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VOLUME III

UNCLASSIFIED

PROJECT PAPER

ENVIRONMENTAL ANNEX

NIGER

NIAMEY DEPARTMENT

DEVELOPMENT PROJECT

PHASE II

683-0240

**USAID/NIGER**

**AGENCY FOR INTERNATIONAL DEVELOPMENT**

UNCLASSIFIED

**ANNEX A**

INITIAL ENVIRONMENTAL EXAMINATION

Project Country: NIGER

Project Title: Niamey Department Development - Phase II (683-0240)

Funding: $11,300,000 (FY 81 - FY 85)

Life of Project: 5 years beginning in FY 1981 through FY 1985

IEE Prepared by: Mark Wentling, Project Officer/USAID/Niger, [illegible]

Environmental Action Recommended: a) An Environmental Assessment of Pesticide Usage by the project.

b) Negative Determination of all other project activities.

Concurrence: [illegible] DATE: 26 May 1981

Jay P. Johnson
Mission Director
USAID/Niger

BUREAU ENVIRONMENTAL OFFICER'S DECISION:

James Hester, AFR/DR/SDP Approved James S. Hester

Disapproved _____

Date 11 February 81

Clearance:
GC/AFR:EDragon, [illegible]

## I. - Description of Project:

This project is the second phase of a long range program of rural development in the Department of Niamey, a region which was severely affected by the 1968-74 Sahel drought. It is one of seven departemental rural development projects initiated by the GON since 1974. The project is designed to continue the pursuit of the development activities initiated during Phase I. Major emphasis will be given to institutionalizing at the village level organizations capable of obtaining and providing on a timely basis the agricultural inputs and credit required to increase crop production.

This concentration on crop production will involve the continued reinforcement of: the 41 village cooperative associations (201 villages) created under Phase I and the creation of 17 new associations (99 villages); the agricultural extension services and the young farmer couple training centers; the National Cooperative Service (UNCC) network and its farm implement production centers (DARMA); and the National Agricultural Bank (CNCA). Also the project components aimed at an integrated development program which were initiated during Phase I will be continued and new efforts will be undertaken to extend them more efficiently and effectively to a greater number of people. These components include the following activities: soil conservation/tree planting; facilitating the vaccination of farm livestock; on-farm fattening programs; literacy classes; radio clubs; grinding mills; and school gardens. All these activities will involve the retraining of existing village agents and the training and equipping of many new village agents. This will include the training of village blacksmiths, coop managers and leaders, farmer demonstrators and farm couples leadership training.

Project implementation will continue to be coordinated by the management unit created under Phase I. This management unit coordinates project activities with the existing GON service agencies and is under the authority of the Prefet of the Department of Niamey. All major planning and budget documents must be approved by the Niamey Department's Development Committee (COTEDEP) which is composed of representatives of all the GON departmental agencies, the district development committees (COTEARS) and important traditional Chiefs. The Ministry of Rural Development has direct responsibility for this project and the Ministry of Plan monitors project progress and the project's financial operations.

## II. - Examination of Nature, Scope and Magnitude of Environmental Impacts:

(In terms of items on the attached Impact Identifiection and Evaluation Form)

### A. Land Use

It can reasonably be expected that some significant positive effects on soil fertility will occur in those fields where farmers have adopted the improved agricultural production package being promoted by the project. These effects will primarily be due to the application of super triple phosphate (STP) and urea fertilizers. The current annual recommended application rates of these essential components of the project's improved production package are as follows: Millet - 34 kgs STP per hectare and 50 kgs urea per hectare; cowpease - 34 kgs STP per hectare.

A major objective of the project is to have the improved agricultural production package used by at least ten percent of the farms in the project zone by the final year of project implementation (1985). If 10% of the farms adopt the recommended practices by the end of this project, approximatel 1200 tons of urea and 1224 tons of STP would be applied on 36,000 hectares at the above mentioned application rates in 1985. The estimated area receiving the recommended application of fertilizers represents less than 2% of the total arable land of the project zone.

After serious consideration of the following five factors, it was concluded that the above described fertilizer application rates will not have detrimental environmental effects.

1) The limited extent and low rate of planned fertilizer application;

2) The positive impact this fertilizer application will have on soil fertility in the project zone and thus increase crop production;

3) The rapid absorption of fertilizer into the predominately sandy soils of the project zone.

4) The small quantity of rainfall which percolates into Niger's subsoil; and,

5) The absence of major bodies of water in the project zone into which fertilizers would wash. (The project zone is defined as excluding the channel of the River Niger and an area of 5 kilometers extending on either side of the channel).

Soil fertility will also be enhanced by the reduction of soil erosion in those areas where the project will carry out its soil conservation activities. These activities include primarily the planting of village tree lots, and protective windbreak belts. It is estimated that 300,000 trees will be planted during the five year phase of this project.

B. Water Quality

There will not be any significant alteration or periodicity of flow storage, location or quality of water.

C. Atmospheric

There will not be any significant changes in air quality.

D. Natural Resources

There will not be any significant changes to either the rates of use or the stocks of non-renewable natural resources. For reasons mentioned under A above, this project will contribute to increasing the standing mass of vegetation through improved crop production practices and soil conservation activities.

E. Cultural

This project will not result in any significant alterations of physical symbols or dilutions of cultural traditions. It is expected that such project activities as local language literacy instruction could have the positive effect of maintaining interest in cultural traditions.

F. Socio-Economic

The goal of the project is to raise rural incomes and to improve rural standards of living. The achievement of this goal will certainly lead to improvements in the socio-economic conditions of the population. It is expected that these improvements will have the positive effect of reducing the number of people who migrate out of the zone each year in search of employment.

G. Health

The health of the population will be enhanced by the improvements in nutrition which will result from increased food supply levels.

H. General

The project will not create changes which may become national or international controversies.

I. The Possible Impact from the Use of Pesticides in the Project Zone.

1. Pesticide Use in the Project Zone

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The use of pesticides in Niger is the responsibility of the National Plant Protection Office (Office National de Protection Vegetale). This office is under the direction of the Ministry of Rural Development's Agricultural Service. It receives considerable technical and financial assistance from Canada and from West Germany. This office is responsible for the supervision of the use of pesticides used in Niger, monitoring the effect of pesticide use and assisting the GON with the development of an integrated crop pest management program. The AID supported CILSS integrated pest management project is assisting this office develop such a pest management program.

A major function of the National Plant Protection Office is to control serious insect attacks which threaten to cause heavy losses of food crops. When an insect attack occurs, this office mobilizes resources available to eliminate or reduce the crop damage caused by the invading pest. In localized attacks, portable sprayers or dusters are used to combat the infestation; in the case of larger more generalized attacks aerial application is employed.

Crop protection activities of this nature usually take place at the request of the district or departmental officials, acting on information provided by extension agents, village chiefs or concerned farmers. Given the urgent nature of these attacks and that the lines of communications are within the Agriculture Service, the NDD project does not become involved in the treatment of such attacks. Although no AID funds are used to purchase pesticides in support of this crop protection activity, funds from the Nigerien contribution to the project will be employed occasionally to finance the cost of pesticide use.

In addition to the use of pesticides for controlling serious insect attacks, the majority of farmers in the project zone routinely protect seeds with fungicide applications. THIORAL is the most commonly used fungicide with the usual application rate being about 25 grams per 10-15 kilograms of seed. The Nigerien Agriculture Service reports that it sold approximately 250.000 - 25 gram packets of THIORAL (6.3 metric tons) in the Niamey Department in 1977. THIORAL is also available on the local market for about 15 cents per 25 gram packet and it is thought that the actual use rate is considerably higher than reflected in the Agricultural Services' report of direct sales to farmers. Use in the project zone (about half of the Niamey Department is estimated in 1977 to be at about 125,000 packets or slightly above 3 metric tons. Such a utilization rate would indicate about 8-9 grams applied per cultivated hectare in the project zone.

Lastly cowpea production has been rapidly increasing in general for Niger and also within the project zone. Cowpeas tend to be more susceptable to insect infestation both while growing and when harvested

than either millet or sorghum. Cowpeas are usually treated with LINDANE or FENITHROTION as a growing crop and with PHOSTOXIN for post harvest storage. Farmers in order to realize benefits from growing cowpeas will most likely increase purchases of pesticides for application on crops. UNCC and others involved in the marketing and storage of cowpeas will also need to increase use of pesticides to safeguard the crop in storage.

2. Description of Estimated Pesticide Use Directly Within the Framework of the Project.

a) Farm Couple Training Centers (CPTs)

During Phase I three CPTs were created and the establishment of seven more such centers is planned during this second phase project. Each of these centers is located on a forty hectare tract of land. The GON contribution to the project will finance through and under the supervision and direction of National Plant Protection Office, the stocking of certain quantities of pesticides and the procurement of portable sprayers, dusters and protection safety equipment for these ten centers. The stocks of pesticides will be used to treat insect attacks on the center's fields, for seed protection and to train participating farmers in the proper use and application of these pesticides. For the five year life of the project, it is estimated that the maintenance of such stocks will probably mean at the very most the procurement of the following quantities of insecticides:

- FENITHROTION (simethyl triophosphate, also known as sumithion or folithion) 400 liters;
- Cancelled. → HCH (25% BHC powder) 12 tons;
- THIORAL (thiram plus heptachlor) 300 kilograms.

Both HCH and THIORAL are inexpensive and readily available to the farmer on the open market.

FENITHROTION is applied by a portable, motorized backpack type sprayer on growing millet and cowpeas in the case of serious insect attacks at the rate of one quarter liter per hectare. In the case of millet, this provides protection primarily for a complex of grasshopper pests and for cowpease provides protection from a complex of stem borers and aphids. Risks to the user are minimized by wearing of a respirator, rubber gloves, boots and aprons. All users will have completed training courses given by the National Plant Protection Office.

In addition to FENITHROTION, HCH is also used on standing millet for the control of grasshoppers at the rate of 1-10 kilograms per hectare. Application will be through the use of gasoline powered, backcarried dusters. Users will be provided with all the requisite equipment and trained as in the case of the use of FENITHROTION.

THIORAL will be used as a dye-marked fungicide to protect seeds at the rate of 25 grams per ten kilograms of seed. Application is by shaking seed and fungicide together in a sack. This procedure is an essential part of the technical package to be promoted by the project.

Treatment of insect attacks in millet is unpredictable. Little treatment has been required during the last two crop years. It is thought that this is due largely to the widespread aerial spraying which Niger undertook in 1978. Crop research has indicated that for cowpeas, one or two treatments per crop cycle is required to avoid substantial crop losses.

The selection of the above insecticides is based on several years experience by the National Plant Protection Office. It considers these pesticides very efficient and that their usage is almost obligatory if food self-sufficiency in Niger is to be realized. Their use to date indicates no significant environmental impact and no significant effects are anticipated on non-target species. It was noted during Phase I of the project that the greatest hazard of the use of these pesticides was to the applicator. This observation prompted the project to purchase protective equipment and materials for use by the Agriculture Service personnel. Providing such equipoment and training in pesticide application will be a standard practice of the second phase of the Niamey Department Development project.

b) Extension Program

Part of the GON contribution to the project will finance the same three pesticides noted above under the project's farmer credit program. Again these pesticides will be acquired through the National Plant Protection Office. Only farmers who have received training in the use of these pesticides will be eligible for pesticide loans. Such loans will only be made to those farmers whose local cooperative has the proper application equipment.

The targeted number of farmers to benefit directly from the Phase II project is 6,000. It is estimated that the maximum amounts of pesticides to be financed by the GON contributed credit fund over the five year life of project are as follows:

FENITHROTION - 8,300 liters to treat approximately 33,500 hectares of cowpeas

BHC HCH - 200 tons on an estimated 17000 hectares of millet

THIORAL - 2.5 tons treating sufficient seed to plant 67,000 hectares of millet and 33,500 hectares of cowpeas.

3. USEPA Registration Status and Toxicological Hazards

a. Fenithrotion: The National Plant Protection Office reports that this pesticide has a very low toxicity level and that the acute oral LD level is 500 milligrams per kilogram. It is believed that this pesticide is currently registered without restriction by USEPA.

BHC

b. HCH (wettable25% BHC powder active ingredients: hexachlore cyclohexane) BHC was registered for seed treatment on sorghum (same or similar use as millet) but has received voluntary cancellation of re-registration on all crops based on oncoginicity, fetotoxicity and reproductive effects in mice and rats. Acute oral toxicity is dependent on the amounts of various isomers present. Most are with low acute toxicity but some with high chronic toxicity. Current USEPA status indicates that a notice of rebuttable presumption against registration (RPAR) has to be issued.

cancelled for armyworms

c. Thioral (Thiram plus heptachlor): Thiram is registered for use on sorghum and millet. On the basis of teratogenicity this material has been accepted for intensive scientific review under the rebuttable presumption against registration or continued registration (RPAR) program. The acute oral toxicity of this material to mammals is in the 385-865 mg/kg range, placing it in a moderate to low classification of acute toxicity.

Heptachlor is registered for use as seed treatment on sorghum (same or similar use as millet). Registration on sorghum will be effectively cancelled or denied on July 1, 1983. Nature of intent to cancel is based on oncogenicity and reduction in non-target species.

4. Evaluation and Recommendation for Each of the Three Pesticides

a. Fenithrotion: In view of the USEPA registration status for this pesticide, the low rate of its application and the application precautions and controls taken, the use of the pesticide is recommended.

b. HCH (BHC): BHC has been used extensively in Niger and many other parts of Africa with no indication of adverse environmental impact. It is a pesticide with which most Nigerien farmers are familiar. It is used on products which are not immediately intended for consumption. The application rates of 1-10 kg per hectare on immature plants is relatively low. In view of the difficulties in assessing the chronic toxicity of technical grade BHC the greatest risk will be to the applicators. Given that the project plans to overcome this risk by the use of protective clothing, the controls placed on this product by the National Plant Protection Office and the above, it is recommended that this pesticide be used but in view of the USEPA regulatory status of BHC, it is also recommended that research be undertaken to find alternative pesticides.

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c. Thioral (Thiram plus heptachlor): This material is used in extremely low dosages. It is used on products not intended for consumption. Its use to date indicates no significant environmental impact and no significant effects are anticipated against non-target species. Thus it is apparent that the only potential risk is to the applicator. This risk is greatly reduced by the use of proper seed treatment methods. Given the above and the current unrestricted registration status of thiram and heptachlor it is recommended that their use be continued. However, with respect to the pre-RPAR status of thiram and the effective cancellation of heptachlor in 1983, it is also recommended that research be encouraged to find alternative materials for seed treatment. ?

References:

1. "Discussion of Import of Pesticide Usage in the Niger Cereals Project", George A. Schaefers, PhD, NYS Agricultural Experimental Station, Geneva, NY 14456, August 4,1978.

2. "Report on Mission to USAID/Niger", by Dr. Rale G. Bottrell, UC/AID Pest Management and Related Environmental Protection Project, October 7, 1979.

3. Agriculturel Sector Assessment, "Plant Protection - The Use of Pesticides", Section C, pps. 25-30, USAID/Niger, January 1980.

III. Recommended Environmental Action

It is estimated that the elimination of pesticide use in the project zone would reduce production by at least 25% (other estimates are as high as 50%). Such a decrease would be devastating to the nutrional well being of the inhabitants of the project zone.

It is clear that the GON must continue using pesticides at least in the short term future, to avoid such devastating consequences. It is also clear that the GON is continuing attempts to reduce potential hazards of the pestcide use as evidenced by its acceptance of Canadian and German assistance to the National Plant Protection Office (which decides GON pesticide policy), GON participation in the CILSS Integrated Pest Management Project, and its support of the USAID-Canadian financed OPG, Tapis Vert (an experimental project which focuses on increasing production without the use of chemical additives).

Thus it is recommended that:

a. A Negative determination be made for this project for all project activities except the financing and the use of pesticides.

b. Given the pesticides currently being used in Niger, the probability of their continued use over the next three to five years and their USEPA registration status, it is recommended that an environmental assessment be made.

It is suggested that this Environmental Assessment be carried out at the same time as the PP design to insure that the project includes the appropriate actions and funding to minimize user hazards and any possible detrimental environment effect identified during the course of the Environmental Assessment.

Given the nature of the other project activities it is recommended that the Environmental Assessment be limited to the issue of pesticides.

B. Identification and Evaluation of Environmental Impacts

Impact Agreas and Sub-Areas

a. LAND USE

1. Changing the character of the land through:

a. Increasing the population. . . . . .N

b. Extracting natural resources. . . . . N

c. Land clearing. . . . . .N

d. Changing soil character. . . . . .L+

2. Altering natural defenses. . . . . .N

3. Foreclosing important uses. . . . . N

4. Jeopardizing man or his works. . . . . .N

b. WATER QUALITY

1. Physical state of water. . . . . .N

2. Chemical and biological states. . . . . N

3. Ecological balance. . . . . N

c. ATMOSPHERIC

1. Air additives. . . . . .N

2. Air pollution. . . . . .N

3. Noise pollution. . . . . .N

d. NATURAL RESOURCES

1. Diversion, altered use of water. . . . . .N

2. Irreversible, inefficient commitments. . . . . .N

e. CULTURAL

1. Altering physical symbols. . . . . .N

2. Dilution of cultural traditions. . . . . .N

f. SOCIOECONOMIC

1. Changes in economic/employment patterns. . . . .L

2. Changes in population. . . . . .N

3. Changes in cultural patterns. . . . . N

g. HEALTH

1. Changing a natural environment. . . . . .N

2. Eliminating an ecosystem element. . . . . .N

h. GENERAL

1. International impacts. . . . . N

2. Controversial impacts. . . . . N

3. Larger program impacts. . . . . .N

4. Other factors. . . . . .

**LEGEND**

N - No environmental impact
L - Little environmental impact
M - Moderate environmental impact
H - High environmental impact
U - Unknown environmental impact

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ANNEX B

Pesticide Section of the

INITIAL ENVIRONMENTAL EXAMINATION

Project Country: Niger

Project Title: Niamey Department Development Project II (683-0240)

Funding: FY(s) 1981-85 $ 13,582,000

Period of Project: 5 years beginning in FY 1981 through FY 1985

IEE Prepared by: Dr. Patricia Matteson

Environmental Action Recommended:

It is recommended that a negative determination be made and no further environmental action is required.

