FILE COPY

SUPPLEMENTARY ENVIRONMENTAL ASSESSMENT FOR LOCUST AND GRASSHOPPER CONTROL IN MAURITANIA

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

OFFICE OF USAID REPRESENTATIVE/NOUAKCHOTT

IN COOPERATION WITH

THE GOVERNMENT OF THE ISLAMIC REPUBLIC OF MAURITANIA

NOUAKCHOTT, MAURITANIA

REVISED MARCH 1995

TABLE OF CONTENTS

		Page
List of Tables, Figures and Appendices		ii
Acronyms and Abbreviations		iii
Preface		iv
1.0	**EXECUTIVE SUMMARY**	**1**
2.0	**PURPOSE AND PROCEDURES**	**4**
2.1	Background	4
2.2	Drafting Procedures	5
2.3	Previous Assessments by USAID	5
3.0	**ENVIRONMENTAL REGULATIONS**	**7**
3.1	USAID Environmental Regulations	7
3.2	Mauritanian Environmental Procedures	7
4.0	**COUNTRY PROFILE AND L/G SITUATION DESCRIPTION**	**9**
4.1	Physical Location, Topography, and Climate	9
4.2	Agricultural Resources	12
4.3	Locusts and Grasshoppers	13
4.4	Locust and Grasshopper Management and Control	20
5.0	**SELECTION AND MANAGEMENT OF PESTICIDES**	**30**
5.1	Pesticide Selection	30
5.2	Pesticide Labeling	31
5.3	Managing Pesticide Stocks	32
5.4	Research on Microbial and other Non-Conventional Pest Control Agents	35
6.0	**PESTICIDE IMPACT EVALUATION AND MITIGATION**	**37**
6.1	Human Health Impacts	37
6.2	Environmental and Non-Target Effects	39
6.3	Future Assessments	44
7.0	**USAID OPTIONS FOR INVOLVEMENT IN L/G OPERATIONS**	**48**
7.1	No Direct Action	48
7.2	Direct Action	48
7.3	Preventive Operations	49
7.4	Disaster Level Operations	49
8.0	**REFERENCES**	51

LIST OF TABLES, FIGURES, AND APPENDICES

LIST OF TABLES

Table 1. Cereal production (in metric tons), in Mauritania for the 1985/86 through 1994/95 cropping seasons (Source: Ministry of Rural Development and Environment).

Table 2. Sorghum and millet production (metric tons), in Mauritania for the 1988/89 and 1989/90 cropping seasons (Source: Department of Agricultural Statistics, Ministry of Rural Development).

Table 3. Quantities of obsolete pesticide stocks in Mauritania by region.

Table 4. Environmentally sensitive areas in Mauritania.

LIST OF FIGURES

Figure 1. Map of Mauritania Showing National and International Boundaries, Administrative Regions, and the National Capital.

Figure 2. Geographic and Climatic Zones of Mauritania.

Figure 3. Distribution of the Desert Locust, *Schistocerca gregaria*.

Figure 4. Distribution of the African Migratory Locust, *Locusta migratoria migratorioides*.

Figure 5. Wetlands of Mauritania.

Figure 6. National Parks and Forest Reserves of Mauritania.

LIST OF APPENDICES

Appendix A. List of preparers and persons contacted

Appendix B. Analysis of PEA recommendations

Appendix C. Selected list of pesticide fact sheets from USEPA.

Appendix D. USAID-approved list of anti locust/ grasshopper pesticides.

LIST OF ACRONYMS AND ABBREVIATIONS

AChE	Acetyl-cholinesterase, a blood enzyme, tested for pesticide exposure (particularly organophosphates)
AELGA	Africa Emergency Locust/Grasshopper Assistance Project (currently under USAID/AFR/AA/DRC)
APHIS	Animal and Plant Health Inspection Service of USDA
CFR	US Code of Federal Regulations
CPS	Crop Protection Service
EA	Environmental Assessment
ECLO	Emergency Center for Locust Operations, FAO
EPA	US Environmental Protection Agency
FAO	UN Food and Agriculture Organization
FEWS	Famine Early Warning System, USAID Regional Project
FMI	Force Maghrebien d'Intervention (Maghrebian Task Force
GIRM	Government of the Islamic Republic of Mauritania
ha	hectare
IPM	Integrated Pest Management
km	kilometer
l/g	locust/grasshopper
mg/kg	milligram per kilogram body weight
NRMS	Natural Resources Management Support Project
OAR/M	Office of USAID Representative/Mauritania
OCLALAV	Organisation Commune de Lutte Antiacridienne et Lutte Antiaviaire.
OFDA	Office of Foreign Disaster Assistance
PEA	Programmatic Environmental Assessment for Locust and Grasshopper Control in Africa and Asia
PNMR	Plan for supporting Natural Resource Management in sub-Saharan Africa
ppm	parts per million ambient concentration
REDSO	Regional Economic Development Support Office
SEA	Supplementary Environmental Assessment
SSRA	Sahel Sub-Regional Natural Resources Management Report
TA	Technical Assistance
ULV	Ultra-low volume (pesticide formulation with almost entirely composed of the active ingredient)
USAID	United States Agency for International Development
USAID/W	United States Agency for International Development, Washington, D.C.
USDA	United States Department of Agriculture
USG	United States Government

PREFACE

This document is a supplement to the Programmatic Environmental Assessment (PEA) for Locust and Grasshopper Control Programs in Africa and Asia (TAMS/CICP 1989). This Supplementary Environmental Assessment (SEA) was prepared using technical assistance funds from the Africa Emergency Locust/Grasshopper Assistance (AELGA) Project from USAID/W, with support from the Government of the Islamic Republic of Mauritania (GIRM). The Ministry of Rural Development, the Crop Protection Service, the Agricultural Statistics Department, and the Nature Protection Service provided valuable input to the draft of this document. The FEWS project in Mauritania also assisted in information gathering. Contact persons are listed in Appendix A.

The original draft of this SEA was prepared in June of 1990 by Bill Tthomas while at USAID/Mauritania, with inputs from AFR/TR/ANR (now AFR/SD/PSGE), OFDA, and the Regional Environmental Development Officer for West and Costal Africa (REDSO/WCA in Abidjan). The final version of this SEA was revised in 1995 by USAID/AFR/AA/DRC AELGA project staff and approved by the Bureau Environmental Officer (BEO). This document reflects the best current description of future options for the USAID assistance programs, through FAO, to the Ministry of Rural Development. It contains the best estimates of environmental impact and possible mitigating strategies. This may include training programs covering improved health and environmental protection, as well as support for early survey and spot treatment programs. Alternatives to chemical pesticides are encouraged in this document. This document also supports prudent and environmentally sound use of pesticides when these materials are necessary. Any commitments for possible future locust/grasshopper (l/g) programs are contingent on the future needs for locust and grasshopper control, the capabilities of the GIRM, and on a decision by USAID to provide assistance.

Because of the impact of the Mission close-out in Mauritania, USAID will be unable to implement many of the recommendations requiring additional funding and technical assistance. The recommendations contained in this SEA and in Appendix B have been revised in light of the close-out and in view of outbreak potential in 1995. However, should an emergency situation arise for which funds may be requested made from USAID/W, implementation of the recommendations discussed herein should be considered accordingly by host country, regional organizations and/or the FAO.

This SEA was finalized in March 1995 by Drs. Yene T. Belayneh, Ecotoxicologist and Assistant Technical Advisor, and

Alan C. Schroeder, Pest Management Specialist for the AELGA Project of AFR/AA/DRC.

1.0 EXECUTIVE SUMMARY

Mauritania is considered to be one of the front-line countries in the development of the desert locust, *Schistocerca gregaria* plagues. The northern deserts, central mountains, and Senegal River delta all serve as breeding grounds for the desert locust. Individual locusts in the solitary phase can be found in at least one of these areas at most times of the year. With favorable environmental conditions of above average rainfall, high humidity, and warm temperatures, populations of solitary desert locusts undergo a transformation to a gregarious phase. When desert locusts reach the gregarious winged adult stage, they become capable of long distance flight and can migrate across the Sahel and North Africa.

In addition to the threat from desert locusts, several grasshopper species also inhabit Mauritania and, over the long run, can be more economically damaging than locusts. The most damaging species is the Senegalese grasshopper, *Oedaleus senegalensis*. Summer rainfall usually provides conditions that allow grasshoppers to reach high annual population densities. With abundant rainfall and a resulting rich vegetative flush, grasshoppers will remain in Mauritania for most of the summer, but with onset of the dry fall season, the grasshoppers will follow the southerly movement of the Intertropical Convergence Zone (ITCZ, an annual weather system that traverses the Sahel) into Senegal and Mali. Since Mauritania can be an ideal breeding area for both the desert locust and various species of grasshopper, a vigilant survey program should be carried out at all times. If this survey program detects significant l/g activity, resources must be made available immediately to support a control operation. At this point in time, the GIRM does not have the resources to support comprehensive on-going survey programs, nor comprehensive control operations. Such activities should be supported through donor assistance as deemed necessary.

This SEA addresses Mauritania-specific environmental concerns regarding possible future USAID assistance for l/g control programs and operations in Mauritania, and is in compliance with USAID Environmental Procedures 22 CFR 216. The SEA identifies and examines the environmental, health and safety aspects which may be encountered in possible future USG pesticide donations, through FAO or other possible venues, to the Mauritanian crop protection authorities in the MRDE.

This SEA supports a thorough surveillance program and preventive action whenever feasible. The migratory nature of

locusts, and to a lesser extent the Senegalese grasshopper, make regional or sub-regional cooperation essential. It is suggested that, where feasible, crop loss assessment studies be undertaken to fully understand the actual impact of grasshopper and locust damage, and to provide better decision-making information.

Mauritania does not have any regulations for directing the safe use of pesticides although GTZ is planning to launch a project to prepare phytosanitary regulations for Mauritania. It was recommended that such regulations be developed and implemented. The present system of delivering pesticides to the end user must be improved. Pesticide labels should provide clear precautionary statements in French and Arabic to avoid adverse human and environmental effects. Specific directions for pesticide use, disposal and/or recycling of empty containers, and recommendations for improved pesticide stock management should also be provided.

The human health aspects of pesticide use in Mauritania must be strengthened, as there is little concern for the safety of pesticide applicators, and the general population. The present system of pesticide applicator training and education is weak and must be enhanced to ensure proper and safe pesticide use. Strengthening applicator knowledge and understanding of safety procedures and pesticide toxicity would likely reduce exposure and risk to the general population. The Mauritanian health care delivery system is inadequate to provide health care for accidental poisoning of applicators. The applicator crew should be given training to handle general pesticide poisoning.

The monitoring of human acetyl cholinesterase (AChE) levels and environmental pesticide residues are important to a l/g control program. The AChE method allows an immediate evaluation of the hazards associated with application and handling techniques, particularly for Organophosphate (OP) pesticides. Environmental samples should be analyzed for residues in areas of extensive pesticide use. And, pesticide effects on non-target species and the biotic environment should be included as an integral part of any pesticide use program. The German International Development Agency (GTZ) has set up a pesticide residues test lab in Akjoujt for this purpose.

This SEA concurs with the PEA recommendation of identifying ecologically fragile habitats, and creating 2-5 km wide buffer zones around these habitats, aquatic systems and other critical areas. Interim areas are identified in which pesticides should not be used, and others in which pesticides should be used with special precautions. This SEA supports the use of non-chemical alternatives, to the extent possible, as appropriate methods of l/g control in sensitive areas.

At the time this SEA was first drafted (1990), the major stock of obsolete pesticides in Mauritania was reported to be 60,000 liters of dieldrin. Since then, however, the stockpile of dieldrin has been found to be 190,500 liters. The next most dangerous chemical present is lindane at 3,200 liters. Proper disposal of these chemicals is essential but should not be undertaken until appropriate technology for the local situation becomes available. In 1993, the barrels of dieldrin were reported to be leaking. As of 1994, the GTZ was planning to rebarrel the dieldrin, and then search for other donors to share the cost of disposal. The responsibility of disposal and/or recycling of empty pesticide containers in Mauritania should be under the jurisdiction of the GIRM. However, because the MRDE is currently unable to launch a thorough disposal program, this SEA recommends that a complete barrel destruction and unused pesticide disposal program should be looked into in the event a pesticide donation is contemplated.

This SEA recommends that future USG-donated pesticides be subject to the following conditions, that: 1) MRDE storage facilities be substantially upgraded, to be able to hold pesticides in a protected and safe manner; 2) MRDE pesticide applicators are trained in, and are able to demonstrate, correct and safe application methods; 3) MRDE utilize environmentally sound criteria in the selection and application of pesticides; and 4) MRDE can demonstrate that there is adequate safe storage space for empty pesticide containers and obsolete pesticides.

