food Research Centre: Meeting with Collaborators

On January 5 we visited Food Research Centre and met with Dr. Hassan Ishag, Dr. B. Bashir, Dr. Amna Khalid, Dr. B. I. Magboul and Mr. A. Zakaria. The check for \$6,000 was handed over to Dr. Ishag. The following things were discussed: (1) Budget for the survey; (2) equipment for proximate analysis; (3) time-table for the survey; (4) possible plan for the next phase of the research. Dr. Magboul pointed out that the cost for the survey will be much higher due to increases in the price of gasoline. According to an estimate the total cost of the survey will be approximately \$20,000. It was suggested that they let us start the survey and, as soon as we return to the United States,

arrangements will be made to send the additional money. The equipment for proximate analysis will not be purchased until the next fiscal year. It was also agreed that the survey should start as soon as possible.

Dr. Singh suggested that for convenience and ease of operation, we would like to group the members as follows: (1) Dr. B. Bashir and Dr. V. Caples in Khartoum; (2) Dr. G. C. Wheelock, Dr. H. Jones, Mr. A. Zakaria and Dr. A. Khalid (El Obeid rural and urban area), Dr. B. I. Magboul and Dr. B. Singh (Wad Medani). (See the chart.) The group agreed and decided to meet again to discuss the survey instruments and other related matters.

Later in the evening we visited Dr. Brian D'Silva and enjoyed the fish fried (Nile Perch) outdoors. We visited Dr. B. D'Silva again on Friday.

5.2 Meeting with Dr. Kamal Mohd and Finalization of Arrangements for Survey in Khartoum

Dr. Magboul and Dr. Singh visited Dr. Kamal Ahmed Mohd in the Ministry of Health on January 7. He assured us that there will be no problem in survey in Khartoum or adjoining cities. He suggested that we return the next day and meet with interviewers.

We later met at the Food Research Centre and discussed several points. Dr. Wheelock and Dr. Jones visited Dr. D'Silva along with Mr. A. Zakaria to make arrangements for the use of computer in the department of rural economy.

We visited Dr. Kamal the next day (Jan. 8) and met with interviewers. The survey instrument was discussed in detail. In addition, a plan was made to initiate the survey. Interviewers were well-trained and were ready to start.

It was proposed that the Khartoum area be stratified as follows according to income levels:

Khartoum North: High - Sofia, Bridge Street
 Medium - Sahabia, Khatimia
 Low - Aad Yousuf

Khartoum: High - New Extension
 Medium - Sajana, Hilla Za Zilla
 Low - Cartoum, Ishis (Huts)

Omdurman: High - Milazam
 Medium - Wadnubauri, Eltharvra
 Low - El Gamayel

In each strata, start from street 1 till 200 (East-West) every eleventh street and include every fifth house. It was advised that the survey should be started at 8:00 a.m. to avoid interference with the breakfast time.

The survey document was explained to the interviewers.

5.3 Visit to USAID Mission: Meeting with Mr. Eric Witt and Miss Elizabeth S. F. Martella

We visited Mr. Eric Witt and Elizabeth Martella and briefed them about our progress on January 8. We express our appreciation for the assistance in getting clearances at the airport. Mr. Witt assured us that the mission will continue assisting the Peanut CRSP.

5.4 Meeting with Dr. James Riley (Western Sudan Project)

On January 9 we visited Dr. James Riley at the Western Sudan Project office. He related that the plane scheduled to go to Western Sudan has been cancelled. This was quite a disappointment. We attempted to make alternate plans; however, they did not materialize.

5.5 Visit to Dr. Mohammed Obeid Mubarak, Vice-Chancellor, University of Gezira

We were invited by Dr. M. M. Dardiri of the University of Gezira to meet with Dr. Mohammed Obeid Mubarak, Vice-Chancellor at the Guest House in Khartoum. Dr. Mubarak was interested in our program and would like to develop linkages in food science area with Alabama A&M University.

5.6 Visit to USAID Office and Eric Witt's Residence

On January 10 we again met Mr. Eric Witt and informed him about our situation with baggage and transportation problems. He invited us to a reception in his office in the evening where we met with the U. S. Ambassador, the team from Consortium for International Development, Tucson, Arizona, and various members of the USAID office. The meeting was useful in many ways.

5.7 Visit to Food Research Centre and Activities During January 11-13

Our plan to go to El Obeid did not materialize and we could not go to Wad Medani as we planned. However, we spent January 11, 12, and 13 in procuring sufficient amount of gasoline for the survey in Khartoum, for the trip to Sudan and the survey in Wad Medani; travel arrangements for El Obeid; familiarization of computer to process survey data by Sudanese scientists; and installation of fluorotoxinmeter.

Personal baggage, survey materials and some laboratory equipments arrived one week late, but the computer Apple IIe and monitor did not arrive.

Dr. D'Silva was agreeable to limited use of his computer facilities at the Rural Economy Department. The fluorotoxinmeter reached safely and there was no problem in handling by Dr. A. Khalid.

On January 13 we made plans to start survey in Khartoum on January 14 (B. Bashir and V. Caples); leave for El Obeid (A. Zakaria, A. Khalid, H. Jones and G. C. Wheelock); leave for Wad Medani (B. I. Magboul and B. Singh).

In the evening we were again the guests of Dr. Brian D'Silva.

6.0 Activities in Wad Medani

On January 14 Dr. B. I. Magboul and B. Singh left Khartoum by car and reached Wad Medani by 11:00 a.m.

6.1 Visit with Dr. H. Ishag and to Dr. Ali Karrar

Dr. Singh visited Dr. Ishag. Dr. Ishag expressed problems in getting the check cashed. He also discussed the details of the budget and handling of the project.

Later, we met Dr. Ali Karrar, Biochemist and Nutritionist at the University of Gezira. He took us to his home and invited us for a lunch which included salad with peanuts prepared in a Sudanese style. Dr. Karrar has lived in the United States and proved to be very helpful in the survey. We discussed the survey instrument and began to talk to interviewers. It became apparent that we have to translate the survey instrument into Arabic. Dr. Magboul and Dr. Karrar began working on the translation.

6.2 Visit to Dr. M. Bakhaeit and ARC Scientists

On Sunday, January 15, I visited Dr. G. A. Zorgani in the Plant Protection Department of the ARC. Dr. Zorgani has worked with aflatoxins and collaborated with a group in Liverpool, England in analyzing food products for aflatoxins. This group has recently published papers linking aflatoxins to Kwashiokar. Dr. Zorgani has a well-equipped laboratory. His equipments include: fluorotoxinmeter,

gas chromatographs, radioisotope facilities, and variety of other sophisticated equipments. Currently, Dr. G. Shimabukuro from the USDA Laboratory, Fargo, North Dakota is visiting with him for 2½ months.

Later, in Dr. Ishag's office, I visited with Dr. M. G. Siriwardana of the University of Gezira. Dr. Siriwardana is working with aflatoxins and is on a program from the French government.

Dr. Ishag seemed to have managed everything really well and I was impressed with his willingness to make the project plans go as smoothly as possible. Even though Dr. Ishag is not a food scientist, his overall knowledge of peanut in the Sudan is of value to the Project.

Dr. Karrar, Dr. Magboul and I visited with Dr. Mohamed Ahmed Amin, Minister of Health and Social Welfare, Central Region, Wad Medani. Dr. Amin expressed his interest and wanted us to keep him informed.

Later in the evening we visited the Nutrition Education Centre and met with the Director, Miss Amna Mahgoub and the interviewers and the Center Director, Mr. Barbiker.

On January 16 I visited Dr. M. Bakhaeit, Director General, ARC. Dr. Bakhaeit expressed his happiness that the project is running well. He appreciated the friendliness of the Peanut CRSP group and wanted us to continue.

6.3 Survey in Villages near Wad Medani

Dr. Magboul and I went to Nutrition Education Centre where we met Dr. Ali Karrar and the interviewers. Each interviewer was given a package containing questionnaire (10 each of consumption and post-harvest handling) and 10 sample bags. There were 6 interviewers. We spread out in the villages: Mobi (interviewers: Naima Kudi and Masara Abdalla); El Basantana (interviewers: El Shol Abdeen and Inam

186

Mohd Ali) and Kreiba (interviewer: Umma el Hussain and Pasarnat Abdurahman).

After a brief review, we proceeded to villages. Dr. Ali Karrar and I were together. Dr. Magboul went with the other group. In the Village Mobi, we met with the chief of the village and he allowed the interviewers to go for the survey. In village El Basantana we met the School Headmaster, Mr. Mubarak Musa. He took us to a traditional breakfast in his home and served us traditional foods: Kisara (at least 36" diameter); mixed gravy with meat, vegetables and other ingredients. Everyone ate in the same dish (large, more than 40" diameter) which included sorghum (Dura, Kisara, minced meat, okra and lamb meat). It is to be noted that the people are very hospitable and to them, the guest is the most important person. I was impressed with their feelings of brotherhood of all mankind.

Interviewers have worked with these villages before and are quite familiar with customs and traditions. To illustrate the interview process, I would like to give an example: The interviewer, Miss El Shol Abdeen contacted a farmer. She explained to him that the project was from the United States of America in collaboration with Agricultural Research Corporation, Wad Medani. The purpose of the project was to assist the farmer in his method of storage, processing, and utilization of peanuts. The farmer was also told that the information would be kept confidential and that his name would not be used. The farmer appeared to be very interested in the project. He explained to us (in Arabic) that he farms under Gezira board Scheme where he is allowed to have 10 feddans and he has to include at least 5 feddans of cotton, 2.5 feddans peanuts, and 2.5 feddans sorghum (or wheat). He is not obliged to sell

his peanuts to the Gezira Board; however, he sells his peanuts to a merchant who can collect it from the field. His peanuts are hand-picked. He stores his own seed for the next year. His main problems in storage are insects. His family would like to use more peanuts but it may cause some stomach problems in early part of the season.

His house had a sand floor which was not cemented. He stored his peanuts in a sack on an old tire. His household included married sons and their children. He does not apply any fertilizer to peanuts. He may do weeding twice a year by hand. No pesticides are used on his farm. He harvests and his peanuts are sold in the field. There is a minimum price guaranteed by the government. He is absolutely not aware of aflatoxin problems. His wife or daughter (35 years old and lives with him) grinds peanuts in a form of paste. The family members enjoy this paste very much.

6.3.1 Additional Information Related to the Project

Dr. Ishag explained that the yield of peanuts is lower because farmers do not use enough seeds. There are more peanuts near oil mills. The main variety used is Ashford. However, efforts are underway to introduce MH 383 (Maini Haryana from India - came through Nigeria). MH 383 gives 20% higher yields and is drought and cercospra resistant.

On the way to the villages, we observed fields of cotton (hand-picked, heaped in the field), wheat (short stand with many weeds), Cajanas cajan (good size with lots of pods), peanuts (harvested in the field, heaped for selling, covered with leaves from sorghum); onions (very green and nice crops) and karkedeh (flower is used for preparation of a beverage).

Houses in villages were either mud or brick mud type. Interviewers explained to us that well-to-do families only have brick houses.

A number of cattle, goats, and donkeys were seen around the villages. Herds of cows appeared to be well-fed.

Every village appeared to have adequate supplies of clean and chlorinated water.

6.4 Survey in Rahad Scheme Area

On January 18 Dr. Ali Karrar, the interviewers, and I went to Rahad Scheme area which is approximately 30 miles from Wad Medani across the Nile River. There, we met with school teachers at the elementary school. These teachers came from other regions of the Sudan; however, they were familiar with families in the Scheme through students. We were offered breakfast.

The people in this Scheme were nomadic and were brought under this scheme through a government program. They normally have huts (small) made up of straw. They farm on the allotted land (22 feddans each). The block inspector, Mr. Fadel Saeed Masad gave us the information on peanuts in block 8 area. The total area is 8100 feddans. The variety of peanuts used in this scheme is Ashford. Planting is done in May or early June by broadcasting unshelled seeds. The cultivation and land preparation is done manually. Some blocks may use machines. The allotment of peanuts is normally $5\frac{1}{2}$ feddans per farmer. Peanuts are rotated with sorghum or cotton. Steps in land preparation and planting may be: disking (machine), ridging, reredging, digging and sowing by broadcast of unshelled seeds. Farmers do not use fertilizers, pesticides or fungicides. Seeds are stored by individual farmers (5-6

sacks), and normally less than recommended amounts of seeds are used for planting by the farmers.

The Scheme provides water and the sale of peanuts is not controlled by the government. I feel that there is plenty of room for improvement in cultural practices.

6.5 Visit to the Market in Wad Medani and Other Activities

In the evening I went to the local market and collected several samples of foods, including peanuts. In the markets, peanuts are sold unshelled, nuts covered with ash, and peanut pastes. The ashed peanuts and peanut pastes are sold by the women who are Nigerian in descent. The paste is prepared from the peanuts gleaned by these women from the fields. The paste is used in salads and also as ingredients in various other preparations.

Later in the evening I was a guest in Dr. Ishag's house. I met with Professor M. Bakhaeit, Director General, Dr. G. Siriwardana and several other members from the ARC.

7.0 El Obeid Activities

7.1 Planning Survey Logistics with Provincial Government, ARC and Ministry of Agriculture

Khalid, Zakaria, Jones and Wheelock took the WSARP plane to El Obeid. Originally scheduled for a 6:30 a.m. departure, Saturday, January 14, the plane was finally cleared for a 9:15 a.m. takeoff. Also on board was the CID - Washington State party which continued on to Kladugli. In El Obeid, we checked into the ARC guest house, ate breakfast and in consultation with Dr. El Hag H. Abulgasim, Director of the El Obeid ARC Research station; Abdel Rahman Khadir Osman, Peanut Breeder (N. C. State); and Hashim Mukhtor, Range Scientist, planned our agenda. The Director generously offered the services of four

technicians to assist with interviewing and confirmed the availability of one pickup transport for the survey team. He also confirmed that ARC fuel supplies were insufficient, but that it was readily available in the free market. The next stop was the office of Kordofan Provincial government. A meeting with the Deputy Governor, Fadlla Ahmad, was arranged thorough the Manager of General Affairs and Protocol, Abdel Aziz Abdel Rahim Salah. While direct contact had not been previously established to arrange for the logistics of the field survey, Amna Khalid had secured advice and recommendations through the Peoples Assembly in Khartoum. On the basis of this recommendation, the Deputy Governor entertained through discussion of plans for the study. The Deputy Governor authorized the necessary fuel at government prices (a saving of about \$2.00 US per gallon), a vehicle to be used in El Obeid, additional interviewers, and logistical support in arranging transportation to and from En Nuhud and Khartoum, if needed. The Protocol officer thus accompanied us to the Ministry of Agriculture to help coordinate logistical support needed to complete the survey. Minister of Agriculture Bashir El Tahir and Dr. Farouk El Tagani, General Production Manager met with the team at 1:30 p.m. They were also willing to allow release time for some of their staff with B.Sc degree to assist us with interviewing in El Obeid area, and to provide a vehicle with a driver.

At the end of the first day, it was evident that interviewers, vehicles, drivers, and fuel were sufficient to do both samples (100 urban households for the consumption survey and 100 peanut farm households for both the post-harvest and consumption surveys) in the El Obeid area. However, logistical support for an En Nuhud farm

sample was in doubt. One three passenger pick-up and two barrels of fuel were committed as soon as they could be arranged, but no fixed date could be set until fuel supplies arrived and drivers were negotiated for the difficult eight hour trip. Guest house facilities were also reserved in En Nuhud, but a new interview team would need to be recruited and trained. The urban survey was fixed, but the choice between En Nuhud and El Obeid area for the farm survey was delayed until more information was available.

Team members spent the evening of our first day in El Obeid reviewing the questionnaire and planning the next day's training session for the interviewers. On Sunday, January 15, logistical work was continued to secure the authorized fuel, to schedule drivers and vehicles, and to arrange for additional interviewers. The first four interviewers agreed to meet with us in the evening for a two-hour training session. The sample design for El Obeid city was work out including two high-income, three middle-income, and three low-income neighborhoods.

7.2 Groundnut Auction Market and Briefing by Farmer Leader

The remainder of the morning was devoted to the auction market and pretesting the post-harvest survey questions with a knowledgeable farmer leader. Farmers who had planted before the first rain in July, 1983 generally considered their crop a success with a yield of 15 Kantars per makama (850 kg./Ha) compared to 9 kantars per makama (500 kg./Ha) for those who planted immediately after the first rain. Others who waited for the second rain failed to get a crop. Thus, forecasting the first rain is critical. The rule of thumb is that five cloudy days in a row signals the end of the dry season and that it is time to plant.

161

The Agricultural Bank has established a credit program through peanut farmer production cooperatives. The cooperatives supervise loan releases to member farmers in three stages. The first-stage loan for planting is made to all accredited cooperative members. Before the second-stage loan is granted, the cooperative credit committee inspects member fields to determine if the crop has been planted on a timely basis. If so, the second-stage loan is granted. Finally, if weeding has been properly completed and the peanut crop looks good, the third stage of the loan is granted to cover harvesting expenses.

In mid January, 1984, the auction market price was averaging 23 to 24 £s/Kantar compared with 15 to 17 £s in 1983. Farmers of this cooperative were all relatively debt free (except for the Agriculture Bank loans) and were not dependent upon Shail or credit from merchants. They were able to transport their own produce and sell in the Auction Market or secure a comparable farm price.

However, since the majority of the farmers in the region were not so successful in planting before the first rains, their crops were generally poorer, and therefore, their credit terms were usually less favorable. Since floor prices were set at 12.50 £s/Kantar at the Auction Market in El Oteid, many of these poorly financed farmers probably contracted their crop for less than one-half the current auction market price.

Seeds are typically stored for five months in the shell in sacks and in the open air. Upon shelling, the best are selected for seed treatment at the rate of one ounce per 24 £s seed. The excess untreated seeds are used for food.

162

7.3 Interviewer Training and Utilization Survey Begins in El Obeid

On Monday, January 16, four additional interviewers met with the team for their training. The sampling design was revised and analyzed for the El Obeid peanut utilization survey. Interviewing started at 12:00 with each of seven interviewers completing one household each. The finished questionnaires were reviewed with each interviewer individually. Only minor clarifications were necessary.

On Tuesday, January 17, two additional interviewers were trained by other team members bringing the total interviewer staff to 10. A total of 15 households were surveyed in the morning and 23 households were completed in the evening.

The interviewer training sessions emphasized correct and uniform interpretation of the survey document items. As seven interviewers were B.Sc. degree holders and three were technicians holding diplomas, they appeared to be quite capable of uniform administration of the English survey document in Arabic. Immediate editing of each document by Zakaria and other team members was useful in correcting problems of interpretation or missing data.

7.4 Completion of Urban Sample and Logistics for Farm Sample

On Wednesday, January 18, nine interviewers completed 44 households by 2:00 p.m., leaving one cluster of 11 El Obeid households (low-income) to be interviewed. The remaining cluster was left for Thursday morning.

Three barrels (135 gallons) of fuel were finally secured from military reserves. The En Nuhud option was dropped in favor of the El Obeid peanut producing region. Four villages were selected for the 100 household sample (see Figure 1). The plan was for the team to visit

one village per day completing the entire village in one day. The two surveys administered to 100 peanut farmers and their household were expected to take about one to one and a quarter hours per household.

Much of the day was spent rescheduling transport back to Khartoum for Jones and Wheelock who had to return to their classroom duties in Alabama. The WSARP flight scheduled for El Obeid to Khartoum on January 19 was cancelled. A second flight with Tropical Airline was also cancelled. Finally, with some assistance from the governors office, Khalid was able to secure reservation with Sudan Airways for a 9:00 departure on January 19. Zakaria and Khalid remained with the 10 interviewers to complete the farm survey.