Concurrence: Jay P. Johnson
Director
USAID/Niger

Date: 19 Dec. 1980

BUREAU ENVIRONMENTAL OFFICER'S DECISION:
James Hester, AFR/DR/SDP

APPROVED. [signature]

DISAPPROVED _____

DATE 1 February 81

Clearance:
GC/AFR:EDragon _____

Pesticide Section of the
Initial Environmental Examination

(Niamey Department Development Project, Phase II, Project No. 683-0240)

As indicated on the attached Impact Identification and Evaluation Form this Project will have few impacts upon the natural environment except for those which are invariably associated with programs designed to increase food crop production. This increased food production can be expected to contribute to the nutritional status and longevity of the population which in turn will result in net increases in the total populations. Since the GON's strategy for food self-sufficiency is predicated on gains in productivity of presently cropped land there will be little or no land clearing associated with this project. Soil fertility, water-holding capacity and levels of soil organic matter are low over much of the project area, and decreasing soil productivity is a recognized problem. Fertilizer use is coupled with closer spacing of plants, and causes increased weed growth. Increased plant cover means that less rainfall percolates away uncaptured by the vegetation and that wind and water erosion are minimized; more organic matter will be returned to the soil, improving its composition and fertility. Thus fertilizer use can help halt the processes of soil degradation. The relatively low level of use of agricultural pesticides envisaged for this project will have relatively little effect on the chemical composition of the ground and surface water and its ecological balance, and upon chemicals in the atmosphere. Since the core of the program is the extension to the farmer of a package of improved agricultural practices for growing millet and cowpeas with the necessary inputs plus credit to purchase them, their adoption will slightly dilute cultural traditions for growing crops and change economic/employment patterns with resultant changes in population and associated cultural patterns.

Planned Pesticide Use

As indicated above, certain pesticides are required for immediate use in the project for the protection of cowpeas, sorghum, millet and peanuts. These include thiram, diazinon, and malathion.

1. USEPA regulatory status of the required pesticides thiram, diazinon and malathion are all registered by the USEPA for the same or similar uses without restriction.

2. Basis for selection of the required pesticides:

a. Thiram (Arasan 50-Red) is to be used as a protective fungicide for the treatment of seeds of millet, sorghum, cowpeas and peanuts. Although thioral (a mixture of thiram and heptachlor) was originally requested by the Nigerien Agricultural Service for use in this project, virtually all U.S. registered uses of heptachlor have either been cancelled or are being phased out by EPA. Furthermore, the effectiveness of thiram (the active ingredient of Arasan) has been compared with thioral (thiram-and-heptachlor) and other seed treatment chemicals by INRAN, the Nigerien National Agricultural Research Institute, and resulted in the following ranking of the four most effective seed treatments:

1. TMTD (Thiram)
2. Orgeatrix (carboxin/maneb/lindane)
3. Cuprosan SD (copper/maneb/zineb)
4. Thioral (thiram + heptachlor)

Accordingly, thiram (Arasan 50-Red) has been selected for use in this project.

b. Diazinon was selected for use, primarily on millet, because it is the least toxic insecticide that is effective against the entire spectrum of millet pests and because it is already being bought and used in the Nigerien national plant protection program. At a cost of approximately 1000 CFA/ha., it is one of the cheaper alternatives.

c. Malathion was selected for use on all NDD II crops because it is relatively nontoxic to humans. It is effective against a broad spectrum of pests, and it has already been used in the context of the Niger government's national plant protection program.

3. The extent to which the proposed pesticide uses are part of an integrated pest management program:

At present, not enough research has been done to institute an effective IPM program for any Nigerien crop. Economic criteria for pest control have not been established; the real value of natural enemies is not known; there has been no effort to seek ecologically selective pesticides; and there is no organized systematic pest population monitoring system for any crop. A major obstacle slowing progress with IPM in Niger is the lack of properly-trained crop protection specialists. NDD II will incorporate as much IPM practice as possible under present circumstances. In the research component which has been designed into the project, these pesticides as well as others will be evaluated and compared economically and minimum effective dosages determined. Traditional nonchemical pest control methods will be evaluated and incorporated into extension recommendations. In this context the other pesticides to be evaluated for possible future use in the project are exempt from the provisions of Rule 16, The Environmental Procedures (see Para 216.3(b)(2)(iii), AID Handbook 3, APP 4B). The procedures to be followed in conducting these evaluations are extensively discussed in other documents entitled "Detailed Study of Pesticides to be Routinely Used and/or Field Evaluated for Possible Use", "Suggested Guidelines for IPM - Oriented extension Recommendations, Pesticide Safety Precautions, Equipment and Training, and NDD II Testing of Pesticides." Pest resistant crop varieties will be used when they become available; at present, no significant degree of resistance to the major pests has been bred into cowpeas, millet and sorghum.

Cultural practices that discourage pest infestations will be recommended to farmers as part of the extension package. When economic injury level information and pest population monitoring methods are developed by INRAN, IITA, ICRISAT, or the planned FAO/CILSS Sahel IPM Project, NDD II will use these techniques to plan crop protection activities. Except for cowpeas, crops will presently be treated with insecticide only when pest infestations occur.

4. The proposed method or methods of application, including availability of appropriate application and safety equipment.

Applications will be made by project personnel or by farmers who have received NDD II credit buy pesticides. Both of these groups will have had instruction in the safe use of pesticides. The materials will be applied at the rates and intervals prescribed on the manufacturer's labels.

Field pesticides will be applied with hand-pump or "Fontan" knapsack sprayers or manual dusters, depending on the insecticide formulation used and the target pest species. ULV sprayers may be considered for adoption at some future date. Sprayers will be stored at farmer cooperatives and for each sprayer, two sets of safety apparel (goggles, masks, filters, aprons, gloves, boots) will be available.

NDD II project managers will enforce, among project personnel and farmer cooperators, the use of essential protective apparel, proper storage and of pesticides and maintenance of application and safety equipment, and proper disposal of used pesticide containers and left-over pesticides. Project personnel will ensure that instructions and precautions, including statements regarding the time of re-entry into the field after pesticide application and the number of days between application and crop harvest, as specified on the product label, are enforced.

5. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use, and measures available to minimize such hazards:

All pesticides are potentially hazardous to humans and the environment and should be treated with great caution regardless of their relative toxicity.

The pesticides required for use in NDD II - Arasan, diazinon and malathion - are used widely in the USA by farmers, homeowners, gardeners, livestock owners, and others and can be purchased and applied without restriction. Each is relatively acutely nontoxic to warmblooded animals, based on its acute oral toxicity value (LD50), and is considered to be relatively safe for use by humans if used according to the label instructions.

None of the chemicals chosen is the subject of present or foreseen USEPA regulatory action.

Diazinon and malathion are toxic to cold-blooded animals in general, and thus represent a danger to bees, other beneficial insects, and fish. High dosages may harm wild birds, livestock and game and (in the case of diazinon) may have phytotoxic effect.

All of these potential hazards can be minimized by adopting appropriate safety procedures and dosages and by applying the pesticides selectively and judiciously based on actual need. Millet and sorghum are wind-pollinated and cowpeas and peanuts largely self-pollinated, so the proposed use patterns present little threat to bees and other pollinators and to successful setting of seed. No bush will be sprayed, and wildlife is sparse in farmed areas, so the potential impact on game is small. Permanent bodies of water are extremely few and the project area does not adjoin the Niger River (Niger's only year-around stream), so these pesticides will not contact aquatic ecosystems to any significant degree.

6. The effectiveness of the required pesticides for the proposed uses:

See para 2 above. The pesticides have been previously tested and/or used in Niger, and additional specific details concerning their recognized range of effectiveness were drawn from U.S. data where pests and cropping situations are similar to those in the project area. The pesticides will be applied according to instructions on their manufacturers' labels. Therefore, it is assumed that their use will adequately control pests unless pesticide-resistant strains are present in Nigerien pest populations. No such resistant strains have been reported thus far.

7. Compatibility of the required pesticides with target and nontarget ecosystems:

See para 5 above.

8. The conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology and soils: See Project Area Description.

9. The availabililty and effectiveness of other pesticides or nonchemical control methods:

See paras 2 and 3 above, and separate documents "Plant Protection in Niger, with Special Reference to Niamey Department and NND II Project Design," and "Suggested Guidelines for IPM - Oriented Extension Recommendations, Pesticide Safety Precautions, Equipment and Training, and NDD II Testing of Pesticides."

10. The requesting country's ability to regulate or control the distribution, storage, use and disposal of the required pesticides.

See separate document. "Plant Protection in Niger, with Special Reference to Niamey Department and NDD II Project Design."

11. The provisions made for training of users and applicators:

All NDD II pesticide use will be supervised by the project agronomist and a staff or consultant entomologist. Enhanced supervision and training components have been designed into Phase II of this project, with a view, among other goals, to ensure the safe, judicious use of pesticides.

These senior staff will familiarize themselves with the appropriate safety measures for project pesticide use, and proper application procedures, and make sure that these guidelines are observed by staff and carefully extended to farmers. CPT extension staff will have attended yearly plant protection short courses given to Niamey Department/Agricultural Service staff by the Plant Protection Section. The farmer-training curriculum at CPTs will emphasize the proper use of pesticides and correct spraying techniques, including potential hazards and precautions to minimize these hazards. Stress will be laid on the proper use of safety apparel and devices and also proper procedures for disposing of used pesticide containers and leftover pesticides. It is the responsibility of project staff to see that this part of the curriculum is carefully and effectively communicated for farmers, and that any subsequent observed misuse of

pesticides be corrected.

Only farmers who have received such training at CPTs will be eligible to receive pesticide purchase credit and access to project-supplied pesticides.

12. The provisions made for monitoring the use and effectiveness of the pesticides:

An applied research component has been designed into Phase II of the NDD expressly to test the cost-effectiveness of the various components of the recommended package of improved agricultural practices, including pesticide use(s). This is fully discussed in the Project Paper and in separate documents entitled "Detailed Study of Pesticides to be Routinely Used and on Field Evaluation for Possible Use." "Suggested Guidelines for IPM - Oriented Extension Recommendations, Pesticides Safety Precautions, Equipment and Training, and UNDD II Testing of Pesticides."

Pesticides used by farmer graduates of CPTs will be observed by project extension agents during routine visits, and monitored closely as one aspect of the evaluation of the effectiveness of the project's training/extension component. A heavy emphasis on such evaluation has been designed into Phase II of the NDD. Misuse of pesticides will be noted and corrected. Senior staff will, in turn, make sure that CPT staff and extension agents are competent with reference to pesticide use, and that the proper procedures are followed by them.

## V. SUMMARY AND CONCLUSION

Most impacts of project activities have been identified as significantly beneficial over the long-term. The project promises to increase agricultural production by small farmers within the project area. Potential benefits should outweight the potential negative impacts on the human environment.

# IMPACT IDENTIFICATION AND EVALUATION

Impact Areas and Sub-areas

A. LAND USE

1. Changing the character of the land through:

   a. Increasing the population _____ L

   b. Extracting natural resources _____ N

   c. Land clearing _____ L

   d. Changing soil character _____ M

2. Altering natural defenses _____ N

3. Foreclosing important uses _____ N

4. Jeopardizing man or his works _____ N

5. Other factors _____ N

B. WATER QUALITY

1. Physical state of water _____ N

2. Chemical and biological states _____ L

3. Ecological balance _____ L

4. Other factors _____ N

LEGEND

N - No environmental impact
L - Little environmental impact
M - Moderate environmental impact
H - High environmental impact
U - Unknown environmental impact

IMPACT IDENTIFICATION AND EVALUATION

C. ATMOSPHERIC

1. Air additives _____ L

2. Air pollution _____ N

3. Noise pollution _____ N

4. Other factors _____ N

D. NATURAL RESOURCES

1. Diversion, altered use of water _____ N

2. Irreversible, inefficient commitments _____ N

3. Other factors _____ N

E. CULTURAL

1. Altering physical symbols _____ N

2. Dilution of cultural traditions _____ L

3. Other factors _____ N

F. SOCIOECONOMIC

1. Changes in economic/employment patterns _____ L

2. Changes in population _____ L

3. Changes in cultural patterns _____ L

4. Other factors _____ N

G. HEALTH

1. Changing a natural environment _____ N

2. Eliminating an ecosystem element _____ N

3. Other factors _____ N

H. GENERAL

1. International impacts _____ N

2. Controversial impacts _____ N

H. GENERAL (cont'd)

3. Larger program impacts _____ _____ N _____

4. Other factors _____ _____ N _____

ANNEX C

Niamey Department Development Project

Phase II (NDD II)

USAID/Niger Project 683-0240

NIGER

Detailed Study of Pesticides to be Routinely Used

and/or Field Evaluated for Use

22

# I. INTRODUCTION

## A. Description of the Project

The 1981-1985 Niamey Department Development Project, Phase II (NDD II) (683-0240 in the AID system), is an integrated rural development project in four arrondissements of Niamey Department, Niger. As stated in the NDD II Logical Framework (September 1980), its purpose is to institutionalize a process of rural development through the establishment of self-managed village organizations and participating individual cultivators capable of achieving increased food production on a self-sustaining basis. The long-term goal is to contribute toward food self-sufficiency in Niger.

The NDD II will support local cooperatives and the Nigerien government rural services such as literacy, health and nutrition, marketing, delivery and distribution of inputs, and extension, with appropriate emphasis on the role of women. The core of the program is the extension to the farmer of a package of improved agricultural practices for growing millet and cowpea with the necessary inputs plus credit to purchase them. These improved agricultural practices, identified by INRAN, Niger's national agricultural research institute, include: rotation of high-yielding varieties of millet and cowpea; the use of a fungicide seed treatment; appropriate spacing of stands, weeding and thinning; the application of chemical fertilizer (urea and triple-phosphate);

two treatments of cowpeas with insecticide; animal traction on farms of appropriate size; and on-farm cattle fattening. This package of improved practices will be taught to farmers and their wifes at ten Farm-Couple Training Centers (CPTs) in the Project Zone. At the end of Phase II, the NDD will have trained 600 cultivators and the spread effect of this technology and the improved government services in and around their home villages will directly affect an estimated 6000 people who plant approximately 12,000 ha. of cowpea and millet in Niamey Department.

The projected increase in annual millet production of at least 9,000 tons and cowpea production by more than 4,400 tons would have a value of approximately $2,300,000 annually and would reduce the chronic cereals deficit in the project zone by approximately 30 per cent.

Further details on NDD II may be found in the "Abbreviated Project Identification Document (PID) for Niamey Department Development Project Phase II (683-0240)," 1980.

B. Reason for the Initial Environmental Examination

Amended Regulation 16 of the Code of Federal Regulations, Part 216, Environmental Procedures (effective date June 28, 1976, as amended May 3, 1978), provides guidelines for preparation of an Initial Environmental Examination of the reasonably foreseeable effects of a proposed action of an AID project on the human

environment. The function of the IEE is to provide the basis for a threshold Decision as to whether an Environmental Assessment or an Environmental Impact Statement will be required.

The IEE has been prepared based upon material contained in this Special Study and has been incorporated into the NDD II Project.

## II. THE ENVIRONMENTAL SETTING

### A. Location, Size and Topography

A landlocked country, the Republic of Niger is the largest state in West Africa, with an area of 489,190 mi.$^2$ It is 2/3 desert. Most of that area is uninhabitable. The remainder is savanna, suitable mainly for livestock raising and limited agriculture. In the north-central region is the volcanic Air Massif, attaining heights of up to 5,900 ft. Massifs along the Libyan border average about 2,600 ft. The Niger River flows for 300 mi. along the southwest border. A portion of Lake Chad is situated in the eastern part of the country (it is also bordered by Chad, Cameroon, and Nigeria).

### B. Climate

Every year from April to July, a warm, wet tropical weather front gradually moves inland N-NE to Niger from the West African coast. It starts to recede again in August and is replaced by a front of cool dust-laden air that blows off of the Sahara and covers Niger during the dry season. On the average, rainfall in the Air Massif is limited to 7 inches annually, and most of this comes during a single two-month period. In the south, rainfall averages 22 inches annually, varying from about 9 inches at Zinder to 30 inches at Niamey;

the rainy season is from June through September, with most rain in July and August. From November to February, the weather is dry and cool. The temperature ranges from 29.4°C (85°F) during the dry season to 40.5°C (105°F) during the humid season. Niger is one of the hottest countries in the world, particularly in the north, where the intense heat often causes the rain to evaporate before it hits the ground.

C. Soils

Nigeri soil resources are rather poor, and deteriorating. Most soils are 85-90% sand. These are young or dunal soils, still evolving from sedimentary rocks. They are characterized by medium to high acidity, low organic matter content, and little capacity to retain water and soluble fertilizer (low cation exchange capacity). They are highly susceptible to wind and water erosion. Millet, cowpea, and peanuts can grow on them.

A second soil type is the isohumic or fadam soil of inter-dunal depressions, basins, and along temporary watercourses. These are richer in clay and humus, finer-textured, hold water better, and are more fertile. Crops with high water and nutrient requirements, such as corn, sorghum, and sugar cane, are grown in these areas.

There is also a significant amount of land featuring a heavy indurated latertic crust. The hardened layer may be at or near the surface, or covered by a sandy layer of variable depth. If this crust is continuous and at or near the surface, the soil is of no value for agriculture.

D. Fauna, Flora and Desertification

As in much of West Africa, Nigerien wildlife represents only a remnant of former populations. Hunting and habitat destruction have virtually eradicated game from populated areas. Large game remain in Niger's one national park, Parc W, around Tillabery (north of Niamey), and in and around the Air Massif. The latter area still shelters large populations of antelope, among them two endangered species, the scimitar-horned onyx and the addax. Other endangered species (as of 1975) included the African wild dog, the slender-horned gazelle, the African slender snouted crocodile, and the Nile crocodile. More common are other species of antelope, lion, water buffalo, giraffe, leopard, hyena, monkey, warthog, and a rich bird, reptile, amphibian and insect fauna.

Three ecological zones, corresponding to annual rainfall belts, cover Niger: the Sudano-Sahelian Zone, with 500-550 mm of rainfall; the Sahelian, with 200-500 mm; and the Saharan, with 200 mm or less. The northern desert has vegetation only after rare rainfalls. The savanna includes a vast variety of herbaceous vegetation, with such useful trees as bastard mahagony, kapok, baobab, and the shea-nut. Forested domain is only about 437 sq. mi (1,150 $km^2$), or less than 1% of the land surface. The trees planted are mostly teak and eucalyptus. (Round wood production was estimated at 2.4 million $meters^3$ in 1973.)