Should the MRDE not be able to meet the above criteria, especially in regard to the application of pesticides and the disposal of empty containers, a program must be included with the USG pesticide donation to fulfill these requirements.

Mauritania, does not have environmental protection legislation, pesticide regulations, and procedures equivalent to the USG's National Environmental Policy Act (NEPA), or USAID's Regulation 216. A department of environment exists within the Ministry of Rural Development, but has little influence on decision-making in l/g control campaigns. Thus, USAID Environmental Procedures, which are consistent with EPA policies, will need to be enforced to control the use of USG donated pesticides. FAO will be responsible for enforcing these, since they will be used as the implementor of US assistance.

2.0 PURPOSE AND PROCEDURES

2.1 Background

Due to a plague of locusts in eastern and Sahelian Africa in 1987, the Administrator of USAID declared an emergency waiver of the Agency's Environmental Procedures [22 CFR part 216] governing the provision of pesticides. The waiver permitted USAID to procure and use pesticides for locust control without full compliance with the Agency's environmental procedures; at the same time it specified that a Programmatic Environmental Assessment (PEA) for Locust and Grasshopper Control in Africa and Asia be produced. The PEA was finalized in early 1989 and the waiver expired on 15 August 1989. Since then, all USAID assistance for procurement and use of pesticides must fully comply with the Agency's environmental procedures. The PEA and the country-specific Supplemental Environmental Assessments (SEAs) provide guidance on environmentally sound locust management procedures. SEAs have been completed and approved for a number of g/l affected countries in Africa and Asia, Botswana, Burkina Faso, Cameroon, Chad, Ethiopia, Eritrea, The Gambia, Kenya, Madagascar, Mali, Morocco, Mozambique, Niger, Senegal, Somalia, Sudan, Mozambique, Tunisia, Yemen, India, Pakistan, and Afghanistan. In 1991, USAID's Africa Emergency Locust/Grasshopper Assistance (AELGA) Project reviewed the PEA and SEAs in a *Review of Environmental Concerns in A.I.D. Programs for Locust and Grasshopper Control*, Publication Series No. 91-7.

Locust and grasshopper control should involve preventive intervention, and, when necessary, emergency response. Ideally, strategic (preventive) locust management will preclude the need for emergency response. The development or spread of locusts in Mauritania requires rapid, coordinated measures to stop their movement further south. Locust and grasshopper outbreaks could devastate large parts of Mauritania's agricultural production base. Future assistance from the AELGA project will likely be in the form of regional grants to FAO.

The Mauritanian crop protection service will be the first line of defense against a locust invasion. The next most important player will be the regional FMI (Force Maghrebian d'Intervention); they were performing well in scouting for and controlling locusts in the northern reaches of the Mauritania in 1993, and their use should be continued in the future. In addition, the Mauritanian military assisted the 1993 locust campaign with the loan of 2 airplanes; and this collaboration should be encouraged in the future as well. Other regional locust and grasshopper control was carried out in the past by the Organisation Commune de Lutte Antiacridienne et Lutte Antiaviaire

(OCLALAV). Unfortunately, OCLALAV has been severely limited in its capacity due to under-funding and was not, as of 1994, operational. The long range goal of U.S. assistance should be to help effect a sustainable preventive approach to locust management in desert locust outbreak areas. This SEA will describe both the immediate and long term measures necessary to achieve environmentally sound locust management in Mauritania.

Should USAID choose to provide chemical pesticides through grants to the FAO, the Environmental Procedures in Regulation 16 (22 CFR part 216) must be followed. The PEA and this document fulfill the requirements necessary to allow USAID to provide assistance through FAO to Mauritania.

2.2 Drafting Procedures

USAID Environmental Procedure 22 CFR 216.3(a)(4) describes the process to be used in preparing an Environmental Assessment. The rationale and approach for country-specific SEAs are outlined in cables State 258416 (12 August 1989) and State 275775 (28 August 1989).

This SEA was finalized in March 1995 by Drs. Yene T. Belayneh, Ecotoxicologist, and Alan C. Schroeder, Assistant Technical Advisors for AELGA Project of AFR/AA/DRC. This version incorporates the most recent information available on the host country vis a vis g/l, pesticide, and pertinent environmental issues. The scoping process for the draft of this assessment, prepared in 1990, relied heavily on the PEA, interviews with USAID/Nouakchott, personnel from the GIRM, assistance from Mauritanian MRDE officials, and data supplied by the FEWS representative in Mauritania.

2.3 Previous Assessments

The previous assessment concerning this subject, and the primary supportive document is the Programmatic Environmental Assessment (PEA) for Locust and Grasshopper Control in Africa and Asia (TAMS/CICP, 1989). This SEA is a supplement to the PEA, and should be considered an integral part of the PEA. This document concerns the country-specific environmental issues not necessarily addressed in the PEA.

The following documents were used in preparing this assessment:

(1) Review of Environmental Concerns in A.I.D. Programs for Locust and Grasshopper Control (U.S. Agency for International Development, Washington, D.C., September 1991);

(2) Final Report on the Handling of Pesticide in Anglophone West Africa. (Youdeowei, 1989 FAO Conference report, Accra, Ghana);

(3) Final Report on Pesticide Management in Francophone West Africa. (Alomenu, 1989 Report on the FAO Conference at Accra, Ghana);

(4) Supplemental Environmental Assessments for Botswana, Burkina Faso, Cameroon, Chad, Ethiopia, Eritrea, The Gambia, Kenya, Mali, Madagascar, Mozambique, Niger, Senegal, Somalia, Sudan, Algeria, Morocco, Tunisia, India, Pakistan, Afghanistan, and Yemen.

(5) The Africa Emergency Locust/Grasshopper Assistance Midterm Evaluation (with specific-country case studies for Chad, Mali, Niger, Mauritania, and Cape Verde) (Appleby, Settle & Showler, 1989).

(6) Pesticide User's Guide: A Handbook for African Extension Workers. (Overholt and Castleton, 1989, USAID/AFR/TR/ANR/AELGA, Washington, DC).

(7) Pest Management Guidelines of the Agency for International Development. (Overholt, Showler, Waite, and Larew, 1991, USAID, Washington, D.C.).

(8) Locust/Grasshopper Management: Operations Handbook. (USAID, 1989, Washington, D.C.).

(9) Assessment of the Africa Emergency Locust/Grasshopper Assistance (AELGA) Project. (Schroeder, 1993).

(10) Proceedings of the USAID West African Regional Conference on Pesticide Disposal: Disposal of Pesticide Containers and Obsolete Pesticides; Niamey, Niger, eds. Knausenberger, Andreason, and Belayneh, 1990.

(11) Grasshoppers and Locusts: the Pleague of the Sahel, PANOS Dossier, The PANOS Institute, London, 1993.

These documents were used in this SEA without citation. Other relevant documents are cited in section 5.0 and Appendix C.

3.0 ENVIRONMENTAL REGULATIONS

3.1 USAID Environmental Procedures

It is USAID policy to ensure that any negative environmental consequences of an USAID-financed activity be identified and mitigated to the fullest extent possible prior to a final funding and implementation decision. This document covers specific environmental consequences involved with chemical pesticide use, and necessary safeguards and mitigation for any future control programs. In addition, alternatives to chemical pesticides are recommended when appropriate, and considered as being integrated pest management (IPM) tactics.

According to *Pest Management Guidelines of the Agency for International Development* (1991):

> **"USAID's regulations require that the potential environmental consequences of USAID-financed activities are identified and considered by USAID and the host country prior to the final decision to proceed with an activity. The procedures that guide this regulation are set forth in 22 CFR Part 216. Section 117(c) of the Foreign Assistance Act and Section 533(g) of the 1991 Appropriation Act require that USAID review its projects, programs, and activities in accordance with requirements of 22 CFR Part 216. USAID's policy is to approve for procurement or use only those pesticides that are critically needed and proven safe."**

U.S. pesticide contributions are regulated by U.S. pesticide laws and procedures (as described in the PEA). Only those pesticides listed in Appendix D can be procured using U.S. funds and can only be used in conjunction with other forms of U.S. assistance for l/g control (e.g., aircraft). In a U.S.-funded operation, pesticides are to be used according to label instructions only. Used pesticide containers and any unwanted pesticide resulting from a U.S.-funded operation must be disposed of properly and safely. No U.S. funds shall be used to purchase, transport, or apply any pesticide that has been banned in the U.S. This includes the chlorinated hydrocarbons such as dieldrin, DDT, lindane, and benzene hexachloride (BHC).

3.2 Mauritania Environmental Procedures

Mauritania, does not have environmental protection legislation, no pesticide regulations, and no procedures equivalent to the USG's National Environmental Policy Act (NEPA), or USAID's Regulation 216. A department of environment exists

within the Ministry of Rural Development, but has little influence on decision-making in l/g control campaigns. Thus, USAID Environmental Procedures, which are consistent with EPA policies, will need to be enforced to control the use of USG donated pesticides. FAO will be responsible for enforcing these, since they will be used as the implementor of US assistance.

4.0 COUNTRY PROFILE AND L/G SITUATION DESCRIPTION

4.1 Physical Location, Topography, and Climate

Mauritania is located in northwest Africa and is bounded by Algeria, Western Sahara, Mali, Senegal, and the Atlantic Ocean. Its Atlantic coastline stretches 666 km, and encompass some of the best commercial and sport fishing waters in the world. The country has a total land area of 1,085,760 sq. km. (Figure 1).

Mauritania can be divided into four geographic and climatic zones (Figure 2): the Saharan, the Coastal, the Sahelian, and the Chemama (Senegal River zone). The Saharan zone covers the northern two thirds of the country. This is primarily desert and is characterized by sand dunes, mountainous plateaus, and scattered oases. The Coastal zone, which receives the least rainfall of any region, is practically devoid of vegetation. The Sahel is characterized by savanna grasslands, palms, baobabs, and acacias. Some agricultural activities are practiced in the far southern Sahel, where millet, maize, and sorghum are grown. The Chemama zone, a narrow belt of land bordering the north side of the Senegal River, is the chief agricultural region of Mauritania. Here millet, sorghum, wheat, and rice can be grown.

Rainfall in the Chemama zone is generally the highest in the country (300 - 500 mm per year). The rainy season is from May to September. The Senegal River normally floods during the months of September and October. The maximum and minimum temperatures for the year are 34.4 and 23.3°C respectively.

In the Sahel zone, precipitation varies between 150 mm in the north to 350 mm in the south. Daily variation in temperature is 15.6 and 21.3°C.

The Coastal zone has a humid but temperate climate moderated by oceanic trade winds. Temperatures range from 20 to 32°C in October and 13 to 26°C in January. The Coastal zone receives less than 25 mm of rain annually.

The Sahara zone receives 25 to 127 mm of rain annually during the rainy season, from July to September. During winter, daily temperature varies between 0 early morning to 37.8°C in mid-afternoon. The harmattan, the hot dry prevailing wind from the east, causes blinding sandstorm in the Sahara in the late winter and early spring. During summer, temperatures range from 15.6 to 49.0°C.

4.0 COUNTRY PROFILE AND L/G SITUATION DESCRIPTION

4.1 Physical Location, Topography, and Climate

Mauritania is located in northwest Africa and is bounded by Algeria, Western Sahara, Mali, Senegal, and the Atlantic Ocean. Its Atlantic coastline stretches 666 km, and encompass some of the best commercial and sport fishing waters in the world. The country has a total land area of 1,085,760 sq. km. (Figure 1).

Mauritania can be divided into four geographic and climatic zones (Figure 2): the Saharan, the Coastal, the Sahelian, and the Chemama (Senegal River zone). The Saharan zone covers the northern two thirds of the country. This is primarily desert and is characterized by sand dunes, mountainous plateaus, and scattered oases. The Coastal zone, which receives the least rainfall of any region, is practically devoid of vegetation. The Sahel is characterized by savanna grasslands, palms, baobabs, and acacias. Some agricultural activities are practiced in the far southern Sahel, where millet, maize, and sorghum are grown. The Chemama zone, a narrow belt of land bordering the north side of the Senegal River, is the chief agricultural region of Mauritania. Here millet, sorghum, wheat, and rice can be grown.

Rainfall in the Chemama zone is generally the highest in the country (300 - 500 mm per year). The rainy season is from May to September. The Senegal River normally floods during the months of September and October. The maximum and minimum temperatures for the year are 34.4 and 23.3°C respectively.

In the Sahel zone, precipitation varies between 150 mm in the north to 350 mm in the south. Daily variation in temperature is 15.6 and 21.3°C.