8.0 Khartoum Survey Activities

8.1 Khartoum Data Collection - V. Caples

The sites for the Peanut Consumption Survey data collection included three areas in Khartoum: Omdurman, Khartoum, and Khartoum North. Each area was divided into clusters as follows:

Khartoum North

- Cluster 11 - Shambat
- Cluster 12 - Al Shaabbia North
- Cluster 13 - Al Shaabbia South

Omdurman

- Cluster 21 - Al Kabagab
- Cluster 22 - Hai Nubbawi
- Cluster 23 - Hai Al Mollazmean

Khartoum

- Cluster 31 - Fallata
- Cluster 32 - Al Hilla
- Al Saggana
- Cluster 33 - Al Ammarat

The clusters in each area were identified as low, middle, and high incomes 1, 2, 3, respectively. Eleven households were to be selected from each cluster with 12 from cluster 33 for a total of 100 households for the Khartoum sample.

Interviewers for the collection of the data were nutrition officers with the Ministry of Health - Division of Nutrition. The officers were experienced in conducting survey research. The officers were:

Nur Mohmd Khair Ahmed, M.S. - Nutrition
 Ihsan Ahmed Hassan, 2 yr. Diploma - Home Economics
 Alia Elsadic, 2 yr. Diploma - Home Economics
 Isham Mustafa, 2 yr. Diploma - Home Economics

8.2 General Observation Notes on Several Clusters

CN 11

°Houses ranged from straw to mud and a combination of mud and mud brick.

°Heads of households worked as laborers or unskilled workers

°Most of the women did not work though some indicated a willingness and need to work.

°Floors of all households consisted of earth.

°Few modern facilities.

CN 12

°Houses consisted of a combination of brick and mud.

°Floors were a combination of brick and earth.

°Combination of modern facilities.

CN 13

°Although classified as a high income area, the concept in some cases may be misleading on households alone. For example, several high income houses consisted of two or three separate families living in a dwelling sharing only the cost of rent or the cost of the home.

°Many of the household heads worked in foreign countries such as Saudi Arabia.

°Houses were constructed of brick or mud. The interiors consisted of tile floors, throw rugs and in some instances, carpet.

CN 21

°This area is nicknamed Texas by the locals. The enumerators explain it was so called due to its wayward ways, crime rate and violence.

°Arrangements had to be made with the local health officers before we could collect data. This was done to inform the villagers of our coming and for our protection.

°Houses were constructed mainly of mud with earth floors.

°Few modern facilities

°Heads of households worked in other villages or in foreign countries.

9.0 Return to Khartoum

On January 19 Dr. Singh returned to Khartoum by bus. Dr. Jones and Dr. Wheelock also returned the same morning by Sudan Airways from El Obeid.

9.1 Visit to USAID, WSARP and FRC

Dr. Wheelock and Dr. Singh visited USAID office and briefed Mrs. Martella about our progress. We also indicated that the FRC may need the assistance of USAID mission in the future.

Later we visited Dr. James Riley and apprised him of our progress. Dr. Riley has been very helpful to our project in many ways. He is keenly interested in our progress.

We visited FRC where Dr. B. Bashir insisted that we should wait until Dr. Magboul returns from Wad Medani. He wanted us to assist in coding the data and initiating the analysis. We agreed to stay until Saturday.

Drs. Wheelock, Caples and Singh spent Friday, January 20 reviewing the questionnaire from Wad Medani and from Khartoum. We prepared instructions for analysis of the data. I was really impressed with Dr.

Caples' work in coding and tabulating the data from the Khartoum area. She has been travelling to the survey areas with interviewers and had collected useful information about households in the Khartoum area.

9.2 Visit to FRC

On January 21, Singh spent most of the morning fixing the returned ticket in the office of the Sudan Airways and then he returned to the FRC where he met Drs. Caples, Wheelock, Magboul and Bashir.

Dr. Wheelock discussed details of editing and coding the questionnaires with Dr. Magboul as well as the plan of analysis of the data.

Dr. Caples again visited the survey site with interviewers.

We discussed with Dr. Bashir and agreed that as soon as Dr. Khalid and Mr. Zakaria return from El Obeid, the data should be coded and should be sent to Alabama A&M. Analysis should be done at both places and reports should be prepared jointly. A preliminary report was planned to include frequency distributions, means, and standard deviations stratified by income, location and family size for the various peanut utilization variables, variations due to income, location, age, and sex.

The data should lead us to determine the (a) plan of research in product development area; (b) post-harvest handling and storage of peanuts; and (c) aflatoxin research in peanuts.

9.3 Meeting with Dr. Siddig Abdmageed Salih

On January 21 in the evening, we contacted Dr. Siddig Salih, Professor of Econometrics at the University of Khartoum. Dr. Salih is a graduate of Duke University (North Carolina) and has recently returned to the Sudan. He has extensive food policy research experience. He has been involved in analysis of extensive household surveys in the Khartoum

area. The data of a new household expenditures survey now being planned will also be of interest to us.

Dr. B. I. Magboul and Dr. Brian D'Silva also joined us at the same time and we had a useful exchange of information.

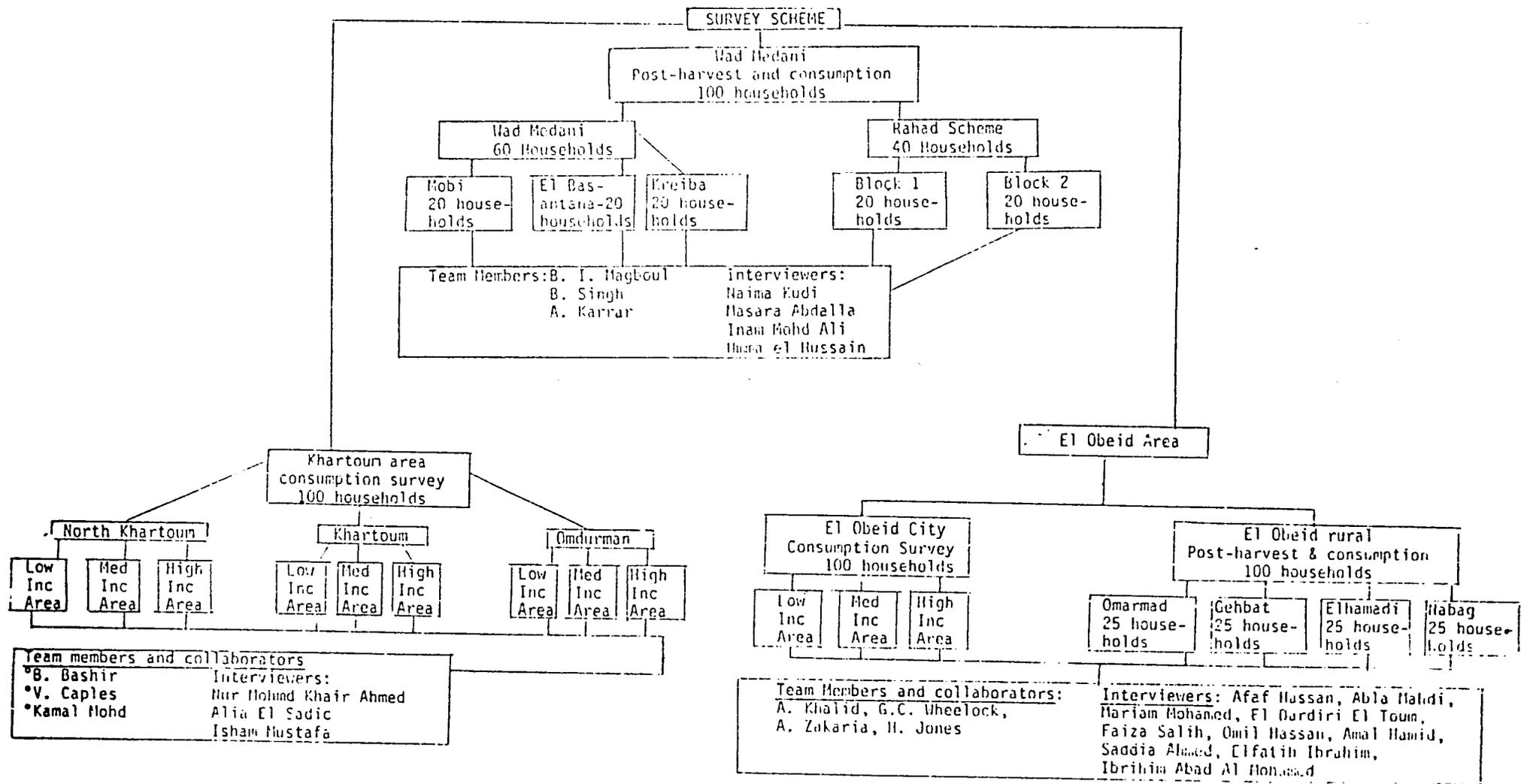


Fig. 1. Scheme of survey of Post-harvest Handling, Storage, and Consumption of Peanuts in the Sudan.

REPORT OF TRAVEL REGARDING THE PROJECT ENTITLED:
AN INTERDISCIPLINARY APPROACH TO
OPTIMUM FOOD UTILITY OF PEANUTS
IN SAT AFRICA

DEMOCRATIC REPUBLIC OF THE SUDAN

Bharat Singh, Food Scientist
Principal Investigator, Department of Food Science

John C. Anderson, Food Scientist
Department of Food Science

Gerald C. Wheelock, Rural Sociologist
Department of Agribusiness

Alabama A&M University, Normal, Alabama 35762

An Activity Report from Peanut CRSP
International Programs, Alabama A&M University

1.0 Purpose of Travel

1. To install computer and train Sudanese scientists to analyze data collected during the survey in El Obeid, Khartoum, and Wad Medani.
2. To install instruments for analysis of peanut samples for aflatoxins and proximate compositions.
3. To discuss the research plan.

2.0 Executive Summary

B. Singh, G. C. Wheelock and John C. Anderson visited Khartoum, Sudan from August 5 through August 14, 1984. The team met scientists from the Food Research Centre/Agricultural Research Corporation and discussed the topics of mutual interest. The Apple IIe microcomputer with an Epson printer was installed. Two scientists and two technicians from the Food Research Centre were trained by the Alabama A&M team members to process data on the microcomputer. The data from the survey conducted in January in El Obeid, Wad Medani, and Khartoum were edited and entered into the computer files. The FRC scientists expressed confidence and it is assumed that they will be able to complete the analysis of data from the El Obeid area. Alabama A&M scientists will complete analysis of the data from Wad Medani and Khartoum. Dr. Asha ElKarib will be responsible for the data analysis in the Sudan. It was also agreed that Dr. Amna Khalid will complete the analysis of peanut samples for aflatoxins and Dr. Magboul will be responsible for the proximate analysis. Dr. Khalid expressed problem in obtaining solvents for aflatoxin analysis. Efforts will be made to send solvents from the US in the future.

It was agreed that in the coming fiscal year, research will be conducted in area of (1) post-harvest handling of peanuts by conducting an in-depth survey of 25 rural families each in Wad Medani area and in El Obeid area; (2) on improvements of method for peanut paste, a commonly used product in the Sudan, (3) and on determination of aflatoxins in peanuts and peanut products. AAMU scientists received excellent cooperation from the FRC scientists. Dr. Hassan Ishag and Dr. B. Bashir were very helpful in coordinating the efforts of scientists. Mr. Eric Witt and Mrs. Elizabeth Martella were helpful in facilitating the clearance of materials and equipment brought to Sudan.

3.0 Itinerary

- Aug 3 Left USA (Huntsville-Atlanta-New York) with 12 packages of equipment and supplies for FRC.
- Aug 4 Stopped at London to collect all packages and then to travel to Khartoum
- Aug 5 Left London and arrived Khartoum m at 12:30 a.m.
- Aug 6 Visited USAID, met with Eric Witt and Elizabeth Martella
Visited FRC: Drs. Bashir, Magboul, Elkarib, and Mr. Zakaria
- Aug 7 Visited FRC, met with Drs. Bashir, Magboul, Elkarib, Khalid, and Mr. Zakaria
Visited USAID, Airport: to clear baggage through customs
- Aug 8 Visited FRC: Arrangements for installation of computer and equipment
- Aug 9-11 Visited FRC: Installation of computer, training of personnel; procurement of electrical accessories for installation of equipment

- Aug 12 Visited FRC: Meeting with Prof. H. Ishag and the research team
Alabama A&M and FRC members: Discussion and review of progress
and plan of research for 1984-85.
- Aug 13 Meeting with Dr. Hanafi
Visited FRC: Meeting with Prof. Ishag and Dr. Bashir
- Aug 14 Visited FRC, meeting with Drs. Ishag, Bashir, Khalid, Magboul,
ElKarib
Luncheon at Peoples Palace
Singh left Khartoum in the night
- Aug 15 Anderson and Wheelock left Khartoum in the morning

4.0 Acknowledgment

The team members would like to express thanks to Mr. Eric Witt and Mrs. Elizabeth Martella of USAID for their assistance during their visit to the Sudan. Mr. El Obeid and Mr. William of the USAID have been very helpful to the FRC in getting equipment and materials cleared through the customs. The team is thankful to Dr. B. Bashir for his hospitality and to Dr. Hassan Ishag and the research group for their excellent cooperation during the period of the visit.

5.0 Arrival at Khartoum

The team members, Drs. Singh and Wheelock arrived Khartoum airport on August 6 at 12:30 a.m. with equipment and materials (12 packages) after overnight stay in London. Attempts were made to clear the baggage through the customs; however, suggestions were made by the custom officials to return next day. Dr. Anderson joined later through different flight (August 7, 10 p.m.)

5.1 Visit to USAID: Meeting with Mr. Eric Witt and Mrs. Elizabeth Martella

Drs. Singh and Wheelock visited USAID in the morning of August 6 and discussed with Mr. Eric Witt and Mrs. Martella the plan of work during the stay. Mr. Witt suggested the team members to arrange a meeting of the members of the Peanut CRSP, Dr. Hanafi, quality control department of the Ministry of Commerce, and Mr. Witt and Mrs. Martella at the FRC to discuss a plan of research and development in area of aflatoxin in peanuts. Dr. Singh took the responsibility to discuss the program with the FRC scientists and to help develop a complimentary program at the FRC. Dr. Singh also appreciated the USAID mission for its keen interest in the Peanut CRSP project. Later, Mrs. Martella assured the team that the USAID will provide assistance in getting equipment and materials cleared through the customs.

5.2 Visit to the Food Research Centre: Meeting with Drs. B. Bashir, Magboul, ElKarib, and Mr. Zakaria

The team members later on August 6, visited FRC and met Drs. Bashir and Magboul. Dr. Asha ElKarib also met with the team. She has newly arrived at the FRC. She had her Ph.D. from England. She will be working with the Peanut CRSP Project because Mr. Zakaria will be going to India to work on his doctoral degree at CFTRI, Mysore. Dr. Ishag will be making a formal request to the Peanut CRSP management to approve the appointment of Dr. ElKarib.

Dr. Bashir reported the progress made on coding of the data processing from El Obeid and other relevant matters. He also indicated that he will be meeting Professor Ishag in Wad Medani and would bring the message about the meeting of all members of the Peanut CRSP and Professor Ishag. He also agreed to send message to Dr. Khalid (who was on leave for that week) to visit with team members.

In the evening, Dr. Singh and Dr. Wheelock walked to Dr. Khalid's home in Omdurman and discussed matters of mutual interest.

5.3 Visit to USAID and FRC

On August 7, team members visited USAID and found that baggage has been already cleared through the customs and brought to the USAID. Arrangements had also been made to deliver it to the FRC. Mr. El Obeid visited the team members at FRC and extended his assistance to the project as much as possible during the stay.

5.4 Visit to FRC

The team members arrived at the FRC early morning on August 8 to prepare room for installation of the computer and other equipment. Drs. ElKarib, Magboul, Khalid, and Mr. Zakaria prepared an inventory of materials and equipment. Also, accessories (electrical plugs, etc.) for installations were ordered from the local sources.

5.5 Installation of Equipment and Training of Personnel

The computer was installed on August 9. Drs. Wheelock and Anderson worked with Dr. ElKarib and Mr. Zakaria to familiarize with the computer. The training sessions and data entry continued from August 9 till 14. It was apparent that Dr. ElKarib with her training at Wales was quite familiar with computers. Mr. Zakaria also went through the training sessions. In addition, two B.Sc. degree holder technicians became familiar with the computer and assisted in entering data on the file. These technicians have completed applications for admission to M.S. degrees in Food Science, possibly will be able to come to Alabama A&M in January, 1985.

Dr. Singh spent time with Drs. Khalid and Magboul in reviewing the analysis of samples collected during survey. The groundnut samples (200) have been stored in ziplock bags since their collection in January, 1984. It was decided that sample analysis should begin as soon as possible. Further, these data on aflatoxin and other parameters will be compared with samples collected during coming post-harvest season.

5.5.1 Meeting of Peanut CRSP Investigators

On August 11, all Peanut CRSP investigators met at FRC. Dr. Ishag reviewed the progress made in research at FRC. He also indicated that additional equipment and materials will be needed to conduct research in food product development area. Briefly, the following has been done: (1) the data from El Obeid have been coded by hand and are ready to be analyzed. These include data from 200 households for consumption and 100 for post-harvest handling; (2) the peanut samples (a total of 200) have been stored at the FRC and may soon be analyzed for aflatoxins and proximate compositions; (3) the hand-coded data from Khartoum (100 households) have already been sent to Alabama A&M for analysis; (4) the survey instruments (100) from the Wad Medani area have been analyzed at Alabama A&M University; (5) Dr. Asha ElKarib has been assigned to handle computer and survey data. However, each group of participants will prepare their own reports (such as group for El Obeid, Dr. Khalid, Zakaria, Jones, and Wheelock); group for Wad Medani: Magboul and Singh; group for Khartoum: Bashir and Caples).

Dr. Khalid expressed her problems in obtaining solvents. Dr. Singh has suggested her to order materials from Europe and arrangements will be made to pay from the project directly. Dr. Ishag will be sending a request to formalize the appointment of Dr. ElKarib to the project. She will be replacing Mr. Ahmed Zakaria who is going for his Ph.D. degree at CFTRI in India.

5.5.2 Research Plans

Dr. Singh outlined the progress at Alabama A&M, including (a) analysis of data from Wad Medani and Khartoum; (2) plan of research for 1984-85 and subsequent years. This plan was based on the preliminary analysis of the consumption survey data: The research plan will include:

(i) Product improvement research; (ii) Post-harvest handling; (iii) Aflatoxin research and monitoring.

Product Improvement - The data from the survey clearly indicated that peanut paste is widely used product in the Sudan. This product is primarily produced in home by certain group of families and is sold in the market. To improve processing and ensure safety of the product, the following has been planned for the year 1984-85.

(a) Description of the product - how commonly the product is used; in what form it is used; who uses it (preference) - rural, urban, age group, sex, ethnic group; who prepares. (Are there variations from one family to another); Method of preparation: acquisition of raw material, especially current practices, processing methods: shelling - sorting - roasting - skin removal - grinding - packaging - storage; marketing, including return on the investment.

(b) Chemical Composition - Protein, fat, fiber, moisture, protease inhibitors, phytic acid, goitrogenic substances.

(c) Contaminants: Mycotoxins: aflatoxins, ochratoxins; microbiological contamination: plate count, coliform; other contaminants: sand, silica, animal residues.

(d) Possible improvements: Processing, packaging, marketing.

Post-harvest Handling and Practices: A survey of current practices in peanut producing areas and possible improvements.

Aflatoxin Research and Monitoring - (a) correlation of aflatoxin contamination levels with post-harvest practices and handling; (b) Monitoring of peanuts and peanut products; (c) Collaborative research with the product improvement research.

The Sudanese scientists have agreed to fully participate and carry out as much research as possible at the FRC. It may be desirable to have short visits of the FRC scientists to the United States. It was also agreed upon that students will include research related to the project in their thesis research.

Dr. Ishag has suggested FRC scientists to prepare mini-research projects and submit to him the plan as soon as possible. Apparently, there will be a need for acquiring additional equipment and materials.