The mixed forest and grassland that once predominated over the southern section of Niger is gradually disappearing because of

increasingly common overexploitation of natural resources. The expansion and intensification of cultivation at the northern agricultural limits, combined with overgrazing, result in widespread, progressive desertification. In some areas, the time in bush fallow has been greatly reduced or even eliminated as a result of the need to grow more food crops. Many soils unsuited for cultivation because of slope, erosion conditions, shallow soil, or frequently inadequate rainfall, are planted and then deteriorate. The edge of the Sahara has been steadily moving southward, characterized by a lack of vegetation, severely eroded areas, exposed rock, surface accumulations of salt, and active sand dunes.

E. Hydrology and Irrigation

The Niger River is Niger's only permanent stream. Dry-season crops and those with a higher water and nutrient requirement can be planted along the river and by ponds, some of which are permanent. At present, about 26,000 ha., largely in small plots, are irrigated by traditional methods. Some 5,000 ha., mainly in the Niger and Komadougou valleys, are under managed irrigation. Potential increase in irrigated area is confined to about 15,000 ha., predicated on construction of a dam at Kandaji which won't be functional until 1990 or later. There are small oases in the north, most in the Air Massif.

F. Population

The 1980 population of Niger is estimated at 5,272,000, and is mostly in the south, below the 350 mm isohyet. In the southeast,

population density is about 15/km$^2$; in the river areas it is 60-70/km$^2$. In 1972, Niamey, the capital, had approximately 85,000 inhabitants. The towns of Zinder, Maradi, and Tahoua also have populations over 20,000. More than 92% of the population is rural; 47% of the population is under 15 years of age.

Agriculture is the main income source for 85-90% of Nigeriens, and the source of employment for 98%. Structural shifts in the population due to a high birth rate and outmigration from rural areas will decrease the percent of people in agriculture relative to the total, and will put pressure on the productivity of the rural sector. The annual growth rate of the total population is 2.7%, but that of the agricultural population is only 1.8%. Where one person fed 2.5 people in 1970, one will have to feed three in 1990.

G. The Agricultural Sector

Only 30 million (24%) of Niger's 126.7 million hectares are agriculturally "useful." The rest is unsuitable because of a harsh climate with annual rainfall below 350 mm, high temperatures and rapid evaporation, or rock outcrops, shallow soil, steep slopes, excessive erosion, or shifting sands. The "useful" area lies largely south of the 350 mm isohyet and extends in a band some 1,500 km long and 200-250 km wide (between 13-15$^{\circ}$ latitude) from the border with Upper Volta and Mali, in the SW corner of the country, to the Chadian border on the east. Within this zone lie about 15 million arable ha. Recognizing the drought hazard and the increasing conflict

between sedentary farmers and nomads in search of pasture, the government established a northern limit of crop production ("Limit Nord de Cultures") in 1954 which roughly coincided with the 350 mm isohyet. It was revised in 1961 due to northward pressure by cultivators. In recent years, population pressure requiring additional land for food crops has pushed the cultivation "limit" to the 300 mm isohyet in most places, and even further around Tanout. In some areas, the concept is largely ignored. Studies in Zinder Department show 192 $km^2$ presently under cultivation north of the limit.

A notable exception to the general demographic pressure on land resources is in the Say Arrondissement. Due to the presence of tsetse fly and onchocerciasis in the region, population densities have remained comparatively low. The WHO program to control the vector of the disease (blackfly) now makes the area more amenable to exploitation. Say is in a relatively high rainfall zone and has much better soils than many other areas in Niger. Estimates of exploitable farmland are in or above the 1/2 million ha. range. Therefore, Say has the potential of adding over 1/4 million tons to the nation's cereal production.

Agriculture is based on millet and cowpea for local consumption and cowpea, peanuts, and cotton for export. The typical agricultural unit is the small family farm (most commonly, in Niamey Dept., 2-3 ha) using traditional agricultural techniques. Few tractors and little animal traction or fertilizer are in use, no soil conservation measures are taken, and farmers themselves use few pesticides.

Thioral, a thiram-and-heptachlor seed treatment, is widely applied. Otherwise, plant protection is effected by a rigorous, heavily-financed government program geared to terrestrial and aerial insecticide application whenever infestations are reported (see Annex to Project Paper "Plant Protection in Niger, with Special Reference to Niamey Department and NDD II Project Design").

Livestock raising accounts for about 10% of the GNP, and until the Sahelian drought the figure was 20% and animal numbers were increasing by 3% per year. From 1970 to 1974, however, the herds were decimated, and meat and milk production (though not hides!) declined accordingly. Numbers of livestock have risen again, and account for 18% of exports, though denial of access to traditional migration corridors and shrinking rangeland present an increasing constraint: less fallow land means less grazing land and fodder.

In the face of drought and periodic food shortages, cash crop production has declined in favor of food crops--with the exception of cowpeas, which can play both roles. The most significant change in Niger's agricultural sector in the last 10 years has been the decline in volume and value of peanut exports. Introduced in 1944, by 1967 production was 298,000 tons and shelled peanuts, peanut cakes, and peanut oil brought in 70% of export earnings. By 1973, production dropped to 100,000 tons. Cotton was introduced in 1956 to reduce Niger's export dependence on peanuts. Prior to the drought years, production was approximately 6,000 tons annually. It has shown a steady decline since 1975, but the government hopes that

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increased irrigated area will reverse this trend. Cowpea production has been increasing since 1966, with areas cultivated up 50% and yield up threefold. In 1975 the value of cowpea exports surpassed that of cotton, and in 1976 they accounted for 8% of foreign exchange earnings. Nigeria is the major market for Nigerien cowpeas and livestock. This trend has declined in recent years due to increased home consumption.

Forty-Five to Fifty percent of cropland is planted to mono-cropped cereals (millet, sorghum, corn), and 45% to cereals inter-cropped with cowpeas or peanuts. Production of millet, the staple food of most of the people, depends heavily upon rainfall. Thus, because of the Sahelian drought, production decreased from one million tons in 1969 to 648,000 tons in 1973. Similarly, sorghum production (342,000 tons in 1969) was down to 129,000 tons in 1973, and rice production (40,000 tons in 1970) was down to 22,000 tons. National grain stocks had virtually disappeared in 1975, but since then there has been a fluctuating, but upward, trend in the total quantity of food grains produced, which presently is marginally higher than pre-drought levels. The 1980 crop will be excellent. In 1979, a 3-month grain supply was on hand (300,000 tons, at 250 kg per capita), mostly in the form of on-farm reserves.

Bad weather, especially low or inconsistent rainfall, could lead to massive food shortages, especially in urban and nomadic zones. Cereal production has exceeded consumption in only 11 of the 19 years since 1970. The increase in food production that has been

necessary to meet population growth has probably been met largely by expanding acreages. 4.5 - 6 million ha. are currently cropped, and this will have grown to approximately 8 million ha by 1990. As area cropped expands, more marginal land is cropped and increased areas in zones of lower and less reliable rainfall are exploited. Fallow is shortened, fewer animals can be kept, and fertility declines. Productivity (kg/ha. yields) appears to have fallen steadily during the past two decades. This further exacerbates the pressure to expand acreage. Provided rainfall is consistent, expanding acreage cropped should be able to maintain adequate cereals production to meet food needs through 1990. Unless productivity can be increased, regular food shortages can be expected thereafter. If the current situation remains unchanged, a deficit amounting to 40% of production will develop by 2000. To maintain self-sufficiency, productivity per ha. must rise by 2%/year; a rise of 3.1%/year will be necessary if Niger is also to have a minimal marketable surplus.

The Government of Niger's strategy for food self-sufficiency over the next two decades is predicated on gains in productivity of presently cropped land. These are to be achieved through a series of geographically specific "Productivity Projects," such as NDD II, aimed at modernizing the farm sector. They are centered around the use of improved cereal varieties, modern cropping practices, chemical fertilizers, insecticides and animal traction, and the eventual attainment of a livestock/cropping integration. Government service improvements in farm input and credit distribution, marketing, and

extension are envisioned as part of such projects. Indeed, greater efficiency in these service areas are vital to their success.

References for this section:

1. "Niger Agricultural Sector Assessment." Warren Enger, ed. USAID, 1980.

2. CILSS/USAID Sahel IPM Program document, 1978.

3. Worldmark Encyclopaedia of the Nations.

## III. DESCRIPTION AND IMPACT OF ACTIONS ON THE ENVIRONMENT OTHER THAN PESTICIDE USE

### A. Fertilizer Use

Demand for and use of fertilizer by Nigerien farmers appears to be increasing. Traditional farmers already are using fertilizer to a limited extent. As described in the Project Paper, a major component of the NDD II is the effort to expand fertilizer use in the project zone. It is hoped that 12,000 ha. will be affected.

1. Potential Beneficial Impacts

No studies on yield response and cost effectiveness have been done for the project zone. Work elsewhere in Niger indicates substantial millet yield increases with fertilizer use as recommended by NDD II. The project recommendations were developed through a 1967-73 series of agronomy trials at INRAN, Tarna/Maradi on sandy dunal soils similar to those of the project zone. 1966-67 multi-locality trials on such soils showed yield increases of 25-89%.[1] In his final report to the INRAN Niger Cereals Project (February, 1980), Research Agronomist and Soil Specialist C. B. Brown states that improved agricultural techniques coupled with fertilizer use can more than double yields of cereals in Niger.

Soil fertility, water-holding capacity and levels of soil organic matter are low over much of the project area, and decreasing soil productivity is a recognized problem. Fertilizer use is coupled

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(1) "Synthese des Resultats Experimentaux II" INRAN, MDR. Campgne Agricole 1977.

with closer spacing of plants, and causes increased weed growth. Increased plant cover means that less rainfall percolates away uncaptured by the vegetation, and that wind and water erosion are minimized; more organic matter will be returned to the soil, improving its composition and fertility. Thus fertilizer use can help halt the processes of soil degradation.

2. Potential Negative Impacts

Improper use or prolonged heavy use of fertilizer in a given area may produce a negative impact. Some of the known interactions in the environment are as follows:

- On permeable soils having low organic matter content, excessive application of fertilizer nitrogen may send some nitrate into drainage waters, especially under conditions of high rainfall. Heavy accumulation of nitrates in underground water has occurred in some areas. If excessive, the nitrates in the water may render it unsafe for human consumption; they may harm health.

- Excessive amounts of fertilizers (which are salts) may injure growing plants under certain conditions.

- Fertilizers are known to interfere with some soil microbes. Use of ammonium-containing fertilizers, for example, will suppress bacteria. But the long-term ecological effects of fertilizer applications in various environments are poorly known.

The NDD II-recommended levels of fertilizer use have been tested in Niger and will be carefully extended to farmers with demonstrations of correct practices. Chances of improper use or overuse are thus minimized. These facts coupled with yield increases

and halt to soil degradation attributable to fertilizer use, indicate that the benefits of this project component will far outweigh any possible negative impacts.

B. Construction

NDD II envisions the construction of 7 CPTs (Farm-Couple Training Centers), a number of cooperative centers (small buildings/ warehouses) in the Say Arrondissement, and a project headquarters (office, warehouse, garage) in Niamey.

This construction will entail the clearing of some native vegetation from construction sites, and also disturbance of the soil. The area and amount of native vegetation and agricultural land affected will be small. It should cause no significant environmental impact except on the construction sites themselves.

C. Animal Traction

1. Potential Beneficial Impacts

Niger is short of farm labor at busy times during the growing season (planting, weeding, harves ). Ox-drawn plows can cultivate and weed larger areas while the presence of the oxen help fertilize the soil. This is a step in the desired integration of livestock and field crops into a single farming system. This innovation is useful only on large farms (larger than 6 ha.), which are in the minority in the project area. Thus extension of this technology may only be done at certain CPTs.

2. Potential Negative Impacts

Deep and repeated cultivation of sandy soils contribute to wind and water erosion problems, and ox-drawn ploughs would be more disruptive in this respect than traditional hoeing. In addition, the labor-saving aspects of animal traction will encourage the planting of a greater proportion of a farmer's land in any given season, and less land will be fallow. Both these factors could lead to soil degradation if countermeasures are not taken.

The fertilizer and closely-spaced stands recommended in the project package will help prevent erosion and loss of soil fertility. The recommended millet-cowpea rotation cropping pattern also contributes to soil fertility and lessens the necessity for fallow periods.

In view of these factors, the potential yield increase from an increase in ha. planted per season by one or two people should outweigh any negative impacts of the use of animal traction.

D. Beef Fattening

At present, cattle are given to nomads to herd, and sometimes cover great distances in search of grazing and water. Under these circumstances, they sustain periodic heavy weight losses, take years to reach a marketable size, and their milk and manure are not available to the farmer. A secondary component of project activities will be a program to encourage the on-farm fattening of cattle and the cultivation of cowpea for forage.

1. Potential Beneficial Impacts

Cattle kept on the farm yield milk and manure and reach a slaughter age quickly. This resource would enhance the quality of the diet and the cash income of farmers and improve soil fertility close to their homes.

2. Potential Negative Impacts

Unless enough forage is stored by the farmer, cattle kept on the farm during the dry season represent extra stress on the sparse dry-season vegetation that is not under grazing pressure from nomadic animals at that time of year. Overgrazing or gathering of native vegetation by the farmer during that period might irretrievably damage local flora and contribute to desertification of a marginal area.

Since the project teaches farmers to grow cowpea for forage, potential negative impact on local flora will be minimized. In view of the benefits derived from on-farm fattening, the overall long-term effects of this project component should be favorable.

## IV. ENVIRONMENTAL EXAMINATION OF PLANNED PESTICIDE USE

### A. NDD II Pesticide Use and Its Economics

NDD II requires pesticides for the following purposes:

1) A fungicide seed treatment for millet and cowpea (incidental use on sorghum and peanut is probable).

2) Two insecticide treatments for monocropped cowpea, the first just before flowering; primarily against thrips, pod borer, pod-sucking bug, flower beetles, and aphids.

3) Occasional insecticide use on millet, sorghum and peanuts when significant pest infestations are seen to exist. The major millet and sorghum pests are stem borers, cecidomyid larvae which mine seeds, grasshoppers, noctuids (especially Rhaguva spp., which mine millet heads near harvest time), scarab and meloid beetles that eat the flowers, sucking bugs and aphids. The major pest of peanuts is Aphis craccivora. (For more detailed information on crop pests, see separate paper, "Crop Pests in Niger.")

Items (1) and (2) are part of the improved agricultural practices package that will be extended to farmers.

No information on the economics of routine fungicide seed treatment is available for the project zone. It is a difficult cost/benefit ratio to assess because the usefulness of fungicide would vary with moisture conditions from year to year. All agricultural research institutes in Niger, Nigeria, and upper volta, use treated seeds for their field trials. The best indication of the usefulness of fungicide in the project zone is the wide acceptance

it has found among farmers. At present, the majority of farmers routinely use Thioral (thiram and heptachlor) at the rate of 25 gm/10 kg of seed. The Nigerien Agriculture Service reports that it sold approximately 250,000 25-gm packets (6.3 metric tons) of Thioral in Niamey Department in 1977. It is also available on the local market for about 15 cents per 25-gm packet and it is thought that the actual use rate is considerably higher than reported in the Agriculture Service's records of direct sales to farmers.[2]

Insect pests are the major consistent constraint on high cowpea yields in West Africa. In the absence of insect protection, farmers harvest an average of 250 kg/ha. Effective crop protection increases yields of monocropped cowpea in the West African savanna by a factor of 4 to 10. The following table contrasts 1978 farmer's field yields obtained from local and improved (VITA 5) cowpea lines with and without flowering and post-flowering insect protection in Funtua, Kaduna State, (northern) Nigeria:[3]

| TREATMENT | VARIETY | Yield KG/HA | Yield GM/STAND |
|---|---|---|---|
| 1. CONTROL Unsprayed | Local | 32.6 | 2.91 |
| | VITA-5 | 8.0 | 0.28 |
| 2. Protection after flowering with Permethrin & Endosulfan | Local | 480.0 | 34.78 |
| | VITA-5 | 2,640.0 | 80.98 |
| 3. Protection after flowering with Endosulfan | Local | 880.0 | 65.67 |
| | VITA-5 | 1,880.0 | 81.03 |

(2) Draft IEE for NDD II, Mark Wentling, May 1980.

(3) IITA Research Highlights, 1979.

In 1979, entomologists with IITA's Upper Volta Cowpea Improvement Program experimented with insect protection at various stages in crop growth. They found that a single application of insecticide at flowering increased yield more (from 785 to 1684 kg/ha.) than a single application at the seedling or post-flowering stage. Of the combinations of any two applications, one at flowering and one post-flowering (similar to NDD II recommendations) gave the best result, though 76 per cent of the combined effect was from the application at flowering:[4]

COWPEA YIELD, kg/ha
with insecticide applications

$S_2$: at flowering; monocrotophos 40 DAP @ 700 g a.i. $ha^{-1}$
and endosulfan at 48 DAP @ 1000 g a.i. $ha^{-1}$

$S_3$: post flowering; endosulfan at 58 DAP @ 1000 g a.i. $ha^{-1}$

| | | $S_2$ - | $S_2$ + | Mean |
|---|---|---|---|---|
| $S_3$ | - | 452 | 1517 | 984 |
| | + | 1119 | 1851 | 1485 |
| Mean | | 786 | 1684 | |

(4) Annual Report, 1979.

Cowpea is both a valuable, protein-rich food and an export crop that commands a good price locally and which will have a large export market in Nigeria for the foreseeable future. Given the kind of yield increases cited above, two insecticide applications will almost certainly pay for themselves, even if expensive chemicals are chosen. At present, no economic injury level data is available for the major cowpea pests, and minimum prophylactic insecticide applications are the only viable alternative in the face of consistent heavy damage. Two insecticide applications is a modest and appropriate recommendation. In Nigeria, where pest problems are more severe than in Niger, recommendations are for weekly insecticide applications after flowering (a total of approximately six).

Routine insecticide applications on millet, sorghum, and peanuts are <u>not</u> economic, especially given the low prices and low yields currently obtained by the Nigerien farmer for cereals and the patchiness and variability of insect infestations. It is the opinion of Rene Beique, CIDA plant protection consultant to the government of Niger 1978-80, that treatment of insect pest outbreaks on these crops turns a small profit. No data exists, and the applied research program of NDD II will collect information on the economics and efficacy of insecticides applied when pest infestations of millet become apparent. The project will apply insecticide to millet on CPTs and demonstration fields <u>only</u> under those circumstances.

B. Applied Research

An applied research component with heavy emphasis on pesticides was designed into NDD II for two purposes: 1) economic assessment of the various components of the recommended package of improved agricultural practices. This has not yet been done in the project zone; and 2) testing pesticides economically and for effectiveness and safety (residue levels, applicator exposure, etc.). This must be done before pesticides heretofore new to Niger can be confidently extended to farmers and recommended to the Nigerien government for general use. The data can also be used to justify AID use of some realatively safe, effective pesticides widely used in Niger and elsewhere in West Africa, but which are not currently registered for the same or similar uses in the U.S. by the EPA. It is hoped that the research results will be helpful to AID projects and to national governments throughout the Sahel where the major crops are the same.

