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REPORT ON PROJECT PROPOSAL:

"Niger National Cereals Production Program"

Applied Research Component, prepared by H.B.Sprague, Consultant

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INTRODUCTION:

This report has benefitted from the detailed Prop (preliminary) provided by CWR (9/15/74) which describes the entire project, and outlines the relationship of the applied research component to the other 2 components which are the seed multiplication activity, and the extension, cooperative & credit, and farmer acceptance activity. The following outline of the applied research activity is intended not only to effectively serve the ultimate goal of sharply increased farm production of adapted cereal grains and associated crops, but also to provide direct linkage and support for the other 2 components.

This report has been prepared following several days of consultation with key personnel of the Ministry of Rural Economy concerned with agricultural production, and with Dr. Ralph Cummings who is director of the newly created International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) located at Hyderabad, India. To supplement these conferences, field trips have been made to millet (and sorghum) growing areas to observe the crops, soil conditions, incidence of pests, and farming practices, as follows:

1. From Niamey:

   a. To the Presidential farm on the west bank of the Niger River.
   b. To Kolo on the east bank of the river.
   c. Toward Filingue, as far as Baleyara.

2. From Maradi:

   a. To Tarna, the location of a major IRAT station.
   b. To the nearby Canadian Station for a program on plant protection (entomology, plant pathology).
   c. To the CFJA -- where superior farming is evident.
   d. To the farm center of Mr. Ockers, who has developed significant farm mechanization with donkeys and oxen, as well as developing wells for local irrigation for vegetables and other crops.
   e. Many millet fields of small cultivators in the region.

3. From Zinder:

a. To a Centre de Perfectionnement (a vocational school and farm of 15 ha) about 35 km south.
b. To Guezaoua, about 75 km north, inspecting millet fields, and talking to a few cultivators, enroute. This is a lower rainfall zone.

4. From Malbaza:

a. To Tahoua, and return to Bedeguicheri observing production of millet and other crops in low rainfall zone.
b. To the joint FED and GON station at Bedeguicheri.

5. From Malbaza to Niamey:

Observing crops of millet, sorghum, and cowpeas enroute, and noting soil conditions and the vegetative cover of extensive areas not currently being cropped.

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On the basis of these field observations and discussions with people of experience in the region, this observer noted many signs and clues that indicate important opportunities for increased production of cereal grains, and substantially more effective use of lands and rainfall. Certain practices proposed by IRAT could be implemented promptly with an extension program. Certain selected varieties (types) of millet could be multiplied for wider use by farmers, and some plant protection measures - particularly suppression of striga (a parasite weed on millet and sorghum) may be invoked. However, the most important constraint on crop production in virtually all areas is low soil fertility. Many instances of sharply increased millet plant vigor appear to result from manure deposited by animals held for short periods during herding.

There were widespread plant symptoms of nitrogen and phosphate deficiencies. Groundnuts & cowpeas also exhibited deficiencies in sulphur; and other leaf symptoms suggest deficiencies in calcium, or magnesium, or in one of the trace elements essential for normal growth (boron, zinc, molybdenum, copper, manganese and iron). Since there appears to have been no soil tests for mineral deficiencies, this approach may permit significant benefits at low cost.

Research is needed to determine the value of reinforcing rock phosphate and triple superphosphate with modest amounts of calcium and magnesium sulphate; or with smaller amounts of the trace elements, to make the phosphates more universally effective on many soil types. There has been almost no planned rotation of cereal grains with legumes (groundnuts, cowpeas) to take advantage of their nitrogen fixing power (the residual nitrogen compounds left in the soil may be the equivalent of 200 kg/ha of sulphate ammonia). The common practice of interplanting cowpeas in millet contributes little to crop yield; there is only a small contribution of residual soil nitrogen to benefit the following crop; and the growing of both a cereal and a legume crop on the land each year only succeeds in propagating the pests of both crops every year. A rotation of solid plantings of each crop type on separate fields should improve yields and enhance soil fertility.

There is serious possibility that the traditional method of planting millet in hills of 3 plants each is counter productive, since there is competition between these plants that inhibit maximum growth and root extension of the entire hill.
There is need to test the merits of row plantings, with single seeds planted at 15-20 cm spacing in the row. Such spacing is practiced with groundnuts and cowpeas, but has not been followed for millet.