6.0 Visit to a peanut paste processing family: Dr. Amna Khalid arranged a meeting with a family where peanut paste is prepared, in the evening of August 11. The processing is done manually using traditional tools primarily by Nigerian women. Two kinds of paste can be prepared: (1) dark color, and (2) lighter color.

Almost all members of the family get involved in processing. The peanuts are obtained from the markets and then they are hand sorted to remove broken, spotty, or moldy peanuts. The process is carefully done to assure cleanliness of the raw material. In one process, peanuts with skin are roasted in sand on a pan. Skin is removed by hand by rubbing. Then, grinding is done using mortar and paste. The fine grinding is done on a stone. The fine-ground paste (lighter color) is then stored in plastic bags. In another method, the peanuts are blanched (boiling water) and then dried and roasted on ash before grinding. It takes about 10 hours to process approximately 15 pounds of peanuts. The product is sold in the market and used in a variety of products as an ingredient.

- 7.0 Meeting with Dr. M. O. Hanafi, Mr. Witt, Mrs. Martella, and Peanut CRSP Collaborators - On August 12, Peanut CRSP collaborators (Sudanese and Alabama A&M) met with Dr. Hanafi and USAID members Mr. Witt and Mrs. Martella to explore the possible collaborative efforts on aflatoxins. Dr. Hanafi emphasized the need for funding monitoring of aflatoxin in the Sudan to ensure quality of the products for export as well as for local consumption. Mr. Witt and Mrs. Martella wanted to determine the role of various groups. There may be a possibility of funding of this project by the USAID mission. The A&M scientists would like to see that the FRC benefits from such programs.

8.0 Meeting with FRC Scientists: On August 13, again the data entry continued. Dr. Singh met with Drs. Ishag, Khalid, Magboul, and Bashir individually. In the group meeting, again it was emphasized that survey data needs to be analyzed soon. Drs. Khalid, Magboul, and Ali presented lists of equipment and materials. Dr. Ishag requested for additional money to carry out the research. Dr. Ishag suggested that Dr. Bashir and he will visit the United States in 1985.

9.0 Visit to USAID - On August 14, Drs. Singh and Wheelock visited Mrs. Martella at USAID to brief her on the progress of the visit. She assured the group of her full cooperation in the future.

Later, we were guests of Dr. Bashir at luncheon at Peoples Palace.

INTERDISCIPLINARY APPROACH TO OPTIMUM FOOD UTILITY OF
PEANUTS IN SAT AFRICA

Annual Report

Submitted to:

Peanut CRSP Management Office
University of Georgia
Experiment, GA 30212

By:

Office of International Programs
ALABAMA A&M UNIVERSITY
Normal, AL 35762

September, 1983

TABLE OF CONTENTS

		Page
1.	TITLE.....	1
2.	INTRODUCTION.....	2
3.	MAJOR ACCOMPLISHMENTS.....	4
3.1	Establishment of Project.....	4
3.2	Research Results.....	4
3.2.1	Survey.....	4
3.2.2	Aflatoxin Laboratory.....	4
4.0	EXPECTED IMPACT OF PROJECT.....	5
4.1	Impact of Project in Sudan.....	5
4.2	Impact of Project in U.S.....	6
5.0	GOALS OF PROJECT.....	7
5.1	General Goal.....	7
5.2	Specific Goals.....	7
6.0	OBJECTIVES.....	7
6.1	Overall Objectives.....	7
7.0	ORGANIZATION.....	8
7.1	Organization at Alabama A & M.....	8
7.2	Organization in the Sudan.....	8
7.3	Relationship with International Agencies.....	11
8.0	APPROACH TO RESEARCH.....	11
8.1	Linkage.....	11
8.2	Survey.....	11
8.2.1	Survey Documents.....	11
8.2.2	Survey, Sites, Sample Size, and Survey Plan.....	12
8.2.3	Analytical Procedures.....	12
8.2.4	Organization of Laboratory.....	13
9.0	ACCOMPLISHMENTS (DETAIL).....	13
9.1	Survey Instrument.....	13
9.2	Survey Sites.....	14
9.3	Survey Data.....	15
9.4	Aflatoxin Laboratory.....	15
9.5	Nutrient Analyses.....	15
10.0	PROJECTED PLANS FOR 1983.....	16

APPENDIX

1. TITLE: An Interdisciplinary Approach to Optimum Food Utility of Peanuts in SAT Africa
 - Host Country: Democratic Republic of the Sudan
 - U. S. Institution: Alabama A & M University
 - Principal Investigator: Dr. Bharat Singh, Food Scientist
 - Co Principal Investigators:
 - Dr. John C. Anderson, Food Scientist
 - Dr. Virginia Caples, Home Economist
 - Dr. H. Jones, Rural Economist
 - Dr. R. Rao, Nutritionist
 - Dr. G. C. Wheelock, Rural Sociologist
 - Collaborating Institution and Scientists from Sudan:
 - Institution: Agricultural Research Corporation
Wad Medani and Food Research Centre
Shambat, Sudan
 - Principal Investigators:
 - Dr. H. M. Ishag, National Coordinator, Groundnuts Research
 - Dr. B. Bashir, Deputy Principal Investigator
 - Co-Principal Investigators:
 - Dr. A. B. Ahmadi, Plant Breeder
 - Dr. S. M. Badi, Cereal Chemist
 - Dr. A. S. Khalid, Microbiologist
 - Dr. B. I. Magboul, Nutritionist
 - Dr. A. G. Tayeb, Chemist
 - Mr. A. B. Zakaria, Economist

2. Introduction:

The project aims to initiate a collaborative interdisciplinary research and development program on peanut utilization for human consumption between Alabama A & M University and the Agricultural Research Corporation in the Sudan. Peanut is an important cash crop in the Sudan. It provides 7 percent of the GNP and employs 12 percent of the population. Sudan is the fourth leading country in peanut production after India, China, and the United States. In the Sudan, peanuts are used primarily as an oilseed crop and approximately 60% of the peanuts are converted to peanut oil. The meal is generally not utilized for human consumption. Most of the peanut meal is exported rather than used within the country. Yet, a recent study from the University of Khartoum indicates that a large segment of Sudanese population (including infants and small children) subsist on an inadequate diet. It has been known that aflatoxin-free peanuts and peanut products can easily be incorporated into daily diets for improvement of protein and calories in underdeveloped countries. Peanut utilization in common dishes of Sudan have been limited by various constraints. Understanding of the environmental and socioeconomic constraints, as well as those of food preservation and preparation technology are needed if sufficient cost-effective, tasty, nutritious and aflatoxin-free peanuts are to be made available. In addition to production technology, cultural practices impacting the supply of peanuts include storage techniques and inventory management system.

The objectives of the project include: (a) description and understanding of variations in environment, socioeconomics and technologies as they constrain the preservation and utilization of peanut supplies; (b) analysis of the current and potential dietary role at different income levels of existing peanut products; and (c) research on the improvement of existing peanut products and the development of new peanut products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.

These objectives have been discussed with collaborators from the Agricultural Research Corporation in the Sudan. Sudanese scientists are fully participating in coordination, implementation, and evaluation of the research. Implied in the collaborative study is the realization that to Sudanese populations, the change most desired in food consumption is a reliable and adequate supply of the traditional diet. This emphasis should effect development of research capabilities sensitive to research needs of the region, specifically, research on optimizing food utility of the peanut. The first phase of the study includes a consumption survey to assess at different income levels and in contrasting markets the current and potential dietary role of existing peanut products. Further, a survey is planned to assess post-harvest practices that impact the supply of peanuts, including storage techniques and inventory management techniques.

3.0 Major Accomplishments:

3.1 Establishment of Project

A considerably long interval elapsed from the time of approval of the project (February, 1982) by the Peanut CRSP Management Office and formal completion of the project documents in June, 1983. The project has been reviewed and approved by the Directorate of Agriculture and the Ministry of Agriculture.

3.2. Research Results

3.2.1 Survey: Two survey instruments have been developed, one dealing with consumption and food utility aspects of peanuts and the other dealing with post-harvest technology of peanuts. The instrument dealing with consumption survey has been pretested in the Khartoum area and has been found to be satisfactory. We have agreed to conduct the survey at four different sites: Khartoum (Capital City and adjoining Omdurman and North Khartoum area), El Obeid (Kordofan Province in Western Sudan) and Wad Medani (Blue Nile Province). The data will be collected from two urban populations (Khartoum, El Obeid) and two rural populations (El Obeid area and Wad Medani area). Arrangements have been made to initiate these surveys during post-harvest period in the fall and continue during the spring.

3.2.2 Aflatoxin Laboratory: Arrangements have been made to establish an aflatoxin laboratory at the Food Research Centre to monitor aflatoxins in peanuts. Equipments and supplies for the laboratory will be acquired through the Peanut CRSP Project and supplied to the FRC during the Fall, 1983.

4.0 Expected Impact of Project:

4.1 Impact of Project in Sudan

- i The project has established a linkage between Alabama A & M University and the Sudanese scientists at the Agricultural Research Corporation and Food Research Centre. Eventually, this will lead to long-term collaborative studies, research and development of peanut-based food products.
- ii The data from the proposed survey will define conditions of storage, preservation and utilization of peanut to promote improved nutrition in rural populations.
- iii Improved and innovative means of storage, preservation and preparation for consumption of peanuts may be introduced. The proposed survey will lead to the identification of existing efficient and more appealing products and procedures.
- iv The most vulnerable Sudanese populations (rural/urban) may have increased and prolonged opportunities to benefit from peanut consumption.
- v To impact favorably the status of women, techniques will be designed to utilize and reward women's indigenous means of production. The project aims to identify improved and innovative peanut processing technologies to allow increased efficiency of women in family food preparation and/or alternative income generating activities, e.g., peanut-based foods as a cottage industry product for sale.
- vi Experience gained in Sudan can be used in developing projects in other countries with similar peanut consumption patterns.

188

vii More specifically, the project will enhance the capability of the Agricultural Research Corporation to analyze peanut, peanut products and other food products for aflatoxin and other contaminants and to analyze the socio-economic impact of peanut utilization.

4.2 Impact of Project in U.S.

- i The project has provided an opportunity to Alabama A & M University to develop capability in solving world problems and to further strengthen programs in international food and agriculture.
- ii Since the establishment of the project, the School of Agriculture at Alabama A & M University has started a project on evaluation of toxic components of peanut flour and meal including protease inhibitors, phytic acid and aflatoxins. It certainly will enhance the program on utilization of peanuts.
- iii Also since initiation of the project, an Alabama A & M farming systems project for North Alabama has been proposed and is expected to be funded by O.I.C.D. It will benefit from the experience with the post-harvest survey and on farm research in Sudan.
- iv The result on breeding and selection of aflatoxin resistant varieties of peanuts in the Sudan and other Peanut CRSP host countries will be of significance to the farmers of Alabama and other peanut growing states.
- v The State of Alabama will further derive benefits through the transfer of technologies of peanut processing and utilization to the Sudan.

5.0 Goals of Project:

5.1 General Goal

To foster interdisciplinary (nutrition, food science, social and economic) institutional-based linkages between U.S. and LDC scientists serving major peanut producing and consuming populations of the Sahel region of Africa for the purpose of optimizing the food utility of the peanut.

5.2 Specific Goals

Specific goals of the project are consistent with the general goal of the Peanut CRSP to develop collaborative research and development programs on the peanut between social scientists and food scientists at Alabama A & M University and the Agricultural Research Corporation of the Sudan.

6.0 Objectives:

6.1 Overall Objectives

- A. Description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies.
- B. Analysis of the current and potential dietary role of existing peanut products.
- C. Research on the improvement of existing peanut products and the development of new products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.

- D. Ensurance of safety of the products with particular reference to mycotoxins in raw and finished products, and
- E. Exchange of peanut germplasm for breeding resistant varieties to aflatoxin.

7.0 Organization:

7.1 Organization at Alabama A & M

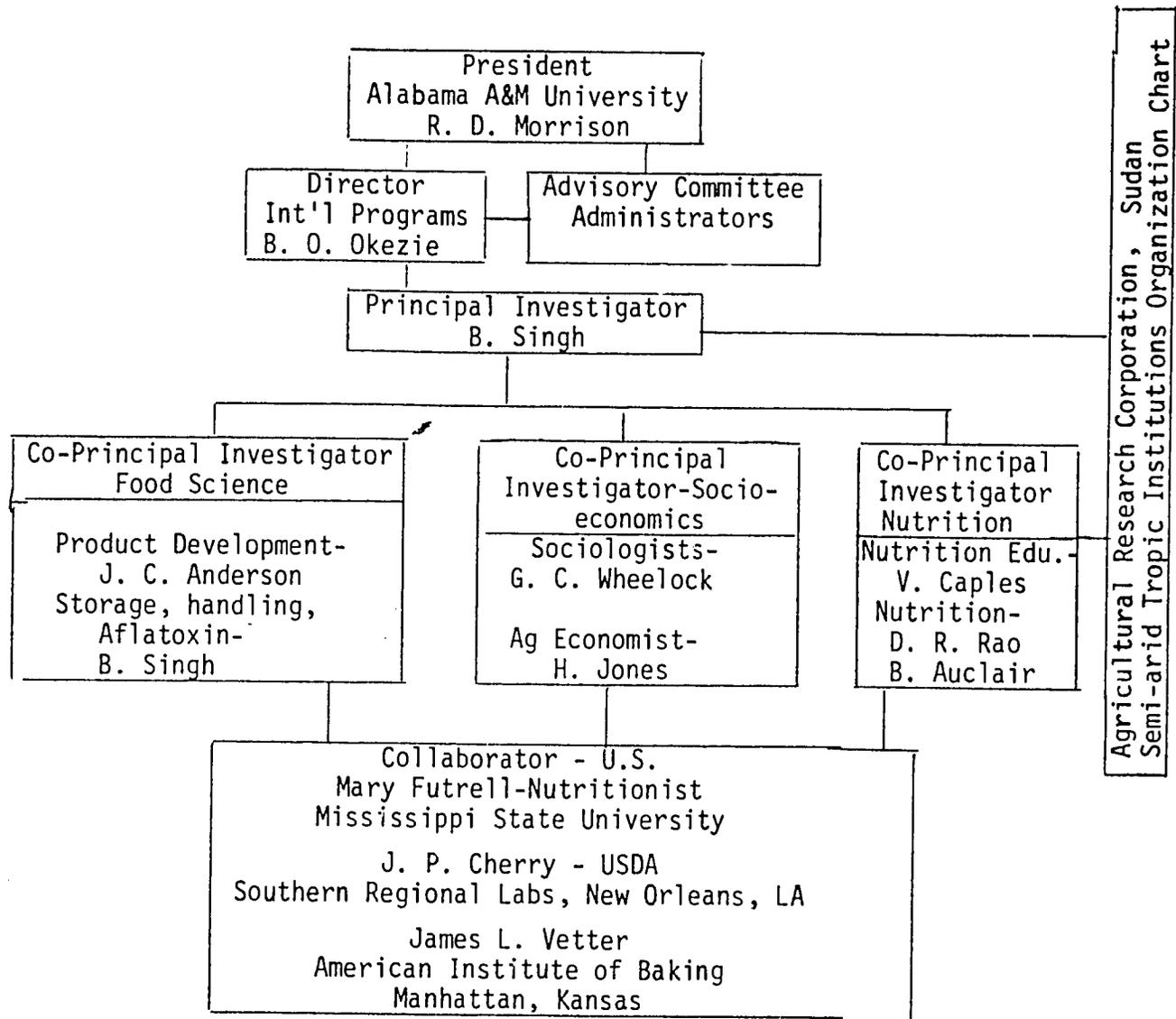
Alabama A & M University's team consists of food scientists, a rural sociologist, nutritionist and an agricultural economist (See Chart 1). Scientists represent the Department of Food Science and Animal Industries, Agribusiness, and the Division of Home Economics in the School of Agriculture, Environmental Science and Home Economics.

7.2 Organization in the Sudan

The research team in the Sudan consists of peanut specialists (plant pathologist, plant breeder, biochemist), nutritionist, cereal chemist, oil seed chemist, food scientist, microbiologist, and rural economist. (See Chart 2). These scientists represent Agricultural Research Corporations of the Sudan. Further, the Nutrition Division of the Ministry of Health (Sudan) has agreed to collaborate during the survey. The interviewers from the Nutrition Division are well trained and have collaborated with other international agencies in the past. Dr. James Riley of the Western Sudan Project has agreed to provide assistance during the project period. We will be seeking advice and assistance from Dr. Brian D'Silva of the Rural Economy Department of the University of Khartoum.

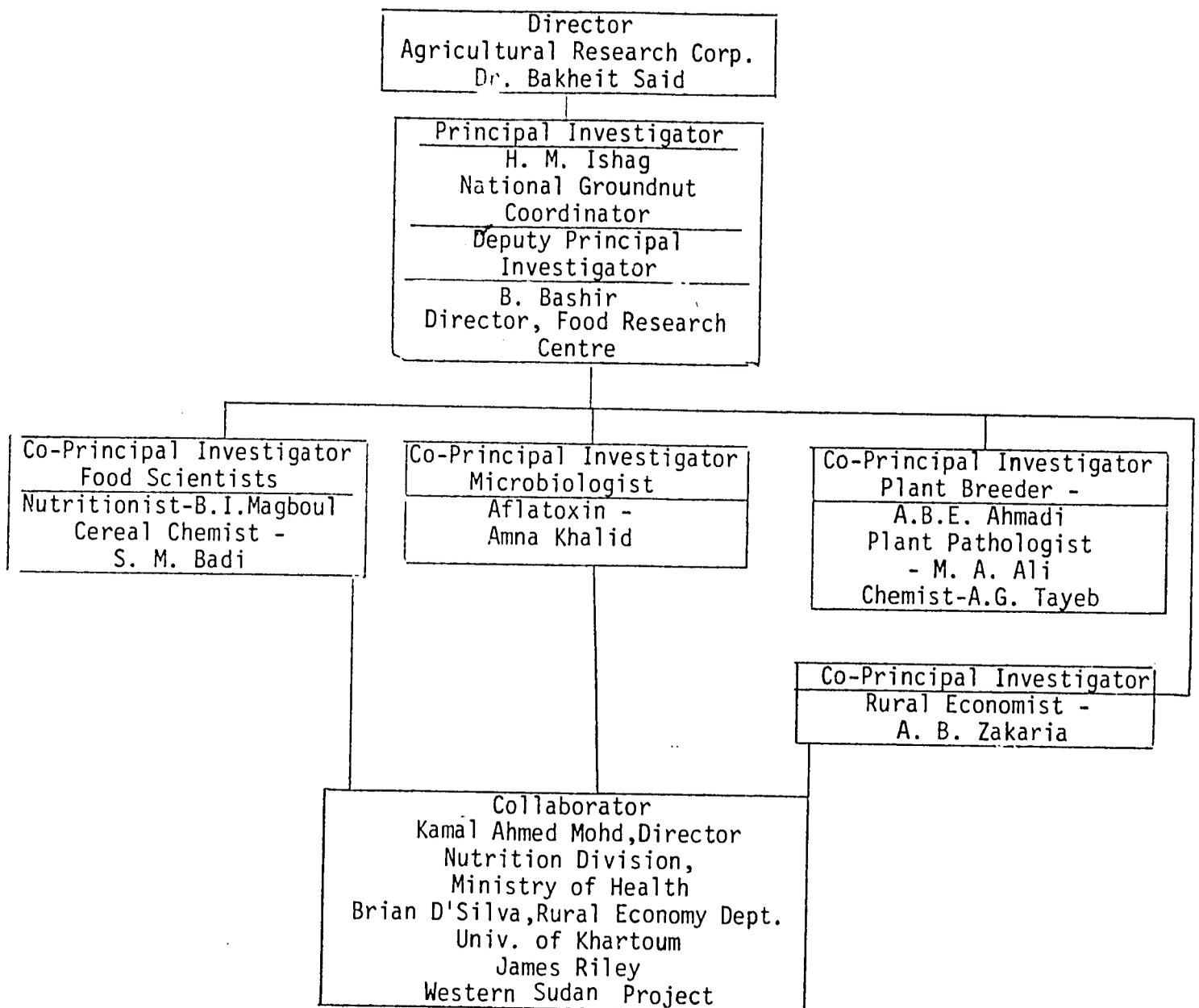
Alabama A & M University
Peanut CRSP

Organizational Chart



Agricultural Research Corporation, Sudan
Peanut CRSP

Organizational Chart



7.3 Relationship with International Agencies

The A & M team members (B. Singh, G. C. Wheelock, V. Caples and H. J. Jones) have discussed the project objectives with members of the Nutrition Division of the FAO. There is a possibility of collaboration in aflatoxin area in the Sudan. Similar relationships and collaborators will be developed with Tropical Products Institute in London and IRCISAT and CFTRI, India in the future.