Consistent with Regulation 16, Part 216--Environmental Procedures, this will be controlled experimentation involving the procurement and use of pesticides only for research or limited field evaluation purposes by or under the supervision of project personnel. Project personnel will be supplied with toxicological and environmental data necessary to safeguard the health of research personnel and the quality of the local environment in which the pesticides will be used. Finally, treated crops will not be consumed by humans or animals. Experimental produce will be used by the Niger Cereals Project for seed. Under these circumstances no Environmental Assessment of pesticide use is required, regardless of the current

EPA status of the materials in question.

This applied research will be supervised and executed by the project agronomist and his staff, and planned either by a staff entomologist (strongly recommended) or consultant economic entomologist(s).

C. Environmental Examination

Paragraph 216.3 (b)(1)(i) of Environmental Procedures establishes the procedures used here for evaluating the risks and benefits of the planned pesticide use.

1. The USEPA Registration Status of the Requested Pesticides.

Table A below lists pesticides recommended for NDD II, and their current USEPA status. Since all these pesticides have already been tested or used by the Nigerien government, it is hoped that they will be approved for immediate project use.

Table B lists pesticides recommended for testing in the applied research program, and their current EPA status. Specific information and recommendations concerning each are in the next section.

Only pesticides registered by the USEPA for the same or similar uses (without active or proposed regulatory action) are requested for immediate use in NDD II. Pesticides recommended for testing under the restrictions specified above can be used for that purpose regardless of their current USEPA status, and without further risk/benefit analysis than that contained in this IEE. Thus, the current regulatory status of the pesticides proposed for use in the NDD II project does not require the preparation of an Environmental Assessment (EA) or Environmental Impact Statement (EIS).

TABLE A: PESTICIDES RECOMMENDED FOR IMMEDIATE NDD II USE

| PESTICIDE | $LD_{50}$ MG/KG | USEPA STATUS | CROP ON WHICH TO BE USED | | | |
|---|---|---|---|---|---|---|
| | | | Cowpea | Sorghum | Millet | Peanut |
| 1. Arasan 50-Red (thiram) fungicide seed treatment; wettable powder formulated for dry treatment of seed. | oral (rat) 780 | Registered without Restriction | X | X | X | X |
| 2. Diazinon-wettable powder, oil and emulsifiable solution, granules, or ULV | oral (rat) 300-400; dermal (rabbit) 3600 | Registered without restriction | X | X | X | X |
| 3. Malathion-emulsiable concentrate, wettable powder, dust, ULV | oral (rat) 1375; dermal (rabbit) 4100 | Registered without restriction | X | X | X | X |

TABLE B: PESTICIDES TO BE TESTED IN THE APPLIED RESEARCH PROGRAM

| | PESTICIDE | $LD_{50}$ MG/KG | USEPA STATUS | CROPS ON WHICH TO BE USED | | | |
|---|---|---|---|---|---|---|---|
| | | | | Cowpea | Sorghum | Millet | Peanut |
| 1. | Orthene (acephate) 75% soluble powder | oral (rat) 866-945 | Tolerances & labels now exist for use on dry and succulent beans, soybeans, and cotton. | X | X | X | X |
| 2. | Cypermethrin (ripcord) emulsifiable concentrate, dust, ULV | technical product: oral (rat) 130 dermal (rabbit) 2000<br><br>emulsifiable conc. product as marketed oral (rat) 535 dermal (rabbit (1782<br><br>ULV formulation as marketed oral (rat) 6487.5 | No US registration | X | X | X | X |
| 3. | Fenitrothion emulsifiable concentrate, wettable powder, granules, ULV, dust, 1% oil-based liquid spray | oral (rat) 250-500 | Not registered for field crop use (forest insects only); tolerance established on wheat gluten imported from Australia. | X | X | X | X |

2. The Basis for Selection of the Requested Pesticides

a) Arasan 50-Red (thiram)

Arasan is registered for use on millet, sorghum, cowpeas, and peanuts; it colors seed red, thus reducing chances that humans will mistakenly consume treated seed; it is formulated for dry treatment of seed, and suitable for use with small quantities of seed--thus it is appropriate for use by Nigerien farmers, who are accustomed to using thioral similarly; it is a wettable powder and may be applied as a suspension--exactly the kind of material required for use in the Niger Cereals Project seed-treating machinery.

Packaging: DuPont's 2-lb. containers are a convenient size for Niger Cereals Project use (Harry Dickherber, personal comment). For extension to farmers, it will be desirable to make this fungicide available in small packets, similar to the 25-gm. packets of thioral (for 10 kg. of seed) that have found wide acceptance. This format is conveniently-sized, inexpensive to the consumer, easy to use, and avoids storage problems. The potential West African market for Arasan packaged thus is huge--most seed treatments currently widely-used and available have been or will be cancelled by the EPA, and USAID (and perhaps other aid donors) will have to adopt a substitute for their agricultural projects and urge its adoption for national plant protection programs.

NOTE: DS/AGR should calculate the exact amount of Arasan to be contained in the small packets. It should be the amount

recommended on the label for 10-12 kg. of millet and cowpea seed. Perhaps 25 gm is correct. Dr. M. J. Lukefahr, the IITA grain legume entomologist, wrote that Arasan 75 at 2 gm/kg of seed is effective as a cowpea seed treatment at Ubadan, Nigeria.

The small packets should be as cheaply produced as possible in order to keep cost to consumers low (all components of the recommended package of improved agricultural practices must pay for themselves without government subsidy). DS/AGR has some Thioral packets as a reference. The packets must be reasonably sturdy and waterproof. DS/AER should investigate the possibility of contracting the packaging to African firms that currently package Thioral and Aldrex seed treatments (Aldrex is produced by Shell, Nigeria). Perhaps this could be arranged with the cooperation of American affiliates of these firms.

Thiram (the active ingredient of Arasan) has been tested against Thioral (the thiram-and-heptachlor compound we wish to replace) by INRAN, the Nigerien national agricultural research institute. In 1976, comparative testing resulted in the following ranking of the four most effective seed treatments:[5]

1° - TMTD (thiram)
2° - Orgeatrix (carboxin/maneb/lindane)
3° - Cuprosan SD (copper/maneb/zineb)
4° - Thioral (thiram and heptachlor)

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(5) Synthèse des Résultats Expérimentaux. INRAN, MDR, Campagne Agricole 1977.

A 1977 study contrasting the average germination of millet and sorghum ten days after planting showed thiram-treated seed with better germination than seed treated with Thioral:

GERMINATION

| | | $P_3$ Kolo Millet | CIVT Millet | L.30 Sorghum | a4d4 Sorghum |
|---|---|---|---|---|---|
| TMTD (thiram) | 150g | 6 | 7 | 4 | 6 |
| | 200g | 6 | 8 | 4 | 6 |
| | 250g | 6 | 7 | 3 | 6 |
| | 300g | 7 | 8 | 3 | 6 |
| Thioral | 150g | 6 | 6 | 3 | 6 |
| | 200g | 6 | 7 | 3 | 6 |
| | 250g | 5 | 8 | 3 | 7 |
| | 300g | 5 | 6 | 3 | 7 |

(It is not known whether the data reported here show a statistically significant superiority of thiram over Thioral.) Finally, 1977 yields from thiram-and Thioral-treated plots of $P_3$ Kolo and CIVT millet were comparable.[5]

In view of this favorable Nigerien data, it is hoped that the Nigerien Agricultural Service will accept Arasan 50-Red for immediate NDD II use as a substitute for thioral.

There are two other possible substitutes for thioral that are presently without active or proposed EPA regulatory action: carboxin (Vitavax) and chloroneb (Demosan). The EPA

is currently evaluating data concerning these compounds, and developing a regulatory position with reference to them. They are less acutely toxic than thiram: oral $LD_{50}$ values (rat) are >11,000 mg/kg for chloroneb and 3820 mg/kg for carboxin. Label and packaging information are unavailable to the author at the time of writing, and DS/AGR should inquire whether either is currently available in a small-packet format. Both are used on cowpea at IITA, Ibadan, Nigeria. Arasan (thiram) was chosen in preference to them because it is satisfactory in every respect as a substitute for thioral, it has been tested in Niger with good results, both Demosan and Vitavax are phytotoxic at high dosages, and Vitavax has performed poorly in comparison with Thioral in INRAN tests (no Niger data is available for Demosan). Dr. M. J. Lukefahr of IITA writes that Demosan inhibits cowpea germination if the dose is too high. A 1979 experiment by Hassane Hamma, plant pathologist and chief of the plant protection section at INRAN contrasted the performance of five seed treatments on millet, sorghum, cowpea and peanuts. Cowpea and peanut data were unavailable; per cent germination 21 days after planting millet and sorghum treated with 4 dosages of each compound is presented in the tables below:

## Sorghum

| Fungicide | Doses | % Germination |
|---|---|---|
| Benlate | A1 | 65,63 |
| | A2 | 68,66 |
| | A3 | 62,66 |
| | A4 | 57,33 |
| Dithame M45 (Maneb) | B1 | 73,33 |
| | B2 | 71,33 |
| | B3 | 78 |
| | B4 | 73,33 |
| Pelt 44 (Thiophanate-methyl) | C1 | 70,66 |
| | C2 | 61,33 |
| | C3 | 62,66 |
| | C4 | 65,33 |
| Vitavax | D1 | 57,66 |
| | D2 | 63,33 |
| | D3 | 14,13 |
| | D4 | 12 |
| Thioral | E1 | 63,33 |
| | E2 | 62 |
| | E3 | 62,66 |
| | E4 | 72,66 |

Millet

| Fungacide | Doses | % Germination |
|---|---|---|
| Benlate | A1 | 82,86 |
| | A2 | 74,66 |
| | A3 | 57,33 |
| | A4 | 51,85 |
| Dithane M 45 | B1 | 65,18 |
| | B2 | 67,33 |
| | B3 | 70 |
| | B4 | 82,66 |
| Pelt 44 | C1 | 58 |
| | C2 | 63,70 |
| | C3 | 71,85 |
| | C4 | 77,04 |
| Vitavax | D1 | 64 |
| | D2 | 54 |
| | D3 | 45,18 |
| | D4 | 37,04 |
| Thioral | E1 | 67,33 |
| | E2 | 72 |
| | E3 | 70,66 |
| | E4 | 78 |

The performance of Vitavax is inferior to that of Thioral, and germination of both millet and sorghum is inhibited by the higher doses of Vitavax.

b) Diazinon

(In this and the following sections, these references are listed by number:

1. Farm Chemicals Handbook, 1980. Meister Publishing Co., Willoughby, Ohio.

2. Bailly, R. & G. Dubois, eds. 1980 Index Phytosanitaire. Association de Coordination Technique Agricole, Paris.

3. Beique, Rene. 1980 Cours de Protection des Vegetaux. Institut Pratique de Developpement Rural, Kolo, Niger.

4. "Insect and Mite Pests of Grain Sorghum--Management Approaches." Texas Agricultural Extension Service Leaflet.

5. Guidelines for the Control of Insect and Mite Pests. USDA Agricultural Handbook #554, April, 1979.

6. Insect Control Guide. 1979. Florida Agricultural Extension Service.

7. "Managing Insects on Texas Peanuts." Texas Agricultural Extension Service Leaflet.

8. "Notes fur quelques Pesticides utilises au Niger--Conseils en l'Epandage aerien de Pesticides." 1979 Protection des Vegetaux, Niamey, Niger.)

Diazinon is recommended for immediate NDD II use, primarily on millet, because it is the least toxic insecticide that is effective against the entire spectrum of millet pests and because it is already being bought and used in the Nigerien national plant protection program. At a cost of approximately 1000 CFA/ha it is one of the cheaper alternatives.

Nigerien government publications mention the use of 10% granules at 10-15 kg/ha. against serious pests of millet and sorghum: la chinille mineuse (Rhaguva spp.), Atherigona (a muscid fly that mines young plants), and the borer Chilo (3). An emulsifiable concentrate is effective against sucking insects, bean fly and leaf beetles (8). Dr. George Shaefers proposed diazinon as an alternative for use in the Niger Cereals Project (1979) because it is effective against grasshoppers and stem borers. It performs well on millet and sorghum in Niger at Present (H. Dickherber, Niger Cereals Project, pers comm.). U.S. extension and plant protection publications recommend it for use against borers in cereals (5), peanuts (7) and sugar cane (2), and against sorghum midge (4)(5), grasshoppers (5), aphids on sorghum (6) and beans (5,6), cutworms on soybeans and foliage feeders on peanuts (5) and root maggots on beans (5).

Diazinon is being tested this year (1980) in comparison with other insecticides against sorghum pests by Dr. Leyni Maiga, INRAN, Tarna/Maradi.

c) Malathion

Malathion is recommended for immediate use on all NDD II crops because it is relatively nontoxic to humans, it is effective against a broad spectrum of pests, and it has already been used in the context of the Niger government's national plant protection program.

Niger government publications point out its low toxicity and the fact that it can be used in the field up to one week before harvest, and mention its effectiveness against hemipterans, beetles, Lepidoptera larvae, flies, and mites. More specifically, 1 kg/ha. of powder or 75g/hl. are recommended for aphids and mites, and 100g/hl or 1400g/ha of powder are r commended for legume insects (8).

U.S. pesticide publications confirm that this chemical is appropriate for use where a high degree of safety to mammals is desired (1). Malathion is recommended for tropical legume crops (2), sorghum midge (4), grasshoppers on cereals and soybeans (5), aphids on cereals (5,6), peanuts (3,6) and beans (5), thrips on peanuts (7) and soybeans (5), leaf beetles on soybeans and leafhoppers on beans (5).

d) Orthene (Acephate)

Tolerances and labels now exist for the use of this insecticide on dry and succulent beans, cotton, and soybeans in the U.S. It has never been used in Niger. An ADI (Acceptable

Daily Intake) has been established for Acephate by the FAO/WHO Joint Meeting on Pesticide Residues, and there is an ADI in the U.S.

Orthene has moderate persistence, with residual systemic activity of approximately 10-15 days at suggested use rates. It is effective against aphids, Lepidoptera larvae, lace bugs, leaf miners, leaf rollers, leafhoppers and thrips (1), and for Heliothis and stink bugs attacking soybeans (5).

Because of its systemic activity, orthene may perform better than diazinon against such hard-to-reach major millet pests as stem borers, Sphenuva spp., and seed midges. It is strongly recommended that this insecticide be tested and economically evaluated against millet and cowpea pests. The results, if favorable, should be given to the Nigerien Agriculture Service along with a recommendation that it be adopted for general use, possibly as a substitute for diazinon if it is more cost-effective.

Its low toxicity recommends it for incorporation into the NDD II extension package if it proves effective and economically justified. Before it can be used on peanuts, sorghum and millet, however, measurements will have to be taken of residue levels under actual use conditions (to document compliance with the ADI). This will entail setting up special supervised field trials at the normal dosage and 2x dosage to make sure the ADI would not often be exceeded. The laboratory tests for residues are rather expensive--about $150 per sample--and NDD II should set aside $5000 for such tests on this and other insecticides being evaluated. Information on residue

data to be collected, and how to collect it, can be obtained from Dr. Carroll Collier, AID DS/AGR. It is possible that the manufacturer would cooperate in such field trials. This information could then be used as the basis for an EA justifying the safe use of orthene by NDD II and other West African AID projects with similar use patterns (millet, sorghum, and peanuts as well as beans).

e) Cypermethrin (Ripcord)

This is one of the synthetic pyrethroid insecticides, a group which has proved to be very effective against cowpea pests in West Africa at low dosages of active ingredient per hectare. They are relatively nontoxic to humans in formulations for field use, and thus are among the safer compounds for extension to LDC farmers.

IITA has been experimenting with these compounds in southern Nigeria for several years, in both high-volume and ULV formulations. The following results have been reported in IITA annual reports (Ambush/permethrin, Sumicidin/fenvalcrat, and decamethrin/Decis are also synthetic pyrethroids):

1976

High volume insecticide applications. During 1976 emphasis was on identifying effective insecticides with low mammalian toxicity in order to find safer insecticides. Efforts were also made in identifying insecticides which are effective in controlling cowpea pests at lower dosages, so that the cost of insecticide may be reduced. Table 12 indicates cowpea grain yield obtained by treatments of various insecticides on Prima cowpea in a field trial.

Insecticides were applied at 10 DAP and subsequently four more applications at 10-day intervals. The pest complex consisted mainly of leafhoppers and M. testulalis. Gammalin at 1000 gr a.i./ha per application and synthetic pyrethroid, Decis, which has low mammalian toxicity at a low dosage of 50 gr. a.i./ha per application had the best yields.

TABLE 12. Yield of Prima cowpea under different insecticide applications, second season, IITA

| Insecticide | Dosage* | % Pod damage by Maruca | Yield kg/ha |
|---|---|---|---|
| Gammalin | 1000 | 23.3 | 844 |
| Decis | 50 | 47.8 | 673 |
| Nuvacron | 500 | 34.3 | 415 |
| Rogor | 500 | 82.5 | 37 |
| Thuricide | 1000 | 85.3 | 23 |
| Control | | 85.3 | 13 |
| S.E.± | | 7.2 | 20.4 |
| C.V. | | 35.0 | 73.0 |

*Grams a.i./ha/application applied five times.

1977

Insecticides--high-volume application. Nine insecticides were compared for control of cowpea pests (Table 10). All were applied at 500 g a.i./ha except for the synthetic pyrethroids--Decis, Ambush and Sumicidin which were applied at the rate of 25.0, 50.0 and 100 g a.i./ha respectively. Insecticides were applied at 25, 35, and 45 DAP on Prima cowpeas. The number of leafhoppers, and the damage caused by flower thrips and pod borers were significantly lower in all the insecticide treatments than in the controls. Yields were low, but plots sprayed with the three synthetic pyrethroids and Nuvacron gave better yields than those treated with other insecticides. Sumicidin was particularly effective for control of pod borers. Decis, Nuvacron, Actellic, Miral and Viydate were effective for control of flower thrips.