The foregoing observations are illustrative of opportunities for greater crop productivity, that will be most pronounced in years of average rainfall, but may be crucial in years of deficient rains. The amelioration of soil fertility need not be dependent on nitrogen fertilizers, since legumes may be grown to supply this nutrient. However, it will be important to learn how to best use phosphates and other minerals. The practice should be evaluated, of placing these minerals in bands (in shallow furrows under the intended crop row) with addition of animal manure where feasible, and light covering with soil, on which seed is placed. The interaction of manure and rock phosphate (long understood in temperate zones) should be tested in these tropical soils.

Looking further ahead, serious attention may be given to the handling of "fallow" so that the soil structure and fertility is definitely improved. The present cover of annual grasses and weeds can hardly compensate for soil depletion under continious cropping.

Perennial legumes and grasses adapted to semi-arid conditions should be tested, to note improvement in soil fertility, as well as to provide feed for animal power, and for village livestock on a year-round basis.

The collection of some 250 indigenous millet types by IRAT should be useful in identifying the more productive types. The world collection of millets being assembled by ICRISAT, may also be useful, although the initial testing of 5 short-season types from ICRISAT, grown in 1974 by IRAT, was dissappointing because of their susceptibility to diseases under Niger conditions. Further collections of indigenous types has promise. A valuable plant type that has not been sufficiently evaluated is one in which the millet head is exserted 4 to 5 cm beyond the uppermost leaf. Most millets seen in the field do not have the exserted head, and the infestations of head worms start from eggs laid in the sheath of the upper leaf that clasps the base of the head. Infection of molds and downy mildew are also favored by the present plant type. It is possible that other indigenous types will carry resistance to the stalk borer. The early stages of research should identify types with immediate superiority, and subsequent breeding should combine the desirable traits of 2 or more types.
Adaptive research is proposed to rapidly evaluate the complete package of the plant materials, cultural practices, soil fertility improvement, and pest control; and to measure the net yield increases against the costs of the collective inputs. This package when evaluated, should form the basis for the seed multiplication activity, and for field demonstrations and the extension program designed to encourage prompt adoption by cultivators in the regions selected for concentrated effort by this project. As the research effort continues, the complete package should be improved as additional knowledge flows from the research. The research program should have increasing value as field evaluations are extended from the research center to branch stations in different rainfall zones.

The following outline is intended to provide the organization, staffing, physical facilties and support activities that will enable effective research to be accomplished. At the beginning, considerable reliance must be placed on a few expatriate scientists, supported by Nigeriens as counterparts or assistants. However, as Nigeriens with scientific capability are made available through education and professional experience, they should assume greater responsibility and become leaders of research.

SECTION I - Site or sites of the research effort

A. Requirements for the Research Center

1. Location

a. Located within a major millet growing area.
b. Accessible by improved roads and commercial air.
c. Near a sizeable town or city.
d. Located in the general vicinity of other research programs, such as IRAT, CIDA, etc.; so as to facilitate exchange of information between professionals.

2. Land Areas

a. Approximately 20 ha of typical "millet land" for field plantings under natural rainfall.
b. Five to ten ha of somewhat heavier soil that may be irrigated from local wells by pumping and portable sprinkle system. May be in several parcels if necessary. Such land is required to enable plant breeders and plant protection specialists to grow 2 or more plant generations per year.
c. Five hectares; for residences, office & administrative buildings, conference & training buildings, service bldgs, shop & warehouses, drying floors, vehicle & machinery parking, access road etc.

3. Structures

a. Residences: (This item to be deleted if Central Station is - sited near Niamey)

5 for senior scientists;
Director & plant breeder - 150 sq meters;
1 for Nigerien counterpart, co Director - 150 sq meters;
4 other scientists - 150 sq meters each
1 for Administrative Officer - 130 sq meters
6 for Peace Corps Volunteers - 100 sq meters, each
6 for Nigerien research assistants, married - 100 sq meters each
1 dormitory for unmarried research assistants - 120 sq meters

b. Administrative buildings (Director's Office, Co-Director's Office, small conference room, accounts & records, personnel, general library, etc.) - 145 sq meters

c. Laboratories and senior scientist offices - 5, plus general conference room.