8.0 Approach to Research:

8.1 Linkage

The linkage with the Agricultural Research Corporation and Food Research Centre of the Sudan and Alabama A & M University and the Management Entity of the Peanut CRSP has been formalized through a Memorandum of Understanding. The plan of work has been further discussed and agreed upon between scientists from the collaborating organizations.

8.2 Survey

- 8.2.1 Survey Documents: Two survey documents have been developed. The consumption survey instrument includes among other things: (a) amounts and types of peanut foods consumed daily, weekly, monthly, seasonally; (b) Intra-family consumption patterns; (c) impact of the role of women on peanut intake; (d) cost and preference constraints; (e) source of peanuts for family; (f) types of fats (oils) consumed; (g) amount of peanut oil consumed; and (h) food preparation methods.

The post-harvest survey instrument will include questions to identify efficient methods, or to diagnose needed modification or development of a new system. Initial quality evaluation will be made on degree of maturity; mold contamination; aflatoxin levels; residue of insects and insect fragments; amounts of protein, fat, and carbohydrates; and, data on temperature, humidity and method of packaging. Samples will be taken to assess the losses during handling and storage.

Research plans on improvement of the products or production of new acceptable foods will be developed after the analysis of the survey data.

- 8.2.2 Survey Sites, Sample Size, and Survey Plan: The following sampling populations are proposed: Khartoum (an urban population); Wad Medani (a rural population); El Obeid (urban and rural population). A minimum of 100 households will be included in each population during the survey. Sample forms will be developed and stratified by income levels.

The survey will be done twice for each community. Once survey will be done during post-harvest period (Fall 1983) at which time there is an abundant supply of peanuts and the other survey will be done during the Spring of 1984.

- 8.2.3 Analytical Procedures: Samples will be analyzed using standard AOAC methods for protein, fat, moisture, fiber and carbohydrates at the Food Research Centre. Aflatoxin levels will be determined using fluorotoxinmeter. They will be compared using standard procedures.

8.2.4 Organization of Laboratory: Equipments and supplies for establishing aflatoxin laboratory at the Food Research Centre will be purchased through the Peanut CRSP Project.

9.0 Accomplishments (detail):

Sixteen months elapsed from the time of approval of the project (February, 1982) by the Peanut CRSP Management Office and formal completion of the project documents in June, 1983. This delay, however, has provided the ARC, Sudan, an opportunity to review the whole peanut program and to determine relevance of the Peanut CRSP Project. Apparently, the administration of the ARC has determined that the completion of the objectives of the Peanut CRSP in the Sudan will be of significance to the total peanut program. A major addition to the proposed objectives has been made to include an objective related to the development of capabilities to monitor peanut and peanut products for aflatoxin contamination.

To finalize details of the project and initiation of the survey during the post-harvest period in 1983 (November-December), Drs. B. Singh, V. Caples, H. Jones and G. C. Wheelock visited Sudan from May 26 - June 17, 1983. We discussed in detail the plan of work including survey instruments, implementation strategies, sites of the survey, and establishment of an aflatoxin laboratory.

9.1 Survey Instrument

Two survey instruments have been developed (See Appendix 1 and 2). The survey instruments dealing with consumption and food utility aspects of peanut were reviewed with Dr. B. I. Magboul

(Nutritionist), Dr. B. Bashir (Food Scientist) at the Food Research Centre. Dr. Kamal Ahmed Mohd, Director, Nutrition Division, Ministry of Health, has agreed to cooperate on the survey. A pretest on the consumption survey instrument was made in the Khartoum area with an assistant from the Ministry of Health. Apparently, there was no major problem in the pretest. There was one problem recognized. That was the method of estimation of the quantity of peanuts. It appeared that (a) the survey instrument was adequate, (b) the interviewer from the Ministry of Health was well trained and had no problems, and finally (c) the family members were willing to provide informations and seemed to be very friendly. Based on limited informations, peanuts are used in a variety of forms in the Sudan and also the lower income families use more peanuts compared to higher income groups.

The survey instrument dealing with post-harvest technology of peanuts was discussed in detail with Mr. Zakaria, Dr. Bashir, Dr. Magboul and Dr. Khalid. Further, it has been discussed with Dr. Brian D'Silva who is currently working as a visiting professor at the University of Khartoum. The instruments appeared to be adequate.

9.2 Survey Sites

We have agreed to conduct the survey at four different sites: Khartoum (capital city and adjoining Omdurman and North Khartoum area), El Obeid (Kordofan Province in Western Sudan) and Wad Medani (Blue Nile Province). In El Obeid area, we will conduct surveys in both rural and urban populations; in Khartoum only

urban populations and in Wad Medani area only rural populations. Arrangements have been made to initiate these surveys during post-harvest period in the Fall and continue during the Spring.

9.3 Survey Data

It has been proposed that the data collected will be analyzed initially in the Sudan. Further analysis and interpretations will be made at Alabama A & M University. A mini-computer will be bought through the project and will be available to scientists at the Food Research Centre.

9.4 Aflatoxin Laboratory

Equipments and supplies for the aflatoxin laboratory have already been ordered and will be sent to the FRC by November, 1983. Dr. Amna Khalid has made a plan to sample, store and analyze peanut samples in her laboratory. The quality of analysis will be maintained by check sample program with American Oil Chemists Society and with Tropical Products Institute in London.

9.5 Nutrient Analyses

Analyses of samples for protein, fat, fiber, carbohydrates and moisture will be made at the Food Research Centre. Although the capability to analyze these data exists at the Food Research Centre, more equipments and supplies are needed to handle the number of samples collected during the survey period and also during the research phase dealing with improvement of existing products and development of new products.

195

10.0 Projected Plans for 1983:

1. Implementation of survey
2. Analysis and interpretation of survey data
3. Analysis of peanut and peanut products for aflatoxin contamination
4. Variations in major nutrients in peanuts grown at various locations in the Sudan
5. Initiation of research on improvement of storage and handling of peanuts during post-harvest periods
6. Initiation of research on improvement of existing food products
7. Initiation of research on development of new food products.

"AN INTERDISCIPLINARY APPROACH TO OPTIMUM FOOD UTILITY OF
PEANUT IN SAT AFRICA"

Alabama A&M University - Democratic Republic of the Sudan

Bharat Singh, Principal Investigator, AAHU

INTRODUCTION

The project aims to initiate a collaborative interdisciplinary research and development program on peanut utilization for human consumption between Alabama A&M University and the Agricultural Research Corporation in the Sudan. Peanut is an important cash crop in the Sudan. It provides 7 percent of the GNP and employs 12 percent of the population. Sudan is the fourth leading country in peanut production after India, China, and the United States. In the Sudan, peanut is used primarily as an oilseed crop and approximately 50% of the peanut is converted to peanut oil. The meal is generally not utilized for human consumption. Most of the peanut meal is exported rather than used within the country. Yet, a recent study from the University of Khartoum indicates that a large segment of Sudanese population (including infants and small children) subsist on an inadequate diet. It has been known that aflatoxin-free peanut and peanut products can easily be incorporated into daily diets for improvement of protein and calories in under developed countries. Peanut utilization in common dishes of Sudan have been limited by various constraints. Understanding of the environmental and socioeconomic constraints, as well as those of food preservation and preparation technology are needed if sufficient cost-effective, tasty, nutritious and aflatoxin-free peanut is to be

made available. In addition to production technology, cultural practices impacting the supply of peanut include storage techniques and inventory management systems.

Project objectives have been discussed with collaborators from the Agricultural Research Corporation (ARC) in the Sudan. Sudanese scientists are fully participating in coordination, implementation, and evaluation of the research. Implied in the collaborative study is the realization that to Sudanese populations, the change most desired in food consumption is a reliable and adequate supply of the traditional diet. This emphasis should effect development of research capabilities sensitive to research needs of the region, specifically, research on optimizing food utility of the peanut. The first phase of the study includes a consumption survey to assess at different income levels and in contrasting markets the current and potential dietary role of existing peanut products. Also, a survey was conducted to assess postharvest practices that impact the supply of peanut, including storage techniques and inventory management techniques.

MAJOR ACCOMPLISHMENTS

Establishment of Project

The project has been reviewed and approved by the Directorate of Agriculture and the Ministry of Agriculture in the Sudan since June, 1983. The linkage with the Agricultural Research Corporation and Food Research Centre of the Sudan and Alabama A&M University and the Management Entity of the Peanut CRSP has been formalized through a Memorandum of Understanding.

Research Results

Teams consisting of scientists from Alabama A&M University and Food Research Centre, completed proposed surveys on consumption and post harvest handling of peanuts in the Sudan in January, 1984. The surveys were conducted at four different sites: Khartoum (Capital City and adjoining Omdurman and North Khartoum area); El Obeid (City of El Obeid), rural areas near El Obeid; and adjoining rural area near Wad Medani. Urban areas (Khartoum and El Obeid) were stratified into low, medium, and high income clusters to determine the relationship between income and peanut consumption. The survey instrument was designed to determine the relationship between family size, age, and peanut consumption. Although the data are not completely analyzed, preliminary observations indicate that peanut is widely used in the Sudan. It was also apparent that more peanuts were used in the rural areas. The common products available and used are roasted peanuts, shelled peanuts covered with ash, and peanut pastes. The peanut paste is used as an ingredient in salads and various household preparations.

The consumption and post harvest surveys in rural areas near Wad Medani were conducted in three villages approximately 15 miles from the ARC and in two blocks under Rahad Scheme. The Rahad Scheme is approximately 30 miles from Wad Medani across the Nile River. The people in the scheme were nomadic and were brought under this scheme through a government program.

In El Obeid area, the surveys on consumption and post harvest handling were conducted in four villages. The analysis of the survey

data is not yet complete, however; it is apparent that much needs to be done in improvements of storage and post harvest handling of peanuts.

A plan of work on improvements of processing of peanut pastes and storage and post harvest handling of peanuts in the Sudan will be finalized in a forthcoming visit to the Sudan.

Aflatoxin Laboratory: Equipment and supplies for aflatoxin laboratory have been purchased. Most of the equipment have arrived at Food Research Centre. Arrangements have been made to carry remaining equipment and supplies in Summer, 1984.

Samples of peanuts from all rural households in the El Obeid and Mad Medani survey have been collected and stored. Analysis for aflatoxin on these samples will be matched with the storage data to identify practices associated with higher levels of contamination.

EXPECTED IMPACT OF PROJECT

Impact of the Project in Sudan

- (1) The project has established a linkage between Alabama A&M University and the Sudanese scientists at the Agricultural Research Corporation and Food Research Centre. Eventually, this will lead to long-term collaborative studies, research and development of peanut-based food products.
- (2) The data from the proposed survey will define conditions of storage, preservation and utilization of peanut to promote improved nutrition in rural populations.
- (3) Improved and innovative means of storage, preservation and preparation for consumption of peanut may be introduced. The

proposed survey will lead to the identification of existing efficient and more appealing products and procedures.

- (4) The most vulnerable Sudanese populations (rural/urban) may have increased and prolonged opportunities to benefit from peanut.
- (5) To impact favorably the status of women, techniques will be designed to utilize and reward women's indigenous means of production. The project aims to identify improved and innovative peanut processing technologies to allow increased efficiency of women in family food preparation and/or alternative income generating activities, e.g., peanut-based foods as a cottage industry product for sale.
- (6) Experience gained in Sudan can be used in developing projects in other countries with similar peanut consumption patterns.
- (7) More specifically, the project will enhance the capability of the Agricultural Research Corporation to analyze peanut, peanut products, and other food products for aflatoxin and other contaminants and to analyze the socio-economic impact of peanut utilization.

Impact of Project in U.S.

- (1) The project has provided an opportunity to Alabama A&M University to develop capability in solving world food problems and to further strengthen programs in international food and agriculture.
- (2) Since the establishment of the project, the School of Agriculture at Alabama A&M University has started a project on evaluation of toxic components of peanut flour and meal including protease

inhibitors, phytic acid and aflatoxins. It certainly will enhance the program on utilization of peanut.

- (3) Also, since initiation of the project, an Alabama A&M farming systems project for North Alabama has been proposed and is funded by O.I.C.D. It will benefit from the experience with the post-harvest survey and on farm research in the Sudan.
- (4) The result on breeding and selection of aflatoxin resistant varieties of peanut in the Sudan and other Peanut CRSP host countries will be of significance to the farmers of Alabama and other peanut growing states.
- (5) The State of Alabama will further derive benefits through the transfer of technologies of peanut processing and utilization to the Sudan.

GOALS

General Goal

To foster interdisciplinary (nutrition, food science, social and economic) institutional-based linkages between U.S. and LDC scientists serving major peanut producing and consuming populations of the Sahel region of Africa for the purpose of optimizing the food utility of the peanut.

Specific Goals

Specific goals of the project are consistent with the general goal of the Peanut CRSP to develop collaborative research and development programs on the peanut between social scientists and food scientists at Alabama A&M University and the Agricultural Research Corporation of the Sudan.

OBJECTIVES

- A. Description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies.
- B. Analysis of the current and potential dietary role of existing peanut products.
- C. Research on the improvement of existing peanut products and the development of new products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.
- D. Ensurance of safety of the products with particular reference to mycotoxins in raw and finished products, and
- E. Exchange of peanut germplasm for breeding resistant varieties to aflatoxin.

ORGANIZATION

Alabama A&M University

Dr. Bharat Singh, Principal Investigator, Department of Food Science, Normal, Food Scientist

Dr. John C. Anderson, Cooperator, Department of Food Science, Normal, Food Scientist

Dr. Virginia Caples, Cooperator, Division of Home Economics, Normal, Home Economist

Dr. Hezekiah Jones, Cooperator, Department of Agribusiness, Normal, Agricultural Economist

Dr. D. R. Rao, Cooperator, Department of Food Science, Normal, Nutritionist

Dr. G. C. Wheelock, Cooperator, Department of Agribusiness, Normal, Rural Sociologist

Sudan

Agricultural Research Corporation and Food Research Centre

Dr. H. H. Ishag, National Coordinator, Groundnut Research

Dr. S. Basnir, Deputy Principal Investigator, Food Research Center

Dr. A. B. Ahmadi, Plant Breeder

Dr. S. A. Badi, Cereal Chemist

Dr. A. S. Khalid, Microbiologist

Dr. J. I. Hagboul, Nutritionist

Dr. A. G. Tayeb, Chemist

Mr. A. B. Zakaria, Rural Economist

Relationship with International Agencies

The A&M team members have discussed the project objectives with members of the Nutrition Division of the FAO. There is a possibility of collaboration in aflatoxin area in the Sudan. Similar relationships will be developed with Tropical Products Institute in London and ICRISAT and CFTRI, India in the future.

Approach

Linkage - The linkage with the Agricultural Research Corporation and Food Research Centre of the Sudan and Alabama A&M University and the Management Entity of the Peanut CRSP has been formalized through a Memorandum of Understanding. The Plan of Work has been further discussed and agreed upon between scientists from the collaborating organizations.

Survey Documents - Two survey documents have been developed and used in the survey. The consumption survey instrument includes among other things: (a) amounts and types of peanut foods consumed daily,

weekly, monthly, seasonally; (b) intra-family consumption patterns; (c) impact of the role of women on peanut intake; (d) cost and preference constraints; (e) source of peanut for family; (f) types of fats (oils) consumed; (g) amount of peanut oil consumed; and (h) food preparation methods.

The post harvest survey instrument includes questions to identify efficient methods, or to diagnose needed modification or development of a new system. Initial quality evaluation will be made on degree of maturity; mold contamination; aflatoxin levels; residue of insects and insect fragments; amounts of protein, fat, and carbohydrates; and, data on temperature, humidity and method of packaging. Samples will be taken to assess the losses during handling and storage.

Research plans on improvement of the products or production of new acceptable foods have been developed (and will be further modified) after the completion of analysis of the survey data, if needed.

Survey Sites, Sample Size, and Survey Plan - The following sampling populations were used: Khartoum (an urban population); Wad Medani (a rural population); and El Obeid (urban and rural population). A minimum of 100 households were included in each sample during the survey. The urban populations in Khartoum and El Obeid were stratified by income levels (Fig. 1).

The interviewers for the collection of data in Khartoum area were nutrition officers with the Ministry of Health, Division of Nutrition. The officers were experienced in conducting survey research; however, they were further trained by the team members from Alabama A&M University and were closely monitored during the survey. Seven

interviewers in the El Obeid area were B.Sc. degree holders and three were technicians holding diplomas. They were tested for their competency in English and were found to be quite capable of uniform administration of the English survey document in Arabic. Additionally, each document was edited by the team members to correct problems of interpretation or missing data. The rural populations in four villages near El Obeid were surveyed for consumption and post harvest handling of peanuts. The survey in Wad Medani area was completed by six interviewers from Nutrition Education Centre in Wad Medani. It was necessary to translate the document into Arabic because interviewers did not have enough background in English. Training of the interviewers was done in Arabic by Dr. Ali Karrar who had experience in survey and Dr. B. I. Magboul, Nutritionist from the Food Research Centre and one of the Scientists on this project.

Analytical Procedure

The data from all sites will be analyzed at Alabama A&M University and The Food Research Centre. The preliminary analyses have been made on data from Khartoum and Wad Medani. The data from El Obeid will be completed at Food Research Centre by December, 1984.

Peanut samples have been collected from each respondent in rural areas. Arrangements have been made to analyze these samples for: protein, fat, fiber, carbohydrates, moisture and aflatoxins at Food Research Centre. Proximate compositions will be determined using standard AOAC methods. Aflatoxins will be determined by a fluorotoxinmeter. Initial results will be checked using standard procedure.

Preliminary results from the survey indicate that the peanut paste is used commonly in the Sudan. However, the processing is done under very unsanitary conditions and it is sold in an open market without any packaging. A study has been proposed to improve processing and devise simple and inexpensive packaging for the product and to determine the most suitable method of storage of peanuts to avoid post harvest losses and development of aflatoxins.

The studies in product development and/or post harvest handling will include socio-economic determinants as it constrains optimum utility of peanuts in the Sudan.

Organization of Laboratory - Equipment and supplies for establishing aflatoxin laboratory at The Food Research Centre have been purchased through the Peanut CRSP project. Additional equipment has been purchased to enhance capability in determining proximate compositions of peanuts.

ACCOMPLISHMENTS IN DETAIL

The Peanut CRSP project document was formally approved in June, 1983 by the Director of the ARC and by the Ministry of Agriculture. The Director of ARC, Dr. M. Bakhaeit Said, has taken a keen interest in the project. He has made it certain that the completion of the objectives of the Peanut CRSP in the Sudan will be of significance to the total peanut program.