The Coastal zone has a humid but temperate climate moderated by oceanic trade winds. Temperatures range from 20 to 32°C in October and 13 to 26°C in January. The Coastal zone receives less than 25 mm of rain annually.

The Sahara zone receives 25 to 127 mm of rain annually during the rainy season, from July to September. During winter, daily temperature varies between 0 early morning to 37.8°C in mid-afternoon. The harmattan, the hot dry prevailing wind from the east, causes blinding sandstorm in the Sahara in the late winter and early spring. During summer, temperatures range from 15.6 to 49.0°C.

Figure 1. Map of Mauritania Showing National and International Boundaries, Administrative Regions, and the National Capital.

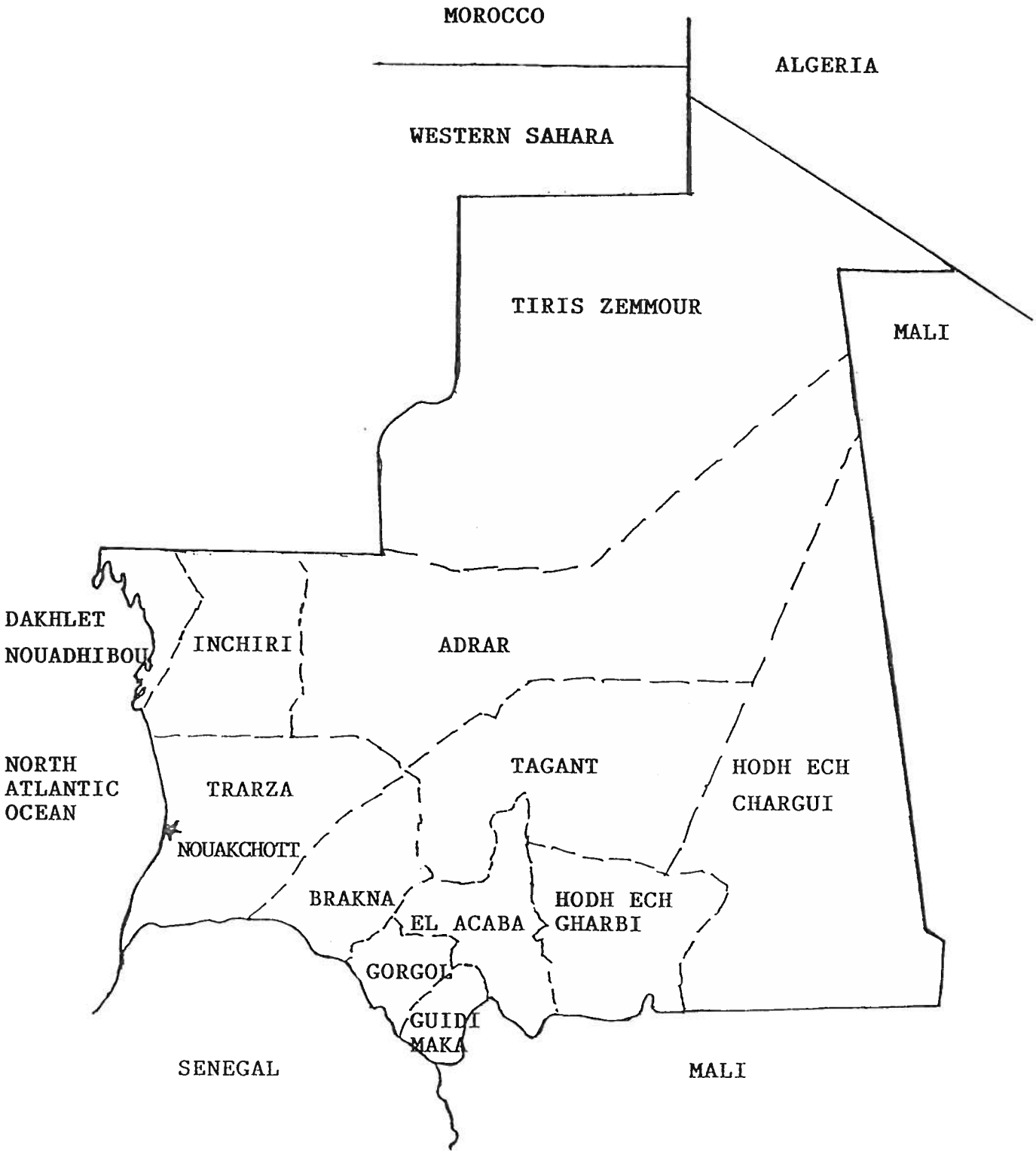
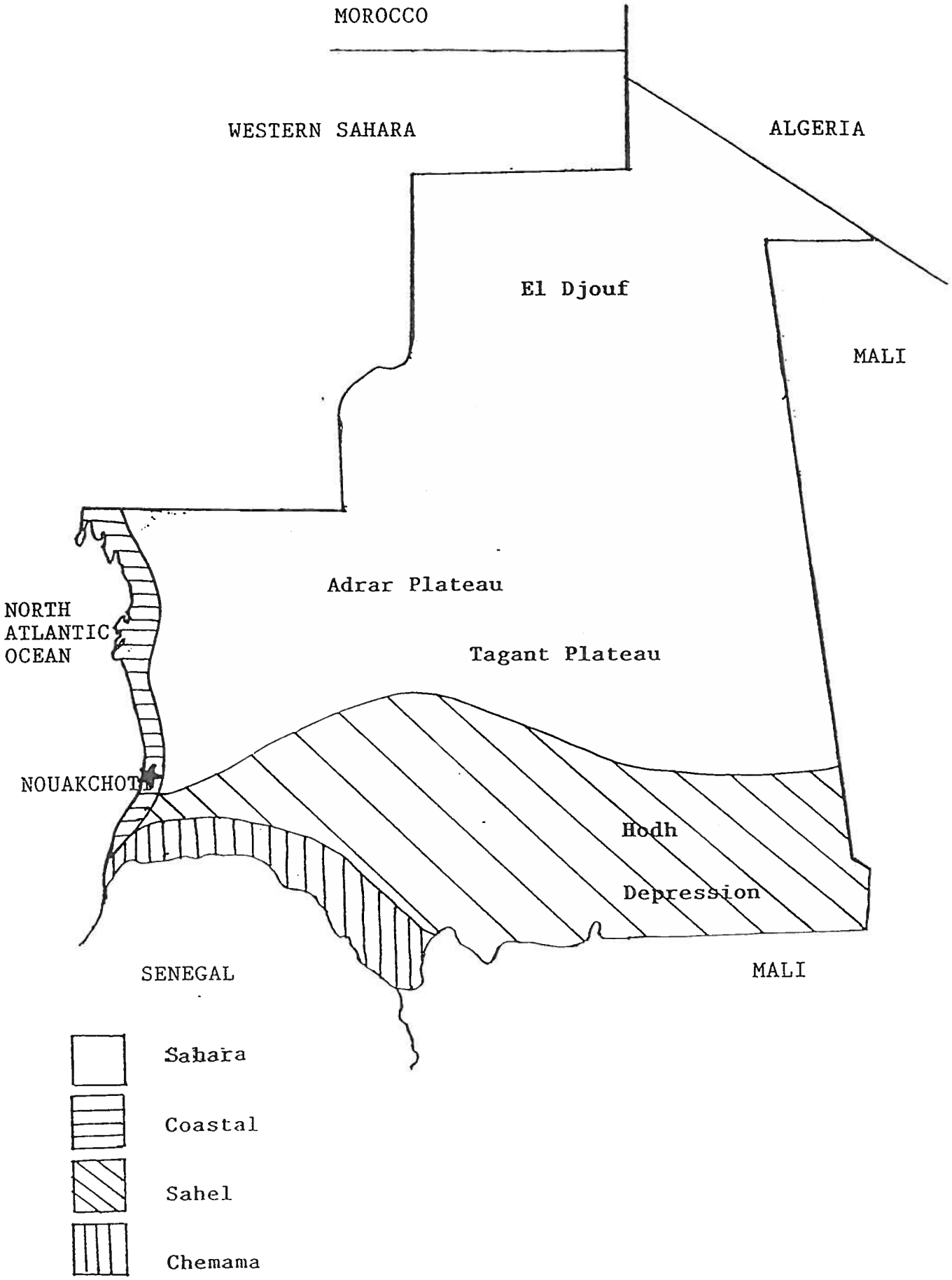


Figure 2. Geographic and Climatic Zones of Mauritania.



4.2 Agricultural Resources

The major crops grown in Mauritania are millet, sorghum, rice, cowpeas, maize, and dates. All of these crops are susceptible to locust and grasshopper attack. The grain crops tend to be distributed primarily along the Senegal River and in the southeastern regions. Millet and sorghum are grown both under rainfed and recessional conditions, while rice is grown by irrigation along the Senegal River. Dates are found in oases in the central and northern regions of the Sahara zone (Figure 2).

Table 1 shows cereal production (in metric tons) for the 1985/86 thru 1994/95 cropping season. Table 2 shows sorghum and millet production (in metric tones) 1988/89 and 1989/90 cropping season. Regions of greatest l/g activity usually coincide with regions of greatest agricultural cultivation. The Agricultural Statistics Division of the Ministry of Rural Development estimated cereals losses from locusts and grasshoppers in 1988 and 1989 at 15%. This is in addition to a general 15% figure attributed to other pests.

Table 1. Cereal production (in metric tons), in Mauritania for the 1985/86 thru 1994/95 cropping seasons (Source: Ministry of Rural Development and Environment).

SEASON	SORGHUM	MILLET	MAIZE	RICE	TOTAL
1985/86	62,882	7,140	978	5,112	76,122
1986/87	81,856	11,560	2,890	19,800	116,105
1987/88	82,892	14,137	856	30,540	128,432
1988/89	92,023	5,670	6,347	30,649	134,609
1989/90	94,483	11,834	2,264	33,040	141,621
1990/91	39,053	2,825	2,047	31,078	75,003
1991/92	49,457	1,810	1,796	25,007	78,070
1992/93	42,627	1,346	2,671	32,460	79,104
1993/94	77,817	3,438	6,344	39,075	126,674
1994/95	99,006	6,219	5,350	31,005	141,580

Table 2. Sorghum and millet production (metric tons), in Mauritania for the 1988/89 and 1989/90 cropping seasons (Source: Department of Agricultural Statistics, Ministry of Rural Development).

REGION	1988/89	1989/90
Hodh El Chargui	17,712	27,841
Hodh El Gharbi	24,290	19,607
El Caba	5,678	2,964
Gorgol	16,204	20,187
Brakna	25,896	32,376
Trazara	4,104	3,778
Guidimaka	17,054	7,939
TOTAL	110,938	114,692

4.3 Locusts and Grasshoppers

The primary locust species in Mauritania, and throughout the Sahara and Sahel, is the desert locust, *Schistocerca gregaria*. This is the species most often associated with large-scale, continent-wide plagues, and is cited as one of the nine plagues in Genesis. Mauritania is a major desert locust recessional breeding area. The next most important locust species in West Africa is the African migratory locust, *Locusta migratoria migratorioides*. The most damaging grasshopper species in the Sahel and West Africa is the Senegalese grasshopper, *Oedaleus senegalensis*.

4.3.1 The Desert Locust (*Schistocerca gregaria*)

The desert locust occurs in xeric habitats from Mauritania to India. The life cycle of the desert locust begins as the females lay 3-4 cm long eggpods containing 20-100 eggs 10 cm deep in loose sandy, warm, and rain-moistened soil. Swarming females lay about three of these eggpods during their life. The eggs absorb water from the surrounding soil and hatch in 10-14 days. There are reports of some eggpods remaining viable for up to 6 months before receiving sufficient moisture to hatch. Locust nymphs, or larvae, are referred to as "hoppers," and a group of hoppers is called a "hopper band." Desert locusts reach maturity in one to six months and then live about two to five months,

depending on temperature; warmer temperatures result in faster development.

Locusts exist in one of two phases, solitary or gregarious. Solitary locusts exist as scattered individuals within a recession area. With certain conditions, such as increased rainfall and vegetative growth in the recession area, solitary locusts begin to breed and rapidly increase in number. These conditions cause a phase transformation from solitarious to gregarious. Sexually immature solitary adult locusts are pale grey or beige in color, and sexually mature adults are pale yellow. In contrast, gregarious locusts are much more brightly colored; sexually immature adults are bright pink and mature adults are bright yellow. Gregarious locusts also become more restless and have an affinity for grouping and mass migration.

