

ANNEX B

REPORT OF THE TEAM AGRONOMIST - CHARLES L. DAVIS

INTRODUCTION

The purpose of the project is to establish a Vegetable Production Service within the Agricultural Directorate of the Ministry of Rural Development and to promote Vegetable Production among small farmers and Cooperatives in Rural Mauritania.

The original project design envisioned providing six person years of long-term technical expertise for three regions in the country for 3 years. Due to funding limitations, this has since been modified and reduced to four person years of long-term technical expertise for a two-year period.

The vegetable production project acquired the services of the consulting firm of Frederiksen, Kamine and Associates 30 May, 1980, to assist in implementing the activity. The FKA team leader arrived in Nouakchott 29 September 1980, the Horticulturalist arrived in mid-July 1980. Two short-term consultants, an Agricultural Economist and a Nutritionist, arrived in October, 1980.

FKA/AID contract now includes an additional short term irrigation Engineer.

Six (6) local project employees, including 3 chauffeurs, an administrative assistant, a typist and a custodian, were employed in December, 1980 to facilitate project implementation. USAID provided the services of a project manager, coordinating his activities with the Director of Vegetable Production, within the Agricultural Directorate of the Ministry of Rural Development.

REGIONS OF ACTIVITY:

Three Regions are involved in project implementation, the 3 rd, 5 th and 6 th regions. Currently there are eighteen (18) demonstration gardens, six (6) demonstration gardens in each region, involving over 600 participants in the three (3) regions as follows:

TRARZA REGION

Keur Massene	- 55 participants (3 gardens)
Dara	- 55
Rosso-PMI	
Tekane	- 88

BRAKNA REGION

Tieneal - 130 participants
 M'Bagne - 58
 Ferallah - 18
 M'Gaural Guidal - 38 members
 N'Jaral - 25

ASSABA REGION

Kiffa - 150 participants (5 gardens)
 Kankossa - 5

Six Peace Corps Volunteers are located in Kiffa, Kankossa, M'Bagne, N'Gaural Guidal, Tekane and Keur Massene.

In each region the project coordinates all of its demonstration trials in cooperation with a local chef de secteur (one in each region).

Mauritanians, working under each chef de secteur, assist locally with demonstration trials.

Activities to improve vegetable production have included:

1. Varietal trials. Root crops and leafy vegetables are being emphasized.
2. Water conveyance and lifting (drip irrigation/pumps).
3. Utilization of manure and local levels of fertilizer and cattle manure.
4. Plant spacing and culture.
5. Soil analysis/water quality.

GARDEN DEMONSTRATION ACTIVITIES

Brakna (5 th Region)

Fifty-eight farm families are involved in the M'Bagne demonstration garden project and have been allocated plots of 6 M x 10 M to plant various varieties of vegetables of their choice for home consumption, and the high quality surplus produce can be preserved and sold on the local market as an additional source of income.

VEGETABLE VARIETIES PLANTED IN THE MBAGNE DEMONSTRATION GARDEN

LEEKs	SWEET PEPPERS	CABBAGE	SQUASH
ONIONS	EGG PLANT	LETTUCE	TURNIPS
CARROTS	MUSTARD GREENS	BEETS	TOMATOES
TROPICAL SPINACH	CHARD		

(all irrigated)

Tieneel:

This is a fishermen's village on the river approximately 45 KM from M'Bagne.

One hundred thirty (130) farm families are involved in the Tieneel demonstration garden project and have been allocated plots of 6 M x 10 M to plant various varieties of their choice for home consumption. Any high quality surplus produce can be preserved or sold on the local market as an additional source of income.

Adjoining the garden demonstration plot within the agricultural directorate of the Ministry of Rural Development, the forestry service has a garden plot testing numerous varieties of vegetables:

CARROTS	CABBAGE	LETTUCE
ONIONS	GARLIC	SPINACH-A WIDE NUMBER OF
BEETS	CHARD	VARIETIES
TOMATOES	EGGPLANT	

It should be mentioned here that on the same demonstration plots Irish potatoes are being tested to determine yields with the application of fertilizer and without fertilizer (10-10-20). Farm families are provided fertilizers to incorporate into the soil to increase yields, and as a result can determine if the application of fertilizer is economically feasible. The "Match Box" system for measuring the quantity of fertilizer to incorporate into the soil is utilized. Clientele are provided with insecticides to assist in controlling insects.

OTHER VILLAGES:

In Bagodin, 22 farm families, in Ferellah, 18 farm families and in N'Gaural, 38 farm families are involved in the garden demonstration project.

In the last three mentioned areas, the farm families plant the same vegetables, but different varieties as follows:

LEEKS	CHARD	CABBAGE
ONIONS	TURNIPS	LETTUCE
CARROTS	ZUCCHINI	BEETS
TOMATOES	EGGPLANT	SQUASH
SWEET PEPPERS	TROPICAL SPINACH	MUSTARD GREENS

The garden demonstration projects are designed to observe fields days and to conduct demonstrations related to spacing, depth of planting and irrigation. One such demonstration was conducted in the Gudunie area with thirty-five (35) farm families in attendance.

ASSABA (3 rd) REGION

The agronomist consultant visited the Kiffa demonstration gardens to observe their operation.

Over 150 farm families are involved in the five Kiffa demonstration gardens and have been allocated plots of 6 M x 10 M to plant various varieties of vegetables of their choice for home consumption. The high quality surplus produce can be preserved or sold on the local market as an additional source of income. Trials are conducted in each of the five (5) demonstration gardens visited, potatoes, onions and tomatoes were planted with and without a commercial fertilizer, and farmyard manure. The region is one of dunes and oases. In most locations the soil is sandy loam to heavy clay. Soil preparation in some cases is very difficult. Small hand tools and sticks are used to prepare the soil for planting. Most gardens are watered by hand from wells. Experimental garden sites for the district include Hassi El Bikai, Guimba Sylla and Aleg Trois. Each experimental garden is approximately 1 ha. Farmers in the area are sun-drying their tomatoes and onion tops in their garden for sale in the local markets when a shortage exists for the fresh produce as a source of income.

Also, insect protection is a serious problem in this district. Extension field practices on insect identification, pesticides and spray rates were demonstrated.

Farm families involved in the demonstration gardens have already begun to harvest potato crops and a large quantity of locally grown potatoes was seen being sold in local markets; sun-dried onion tops were also being sold. Another problem observed was the over-ripening of tomatoes on the vines and eggplants remaining on the vines beyond maturity. The various vegetable varieties found planted in the demonstration gardens follows:

WHITE POTATOES	TOMATOES	CABBAGE
SWEET POTATOES	CARROTS	
BEETS	SQUASH	
ONIONS	OKRA	

TRARZA (6 th) REGIONKEUR MASSENE

The vegetable project is working with three cooperative gardens. The "Groupement" of women with a production garden of 4 ha has approximately 27 members, the youth groupement with a garden of 1 ha has 26 members, and a third group of individual gardeners (about 25, most of whom are merchants), gardening for home consumption and the high quality surplus produce sold on local market as an additional source of income.