The initial planning included surveys at four sites in the Sudan. Two survey documents were developed; one dealing with consumption of peanuts and the other with post harvest handling of peanuts. Design of the consumption survey document was coordinated with the Food Science

Project "Georgia" in Thailand to ensure compatibility across the Peanut CRSP regions. Standard procedures for all Sudan survey sites were framed by the team members from Alabama A&M University, including B. Singh (Food Scientist), V. Caples (Home Economist), H. Jones (Agricultural Economist), and G. C. Wheelock (Rural Sociologist), and the scientists from the Food Research Centre, B. Bashir (Food Scientist), B. I. Magboul (Nutritionist), A. Khalid (Microbiologist), and A. Zakaria (Agricultural Economist). Additional assistance was provided by Dr. Hassan Ishag, Principal Investigator and National Coordinator, Groundnut Research and Dr. Kamal Mohammed, Nutritionist from the Ministry of Health, and Dr. Ali Karrar from the University of Gezira, Wad Medani. Dr. D. R. Rao (Nutritionist) and Dr. J. C. Anderson (Food Engineer) provided assistance in developing the survey documents.

Survey Sites

The two urban sites for the peanut consumption survey were greater Khartoum (Omdurman, Khartoum, and Khartoum North) and El Obeid and were sampled by clusters as follows: three high income, three middle-income, and three low-income.

Eleven or twelve households were selected from each cluster for a total of 100 households for the Khartoum sample and 100 for the El Obeid sample.

El Obeid Area (Rural Site)

For the post harvest survey, 100 farms from four villages (Omonainad, Gehbat, El Hamadi, and Mabag) near El Obeid and another 100 farms from three villages near Wad Medani (Mobi, El Bastantana, and Kreiba) and two blocks in the Rahad Scheme were included.

Survey Procedure

Three survey supervisory teams each composed of at least one ARC-FRC scientist and one AAMU scientist were dispatched to train interviewers and implement the surveys. The interviewer training sessions emphasized correct and uniform interpretation of the survey document items. In the Khartoum area and in El Obeid, the document in English did not present any special problem; however, in Wad Medani, due to the language skills of the enumerators, the instrument needed translation into Arabic. In rural area, in addition to the consumption and post-harvest questionnaire, interviewers were also provided with sample bags to collect peanut samples. At the end of each day, interviewers were again allowed to present their problems. Immediate editing of each document by a team member was also found to be useful in correcting problems of interpretation or missing data.

The combined consumption and post harvest interviews lasted from 1 - 2 hours.

The data analysis plan was to analyze the El Obeid data at FRC and the Khartoum and Wad Medani data at AAMU. Preliminary analysis of consumption data in Khartoum and Wad Medani are available.

Khartoum and Wad Medani samples had household heads of about the same age (48 vs 49), but family eating units were larger in Khartoum (8 to 6). It is likely that urban households contain more relatives migrating to the city. Education levels and household incomes in Wad Medani are much less than in Khartoum. Male heads in the rural Wad Medani had an average of 2 years of education and the females 0 years compared with 8 and 5 years respectively in Khartoum. Gross incomes were found at an average of 1414 Sudanese pounds in Wad Medani compared with 7085 in Khartoum.

As did the Wad Medani sample, the Khartoum sample had 100 households, but only 66 cases were available for analysis at AAMU. The remainder, along with the El Obeid samples are being processed in Khartoum.

Table 1. PROPORTION OF KHARTOUM AND WAD MEDANI HOUSEHOLDS
USING PEANUTS IN VARIOUS FORMS

FORM	KHARTOUM	WAD MEDANI
	(N=66)	(N=99)
	%	%
1. ROASTED	77.2	70.6
2. GROUND OR PASTE	65.1	72.6
3. PEANUT OIL	39.4	90.9
4. RAW	10.7	9.0
5. BOILED	06.0	56.5

In Table 1, the Khartoum and Wad Medani samples were compared for the form in which peanuts were used. Naturally, peanut growers (Wad Medani) would eat peanut in more ways than would a random sample of urban residents. The only form in which Khartoum household used peanuts more frequently was roasted. Ground peanuts or peanut paste was used by 65.1% in Khartoum sample and 72.6% in the Wad Medani sample. The farmer sample households were much more likely to use boiled peanuts (56.5% vs 0.6%) and they use peanut oil more frequently (90.9% to 39.4%). Of course, the urban households (Khartoum) may choose among peanut oil, sesame oil and other oils. It is also suspected that many urban residents might not know the vegetable oil they use is peanut oil.

In spite of the fact that they grow peanuts for sale and cash income, peanut farmers reported that they ate peanuts in their favorite form at least as frequently as their urban counterparts and they prefer them more. At the median, both urban and rural households reported eating peanuts eight times per month. The median preference rank on a scale of one (low) to 10 (high) for peanuts among peanut farmers was eight compared with seven for Khartoum households.

In the urban households, those preferring ground peanut products (paste, or peanut butter) reported eating them much more frequently than did those who prefer roasted, raw, or boiled products. Over 55% reported eating ground peanuts more than 10 times per month, while only 29% of those preferring the roasted, raw or boiled products indicate eating them at least 10 times per month.

Table 2. RANK OF PEANUT FORM (1-10) BY PREFERRED PEANUT FORM

-KHARTOUM ONLY-

(CHI SQUARE = 22.2 : 4 D.F.)

PREFERENCE RANKING	ROASTED RAW OR BOILED		PEANUT PASTE OR GROUND		ALL FORMS OF PEANUTS	
	N	%	N	%	TOTAL N	%
0 - 4	4	17	2	5	6	10
5	13	54	4	10	17	27
6 - 8	4	17	6	16	10	16
9	1	4	14	37	15	24
10	2	<u>8</u>	12	<u>32</u>	14	23
Sub-Total		100		100		
TOTAL	24	39	38	61	62	100

Similarly, those Khartoum households preferring ground peanut products used in salads and soups were much more likely to rank them high among all foods than were those preferring roasted, raw, or boiled products. Over 68% of the farmers ranked ground products 9 or 10 while

only 12% of those preferring roasted, raw, or boiled products ranked them as highly (Table 2). Ground peanuts are clearly a preferred product by most households. The convenience of roasted peanuts as a snack or meal may explain the higher percent of families eating roasted peanuts (77%) vs 65% eating ground peanuts in Khartoum (Table 1).

All but three Khartoum households reported purchases of processed peanut products (roasted, whole, ground, or in paste products). Twenty seven percent of the households reported monthly purchases of at least 6 pounds. The median monthly purchase was three pounds and the mean was 5.5 pounds. Forty one percent of the households reported purchase of four to 40 pounds of peanut oil purchased during December, 1983.

The median reported purchase for the month was zero pounds but the average was 7.4 pounds. Again, many households may not have known that this cooking oil was from peanuts.

Table 3. REASONS FOR NOT CONSUMING (MORE) PEANUTS - KHARTOUM

	N	%
No Reason	32	48.5
Expensive	11	16.6
Don't Like Them	11	16.6
Use With Other Foods	5	7.6
Allergy, Stomach, Sleepy	3	4.6
Not Available	3	4.6
Fattening	1	1.5
	<hr/> 66	<hr/> 100.0

Regarding reasons for not consuming more peanuts, over 21% of the Khartoum sample households indicated expense or availability as the major reason for not consuming more peanuts. Increased and more efficient productivity and marketing are needed to help these households. Nearly 17% said they don't like them, Another seven percent indicated they use other foods to balance this already substantial peanut intake. Less than five percent indicated an allergy

problem. Type of preparation may be a problem for these households. The largest proportion (48.5%) gave no reason except to say that they already ate enough. New peanut products at low prices would be likely to increase intake in most of these categories (Table 8).

Among peanut farmers at Wad Medani 73 percent of the households reported storing peanuts for food, 83 percent storing for sale, and 82 percent storing for seed. The remainder were presumed to have sold their peanuts as of the January, 1984 survey. On the average, the farmers have stored a total of 4500 pounds. Of these, 3766 were for sale, 417 for seed, and 334 were for direct food use. The median family had only one sack (100 pounds) stored for food use.

Aflatoxin Laboratory

Equipment and supplies for aflatoxin analysis has been purchased and delivered to The Food Research Centre. Additional supplies will be carried during this summer. The quality of analyses will be maintained by check sample program with American Oil Chemists Society and with the Tropical Products Institute in London.

Proximate analyses - Equipment and supplies for proximate analyses will be supplied to The Food Research Centre through the Peanut CRSP project. Although the capability to analyze these data exists at The Food Research Centre, more equipment and supplies are needed to handle the number of samples collected during the survey period and also during the research phase dealing with improvement of existing products and development of new products.

Plans for 1984

1. Analysis and interpretation of survey data.
2. Analysis of peanut and peanut products for aflatoxin contamination.
3. Analysis of peanut and peanut products for major nutrients in samples collected from the Wad Medani area and the El Obeid area.
4. Initiations of research on improvement of storage and handling of peanut during post harvest periods.
5. Initiation of research on improvement of existing food products.
(a) The existing method of processing for peanut pastes will be studied, and efforts will be made to improve the quality of the peanut paste.

(b) The product will be analyzed for nutrient content and also for contaminants such as extraneous matter (sand, silica, insect fragments), and protease inhibitors.

(c) The feasibility of developing a suitable packaging for the peanut paste will be studied.

(d) Acceptability of the improved peanut pastes will be determined.

(e) The socio-economic considerations of the improvement of the peanut paste production will be determined.

6. Initiation of research on development of new food products.

The objectives 4, 5, and 6 will be carried through 1985, 1986, and 1987. Further modifications will be made on the basis of progress in 1984-1985.

AGREEMENT FOR A SUBGRANT
BETWEEN
UNIVERSITY OF GEORGIA AS MANAGEMENT ENTITY
and
ALABAMA A & M UNIVERSITY

This agreement is entered into this _____ between the University of Georgia, referred to hereafter as the "MANAGEMENT ENTITY", and Alabama A & M University, referred to hereafter as the "PARTICIPATING INSTITUTION".

I. INTRODUCTION

This agreement is made in consideration of the following circumstances:

A. The MANAGEMENT ENTITY is the recipient of a grant, Number DAN-4048-G-SS-2065-00 from the United States Agency for International Development (A.I.D.) for implementation of the Peanut Collaborative Research Support Program (CRSP). A copy of this Grant and the Standard Provisions are incorporated herein as Appendix I and constitute a part of Subgrant. The Peanut CRSP is an integrated and coordinated group of individual research projects each on specific aspects of peanut production and utilization. These research projects are to be carried out by scientists from U. S. institutions or their agents and their scientific counterparts from non-U. S. institutions working together in close collaboration.

B. The PARTICIPATING INSTITUTION agrees to undertake a research project(s) consistent with the plans described in the A.I.D. Grant Document, or as outlined in the Plan(s) of Work to this Subgrant. The PARTICIPATING INSTITUTION agrees that it will use its best efforts to perform the services required to carry out the objectives for which funds are budgeted and the MANAGEMENT ENTITY agrees that it will compensate the PARTICIPATING INSTITUTION in accordance with the terms, and conditions of this Subgrant and Plan(s) of Work.

C. The Peanut CRSP is under direction of the MANAGEMENT ENTITY with the guidance of the Board of Directors, Technical Committee, and the External Evaluation Panel.

D. Plan(s) of Work under this Subgrant sets forth research activities and accomplishments which can be expected to be achieved within the time frame designated and funding authorized. Funds budgeted for each project will be detailed in each Plan(s) of Work.

II. PERIOD OF PERFORMANCE

The period of performance of this subgrant shall be from date of final signature through June 30, 1987, unless terminated earlier or extended by mutual written agreement between the parties, and the Prime Grant to the MANAGEMENT ENTITY from A.I.D. remains in effect. The MANAGEMENT ENTITY shall have the right to terminate or modify the Subgrant or Plan(s) of Work earlier with the approval of Board of Directors. Recommendations for termination may originate with one or more of the following groups: the MANAGEMENT ENTITY, Technical Committee, the External Evaluation Panel, A.I.D., BIFAD, participating institution, and the collaborating country institution. In the event of an early termination, the PARTICIPATING INSTITUTION shall be reimbursed for all allowable costs incurred to the date of termination. A minimum of ninety (90) day notice of the intent to terminate the Subgrant and/or Plan(s) of Work will be given, unless the Board of Directors decides on earlier termination due to extenuating circumstances. (Article XII B of the Prime A.I.D. Grant).

III. ALLOWABLE COSTS AND PAYMENTS.

A. Budget

For the performance of work specified in this Subgrant, the MANAGEMENT ENTITY shall reimburse the PARTICIPATING INSTITUTION from funds provided by A.I.D. under the Prime Grant an amount not to exceed the obligated budget of each Plan(s) of Work. Funds obligated for a given period and not utilized may be carried forward provided an active Plan of Work remains in effect.

B. Conditions

Reimbursable project costs will be those determined by the MANAGEMENT ENTITY to be allowable in accordance with:

1. OMB Circular A-21, "Cost Principles for Education Institutions" as it may from time to time be amended, modified, or superseded;
2. The budget approved by the MANAGEMENT ENTITY for the Plan(s) of Work of this Subgrant.
3. Grant DAN-4048-G-SS-2065-00 and the Standard Provisions.

Funds may be transferred among budget categories by the PARTICIPATING INSTITUTION as necessary to accomplish the project(s) objectives.

C. Indirect Costs

The MANAGEMENT ENTITY will reimburse the PARTICIPATING INSTITUTION from funds provided under the Prime Grant for allowable indirect costs incurred under this Subgrant, according to the approved indirect cost rate and base as determined by the institution's cognizant federal audit agency. Indirect costs shall be claimed on the periodic invoices.

D. Cost Sharing

The PARTICIPATING INSTITUTION shall assure that expenditures from non-federal funds equal or exceed 25 percent of the total expenditures for research projects, excluding obligations made to LDC institutions under Plans of Work in furtherance of grant objectives. Failure to comply can result in termination of the Subgrant. Refer to Article X of the Prime A.I.D. Grant.

E. Invoice

1. The PARTICIPATING INSTITUTION shall submit to the MANAGEMENT ENTITY, at least quarterly but not more than monthly, a summary identifying expenditures of claimed allowable costs by major item categories. The PARTICIPATING INSTITUTION shall retain the supporting documents for reference in any program audit. Individual invoices should be submitted for each Plan(s) of Work under this Subgrant.

2. Similarly, a final invoice listing expenditures by major categories shall be submitted by the PARTICIPATING INSTITUTION to the MANAGEMENT ENTITY within 90 days following termination of this Subgrant or any Plan of Work, including refund of any unexpended funds.

F. Payment

1. The MANAGEMENT ENTITY shall make payment from funds provided under the Prime Grant for all allowable costs incurred by the PARTICIPATING INSTITUTION, after receipt and validation of each invoice.

2. To the extent permitted under the Federal Letter of Credit System and consistent with other provisions of the Prime Grant, the MANAGEMENT ENTITY will make an initial advance of a reasonable and mutually agreed upon sum which will be replenished upon submission of the above described invoices. Interest or income earned on advances must be remitted to the MANAGEMENT ENTITY.

IV. FISCAL EVALUATION

Fiscal evaluation of the Participating Institution will be accomplished by routine reports from the cognizant federal audit agency rather than independent audits by the MANAGEMENT ENTITY (refer to Standard Provision 2 and 3 of the Prime A.I.D. Grant). Amounts found to be disallowed by audit will be refunded to A.I.D. through the MANAGEMENT ENTITY.

V. SUBCONTRACTS AND SUBGRANTS

Intents to subcontract or subgrant work to U. S. institutions must be identified in the PARTICIPATING INSTITUTIONS Project Outline, and must include the same terms and conditions as this Subgrant. The PARTICIPATING INSTITUTION will be responsible to the MANAGEMENT ENTITY for performance of the subgrant or subcontract and shall not be relieved of any responsibility of this Subgrant.

VI. INTERNATIONAL TRAVEL

Travel approval will comply with Standard Provision 8 of the Prime A.I.D. Grant. Prior approval for travel must be obtained through the MANAGEMENT ENTITY from A.I.D. A detailed trip report must be submitted to the MANAGEMENT ENTITY following travel.

VII. REPORTS

Schedules for interim and final performance, progress, and financial reports will be developed by the MANAGEMENT ENTITY to meet program and A.I.D. needs. Sufficient copies of each technical and informational publication resulting from this Subgrant to meet A.I.D. and program needs will be supplied by the PARTICIPATING INSTITUTION. Refer to Article XII of the Prime A.I.D. Grant.

VIII. PROCUREMENT OF GOODS AND SERVICES

The PARTICIPATING INSTITUTION will comply with Standard Provision 13A regarding inventory and property control. In regard to inventory and property control of purchases under Plan(s) of Work between the Participating Institution and the collaborating country, Standard Provision 13C will apply. An inventory of property purchased under this Subgrant will be maintained. Procurement of goods and services must comply with Standard Provisions 10A. and 10B.

IX. NON LIABILITY

The PARTICIPATING INSTITUTION agrees that it will not hold the MANAGEMENT ENTITY, its agents, or employees liable for any property damage, personal injury, or other liability that results from carrying out its obligations pursuant to this Subgrant.

PLAN OF WORK
Under The Subgrant
Between the
University of Georgia Management Entity
and
Alabama A & M University (AAMU)
to Implement a
Research Project under the
Peanut Collaborative Research Support Program (CRSP)

This agreement is entered into between the University of Georgia referred to hereafter as the "MANAGEMENT ENTITY", and the Alabama A & M University referred to hereafter as the "PARTICIPATING INSTITUTION".

I. Purpose

This Plan of Work describes the Peanut CRSP research project "An Interdisciplinary Approach to Optimum Food Utility of Peanuts in SAT Africa" (AAMU/FT/S), under the Subgrant between the "MANAGEMENT ENTITY and the PARTICIPATING INSTITUTION.

The research project attached as Appendix I to this document defines in detail goals, objectives, procedures, individual obligations, and expected accomplishments; and serves as the overall guide for the planned research.

II. Goal.

The major goal of this research project is to develop means for greater utilization of peanuts as a direct food through determining the role of peanuts as food items in diets, improvement of existing peanut food products, and development of new peanut food products. Research will be conducted collaboratively between Alabama A & M University and the Agricultural Research Corporation, Food Research Center, (ARC,FRC) Khartoum, Sudan.

II. Objectives.

The overall objectives are:

- A. Description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies.
- B. Analysis of the current and potential dietary role of existing peanut products; and,
- C. Research on the improvement of existing peanut products and the development of new peanut products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.

IV. Cooperating Personnel

AAMU

Dr. Bharat Singh
Dr. Gerald Wheelock
Dr. John C. Anderson
Dr. D. R. Rao
Dr. Virginia Caples
Dr. Hezekiah S. Jones

ARC, FRC

Dr. B. I. Magboul
Dr. B. Bashir
Dr. A. K. Ahmed
Dr. A. S. Khalid
Dr. S. M. Badi
Mr. A. B. Zakaria

V. General Procedures for Accomplishing Research

The U. S. Principal Investigators plan to spend at least two accumulative months each year at ARC, FRC in research planning, supervision, and research. Selected ARC, FRC Principal Investigators will make training visits to the U.S.. Both AAMU and ARC, FRC Principal Investigators will independently spend time fulfilling the objectives of the project.

VI. Research Training

The U. S. Principal Investigators will provide on-site training for ARC, FRC scientists and technicians, short term training for selected ARC, FRC in the U. S., and provide graduate training for selected Sudanese students. Qualified researchers and individuals with baccalaureate degrees may apply for admission to graduate programs at AAMU to conduct thesis research (including classwork) on the proposed research that will lead to MS or PhD. degrees. U. S. Principal Investigators will participate in the selection of trainees. ARC, FRC should facilitate in clearance, approval, and to the extent feasible, financial support for students forwarding records and admission requirements for students in advance of arrival.

VII. Budget

Funds obligated for this project are \$83,733 for the period from date of final signature to April 30, 1983.

The tentative 5-year budget for this project is presented in Appendix II. This budget will be used as the basis for total annual allocations, and could change due to availability of funds from A.I.D. and deliberations of the Board of Directors and Technical Committee.