Total area - 480 sq meters (30 x 16 meters)

d. Closed storage - 70 sq meters;
e. Open storage - 140 sq meters;
f. Shops and repair - 70 sq meters;
g. Diesel electric generator building
h. Pump house and elevated storage tank
i. Transient guest house - 6 rooms = 96 sq meters
(delete if Central Station is near Niamey)

B. Branch Stations:

1. Locations: Up to 3 branch stations located in different rainfall zones to supplement general station, and to serve as focal points for the overall project objectives.

a. In important millet growing areas, on representative soils.
b. Accessible by all-weather roads.
c. In the vicinity of a sizeable settlement.
d. If possible, near any other local research or governmental institution serving agriculture.

2. Land Area

10 or more ha. of relatively smooth land, suitable for controlled field trials, as extension of research at the Central Station.

3. Structures

a. Residences:
1 each for Station Manager and Co-Manager
(2) @ 130 sq meters
2 for research assistants @ 100 sq meters each

b. Administrative Building:
Offices, conference & library, clerical, files, accounts etc. = 130 sq meters

c. 1 Laboratory Building - 70 sq meters
d. 1 Storage building with space for grain, seed, small equipment, fertilizers, pesticide chemicals etc. 140 sq meters
e. 1 covered, screened shed for shop, repairs, etc. 140 sq meters
f. Diesel electric generator building
g. Well and pump house and elevated storage tank
h. Parking area for farm equipment, etc.

SECTION II

Personnel for initial 3-year period.

(Senior professional positions to be filled with Nigerien scientists when fully qualified men become available)

A. Fields of: Agricultural Science

1. Plant Breeding. Major emphasis on millet, secondary emphasis on sorghum and cowpeas, to identify and multiply superior types and varieties, that are high yielding, drought resistant, and resistant to pests.

One senior scientist (expatriate)
One Peace Corps Volunteer Aide (Niger)
One Research technician (Nigerien)
Two research assistants (Nigerien)

2. Crop Physiology & Ecology: Soil and water management for rainfall conservation, and efficient use of soil water by crop plants.

One senior scientist (expatriate)
One Peace Corps Volunteer Aide (Niger)
One research technician (Nigerien)
Two research assistants (Nigerien)

Plant Protection - Control of insect pests, plant diseases and nematodes, plant parasitic weeds and other pests

One senior scientist (expatriate)
One Peace Corps Volunteer Aide (Niger)
One research technician (Nigerien)
Two research assistants (Nigerien)

4. Soil Fertility & Management - Identification of soil mineral nutrients deficiencies and effective use of fertilizers and soil amendments; use of legumes to supply total nitrogen needs; use of animal manure. Soil fertility improvement.

One senior scientist (expatriate)
One Peace Corps Volunteer Aide (Niger)
One research technician (Nigerien)
Two research assistants (Nigerien)

5. Agronomy - Farming Systems - Evaluation of cultural practices, tillage methods (including animal power), crop rotations, effective methods of improving soil structure through cropping systems, for different rainfall zones and soil types.

One senior scientist (expatriate)
One Peace Corps Volunteer Aide (Niger)
One research technician (Nigerien)
Two research assistants (Nigerien)

NOTE: a. Research Technician, should be college graduate, or have experience plus 2-3 years of college.
b. Research Assistants, should be graduates of high school as a minimum, and preferably with one or more years of college.

B. Administration Personnel

Director of Research (expatriate)
(Also serves as Plant Breeding Scientist)

Peace Corps Volunteer Aide (Niger)
Co-Director and Administrator (Nigerien)
Engineer Officer - to supervise maintenance, repair and operation of utilities, structures, vehicles, farm machinery and special research facilities (expatriate)

Vehicle Drivers & Assistant Mechanics (Nigerien)

Accounts & Records (Nigerien)

Secretary & Clerical (Nigerien)
Vehicle Drivers, equipment operators, etc., as found necessary.
Seasonal labor from local sources.