Efficiency of different insecticides applied as high volume spray against cowpea pests. Second season, 1977, IITA

| Insecticide | g a.i. ha per application | No. of Leafhoppers per plant | % Damage by thrips on flower buds | % Damage of pod borer on pods | Yield kg ha |
|---|---|---|---|---|---|
| Sumicidin | 100 | 21.7 | 15.0 | 4.7 | 577 |
| Ambush | 50 | 15.0 | 10.0 | 15.7 | 518 |
| Decis | 25 | 16.0 | 8.7 | 25.0 | 412 |
| Nuvacron | 500 | 15.0 | 7.7 | 43.7 | 403 |
| Actellis | 500 | 14.3 | 8.7 | 38.3 | 374 |
| Versuchs | 500 | 18.3 | 10.0 | 56.3 | 298 |
| Miral | 500 | 11.7 | 7.0 | 28.3 | 269 |
| Baygon | 500 | 21.7 | 15.0 | 42.0 | 139 |
| Viydate | 500 | 10.0 | 9.7 | 51.0 | 116 |
| Control | | 66.6 | 32.7 | 100.0 | 0 |
| S.E. | | 1.3 | 1.0 | 1.6 | 15.8 |
| C.V. | | 33.9 | 47.2 | 28.8 | 23.8 |

Ultra-low Volume (ULV) application: Because synthetic pyrethroids are of low mammalian toxicity, four which are commercially available as ULV formulations (Decis, Ambush, Ripcord and Sumicidin) were tested against the standard insecticides recommended for cowpea pests in a replicated field trial on a farmer's field on Odo-Ogun, a village northwest of IITA.

The insecticides were applied at 33, 44, and 55 DAP. Treatments with synthetic pyrethroids and Nuvacron gave good results. Thiodan was the least effective (Table 11).

Table 11. Yield of VITA-5 under different ULV insecticide applications on a farmer's plot. Second season, 1977.

| Insecticide | a a.i. ha per application | Yield kg/ha |
|---|---|---|
| Ripcord | 70 | 960 |
| Nuvacron | 500 | 793 |
| Decis | 25 | 690 |
| Sumicidin | 250 | 683 |
| Ambush | 50 | 525 |
| Thiodan | 500 | 423 |
| Control | | 175 |
| C.V. | | 33.6 |

1978

Comparison of insecticides applied at high volume for control of cowpea pests (IITA. 1978.)

| Insecticides | Dosage g a.i. ha application | % damage by Leafhoppers on foliage | Ootheca on leaves | Maruca on pods | Thrips on flower buds | Thrips Count on 10 flowers | Yield kg ha |
|---|---|---|---|---|---|---|---|
| 1. Decis | 12 | 6.7 | 11.7 | 30.7 | 18.3 | 53.7 | 542 |
| 2. Decis | 25 | 7.7 | 7.7 | 37.3 | 12.4 | 51.8 | 818 |
| 3. Permithrin | 25 | 4.3 | 12.7 | 25.3 | 8.2 | 29.3 | 922 |
| 4. Permithrin | 50 | 7.7 | 7.0 | 26.7 | 7.0 | 17.4 | 917 |
| 5. Sumicidin | 50 | 8.3 | 8.3 | 16.0 | 11.0 | 31.8 | 708 |
| 6. Sumicidin | 100 | 5.3 | 8.5 | 10.0 | 6.7 | 26.4 | 519 |
| 7. Moncrotophos Combi | 500 | 6.7 | 8.4 | 23.3 | 3.0 | 2.7 | 981 |
| 8. Methomyl | 500 | 9.3 | 20.3 | 12.7 | 8.3 | 21.6 | 817 |
| 9. Control | | 33.3 | 25.0 | 45.3 | 33.4 | 159.7 | 399 |
| S.E. | | 0.7 | 1.5 | 1.7 | 1.0 | 6.6 | 33.9 |
| C.V. | | 38 | 62 | 35 | 44 | 78 | 24 |

There is an excellent chance that one of the synthetic pyrethroids would be superior to malathion as the pesticide extended in NDD II for regular use on cowpea. As with orthene, they are not currently registered for use on any of the NDD II crops in the U.S.--thus, residue data would have to be collected as the basis for an E.A., and this would be simplest for either permethrin or fenvalerate since ADIs have been established in the U.S. and both have been granted crisis exemptions for food crops. Permethrin also has a provisional maximum residue level (MRL) on beans established by the joint meeting of FAO/WHO on pesticide residues.

Permethrin is not recommended for NDD II trial because the author has tested it on farmers' cowpea fields in northern Nigeria and found that it is not very effective against pod-sucking bugs (the major pest in that area), and that its use tended to trigger late-season aphid infestations. ICI has withdrawn it from the Nigerian market in favor of cypermethrin, which was found effective for cowpea protection in 1979 field trials at Zaria, (northern) Nigeria by Dr. Ashok Raheja, Ahmadu Bello University entomologist. Weekly ULV applications after flowering were best, and World Bank projects in Nigeria are planning to extend it to farmers on that basis. (Such a heavy application rate should not be necessary in Niger, where pest problems are less severe.) Fenvalerate (Pyrin or Sumicidin) is generally

less effective than the other synthetic pyrethroids, even in much larger doses (see IITA data above).

Either cypermethrin or decamethrin would seem the superior choice for use in Niger on cowpeas. Cypermethrin (Ripcord) is desirable for possible future inclusion in the NDD II extension package. It is very effective at low dosages (see IITA data above), and has been successfully tested in Nigeria.

Since there has been no ADI established in the U.S., DS/AGR should advise NDD II staff about what field data will be necessary as background for an EA, and how to collect it (residues, applicator exposure, etc.). This data collection should be carefully supervised and done soon, as the effectiveness of this compound in Niger is likely to be confirmed.

NOTE: Because cypermethrin, like other synthetic pyrethroids, is comparatively expensive, COST-EFFECTIVENESS in relation to the alternatives (malathion, diazinon, orthyene, fenitrothion) should be the criterion for its incorporation into the NDD II extension program. In any case, an EA justifying its use by project personnel would be helpful for this and other USAID projects.

Another observation that should be carefully made when testing Ripcord is whether its use leads to outbreaks of secondary pests such as aphids, by being relatively harder on small beneficial species.

f) Fenitrothion

Fenitrothion is currently being used on a large scale in Niger, applied both on the ground and (more often) by airplane, for pests of millet and cowpea. It is being supplied by foreign donors, is only moderately acutely toxic, and is relatively inexpensive.

It is recommended for cost-benefit testing by NDD II as a possible future component in the extension package. It is likely to be employed in Niger for the foreseeable future and it would be helpful to justify its use by AID personnel in an EA. Again, DS/AGR should advise on the type of data collection necessary to do so. The tolerance established on wheat gluten imported from Australia should provide a starting point.

3. The Extent to Which the Proposed Pesticide Use is Part of an Integrated Pest Management Program

Reliance on a single pest control method such as a chemical pesticide does not always provide lasting protection. Experience has shown the desirability of spreading the burden of pest protection over a variety of methods--biological, physical, and chemical--integrated and used on the basis of anticipated economic, ecologic and social consequences. The approach is known as "Integrated Pest Management" (IPM).

Highly desirable components of many IPM systems include the use of crop plants that genetically resist or tolerate pest

populations; the use of naturally-occuring biological organisms such as predators, disease agents, and parasites; and the use of cultural or habitat management practices such as crop rotation, destruction of postharvest crop residues, selection of planting time, and selection of appropriate crop mixes. Some of the most effective non-chemical IPM techniques are traditional. An objective of IPM is to identify and maximize the use of natural biological, environmental, and traditional control methods known to be effective. Pesticides are used only when definitive data demonstrate their economic advantages as supplements to the non-chemical methods; their use is based on economic criteria that determine when and where control is truly justified. Further, pesticides that pose minimal risks to humans, other nontarget organisms, and the environment, are sought and encouraged.

At present, not enough research has been done to institute an effective IPM program for any Nigerien crop. Economic criteria for pest control have not been established; the real value of natural enemies is not known; there has been no effort to seek ecologically selective pesticides; and there is no organized systematic pest population monitoring system for any crop. A major obstacle slowing progress with IPM in Niger is the lack of crop protection specialists properly trained in the ecological principles of pest management.

Pesticide use by NDD II will incorporate as much IPM practice as possible under present circumstances. The pesticides will

be evaluated and compared economically and minimum effective dosages determined. Traditional nonchemical pest control methods will be evaluated and incorporated into extension recommendations. Pest-resistant crop varieties will be used when they become available; at present, no practically dependable resistance to the major pests has been bred into cowpeas, and millet and sorghum breeders in the Sahel are not evaluating this aspect of their lines, although there is potential for progress. (Beique (3) suggests that contarinia and Atherigona are promising targets on sorghum and millet, and observes that Rhaguva spp. do less damage to dense-headed millet and that H2D2 millet seems to be resistant to the borer Chilo pyrocaustalis.) Cultural practices that discourage pest infestations will be recommended to farmers as part of the extension package. When economic injury level information and pest-population monitoring methods are developed by INRAN, IITA, ICRISAT, or the planned FAO/CILSS Sahel IPM Project, NDD II will use these techniques to plan crop protection activities. Except for cowpea, crops will presently be treated with insecticide only when pest infestations occur (see IV. A.).

### 4. The Proposed Method or Methods of Application, Including Availability of Appropriate Application and Safety Equipment

Applications will be made by project personnel or by farmers who have received NDD II credit to buy pesticides. Both of these

groups will have had instruction in the safe use of pesticides (See IV.C. 11. below). The materials will be applied at the rates and intervals prescribed on the manufacturer's labels.

Field pesticides will be applied with hand-pump or "Fontan" knapsack sprayers or manual dusters, depending on the insecticide formulation used and the target pest species. ULV sprayers may be considered for adoption at some future date. Sprayers will be stored at farmer cooperatives and for each sprayer, two sets of safety apparel (goggles, masks, filters, aprons, gloves, boots) will be available.

NDD II project managers will enforce, among project personnel and farmer cooperators, the use of essential protective apparel, proper storage and maintenance of pesticides and application and safety equipment, and proper disposal of used pesticide containers and left-over pesticides. Project personnel will ensure that instructions and precautions, including statements regarding the time of re-entry into the field after pesticide application and the number of days between application and crop harvest, as specified on the product label, are enforced.

5. Any Acute and Long-Term Toxicological Hazards, Either Human or Environmental, Associated with the Proposed Use, and Measures Available to Minimize Such Hazards

All pesticides are potentially hazardous to humans and the environment and should be treated with great caution regardless of their relative toxicity.

The pesticides requested for use in NDD II--Arasan, diazinon and malathion--are used widely in the USA by farmers, homeowners, gardeners, livestock owners, and others and can be purchased and applied without USEPA restriction. Each is relatively acutely nontoxic to warmblooded animals, based on its acute oral toxicity value ($LD_{50}$), and is considered to be relatively safe for use by humans if used according to the label instructions. The pesticides chosen for experimentation and possible future NDD II use are of the same order of low acute toxicity, and they are proposed for experimentation only because their cost-effectiveness in Niger must be proven, and to collect data to justify their use in the absence of USEPA registration for NDD II crops. The absence of such registration is not necessarily a sign that a certain pesticide is undesirable; world marketing arrangements and the long USEPA registration process for a wide range of crops mean that many relatively safe, effective, and widely-used chemicals will not yet have achieved registered status in the U.S.

None of the chemicals chosen is the subject of present or foreseen USEPA regulatory action.

Diazinon, malathion, cypermethrin, orthene and fenitrothion are toxic to cold-blooded animals in general, and thus represent a danger to bees, other beneficial insects, and fish. High dosages may harm wild birds, livestock and game and (in the case of diazinon) may have phytotoxic effects.

All of these potential hazards can be minimized by adopting appropriate safety procedures and dosages and by applying the pesticides selectively and judiciously, based on actual need. Millet and sorghum are wind-pollinated, and cowpea and peanut largely self-pollinated, so the proposed use patterns present little threat to bees and other pollinators and to successful setting of seed. No bush will be sprayed, and wildlife is sparse in farmed areas, so the potential impact on game is small. Permanent bodies of water are extremely few and the project area does not adjoin the Niger River (Niger's only year-around stream), so these pesticides will not contact aquatic ecosystems to any significant degree.

6. The Effectiveness of the Requested Pesticides for the Proposed Use.

This is discussed under IV.C. 2. above. The pesticides requested for immediate NDD II use have been previously tested and/or used in Niger, and additional specific details concerning their recognized range of effectiveness were drawn from U.S. data where pests and cropping situations are similar to those in the project area. The requested pesticides will be applied according to instructions on their manufacturers labels. Therefore, it is assumed that their use will adequately control pests unless pesticide-resistant strains are present in Nigerien pest populations. No such resistant strains have been reported thus far.

7. Compatibility of the Proposed Pesticides With Target and Nontarget Ecosystems.

See IV.C. 5., above.

8. The Conditions under which the Pesticide is to be Used, Including Climate, Flora, Fauna, Geography, Hydrology and Soils.

See II. above.

9. The Availability and Effectiveness of Other Pesticides or Nonchemical Control Methods

See IV.C. 2 and 3., above, and Project Paper Annexes "Plant Protection in Niger, with Special Reference to Niamey Department and NDD II Project Design," and "Suggested Guidelines for IPM-Oriented Extension Recommendations, Pesticide Safety Precautions, Equipment and Training, and NDD II Testing of Pesticides."

10. The Requesting Country's Ability to Regulate or Control the Distribution, Storage, Use and Disposal of the Requested Pesticide.

See Project Paper Annex "Plant Protection in Niger, with Special Reference to Niamey Department and NDD II Project Design."

11. The Provisions Made for Training of Users and Applicators

All NDD II pesticide use will be supervised by the project agronomist and a staff or consultant entomologist. Enhanced supervision and training components have been designed into Phase II of this project, with a view, among other goals, to ensure the safe, judicious use of pesticides.

These senior staff will familiarize themselves with the appropriate safety measures for project pesticide use, and proper application procedures, and make sure that these guidelines are observed by staff and carefully extended to farmers. CPT extension staff will have attended yearly plant protection short courses given to Niamey Department Agricultural Service staff by the Plant Protection Section. The farmer-training curriculum at CPTs will emphasize the proper use of pesticides and correct spraying techniques, including potential hazards and precautions to minimize these hazards. Stress will be laid on the proper use of safety apparel and devices and also proper procedures for disposing of used pesticide containers and left-over pesticides. It is the responsibility of project staff to see that this part of the curriculum is carefully and effectively communicated to farmers, and that any subsequent observed misuse of pesticides be corrected.

Only farmers who have received such training at CPTs will be eligible to receive pesticide purchase credit and access to project-supplied pesticides.

### 12. The Provisions Made for Monitoring the Use and Effectiveness of the Pesticides

An applied research component has been designed into Phase II of the NDD expressly to test the cost-effectiveness of the various components of the recommended package of improved agricultural practices, including pesticide use (5). This is fully discussed

in section IV. B. and in the Project Paper Annex, "Suggested Guidelines for IPM-Oriented Extension Recommendations, Pesticide Safety Precautions, Equipment and Training, and NDD II Testing of Pesticides."

Pesticide use by farmer graduates of CPTs will be observed by project extension agents during the routine visits, and monitored closely as one aspect of the evaluation of the effectiveness of the project's training/extension component. A heavy emphasis on such evaluation has been designed into Phase II of the NDD. Misuse of pesticides will be noted and corrected. Senior staff will, in turn, make sure that CPT staff and extension agents are competent with reference to pesticide use, and that the proper procedures are followed by them.

## V. SUMMARY AND CONCLUSION

Most impacts of project activities have been identified as significantly beneficial over the long term. The project promises to increase agricultural production by small farmers within the project area. Potential benefits should outweigh the potential negative impacts on the human environment.

RECOMMENDED THRESHOLD DECISION:

Negative. An Environmental Assessment or an Environmental Impact Statement are not required.

ANNEX D

# NDD II PROJECT DESIGN
# WITH RELATION TO PESTICIDE USE

## I. USAID REGULATION 16

USAID Regulation 16, Part 216 -- Environmental Procedures, became effective on June 28, 1976, as the result of a court order in the United States, and was amended in compliance with that court order on May 3, 1978. Regulation 16 was adopted to protect the environment of developing countries and the health of those countries' people. It applies to any project and in which funds may be used for the procurement and/or the application of pesticides. In the case of non-compliance, a project will not be approved for funding by USAID/Washington. USAID fundings for Phase II of the Niamey Department Development will therefore be contingent on a certification of compliance with Regulation 16.

Regulation 16 discourages the use of USAID funds for projects that procure or use pesticides that are not registered for the same or similar purposes by the US Environmental Protection Agency (USEPA) in the United States. The Project Paper, which is a technical analysis of the project to be submitted to USAID for funding approval, contains an Initial Environmental Examination which describes proposed pesticide use by the project and attempts to justify this use. When the IEE contains a proposal for the use of:

A. Any pesticide <u>other than</u> one registered in the U.S. for the

same or similar use as that proposed in the project, or for general use, or

B. Any pesticide for which a notice of rebuttable presumption against registration (RPAR), notice of intent to cancel registration, or notice of intent to suspend registration has been issued by the USEPA, a formal, technically sophisticated and well-documented Environmental Assessment (EA) must be prepared evaluating the risks and benefits of the proposed pesticide use and the possible alternatives. This assessment must be submitted as part of the Project Paper and approved by USAID/Washington with comment by the USEPA before the U.S. Government can commit funds to the project.

The regulation allows the following exceptions to the above rule, suspending the requirement of an Environmental Assessment,

A. When USAID is a minor donor to a multi-donor project. USAID is considered a minor donor when

1. AID's total contribution to the project will not exceed either $1,000,000 or 25% of the estimated project cost; and

2. AID does not, under the terms of the agreement governing its contribution, control the planning or design of the multi-donor project.

B. Under emergency conditions. Emergency conditions shall be deemed to exist when it is determined by the USAID Administrator in Washington, in writing, that

1. A pest outbreak has occurred or is imminent; and
2. Significant health problems (either human or animal) or significant economic problems will occur without the prompt use of the proposed pesticide; and
3. Insufficient time is available before the pesticide must be used to evaluate the proposed use in accordance with the provisions of Regulation 16.

C. When the pesticides in question are to be used for research or limited field evaluation purposes by, or under the supervision of, project personnel. Treated crops will not be used for human or animal consumption unless appropriate tolerances have been established by the USEPA or recommended by FAO/WHO, and the rates and frequency of application together with the prescribed post-harvest intervals, do not result in residues exceeding such tolerances.