Solitary desert locusts inhabit zones called recession areas; when they become gregarious and migrate, the expanded occupation zone is called the outbreak or invasion area. The recession area encompass drier parts of the locust's distribution, which includes a band from the northern half of Mauritania to India. The desert locust invasion area is much larger and includes more countries to the north and south, east and west of the recession band (Figure 3). The pattern of the 1993 infestation of locust swarms in Mauritania suggests that the immediate source was Mali and other Sahelian countries to the east, and that some local solitary populations became gregarious and augmented these immigrant populations after their arrival. The ultimate origins can be the Horn of Africa, or even the Arabian Peninsula and India. Most plagues begin with population explosions in the Horn of Africa, especially along the Red Sea coast and, if uncontrolled, spread from there.

Gregarious locusts are capable of long range flight, covering several hundred kilometers in a day, generally moving on prevailing weather and wind systems, whereas solitary locusts may only move several kilometers in a lifetime. Solitary locusts are of little economic importance, but gregarious locusts are capable of quickly devouring large amounts of vegetation and causing large crop losses in a short time.

Locust outbreaks and plagues are difficult to predict far in advance; they follow seasons of unusually wet weather in the key breeding areas and are thus as unpredictable as the weather.

4.3.2 Desert Locust Infestation of 1993

Gregarious desert locust swarms first invaded Mauritania in the Tagant in July of 1993. It is likely that they arrived from immigrants crossing the Sahel from East Africa and the Red Sea

coastal areas. Apparently they did not stop and reproduce heavily along the way through Chad, Niger, or Mali. The locusts did reproduce in Mauritania and moved from the Tagant to parts of southern and central Mauritania in August and September.

In October, locusts were concentrated around Lake R'Kiz, Boutilimit, and along the Senegal River in the south. From there they moved westward and northward up the coast and by the end of November there were reports of hopper bands in the Banc d'Arguin national park and north central parts of the country (south Tiris Zemmour), thus egg laying likely occurred in early November in these areas. Locust swarms moved from here into southern Morocco and Algeria late in December, 1993 and early January, 1994. As of May of 1994, there were still 15,000 hectares infested with third generation nymphal bands in Tiris Zemmour.

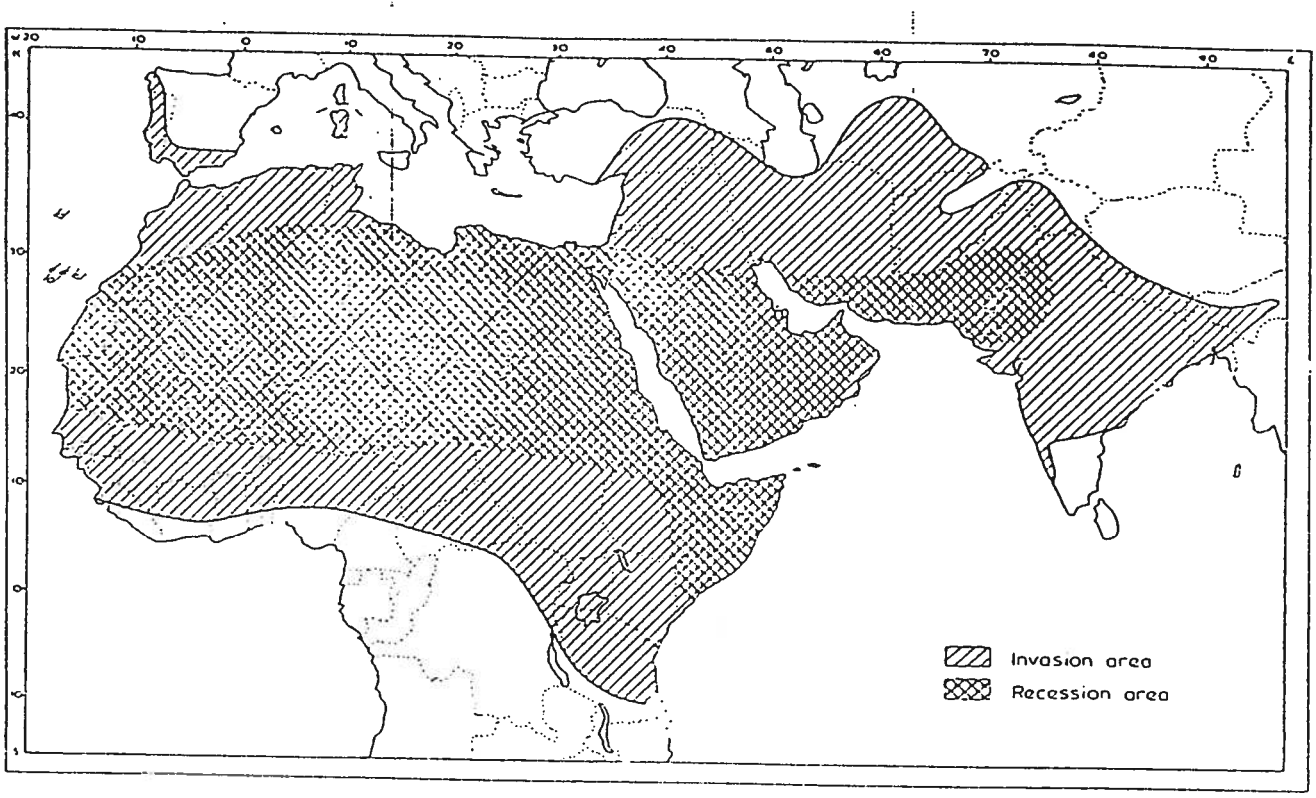
Control operations were slow in starting in 1993 due to the general difficulties of quickly organizing a large-scale campaign. But by October, eight to ten aircraft were operating every day as well as numerous ground teams composed of crop protection service and FMI personnel. As of the end of April, 1994, more than 840,265 hectares had been treated in Mauritania.

4.3.3 Desert Locust Infestation of 1988

Locusts were first noted in the extreme northern regions of Mauritania in the winter of 1987/88. The ultimate origin of the invasion was suspected to be in Chad and the Sudan. Although multiple surveys revealed relatively high numbers of locusts in northern Mauritania, control operations were not initiated there because of the presence of land mines and surface-to-air missiles in the area (due to the war between Morocco and Western Sahara).

Then in March of 1988, extensive surveys failed to locate these locusts; they had moved north into Morocco on prevailing winds. But by July, large locust swarms returned from Morocco and were reported to be grouping in the southeastern regions of Mauritania, where most of Mauritania's crop production is centered. By September of 1988, all regions of the country reported various levels of infestation.

Figure 3. Distribution of the Desert Locust, *Schistocerca gregaria*.



4.3.4 African migratory locust (*Locusta migratoria migratorioides*)

The African migratory locust, the second most important locust species in Africa, breeds in the flood plains of the Middle Niger in West Africa (Figure 4) and spreads from there to other Sahelian countries, including Mauritania. It also breeds in other parts of Africa, especially in arid regions of the East and South, but is not capable of the long range flights across the continent that characterize the desert locust. The African migratory locust does not breed in outbreak proportions in Mauritania; rather it remains in the solitary phase in the southern half of the country.

4.3.5 The Senegalese grasshopper (*Oedaleus senegalensis*)

The Senegalese grasshopper ranges across dry savannah areas from Cape Verde to India, and is the major grasshopper pest species in Mauritania. In Mauritania, their distribution falls in the southern and southeastern regions, bordering both Senegal and Mali. These areas are also the major cropping zones and pasture lands. This species produces two to four generations per year and lays egg pods (2-3 in a lifetime, containing 8-37 eggs) that remain viable during periods of extreme drought. The first generation will appear 10-12 days after summer rains of 25 mm or more. The hoppers pass through five instars, and become adults within about 30 days of hatching. Population levels, numbers of generations, and distribution patterns are generally governed by precipitation. Senegalese grasshopper habitat is characterized 100 to 500 mm of annual rainfall (mostly occurring in the summer), presence of light sandy soils, and the availability of grain food source (in Mauritania, this includes pasture grasses, millet, sorghum and occasionally rice).

The Senegalese grasshopper shows some migratory-like behavior, such as the formation of marching hopper bands and loose swarm migration of adults. However, unlike the desert locust, it is not subject to a morphological phase change. Nor do movements involve extensive distances common to the desert locust. Migratory patterns follow the northern progression and southern retreat of the ITCZ weather system. The adult progeny of the last seasonal generation will usually migrate south with the ITCZ weather system. Eggs laid in drying soil normally enter obligatory diapause until the next rainfall. Not all of the eggs will hatch after the first summer rain; some eggs will hatch after subsequent rains, assuring survival if the initial rainfall is inadequate.

During 1986, 1987, and again in 1989, Mauritania experienced population explosions of grasshoppers, with the Senegalese grasshopper leading the pack; these destroyed large tracts of millet and sorghum in the southern third of the country.

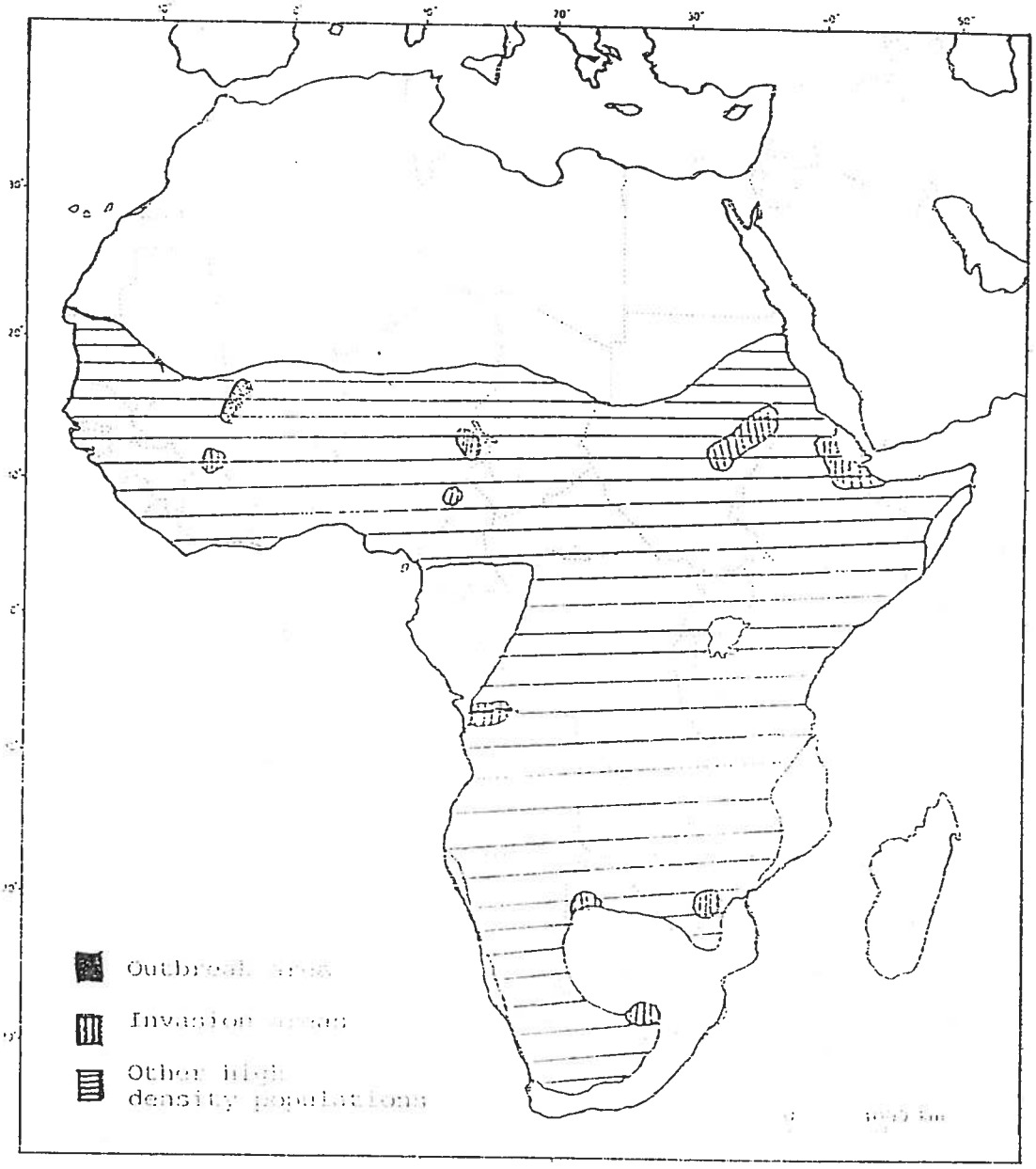
In the course of every agricultural season, grasshoppers continue causing considerable damage to the agro-silvo-pastoral zones of Mauritania. According to information obtained from the Ministry of Rural Development and Environment, very strong and active grasshopper populations at densities of 100 to 200 individuals/m^2 are observed every year in the south and southeastern parts of the country. During the agricultural campaign of 1990-91, areas close to 2,318,000 ha were infested in the whole agro-pastoral zones of the country.