C. Branch Stations Personnel (3)

(under direction of Central Station)

For Research:

Manager (ex PCV)
Co-Manager (Nigerien)
Research Assistants 2 (Nigerien)
Assistant Mechanic
Vehicle Driver
Equipment Operator
Seasonal field labor as required

D. Consulting Scientists

Use should be made of selected consultants to supplement the resident scientific staff, in coping with important problems that arise. It is expected that appropriate consultants may be found in other agricultural research organizations including ICRISAT (India), Bambey (Senegal), Samaru (Nigeria), IITA (Ibadan), ORSTOM (France), CIDA (Canada) and USAID/Washington (TA/AGR). The following types of consultants may be enlisted at appropriate times:

1. Entomologists
2. Plant Pathologists
3. Nematologists
4. Weed Control Scientists
5. Soil Survey & Mapping
6. Climatologists
7. Soil Scientists
8. Farm Management Economists
9. Agricultural Engineers:

    a. Water erosion control
    b. Farm machinery & mechanization
    c. Water development & irrigation systems

10. Geneticists & Plant Breeders
11. Botanists
12. Statisticians - experimental design and data processing

SECTION III - Plan for Providing Total Personnel Requirements

A. Funding

USAID may prefer to budget the entire costs. Or CIDA, FAC, and other agencies may be invited to participate.

A reduction in number of expatriate senior scientists (plus an engineer officer) is undesirable since this would result in neglect of certain scientific fields that are essential to a balanced treatment of all contributing constraints on production. A minimum of 5 senior scientists, supplemented by consultants should constitute a balanced team.

B. Recruitement of Expatriates

A feasible method would be to contract with a selected University or some other research agency to provide qualified senior scientists for a specified period. The minimum qualifications for appointees should be established. The University or other research agency probably would provide scientists on 2-year appointments, and these scientists would retain retirement and fringe benefits at the contracting institution.

The possibility of enlisting the cooperation of CIDA, FAC, FED, etc., in providing one or two senior scientists is worthy of consideration. FED might be willing to participate in providing one or more expatriate senior scientists. Qualified scientists who are multilingual and well trained, would be particularly effective contributors to the scientific team's efforts.

C. Enlistment of Peace Corps Volunteers

There is a large body of men who have completed 2 years of service in Niger. They are fluent in French and some speak Hausa. They are knowledgeable as to the people and their customs. They have had sufficient Nigerien experience to be effective in counseling Nigerien personnel on this project, serving in the capacity of Aides to the senior scientists. Their fluency in French will be valuable to the scientists who must concentrate their efforts on scientific matters and will need assistance with the French language. There should be no difficulty in recruiting selected ex PCV for 2-year periods.

Current Peace Corps Volunteers in their second year of service would be acceptable as Aides to some of the expatriate scientists. Funding for these would be provided by the Peace Corps.

D. Research Technicians - Nigerien

The Government of Niger should accept the responsibility of locating 5 research technicians who are college graduates, or who have had 2 to 3 years of college plus some experience on agricultural programs. If possible, some returning US participant trainees should be assigned to the project. Technicians assigned by GON should be committed for at least 2 years, to permit development of technical proficiency. It is suggested that participant trainees returning from the US would not only be most useful to the project, but such service would also advance them professionally.

The reward for effective performance as a research technician for one or more years should include a promotion in grade and adjustment in salary.

E. Research Assistants - Nigerien

These youths should have completed secondary schooling as a minimum for such appointments; and preferably should have completed one or more years of college level education. Appointments should be made for a minimum of 2 years. Satisfactory performance of assigned duties for more than one year should be rewarded by a salary adjustment. Each assistant should be under the direction of a specific senior scientist.

F. Administrative & Support Personnel

(1) Co-Director and Administrator (Nigerien)
This position should be filled by an experienced Nigerien, who has served in responsible positions concerned directly with agricultural programs. His duties will include responsibility for supervising the actions required to implement the director's decisions, so that the research functions of this program may be performed smoothly and promptly. He will also supervise keeping of records & accounts, and personnel management, and other administrative duties specified by the Director.

(2) Engineer Officer - probably expatriate
This officer should have the responsibility for supervising all maintenance, repair & operation of utilities, structures, vehicles, farm equipment & machinery and special research equipment, both at the Central Station and the Branch Stations. He will be responsible for training of Nigerien drivers, mechanics and utility service personnel, and for monitoring their technical performance.