Production problems that are common to all gardens include:

- A. Water transport from the marigot (rain-fed lake) to the bordering garden sites. Water is carried by hand in buckets.
- B. Lack of adequate protection from predators, i.e., wild pigs, goats, cows and camels. The project is providing some fencing for key administrative sites; however, the quantity allocated is limited.
- C. Water salinity. After the water in the marigots evaporates or disappears, most shallow wells become increasingly saline, limiting crop yields and production.

Demonstrations are directed to provide training and to obtain needed information to base technical recommendations. Seven demonstrations have been established at the Keur Massene gardens. These include: vegetable variety trials-onions, cabbage, tomatoes, potatoes spacing and depth of planting trials. Potato pesticides trials, potato and cabbage fertilizer and barnyard manure trials.

DARA:

This demonstration site is approximately 14 km east of KeurMassene. This cooperative has approximately 55 gardeners who are responsible for rain-fed agriculture of beans/melons interplanted with sorghum "Dieris and Wadis". The rain-fed gardens are approximately 40 ha. An irrigated demonstration garden of approximately $\frac{1}{2}$ ha was established. A new shallow well was dug and a hand pump installed. The following demonstration trials were in progress: potato spacing and depth of plant trials, potato fertilizer land trials and water management trials, potato pesticide trials, onions and cabbage field trials, surface and drip irrigation.

From observation it appears that onions, cabbage and egg-plants grow best in this area and the real problem is the lack of water supply.

PEACE CORPS VOLUNTEERS

The project was designed to engage nine (9) Peace Corps volunteers with some expertise in agriculture, however, there are six (6) Peace Corps volunteers currently in the field assisting in implementing the garden project.

RECOMMENDATIONS

1. Careful consideration should be given to importing varieties of vegetable seeds not heretofore grown in Mauritania for several reasons: A) the people's eating habits; B) their adaptability to the area; C) the availability of the seeds after phasing out the activity by USAID.
2. Some consideration should be given to establishing a regional complex between Mauritania, Senegal and Mali within the same frame-work of collaborating with other research projects to conduct research on planting, harvesting and storing seed potatoes for wide distribution in each country.

USAID procures from Holland 20,000 metric tons^{of} potato seed for distribution to home gardeners/cooperatives to determine yields per/ha, their adaptability to the areas, with a view to determine if it is economically feasible to rely upon imports. To produce high quality seed potatoes, they must be stored under refrigeration for at least three months (3) before distribution to farmers. The cost of refrigeration for storing potato seeds in large quantities would involve a tremendous capital outlay, while the refrigeration requirements do not now exist within the three countries.

3. Farm families should be encouraged to establish roadside markets, "door to door" marketing of their high quality surplus produce as their major source of income and as a supplementary source.
4. Farm families need technical assistance in constructing and maintaining appropriate water management systems.
5. Farm families involved in the demonstration gardens should be encouraged to preserve some of their seeds for planting, and/or for sale to interested farmers, since most of the seeds distributed are not hybrid.
6. Consideration should be given to providing more seeds for the production of root crops such as onions, potatoes, carrots and turnips, and less of the seeds that produce perishable crops such as lettuce, chard, mustards, tomatoes and cucumbers. There are several factors relative to a high production of perishable produce in Mauritania due to:

A) lack of refrigeration for adequate storage; B) markets and transportation systems have not been developed for immediate shipping to markets; C) highly perishable produce should be produced around highly populated areas. There is one other factor related to market outlets in Africa. Europeans are bigger consumers of perishable produce at present than Africans. This is due in part to a higher average income, and also eating habits. Most Europeans are accustomed to eating lettuce, chard, cucumbers and mustards, so the best market outlets will be in areas containing large number of Europeans.

7. Further consideration should be given toward assisting clientele in the techniques of drying some of their surplus high quality produce.

There seems to be no problems with the villagers in sun-drying okra. The same drying process can involve cabbage, beets, peppers, onions and tomatoes.

8. Prior to planting time considerable emphasis should be placed upon cultivation of the soil, proper spacing and depth for plants. For soils known to be heavily infested with nematodes, the planting of marigolds may provide some control.
9. A high level conference with GIRM and USAID officials to discuss the possibility of limiting the imports of a wide selection of vegetables into Mauritania during the height of harvesting season and coordinate a transportation linkage to villages and urban areas where the produce can be assembled and sold on the local market.
10. Yield data, consumption patterns or any other data released from the results of the demonstration gardens, should be considered with the national agricultural school at Kaedi for instructional purposes to keep extension agents abreast of the results for disseminating this information to clientele with a view to creating an incentive on their part to want to become involved in vegetable production for home consumption and for sale.
11. Leaflets, pamphlets and fact sheets related to the results of the demonstration gardens should be published for a wide distribution throughout Mauritania.
12. It would be highly appropriate to develop slides of the demonstration gardens from the day of planting until the time of harvesting the produce. Garden slide sets could be used as a tool to induce other villagers not yet involved in the project to establish demonstration gardens in their villages.

These same slides can be utilized when conducting demonstrations in spacing, depth of planting, application of fertilizers and herbicides.

13. Considerable emphasis should be placed on timely harvesting of the produce, especially the highly perishables such as tomatoes, squash and eggplants.

CONCLUSIONS

I. PHASE I.

Data gathering and feasibility for expansion. The information gathering aspect of the program is being initiated and will require two additional years beyond the current date.

II. PHASE II.

Ongoing research, extension and increased production will require 3-5 years.

III. Short-term consultants should become long-term, including the agriculture engineer.

IV. The project as designed required Peace Corps volunteers trained in agriculture coordinating and cooperating their activities in the various regions with the Chef de Secteur and with members of the contract team. The Peace Corps volunteers have worked effectively with the contract team, in spite of their lack of formal technical training, and view this as their most successful agricultural project.

V. The agronomist consultant visited each of the three (3) regions with the FK team and the Peace Corps volunteers. Contacts, observations and conversations reveal that the vegetable project is highly accepted by the GIRM, Director of Agriculture, Chief of Vegetable Production and the Chefs de secteur. Their desire is to expand the effort in the existing regions to be used as a model for expansion in other regions.

Farm families involved in the activity exclaim that they are receiving as benefits highly technical information and that the vegetable gardens are providing them with some of the basic human needs, nutrition and a source of income from sale of their high quality surplus produce. They have been involved in the production of a wide variety of vegetables not heretofore produced and consumed. Based upon these facts and observations, it is believed that USAID and other donors should continue its strong efforts and consider an expanded program in vegetable production for the people in Mauritania.

Further, it is believed that the cost for external training, facilities, equipment and long-term personnel for a complete program in vegetable production for Mauritania would be small in comparison to many other USAID projects and the speed with which a vegetable production program could be developed would be faster than with any other agricultural program.