The areas infested by the sedentary locusts and diapausing stages exceeded 102,000 ha in the beginning of the 1992/93 season which grew to 1,200,000 ha by the close of season. The total areas infested were 800,000 km^2 in the course of the 1994/95 campaign with an average density of 80 to 100 individuals/m^2. The major grasshopper species by order of importance were:

Oedaleus senegalensis,	*Cataloipus rymbiferus,*
Hieroglyphus daganensis,	*Acrida bicolar,*
Kraussaria angulifera,	*Catantops axillaris.*

In Mauritania, grasshoppers are always considered as the ravagers and the most important enemies causing considerable injuries in any agro-pastoralist zones of the country.

Figure 4. Distribution of the African Migratory Locust, *Locusta migratoria migratorioides*.



4.3.6 Other Crop Damaging Acridids

A number of other locusts and grasshoppers are of some agricultural importance. For instance, the tree locust, *Anacridium melanorhodon* has been noted in the southern regions, and can damage trees, although it is not considered to be as serious as the desert locust. *Kraussaria angulifera* can be an important pest in the south-eastern most parts of the country. A number of other grasshoppers and locusts are of agricultural importance and are listed in the PEA. Although many of these other species will likely not become serious threats to agricultural production, the crop protection service may require assistance in managing these pests.

4.4 Locust and Grasshopper Management and Control

4.4.1 Crop Protection vs. Strategic Control

The goal of **crop protection** is to destroy locusts or grasshoppers near or in crops during plagues or outbreaks, while **strategic control** is an attempt to prevent plagues by managing sexually immature desert locust or grasshopper populations in major breeding areas. This SEA recommends that strategic (or preventive) control be implemented whenever possible. This approach relies heavily on good survey, immediate intervention in limited areas, and control actions aimed at nymphal control, rather than swarm control. If strategic control is successful, then locust plagues will be prevented and there will be no need to implement crop protection. The USG should urge FAO to put in place a preventive control plan for the "central locust region," that is, the tractional breeding area surrounding the Red Sea and the Horn of Africa, where desert locust plagues generally start. The maintenance of populations in a recession state with minimal application of pesticides should be the strategy of choice.

Integrated pest management (IPM) tactics will be important components of a strategic control program. An IPM program uses a variety of methods to keep locust populations below levels where economic loss or, in the case of desert locusts, a major population surge in critical breeding habitats, is imminent. Chemical pesticides should only be used when necessary, thereby reducing the environmental impact of locust control operations, costs, and exposure to handlers.

To apply pesticides at optimal times, it is necessary to survey for locusts early in the season with trained personnel and

proper equipment. A successful locust survey program requires survey teams that:

1) know the physical and temporal distribution of locusts;

2) monitor environmental conditions which could lead to increased numbers of locusts;

3) conduct vulnerability assessments of the crops threatened by locusts;

4) have access to pest management support resources that can be rapidly mobilized for control, such as: chemical or biological pesticides, safety and application equipment.

The crop protection service should ensure that each of their stations is prepared to respond to a locust infestation. Adequate preparation includes: radio communication, vehicles, application equipment, clean protective clothing and safety equipment, and a sufficient amount of the proper pesticides carefully stored and ready for use. Strategic control can only be effective when accurate, up-to-date records of survey and spray operations are maintained. Such records should include:

A. Survey

1) Where the survey was conducted (longitude, latitude)
2) When the survey was conducted
3) How the survey was conducted
4) The density of locusts (average no./m^3)
5) Locust stages present, relative numbers of each stage
6) crops affected, types of vegetation
7) Climatic conditions (temp, wind, soil moisture)
8) Magnitude (no. of hectares) of infestation

B. Spray

1) Where the pesticide was applied
2) What kind of pesticide was applied
3) The application rate and area covered
4) When the area was treated
5) Crops and vegetation treated
6) Results of follow-up survey to see the effect of spraying: the percent of locusts that were killed by the operation
7) Non-target effects, other animals killed

4.4.2 Village Brigades for Locust and Grasshopper Control

Most of the rural people in the north of the country are migrating herders, thus it will be difficult to form village brigades for control; control here would be more strategic in nature, i.e., to keep the locusts from multiplying and moving into areas of high agricultural productivity. Village brigades can be formed in the extreme south along the Senegal River, where sedentary farmers exist, and where most of Mauritania's agricultural production also exists and needs to be protected from loss. A little to the north of this are pasture lands, that may also need to be protected from loss, however control here would also be more strategic in nature. The northern two thirds of the country are relatively barren of production, with the only crops being grown in scattered date palm oases.

4.4.3 National Locust Management Operations: MRDE

The Ministry for Rural Development and Environment (MRDE) is responsible for carrying out all crop protection activities in Mauritania. The MRDE does not have a sufficiently large cadre of crop protection personnel trained in locust monitoring and control tactics. The GTZ is attempting to address this need by training key members of the MRDE; thus due, in large part, to these efforts the 1993 locust control campaign was well organized and implemented. The 1993 campaign also relied heavily upon the assistance from FMI teams for monitoring and control activities; the MRDE's close association with FMI and other groups, through on-the-job training, should continue to help enhance their capabilities.

4.4.4 Regional Locust Management Operations: FMI

In 1990, Mauritania, four North African countries, and the FAO conceived the Force Maghrebian d'Intervention (FMI), following a loan from the Islamic Development Bank. This group is responsible for regional operational l/g survey and control in all of the member countries, and has been used at times for supporting control operations in the northern parts of Sahelian countries. For example, they were heavily used in northern Mali in 1993, until hostilities forced their withdrawal. In East Africa, the Desert Locust Control Organization (DLCO) was established in 1962 for locust and grasshopper control in seven countries. These regional groups pool resources and personnel from member countries for cross-border control operations and are the major repositories of experience for their mandated regions.

Sahelian regional locust, grasshopper and bird monitoring and control used to be coordinated by OCLALAV, which was formed in 1965. However, subsequent funding problems caused OCLALAV to significantly change its mandate. Presently, OCLALAV serves as an information source for locust, grasshopper, and bird activities in the ten member countries (including Mauritania), but is no longer operational with regard to survey and control. Most of OCLALAV's equipment and resources have been liquidated. There are two OCLALAV officers remaining, a Director General and a Technical Director, both based in Dakar. New executive officers are appointed every 4 years, and elections for new officers were held in October, 1993 at a meeting of OCLALAV convened in The Gambia.

A regional locust and grasshopper control organization with a strong coordinating role for the Sahelian countries is lacking at this time. Most of the operational functions within each country are presently undertaken, with reasonable success, by the national crop protection services. However, there is no group that can go across borders and use regional pooled resources for control.

4.4.5 International Locust Management Operations: FAO

In addition to assisting the FMI with locust monitoring and control in northern Africa, the FAO has a globally mandated Emergency Center for Locust Operations (ECLO). This group assists in monitoring locust outbreaks and coordinating donor support for control operations. In 1993, they were responsible for mustering over USD $15 million for control operations across Africa, the Middle East, and East Asia; much of this was directed toward the locust outbreaks in Mauritania.

4.4.6 USAID Assistance in Locust Management Operations

In 1988, the USAID Mission in Mauritania supplied pesticides to the MRDE for locust control operations. Although there was also a regional USG-contracted aerial control operation in 1988 which used some of the donated pesticides, MRDE ground control teams were the primary user.

In 1993, the AELGA project supplied several forms of assistance to the locust control campaign in Mauritania. The most notable of these was a USD $1.4 million grant to the FAO for control in Mauritania, and to a lesser extent, in Senegal. The money was reportedly used for the following goods and services:

* 120 hours flying time for 4 fixed-wing planes from the government of Luxembourg
* 32,400 liters of dursban 45% ulv (shared with Canada)
* 41,600 liters of dursban 45% ulv
* $21,000 for per diems, etc for FMI teams
* $28,750 for per diems, etc for Algerian bilateral teams
* $5,000 supplement for FMI team maneuvers and guides
* 9 ICOM radios

The AELGA project also provided technical assistance in 1993. An AELGA core staff entomologist was sent to verify the gravity and extent of the problem and follow up on USAID donations for monitoring and control.

4.4.7 Non-traditional Donor Assistance in Locust Management

Since the late 1980s, USAID and other donors have attempted to get developing countries with large stocks of pesticides, such as Mauritania (with over 3 million liters of malathion), to donate these to other countries in greater need. In doing so, the donating country may solve a potential pesticide disposal problem, especially if the pesticide is several years old and is nearing its expiration date. In 1993, donations were made by several North African countries to other countries in need. Pesticide donations from 'non-traditional' donors to Mauritania were as follows:

* Algeria - 16,000 liters of dichlorvos 30%,
  - 15,400 liters of fenitrothion 100%;
* Tunisia - 12,000 liters of malathion 96%;
* Morocco - 50,000 liters of malathion 96%;

This system of pesticide donations is not without its problems. For instance, the dichlorvos (also known as DDVP) donated by Algeria was so volatile that it could not be used in the excessively hot Mauritanian environment; it would evaporate quickly after leaving the spray nozzle. In addition, dichlorvos is very toxic to humans, and is not recommended by USAID for use against grasshoppers and locusts. The MRDE will likely not accept donations of dichlorvos in the future.

4.4.8 Predictability/Breadth Operations

L/G infestations are difficult if not impossible to predict in advance. Rainfall distribution is the best single indicator, but l/g often occur in patterns not readily related to easily measured factors. Prediction is an essential component of being

prepared to take preventive action, and preventive action is essential to attaining the efficiency of non-emergency conditions. Therefore, surveillance is essential for maintaining control at less than plague proportions. Because rainfall and the vegetation that follows it are important to l/g survival, satellite image greenness maps can serve as an important guide for field surveillance. Mauritanian nomadic herders are also rich sources of information on rainfall and vegetation patterns, as well as the actual location of l/g. The vastness of Mauritania, combined with a small and often inadequate MRDE survey force, will inevitably allow the highly mobile locust swarm to escape control. Therefore, international donor assistance will be mandatory to prevent or slow locust breeding in Mauritania.

Historically the geographic "ecological-zone" survey and control approach had been addressed through OCLALAV in West Africa. However, political and funding problems have weakened this operational organization. In Mauritania, this "regional" approach is currently being made by the FAO International Strike Force, and the Maghreb Survey Force. Although administratively separate, both coordinated survey operations in Mauritania in 1989, and will continue in 1990. Combined with the national MRDE, these operations may well be able to avert a "plague" situation. While the next locust outbreak may occur-anytime in the; foreseeable future, it is doubtful whether the presently allocated funds for survey will last beyond the next few years.

FAO is considered the official coordinator for locust control and forecasting activities and should be supported. In addition, MRDE and OCLALAV should be encouraged to improve their surveillance capability because of Mauritania's history of difficulties in coping with l/g infestation. Support for the coordinated International Strike Force concept of survey and control assistance is recommended.

4.4.9. Crop Loss Assessment

Crop loss assessment and intervention thresholds for control are important concepts in IPM. However, there are a number of problems in applying these principles to decisions about locusts or grasshoppers in Mauritania. Since reliable crop yield productivity data is scarce, a crop loss assessment is difficult because of uncertainties in the predictability of l/g populations, and because of poor data correlating population levels to crop losses. Furthermore, collection of data for the latter would be difficult and expensive. A study based on existing fields in any given year would likely yield poor data because of the difficulty of obtaining comparable treated and untreated areas. The movements of locusts or grasshoppers would

necessitate very large study areas. Large areas are likely to be flawed with regard to scientific comparability (maintaining uniformity among study plots), and it would be politically impractical to leave large areas untreated during a plague. Any study not relying on comparison of treated and untreated areas would require extensive sampling of many factors to delineate the confounding effects of other variables. Such research is likely to be complex and expensive if conducted in a scientifically defensible fashion (Showler, 1989), and may present data not in line with current host country assumptions concerning the importance of continued donor assistance.

Despite the general unavailability of accurate figures on l/g related crop losses, estimates have been attempted. The best estimates from FAO on crop loss are in the PEA and indicate that "worst case" is usually 12% to 18% and the "best estimate" (which admittedly is not very good) over a wide area is 1.5%. In view of the great range between these estimates, a study of the effectiveness of control operations is important. Undoubtedly, the distribution and success of control efforts among the regions of Mauritania in proportion to infestation levels are not uniform from year to year. Currently, the MRDE and the Agricultural Statistics Department use, a standard 15% normal crop loss due to general pests. In 1988, another 15% was added for loss due to locusts. These estimates are based on a limited field sampling, and probably do not reflect the actual situation. Data on crop production and loss in Mauritania must be verified and compiled to be able to reach substantial conclusions. If semi-quantitative estimates of l/g infestations and efficacy of control efforts were to be kept over a period of years for each region, a much better estimate of cost effectiveness could be made.