Assistance may well be sought from FED, CIDA, and UNDP-FAO in recruiting a qualified engineering officer. Appointment should be made for a 2-year period, following a 3 month trial period.

(3) Drivers, mechanics, and other semi-skilled employees, may be recruited from graduates of vocational and technical training schools, who have acquired additional experience. The GON may provide a roster of these schools, and the types of trainees produced.

G. Branch Station Personnel

For the initial 2 years of development and operation of each station, it is proposed that the Manager be an ex PCV (Niger), and that the Co-Manager be Nigerien. It is hoped that the initial manager will be replaced by a Nigerien after 2 years.

There should be 2 research assistants to implement the research directed from the Central Station.

The ex Peace Corps Volunteer should be sufficiently mature to meet this responsibility, and have had some agricultural education so as to fully understand the experimental work.

The Co-Manager (Nigerien) should have completed secondary education and have had responsible assignments in agricultural programs. Additional training at the college level would be desirable.

The 2 Research Assistants (Nigerien) should have the qualifications cited in item E. of this section. The GON should be solicited for help in locating qualified candidates for these positions.

Drivers, equipment operators, and a mechanic should be Nigerien, recruited with assistance from the GON. Ability to function at such remote stations is a prime requirement.

SECTION IV - Training Needs of Nigerien Personnel

A. In-Service Training

Initially, it is proposed that all Nigerien personnel assigned to this research program be placed on an in-service training status. All professional staff should set aside time for such training, and participate personally in training to ensure that each man on his project becomes well informed and competent in performing his functions. Training will constitute direct support of this project, which is designed to ultimately enhance farmer effectiveness in producing food crops. It is suggested that 4 hours per week be devoted to such training. The training program should begin as soon as the necessary facilities become available.

B. Participant Training

Such training may be handled as an integral part of this program, but it may be more easily handled as a collateral but separate activity. The initial goal of such training should be to train Nigeriens so that they may replace expatriates. However, the research assistants specified in this research plan will probably not be fully qualified, and training for these positions also is needed.

(1) Training to the M.S. and Phd levels

For the PhD level, training will ultimately be required for senior scientist positions. Initially, the interim M.S. level may have to suffice for some positions. The ideal situation would be to select participant trainees from the current research staff, but it seems unlikely that Nigerien staff in the initial stages of project development will be qualified for admission to US graduate programs. Therefore, it is suggested that GON select qualified candidates from any source, and nominate them for participant training in the major agricultural science fields represented in the research plan.

The appointees should make a firm committment for assignment to this research program upon return to Niger. Such participant training may be 2 stages; stage 1 to the M.S. level, and stage 2 to the PhD level, with at least one intervening year of service in Niger. Consideration may be given to participant training opportunities at ICRISAT (India) as well as in universities of developed countries. Mr. Adamou is currently a US participant trainee in plant breeding and Mr. Kassa is a participant trainee in soil science.

(2) Training to the B.S. level

A considerably larger number of Nigeriens educated to the B.S. le agricultural sciences will be needed than those with advanced de US participant training or training at American University - Beirut a feasible solution pending the time when the Niger University g enlarges its baccalaureate program in agriculture. There are only students enrolled for the B.S. in agriculture in Niger at present. the Nigerien economy is more than 90% agricultural, education in t field is a prime requirement for sustained agricultural development. survey of positions in Niger that should be filled with agricultural college graduates, in comparison with qualified men now available, provide an index to such training needs.

C. Sub professional agricultural training

Many countries in the past, and currently, are meeting the need trained men either by including vocational agriculture in the last 2 yea of secondary schools, or by establishing a series of special 2 year v tional schools to teach the elements of modern agriculture. It is obv that such training must be done within Niger, to have it properly orien to national problems, and to train the large number of men needed by the nation. The implementation of virtually all types of agricultural progra would be tremendously assisted by a sustained flow of graduates from s schools. An intensive program for such education is much needed.

SECTION V - First Year Research Program

1. Recruit the research staff - senior scientists, research technicians and research assistants, for the Central Station.
2. Recruit ex PCV's for the Central Station and one Branch Station.
3. Recruit Administrative and Support Personnel.
4. Determine the highest priorities for vehicles, tractors, farm machinery and equipment, and place orders for earliest feasible delivery.
5. Plan, design and construct the structures and facilities for the Central Research Station and the first (of 3) Branch Stations.