APPENDIX A

REPORT OF TEAM AGRONOMIST - VEGETABLE PRODUCTION

- I. Initial work plan: Frederickson, Kamine and Associates
- II. Work plan: Irrigation Engineer, FKA
- III. Work plan: Marketing and Production Economics, FKA
- IV. Highest Vegetable Crop Yield (T/HA) for Three (3) Years in Southern Mauritania (FKA)
- V. Vegetable seed collection in Mauritania (FKA)
- VI. Vegetable Marketing and Transport (FKA)
- VII. Food Habits in Mauritania (FKA)

VEGETABLE PRODUCTION PROJECT 1/Initial Work Plan - Oct. 27, 1980INTRODUCTION

The vegetable project contract with FK is for a two year period and this report will summarize the work plan established for the remaining 20 month period. The project is designed to provide necessary technical, economic, marketing, and nutrition information required to determine the feasibility of expanding vegetable production in the country and to serve as a basic guide in any future assistance activities by the GIRM and external donors in vegetable production. Information regarding improved vegetable production, seed preservation techniques and marketing systems will be developed. Improved vegetable food preparation techniques will be introduced and GIRM personnel will be trained in vegetable production and extension at the national, regional, and local levels.

The original project design envisioned providing six technical experts for three regions in the country for three years. Due to funding limitations, this has since been modified and reduced to four technical experts for a two-year period. Technical assistance to the project is also being provided for by one US AID agricultural specialist and five to nine Peace Corps Volunteers. The FK team leader will coordinate all project activities with the US AID mission, GIRM institutions, and Peace Corps. A summary of the three major activities of the project, i.e. production, marketing, and nutrition, and a diagrammatic activity schedule are presented in the following pages. As indicated, some of the activities are essentially continuous, whereas other inputs, for example from the nutritionist and the agricultural economist, are coordinated with their twelve-month period scheduled throughout the remaining twenty months of the project.

After the first three months of team operation a quarterly progress report will be presented to the AID mission to assess progress against the work plan objectives. A format for quarterly progress reports, a mid-project report and the final report will be established. These reports will summarize project activities and include recommendations for consideration in follow-up programs. A discussion to involve minorities and women in the expansion of the country's vegetable production will also be included in the final report.

VEGETABLE PRODUCTION:

The task of an extension-oriented agronomist, which is what the project calls for, is to solicit problems from the field; that is, from the Agricultural Chefs de Secteur, moniteurs,

1/ Source: Technical assistance contract team: Frederickson, Kamine and Associates.

Peace Corps Volunteers, and the groupements, as well as giving consideration to research results from the Agricultural School at Kaedi. Following this, trial situations are devised to solve these problems.

Mauritanian agriculture is in that state in which the questions posed are necessarily simple and where the appropriate solution is the straightforward demonstration of practices that have been elsewhere researched.

Each of the project demonstration gardens therefore reflects questions posed at that site. In the three months that have passed since problems were first requested, response has grown geometrically and seventeen sites have been established. It is expected that there will be at least six sites in each region.

Local interest is directed to four areas:

- 1) Cultural practice - how to maximize yield by improving manual work techniques.
- 2) Protection - how and when to use insecticides, etc.
- 3) Seed collection - how to secure the next year's supply.
- 4) Water - how can the present transport system (in buckets) be improved.

Our demonstration will address these problems, and our aim will be to double present production either in improved yields or lengthened growing period or increased acreage.

Each supervisor of trials will be visited monthly or as nearly that as is practical, his problems discussed and the next month's work formulated in accordance with the World Bank "Visit & Train" extension system.

A framework has been provided for the collection of data by moniteurs and volunteers, and all relevant information will be set out into instruction manuals. These will be developed for the use of the Agricultural Extension Service and other interested institutions. Tools and all necessary trial equipment will be distributed and further purchases coordinated through the US AID agricultural specialist.

Finally, the demonstration plots and other agricultural operations in their vicinity will form the basis of a teaching series of slides. These can be duplicated for projection in villages, schools and interested institutions. Literature will be written to accompany these slides.

In this manner a basis will be laid for further GIRM activity in the fields of vegetable production and extension.

AGRICULTURAL ECONOMICS

The objective of the project that is relevant to the work of the agricultural economist is "the collection of base data which will be used for management decision making for future expansion of vegetable production".

The tasks to be performed to achieve this objective begin with familiarity with and understanding of data and information already gathered and made available concerning agriculture, village life, marketing, and other essential aspects of the current scene in Mauritania. Building on this foundation, largely through work in the field, a base of familiarity and understanding of the activity of vegetable production will be developed in the context of the family or group that undertakes it. This context evidently includes women as the motivators, entrepreneurs, and primary sources of labor for vegetable production.

Answers to these and perhaps other questions should emerge from the study, and will be discussed in the report to be prepared:

- Are there any ethnic, cultural, traditional, legal or other institutional barriers that do or will interfere with production of vegetables on either a subsistence or commercial scale?
- If so, how and to what extent can these barriers be overcome or removed?
- What is the availability of resources to support vegetable production, and what alternative uses for those resources pose claims upon them? Resources that are relevant in this context are land; family labor; hired labor; purchased inputs such as seed, chemical fertilizer, manure, and necessary tools; and money or credit with which to purchase or hire that which is needed.
- What scale or volume of vegetable production appears to be desirable and feasible under conditions observed in the project area?
- What effect can the family's production and use of vegetables for subsistence (feeding the family) have on the family's economic situation? Relevant aspects are substitution of homegrown vegetables for other foods formerly purchased, and use of land, labor and capital for vegetable production rather than for other purposes, so that opportunity cost - the value of those resources in other uses- must be considered.

Conceptually subsequent to production, although to be pursued concurrently, is the broad question of marketing of vegetables.

Study of marketing will focus on the commercial-scale assembling, preparation and transport of vegetables, and their sale at points both within and outside of the village where produced on a cash basis (as opposed to barter). Investigation of vegetable marketing as it exists at present will be confined to basic and pragmatic considerations that will assist in the development of a marketing program for the producers in the project. Seasonal variation in prices and the inverse relationship of prices to supply, transportation costs, marketing margins, the role of imported vegetables in establishing prices for domestic vegetables, and the possibility of useful disposition of surplus production will all be investigated. Thus consideration of processing, particularly by drying, cannot be avoided.

- Answers to these and related questions will be sought:
- At what price can vegetables be sold at the points to which the produce of the project can be transported? What seasonal variations exist? What quantities can be absorbed at these prices? What minimal quantities must be available for efficiency in sales? What varieties or special characteristics (such as size, degree of ripeness, etc) are desired?
 - What activities or services must be performed to facilitate sale of vegetables? Are washing, tying in bundles, sorting by size, removal of tops/shells/skins, and/or bagging or boxing desirable? If so, how can these services best be provided: at the moment of harvest and by the individual producer, or at some later time and/or by some intermediary?

A report of findings relative to marketing will be prepared, describing and proposing a marketing program for the vegetables produced by participants in the project. This program will combine the features of seasonality, scale, assembly, preparation, packaging, transporting, etc., that have been found in the studies to be most desirable. The program will be carried out under the supervision of the agricultural economist, whose final report will relate this experience and give further recommendations for subsequent marketing, with or without continuation of the project.