Another approach for crop loss assessment that could be used is theoretical modeling. USAID/W is pursuing research in this area. A major difficulty is that such models must be based on good field data to have any validity. Thus, it will tend to suffer from all the uncertainties discussed above. Modeling can be a useful adjunct to field data, and in the long-term, modeling research might have some relevance to conditions in Mauritania. The crop loss statistics currently available from GIRM are of such poor quality that they would not be able to form the basis of any such modeling system.

A third approach to assess crop loss is to allow control operation intervention thresholds to act as an indicator of current or potential crop loss. While this will give no hard data, it will give some reference to crop damage levels, which may or may not relate to real time quantitative crop loss. This system requires the National MRDE survey component be competent in the identification of the pest in question, as well as to accurately assess population densities to determine time of

intervention. Although this may be dependent on donor-provided expertise for the actual assessment, it will allow some data gathering with current control operations, and provide some information until a better mechanism for crop loss assessment is developed.

It is well known that both l/g and agricultural productivity in Africa tend to be dependent on rainfall. The extent to which interventions affect crop yield should be determined by collecting data on the relationships among crop loss, crop value, control costs, infestation levels, and success of control. It would then be possible to have a much more accurate estimate of the cost-benefit ratio for l/g control. In the future, such a program may be an appropriate USAID project for Mauritania. This SEA recommends such program be considered to both better understand the impact of l/g on crops, as well as a way to reduce pesticide usage.

4.4.10 Government of Mauritania Operations

4.4.10.1 Pesticide Regulation

GIRM does not have formal pesticides registration and control legislation. The MRDE is commissioned to oversee pesticide use in Mauritania. There is currently no law requiring the granting of pesticide pre-import clearance. The Ministry of Foreign Affairs issues permits for importation, usually with little or no assessment of potential risks. It can be concluded that pesticide laws are needed; especially to protect human health and the environment. In developed countries it has been useful to combine items such as agriculture, health, and disposal safety precautions, as well as environmental safeguards into the pesticide laws. This SEA recommends such laws be deployed and enacted as soon as possible.

Several recommendations of the PEA are relevant to the expansion of government involvement to include pesticide regulations not strictly related to agricultural practices. It is recommended that there should be control over imported and internally produced pesticides to avoid over-stocking and shortages.

4.4.10.2 Pesticide Registration and Labeling

The pesticide product label, which should be a requirement of the registration process, can effectively communicate a number of important properties of each pesticide as well as precautions

appropriate to its use. Knowledge of these aspects of pesticide use could maximize efficacy and cost effectiveness as well as minimize adverse effects on man and the environment. Protective measures for the user can be included as well as first aid measures, precautions recommending against use in certain habitats (e.g., wetlands), instructions on-container disposal, as well as the most efficacious application rates for particular pest species. Such "label improvements" specific for local needs and environment probably would require close collaboration among international pesticide experts and appropriate GIRM officials, scientists, and MRDE technicians. In addition, the GIRM/MRDE should require that pesticide shipments from donor countries be labeled at least as comprehensively as required by donor country's laws. In summary, a strong licensing and labeling program by the GIRM could be considered an important step to being self-reliant in the safe use of pesticides in agriculture. Such action should be considered carefully when a U.S.G. pesticide donation is requested.

The PEA recommends that high priority in any assistance program be given both to host country pesticide registration laws, and the proper labeling of pesticides. Pesticide registration and regulation can and should be used by the GIRM to license the use of pesticides in Mauritania based on scientific and administrative evaluations on utility, public health risks, and country-specific environmental impacts.

4.4.10.3 Assessment of Pesticide Effects on Human Health and the Environmental

Since the GIRM does not have pesticide laws, it can be concluded that this situation should be rectified with the appropriate use of outside expertise. Over the past five to seven years the EPA has evaluated the health aspects and the environmental impacts of most of the pesticides which will be used in Mauritania for l/g control. The findings of these evaluations are widely available in various formats. The most simple format in which this information is available is the "Pesticide Fact Sheet" (Appendix C). This type of information could serve as an updated, quick reference for describing the properties of a pesticide, used by both USAID and the GIRM. Such precautionary information, which also includes an assessment of the uncertainties still existing in the risk assessment of pesticides, could be incorporated into a user reference handbook on pest control. More extensive and complex information on the health effects and the environmental assessment of these particular pesticides could be made available on a "as needed" basis.

4.4.10.4 Surveillance and Reporting

The MRDE survey and reporting component is inadequate to cope with Mauritania's vast territory. Even with donor assistance, MRDE survey teams are easily overwhelmed by either locust or grasshopper outbreaks. Given that locust breeding in Mauritania will affect other countries, the regional cooperative assistance approach is probably the best strategy until the GIRM MRDE has developed the capacity to take on more responsibility.

With logistical support from the FAO, the MRDE distributes reports describing the current l/g situation, and operations material status and needs to all donor organizations, including USAID, in seasonal weekly Coordination Committee meetings. During these meetings, coordination of needed materials as well as pest management options are discussed. Despite such active coordination, donated material duplications do occur, and coordination in general could be improved. Considering the amounts of donor support that has been given, donor organizations should coordinate to determine the best use of resources and the most effective and least environmentally damaging approach. The donor assistance approach will be required both for emergency assistance and for "normal" operations, until the MRDE is able to handle low level control operations independently.

4.4.10.5 Training and Safety

The MRDE, with donor assistance, provides some training for pesticide applicators and field technicians. This training is primarily geared toward effective pest control, but often neglects essential aspects of safe pesticide use. Elsewhere in this SEA (section 5.0), more comprehensive applicator training is advocated. Such training should include public health and environmental concerns. It is recommended that an "integrated" training program for pest control operators be conducted to include potentially adverse and beneficial aspects of pesticide use. This SEA recommends that a safety training program be tied to future U.S.G. pesticide donations.

5.0 MANAGEMENT OF PESTICIDES

5.1 Pesticide Selection

The impacts of pesticides on the environment and associated health risks to humans makes the way pesticides are selected and used an important aspect of management programs. Due to the unique ecology and bio-diversity of Mozambique, pesticides should be used with extra caution, and only when necessary.

To use a pesticide in a specific area at specific times, it is necessary to have detailed knowledge of the physical and chemical attributes of the product, the ecology of the area to be treated, as well as the biology of the target pest or pests. Pesticides intended to be used for locust and grasshopper control, in addition to being approved by FAO, A.I.D, or other regional organizations responsible for the control operation, should possess the following qualities :

- Effectiveness at low application rates;
- None to minimal effects on nontarget organisms, including people and animals, and specifically predators and parasites of locusts/grasshoppers;
- Minimum persistence of residues on and in native fauna, flora, aquatic systems, soil, and crops;
- Low toxicity and ease of handling;
- Good storage capacity and shelf-life;
- Compatibility with existing application equipment.

Although a number of pesticides have been used in Mozambique against locusts/grasshoppers in the past, any pesticide involved in an operation funded by the USG must be approved for use in the United States by the Environmental Protection Agency (EPA). Several approved pesticides are listed in the Programmatic Environmental Assessment (PEA) and this list has been clarified and updated in STATE 118760 (Appendix D), to include nine pesticides. This should be referred to during both the planning and implementation of phases of locust/grasshopper control. In addition, regulations governing the use of a particular pesticide, as set forth on the label, must be followed.

It is particularly important to note that five (bendiocarb, chlorpyriphos, fenitrothion, lambda-cyhalothrin, and tralomethrin) of the recommended, USAID-approved nine pesticides for grasshopper and locust control are Restricted Use Pesticides (RUP) in the U.S. Further, two of the products approved by USAID (acephate and bendiocarb) are apparently not registered in Mozambique. This underlines the need for proper consultation with local authorities prior to making decisions as to use.

Also, only properly and fully trained applicators should be using these restricted use products.

Bendiocarb, malathion, acephate, lambda-cyhalothrin and **tralomethrin**) are among the pesticides preferred for use in terrestrial ecosystems and are thus included in the recently updated list of USAID-approved pesticides for locust/grasshopper control.

Acephate would be the pesticide of preference, from an environmental standpoint, for use near aquatic ecosystems as it is less toxic to fish, and is systemic in plants, thus best used for larval control. Acephate can be considered to be one of the safest pesticides in use. However, it should be noted that there is always the possibility for aquatic contamination with any pesticide application; hence care must be taken while handling such products near aquatic habitats.

Carbaryl is toxicologically acceptable, but in certain formulations it is more difficult to store and apply (especially from aircraft), than other approved pesticides and is very toxic to bees. **Diazinon** and **chlorpyrifos** are registered for use and are also included in the USAID-approved list. **Fenitrothion** should be used only with extra precautions and with mitigative measures. This pesticide is known to pose serious adverse side-effects, particularly on avian species. Mauritania has coastal areas that should be protected from pesticide contamination as much as possible and pesticide selection for locust/grasshopper control should be the ones listed as USAID-approved pesticides (Appendix D) or those approved both by FAO and WHO, particularly when involving funds from USG.

Chlorinated hydrocarbons, such as **dieldrin** and **lindane**, are <u>not acceptable for use under any circumstances</u>, due to their environmental persistence, bio-accumulation, acute toxicity and broad spectrum target range. **It should be noted that U.S.-funds cannot be used in any way whatsoever in connection with these pesticides. This includes funding any aspect of ground application or aircraft which spray chlorinated hydrocarbons, or the transport of such materials.**

5.2 Pesticide Labeling

Pesticide labeling is a way to give important information to the pesticide user. The label is the main and often only medium for instructing users in correct and safe use practices. The labeling process should go hand-in-hand with in-country pesticide registration. Both registration and proper labeling require good solid legislation at the national level. It is important that the GIRM draft further legislation on approval and control of

pesticides, including a legal framework that will require more complete pesticide labeling and registration in Mauritania. A strong licensing and labeling program by the GIRM would be an important step in achieving safe use of pesticides.

The pesticide product label can be effectively used to communicate a number of important properties of the pesticide and precautions appropriate to its use. In addition to directions for use, the label should include needed protective measures, first aid measures, precautions recommending against use in certain environments, methods of container disposal, and application rates for particular pest species.

Mauritania does not have any Pesticide Regulations that require standardized labeling. In general, pesticides in the original container should carry a label with adequate information for application. Some labels, though not all, contain some information on first-aid or disposal.

While labeling must be specific to local needs and the social environment of Mauritania, the FAO has prepared a global set of guidelines which can assist a labeling program. In addition to enacting legislation, the GIRM should insist that donated pesticides be labeled in comprehensive language as required by donor country law, and be in Arabic or some other local languages.

The situation in the Mauritanian rarely allows a pesticide review and selection process. Usually there is only one pesticide available in a given region, and this is used for all types of grasshopper and locust control. Unfortunately, the MRDE is often left using whatever the donors have supplied, be it appropriate for the situation or not. This can create hazardous situations, such as using the wrong formulation for existing application equipment, or applying environmentally disruptive chemicals. A thorough and complete training program may prevent such occurrences in the future. This SEA recommends such a training program be tied to future U.S.G. pesticide donations.

5.3 Managing Pesticide Stocks

One of the basic requirements for managing pesticide stocks is a secured pesticide storage facility. Such facility should include:

- a fenced and covered area for the pesticides and a warehouse that is:

1) isolated from dwellings in order to avoid fire, leakage, and contamination of surface and ground water;

2) supplied with water in order to clean spills and fight fire;
3) supplied with a shower for the people who handle pesticides
4) aerated to avoid toxic fume concentration;
5) regularly inventoried;
6) equipped with protective gear such as overalls, boots, gloves, goggles, breathing masks , and respirators;
7) stocked with a first aid kit with antidotes;
8) staffed with trained personnel who are familiar with diagnosis and treatment of pesticide poisoning.

A management system is needed to record the date each pesticide arrived at the facility, how long it stays in storage, and when it is removed for use. In addition, the storage requirements for each pesticide must be posted and known by the management staff. Stored pesticides must be tested periodically to insure that the active ingredient is as described on the label, and that the formulation concentration is correct. Also the disposal of unused and obsolete pesticides, and the destruction of their containers, must be part of the management system.