6. Establish the basic layout of the research farm on the upland area, for cropping under natural rainfall. Make preliminary allocations of land to different research divisions.

7. Field Research Activities

a. Select the most promising components of a complete package of superior production practices of millet, for sorghum, and cowpeas, in the light of research findings by IRAT and other agencies. Make a careful field evaluation of each package, and estimate the increased yields above those of traditional practices, and the costs of the necessary inputs for the complete package.

b. Make supplemental field trials of variations in the components of the selected package, to identify possible improvements in the package for 1976.

(1) Evaluate various promising strains of each crop as may be available from IRAT, Bambey, Samaru, ICRISAT, and elsewhere.

(2) Evaluate various fertilizers and fertilization practices, in the light of chemical soil tests to indicate nutrient deficiencies.

(3) Test alternate methods of land preparation to conserve rainfall and establish seedlings.

(4) Test the effect of spaced plants in rows, versus traditional hill plantings.

(5) Evaluate various control methods for headworms, stalk borers, molds and downy mildew, and striga weed, and the increased yields following successful controls.

(6) Evaluate different planting dates for crop types with short, medium and longer life periods, in relation to incidence of early rains.

c. Plant yield trials of all promising strains and the available indigenous types of millet, sorghum and cowpeas that have been recommended by IRAT, Bambey, Samaru, and ICRISAT. Make notes on crop performance and plant characteristics in conjunction with incidence of rains.

d. Undertake a comprehensive collection of indigenous strains and types of millet grown by farmers in rainfall zones of 300 to 700 mm. All scientists should participate in collection of seed, as other work permits, as a means of acquiring intimate knowledge of the major cereal growing regions, observing plant characteristics, and the traditional production practices.

8. Undertake development of the land reserved for irrigation and production of crops during the dry season. Dig the necessary wells, install pumps, and acquire portable pipe and sprinklers for irrigation. Begin the growing of identified varieties and types of millet (and sorghum and cowpeas), as well as new collections made in 1975.

9. Determine the more urgent office and laboratory equipment needs, and place orders for delivery by the date the structures will be available.

10. Branch Stations Follow a similar sequence as for the Central Station, on the scale appropriate to the dimensions of the Branch Station and its research functions: as follows:

a. Recruit personnel.
b. Determine needs for vehicles, tractors, farm machinery and equipment and place orders for earliest feasible delivery
c. Design and construct the building and all facilities for the Branch Station.
d. Layout the research fields for assignment of experiments to specified areas, for long term use. Fencing, field markers, service roads.
e. Establish field trials of a selected package of production practices, based on research results from IRAT and other agencies.
f. Make supplemental trials of variations in the component of the package, with a view to improving it for 1976.
g. Participate in the collection of indigenous types of millet in regions surrounding the Branch Station.
h. Make survey of actual yields in farmer's fields, with observations on production practices, and occurrence of rains. Report basic data on production costs, for analysis at the Central Station.

Tentative list of Equipment, Vehicles & Machinery

CENTRAL STATION

Diesel engine & electric generator
Well, pump & elevated storage tank

Vehicles

6 Toyota Land Cruisers - 4-wheel drive, airconditioned
2 Pick-Up Trucks - 4-wheel drive, airconditioned
1 Larger flat bed truck - 4-wheel drive, airconditioned

Field Equipment & Machinery

Medium size tractors -2	*	Furrowing machine (lister)
Tow carts -2	*	Row cultivator
Moldboard plow	*	Groundnut lifter (digger)
Double disk - medium size	*	Threshers
Offset disk medium size	*	Seed cleaner
Spike tooth harrow	*	Power sprayer
5-foot sickle-bar	*	Donkey - power field machines (Mr. Ockers)
Rotary mower (1 meter diam)	*	
Fertilizer spreader	*	Platform scales
Planter, with fertilizer attach.	*	Spring scales

* * * * * * * * * * *

Shop equipment & tools - mechanical, electric, welding & forge:

Hand Tools *

Back-pack sprayer	*	Back-pack duster
Single-bit axes	*	Hand axes
Round pointed shovels	*	Square pointed shovels
Flat spades	*	Mattocks
Claw hammers	*	Sledge
Saws, crosscut	*	Garden hoses
Garden rakes	*	Watering hose
Picks	*	Garden planters
Spading fork (root studies)	*	Rotary seed treater
Pitchforks, 4-tine	*	Hand sickles & machetes

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Weather Instruments

Rain guage, max-min thermometer, recording thermometer, anemometer

General Equipment for Laboratories

Refrigerators - Dissecting microscopes - compound microscopes
Chemical balances - Spring scales - Glassware for chemistry
Drying ovens - Water distilling unit

Add special equipment for each of 5 types of laboratories.