In general, the visits of the agricultural economist to Mauritania will be timed to facilitate studies of vegetable production during the critical portions of the production season, studies of marketing during the marketing season for domestically produced vegetables, and intervention in marketing when the maximum of produce is expected to be available. Reports of these activities are programmed to be submitted at the end of the economist's visit relative to each activity.

NUTRITION

The nutritionist will collect, analyse, and report data on nutrition and food consumption which help determine the need and the potential for encouraging or increasing consumption of vegetables.

A baseline nutrition survey will be planned and conducted early in the project to compile existing data and to acquire and analyze new data at project sites. Baseline data will be compared and contrasted to subsequent data collected in a similar survey during the second year of the project. Comparison of data will permit evaluation of the impact of the project from a nutritional point of view, and determine consumer acceptance of and demand for vegetables. The baseline survey and the second, comparison survey will attempt to achieve the following objectives:

- Determine
 - a) availability of food supplies at project sites
 - b) family access to food
 - c) actual household food consumption
 - d) distribution of food among individuals within the household
 - e) food preferences, beliefs, and knowledge, factors affecting these
 - f) methods of food preparation and storage, esp. vegetables
 - g) interest in eating more vegetables
 (Yearly averages as well as seasonal variations will be determined.)
- Evaluate the nutrient content of diets (yearly average and seasonal variability.)
- Compare actual intake with the nutritional needs of the family; estimate dietary adequacy; and identify nutrients inadequately supplied.
- Determine what nutritional contribution could be made by vegetables produced for local consumption.
- Compare cost of present diets to the cost of obtaining adequate diets.
- Compare and correlate dietary intake data with information acquired from Ministry of Health, local hospitals, MCH centres, and other sources about actual health and nutritional status of the population at project sites, such as:
 - Infant and maternal mortality rates

- Leading causes of death
- Percentage of infants born "low birth weight"
- Leading health problems
- Percentage of child population under age 3 treated at local malnutrition rehabilitation centers (CREN)
- Standard measures of nutritional deficiencies, (or excesses)

including, weight for age and height; mid-arm circumference; clinical and biochemical indicators

- patterns of infant feeding and weaning.

The services of an interpreter will be required to help conduct the surveys. PCV's may also be of valuable assistance in collecting some data.

Feedback from the first nutrition survey will form the basis of recommendations for the second year growing season, as well as a program of consumer nutrition education. The nutritionist will work closely with other team members to identify which vegetables in what quantities will:

- a) contribute significantly to identified nutritional needs,
- b) have consumer acceptance, and
- c) withstand conditions encountered in transport and storage with minimal loss of nutrients.

Nutrition education will be planned and implemented at project sites following the baseline survey and again after the second survey. This will be conducted with assistance from appropriate people including MCH center monitrices, agriculture extension agents, and PCV's. The purpose of the education will be to teach new methods of preparing the vegetables grown locally, the benefits of including vegetables in the diet, how to conserve their nutritional value in preparation and storage. Education will be directed to the appropriate groups and level of comprehension, through the demonstration and tasting of various recipes using vegetables produced from that location. Consumer acceptance of vegetables prepared in various ways will be assessed.

Results of nutrition surveys and education will be integrated in the final report with findings of the agricultural economist and results of the field trials.

February 25, 1981

Work-plan - Vegetable Project^{1/}
Irrigation Engineer: Ross Hagan

The following is an outline of the approach that will be taken for the first visit, February through April. A second trip is planned for October or November, during the 1981-82 growing season, to assist in the implementation of the proposed systems.

1. Collect available data (see Table A for a list of the data needed. Some of this information may not be available. A literature search will be made.
2. Visit the vegetable project demonstration plots. This will provide an opportunity to observe present water application methods. Discussions with the PCVs and Mauritians working in the field will offer them an opportunity to outline their perceptions of the problems and possible solutions.
3. Assess the various alternative methods of lifting water, temporary storage and application.
4. Assess the local availability of material and equipment that would be needed in implementation of the irrigation aspect of the Vegetable Production Project.
5. Decide on the most appropriate alternative through discussions with the GIRM officials involved in the project.
6. Compile lists of material needed for implementation. Locally available material will be separated from commodities that must be imported.
7. Complete a trip report. The draft report will be circulated for comments before the final copy is completed.

Obviously, several of these activities can be ongoing at the same time. Others may not necessarily be undertaken in this order.

As arrangements are made, short courses on irrigation will be held for the PCVs and GIRM personnel.

A second trip is planned for the growing season (October/November 1981) for the implementation of the irrigation systems.

1/ Source: Technical Assistance Contract Team - Fredericksen, Kamine and Associates

TABLE A. DATA

1. Maps: Topographic showing locations of water sources, plots
2. Meteorological: Rainfall, wind, temperature, humidity, sunshine
3. Geological: Potentials for ground water
4. Soil analysis: Infiltration rate, water holding capacity
5. Vegetables: Water demand, water quality tolerance
6. Water sources:
 - A. Water quality over time*
 - B. Reliability of supply*
 - C. Quantity of water available*
 - D. Lifting mechanisms
 - E. Transport methods
7. Water application:
 - A. Methods
 - B. Quantities applied
 - C. Frequency of application

* An attempt will be made to set up a monitoring network using the PCVs and GIRM personnel.

III

Preliminary Work Plan - Vegetable Project^{1/} February 25, 1981
Marketing and Production Economics - Kathryn Craven

The Agricultural Economist for the Vegetable Production Project arrived in Mauritania for a tour of duty that is to extend from February 23 to approximately May 15. Three different areas of economics for the project, i.e., marketing, consumption and production will be studied. The basic goal is to better define supply and demand for vegetables and the marketing link between the two.

Much of this information will probably have to come from primary sources - interviews with vegetable vendors, transporters, farmers, Peace Corps Volunteers, and Mauritanian government officials. Some work may also be effected through questionnaire surveys. Available secondary source material will naturally be sought out: RAMS, UNDP, EDF, Direction de la Statistique and relevant Ministries will all be consulted to see what information they have.

The outline below reflects the current thinking on both the sources and the kind of data the Agricultural Economist would like to consult over the next two to three months. At present, plans are to divide time spent between Nouakchott and the three producing regions - two trips to each of the regions of about 6-10 days each.

I. Data-Gathering for Vegetable Marketing

A. Nouakchott

1. Discuss with Ministry of Transport and the Syndicat des Transporteurs about:

- a) Types and quantities of transport available in Mauritania for:
 - longdistance haulage - trucks, boats, buses, taxis
 - regional transport - canoes, small trucks, carts
- b) Which kinds of transport go regularly to the vegetable project regions?
 - do any have empty back-haul?
 - do any now carry vegetables back?
 - what transport is available to go out that does not now do so?
- c) Costs of transportation - both standing and running
 - official government tariff
 - real costs and charges
 - distances to and between vegetable projects

- conditions of roads; traffic potential on river and marigots - seasonally
- average life of vehicles.

d) Seasonality of current transport flows and any other peculiarities of Mauritanian transport (e.g., limitations due to number of refueling sites, availability of mechanics or spare parts).