## II. USEPA STATUS OF PESTICIDES PRESENTLY USED IN NIAMEY DEPARTMENT AND THE NDD PHASE I

The table on the following page lists the principal pesticides used by the Department of Agriculture and by the NDD Phase I in Niamey Department, and their present EPA status.

| PESTICIDE | USEPA STATUS |
|---|---|
| HCH (25% BHC) | (BHC) pre-RPAR*, and registration voluntarily cancelled on all crops by the manufacturers based on oncogenicity, fetotoxicity, and reproductive effects (chronic toxicity). |
| LINDANE (Gamma-20) | RPAR based on oncogenicity, teratogenicity reproductive effects (chronic toxicity), and acute toxicity. |
| DIAZINON | Registered for use on sorghum (and therefore millet, a similar use) without restriction. |
| DIMETHOATE (Systoate, Asthoate) | RPAR based on oncogenicity and mutagenicity (chronic toxicity). |
| FENITROTHION | Registered for forest insect control only. |
| 45-12 (Endrin/DDT) | All field crop insecticides containing DDT have been cancelled. |
| PEPROTHION (Methyl parathion/endosulfan/ DDT) | All field crop insecticides containing DDT have been cancelled. |
| HEPTACHLOR (in Thioral) | Cancelled by July 1, 1983. |
| <u>Pesticides being tested as HCH substitutes</u> | |
| BAYGON (Unden) | Not registered for food crops and no new registrations anticipated in the near future. |
| DECAMETHRIN (Decis) | Believed not yet registered for the same or similar uses (Washington's confirmation pending) |

* RPAR means that USEPA intends to deny registration of the pesticide after a waiting period during which rebuttals of that decision may be submitted.

Seven of the eight principal pesticides used by the Niger Department of Agriculture and NDD II would require preparation of an EA to consider justifying their use or purchase with USAID supported NDD II project funds. USAID/Washington informed the USAID Niger Mission that trying to adequately justify the use of such chemicals as heptachlor and BHC in an EA would require visits to Niger by several pesticide specialists and a long delay before consideration of the funding request. USAID therefore engaged the services of an environmental expert to find approved substitutes for the undesirable chemicals for use in NDD II.

Substitutes for use in NDD II and of potential value in other projects have been tentatively identified, but the GON feels, with justification, that they must be tested for dependability before their use. Pesticides intended for extension to farmers by NDD II must also be tested for safety and economic viability.

## III. PROPOSED DESIGN FOR NDD II PESTICIDE USE

USAID/Niger believes that pesticide use in other Sahelian countries may be similar to that in Niger. Other USAID-supported projects that are currently under consideration in Niger or in such Sahelian countries, or extensions of existing projects, will encounter difficulties complying with Regulation 16. With this in mind, the USAID design team for NDD II

proposes the following for consideration by USAID and the GON:

A. In consultation and perhaps cooperation with the USAID-supported Niger Cereals Research Project, the CILSS/USAID Sahel IPM Program and INRAN, NDD II will

1. Conduct applied pesticide research under the supervision of project personnel, and
2. Attempt through said research to
   a. confirm the identification of effective substitute pesticides that are reasonably safe for applicators and registered for the same or similar uses by the USEPA, and
   b. collect data on applicator exposure, residues, safety, proper dosages and effectiveness of pesticides which may prove to be safe and effective substitutes but which have not yet been registered for use on field crops by the USEPA. This data can be used to justify the use of such pesticides by the NDD with a detailed and convincing EA that will be acceptable to USAID.
3. Transfer grain grown on fields that are used for applied pesticide research to the seed multiplication centers under the National Cereals Project. Such grain will then be processed and treated for use as seed by the seed multiplication centers, thus avoiding consumption

of the grain by humans or animals.

B. Safe and effective pesticides identified by the research program described above will be incorporated into the NDD II package of improved agricultural practices subject to

1. Economic evaluation and justification of their use, and

2. Approval of their use in the project by the GON and USAID. (USAID approval for inclusion of such pesticides in the NDD II extension package may require the filing of an amended IEE and, if pesticides not registered by the EPA are to be used, the submission of a risk/benefit analysis in the form of an EA.)

C. Pending

1. Identification of substitute pesticides acceptable to GON and USAID, that are then adapted for general use in the project zone, and

2. Exhaustion of stocks of unapproved pesticides, or the complete phasing-out of such pesticides for general use in the project zone.

USAID will require an agreement with the GON (in the form of a covenant in the convention between USAID and the GON) that, with the exception of pesticides accepted for NDD II use and extended by the project to farmers,

1. All plant protection in the project zone will be

effected by or under the supervision of Agriculture Service personnel unconnected with NDD II, and

2. No project resources, including personnel, vehicles, equipment, or funds will be used for the purchase or use of pesticides, except if the Administrator, AID determines that emergency conditions exist as in (I) above. He may be aided in this determination by other international organizations such as WHO and FAO.

This NDD design proposal is offered as a constructive step toward approval of the NDD II, and toward a long-term solution of the problems posed by USAID Regulation 16 for this and other USAID Sahel agricultural projects that procure or use pesticides.

We respectfully submit this proposal to the GON and urge its timely acceptance.

ANNEX E

NDD II September 1980

# SUPPLEMENT TO PROJECT PAPER

## Suggested Guidelines for IPM-Oriented Extension Recommendations, Pesticide Safety Precautions, Equipment and Training, and NDD II Testing of Pesticides

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## I. IMPLEMENTING AN INTEGRATED PEST MANAGEMENT APPROACH

A. Traditional insect control methods, such as burning Coleopteres in the field, should be preferred to pesticide use and assessed for incorporation into the NDD extension package.

B. Experimental data routinely taken for field crop pesticides should include not only yields, but also comparative counts of each major pest for the different treatments: a) as early in the season as their presence can be detected; and b) again during the period of major crop damage. This will aid in interpretation of experimental results and facilitate the development of Economic Injury Level standards that will ultimately enable project personnel and farmers to avoid unnecessary pesticide applications. Observation methods and/or early detection of some major pests:

MILLET

1. Rhaguva spp., "la chinille des chandelles du mil": the small larvae mine flowers, and can be detected by their frass--small white granules emitted from the flowers--before they grow large enough to start mining the surface of the seedhead.

2. Geromyia Penniseti (millet) and Contarinia sorghicola (sorghum), "les cecidomyies.": the larvae of these midges mine seeds. Large numbers of adults on the young seedheads mornings and evenings are a sign of an impending infestation (as with other

pests listed here, no numerical standards for a significant number exist for West Africa). Slipping a clear plastic bag over the seedheads quickly can capture them for counting. See "Insect and Mite Pests of Grain Sorghum--Management Approaches," Texas Agricultural Extension Service leaflet.

3. Stem borers: local entomologists and the NDD entomologist should try to identify early detection methods usable by farmers (light traps being too expensive).

COWPEA

1. Thrips: inspect flower buds just as peduncles begin to lengthen. If many buds have dropped off of the peduncles, it is probably due to a heavy thrips infestation. Try to develop a practical damage-rating system.

2. Pod borer (*Maruca testulalis*): If a large proportion of flowers are infested with small (~1 mm) *Maruca* larvae early in the flowering period, substantial damage is likely. % infestation can be recorded (# of flowers infested/100 flowers).

3. Pod-sucking bugs can most easily be counted by taking numbers observed visually per X no. of cowpea stands.

These are meant as general guidelines and it is hoped that entomologists from CILSS/FAO, INRAN, IITA, and ICRISAT will be able to enlarge upon them and advise for other major pests (large beetles, aphids, and hemipterans in general can probably be handled with some sort of visual sampling unit).

C. Minimum effective dosages of pesticides should be determined and recommended.

D. Only pesticides which pay for themselves (in increased yield) at the recommended doses should be extended to farmers.

E. If pest-resistant varieties of cowpea and millet are identified by INRAN, IITA, or ICRISAT, they should be used by NDD and pesticide recommendations reduced accordingly.

F. If economic injury level information and pest population monitoring methods are developed by INRAN, IITA, ICRISAT or the FAO/CILSS Sahel IPM Project, these techniques should be taught to farmers for their use in making crop protection decisions.

G. Pesticides should be applied to millet only when pest infestations occur. (See B. above for observation methods.)

H. Cultural practices that discourage pest infestations should be extended to farmers. Among them are:

1. Weed removal near fields reduces stem borer populations.
2. Stem borers can be killed by drying crop residues in the hot sun before they are used as building material or animal feed. Unused residues should be burned or turned under the soil <u>deeply</u>.
3. Dense, early planting of peanuts discourages aphid attacks.
4. Early, uniformly-maturing cereals tend to escape the buildup of seed midge populations.

## II. PESTICIDE SAFETY PRECAUTIONS

### A. Field Crop Pesticides

1. Two sets of safety apparel will be available with every sprayer for NDD staff or farmer use (sprayers and safety equipment for farmers will be maintained and stored at cooperatives). These will consist of goggles, mask, filters, apron, gloves and boots. Safety apparel should ALWAYS be worn during spraying operations. This should be taught to farmers at CPTs and enforced by--and demonstrated by--project personnel.

2. Precautions specified on manufacturer's pesticide labels should be observed, including statements regarding the time of re-entry into the field after Pesticide application and the number of days between application and crop harvest.

3. Project staff and CPT farmer-trainees should be carefully instructed about correct use of sprayers, especially with reference to wind conditions. This will reduce applicator exposure to pesticides.

4. Farmers and staff should be carefully instructed about safe methods of mixing the recommended dosages of pesticide for field application, and the correct proportions of insecticide and water for the various chemical dilutions. Locally-available containers (i.e. evaporated milk cans or

mackeral cans) could be used as easy-to-remember standard measures.

B. Arasan Seed Treatment

1. Farmers should tie a cloth over their nose and mouth while treating seed, so as to avoid breathing the fungicide dust.

2. Fungicide and seed should be mixed with a stick or other implement in an enamel basin. Calabashes and (to a lesser extent) plastic containers will adsorb poisons and could be dangerous if reused for other purposes. The enamel basin should be washed thoroughly before reuse.

3. Handling of fungicide and treated seed with bare hands should be avoided. Hands (and other parts of the body or clothes) that have been in contact with the fungicide should be immediately and carefully washed.

III. EQUIPMENT

A. Sprayers

1. The "Fontan." This is the sprayer presently used by NDD. Its advantages are delivery of a good droplet size and the fact that it can handle any form of pesticide. Some often-overlooked points of proper maintenance:

a) The Fontan's air filter attachment is rather flimsy and gets easily knocked off or away in the field. Care should be taken that it is tightly in place and

fitted with a clean filter. Otherwise, engine life is reduced by two-thirds.

b) Models with spark plugs on top are best. The best way to stop the engine is to turn off the petrol feed and let it die. When the engine is turned off with the choke (a frequent mistake), spark plugs on the bottom of the sprayer get flooded with oil and must then be cleaned.

c) The petrol/oil mixture must be correct.

2. Ultra-Low Volume (ULV) Sprayers. The "Fontan" sprayer used by the project at present is very expensive ($5,000), heavy and unwieldy, complicated to repair, and has a short lifespan (approximately 2 years) under project conditions. ULV sprayers, designed to deliver pesticides in an aerosol (breeze-born small droplets), are being used in many developing countries, especially where labor and/or water are not plentiful. They are light, handheld, and run on ordinary flashlight batteries. Advantages: 1) Superior pesticide delivery/crop coverage when sprayer is properly used. 2) No mixing of pesticides with water--and therefore no hauling of water to the field--is necessary. Special concentrated spray formulations are packaged (in a convenient size) for direct use. 3) Large areas can be sprayed quickly; one person

can spray the average Niamey Department farm in two to three hours. 4) Ease of transport and manipulation. 5) Inexpensive: in 1979, sprayers were sold to farmers at cost by the World Bank in northern Nigeria for 16 naira ($30.00 U.S.). Batteries must be changed often and are an added expense.

Disadvantages: 1) Unsafe for use with toxic pesticides by unsophisticated applicators since concentrated chemicals are delivered in a form easily inhaled/assimilated by humans. 2) The technology is still being perfected. A particular problem is the lack of an indicator to show the user when the battery power has dropped below necessary levels for effective operations. General sprayer design and performance are being rapidly improved by Prof. G. W. Matthews and graduate students at Imperial College, Field Station, Silwood Park, Ascot, Berks. SL5 FPY, U.K. Major improvements should become available with the next 2-3 years, including a battery strength indicator, far better battery life and superior delivery of the pesticide, which will lower pesticide dosages.

USAID should consider conversion to use of these sprayers after they have been improved. If, in the meantime, the "Fontans" seem inappropriate, hand-pump knapsack sprayers are a third alternative.

B. Sprayer Maintenance

1. No equipment should be extended to farmers without provision of repair services and spare parts. When sprayers become available at local cooperatives for the recipients of pesticide purchase credit, each CPT should carry a stock of spare parts and have a repair facility with a mechanic available who is specifically trained in the repair of these machines.

   Training in the repair of "Fontans" can be obtained through the Canadian aid mission to Protection des Vegetaux. The project should buy and stock a selection of spare parts.

   If another type of sprayer is adopted for project use, the manufacturer should be asked to train repair personnel and instruct project staff concerning proper methods of pesticide application with the new equipment.

2. Coop officials should be held responsible for proper maintenance and storage of sprayers, pesticides and safety equipment. This should be continuously monitored by project staff, and coop officials should be paid for responsible caretaking of project equipment.

## IV. TRAINING

See Section IV.C. 11. of the "Detailed Study of Pesticides to be routinely Used and/or Field Evaluated for Possible Use."

## V. PESTICIDE TESTING

### A. Personnel Requirements

The importance of applied pesticide research to the NDD project and to other AID agricultural projects in the Sahel justifies the employment of a full-time entomologist. Barring this, a consultant economic entomologist should be hired for approximately six weeks to advise the project agronomist, generate the experimental design (including methodology for taking the required observations), and give instructions for correct statistical analysis of the resulting data.

### B. Data Collection for Economic Analysis

Labor input (person-hours) and expense required per ha. for each spray technology and pesticide tested (at the dosages found to be most effective) must be carefully recorded.

### C. Time Frame

Insecticides new to Niger should not be recommended to the Nigerien government nor extended by the NDD without data from two to three growing seasons. During this period, they should have been assessed against the major pests of the crop(s) for which

they are intended, and their use justified economically. Field crop pest infestations vary from year to year and place to place. It is quite possible that, in some years, insect pest infestations will be inadequate for testing insecticides on a certain crop (INRAN entomologists at Tarna-Maradi have encountered this situation). Therefore ("worst-case" projection), it may take as long as the entire 5-year life of the NDD II project to identify safe, dependable, economic pesticides for certain crops/pests. NDD II should simply incorporate desirable pesticides into its technical package extension/credit system as they are identified.

D. Pesticides

1. Pesticides should be ordered on a yearly or biannual basis in order to avoid degradation during storage under tropical conditions. This will also avoid unnecessary outlays for pesticides that prove unsatisfactory for inclusion in the NDD improved agricultural package, or which are replaced by more effective chemicals.

2. Chemicals <u>not</u> registered for the same or similar uses in the U.S. may be found safe and effective under Nigerian conditions. (For example, synthetic pyrethroid insecticides are not yet registered for many field crop applications in the U.S.) In anticipation of this, applicator exposure and residue data should be collected during the last year of testing so that a risk/benefit analysis of the pesticide use (in the form of an

Environmental Assessment) can be easily and convincingly prepared. DS/AGR will advise concerning the type of data necessary and appropriate ways of collecting and analyzing it.

3. The manufacturers of the pesticides must provide toxicological and environmental data necessary to safeguard the health of research personnel and the quality of the local environment in which the pesticides will be used. Project personnel should request this data and plan their activities in reference to it.

E. Experimental Layout and Techniques

1. Agricultural conditions vary considerably in different parts of the project zone, and we wish to develop high-quality data at every CPT because it will be the only reliable source of information on the special pesticide requirements of that particular environment. Also, insect pest infestations are often patchy. For these reasons, experimental treatments should be replicated, with control plots, several times on each CPT, and if possible, these replicates should be scattered over the entire 40 ha. CPT area. Cowpea experimental plots can be planned and laid out before the growing season starts. For testing insecticides against millet pests, which may occur patchily and intermittently, comparative plots can be created where incipient infestations are detected early in the season (see I.B.). The entomology consultant or staff entomologist should generate complete and detailed designs for both types of experiment, and the analysis of the resulting data.

2. The experimental designs should be simple enough so that the results can be analyzed with a pocket calculator by project staff.

3. To minimize insect pest immigration to experimental plots from other treatments or untreated areas, individual experimental plots should be as large as is practicable. Large plots (at least 25 x 25 m) are required for treatments with ULV and "Fontans" sprayers. Observations and yield data should be taken from the central area of the plots.

4. To avoid pesticide drift, a) experimental plots should be separated by wide buffer zones of weeds or unsprayed crops, and b) spraying should not be done under wind conditions that favor drift from one experimental plot onto others.

## VI. SOURCES OF ADVICE AND COOPERATION

1. Drs. M. J. Lukefahr and S. R. Singh
   Entomologists, Grain Legume Improvement Program
   IITA
   Oyo Road, P.M.B. 5320
   Ibadan, Nigeria

   Telephone: 413440
   Telex: TROPIB NG 31417
   Cable: TROPFOUND IKEJA

   NOTE: IITA gives an annual French/English cowpea production training course for African technicians.

2. Dr. Rathore
   Entomologist
   SAFGRAD/USAID/IITA Cowpea Improvement Program
   Kamboinse, Ouagadougou, Upper Volta

ANNEX F

NDD II September 1980

SUPPLEMENT TO PROJECT PAPER: Plant Protection in Niger with Special Reference to Niamey Department and NDD II Project Design

Only gross loss estimates exist for the impact of crop pests in Niger. According to CILSS reports and interviews, grasshoppers and birds take 25-50% of the millet crop, 10-50% of sorghum is lost to *Striga*, 5-15% to diseases, and 5-15% to storage pests, and rosette virus can reduce peanut harvests by up to 50%. A list of Nigerien pests by crop is appended to this paper.

In the face of these losses, the periodically famine-sticken nation has adopted food self-sufficiency as a national goal, and devoted large amounts of government revenue and foreign aid to the development of a national plant protection program. At present, this program uses large quantities of pesticides that have been banned in many developed countries. This report describes that effort and discusses possible ways to legally integrate the NDD II and other agricultural projects supported by responsible foreign donors into the national program.