Based on consultations between U. S. and Sudanese collaborators in February 1982, the following year 1 plan for fund utilization was developed.

<u>Item</u>	<u>AAMU</u>	<u>ARC/FRC</u>
	<u>Year 1</u>	<u>Year 1</u>
	U. S. dollars	
Salaries	\$18,064	9,650
Fringe Benefits	4,335	0
Equipment	1,290	14,000
Supplies	1,291	4,000
Travel	11,870	5,000
Other Direct Costs	2,064	1,913
Indirect Costs	7,169	3,087
TOTAL	<u>\$46,083</u>	<u>\$ 37,650</u>

A detailed annual budget plan will be submitted to the Management Entity by the Principal Investigator.

III. Duration

This project should run concurrent to the Prime Grant, subject to termination in accordance with Section II of the Subgrant. This Plan of Work may be reviewed and/or revised annually as mutually agreed upon.

IX. Order of Precedence

The Prime A.I.D. Grant document and the Standard Provisions to the University of Georgia as Management Entity, and the Subgrant Agreement to Alabama A & M University as a Participating Institution take precedence over this document in any case of omission, or inconsistency that may occur between this and the above documents.

X. Approvals.

Having read this Plan of Work the persons below have signed their names and shown their agency affiliation indicating their concurrence with the collaborative research relationships outlined therein. All parties involved agree to use their best efforts to perform the duties required to attain the objectives of the research project, and to resolve any problems that may arise as the work progresses.

MANAGEMENT ENTITY

PARTICIPATING INSTITUTION

Program Director Date
Peanut CRSP

Bharat Singh 9.15.82

Principal Investigator Date

Vice President for Research Date
University of Georgia

Annabelle 9/15/82

Director, International Date
Programs

Date

A. Morrison 9/15/82

President Date

PLAN OF WORK - HOST COUNTRY
UNDER
MEMORANDUM OF UNDERSTANDING

Between
Alabama A & M University (AAMU)
and
Agricultural Research Corporation, Food Research Center, (ARC, FRC)
Khartoum, Sudan
to Conduct a
Research Project Under the
Peanut Collaborative Research Support Program

I. Purpose

This Plan of Work implements the research project, "An Interdisciplinary Approach to Optimum Food Utility of Peanuts in SAT Africa" (AAM/FT/S), (Appendix I) under the Memorandum of Understanding establishing a Collaborative Research relationship.

II. Goal.

The major goal of this research project is to develop means for greater utilization of peanuts as a direct food through determining the role of peanuts as food items in diets, improvement of existing peanut food products, and development of new peanut food products.

III. Objectives.

The overall objectives are:

- A. Description and understanding of variations in environment, socioeconomics, and food technologies as they constrain the preservation and utilization of peanut supplies.
- B. Analysis of the current and potential dietary role of existing peanut products; and,
- C. Research on the improvement of existing peanut products and the development of new peanut products with suitable energy density, nutrient concentrations and preferred tastes at acceptable cost.

IV. Cooperating Personnel

AAMU Dr. Bharat Singh
Dr. Gerald Wheelock
Dr. John C. Anderson
Dr. D. R. Rao
Dr. Virginia Caples
Dr. Hezekiah S. Jones

ARC,FRC Dr. B. I. Magboul
Dr. B. Bashir
Dr. A. K. Ahmed
Dr. A. S. Khalid
Dr. S. M. Badi
Mr. A. B. Zakaria

V. General Procedures for Accomplishing Research

The U. S. Principal Investigators plan to spend at least two accumulative months each year at ARC,FRC in research planning, supervision, and research. Selected ARC,FRC researchers will make training visits to the U. S. Both AAMU and ARC,FRC researchers will independently spend time fulfilling the objectives of the project.

VI. Research Training

The U. S. Principal Investigators will provide on-site training for ARC,FRC scientists and technicians, short term training for selected ARC,FRC in the U. S., and provide graduate training for selected Sudanese students.

Qualified researchers and individuals with baccalaureate degrees may apply for admission to graduate programs at AAMU to conduct thesis research (including classwork) on the proposed research that will lead to MS or PhD. degrees. U. S. Principal Investigators will participate in the selection of trainees. ARC should facilitate in clearance, approval, and to the extent feasible, financial support for students forwarding records and admission requirements for students in advance of arrival.

VII. Budget

A. Pending fund availability each year through the Prime A.I.D. Grant for the Peanut CRSP, the following Year 1 budget is proposed for use by or for ARC-FRC in conducting this research project. The budget is subject to annual review and possible revision.

<u>Item</u>	<u>Year 1</u> U. S. dollars
Salaries	\$ 9,650
Equipment	14,000
Supplies	4,000
Travel	5,000
Other Direct Cost	1,913
TOTAL	<u>\$34,563</u>

B. ARC-FRC shall submit, at least quarterly but not more frequently than monthly, to Alabama A & M University, a voucher identifying expenditures of claimed allowable costs by major categories and individual items within major categories. Copies of receipts or vouchers supporting these expenditures shall be attached.

Procedures to reimburse expenditures will be mutually agreed upon by ARC-FRC and AAMU in compliance with Item II. A. of Memorandum of Understanding between AAMU and ARC,FRC to Establish a Collaborative Research Relationship.

The form attached as Appendix II will be used for reporting expenditures; and estimates of ARC,FRC contributions in terms of personnel, supplies, equipment, and facilities will be reported on the form attached as Appendix III.

VIII. Inventory and Property Management

Title to all equipment, material, and supplies purchased by or for ARC,FRC under this Plan of Work will be in the name of ARC,FRC. All such property shall be under the custody and control of the Participating U. S. Institution. When requested, the collaborating institution shall submit an inventory schedule covering all items of equipment which have not been consumed in performance of the research. Advice will be given by the Participating U. S. institution as to the disposition of property at the end of the Plan of Work.

IX duration

This project should run concurrent to the Prime Grant, subject to termination in accordance with Section II.B. of the Memorandum of Understanding. This Plan of Work may be reviewed and/or revised annually as mutually agreed upon.

X. Attachments

The research project outline attached as Appendix 1 to this document further defines goals, objectives, procedures, individual obligations, and expected accomplishments; and serves as the overall guide for the planned research. As the project progresses, necessary changes may be made in the project upon approval of AAMU and ARC-FRC Principal investigators, and the Management Entity (to include the Technical Committee and Board of Directors).

233

XI. Approvals

Having read this Memorandum of Understanding, the persons below have signed their names and shown their agency affiliation indicating their concurrence with the collaborative research relationships outlined therein. All parties involved agree to use their best efforts to perform the duties required to attain the objectives of this research project, and to resolve any problems that may arise as the work progresses. This Plan of Work becomes effective upon execution of this document, a copy of which will be filed with the A.I.D. Mission.

U. S. PARTICIPATING INSTITUTION

HOST COUNTRY INSTITUTION

 Barab Singh 10.20.82
Principal Investigator Date

_____ Date

 Prasanna Kumar 10/20/82
Director, International Programs. Date

_____ Date

 R. Harrison 10/24/82
President Date

_____ Date

MEMORANDUM OF UNDERSTANDING

between
The University of Georgia as
The Peanut Collaborative Research Program Management Entity,
Alabama A & M University
and
Ministry of Agriculture,
Agricultural Research Corporation,
Khartoum, Sudan
With Regard to the Establishment of a Collaborative
Research Relationship

I. The Peanut Collaborative Research Support Program (Peanut CRSP)

The Peanut CRSP operates by approval of the U. S. Government under the provision of Grant No. DAN 4048-G-SS-2065-00, to the University of Georgia, designated as the Peanut CRSP Management Entity. The Peanut CRSP is under direction of the Management Entity with the guidance of the board of Directors, Technical Committee, and the External Evaluation Panel.

The Peanut CRSP is an integrated and coordinated program of individual research projects each on specific aspects of peanut production and utilization. These research projects are to be carried out by scientists from U. S. institutions and scientists from Host Country institutions working together in close collaboration. The participating scientists are equal collaborators and the rights for publication of findings carried out under the Peanut CRSP should be so viewed. All publications must acknowledge support from A.I.D. and include the grant number. All publications should be attributed to the authors, stating that opinions expressed or recommendations made do not represent an official position or policy of A.I.D.

A. Goal

The goal of the CRSP is to assist identified countries to address problems of famine and malnutrition through collaborative research on peanut production and utilization as related to farmer and consumer needs. This goal is in support of the U. S. Government commitment to Famine Prevention and Freedom from Hunger under the Foreign Assistance Act.

5. Procedure for Establishment of the Collaborative Research Relationship.

With mutual understanding of the CRSP and its goal as described above, a collaborative research relationship is developed as follows:

1. Based on previous discussions and consultations on constraints to peanut production and utilization and research needs to relieve these constraints; projects were prepared, reviewed, and selected through established procedures. The U. S. Principal Investigator visited Sudan and discussed the project with potential collaborators and made necessary revisions of project objectives and procedures. Based on this tentative approval of the project by Peanut CRSP and U. S. and Sudanese Institutional representatives this formal collaborative agreement has been reached.
2. The collaborative research agreement will include:
 - (a) this Memorandum of Understanding between the Peanut CRSP Management Entity and Sudan, (b) a Plan of Work to implement the research proposal(s) between the participating U. S. and Sudanese institutions with the research project attached detailing research to be done.
3. Any number of Plan(s) of Work following these same procedures may be developed as appropriate under this Memorandum of Understanding.
4. After receipt and acceptance of these documents by the CRSP Management, funds can be released to implement the research.

II. Administration of Collaborative Research Projects.

A. The Peanut CRSP is funded by A.I.D. and the Participating U. S. Institution, and administered by the Management Entity, the University of Georgia. The Management Entity is responsible to A.I.D. for all fiscal matters and research progress. Each participating U. S. institution in turn is responsible to the Management Entity for project expenditures and research progress under their project(s). The collaborating Sudanese institution is in turn responsible to the participating U. S. institution for project expenditures and research progress.

1. All project expenditures will be managed by the U. S. participating institution which is held accountable by the Management Entity for the total project funds. Funds to be expended in Sudan directly on its behalf, can be disbursed through the ARC, an International Bank, or other fiscally auditable entity agreeable to the Peanut CRSP Management Entity, the collaborating U. S. institution, ARC, and the A.I.D. Mission.

2. Funds to be expended directly on behalf of, but not specifically in Sudan, such as for students studying in the U. S. or for purchase of research materials to be sent to Sudan, may most efficiently and most cost effectively be expended by the collaborating U. S. institution with the concurrence of the Sudanese collaborator.

3. The Agricultural Research Corporation (ARC) will be administratively responsible for all funds provided to them for expenditure under the Peanut CRSP, will provide to the participating U. S. institution documentation of expenditures as outlined in the subagreement, and shall submit all records for fiscal audit as requested by the participating U. S. institution. Copies of all audit reports applicable to the Plan(s) of Work will be provided to the participating U. S. Institution. It will be the responsibility of the Peanut CRSP Management Entity to conduct an external audit, if required by A.I.D.. ARC will also be responsible for submitting a research progress report to the U. S. institution and the Management Entity.

4. All project commodities sent to Sudan will be received without customs or duty.

B. Duration

1. This Memorandum of Understanding or Plan(s) of Work for project(s) covered by this document shall continue until terminated by:

a. Immediate notification of termination of the Peanut CRSP funding grant by A.I.D. Washington;

b. Acceptance by the Board of Directors of a request to terminate by the Sudanese institution; or

c. Acceptance by the Board of Directors of a recommendation to terminate by the Peanut CRSP Management Entity.

2. Either the U. S. or Sudanese institution may request the Peanut CRSP Management Entity to consider adjustments in their collaborative arrangements.

3. The Peanut CRSP is a continuing project funded annually.

III. Approvals

Having read this Memorandum of Understanding, the persons below have signed their names and shown their agency affiliation indicating their concurrence with the collaborative research relationships outlined therein. Additional U. S. Institutions may enter into research with ARC upon joint concurrence with this Memorandum of Understanding and the mutual agreement on a Plan of Work.

U. S. INSTITUTIONS

HOST COUNTRY INSTITUTION

D. M. K. K. K. *10/25/82*
Director, International Programs Date
AAMU

Date

R. Morrison *10/20/82*
President, AAMU Date

Date

David G. Cummins, Program Director/Date
Peanut CRSP

Robert C. Anderson Date
Vice President for Research
University of Georgia

Date

ACKNOWLEDGEMENT

The U.S.A.I.D. mission has received and reviewed a copy of this Memorandum of Understanding and believe that the intent and content of the document is compatible with and in support of the goals and interests of the Mission. Travel requests will be reviewed and expeditiously cleared and other services may be offered, as feasible, by the Mission.

EXPLANATION AND DIRECTION FOR THE CONSUMPTION INSTRUMENT

I. PURPOSE OF SURVEY

The overall purpose of the consumption survey is to assess the correct and potential dietary role of existing peanut products. Data from the consumption survey will provide a basic framework for additional research on the improvement and expansion of existing peanut products and the development of new products. Additionally, the consumption survey will add to the data base on factors associated with storage and marketing of peanut products.

The emphasis of the peanut consumption survey is on the impact of peanuts on nutritional intake rather than on the nutritional status of the population of Sudan. As such, the survey will seek to establish basic data on food intake and the relationship of peanuts to overall food intake. A main focus is an understanding of consumption patterns; product preferences (form); methods of preparation; resources used in the acquisition and gained from the disposal of peanuts; and constraints associated with peanut utilization.

It is expected that the consumption survey will provide the following outcomes:

1. Identification of existing practices regarding the utility or peanut products (amount and major forms of peanuts consumed). The relationship of form of peanuts to amount consumed.
2. Understanding of socio-economic variables and the relationship to enhancing or restricting peanut utilization (age, sex, income, education, religion, location, ethnicity).
3. Identification of individuals responsible for peanut selection, preparation and storage and the relationship to consumption.
4. Identification of major constraints to peanut utilization.
5. Understanding of the role of peanuts to overall food intake.

II. EXPLANATION OF QUESTIONNAIRE/INTERVIEW DIRECTIONS

Directions

Interviewer: Introduce yourself. Tell where you are from and the purpose of your visit. State that you are visiting households to get information about the way families use peanuts as a part of their food intake. Explain that you would like to ask a few questions about the family and themselves. Explain that the information will be kept confidential and no single family will be identified. Indicate that the information is being collected for research being conducted on peanuts by the Agriculture Research Corporation and the Food Research Center.

Questions 1 - 8. Demographic

These questions are designed to obtain basic socio-economic data regarding the sample. These data are necessary in order to correlate consumption with age, sex, education, income, religion and ethnic background.

Address: Where the respondent lives (name of village or section of town).

District/Province: Indicate the government designated district and province where the respondent lives.

Religion/Tribal Origin: What is the respondent's religion? What is the ethnic background of the respondent (tribe, race or national origin)? What is the cultural background of the respondent?

Question 1, Address

1. How long has the respondent lived in a given location or general area? Distinguish between the number of years the family generation has lived in the household and the number of years the current family has lived there.

Question 2 - 3, Household Composition

2. What is the composition of the household? Who are the permanent members of the household and what is their relationship to each other? (Individuals who come and go and live in the household less than a month are not considered permanent).
- 3.1. Number each family member.
- 3.2. List the name of each family member.
- 3.3. List the sex of each family member.
- 3.4-5. If respondent does not know the date of birth of family members, encourage him/her to give approximate age.
- 3.6. Indicate the relationship of each family member.

Question 4 - 5, Education

- 4,5. What is the educational level of female and male household heads?
Numbers 1-8 indicate primary and elementary education.
Numbers 9-12 indicate intermediate and high school education.
Numbers 13-20+ indicate a certificate beyond high school or college diploma. Individuals in the 13+ category may have taken a trade rather than gone to college.

Questions 6 - 7, Employment of Household Members

6. How many members of the household are employed away from home one-third of the time?
7. Indicate the type of work that members perform and where work is performed. Be sure to include work that is performed for in-kind service.

Question 8, Income

- 8.a. What is the total amount of income received in your household per year? Respondents may refer back to questions 6-7 to help determine all sources of income.
- 8.b. Section "b" should only be used if the respondent is unable to give an answer in section "a".

Questions 9 - 11, Food Selection, Storage, Preparation

- 9-11. What family member(s) has the major responsibility for the purchase, storage and preparation of the family food? List the individual(s) with the major responsibility for the tasks and perform them consistently (daily, weekly, monthly).

Questions 12 - 14, Food Expenditure

- 12-14. How much money does the household spend for the purchase of food that the family consumer per week? Include the approximate value of food or services that may be used for trade or gifts. Interviewer may help respondent to estimate value of home grown food eaten per week by asking...How much would you sell the food for?...What would you pay for the food if you had to purchase it at the market?

Questions 15 - Peanut Consumption

15. This question is designed to determine if peanuts are utilized by the family in any and all forms (i.e., peanuts, peanut product, peanut oil). If the respondent indicate yes, complete the lower half of the questions and continue with the remainder of the questions on the questionnaire. If the respondent indicates that his/her family does not use peanuts or peanut products in any form, go to question Number 23 and complete the remainder of the questionnaire.

Question 16, Availability of Stored Peanuts

16. Does the family have peanuts in storage? If so, how much is available for home use, for sale or for seed? Specify as close as possible the amounts of peanuts stored. (Individuals in urban areas may have peanuts stored for home use. If so, indicate the amount).

257

Question 17, Forms of Peanuts/Peanut Products

17. In what form are peanuts or peanut products most often consumed by the family? Check all that apply and indicate other specific uses such as in soups and salads.

Question 18, Peanut Preference

18. This question is designed to determine how well each family member likes peanuts in relation to other foods. Of all the foods that a family member may like or dislike, how would this food compare with peanuts? Ask respondent to think of family members favorite foods and least favorite foods.
- 18.a. Indicate the form of peanut most preferred by each family member in column a. Use form listed in question 17.
- 18.b. How many times does each family member eat his/her preferred peanut product in a month?
- 18.c. Rank preference in relation to other food in column c. For example
- | | | | |
|------|----|---|---|
| High | 10 | - | More than most favorite food |
| Low | 9 | | |
| High | 8 | - | As much as most favorite food |
| Low | 7 | | |
| High | 6 | - | Almost as much as most favorite food |
| Low | 5 | | |
| High | 4 | - | Not near as much as least favorite food |
| Low | 3 | | |
| High | 2 | - | Less than least favorite food |
| Low | 1 | | |

Be sure that responses correspond to family member number as listed under question Number 3.

Question 19, Quality Value of Peanuts

19. For each form of peanuts listed, about how much was used by the total family last month? What do you estimate to be the value or cost of the peanuts? How much did you pay for them? How much was the value of the in-kind service or trade? It may be necessary to average the weekly amount consumed for each product and determine if it has been used in the same approximate amount for a month.

Questions 20 - 21, Acquisition of Peanuts

20-21 Are all of the peanuts used by the family produced at home? If not, from where are peanut products and oil purchased? Estimate the amount of the peanut products and oil acquired last year. (Peanut products would be all forms: raw, roasted shelled, unshelled, etc.).

Question 22, Preference of Food Preparer

22. Does the individual who usually buy or prepare food for the family prefer finished peanut products (processed and distributed at the market) or peanuts that are home produced and products that are made at home?

Questions 23 - 24, Reasons for low or Non-consumption of Peanuts

Perhaps the family eats peanuts but the consumption level is very low or maybe the family does not eat peanuts at all. Let the respondent freely indicate the reasons why the family does not consume peanuts or consume only a few. Let the respondent give as many reasons as possible for each category.

Question 25, Attitudes Toward Peanuts

This information is designed to determine attitudes or perceptions about peanuts. The forced choice arrangement is designed to get the respondent's first impression. The interviewer if needed, may explain a category. For nutritious...not nutritious may be explained as good for you...not good for you.

Question 26 - 28, Information Access

26-28 What are the major sources by which the family receives information (things that are happening in the local community and on the national and international levels)?