2. Do informal survey of vegetable marketing facilities in Nouakchott.

- a) Talk to wholesalers of imported produce.
 - how much do they buy, of what, and how often
 - what prices do they pay and sell for throughout the year
- b) Talk to retailers about above; also, do they note any seasonality in either supply or demand
 - What are the handling and transport costs paid for sales in Nouakchott?

3. a) Get statistics at the Central Bank and Customs (or Ministry of Fincance) of all vegetable imports.
- b) What is paid for vegetable imports, when imported, and what quantity?

B. Vegetable Marketing Data "en brousse"

1. Talk with villagers about:
- a) the connection between the village and Nouakchott: what transport goes by, how often, and what does it carry?
 - b) transport linking the village with the river: canoe and barge traffic - how often? how many? what do they carry?
 - c) local means of transport (other than boats or motor vehicles) donkeys, carts, camels, etc. are any of these rented? how transported? for how much?
2. Find out about the local vegetable markets.
- a) where are they? how far from plots?
 - b) How much is sold? over what period?

- c) What prices hold in what season?
 - d) If taken to nearby market, how transported?
for how much?
3. Did village experience glut - now or recently?
- a) When?
 - b) How much was sold? How much wasted?
 - c) What was price at beginning and end?
 - d) What did farmers do? Didn't produce again?

II. Data Gathering on Consumption

- A. For Nouakchott see I.A.3.
For project areas:
- B. Talk to Cindy Reeser, RAMS, PC, GIRM officials and other FK team members about amounts purchased or consumed daily:
 - a) by vegetable farmers
 - b) by non-vegetable producing neighbors
 - c) by people in village or town who can purchase vegetables.
- C. What is the acceptability of the various crops, by crop? Peace Corps, Project Team, moniteurs, and farmers' opinions?

III. Local Production

- A. From Chef du Secteurs, PCVs, FK team members:
 - a) Area by crop, by site
 - b) Yield by crop, by site
 - c) Harvest time for various crops, last year, this year
- B. From same sources as above:
 - a) What are major agronomic constraints in each area?
(salt, wind, water, seed, fertilizer, pesticides)
 - b) What are major economic constraints?
(labor, land, area or soil fertility, capital)
 - if this is a constraint - does anyone lend money?
at what interest rate?

- what are the alternative uses of labor wages, etc.?

c) Prepare production budgets (costs of production) for major vegetables - tomatoes, potatoes, onions.

IV. Prepare end of tour report and present Seminar on results to USAID, GIRM, PC and FK team members.

1/ Source: Technical Assistance Contract Team - Fredericksen, Kamine and Associates.

Highest Vegetable Crop Yields (T/ha) for 3 years in Southern Mauritania. 1/

Crop	1976*	1977*	1981#
Lettuce	12.5	-	3.6
Potatoe	-	16.0	88.0
Cabbage	25.0	16.0	31.8
Tomato	20.0	17.0	19.0
Onion	35.0	26.0**	42.0
Beet	6.0	12.0	19.3
Carrot	7.5	14.0	18.0
Okra	-	15.0	-
Eggplant	-	104.0**	72.0
Melon	-	17.0	-
Squash	-	-	1.6
Sweet Pepper	-	-	21.0

* Yields taken from annual reports of the regional agricultural chiefs to the Ministry of Agriculture.

Yields taken from project vegetable gardens.

** Yields taken from Kaedi Research Station.
M. Henri de Bon, Horticulturist.

1/ Compiled by technical assistance team agronomist - Frederickson, Kamine and Associates.

VEGETABLE SEED COLLECTION IN MAURITANIA^{1/}

Seed Variety	Local practise.*
Lettuce	Not collected
Onion	Collected from a few bulbs kept for the purpose at the end of the season
Tomato	Collected from selected fruits
Parsely	Not collected
Hot	Collected from selected fruits
Sweet pepper	Not collected
Zucchini	No information
Carrot	Collected and replanted for 2 generations but the third generation of seed does not yield the swollen tap root characteristic of the carrot, only an ordinary tap root.
Cabbage	Not collected
Beet	Not collected
Okra	Collected from selected pods.
Haricot	Selected from main harvest
Pumpkin	Selected from main harvest
Egg plant	No information
Melon	Collected in the past, but did not breed true and is no longer collected (possibly the original fruit was hybrid).

* Information obtained from observations of from talks with farmers.

1/Source: First Quarterly Report - Frederiskson, Kamine and Associates, December, 1980.

Vegetable Marketing and Transport^{1/}

Mauritanian farmers are growing increasing quantities of vegetables both on individual and cooperative plots. In some areas, production has exceeded local demand and this has led a number of people to explore the possibilities of marketing vegetables beyond the immediate production area. In order to do this successfully, a number of things must be considered. These can be most reasonably divided between technical transport and organizational problems, and economic obstacles. The following discussion will focus on the problems of marketing Kiffa vegetables.

Technical Difficulties

The technical difficulties that Kiffa faces in marketing its current supply of vegetables include 1) instructing farmers in proper quality control; 2) packing; 3) organizing farmers to seek out transport themselves; and 4) finding sufficient and timely transport to Nouakchott (or other towns).

A few runs to Nouakchott with vegetables should give the Kiffa farmers a good idea about what is and is not acceptable in terms of vegetable quality. The project may be able to aid in this flow of information by interviews with vegetable buyers concerning what kinds of things they are looking for in vegetable type and quality.

Packing vegetables for market is a more difficult problem to solve. Cardboard boxes were purchased in Nouakchott for one trial sale, but unless one of the farmers goes regularly to Kiffa to purchase these boxes, they will not be available. Two possible alternatives exist: packing materials of local manufacture (straw baskets) may be available, or farmers might persuade a Kiffa merchant who receives regular supplies from Nouakchott to order the boxes for them and bring them out. For some vegetables, jute sacks may be sufficient, and efforts should be made to see if these can be procured locally. Since many products are shipped out to Kiffa in these sacks (sugar loaves, rice, millet, etc.), they should be available for re-sale.

Farmers should be encouraged to seek out all the means available for marketing their vegetables outside the Kiffa region. The experience they gain in dealing directly with

1/ Source: First Quarterly Report - Fredericksen, Kamine and Associates, December, 1980.

truckers or commercial middlemen will provide them with invaluable information that they will need in making production decisions next year. They will rapidly acquire the knowledge they need concerning the type of vegetable being demanded outside of Kiffa, the prices that are being paid for those vegetables, and the quality desired.

In this vein, the farmers should be encouraged to find transport that fulfills the following ideal specifications: 1) a truck that will take just vegetables; 2) will go directly and rapidly to Nouakchott; 3) will travel at night. All of these things will prevent spoilage and will help guarantee a higher return to the farmers.