I. PLANT PROTECTION PROGRAMS AND RESEARCH

A. Projet Nigero-Allemand Protection des Végétaux

This plant pathology project was initiated in April, 1978 in conjunction with the Deutsche Gesellschaft für technische Zusammenarbeit (GTZ) GMBH. The first two years

have seen the basic infrastructure for a pathology program put in place: a headquarters building/laboratory and a repair workshop in Niamey and smaller facilities at Zinder and Tillabery have been constructed; vehicles and equipment have been obtained; a field trial ground has been prepared; and stipends have been offered for the training of Nigerien counterparts to the GTZ staff. The latter consist of a project leader, a field researcher, and a newly-arrived vehicle and equipment mechanic. A vacant plant pathologist's position has remained unfilled. The February 1980 project assessment noted serious problems with lack of candidates for counterpart training and the inability of the Nigerien government to contribute promised services and efficient administrative liaison.

A six-year extension of the project has been recommended, in two 3-year phases. Proposed for the next phase are continued infrastructure development, four more substations, training of Protection des Végétaux (PV) personnel, development of an extension program, and commencement of field research. Experiments suggested include cultural methods for controlling Striga, identification of disease-resistant crop varieties, and some entomology trials--trap cropping and testing of synthetic pyrethroid insecticides against vegetable pests.

B. Projet Nigero-Canadien de Protection des Végétaux

The entomology component of the national plant protection campaign has evolved in three phases since 1970 with Canadian aid and counsel. The project has three Canadian staff at present. An entomologist working for Pluritec Consultants, Quebec, advises the PV staff in Niamey and two researchers, a millet entomologist and an insect taxonomist, are at the Tarna-Maradi INRAN research station. Phase III (1977-1982) is funded for 13 million Canadian dollars, 10 million from the Canadian International Development Agency (CIDA) and the balance from the Government of Niger (GON). This series of projects has established a headquarters in Niamey and an equipped laboratory at Tarna-Maradi, and four quarantine inspection posts. Depots for pesticide and equipment storage are planned for Niamey, Dosso, Maradi and Zinder. Vehicles, sprayers, large quantities of insecticides, and, more recently, aerial application equipment, facilities, and personnel, have been supplied.

Emphasis was placed on training personnel, since the shortage of trained Nigerien staff at all levels hinders the execution of a safe and effective plant protection program. However, Nigerien recipients have not been identified for most of the scholarships offered, and only one of five trainees at Canadian universities completed

the planned degree. Canadian staff help train agricultural agents at the Institut Practique de Developpement Rural (IPDR), Kolo, and give in-country short-course training to about 250 extension aides every year.

C. Biological Control of the Date Palm Scale

The Church World Service continues to fund a biological control program against *Parlatoria blanchardi* based at a laboratory in Agadez. Since the successful introduction of the predatory coccinellid beetle *Chilocorus bipustulatus*, dates are again an economic crop. This project is a section of INRAN (see below).

D. Organisation commune de la Lutte antiacridienne et de Lutte antiaviare (OCLALAV)

OCLALAV, with its headquarters at Zinder, is responsible for the control of locusts and bird pests.

Aerial applications of parathion are directed against the roosts and nesting colonies of graminivorous birds.

Fenitrothion and dieldrin are applied by airplane and UNIMOG "exhaust sprayers" when prospective locust outbreaks are detected. OCLALAV fields 5 prospecting teams that canvass known locust reproduction areas. There has been no serious problem with locusts in recent years. The last plague of *Shistocerca gregaria*, which breeds in the desert area W and NW of Agadez, was in 1954. *Locusta migratoria migratoroides* reproduces only in Mali and on the southern

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shore of Lake Chad. There is currently (1980) an infestation at the latter location, but other locust-control organizations are dealing with it.

A Centre for Overseas Pest Research (COPR)/OCLALAV team has been in Niamey since 1975, studying grasshoppers along the Niger River between Gao (Mali) and Gaya. The Groupement d'Etudes et de Recherche pour le Developpement de l'Agriculture Tropicale (GERDAT) did grasshopper research at Maradi for two years.

E. The CILSS/USAID Sahel Integrated Pest Management Program

Niger is a member of the Comité permenant Interetats pour la Lutte contre la Secheresse au Sahel (CILSS), and is participating in the researching and development of a Sahel-wide IPM program. The main components will be a surveillance system to signal serious insect attacks (8 observation posts in Niger), bioecological research, the development of loss profiles (Senegal and Niger are the "pays pilotes" of this component), the development of an IPM extension program, nematode research (ORSTOM, Dakar), and training of staff. Specialists in mixed cropping, surveillance and experimentation, legume and cereals entomology, and plant pathology will be employed, each with a counterpart.

F. Institut national des Recherches d'Agriculture Nigerien (INRAN)

Before 1975, because of lack of trained Nigerians,

agricultural research was contracted to French firms, notably IRAT. This organization operated two research stations, one at Kolo/Niamey and one at Tarna/Maradi, and several field stations. In 1975 the Government of Niger (GON) assumed responsibility for agricultural research, creating INRAN.

Seven sections are currently operating at the Tarna/Maradi research station:

--- selection and plant genetics

--- plant protection (pathology and entomology)

--- general agronomy

--- peanuts

--- agricultural machinery

--- animal technology

--- hydrology and water conservation

There is a biological control laboratory at Agadez (mentioned above), a sugarcane station at Tillabery, a rice station at Kolo, stations at Tara and Bengou, and support facilities at Ouallam, Kallapate, Kawara and Magaria.

The staff of the Tarna/Maradi subsection are:

--- Dr. Leyni, Chief; sorghum entomology

--- Mr. Ousmane Bako; cowpea and peanut entomology

--- Mlle. Hélène Guèvremont; millet entomology

--- M. Paul Bouchard; taxonomist

Although the German and Canadian advisors to the Nigerian plant protection program have increasingly urged conversion to an IPM approach, INRAN research at present does not reflect this. There is no work being done on the natural enemies of pests, or economic injury levels. Millet and sorghum breeders do not include insect resistance in their trials, but instead confine themselves to comparing precocity, yield, and seed qualit Some research on pest resistance in cowpea has been carri out in conjunction with the International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. Staff entomologists' efforts center on pesticide trials, and are beginning to emphasize less toxic chemicals such as t synthetic pyrethroids.

## II. PLANT PROTECTION OPERATIONS

### A. National Staff and Operations

The Plant Protection Division (Protection des Végétau or PV) of the Agriculture Service, Ministry of Rural Deve ment, is responsible for all pesticide use in Niger, and for plant quarantine. PV is based in Niamey and has no independent structure in the field; field activities are carried out by Agriculture Service agents. There is a shortage of competent, trained personnel. For the most part, the field personnel are low-level technicians who have had short-course training in the identification and

general characteristics of the common pests, control measures, and use and care of pesticide equipment. They are, as a group, often not equal to the proper execution of their duties.

The PV budget has mushroomed from 65 million CFA in 1978 to 90 million in 1979 and 200 million in 1980. This is not applicable to field staff, who are employees of the Ministry of Rural Development. It is being used for vehicles, insecticides, sprayers, spare parts, safety equipment, and airplanes.

Aerial applications were made on 20,000 ha in 1976 in an effort to control stem borer in millet and sorghum. In 1977, 110,000 ha were sprayed with fenitrothion for the control of grasshoppers and locusts and in 1978 the area jumped to 330,000 ha, nearly all of which was to combat the desert locust. In 1979 there was a diminution of grasshopper and locust attacks (attributed by PV to the effectiveness of the 1978 campaign), and the area sprayed dropped to 67,000 ha.

The long-term goal of PV is to transfer plant protection responsibility to farmers, intervening only in case of serious, large-scale insect infestations. At present, a seed treatment (Thioral, thiram/heptachlor) and HCH powder are distributed to farmers by government agriculture personnel for unsupervised use. All other insecticides are

applied by farmers under the supervision of field personnel, who bring insecticide and sprayers to areas where insect attacks have been reported.

Maintenance and storage of sprayers, insecticides and safety equipment on the local level are poor. Equipment is neglected, stored unwashed and unprotected, and not repaired promptly. Old stocks of insecticide leaking from decomposing drums poisoned a number of goats in one Niamey Department village recently.

There is no systematic appraisal of insect attacks before treatments commence, nor an evaluation of results. Observers remark that a goodly proportion of plant protection activities are "political."

Preharvest intervals when spraying is prohibited are reasonably well-observed with liquid pesticides, but sometimes farmers merely switch to HCH for use up until harvest. Farmers often do not know the correct application methods and dosages for HCH, and it is overused. Widespread misuse of pesticides is indicated by the results of residue testing of foodstuffs purchased in Nigerian markets in 1978 by GTZ researchers (to be repeated in the near future). The report cautions against drawing conclusions from a single set of samples. However, a problem appears to exist: 51% of samples taken of vegetables, fruit, grain, beans, peanuts and tea were found to be

contaminated and unfit for sale (German residue standards). This included 13 of 13 grain samples (rice, corn, sorghum, millet; some imported) and three of five cowpea samples. HCH and Lindane accounted for most of the contamination, but fresh vegetables also included excessive residues of Aldrin, Dieldrin, Heptachlorpoxid, Heptachlor, Chlordane, Endrin, and DDT.

Only a very few farmers have been trained at CFJAs or rural development projects to use pesticides properly. Government field supervision of pesticide application is sometimes inadequate. A 1980 Dosso Department spraying demonstration for the Pluritec plant protection assessment team involved faulty handling of pesticides that was potentially very dangerous to the applicator. Agriculture agents sometimes do not supervise farmer/sprayers closely enough, or insist on the use of protective equipment. Two farmer deaths from Lindane poisoning (Zinder Department) and one case of acute Diazinon poisoning (Konni) came to the attention of officials in 1980. In all cases, farmers presumably spraying under supervision reportedly refused to wear their face masks because the masks are hot and uncomfortable.

Such incidents and the general misuse of pesticides reflect public ignorance about the toxicity, especially the chronic toxicity, of pesticides. HCH is commonly

applied to produce in markets and is rubbed into the scalp for delousing. Interviewees reported seeing Shelltox sprayed on fresh produce and meat, plates of food, and (by nurses) patients in a hospital before the doctor's examination. Children are sometimes allowed, in the presence of their parents, to play in fields still dripping from an insecticide application.

## III. PESTICIDES

There are no pesticide laws in Niger, nor laboratories for residue analysis, though PV officials would welcome training and equipment aid for opening such a laboratory. Decisions on which pesticides to buy are made within the Agricultural Service.

The table on the following page lists the principal pesticides used in Niger and their USEPA registration status. Seven of the eight have had or will soon have their registrations cancelled, or are not registered for the same or similar uses in the U.S. PV plans to depend chiefly on five of these (Unden, HCH, Fenitrothion, Lindane, and Asthoate) for the foreseeable future.

| Pesticide | USEPA Status |
|---|---|
| HCH (25% BHC) | (BHC) pre-RPAR*, and registration voluntarily cancelled on all crops by the manufacturers based on oncogenicity, fetotoxicity, and reproductive effects (chronic toxicity). |
| LINDANE (Gamma-20) | RPAR based on oncogenicity, teratogenicity, reproductive effects (chronic toxicity), and acute toxicity. |
| DIAZINON | Registered for use on sorghum (and therefore millet, a similar use) without restriction. |
| DIMETHOATE (Systoate, Asthoate) | RPAR based on oncogenicity and mutagenicity (chronic toxicity). |
| FENITROTHION | Registered for forest insect control only. |
| 45-12 (Endrin/DDT) | All field crop insecticides containing DDT have been cancelled. |
| PEPROTHIOI (Methyl parathion/endosulfan/ DDT) | All field crop insecticides containing DDT have been cancelled. |
| HEPTACHLOR (in Thioral) | Cancelled by July 1, 1983. |
| <u>Pesticides being tested as HCH substitutes</u> | |
| BAYGON (Unden) | Not registered for food crops and no new registrations anticipated in the near future. |
| DECAMETHRIN (Decis) | Not registered in the U.S. |

* RPAR means that USEPA intends to deny registration of the pesticide after a waiting period during which rebuttals of that decision may be submitted.

## IV. PLANT PROTECTION IN NIAMEY DEPARTMENT AND THE NIAMEY DEPARTMENT DEVELOPMENT PROJECT, PHASE I

The pesticides listed above are presently used by Niamey Department Agriculture Service personnel. The following table estimates the scale of field applications for the period 1977-79.

| | 1977 | | 1978 | | 1979 | |
|---|---|---|---|---|---|---|
| Pesticides | amount | ha. treated | amount | ha. treated | amount | ha. treated |
| HCH kg | 73,980 | 14,796 | 70,770 | 14,154 | 54,034 | 10,807 |
| LINDANE l. | 1,855 | 1,855 | 990 | 990 | 200 | 200 |
| DIAZINON l. | 200 | 400 | 100 | 200 | 100 | 200 |
| DIMETHOATE l. | 820 | 820 | 200 | 200 | 795 | 795 |
| FENITROTHION l. | 7,530 | 30,120 | 21,680 | 86,720 | ? | |
| PEPROTHION l. | -- | -- | 2,496 | 2,496 | 4,220 | 4,220 |
| 45-12 l. | 549 | 549 | 335 | 335 | -- | -- |

NDD Phase I occurs in two contexts:

1. There are two pesticide components in the NDD package of recommended agricultural practices: a seed treatment with Thioral (Thiram and Heptachlor) at the rate of 25g/10-12 kg of seed; and the spraying of sole crop cowpea twice, the first treatment at flowering. These techniques were taught to trainees at the Farm-Couple Training Centers (CPTs), and applied in project demonstrations. Cowpea was usually treated with Peprothion (Methyl parathion/Endosulfan/DDT), but Dimethoate, Fenetrothion, or Lindane were sometimes applied. Insecticide was also applied

to millet at CPTs and on demonstration plots--usually HCH, but sometimes Unden, Fenitrothion or Dimethoate. The 1979 NDD annual report listed pesticides used as: 2080 25-gm packets of Thioral, 1850 l of Peprothion, and 3,000 kg of HCH. Among the project's goals is the provision of recommended pesticides and credit for their purchase to farmers in the project zone who have been trained at CPTs or the CFJA to use them. This system is not yet in operation.

2. One of the stated aims of Phase I of the NDD was to support the activities of the Agriculture Service and other government services in the project zone. Their personnel were integrated into the structure of the project. Forty Agriculture Service field agents staff CPTs and plant demonstrations for the NDD. Their salaries, as well as the expense of pesticides, sprayers and safety equipment, are counted as part of the GON's contribution to the overall project budget. The Agricultural Service still depends on this staff and equipment for carrying out its tasks in Niamey Department, including that of plant protection. NDD staff, pesticides, sprayers, and vehicles are routinely mobilized to effect insecticide treatments where insect attacks have been reported by extension agents, village chiefs, or concerned farmers. At present, the Agricultural Service does not have enough staff, vehicles, or equipment unconnected with the project to carry out these operations independently.

Occasionally senior project administrators have objected to the inconvenience and hindrance of project operations caused by the unpredictable disappearance of staff and vehicles. In reply, a Nigerien law was cited which gives the government the right to enlist even private citizens and their vehicles to cope with emergencies. Given Niger's periodic food shortages, the government chooses to consider the threat of any crop loss due to insect attack as an emergency, at least where NDD resources are concerned.

## V. NDD II PROJECT DESIGN WITH RELATION TO PESTICIDE USE

### A. USAID Regulation 16

NDD I project funding of the purchase and use of insecticides (as described above) was clearly in contravention of USAID Regulation 16, Part 216--Environmental Procedures. This regulation became effective on June 28, 1976, as the result of a court order in the United States, and was amended in compliance with that court order on May 3, 1978. Regulation 16 was adopted to protect the environment of developing countries and the health of those countries' people. It applies to any project and in which funds may be used for the procurement and/or the application of pesticides. In the case of non-compliance, a project will not be approved for funding by USAID/Washington. USAID funding for Phase II of the Niamey

Department Development will therefore be contingent on a certification of compliance with Regulation 16.

Regulation 16 discourages the use of USAID funds for projects that procure or use pesticides that are not registered for the same or similar purposes by the US Environmental Protection Agency (USEPA) in the United States. The Project Paper, which is a technical analysis of the project to be submitted to USAID for funding approval, contains an Initial Environmental Examination which describes proposed pesticide use by the project and attempts to justify this use. When the IEE contains a proposal for the use of:

1. Any pesticide other than one registered in the U.S. for the same or similar use as that proposed in the project, or for general use, or
2. Any pesticide for which a notice of rebuttable presumption against registration (RPAR), notice of intent to cancel registration, or notice of intent to suspend registration has been issued by the USEPA, a formal, technically sophisticated and well-documented Environmental Assessment (EA) must be prepared evaluating the risks and benefits of the proposed pesticide use and the possible alternatives. This assessment must be submitted as part of the Project Paper and approved by USAID/Washington with

comment by the USEPA before the U.S. Government can commit funds to the project.

The regulation allows the following exceptions to the above rule, suspending the requirement of an Environmental Assessment,

1. When USAID is a minor donor to a multi-donor project. USAID is considered a minor donor when
   a. AID's total contribution to the project will not exceed either $1,000,000 or 25% of the estimated project cost; and
   b. AID does not, under the terms of the agreement governing its contribution, control the planning or design of the multi-donor project.
2. Under emergency conditions. Emergency conditions shall be deemed to exist when it is determined by the USAID Administrator in Washington, in writing, that
   a. A pest outbreak has occurred or is imminent; and
   b. Significant health problems (either human or animal or significant economic problems will occur without the prompt use of the proposed pesticide; and
   c. Insufficient time is available before the pesticide must be used to evaluate the proposed use in accordance with the provisions of Regulation 16.
3. When the pesticides in question are to be used for research or limited field evaluation purposes by, or

under the supervision of, project personnel. Treated crops will not be used for human or animal consumption unless appropriate tolerances have been established by the USEPA or recommended by FAO/WHO, and the rates and frequency of application together with the prescribed post-harvest intervals, do not result in residues exceeding such tolerances.

B. Proposed Design for NDD II Pesticide Use

The pesticides used by the Niger Department of Agriculture and NDD I would require preparation of an EA to consider justifying their use or purchase with USAID supported NDD II project funds. USAID/Washington informed the USAID Niger Mission that trying to adequately justify the use of such chemicals as heptachlor and BHC in an EA would require visits to Niger by several pesticide specialists and a long delay before consideration of the funding request. USAID therefore engaged the services of an environmental expert to find approved substitutes for the undesirable chemicals for use in NDD II.

Substitutes for use in NDD II have been tentatively identified, but the GON feels with justification that they should be tested for dependability before their purchase for widespread use. Pesticides intended for extension to farmers by NDD II must also be tested for safety and economic viability.