EXPLANATIONS FOR SURVEY ON POST HARVEST HANDLING OF PEANUTS IN SUDAN

PURPOSE OF SURVEY:

The purpose of this survey is to obtain relevant information on the level of peanut production under different types of land tenure, and to determine if the type of tenure or the expected disposition of produced peanuts influences pre and post harvest resource allocation by producers. In addition, the survey will attempt to identify common problems associated with peanut storage.

- Questions 1-2: Designed to get information on the proportion of cropped area planted in peanuts, as well as planting dates and plant population. Specify applicable units and enter the number of units.
- Question - 3: Designed to get information on incentives to maintain quality of peanuts through seed quality. Check source of seed and whether seed treatment was used before or after acquisition.
- Question - 4: Designed to get information on the role of peanuts in the cropping system. (a) If peanuts are a part of a rotation system enter the crop produced on the same area before peanuts. (b) If peanut is intercropped enter crop with which peanuts were produced. (c) Enter the dominant soil type.
- Question - 5: Designed to get information on the extent to which purchased inputs, such as commercial fertilizer, are allocated to peanut production. If commercial fertilizer is applied to the peanut crop (a) enter peanut area fertilized with commercial fertilizer, (b) enter total amount of commercial fertilizer applied to peanuts, (c) enter type of commercial fertilizer used, (d) if any part of the peanut crop was manured enter area manured.
- Question - 6: Designed to determine the timeliness of weeding operation and possibly the nature of weed infestation. Enter days, where applicable, between the completion of planting operations and the completion of first weeding, second weeding and third weeding.
- Question - 7 & 8: Designed to obtain information on the quantity of peanut harvested to date. If all or part of the peanut crop has been harvested enter date completed, area completed and weight of nuts and hay harvested.
- Question - 9: Designed to get information on total hours of labor utilized in harvesting and pre-storage or pre-sale operations in order to estimate the effects of labor availability on peanut quality. Enter the number of days of family labor men and

- Question 9 - (Cont'd) women - used on these operations. If hired labor was used enter the number of days of hired men and/or hired women used.
- Question 10: Very important from quality point of view - especially moisture, mold contamination and other quality considerations (protein and oil especially). Check the applicable response.
- Question 11a & 11b: Designed to identify constraints to optimum timing of harvest, and to determine the method of maturity determination. Get most important reasons and most reliable criteria respectively.
- Question 12: Designed to determine the timeliness of various post harvest operations. This is important from the point of view of contamination, moisture changes and changes in nutrients. Enter days between lifting and rowing and each of the indicated operations.
- Question 13: Designed to obtain information on marketing strategy, efficiency of transportation and prices received for peanuts. If peanuts were used to pay for labor enter amount in Kantar and date delivered. In any other case enter to whom sale was made, type of transportation used, time it takes to get peanuts to point of sale, weight of peanuts delivered to this destination, actual price received per kantar and the transaction date.
- Question 14: Designed to estimate the effects of off-farm farm employment on the timing of selected field operations in peanut production. Enter family member's name and days worked on other farms.
- Question 15: Designed to get information on quantity of peanuts stored, nature of stored peanuts and common problems associated with storage. For "a, b, c, and d" enter quantities; for "e" enter name of the family member who is in charge of stored peanuts; for "f" enter average period between successive entries into stored peanuts, for "g" and "h" enter location of peanut storage and type of storage container respectively; for "i" enter the four most important problems encountered in storing peanuts, and for "j" enter the approximate amount of peanut lost in storage.
- Question 16: Intended to provide information on the quality of peanut in storage. Try to obtain a representative sample.

2016

CONFIDENTIAL

PEANUT CRSP - SUDAN

AGRICULTURAL RESEARCH CORPORATION/FOOD RESEARCH CENTRE

A SURVEY ON PEANUT CONSUMPTION IN SUDAN

Survey No: _____ Date: _____ Interviewer: _____

Respondent's Name: _____ Cluster No: _____

Address: _____ House No.: _____

_____ Lane: _____

_____ Street: _____

District: _____ Province: _____ Part of Sudan: _____

Religion _____ Tribal Origin _____

1. How long has your family lived at this address (years)? _____
2. How many persons are there in your household? That is how many eat their meals regularly in your home? (Do not include visitors of less than one month) _____
3. List the head of household first and then list the names, ages, and relation of other household members to head of household.

Family Member Number	Name (First & Last)	Sex	Age	Relationship to Head (Father, Son etc.)	Migration (Mo/Year away from this home)
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

15. Does your family consume peanuts, peanut products or peanut oil? (Yes/No) If No, go to Question 23. If Yes, what proportion is obtained from each of the following sources:

Home Grown _____% By Purchase _____% Gift _____% Payment in-kind/Trade _____%

16. Please tell me the amount of peanuts you have in storage for the following uses:

Home consumption? _____ Sale? _____ Seed? _____

17. In what forms are peanuts used by members of the family? (Check all that apply)

Raw () Peanut Butter ()
 Boiled () In Candy ()
 Roasted () As Ingredients ()
 Fried () Peanut Oil ()
 Ground () Other () Specify _____

- 18.a. What are the preferences of family members for peanuts by form used? (List in column a. for each family member)

- b. How many times have peanuts been eaten in preferred form in the past month? (List in column b. for each family member)

- c. How much preferred compared with all foods? (Check one for each family member in column c.)

Family Member Number*	a. Peanut Product Preferred	b. Number of Times eaten in Month	How much Preferred												
			Most Favorite Food	10	9	8	7	6	5	4	3	2	1	Least Favorite Food	
1.			()	()	()	()	()	()	()	()	()	()	()	()	()
2.			()	()	()	()	()	()	()	()	()	()	()	()	()
3.			()	()	()	()	()	()	()	()	()	()	()	()	()
4.			()	()	()	()	()	()	()	()	()	()	()	()	()
5.			()	()	()	()	()	()	()	()	()	()	()	()	()
6.			()	()	()	()	()	()	()	()	()	()	()	()	()
7.			()	()	()	()	()	()	()	()	()	()	()	()	()
8.			()	()	()	()	()	()	()	()	()	()	()	()	()
9.			()	()	()	()	()	()	()	()	()	()	()	()	()
10.			()	()	()	()	()	()	()	()	()	()	()	()	()
11.			()	()	()	()	()	()	()	()	()	()	()	()	()
12.			()	()	()	()	()	()	()	()	()	()	()	()	()
13.			()	()	()	()	()	()	()	()	()	()	()	()	()
14.			()	()	()	()	()	()	()	()	()	()	()	()	()
15.			()	()	()	()	()	()	()	()	()	()	()	()	()

*same as Question 3

4. Male Head () () () () () () () () () () () () () () () ()
 Yrs. of Educ. 0 1 2 3 4 5 6 7 8 9 10 11 12 13 15 16+

5. Female () () () () () () () () () () () () () () () ()

6. How many members of your household are employed more than one-third outside the home? _____

7. Which members were these and where employed?

Member's Name (Number)	Where Employed	Type of Job or Work

8. About what was the total gross income of all members of your household from all sources in 1983?

a. _____ £s Sudanese

b. If unable to obtain estimate above, check bracket below:

Under 99 £s () 400 - 499 £s () 2,000 - 3,999 £s ()
 100 - 199 £s () 500 - 699 £s () 4,000 - 5,999 £s ()
 200 - 299 £s () 700 - 999 £s () 6,000 and over £s ()
 300 - 399 £s () 1,000 - 1,999 £s ()

9. Who does the primary food preparation? (Specify name and number) _____

10. Who is in charge of the family food storage? (Specify family member number) _____

11. Who does the primary shopping for food? (Specify name and number) _____

12. About how much does your household spend for food per week, not including money spent for meals eaten away from home? _____ £s

13. What is the value of home-grown food eaten by household per week? _____ £s

14. What is the value of (payment-in-kind, trade or gifts) food eaten by household per week? _____ £s

19. Of the peanuts used during the past month by your household, list below the amount and value for each form in which they were acquired.

Form of Peanuts	Amount home Produced	Value of home Produced	Amount Purchased	Value of purchased Amount	Amount Received as Gift	Value of Gift
Raw, in shell	_____	_____	_____	_____	_____	_____
Raw, shelled	_____	_____	_____	_____	_____	_____
Boiled, in shell	_____	_____	_____	_____	_____	_____
Boiled, shelled	_____	_____	_____	_____	_____	_____
Roasted, in shell	_____	_____	_____	_____	_____	_____
Roasted, shelled	_____	_____	_____	_____	_____	_____
Fried	_____	_____	_____	_____	_____	_____
Ground	_____	_____	_____	_____	_____	_____
Peanut Butter	_____	_____	_____	_____	_____	_____
In Candy	_____	_____	_____	_____	_____	_____
Peanut Oil	_____	_____	_____	_____	_____	_____
Other (Specify)	_____	_____	_____	_____	_____	_____

20. If you acquired peanuts during the past month, where did you buy them or how did you acquire them?

	Place(s) Purchased (Specify location)	Amount
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	Home produced	_____
e.	Payment in-kind/trade or gift	_____
f.	Other (Specify) _____	_____

21. If you acquired peanut oil during the past month, where did you buy or how did you acquire it?

	Place(s) Purchased (Specify location)	Amount
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	Home produced	_____
e.	Payment in-kind/trade or gift	_____
f.	Other (Specify) _____	_____

22. Does the person who usually prepares the food prefer to (check one)

- a. cook peanuts at home ()
- b. buy finished peanut products ()

23. If your family does not eat peanuts, please explain why? _____

24. If your family consumes peanuts, what are the reasons for not consuming more peanuts? (Specify) _____

25. How do you feel about peanuts as a food?

- a. Plentiful () or scarce ()
- b. Nutritious () or not nutritious ()
- c. Hot () or cool ()
- d. Contaminated () or clean ()
- e. Expensive () or inexpensive ()
- f. Eat with sorghum () or eat with millet ()
- g. Healthy () or unhealthy ()
- h. Full () or empty ()
- i. Unsafe () or safe ()
- j. Strong () or weak ()
- k. Easy Preparation () or difficult preparation ()

26. Do you usually read the newspaper? (Check one) Yes () No ()

27. Do you usually listen to the radio? (Check one) Yes () No ()

28. Do you usually watch television? (Check one) Yes () No ()

CONFIDENTIAL

PEANUT CRSP - SUDAN

AGRICULTURAL RESEARCH CORPORATION/FOOD RESEARCH CENTRE

A SURVEY ON PEANUT CONSUMPTION IN SUDAN

Survey No: 1/10/83 Date: 16.1.84 Interviewer: Hassan Kadi

Respondent's Name: Abdullah M. Bani M. Bani Cluster No: 3

Address: _____ House No.: _____

Lane: _____

Street: _____

District: Madin Province: _____ Part of Sudan: _____

Religion: Muslim Tribal Origin: _____

- How long has your family lived at this address (years)? 20
- How many persons are there in your household? That is how many eat their meals regularly in your home? (Do not include visitors of less than one month) 4
- List the head of household first and then list the names, ages, and relation of other household members to head of household.

Family Member Number	Name (First & Last)	Sex	Age	Relationship to Head (Father, Son etc.)	Migration (Mo/Year away from this home)
1	Abdullah M. Bani M. Bani	M	55	Father	
2	Ashia Eassa	F	43	Mother	
3	Hassan Abdulla	M		son	
4	Muhammad Abdulla	M		son	
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Handwritten note

- Male Head () () () () () () () () () () () () () () ()
Yrs. of Educ. 0 1 2 3 4 5 6 7 8 9 10 11 12 13 15 16
- Female () () () () () () () () () () () () () () ()
- How many members of your household are employed more than one-third outside the home? 1
- Which members were these and where employed?

Member's Name (Number)	Where Employed	Type of Job or Work
Hassan Abdulla (3)	First Sudan	Labourer

- About what was the total gross income of all members of your household from all sources in 1983?

a. 1500 £ Sudanese

- If unable to obtain estimate above, check bracket below:

Under 99	()	£ 400 - 499	£ ()	2,000 - 3,999	£ ()
100 - 199	()	£ 500 - 699	£ ()	4,000 - 5,999	£ ()
200 - 299	()	£ 700 - 999	£ ()	6,000 and over	£ ()
300 - 399	()	£ 1,000 - 1,999	£ ()		

- Who does the primary food preparation? (Specify name and number) Ashia Eassa (2)
- Who is in charge of the family food storage? (Specify family member name and number) Ashia Eassa
- Who does the primary shopping for food? (Specify name and number) Ashia Eassa
- About how much does your household spend for food per week, not including money spent for meals eaten away from home? _____ £
- What is the value of home-grown food eaten by household per week? 90 £
- What is the value of (payment-in-kind, trade or gifts) food eaten by household per week? _____ £

Handwritten mark

CONFIDENTIAL

PEANUT CRSP - SUDAN

AGRICULTURAL RESEARCH CORPORATION/FOOD RESEARCH CENTRE

A SURVEY ON PEANUT CONSUMPTION IN SUDAN

Survey No: 14/11/102 Date: 16.1.84 Interviewer: Naima Kudi

Respondent's Name: Abdulla Muchiger Berame Cluster No: 3

Address: _____ House No.: _____

_____ Lane: _____

_____ Street: _____

District: Mubi Province: _____ Part of Sudan: _____

Religion: Muslim Tribal Origin: _____

1. How long has your family lived at this address (years)? 20

2. How many persons are there in your household? That is how many eat their meals regularly in your home? (Do not include visitors of less than one month) 4

3. List the head of household first and then list the names, ages, and relation of other household members to head of household.

Family Member Number	Name (First & Last)	Sex	Age	Relationship to Head (Father, Son etc.)	Migration (Mo/Year away from this home)
1	Abdulla M. Berame	M	55	Father	
2	Asker Easa	F	43	Mother	
3	Hassan Abdulla	M	20	son	
4	Muhammad Abdulla	M	10	son	
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

15. Does your family consume peanuts, peanut products or peanut oil? (Yes/No) If No, go to Question 23. If Yes, what proportion is obtained from each of the following sources:

Home Grown _____ % By Purchase _____ % Gift _____ % Payment in-kind/Trade _____ %

16. Please tell me the amount of peanuts you have in storage for the following uses:

Home consumption? 30 ~~3~~ Sale? 15 Seed? 2 (Specify measure kg, kantar, etc.)
 sack sack sack

17. In what forms are peanuts used by members of the family? (Check all that apply)

- Raw () Peanut Butter ()
- Boiled (✓) In Candy ()
- Roasted (✓) As ingredients ()
- Fried () Peanut Oil (✓)
- Ground () Other (✓) Specify: in salad

18.a. What are the preferences of family members for peanuts by form used? (List in column a. for each family member)

b. How many times have peanuts been eaten in preferred form in the past month? (List in column b. for each family member)

c. How much preferred compared with all foods? (Check one for each family member in column c.)

Family Member Number*	a. Peanut Product Preferred	b. Number of Times eaten in Month	c. How much Preferred													
			Most Favorite Food	10	9	8	7	6	5	4	3	2	1	Least Favorite Food		
1	<u>raw</u>	<u>4</u>	()	()	()	()	()	()	()	()	()	()	()	()	()	()
②	<u>in salad</u>		()	()	()	()	()	()	()	()	()	()	()	()	()	()
3.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
4.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
5.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
6.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
7.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
8.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
9.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
10.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
11.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
12.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
13.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
14.			()	()	()	()	()	()	()	()	()	()	()	()	()	()
15.			()	()	()	()	()	()	()	()	()	()	()	()	()	()

*same as Question 3

19. Of the peanuts used during the past month by your household, list below the amount and value for each form in which they were acquired.

Form of Peanuts	Amount home Produced	Value of home Produced	Amount Purchased	Value of purchased Amount	Amount Received as Gift	Value of Gift
Raw, in shell	10 sacks	KS. 160				
Raw, shelled						
Boiled, in shell						
Boiled, shelled						
Roasted, in shell						
Roasted, shelled		1				
Fried						
Ground						
Peanut Butter						
In Candy						
Peanut Oil						
Other (Specify)						

20. If you acquired peanuts during the past month, where did you buy them or how did you acquire them?

Place(s) Purchased (Specify location)	Amount
a. _____	_____
b. _____	_____
c. _____	_____
d. Home produced	_____
e. Payment in-kind/trade or gift	_____
f. Other (Specify) _____	_____

21. If you acquired peanut oil during the past month, where did you buy or how did you acquire it?

Place(s) Purchased (Specify location)	Amount
a. _____	_____
b. _____	_____
c. _____	_____
d. Home produced	_____
e. Payment in-kind/trade or gift	_____
f. Other (Specify) _____	_____

22. Does the person who usually prepares the food prefer to (check one)

- a. cook peanuts at home ()
 b. buy finished peanut products ()

23. If your family does not eat peanuts, please explain why? _____

Do not like it

24. If your family consumes peanuts, what are the reasons for not consuming more peanuts? (Specify) _____

25. How do you feel about peanuts as a food?

- a. Plentiful () or scarce ()
 b. Nutritious () or not nutritious ()
 c. Hot () or cool ()
 d. Contaminated () or clean ()
 e. Expensive () or inexpensive ()
 f. Eat with sorghum () or eat with millet ()
 g. Healthy () or unhealthy ()
 h. Full () or empty ()
 i. Unsafe () or safe ()
 j. Strong () or weak ()
 k. Easy Preparation () or difficult preparation ()

26. Do you usually read the newspaper? (Check one) Yes () No ()

27. Do you usually listen to the radio? (Check one) Yes () No ()

28. Do you usually watch television? (Check one) Yes () No ()

CONFIDENTIAL

PEANUT CRSP - SUDAN

AGRICULTURAL RESEARCH CORPORATION/FOOD RESEARCH CENTRE
SURVEY ON POST-HARVEST HANDLING OF PEANUTS IN SUDAN

102

Survey No: 102 Date: _____ Interviewer: _____

Respondent's Name: Abdella Muhayir Birasima Cluster No: _____

Address: _____ House No.: _____

_____ Lane: _____

_____ Street: _____

District: _____ Province: _____ Part of Sudan: _____

Religion _____ Tribal Origin _____

1. Total area cropped (feddans/~~malhamas~~)
1983 rainy season

	Land Owned	Land Leased	Land Sharecropped
--	------------	-------------	-------------------

Planted	(1.5)	()	()
---------	---------	-----	-----

Harvested	(20)	()	()
-----------	--------	-----	-----

sacks

2. Peanuts Planted

6 Date	20/June	()	()
--------	---------	-----	-----

1.5 Area	(1.5)	()	()
----------	---------	-----	-----

-99 Seed (Kgs)	()	()	()
----------------	-----	-----	-----

(Variety)	()	()	()
-----------	-----	-----	-----

3.a. If Peanuts were planted, where was the seed acquired

Government	()	()	()
------------	-----	-----	-----

Private agents	()	()	()
----------------	-----	-----	-----

3 Self produced	(✓)	()	()
-----------------	-------	-----	-----

b. Was seed treatment used?	()	()	()
-----------------------------	-----	-----	-----

4.a. Peanut Rotated after (fallow/crop)	()	()	()
---	-----	-----	-----

b. Peanut Intercropped with (crop)	()	()	()
------------------------------------	-----	-----	-----

c. Soil type	()	()	()
--------------	-----	-----	-----

Land Owned

Land Leased

Land Sharecropped

5. Peanut Fertilized

a. Commercial Fertilized (Area)	()	()	()
---------------------------------	-----	-----	-----

b. Total Amount (Kgs)	()	()	()
-----------------------	-----	-----	-----

c. Type of Fertilizer	()	()	()
-----------------------	-----	-----	-----

d. Peanuts Manured (Area)	()	()	()
---------------------------	-----	-----	-----

6. Peanut Weeding (Days after Planting)

-99 1st Weeding Completed	()	()	()
---------------------------	-----	-----	-----

-99 2nd Weeding Completed	()	()	()
---------------------------	-----	-----	-----

-99 3rd Weeding Completed	()	()	()
---------------------------	-----	-----	-----

7. Peanuts Harvested (lifted)

1 Date Completed	(6 months)	()	()
------------------	--------------	-----	-----

1.5 Area	(1.5)	()	()
----------	---------	-----	-----

20 Nuts (weight)	(20 packs)	()	()
------------------	--------------	-----	-----

-99 Hay (weight)	()	()	()
------------------	-----	-----	-----

Summary

8. How many days ago was Peanut lifting completed?	()	()	()
--	-----	-----	-----

9. How many days of labor were required for harvest (lifting through storage or sale)?

Men in family	()	()	()
---------------	-----	-----	-----

Women in family	()	()	()
-----------------	-----	-----	-----

3 Hired men	(✓)	()	()
-------------	-------	-----	-----

Hired women	()	()	()
-------------	-----	-----	-----

10. Were peanuts lifted at proper maturity?

1 Yes,	(✓)	()	()
--------	-------	-----	-----

Somewhat early	()	()	()
----------------	-----	-----	-----

or Somewhat late	()	()	()
------------------	-----	-----	-----

11.a If peanuts were not harvested at proper maturity, state reasons why.