Obviously, finding such ideal conditions in transport will be difficult, but farmers should seek as many of the above specifications as they can. The travel distance from Kiffa to Nouakchott is not inordinately long, as long as the transport vehicles don't take too many rest stops. For all but the most perishable vegetables (spinach, chard, lettuce), the current transport system should be adequate. A great many of the vegetables in the limited states are trucked much greater distances without refrigeration. The most perishable should not be sent to Nouakchott from Kiffa, anyway. Although few trucks appear to leave Kiffa empty, truckers there told us that they often have to wait several days before getting a sufficient load to leave. Transport prices from Kiffa to Nouakchott are less than Nouakchott to Kiffa, which is another indicator that there is excess capacity in the return journey. So farmers should not have difficulties in finding space to ship their vegetables. They will have difficulties if they must always accompany their vegetables back to Nouakchott, because this is very time-consuming. With some luck, commercial middlemen will start to get involved in the vegetable marketing. They will buy the produce, assuring quality control, and take care of transport and re-sale. The price differential between imported tomatoes in Nouakchott (100 UM/kg) and the price received in the Kiffa market (30 UM/kg) gives plenty of room for profit for farmers, truckers and merchants. One merchant has already expressed an interest in getting involved with Kiffa produce sales in Nouakchott.

Economic Obstacles

Potentially greater obstacles to the long-run viability of vegetable marketing from the interior to Nouakchott, are the economic, rather than technical ones.

Many people throughout Mauritania are now growing vegetables. Tomatoes are grown in Nouakchott, and they come in from Rosso, Senegal, and elsewhere. Carrots come into Nouakchott from

Atar more cheaply than those from Rosso. So even with low production costs (free seed and tools), the competition of vegetables grown closer to Nouakchott may prevent places as far as Kiffa from being able to market its vegetables here. In order to make a long-run assessment of which areas can supply Nouakchott cheaply and which cannot, we will need to look at the costs of vegetable production in the various areas that will potentially supply Nouakchott, and the costs of transport from those areas into the capital.

VII

VEGETABLE PRODUCTION PROJECT

FOOD HABITS IN MAURITANIA^{1/}

The general impression from studies of food habits and the food supply is that the southern regions of Mauritania along the river, where agricultural production is concentrated, e.g., Regions 4 and 10, have a more balanced and varied diet. Wide seasonal fluctuations in food consumption exist, particularly in isolated areas poorly supplied from the outside. Limited supply, storage, preservation and transport of foods makes distribution uneven and prices high. There is a heavy dependence on imported foods, e.g., wheat flour, rice, milk, oil, sugar, etc.

A whopping 75% of household monetary expenditure is for food in the rural sedentary population, and 85% in the nomad population, based on data collected by the RAMS project for November, 1979 - November, 1980.^{2/} Thirteen percent of all consumption by rural sedentary groups and fifty-one percent for nomadic groups is non-monetarized, in the form of auto-consumption, gifts and exchanges (barter). Much of this non-monetary consumption may also be foodstuffs.

Limited supplies of cooking fuel, equipment and utensils, and an unpredictable food supply make meal preparation necessarily simple and spontaneous. Wood and charcoal are both used, and cooking pots are cast aluminum. Almost every meal features either a cereal grain or bread. Noon and evening meals are usually one-pot affairs, with the meat or fish and vegetables cooked together first in a stew or sauce, and served with either rice or couscous. Porridges with milk are often made for breakfast. Milk is usually consumed between meals, rather than with meals. Food is served in large platters or porcelain enamel bowls and eaten with the hands. Men and women often eat separately. People do not dawdle over a meal, or converse while eating, but socialize leisurely afterwards over glasses of sweet tea.

The mean calorie intake is approximately 2,200 calories per person per day. Calorie intake is highest in Regions 4, 9 and 10 and lowest in Region 3, according to the data collected in the second and third passes of the Household Food Consumption Survey conducted by the RAMS project in eight regions of Mauri-

* Due to incomplete and often contradictory sources of data, frequent references will be made to the specific sources. RAMS data is unpublished and unofficial as of this writing.

1/ Source: Second Quarterly Report - Fredericksen, Kamine and Associates, April, 1981

2/ RAMS Rapport Preliminaire, La Consommation des Produits Alimentaires et Non-Alimentaires dans le Secteur Rural Mauritanien, December, 1980.

tania in 1979-80.^{3/} This level of intake appears to be slightly low by FAO standards, despite that there are few adult males in most households. The RAMS survey reported that calorie intake met estimated household requirements 47% of the time in March/April, and 54% of the time in June/July.

Cereal Grains and Products

Cereals are the staple of the diet. The most commonly eaten foods include the following:

- sorghum - considered by some white Maures as food for animals, not people.
 - preferred in the south and Mali border areas by Haratine, Wolof and Toucouleur. It is said that an acceptable meal can be made from it at lower cost than wheat, which must be accompanied by meat.
 - pounded into flour, then rolled into couscous and steamed, served for the evening meal. Sorghum is boiled into porridge often for the morning meal.
- rice - now commonly consumed by all groups at the noon meal, with fish ("Thiebu Dien") or meat. In high demand.
- wheat - preferred by white Maures and in northern regions, a higher status grain. Growing in popularity over sorghum.
 - made into couscous or porridge. Wheat flour consumption is highest in Region 12.
- bread - consumption depends on presence of bakeries; is highest in Regions 4, 12 and 6. Often eaten for breakfast.

Mean cereal and cereal product consumption among the sedentary rural population is 476 gm/person/day, or 173 kg/person/yr. contributing 78% of mean daily calories and 38% of mean daily protein intake.^{4/} Daily per capita cereal intake is highest in Regions 10 and 3. Cereals provide the most calories to the diet in Regions 2, 3 and 10 and the most protein in Regions 2 and 3. In Region 3, cereals provide 95% of all calories and protein intake is still adequate.

3/ Calculated from RAMS Report La Situation Alimentaire et Nutritionnelle en Mauritanie, Nov. 1980, Table 1, pp. 48-50

4/ This figure is based on passes 2 and 3, RAMS Survey, recalculated from data in tables 1,2 & 5, La Situation Alimentaire et Nutritionnelle en Mauritanie, Nov. 1980. Their figure of 155 kg/person/yr excludes some cereal products.

As total calories intake increases, the percent of calories from cereals decreases.

Cereal intake is slightly higher in June/July than in March/April,^{5/} accompanied by a slight decrease in animal protein intake at that time.

Preliminary RAMS data indicated that the greatest percentage of monetary expenses of the rural sedentary groups went for cereals,^{6/} on the average, with Regions 10 and 3 spending more than average.^{7/} It was also reported that sorghum consumption is declining in all ethnic groups in favor of rice, which is linked to diminishing sorghum production and increased rice production. Compared to sorghum, rice (particularly white milled rice) is inferior in protein, calcium, iron, thiamine, riboflavin and niacin. Sorghum dishes are prepared from the whole grain. Some traditional sorghum recipes are no longer made "now that rice is available."