USAID/Niger believes that pesticide use in other Sahelian countries may be similar to that in Niger. Other USAID-supported projects that are currently under consideration in Niger or in such Sahelian countries, or extensions of existing projects, will encounter difficulties complying with Regulation 16. With this in mind, the USAID design team for NDD II proposes the following for consideration by USAID and the GON:

1. In consultation and perhaps cooperation with the USAID-supported Niger Cereals Research project, the CILSS/USAID Sahel IPM Program, and INRAN, NDD II will
   a. Conduct applied pesticide research under the supervision of project personnel, and
   b. Attempt through said research to
      1) confirm the identification of effective substitute pesticides that are reasonably safe for applicators and registered for the same or similar uses by the USEPA, and
      2) collect data on applicator exposure, residues, safety, proper dosages and effectiveness of pesticides which may prove to be safe and effective substitutes but which have not yet been registered for use on field crops by the USEPA. This data can be used to justify

the use of such pesticides by the NDD with a detailed and convincing EA that will be acceptable to USAID.

c. Transfer grain grown on fields that are used for applied pesticide research to the seed multiplication centers under the National Cereals Project. Such grain will then be processed and treated for use as seed by the seed multiplication centers, thus avoiding consumption of the grain by humans or animals

2. Safe and effective pesticides identified by the research program described above will be incorporated into the NDD II package of improved agricultural practices subject to:

a. Economic evaluation and justification of their use, and

b. Approval of their use in the project by the GON and USAID. (USAID approval for inclusion of such pesticides in the NDD II extension package will require the filing of an amended IEE and, if pesticides not registered by the EPA are to be used, the submission of a risk/benefit analysis in the form of an EA.)

3. Pending

a. Identification of substitute pesticides acceptable

to GON and USAID, that are then adapted for general use in the project zone, and

b. Exhaustion of stocks of unapproved pesticides, or the complete phasing-out of such pesticides for general use in the project zone.

USAID will require an agreement with the GON (in the form of a covenant in the convention between USAID and the GON) that, with the exception of pesticides accepted for NDD II use and extended by the project to farmers,

a. All plant protection in the project zone will be effected by or under the supervision of Agriculture Service personnel unconnected with NDD II, and

b. No project resources, including personnel, vehicles, equipment, or funds will be used for the purchase or use of pesticides, except if the Administrator, AID determines that emergency conditions exist as in (I) above. He may be aided in this determination by other international organizations such as WHO and FAO.

This NDD design proposal is offered as a constructive step toward approval of the NDD II, and toward a long-term solution of the problems posed by USAID Regulation 16 for this and other USAID Sahel agricultural projects that procure or use pesticides.

## VI. COOPERATION AMONG AGRICULTURAL AID DONORS IN NIGER CONCERNING PESTICIDE USE

Present patterns of pesticide use in Niger will inevitably come increasingly into conflict with national laws of foreign donors that fund agricultural projects including the procurement and use of pesticides.

This problem has developed only recently. Because of variations in donor nation laws concerning pesticide purchases and use abroad, and lack of coordination between donors (both individual nations and multidonor agencies), a chaotic situation exists. Many of the pesticides that USAID (and, probably CIDA) must endeavor to find substitutes for in Niger are supplied by foreign donors. In 1979, Niger received the following insecticides in large quantities: HCH, Unden, Lindane, Fenitrothion, and Dimethoate from Canada; Trichlorfon from Austria; and Fenitrothion from BADEA (FAO). The World Bank integrated rural development project in Maradi Department uses insecticides containing Endrin and DDT.

It is strongly recommended that foreign agricultural aid donors in Niger and other developing countries cooperate with each other and with the host countries to encourage the phasing-out of highly toxic or environmentally harmful pesticides in national plant protection programs, and their replacement with effective chemicals that all donors can legally purchase and/or use with their project funds.

INFORMATION SOURCES

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6. Niamey Department Development Project Annual Report and Evaluation 1979. Ministry of Rural Development, Niamey Department.

7. Visits and interviews.

Department of State

INCOMING TELEGRAM

PAGE 01 NIAMEY 00485 2314042 060516 AID1359

ACTION AID-35

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SUBJECT: PESTICIDES AND PESTICIDE EQUIPMENT

1. ESTIMATED PESTICIDE NEEDS FOR 1981 ARE AS FOLLOWS:

| ITEM | QUANTITY |
|---|---|
| ARASAN 50 RED (THIRAM) | 100 KILOS |
| DIAZINON 48 PERCENT EMULSIFIABLE CONCENTRATE | 800 LITERS |
| MALATHION WETABLE POWDER 2 PERCENT A.I. | 1,000 KILOGRAMS |

2. PROJECTIONS FOR YEARS 82 - 85

| | 82 | 83 | 84 | 85 |
|---|---|---|---|---|
| ARASAN 50 RED | | | | |
| THIRAM | 300 KILOS | 500 KILOS | 1,000 KILOS | 1,500 KILOS |
| DIAZINON | 2,400 KG. | 4,000 L. | 6,400 LITERS | 10,000 L. |
| MALATHION WETABLE POWDER | 4 METRIC TONS | 7 M.T. | 10 M.T. | 15 M.T. |

3. PREFERRED PACKAGING AS FOLLOWS

ARASAN PACKETS OF 25 GRAMS

DIAZION FOUR LITERS OR ONE GALLON CONTAINERS

MALATHION REASONABLY BREAK PROOF CONTAINERS OF FIVE TO TEN KILOS

4. REALIZE PACKAGING SMALL QUANTITIES MAY BE COSTLY. IN VIEW OF THIS POSSIBILITY, WE NEED MORE INFO ON AVAILABILITY AND COST OF DIFFERENT SIZE CONTAINERS TO DETERMINE AT WHAT POINT CONVENIENCE OF SMALLER CONTAINERS NOT ECONOMICALLY JUSTIFIABLE

5. IF AVAILABLE EXPERTISE CAN RECOMMEND MORE ECONOMIC OR CONVENIENCT FORMULATIONS OPEN TO SUGGESTIONS PARTICULARLY FOR MALATHION

6. IF CONSIDERING PURCHASES LARGE QUANTITIES SHOULD HAVE INFORMATION ON EFFECT OF LONG TERM STORAGE UNDER LOCAL CLIMATIC CONDITIONS ON CHEMICAL COMPOSITION OF PRODUCT

7. FOR FUTURE REFERENCE WOULD APPRECIATE LATEST FARM CHEMICAL HANDBOOK AND 1980 PESTICIDE LABEL BOOKS FROM MAJOR PESTICIDE MANUFACTURERS E.G. SHELL, CIBA GEIGY, ETC

8. INVESTIGATE PURCHASE OF SMALL QUANTITIES (ONE TREATMENT OF 50 - 100 HA) OF PESTICIDES RECOMMENDED FOR EXPERIMENTAL USE AS PER PATTERSON REPORT TABLE B P. 26 ORTHENE (ACEPHATE) 75 PERCENT SOLUBLE POWDER AND CYPERMETHRIN (PIPCORD) EMULSIFIABLE CONCEN RATE, DUST, ULV

9. INVESTIGATE PURCHASE OF DILOS FOR MEASUREMENT OF EXPOSURE OF APPLICATOR TO PESTICIDE

10. RE SAFETY EQUIPMENT, RECOMMEND A MINIMUM OF 30 SETS OF EQUIPMENT PER CPT SIMILAR THAT ORDERED UNDER PIO/C 683-205-9-20059.

11. INVESTIGATE PURCHASE CONVENTIONAL AND ULV BACK PACK SPRAYERS. BISHOP

## ANNEX G

### Pesticide Specifications

# ANNEX H

## CROP PESTS IN NIGER



A. Insects (by crop)

| Crop | Name | Instar | Damage | Remarks |
|---|---|---|---|---|
| Millet | Rhaguva albipunctella<br>R. bordati<br>R. graminivorella<br>(LEP: Nostuidae)<br>"la chenille les chandelles du mil" | larva<br>(1-2)<br>older | eat flowers, mine surface of seedhead, cutting lower peduncles; hidden between stalk and cut flowers; spiral path the length of the seedhead | Major pest. Not abundant until recently (1974): losses est. 20-25%; one generation per year: pupates 5-20 cm. deep in soil; eggs laid on young seedhead; infestations can be recognized early by frass-little white granules--emitted from flowers by small larvae; worse in damp weather |
| | Geromyia penniseti<br>(DIPT: Cecidomyidae)<br>"cecidomyie du mil" | larva | eats flowers | Larva spend the dry season in the flowers of heads left in the field; adults produced just as first new heads appear; as many as 5 generations/year; difficult to reach with pesticides |
| | Mylabria, Coryna<br>(COL: Meloidae)<br>"Mylabres," "cantharides" | adults | eat flowers | Also eats cowpea flowers; said to respond to same pesticides as grasshoppers |

| | | | | |
|---|---|---|---|---|
| | Schizonicha africana, Pachnoda spp. Anomala plebeja (COL: Scarabaeidae) "caleoptères" | adults | eat flower parts and young milky grains | Attack at night; 1980 infestation more widespread and more serious than usual |
| Sorghum | Contarinia sorghicola (DIPT: Cecidomyidae) "la cecidomyie" | larvae | eat ovary of flowers | Many generations per year; hard to reach with insecticides; major pest |
| | Aphis sacchari (HOM: Aphididae) | all instars | suck plant juices | |
| Sorghum<br>Millet | Atherigona soccate (DIPT: Muscidae) "la mouche du sorgho" | larva | meristem and leaves of young plants | Mostly on sorghum; major pest |

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| | | | |
|---|---|---|---|
| Chilo pyrocaustalis<br>C. partellus<br>(LEP: Pyralidae)<br>"le foreur des tiges du mil" | larva | stem borer | Major pest |
| Dysdercus volkeri<br>(HEM: Pyrrhocoridae)<br>"punaise rouge du cotonnier" | nymphs and adults | sucks young milky seeds | Also attacks cotton and other Malvaceae; Baobabs are secondary hosts |
| Haimbachia ignefusalis<br>(LEP: Noctuidae)<br>"boreur" ou "foreur du mil" | larva | stem borer | Major pest |
| Busseola fusca<br>(LEP: Noctuidae)<br>"borer de mais" | larva | stem borer | 3-4 generations/year; diapauses in dry stalks; major pest |

| | | | |
|---|---|---|---|
| *Sesamia calamistis*<br>*S. cretica*<br>(LEP: Noctuidae)<br>"borer rose" | larva | stem borer | Adults diapause in dry stalk; 5-6 generations/ year; major pest |
| *Spodoptera littoralis*<br>*Heliothis* sp., *Agrotis* spp.<br>(LEP: Noctuidae) | larva | defoliator | Also attack cowpea, cotton |
| *Nezara viridula*<br>*Agonosceles leontyii*<br>*Acrosternum acutum*<br>(HEM: Pentatomidae) | adult | sucks milky seeds | Also attacks cowpea |
| *Epilachna similis*<br>(COL: Coccinellidae) | adult | defoliator | |

| | | | | |
|---|---|---|---|---|
| | *Penegrinus maidis*<br>*Rhopalosiphum maidis*<br>(HOM: Aphididae) | all instars | suck plant juices | |
| | *Forficula senegalensis*<br>(DERMAPTERA) | all instars | chews plants | |
| Cowpea | *Melanagromyza phaseoli*<br>(DIPT: Agromyzidae) | larva | mines stems and leaves of seedling | |
| | *Ootheca mutabilis*<br>(COL: Chrysomelidae) | adult | chews holes in leaves of young plant | Virus vector: seldom does significant physical damage |
| | *Empoasca* sp.<br>(HOM: Cicadellidae) | nymph and adult | sucks plant juices (leaves) | Usually not a serious pest in Africa; also attacks cotton |
| | *Aphis craccivora*<br>(HOM: Aphididae) | nymph and adult | sucks plant juices (stems and pods; more seldom, leaves) | Virus vector; seldom a serious pest otherwise |

| | | | | |
|---|---|---|---|---|
| | Megalurothrips sjostedti (Thysanoptera) | nymph and adult | sucks plant juices from buds, flower peduncles, flowers | Economic damage done to flower buds and peduncles; causes bud abortion; a severe attack prevents flowering of the crop; major pest |
| | Maruca testulalis (LEP: Pyralidae) | larva | eats flowers; larger instars mine pods | To detect level of infestation, look for tiny (less than 1 mm) larvae in flowers early in the season; major pest |
| | Anoplochemis curvipes Mirperus jaculus Clavigralla tomentosicollis (HEM: Coreidae) | nymphs adults | pod-sucking bugs; cause young pods to shrivel and drop; shrivel seed in mature pods | Major pests; also attacks cotton and peanuts |
| Peanuts | Aphis craccivora (HOM: Aphididae) "puceron de l'arachide" | nymphs adults | suck plant juices; stunt young plants and hinder fruit set | Rosette virus vector; major pest; also attacks Malvaceae, Consulvulaceae, Cucurbitaceae, Solanacear; adults diapause in cracks in the soil; less serious in dense plantings |

| | | | | |
|---|---|---|---|---|
| | *Bemisia* sp.<br>(DIPT: Aleurodidae) | adults | suck juices of leaves | |
| | *Creontiades tellini*<br>(HEM: Miridae) | nymphs<br>adults | sucks fruits | |
| Cotton | *Aphis gossypii*<br>(HOM: Aphididae)<br>"puceron du melon"<br>"puceron du coton" | nymphs<br>adults | suck plant juices | Wide host range - Cucurbitaceae, Malvaceae, Solanaceae; virus vector |
| | *Spodoptera littoralis*<br>(LEP: Noctuidae)<br>"le ver du cotonnier" | larva | defoliator | Wide host range |
| | *Heliothis armigera*<br>(LEP: Noctuidae)<br>"chenille du coton" | larva | prefers reproductive parts of the plant | Wide host range |

| | | | | |
|---|---|---|---|---|
| | Earias biplaga (LEPIDOPTERA) | larva | flowers, seeds; causes premature flower drop | Wide host range; economic injury level: 8-15 capsules attacked per 100 plants; pupates 25-30 mm deep in soil; 7-8 generations/year; more abundant in wet weather |
| | Podagria sp. (COL: Chrysomelidae) | adult | flowers | |
| Citrus | Coccidus viridus (HOMOPTERA) "la cochenille verte du citronnier" | nymphs adults | suck juices of all plant parts, including roots | |
| Malvaceae, Peas, Beans, Cassava | Bemisia tabaci (HOM: Aleurodidae) "la mouche blanche du Tabac" | adults | larvae mine leaves; adults suck leaf juices | Virus vector |
| Date Palm | Parlatorea blanchardii (HOMOPTERA) "cochenille blanche du Palmier dattier" | nymphs adults | suck juices of fronds, and in severe attacks, fruit and leaf bases | Worse towards the center of an oasis: successfully controlled by an Agadez-based biological control program using Chilocorus bipustulatus (Coccinellidae) and neuropterans |

| | | | | |
|---|---|---|---|---|
| General Field Crops | Myzus persicae<br>(HOM: Aphididae) | nymphs<br>adults | suck plant juices | |
| | Grasshoppers<br>(ORTHOPTERA: families Acrididae, pyrgomorphidae)<br>Oedalus senegalensis<br>O. nigeriensis<br>Ailopus simulatrix<br>Hieroglyphus daganesis<br>Kraussaria angulifera<br>Cataloipus sp.<br>Zonocerus variegatus<br>Cantatops axillaris<br>Gastrimargus agricana<br>Kraussela amabile<br>Acrotylus spp.<br>Locusts: Locustidae<br>Locusta migratoria migratoroides<br>Shistocerca gregaria | nymphs and adults | general defoliators | |
| Stored Products | Lasioderma serricorne<br>(COL: Anobiidae)<br>"coloptere des cigarettes" | --- | 26-90 day cycle | 6-11 generations; attacks tobacco, flour, cereals, peanuts, beans |

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| Oryzaephilus surinamensis (COL: Silvaniidae) "cucugide dentelé du grain" | | 25 day cycle or less | Cereals, flour (especially wheat flour); adults live up to 3 years |
| Tribolium confusum (COL: Tenebrionidae) "ver de la farine" | larva | 31 day cycle | Flour, chocolate; adults live 6 months |
| Callosobruchus maculatus (COL: Bruchidae) | larva | bores holes in peas 25-33 day cycle | Beans of all kinds; adults lay eggs on mature pods in the field; larvae bore into peas in storage; eggs laid on seed surface; adults live 10 days--several months |
| Sitophilus oryzae S. zea (COL: Curculionidae) "charançon du riz" "charançon du mais" | larva | 26 day cycle | Cereals on the field and in storage; adults live 5 months in humid tropics |

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| Sitrotroga cerealella (LEP: Gelechiidae) alucite des céréales" | larva | 35-37 day cycle | Cereals on the field and in storage: adults live a few days: major pest in arid areas |
| Ephestia cautalle (LEP: Pyralidae) "teigne de l'amandier" | larva | 30-145 day cycle | Cereals, nuts, dried fruit, coffee, skins; adults live 10-12 days; can be major pests |
| Plodia interpunctella (LEP: Pyralidae) "pyrale des fruits" | | 24-31 day cycle | Dry fruit, cereals, flour products, nuts, sugared materials; adult lives 24-31 days (diapause extends this period to 50-60 days); can be major pest |

B. Diseases (by crop)

The plant pathogens of current economic importance in Niger are:

-- Millet

*Sclerospora graminicola*, mildew; *Tolyposporium penicillariae*, grain smut

-- Sorghum

*Sphacelotheca sorghi*

*Tolyposporium ehrenbergii*, smut

-- Cowpea

viruses, bacterial diseases

*Cercospora* sp.

-- Peanuts

*Puccinia arachidis*, rust; first appeared in Niger in 1977

Rosette virus

*Cercospora* sp.

Also present and of potential importance:

-- Cassava

*Zanthomonas manihotis*

-- Bambara groundnut

*Macrophomina*

-- Sugarcane

*Ustilago scitaminea*

-- Rice

*Phyricularis oryzae* (almost eliminated 1979/80 by planting resistant varieties; an as yet undefined disease)

-- Vegetables

Cucumber mosaic virus of peppers, heavy nematode infestations

C. Weeds (by crop)

-- Millet & Sorghum

*Striga hermonthica*

*S. lutea*

-- Cowpea

*Striga gesneroides*

-- General

sedges, genus Cyperus

D. Birds

The three most damaging bird pests in Niger are:

Quelea quelea, black-faced dioch

Ploceus cucullatus, village weaver

Passer luteus, golden sparrow

E. Rodents

Praomys natalensis (Muridae)

Arvicanthis niloticus (Muridae)

Gerbillus agag (Cricetidae)

G. gerbillus (Cricetidae)

Taterillus gracilis (Cricetidae)

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