5.3.1 Maintaining and Disposing of Obsolete Pesticide Stocks.

Pesticides in Mauritania are procured through three major sources: donations from the international community (including the pesticide bank); formulation by a local company representing a foreign agrochemical firm; and some imports from major multinational chemical companies. The MRDE is responsible for maintaining and distributing pesticide stocks through a storage center in Nouakchott, and Agricultural Inspection Stations located in all regional capitals. Some smaller towns and villages may also have local storage facilities (although these are likely to be crude and inadequate). Pesticides are distributed by the MRDE to villages and farmer cooperatives. Given that MRDE pesticide storage facilities are generally poorly maintained and unsafe, excess donations of pesticides should be avoided whenever possible. Simple storage safety measures, such as keeping stocks secured and out of the weather, posting warning signs in the local languages, and preventing cohabitation (humans or animals living with the pesticides) should be required and monitored for all pesticides used by the MRDE.

The maintenance of pesticide stores by MRDE could be vastly improved. The central store near Nouakchott shows little evidence of good maintenance practices. Most of the pesticide drums and sacks are in disorder and piled haphazardly on the ground without shelter from the environment. The majority of the

containers are damaged and poorly labeled. Pesticide had been spilled in the open on bare ground in several areas, and a damaged gate allows the neighborhood people to freely visit the storage facility and remove pesticides. This SEA strongly recommends that the MRDE improve its pesticide storage practices and facilities. The current storage facility leaves great doubt as to whether or not a U.S.G. donation of pesticide could be stored in a responsible manner.

The MRDE reports that empty pesticide containers are refilled with pesticides, reused by the petroleum industry or are split open to be used for roofing or other construction material. However, field experience has shown that most used pesticide containers are either sold or given to the general population to later be used to store fuel, drinking water, food, and other materials, and for cooking. The majority of these uses, although popular, present serious health hazards. This SEA advises the immediate destruction of empty pesticide containers. This SEA recommends the use of a barrel crusher in all U.S.G. pesticide-provided operations. All U.S.G.-donated pesticide barrels, when emptied by the GIRM MRDE or another donor, must either be rendered unusable, or be immediately delivered to appropriate parties for approved reuse. To facilitate reuse, container sizes should compatible with reuse requirements. Small containers (i.e., liter size) should be avoided, given the increased potential they present for use as cooking or water containers. In addition, MRDE should periodically inspect the reformulation facilities to ensure proper handling.

Pesticides donated to the MRDE normally have been requested for a specific purpose by the GIRM, and are used in a relatively short period of time, such as one agricultural season. Occasionally, however, donated pesticides have not been requested and have no specific purpose. Such pesticides often fall outside of the list of EPA approved pesticides, and therefore control operations involving these types of pesticides cannot include U.S.G. funds. Such pesticides often create more of a problem than they alleviate by causing additional disposal problems.

Mauritania does not currently have environmentally sound pesticide disposal options. Over 60,000 liters of dieldrin had been stored at the OCLALAV base in Aioun since 1961 (Table 3). Disposal options for this material include incineration, land disposal, and detoxification, but none are currently viable for Mauritania. Any disposal operation would have to be financed and conducted in its entirety through donor assistance. Proper central management of pesticide supplies can minimize the need for disposal of obsolete stock, which is a serious problem in an area which does not have options for hazardous material disposal.

Table 3. Quantities of obsolete pesticide stocks by region in Mauritania.

Source of info?

Region	Locality	Quantity	Concentration
Adrar	Atar	34,000 l	ULV 50
Assaba	Kankossa	1,200 l	50 EC
H El Gharbi	Aioun	17,000 l	ULV 200/ULV 50
Trarza	Rosso	73,000 l	50 EC
District	Nouakchott	3,600 l	ULV 200
Total		190,500 l	

(other products not identified 15,000 l to 20,000 l)

GTZ Mauritania, Seffler V. personal com. 1995)

5.4 Research on Microbial and other non-Conventional Pest Control Agents

5.4.1 Microbial Pest Control Agents

The microsporidian Nosema locustae has been tested in the U.S. and in parts of Africa for its potential as a l/g control agent. Much of the current research on this material is being supported by USAID/W. Although this testing is not being conducted in Mauritania, it is probable that results can be extrapolated to conditions in Mauritania. The extremely dry conditions of Mauritania may diminish this agents efficacy.

USAID, Africa Bureau has been actively involved in developing alternative control option to the pesticide use against l/g. To date, a number of research projects have been funded by USAID/AFR and USAID missions in Mali and Madagascar. Promising results have been obtained. It is anticipated that these results could be tried in countries such as Mauritania where l/g are important problems.

5.4.2 Other Control Measures

The concept of integrated pest management (IPM) is a combination of chemical, cultural, and biological methods. IPM is a means to control pests which would reduce the use of chemical inputs by using them more judiciously. Insect growth

regulators (e.g., diflubenzuron) are often considered "safe" alternatives to conventional pesticides because of their different mode of action. Continued research in this area is encouraged, but caution concerning environmental effects should be taken since this class of chemicals may significantly affect aquatic non-target invertebrates although this is less of a problem in Mauritania. Whenever locust or grasshopper control is implemented in Mauritania, the principles of IPM should be applied to the extent possible. A review of the past U.S.G.-funded IPM projects in Africa should be conducted prior to the implementation of an IPM oriented project.

This SEA supports the idea that operationally, the approach to be adopted for l/g control should evolve one that considers integrated pest management methods that are currently feasible or that show promise for future use.

Under the IPM alternative a full range of l/g control methods is available, including control with the environmentally disruptive pesticides. Selection of control measures can fully consider the positive aspects of various control measures as well as the negative aspects of those measures (e.g., elimination of non-target species such as natural predators).

Promotion of self-sufficiency for the GIRM locust control program should be considered in the selection process for all of the control measures. If control of l/g infestations is not possible using locally available control methods, and those infestations could have impacts which exceed politically and economically acceptable levels, USAID involvement is an available option.

The current policy of l/g control in Mauritania utilizes survey and early intervention, supported by satellite and ground weather information. The effectiveness of surveillance and early intervention can be greatly enhanced by expanding these activities to a regional level. Control methods such as burning and plowing of debris should be encouraged as should the use of biological controls.

6.0 PESTICIDE IMPACT EVALUATION AND MITIGATION

6.1 Human Health Impacts

At all levels of pesticide use (transport, storage, application, and disposal), injurious human/pesticide contact is possible. Due to the often unskilled nature of those working directly with pesticides in Mauritania, the probability of adverse effects is increased. The l/g control program in Mauritania has essentially three levels of pesticide use activity: (1) the operational level of the MRDE/Village Cooperative where low or "normal" levels of the pests are controlled in the normal course of agricultural pest control; (2) the next higher level where more significant pest outbreaks are anticipated; and (3) the emergency level, where a locust or extensive grasshopper outbreak has occurred and increased control efforts are required. The potential for adverse human health effect is similarly stratified. Under all of these conditions, the prevention of exposure of humans is the best approach to minimizing adverse health impacts.

6.1.1 Prevention and Monitoring of Exposure

The general population is most effectively protected from any adverse health effects by implementing the proper application methods. Whether or not the application method is considered safe for the general population depends primarily on the toxicity of the pesticide formulation used, the concentration of the pesticide in the formulation and the frequency of application.

In areas of highest population densities treatment-free perimeters should be observed in order to avoid human exposure.

The most effective way to reduce the exposure of the general population to an acceptable level is to train, educate, and ; supervise all applicators and users of pesticide. It is also concluded that this training and supervision has to be an ongoing effort and must be detailed enough to include the differences between individual pesticide active ingredients, formulations, application methods, and disposal techniques. Some past training sessions, although well intentioned, have often failed to install basic safe pesticide use habits. Follow-up for the trainees with practical application information is considered important, and should be integrated into any U.S.G.-sponsored program. Updates and refresher courses should also be provided

The PEA makes several recommendations for monitoring the exposed human population, proposing the measurement of cholinesterase inhibition (AChE) in persons exposed to organophosphate pesticides. This SEA concurs with the PEA concerning these recommendations for Mauritania. However, because of the weak national health care system, any such testing would have to be addressed by donor TA. This SEA recommends that any U.S.G. pesticide donation require applicator exposure testing as part of the pesticide application program.

6.1.2. Pesticide Applicators

Pesticide applicators are generally at the highest risk for pesticide intoxication because they are handling the concentrates and may spill the products on themselves. In addition to the training and supervision indicated above, they should be made thoroughly familiar with the dangers of pesticides. They also should be provided with equipment that is in good working condition in order to prevent accidents. Such equipment may include pumps to transfer pesticides to avoid pouring, body protection in the form of aprons, respirators, rubber gloves and boots, and face shields. It is particularly important that some form of protection be worn (heavy duty rubber gloves, goggles and face masks, overalls, rubber boots, respirators, etc.) during the short periods while handling the concentrates; somewhat lower levels of protection may be appropriate during the spraying of the diluted pesticides. Exposure of applicators is mostly via the dermal route; although the skin can provide a barrier to the entry of the pesticide, concentrated materials or contamination left on the skin for long periods will allow penetration. Therefore, exposed applicators should wash the exposed areas of their bodies frequently. If water is scarce the wash water could be reused for diluting pesticides. The use of both of safety equipment and safe attitudes must have top priority in any control operation involving U.S.G. donated pesticides.

6.1.3 Public Health Awareness

The public health delivery system in Mauritania is not well developed and likely would not be able to handle either acute or chronic pesticide poisoning cases. Although health centers have either a resident nurse or medical assistant, most staff are not knowledgeable on the practical aspects of pesticide toxicity. All health centers should be provided with information materials concerning pesticide poisoning. The personnel of these centers should also be given the necessary training to recognize and treat any kind of poisoning case they may encounter, as specified in the EPA handbook on pesticide poisonings (Morgan, D.P., 1989).

Such information transfer and related health training should be part of any U.S.G. pesticide donation.

Since the health care system in Mauritania is not able to handle serious poisoning cases which is most likely to involve an applicator), applicator crews should be self-sufficient in handling such an emergency. This requires that the supervisor is not only familiar with the safe handling of pesticides, but also can administer first aid, including administering needed antidotes in critical situations. The supervisor also should be familiar with the early warning signs of poisoning in order that he may remove workers from immediate contacts with the pesticides, thus avoiding more serious effects.

Reports of adverse effects at any level, either in the general population or with applicators, should be communicated to, the managerial level of the control operation. Such a report should be passed to both the MRDE and the donors responsible for the pesticide, equipment, and operations. Depending on the frequency and seriousness of the adverse effects, appropriate steps should be taken to avoid any future occurrences.

The general public, which incurs minimal risk if the necessary precautions are taken, should nevertheless be informed about pesticide use in the area. This can achieved by a number of public outreach means, including posters, radio and TV, and the local newspaper. In 1987, USAID/Nouakchott produced several radio public service announcements on the safe use of pesticides. Assistance was also given to help set up a radio alert system to announce where pesticides were to be used by CPS and donor control operations. Unfortunately, once direct USAID assistance was withdrawn (late fall 1987), neither system was actively continued by the CPS.

6.2 Environmental and Non-Target Effects

During past Mauritanian l/g campaigns, data has not been collected regarding the effects of control activities on the environment or on non-target species. Although these effects have been studied to some extent in other countries, they cannot consider the numerous and specific variables unique to Mauritania. The conclusions of past studies and monitoring efforts can be extrapolated for Mauritania and used in a general sense as recommendations to avoid or minimize unintended effects; associated with pesticide use as well as to optimize the control of target species.

Environmental impact studies associated with pesticide applications has been conducted by Dynamac for USAID in Mali and Sudan. Although these studies are not specific to Mauritania,

Such information transfer and related health training should be part of any U.S.G. pesticide donation.

Since the health care system in Mauritania is not able to handle serious poisoning cases which is most likely to involve an applicator), applicator crews should be self-sufficient in handling such an emergency. This requires that the supervisor is not only familiar with the safe handling of pesticides, but also can administer first aid, including administering needed antidotes in critical situations. The supervisor also should be familiar with the early warning signs of poisoning in order that he may remove workers from immediate contacts with the pesticides, thus avoiding more serious effects.

Reports of adverse effects at any level, either in the general population or with applicators, should be communicated to, the managerial level of the control operation. Such a report should be passed to both the MRDE and the donors responsible for the pesticide, equipment, and operations. Depending on the frequency and seriousness of the adverse effects, appropriate steps should be taken to avoid any future occurrences.

The general public, which incurs minimal risk if the necessary precautions are taken, should nevertheless be informed about pesticide use in the area. This can achieved by a number of public outreach means, including posters, radio and TV, and the local newspaper. In 1987, USAID/Nouakchott produced several radio public service announcements on the safe use of pesticides. Assistance was also given to help set up a radio alert system to announce where pesticides were to be used by CPS and donor control operations. Unfortunately, once direct USAID assistance was withdrawn (late fall 1987), neither system was actively continued by the CPS.