Meat

Consumption of meat and fresh milk has declined since the drought, due to reduction in the size of herds (of camels, goats, sheep and cattle), diminishing supply, and rising prices. However, more money is spent on meat than any other single item, accounting for twenty percent of total purchases, among the rural sedentary. Meat intake varies considerably. The RAMS Survey found that meat is consumed in larger amounts by Maures and Toucouleur than the Wolof. The rural sedentary population of the Tagant spend a higher than average percentage of their food budget on meat, compared to other regions surveyed.^{8/} Sedentary groups consume 33 kg/person/yr on the average.^{9/} Dried meat, called "tichtar" is consumed, particularly during the hot, dry season when herds are moved to greener pastures and meat is scarce.

5/ Calculated from Table 3, pp. 55-57, op. cit.

6/ RAMS Rapport Preliminaire, La Consommation des Produits Alimentaires et Non-Alimentaires dans le Secteurs Rurale Mauritanien, RAMS, December, 1980.

7/ Quelques Elements de l'Enquete de Budget/Consommation, Rapport de Synthese, RAMS, September, 1980.

8/ Quelques Elements de l'Enquete de Budget/Consommation, Rapport de Synthese, RAMS, September, 1980.

9/ Rapport Preliminaire, La Consommation des Produits Alimentaires et Non-Alimentaires dans le Secteur Rural Mauritanian, Dec. 1980.

Commercial milk is fairly widely available canned, dried, and in extended shelf-life cartons. The supply and consumption of fresh milk has dropped since the drought. Average milk consumption in sedentary groups was reported by RAMS at 20 litres/person/year,^{10/} (79 gm/person/day), although this varies widely from household to household. Calcium intake has been judged adequate.^{11/} Milk intake was found to be higher in June/July than in March/April and is higher among Maures, and higher in the Tagant and Assaba Regions. Nomadic Maures are highly self-sufficient in their milk supply; virtually all the 166 litres consumed per person per year are from their own herds.^{12/}

The wealthy white Maure practice of force-feeding girls from a young age with as much as twenty litres of milk a day to develop body fat and hasten maturity has diminished somewhat as the drought has reduced milk availability. Milk is most often consumed in the form of "zrig," made from powdered milk, water, sour milk culture, and sugar. This is consumed between meals. Milk is also added to porridges.

Fish

Fish is not traditionally consumed by Maures from northern regions, partly due to lack of availability. City living is changing traditional food habits, however. A study of immigrants in Nouakchott and Nouadhibou from northern regions of the country found that eighty-five percent regularly ate rice and fish at noon.^{13/}

Fish is widely consumed in the river region, particularly in the Kaedi and Guidimaka Regions. Rural sedentary groups consume an average of 7 kg of fish per person per year. But fish consumption is insignificant or nil in the Hodh el Charbi, Assaba and Tagant Regions.

Eggs and Poultry

Eggs are not usually eaten but are allowed to develop into chicks, chickens being more valued. Eggs are seldom fed to young children due to the belief among Toucouleur, Wolof and

10/ Ibid. (A figure of 31 kg was cited based on passes 2 and 3.)

11/ La Situation Alimentaire et Nutritionnelle en Mauritanie, p 64.

12/ RAMS Rappor Preliminaire, La Consommation des Produits Alimentaires et Non-Alimentaires dans le Secteur Rurale Mauritanien, RAMS, December, 1980.

13/ FAO, Manual de Nutrition Scholaire, R.I.M., Nouakchott, 1976, p. 48.

Peulh that this will prevent them from learning to speak well.

Poultry is scarce and expensive and not usually eaten except on special occasions, when it is served with rice. Chicken is popular with the Toucouleur.

Altogether, animal sources provide, on the average, twenty-nine percent of total protein in the diet.^{14/} Region 12 has the highest intake of animal proteins and Region 2 the lowest. Mean protein intake is 68 gm/person/day, which is adequate. (FAO recommends 53 gm protein/day when the Net Protein Utilization is 70%, as is estimated in the Mauritanian diet.) Protein intake is the highest in Region 10, but this is related to high cereal intake, not meat, in that region. Proteins provide about twelve percent of total calories consumed, overall, which is quite adequate.

Fats

Fats provide a variable contribution to the diet. Although Maures seem to value animal fat, they use very little oil in their diet, compared to Wolof and Toucouleur, who consume it to excess. The difference is due to the frequent consumption of Thieby Dien (fish and rice) among the latter, which is prepared with a large amount of peanut oil. Variations in caloric intake among different groups result primarily from the different amounts of oil consumed.

Legumes and Oilseeds

Legumes and oilseeds include cowpeas ("Niebe"), watermelon seeds ("beréf"), and peanuts. Peanuts are more common in the diet along the river in Regions 4 and 10. They are eaten grilled (often for breakfast), or pounded into meal added to certain dishes. Peanut butter is also used in some dishes. Melon seeds are collected from the melons, dried, and pounded into a meal, which is often cooked in combination with cowpeas and a vegetable and served with rice or couscous. Melon seed consumption was noticeably higher in March/April than in June/July. Dishes involving these foods are considered poor man's food, consumed when other foods are scarce.

Sugar

Sugar consumption has increased due to the growing popularity of tea, which is imbibed strong and sweet three times a day, three small glasses at a sitting. The elderly population appears to drink more than anyone else, due probably to more leisure time and as a social ritual. Sugar is also added to the sour milk beverage "zrig." Average sugar intake by rural sedentary populations surveyed is 13.6 kg/person/year.^{15/} Tea intake was

14/ Protein intakes calculated from Table 2, La Situation Alimentaire et Nutritionnelle en Mauritanie, RAMS, Nov. 1980.

15/ A figure of 12.4 kg/person/yr was reported based on passes 2 and 3 only.

higher in the Tagant and Assaba Regions than elsewhere. Nomadic Maures reported a 7 kg per person per year sugar intake.^{16/}

Fruits and Vegetables

Vegetable intake has increased along the river, particularly in Regions 2 and 10, since vegetable production has been encouraged there, and as nomads have become sedentarized and begun to practice agriculture. The most popular vegetables are onions, potatoes, okra, carrots, cabbage and cowpea leaves ("hacco"). Not well liked are the sour and less sweet vegetables including radishes and cucumbers, although these are grown in places and are sometimes discovered cooked in sauces and stews.

Vegetables are not prepared individually as separate dishes, but are incorporated into the main dish. Small quantities of available vegetables are usually boiled in sauce and served with rice or couscous. A meat and potato stew called "bonava" is popular and served with bread. Lettuce salads are known and eaten in some places, but vegetables are rarely eaten raw.

Vegetables are not much appreciated by Maures, but are liked by Wolof, Toucouleur, and other groups. Where consumption is low, availability has usually been limited and thus vegetables and their uses are unfamiliar. Their nutritional importance in the diet is not recognized, even where they are well eaten, but vegetables are appreciated by many for the variety they add to an otherwise monotonous diet. The RAMS survey reports an average consumption of fruit and vegetables at 24 kg per person per year, equaling 65.7 gm/person/day by rural sedentary populations and only 5 kg/person/year by nomadic Maures, 5 kg of which was fruits, mostly dates and melons.^{17/} Vegetables still make a very small contribution to the diet.