11.b How is proper maturity determined

No flower

12. Indicate the number of days from lifting and rowing peanuts to completion of operation. (If operation is incomplete, indicate days from lifting to expected completion).

	For Food	For Seed	For Sale
a. Stacking in field for drying	()	()	()
b. Drying before thrashing	(<u>8 months</u>)	()	()
c. Thrashing and cleaning	()	()	()
d. Gleaning loose peanuts from field	()	()	()
e. Gleaning by livestock	(<u>15 month</u>)	()	()
f. Grading of peanuts (seed, sale, or food)	()	()	()
g. Sacking of peanuts for storage	()	()	()
h. Last sale of peanuts	()	()	()
i. Last shelling of peanuts for food or oil	()	()	()
j. Last feeding or sale of peanut hay for livestock	()	()	()

13. Sale of peanuts (actual or expected)

To Whom	Transportation		Kantar	± Kantar	Date	
	Mode	Time			Contracted	Delivered
a. Payment in-kind for labor						
b. <u>Merchant</u>						
c.						
d.						
e.						

14. Which adult members of your family were employed part-time on other farms during peanut growing season?

Members Name	Days		
	Planting	Weeding	Harvesting
	0	0	0

15. Information about peanuts in storage
- | | For Food | For seed | For Sale |
|--|---------------------------|----------|-----------|
| a. Quantity thrashed (harvested)? | <u>4</u> | <u>2</u> | <u>15</u> |
| b. Quantity cleaned? | <u>See a</u> | | |
| c. Quantity stored shelled? | | | |
| <u>20</u> d. Quantity stored unshelled? | <u>3</u> | <u>2</u> | <u>15</u> |
| e. Who is responsible for inventory? (inspection or distribution) | <u>Abdulla M. Benamer</u> | | |
| f. Frequency of entry into inventory? (Interval in days) | | | |
| g. Where are peanuts stored? | <u>House</u> | | |
| h. Type of storage container? | <u>House</u> | | |
| <u>0</u> 1000 j. Problems in storage (insects, molds, rodents, theft, germination, heating, rancidity or any other/specify) | 1st | | |
| | 2nd | | |
| | 3rd | | |
| | 4th | | |
| i. Amount of loss in storage (Total) | | | |

16. Take 100 gm sample of peanuts stored for food. Use numbered plastic bag supplied.

General observations, shells damaged, rot, mold, rancid, etc. _____

CONFIDENTIAL

PEANUT CRSP - SUDAN

AGRICULTURAL RESEARCH CORPORATION/FOOD RESEARCH CENTER

FOLLOW-UP SURVEY ON POST-HARVEST HANDLING OF PEANUTS IN SUDAN

Survey No: _____ Date: _____ Interviewer: _____

Respondent's Name: _____ Cluster No: _____

Address: _____

District: _____ Region: _____

1) Land cultivated - area owned: _____, area leased: _____,
area sharecropped: _____ (Feddan/Makhamas)

2) Total area cropped (Feddan/Makhamas) Planted: _____, Harvested: _____

3) Peanuts planted:

(a) When were peanuts planted? _____ Date

_____ before first rain

_____ after first rain

(b) Area planted _____ (Fed./Mak.)

Date planted _____; Amount of seed: _____ sacks; _____ weight;

Variety planted: _____

(c) Were you satisfied with peanut germination? _____ yes; _____ no

- If no, did you replant peanuts? _____ yes; _____ no

(d) In irrigated area only:

How many times did you irrigate peanuts? _____

Did you irrigate before planting? _____ yes; _____ no

4) Source of seed (tick) Government _____; Private agents _____; Self produced _____

5) Was seed treatment used? _____ yes; _____ no

6) Were peanuts rotated (tick) (a) after crop? _____ after fallow? _____

If after crop, which crop? _____

7) Were peanuts intercropped? _____ yes; _____ no. If yes, which crop(s)? _____

8) Were peanuts double cropped? _____ yes; _____ no.

9) Peanut weeding:

(a) First weeding:

Date started _____ Date completed _____ Days of actual weeding _____

(b) Second weeding:

Date started _____ Date completed _____ Days of actual weeding _____

(c) Third weeding:

Date started _____ Date completed _____ Days of actual weeding _____

10) Peanut harvest (lifting)

Date completed _____ Area harvested _____ (Fed./Mak.)

Total nuts harvested: _____ sacks

11) Days of labor used to harvest, dry, thresh, clean, & sack peanuts:

Family labor: Men _____; women _____; children _____

Hired labor: Men _____; women _____; children _____

12) How was peanut maturity determined?

Explain: _____

13) Were peanuts harvested at proper maturity?

Yes _____, somewhat early _____, somewhat late _____

If peanuts were not harvested at proper maturity, give reasons

14) Peanut drying, threshing, cleaning and sacking:

Date started _____ Date completed _____

Gleaning loose peanuts from field?

Quantity _____ Date completed _____

15) Sale of peanuts:

(a) Quantity sold before harvest: _____ sacks,

To whom _____, total revenue (Ls) _____

Date contracted _____, date delivered _____

(b) Quantity sold in field at harvest: _____ sacks,

To whom _____, total revenue (Ls) _____; date of sale _____

(c) Quantity sold in the market at harvest: _____ sacks;

Total revenue (Ls) _____; Date of sale _____;

To whom: Local trader ___; Auction market ___; Other ___.

(d) Mode of transportation: _____

(e) Were peanuts sacked before sale? ___yes; ___no

(f) Mode of payment: Cash _____ or in kind _____

16) Stored peanuts: The following questions relate to peanuts stored for food, sale, and/or seed:

(a) How much peanuts did you store at harvest for

food _____; sale _____, seed _____

(b) Complete the tables below:

	Quantity Peanuts		Quantity Disposed (Kgs)			
	Produced (Harvested)	End of Month balance in Storage	Sale	+ Food	+ Seed	+ Lost
November
December
January
February
March
April
May
June	_____	_____	_____	_____	_____	_____
		=	+	+	+	+

- 17) What type of storage container was used for peanut storage? In shell _____ Shelled _____
- 18) Estimate kilograms lost due to any problems you have had with stored peanuts this year, germination ___ kg, heating ___ kg, insects ___ kg, molds ___ kg, rancidity ___ kg, rodents ___ kg, theft ___ kg, Other ___ kg
- 19) (a) Take two 100 gram samples, one at harvest and one toward the end of storage period.
- (b) Comment on observed condition of peanuts in storage at the beginning of the storage:
- _____
- _____
- _____
- (c) Comment on observed condition of peanuts toward the end of the storage period.:
- _____
- _____
- _____

Revised March 11, 1985

PEANUT PASTE CONSUMPTION SURVEY

- Objective To assess the role of peanut paste in the nutrition of Sudanese families consuming peanut paste.
- Justification Previous survey indicates that 68% of the families consume peanut paste/ground peanut. Preliminary indications are that it is consumed in substantial quantities. These data, however, do not provide enough information to assess the relative contribution of peanut paste in the nutrition of the families consuming peanut paste. Thus, detailed basic information on the role of peanut paste is essential before we attempt to engage in product improvement.
- Approach
- Survey of selected families (about 100 households/site) on peanut paste consumption.
 - To include Khartoum (urban), Wad Medani (urban and rural) and El Obeid (urban and rural) areas.
 - Chemical composition and protein quality evaluation of peanut paste.

238

Confidential

Date 3/11/85 draft _____

PEANUT CRSP - SUDAN
Alabama A&M University/Agricultural Research Corporation
(Food Research Center), Sudan

A Survey on Peanut Paste Consumption in Sudan

I. DEMOGRAPHY

Survey No: _____ Date: _____ Interviewer: _____

Respondent's Name: _____ Cluster No. _____

Address: _____ House No. _____
Lane: _____
Street: _____

District: _____ Province: _____ Part of Sudan: _____

Religion _____ Tribal origin _____

1. How long has your family lived at this address (yrs)? _____

2. How many persons are there in your household? Include number of persons) _____

3. List the head of household first and then list the names, ages, and relation of other household members to head of household.

Family Member Number	Name (First & Last)	Sex	Age	Relationship to Head (Father, Son etc.)	Migration (Mo/Year away from this home)
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

251

4. Male Head () () () () () () () () () () () () () () () () ()
 Yrs.of Educ. 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16+
5. Female () () () () () () () () () () () () () () () () ()

6. Which members of your household were employed last year, and where?

Member's Name (Number)	Where Employed	Type of Job or Work

7. What was the total gross income of all members of your household from all sources in 1983?

a. _____ ts Sudanese

b. If unable to obtain estimate above, check bracket below:

- | | | |
|---------------|-------------------|---------------------|
| Under 99 () | 400 - 499 () | 2,000 - 3,999 () |
| 100 - 199 () | 500 - 699 () | 4,000 - 5,999 () |
| 200 - 299 () | 700 - 999 () | 6,000 - 9,999 () |
| 300 - 399 () | 1,000 - 1,999 () | 10,000 and over () |

8. Of the peanuts used during the past month by your household, list below the amount and value for each form in which they were acquired.

Form of Peanuts	Acquisition			Home Processing			Disposition			
	Source* (1,2,3)	Amount (kg)	Value (S/kg)	Amount of Form Used (kg)	Amount Produced (kg)	Value (S/kg)	Amount Consumed (kg)	Gift (kg)	Sold (kg)	Value (S/kg)
Raw, in shell										
Raw, Shelled										
Boiled, in shell										
Boiled, shelled										
Roasted, in shell										
Roasted, shelled										
Fried										
Ground										
Peanut paste										
In candy										
Peanut oil										
Other(specify)										

*1=Home Produced; 2=Purchased; 3=Gift
 If more than one source, indicate % of each source

9. Does your family consume peanut paste or ground peanut?
_____ Yes _____ No

10. If the answer is No, give reason(s) for not consuming _____
(Move to No. 18).

11. If the answer to No. 9 is yes, would you like to consume more peanut paste/ground peanut? _____ Yes _____ No

12. If the answer to No. 11 is yes, give the reason for not consuming more _____

14. If the answer to No. 11 is no, give the reason _____

13. How frequently is the peanut paste/ground peanut consumed in your family?

	<u>Paste</u>	<u>Ground</u>
a. every day	_____	_____
b. twice a week	_____	_____
c. once a week	_____	_____
d. once in two weeks	_____	_____
e. once a month	_____	_____
f. less than once a month	_____	_____

15. Where did you get the last supply of your peanut paste/ground peanut?

	<u>Paste</u>	<u>Price, ₦/kg</u>	<u>Ground</u>	<u>Price, ₦/kg</u>
a. grocery store	_____	_____	_____	_____
b. street vendor	_____	_____	_____	_____
c. market	_____	_____	_____	_____
d. prepare at home	_____	_____	_____	_____
e. gift	_____	_____	_____	_____

16. What kind of container did this vendor furnish?

- a. Leaves _____ (specify) _____
- b. Paper _____ (specify) _____
- c. Glass bottle _____
- d. Tin can _____
- e. Plastic bag _____
- f. Other _____ (specify) _____

17.a Indicate the frequency, preference, and the form of peanut paste consumed in the past week by age and sex groups:

PRODUCT	GROUPS								TOTAL CONSUMED IN THE FAMILY(KG)
	CHILDREN (<6 yr)		CHILDREN (6-11)		ADOLESCENTS (12-20)		ADULTS (>20 yr)		
	M*	F*	M*	F*	M*	F*	M*	F*	
-----Frequency-----									
As is									
In soup									
In Salad									
As Spread									
Other (Specify)									
-----Preference----- (Circle one number)**									
As is	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	
In Soup	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	
In Salad	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	
As Spread	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	
Other (Specify)	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	

*M=Male; F=Female

**1=Dislike; 2=Indifferent; 3=Like

262

17.b Indicate the frequency, preference and the form of ground peanut consumed in the past week by age and sex group.

PRODUCT	GROUPS								TOTAL CONSUMED IN THE FAMILY(KG)
	CHILDREN (<6 yr)		CHILDREN (6-11)		ADOLESCENTS (12-20)		ADULTS (>20 yr)		
	M*	F*	M*	F*	M*	F*	M*	F*	
-----Frequency-----									
As is									
In soup									
In Salad									
As Spread									
Other (Specify)									
-----Preference----- (Circle one number)**									
As is	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	
In Soup	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	
In Salad	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	
As Spread	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	
Other (Specify)	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	1,2,3	

*M=Male; F=Female

**1=Dislike; 2=Indifferent; 3=Like

18. Give the total amount (before cooking) and type of food consumed yesterday by your household.

	<u>Type</u>	<u>Amount (kg)</u>
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	_____	_____
e.	_____	_____
f.	_____	_____

19. Give the price paid for the following foods:

Meat _____ ₱/kg
Beans _____ ₱/kg
Milk _____ ₱/liter
Eggs _____ ₱/dozen
Fish _____ ₱/kg
Peanuts raw _____ ₱/kg
Peanuts
Shelled _____ ₱/kg
Other protein food _____ ₱/kg

Observations on the respondents or other family members seen:

- a. Swelling of the neck for goiter
- b. Kwashiorkor in children - visual symptoms
- c. Skin condition
- d. Blindness

[Note: If possible, please collect a sample of peanut paste (100 g) in the container provided.]

26

Chemical Composition and Protein Quality Evaluation
of the Peanut Paste

Chemical Composition

- (i) Protein, fat, fiber, moisture, vitamins, minerals,
amino acids
- (ii) Natural toxicants: Protease inhibitor
Phytic acid
Goiterogenic substances
- (iii) Contaminants: Mycotoxins - aflatoxins
other mycotoxins
- (iv) Microbiological - Plate count
Coliform
- (v) Sand, Silica, Animal residues

Protein Quality Evaluation - In addition to amino acid analysis, the protein quality of the peanut paste will be evaluated biologically. Protein Efficiency Ratio (PER), Net Protein Retention (NPR) and Net Protein Utilization (NPU) will be measured using weanling rate by standard methods. Facilities for biological evaluation of protein quality available at the Food Research Center will be supplemented so that the experiments could be carried out in Sudan. The experimental protocol and schedule will be discussed during our visit in Summer, 1985. It is anticipated that we will begin these experiments by October, 1985. The rats will be posted for preliminary observations on gross pathology. (If necessary, the suspected organs may be subjected to histopathological examination.) The attached procedure will be followed for PER studies.

2/6

A O A C Procedure for PER Assay of Peanut Paste

Animals*

weanling rats from same colony
 age: not less than 21 days
 not more than 28 days
 weight: range less than 10 g
 acclimation: Min. 3 day Max. 7 d

*Rats and cages to be provided by FRC where the PER study will be conducted.

Materials*

1. ANRC Reference Casein
2. Salt mixture USP (see Appendix)
3. Vitamin mixture (see Appendix)
4. Cottonseed oil
5. Cellulose (Solka floc etc)
6. Corn starch
7. Peanut paste

*All ingredients except peanut paste will be purchased in the U.S. and shipped to Sudan.

Diet formulation

Ingredient	g
Peanut paste <u>or</u> casein	x (to give 10 g of protein)
Salt mix	$5 - \frac{(x \cdot \% \text{ Ash})}{100}$
Vitamin mix	1
Cotton seed oil	$8 - \frac{(x \cdot \% \text{ Ether extract})}{100}$
Cellulose	$5^* - \frac{(x \cdot \% \text{ crude fiber})}{100}$
Water	$10^* - \frac{(x \cdot \% \text{ moisture})}{100}$
Corn starch to make 100 g	

*Cellulose and H₂O to be adjusted upward depending on the CF and moisture in the sample.

Assay

- No. of Diets: 5 composite samples of peanut paste
1 casein control
- A total of 6 experimental diets
- 10 - 15 rats will be assigned to each experimental diet (No. of rats to be the same in each group).
- Feed and water made available ad lib. for 28 days

Measurements

At weekly intervals and on 28th day, measure weights of the rat and feed consumed.

PER Calculation

$$\text{PER} = \frac{\text{Weight gain (g) in 28 days}}{\text{protein intake in 28 days}}$$

- Adjusted PER: (Standard Way)
1. Equate casein (control) PER to 2.5
 2. Express PER of peanut paste relative 2.5.

PER ratio (per AOAC): Report protein quality of the peanut paste as % PER of casein

Appendix

Salt mixture USP. - Either USP salt mixt. or salt mixt. having essentially same proportions of the elements. Prep. USP XIX (p. 612) salt mixt. (or corresponding USP XX item) as follows: Grind in mortar portion of 139.3 g NaCl with 0.79 g KI. Similarly grind together remainder of the NaCl with 389.0 g KH_2PO_4 , 57.3 g MgSO_4 anhyd., 381.4 g CaCO_3 , 27.0 g $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$, 4.01 g $\text{MnSO}_4 \cdot \text{H}_2\text{O}$, 0.548 g $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$, 0.477 g $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, and 0.023 g $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$, finally adding the NaCl-KI mixt. Reduce entire mixt. to fine powder.

Vitamin mixture -

	mg/100 g ration
Vitamin A (dry, stabilized)	2000(IU)
Vitamin D (dry, stabilized)	200(IU)
Vitamin E (dry, stabilized)	10(IU)
Menadione	0.5
Choline	200
p-Aminobenzoic acid	10
Inositol	10
Niacin	4
Ca D-pantothenate	4
Riboflavin	0.8
Thiamine.HCl	0.5
Pyridoxine.HCl	0.5
Folic acid	0.2
Biotin	0.04
Vitamin B ₁₂	0.003
Glucose, to make	1000

NPR and NPU studies may be also carried out simultaneously (or separately). Please see Rao et al. Nutr. Rep. Int'l., 21:6, 1980 for the procedure.

Table 2

Budget for Alabama A & M University
Food Technology Project (AAM/FT/S)

AID FUNDS

<u>Category</u>	<u>FY82</u>	<u>FY83</u>	<u>FY84</u> <u>Cost Shared</u>	<u>FY85</u>	<u>FY86</u>
Salaries	\$18,064	35,000	39,935	39,935	39,935
Fringe Bene.	4,335	8,400	9,584	9,584	9,584
Supplies & Equipment	2,581	5,000	5,705	5,705	5,705
Travel	11,870	23,000	26,243	26,243	26,243
Other direct costs	2,064	4,000	4,564	4,564	4,564
Indirect Costs	<u>7,169</u>	<u>13,890</u>	<u>15,849</u>	<u>15,849</u>	<u>15,849</u>
Total	46,083	89,290	101,880	101,880	101,880

Not Cost Shared - Pass Through Funds

Total	37,650	42,859	48,902	48,902	48,902
Total AID	83,733	132,149	150,782	150,782	150,782

NON-FEDERAL COST SHARED FUNDS

Total AAMU	15,994	30,990	35,360	35,360	35,360
GRAND TOTAL	99,727	163,139	186,142	186,142	186,142