SECTION VI - Basic Research Needs for Other Crops to be Included

Millet should receive about 70% of the total research effort, including related soil fertility and farming system aspects. The remaining effort should be allocated to sorghum, cowpeas and possibly sesame, and to the management of "fallow" lands. Cowpeas and groundnuts, which are legumes important for restoring soil nitrogen, must be studied as part of a more productive farming system. However, cowpeas should be treated as a potentially important cash crop, which provides an alternative to groundnuts whenever the latter is unsuited to the soil or the rainfall. Sorghum is traditionally grown at present on areas with heavier soils that have more sustained water supplying capability that "millet soils".

a. Sorghum Short-season types with short stalks and a high ratio of grain to stalk and leaf should be sought. Field evaluations in several rainfall zones should be made of early types from Samaru, Bambey, ICRISAT and elsewhere. The grain yielding ability of such sorghum in comparison with millet should be determined under recorded conditions of soil fertility and rainfall.

b. Cowpeas (Niebe) There is evidence that millet (and probably sorghum) should be rotated with solid plantings of a grain legume. Cowpeas are the preferred choice, where groundnuts are not adapted. Such legumes are needed to contribute residual soil nitrogen to the following cereal grain, to reduce the incidence of striga weed, and to reduce the hazards of root nematode invasions and injury to the cereal crop. However, the cowpea crop must be made as profitable as millet, to be accepted by growers. Market prices for cowpeas are several fold greater than for millet, so that the merits of cowpeas should be based on relative cash values for the 2 crop types rather than on weights of crop produced. High yielding varieties of cowpeas are needed, and this requires adaptation to various rainfall zones. Effective cultural practices and the most appropriate use of phosphate and other fertilizers will be essential to profitable yields.

Initially, tests should be made of all promising short-season varieties capable of maturing with limited rainfall, in several rainfall zones, on representative soils when soil mineral deficiencies have been corrected by fertilization.

c. Sesame, an oil seed crop widely grown for food and a cash crop in the tropics, should be tested to determine its yielding capacity and cash value on soils generally planted to sorghum. It appears to be adapted to semi-arid and subhumid regions (Sudan grows great amounts of sesame). There are early varieties of sesame; and non-shattering strains have been developed in the US, that should be evaluated in Niger. Research on sesame is now being undertaken in Sudan and India.

Arrangements should be made to import seed of representative types from the US collection at the University of California (Dr. Yermanos) for field trials. Sesame would add diversity to the cropping system, it does not suffer from the parasitic weed-striga, and it is not susceptible to other pests of millet and sorghum. Sesame might serve as an alternate crop to millet & sorghum.

d. Fallow lands Impoverished arable land is frequently "rested" by allowing growth of annual grasses and weeds for 2 or more years, with the expectation that the land's crop producing ability will be restored. This practice has very doubtful value in soil restoration; and fallow lands provide scanty and very low quality forage for livestock. On the basis of results in other semi-arid regions (Australia) it appears possible to make plantings of adapted perennial desert grasses and drought tolerant legumes on lands diverted to fallow, with the prospect of notably increasing soil structure and water storing capacity, and of accumulating sufficient residual soil nitrogen to support 2 or 3 succeeding crops of millet or sorghum. The most promising perennials are buffel grass, love grass and stylosanthes legume. Such forage species would provide rather abudant feed for livestock (village herds and working stock), of a greatly improved nutritive value.

Experiments should be initiated to evaluate the merits of such types of "fallow", not only for its benefits to the following grain crops, but also as direct contribution to farmers incomes. Such research should be a component of studies on improved farming systems.