Fruits are in very limited supply. Although a variety of imported fruits is available in Nouakchott markets, fruit elsewhere is limited to various melons, dates, bananas in some areas, wild fruits called "jujube" and "toug," and "pain de singe" - the fruit of the baobab. For most of these fruits, availability is limited to the season. Jujube, pain de singe, and fresh dates (not dried) are significant sources of Vitamin C in the local diet. Potatoes also add Vitamin C to the diet where they are consumed in significant quantity.

Other plants consumed include hibiscus flowers ("bissap"), also high in Vitamin C from which a beverage is prepared; baobab leaves ("laalo"), a very good source of Vitamin A and iron, which is added regularly to couscous to improve the "mouth feel;" and

16/ and 17/:

RAMS Rapport Preliminaire, La Consommation des Produits Alimentaires et Non-Alimentaires dans la Secteurs Rurale Mauritanien, RAMS, December, 1980.

water lily seeds and bulbs ("ninuphar"), whose nutritional value is unclear, which are collected from the marigots and sometimes eaten with fish.

There are several indications that Vitamin C and A in the diet is inadequate. This could readily be corrected if vegetables were more widely and more regularly available and consumed. Vegetables not currently consumed in significant amounts, which should be encouraged for their potential contributions to the diet of primarily Vitamin A, Vitamin C and iron, include the following:

- parsley
- green leaves (mustard greens, turnip greens, spinach,
beet greens, swiss chard)
- green peppers
- tomatoes
- turnips
- sweet potatoes
- squash

Initial experiences have shown that these vegetables can be easily adapted to the taste preferences and familiar recipes of different ethnic groups, but must be demonstrated and promoted.

ANNEX C

REPORT OF THE PROJECT MANAGER - JAMES HUGHES

The adaptive research being carried out at the village level for the vegetable production project is based on the "farmer research approach". Due to little or no adaptive research data available Mauritania for vegetable production, a farmer research approach is necessary.

The farmer research approach takes into consideration the traditional methods of farming practices in areas influenced by the project. Interjection of selected improved technologies designed to enhance traditional production methods on a progressive basis are then introduced on a trial basis.

Once groups of improved technologies (ex. - new varieties plus low levels of fertilizers) have been proven worthwhile in demonstration gardens they are introduced to other farming communities. It is imperative that an understanding of local farming conditions be developed prior to inserting improved technologies if they are to be successful.

In this project adaptive agronomic research is being carried out on: variety testing, fertilizer levels, spacing, irrigation, the use of a limited number of insecticides, and manure incorporation.

Demonstration gardens serve as extension multipliers for farmers as well as G IRM agricultural officials. A Chef de Secteur responsible for agricultural extension in each of the three project regions aided by local village moniteurs extend better farming practices at the village level.

Due to lack of transportation (Land rovers, and gasoline/oil) Chef de Secteur and moniteurs are limited in their extension endeavors.

The planting of alfalfa for soil improvement, rather than for forage for village animals has not been investigated to date. Planting of alfalfa during the dry season is anticipated which will contribute to feed for animals during the off-season. Much research remains, however, to be investigated with soil improvement and forage/composting techniques.

Seed preservation is an important aspect of a viable vegetable production project. Most of the seed planted by Mauritanian farmers is imported from France. Imported seed is expensive for the traditional farmer and is oftentimes not available. More effort needs to be carried out on seed preservation techniques suitable for acceptance by villagers.

Seed preservation is a rather specialized technique. Work with a few better motivated farmers in each region to learn the techniques of seed preservation has yet to be initiated. The amount of water which can be hand-drawn from a village well and carried to a garden site is one of the major production constraints.

Investigations are now underway to introduce a simplistic gravity flow irrigation system which would be practical for village farmers. Field tests to date indicate that with incorporation of manure and fertilizer, one-half less water for gravity flow irrigation compared to hand watering has resulted in 2 times more potato production in one site. These trials will be expanded during the 1981-82 growing season since a short-term irrigation engineer has been added to the consultant staff.

RECOMMENDATIONS

1. More emphasis on inputs such as:
 - A. Manure incorporation
 - B. Low levels of fertilizer
 - C. Different irrigation materials
 - D. Nematode resistant varieties including nematode controlling plant varieties.
 - E. Emphasis on fewer vegetable variety trials based on growing seasons remaining.
2. Where market potential looks promising, concentrate on a large cooperative for production. Maximizing white potato production for example, with inputs of fertilizer, manure, insecticides if needed, - deducting costs of production, transportation, marketing - to determine if farmers can make a profit.
3. Study use of small rototillers along Senegal River where labor constraints, cash markets might warrant such intermediate technology.
4. Alfalfa and other soil building crops should be investigated for forage particularly during the hot, dry season.
5. Seed preservation studies. Mississippi State University has been contacted for 30 day consultation on seed preservation. No cost to mission or project.
6. Determine number of wells to be reinforced (cemented) and study other hydrologic problems.

ANNEX D

VEGETABLE PRODUCTION PROJECT - BUDGET ADDITIONS FOR
THIRD YEAR OF CONTRACT TECHNICAL ASSISTANCE AND
RELATED COSTS

<u>ITEM</u>	<u>OPTIONS</u>		
	<u>HIGH</u>	<u>MEDIUM</u>	<u>LOW</u>
<u>I. TECHNICAL ASSISTANCE</u>			
Team Leader (12 mos.)	125,000	125,000	125,000
Hort./Agronomist #1 (12 mos.)	55,000	55,000	55,000
Hort./Agronomist #2 (12 mos.)	90,000	75,000	-
Agricultural Economist (9 mos.)	75,000	-	-
Irrigation Engineer (12 mos.)	95,000	95,000	95,000
Nutritionist (9 mos.)	70,000	-	-
<u>SUBTOTAL</u>	510,000	350,000	275,000
Home Office (1 mos.)	5,000	5,000	5,000
Overhead	335,000	230,000	180,000
Fee	50,000	35,000	25,000
<u>TOTAL</u>	900,000	620,000	485,000
<u>II. PARTICIPANT TRAINING</u>	110,000*	10,000	10,000
<u>III. COMMODITIES</u> (Seed, Fert. Pesticides)	90,000	80,000	70,000
<u>IV. EQUIPMENT</u> (Teaching Aids, Tools, Fenc.)	20,000	15,000	10,000
<u>V. VEHICLES SPARE PARTS</u>	20,000	20,000	20,000
<u>VI. OTHER COSTS</u>			
1. Pol/Maintenance	90,000	90,000	90,000
2. Housing/Maintenance	40,000	40,000	40,000
3. Local Employees	50,000	45,000	40,000
Other Operational Costs			
<u>TOTAL</u>	\$1,320,000	\$920,000	\$765,000

* Includes possibility of 4-years U.S. based training program for Chief of Vegetable Production.