SECTION VII - Coordination of this research effort with other Agencies

GON has created INRAN as the instrument for coordinating all agricultural research in Niger, including research supported by external agencies. Presumably, that coordination will provide a mechanism for facilitating consultation between the administrators and scientists of this project with those of the IRAT stations, the CIDA plant protection project, the research activities of UNDP-FAO and the FED program (which is primarily extension rather than research). ICRISAT through its Director, Dr.Ralph - Cummings, has initiated discussions on methods for exchange of promising plant materials, information on research findings, and conferences between scientists at ICRISAT and at Bambey (Senegal) and Samaru (Nigeria).

Since this AID sponsored research program will come under the responsibility of INRAN, the AID grant should detail the privileges this research team should have in consulting and cooperating with other research agencies with similar interests.

One of the most effective methods of coordinating research efforts to expedite significant progress, is by authorizing the use of selected specialists from other agencies as "Consultants". The costs of enlisting such consultants is included in the AID proposed budget. The reciprocal procedure of sending scientists from this Niger Cereals Production Program to ICRISAT, IITA, Bambey, Samaru, etc., for conferences may need to be specially authorized under the terms of this grant.

Some specific aspects of cooperation to be offered under this research program follow:

a. The improved varieties of millet, sorghum, and cowpeas that either are verified as being superior for Niger, or are newly developed, should be multiplied initially as "Breeders Seed" ; and delivered to the "Seed Multiplication Service" of this program for further multiplication, and then made available to farmers through the Extension Service & Cooperatives. Such Breeders Seeds should also be made available to other research agencies, such as those cited above.

b. The research staff of this program should prepare an annual summary of research results, and the latest revised package of improved crop varieties and cultural practices, probably by January of each year. This should be delivered promptly to the Extension Service and other agencies concerned with agricultural production, within the geographic area where this program effort will be concentrated. Such a summary report would permit Mobilization of Activities to support production efforts, well in advance of the planting season.

c. ICRISAT has proposed to post a Field Trials Officer in the Sahel Region to provide continuing liaison between research and extension and to assist in conducting field demonstrations on selected farms in areas where research results are believed to be applicable. The ICRISAT Field Trials Officer also would provide a convenient medium for transfer of new materials and practices between countries.

d. Yearly invitations should be issued by the Director of this research program, to key personnel of other agencies in Niger concerned with agricultural development ,to participate in a field day at the Central Research Station, to view field experiments and engage in discussions on their significance. This would be most useful during the period just before harvest. Other visitations by smaller groups should be welcomed, upon advance notice. Extension agents should be encouraged to attend.

e. A yearly seminar helding during the dry season, probably in January when the annual summary is issued, should be held for the benefit of all responsible personnel engaged in various aspects of cereal production in Niger. At the seminar, the results of the previous growing season should be reviewed, together with an interpretation of their significance for production in the year ahead.

SECTION VIII - Plans for transmittal of information from this research program to extension units for their dissemination to cultivators

The relationship between research and extension should be regarded as one of mutual interchange of information. Research should report on improved varieties, the need for specific inputs, and on practices that will increase production. Extension should report to research on ther evaluation of constraints affecting production, and certain types of research that might be helpful. The components of such a plan may include:

a. Field Trials Officer from ICRISAT

(See item C of the foregoing section). Similar GON officers should provide liaison between research and extension, as a function of the extension program.

b. Farmer Demonstration Plots. These should be sited by the extension service, with research counsel, to illustrate under representative conditions, the benefits resulting from using superior varieties in conjunction with a package of the improved inputs and practices. The research team should make recommendations on the basis of field trials, but the extension service should assume full responsibility for farm demonstrations.

c. The annual published report of the research unit, should be presented in a form useful to extension, indicating the estimated potentials for increasing crop production. It is obvious that the lessons illustrated in farm plots will change yearly, as new research results are achieved.

d. The plant breeders of the Central Research Station should increase;

Breeders Seed of all recommended varieties, and deliver this seed to the Seed Multiplication Unit for further increase, so that farmers may gain access to superior varieties through the Extension Service.

e. The Extension Service should be invited to report to the Research Center, the apparent results achieved by growers from using the package of superior varieties and improved cultural practices. The Extension Service should also be alert to significant constraints on production experienced by cultivators, and be willing to contribute ideas on appropriate research believed to be useful.