6.2 Environmental and Non-Target Effects

During past Mauritanian l/g campaigns, data has not been collected regarding the effects of control activities on the environment or on non-target species. Although these effects have been studied to some extent in other countries, they cannot consider the numerous and specific variables unique to Mauritania. The conclusions of past studies and monitoring efforts can be extrapolated for Mauritania and used in a general sense as recommendations to avoid or minimize unintended effects; associated with pesticide use as well as to optimize the control of target species.

Environmental impact studies associated with pesticide applications has been conducted by Dynamac for USAID in Mali and Sudan. Although these studies are not specific to Mauritania,

the results are relevant in a general sense. The pesticides tested in Mali were carbaryl, malathion, chlorpyrifos, and lambda-cyhalothrin. In Sudan bendiocarb, carbaryl, carbosulfan, chlorpyrifos, lambda-cyhalothrin, diazinon, and fenitrothion were tested.

In general, these studies indicated that no major environmental impacts occurred if applications were carefully conducted. Recommendations from the studies included: 1) ensuring that pesticides be properly applied; 2) avoiding sensitive habitats, such as wetlands; 3) monitoring impacts on selected beneficial insects; and 4) for the Senegalese grasshopper, using a low rate of pesticide application (efficacy against locust was not sufficiently determined to be able to make a recommendation about application rate). Each study noted that some differences in sensitivity of environmental organisms to these pesticides seem to exist, but the tests were not sensitive enough to determine the degree of difference. The results do suggest that selection of pesticides based on reducing the potential for environmental impact is a legitimate approach.

If pesticide use is necessary, the non-target species and the type of ecosystem should be major factors determining the choice of pesticide and application method. A pesticides characteristics, such as selectivity, mobility in ground water, persistence, and metabolite products should receive the same degree of consideration as effectiveness against target species. Past CPS performance in this regard has often been lacking.

The response of different animals and ecosystems to pesticide exposure varies dramatically. For example, EPA Registration Standards state that carbaryl has only low toxicity to birds. It is, however, extremely toxic to aquatic invertebrates and certain wetland organisms. While application of carbaryl may be appropriate in some agricultural areas, its application in areas important to waterfowl and migratory shorebirds, such as National Parks or Reserves in Mauritania's coastal and river areas should be prohibited.

Although this SEA strongly recommended against any pesticide applications near aquatic habitats, acephate is comparatively non-toxic to freshwater fish and invertebrates and is potentially the least likely of the USAID-considered pesticides to have adverse effects on aquatic habitats. Acephate should be one of the preferred pesticides if applications are necessary adjacent to aquatic systems, particularly when threatened or endangered species may be affected. Due to its mobility in soils, however, acephate has the potential to contaminate ground water. The application of acephate to areas providing recharge to domestic water supply wells should be avoided.

The above two examples illustrate the importance of assessing both a pesticide's characteristics and those of potentially exposed habitats and non-target species. A current information source, such as EPA Pesticide Fact Sheets (Appendix C), should be reviewed prior to selection of a pesticide to allow full consideration of potential effects to the environment and non-target species. This SEA strongly recommends that the alternatives to pesticide use as discussed in the PEA, or other non-chemical pest control methods such as burning debris or plowing soils containing eggs, be employed whenever feasible. Despite pesticides' potential adverse effects, several studies indicate that the pesticides approved USAID for use against l/g can be used with minimal adverse environmental impacts when applied at recommended rate. It is important to note, however, that careful controls were used during pesticide application in those studies and sensitive habitats were avoided. Consistent application of such stringent controls may not be possible under actual l/g control operations.

6.2.1 Effects Monitoring

Monitoring the effects of pesticide treatment activities can give valuable feedback on the modification of pest management activities, and can provide some general conclusions on pesticide use patterns. Given the large number of variables that can affect results and the limited resources likely to be available for monitoring, using mortality, population counts, and behavior observations may be the most practical ways to assess treatment effects. Baseline conditions for an indicator species and its habitat should be determined prior to pesticide application, and post-application monitoring should be conducted at intervals sufficient to allow assessment of both immediate and long-term effects. It is also important to select species with demonstrated sensitivity to pesticide exposure.

Aquatic habitats are heavily used by fauna, and often provide critical habitat to sensitive species and migratory birds. Therefore, they should be avoided wherever possible. However, application of pesticides for l/g control is generally conducted during or close to the time of seasonal rains indicating the potential for direct application to open water or introduction into water supplies and aquatic systems in runoff. Because invertebrates are generally much more sensitive to pesticide exposure than vertebrates, monitoring the observable effects of pesticide use on invertebrates is the preferred method for monitoring aquatic habitats.

A similar monitoring approach should be used for pesticides in terrestrial ecosystems. Selection of soil microorganisms or other low tolerance invertebrates as indicator species is recommended. Monitoring animals of economic value or threatened status should also be required. In cases where pesticide persistence is an issue, residues should be measured. Populations of predators, such as birds of prey or other carnivores, are likely to fluctuate too much to make population counts an effective monitoring tool. However, reproduction monitoring (e. g., observations of egg conditions, birth defects, chick mortality) may be a useful tool in determining the effects of pesticides known to affect reproductive success, particularly in-cases where baseline data are known.

6.2.2 Residue Testing

Mauritania does not have an adequate residue chemistry laboratory which could accurately measure actual residues in the environment that coulg result from pesticide spraying. Hence, any such residue testing would have to be done outside Mauritania. Information resulting from such testing could be evaluated and incorporated into future programs. Such information could assist not only future USG projects, but also those of the CPS and other donors. This SEA suggests that USAID consider such a monitoring program for Mauritania along with any USG-donated pesticide.

6.2.3 Special Designation Areas

There are six designated wetlands, and nineteen forest reserves in Mauritania (Figure 5). Mauritania also has established and administers one national park which is located along the northern coast (Figure 6). The major biotic communities represented in this park are primarily marine in nature, although some desert area is also included.

The SEA supports the PEA recommendation to establish a 2.5 km buffer zone around water bodies, areas containing endangered species, and critical habitat. For Mauritania, until a valid natural resources assessment indicates otherwise, areas in which pesticides should not be used should include the environmentally sensitive areas listed in Table 4 and Figures 5 & 6).

Given the importance of biodiversity in these habitats, l/g control adjacent to buffer zones surrounding them should be with a pesticide that has the lowest potential to impact non-target species while still meeting the level of accepted efficacy for target species. In addition, pesticide use should be avoided if

at all possible (or else highly restricted) in non-designated wetlands. These areas are not expected to be significant sources of massive populations of locusts or grasshoppers and could serve as reserves for native pathogens, parasites, or predators.

In the pasture lands which are extensively used by herders during the rainy season, pesticide use should be permissible to the extent that it is consistent with other management objectives of those areas. Such use should be primarily for preventive purposes. When locust or grasshopper population levels have gone beyond the capacity of ground treatment units and small aircraft, these reserves may have to be left untreated. However, large aircraft have treated range land areas in the past, and may be needed if outbreak levels reach a critical point. In as much as possible, large aircraft (e.g., DC-4, C-130, etc.) should not be used. If circumstances dictate that this as the only option, the decisions should be based not only on extent of infestation, but logistical considerations as well, such as distance from airport to the spray area. Environmental considerations must also be weighed carefully in such a situation, as massive use of pesticides will affect non-target and beneficial organisms.

Large-scale control programs may actually increase the likelihood of future outbreaks by removing most naturally occurring l/g predators and parasites. Additionally, wells and watering holes in these areas provide water to both humans and livestock. The buffer zones required by the PEA should be observed for these areas.

No species are officially listed as endangered or threatened in Mauritania. However, areas that may contain possible threatened or endangered species should allow only limited emergency use of pesticides. Since Mauritania has yet to define such species, compilations from adjoining countries must be resorted to.

6.2.4 Rivers

Mauritania has two rivers, the Senegal and the Gorgol, which are partially flanked by desert, scrub land, sparse forests and to a limited extent, wetland habitats (Figure 5). This SEA recommends that pesticide use should be banned, restricted, or accompanied by conservative protection measures near these rivers. This includes careful and precise pesticide application in the irrigated rice fields which are adjacent to the Senegal river. It is worth noting that GIRM has not officially designated river areas as off-limits to pesticide use.

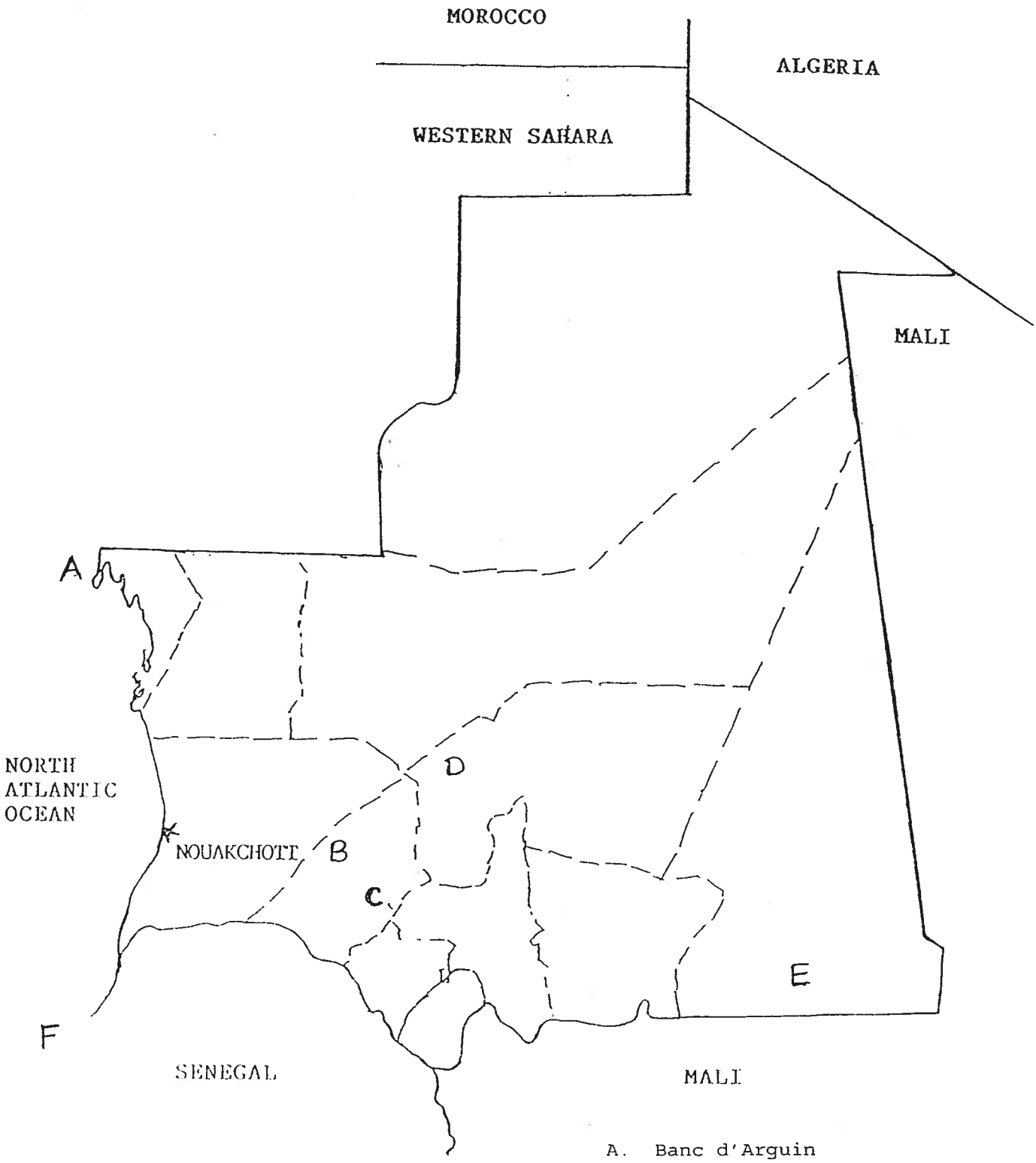
6.3 Future Assessments

This SEA suggests that an assessment of natural resources in Mauritania be performed. Such a study would likely provide a more adequate framework for a description of Mauritania's protected areas, their distribution, and the ecological corridors between them than presently exists. Identification of buffer zones that would help preserve biodiversity and assign land stewardship responsibilities to neighboring populations should be included in a Mauritania-specific NRMS planning document. Such a document would also identify natural resource use conflicts that preclude biodiversity maintenance, including non-targeted pest management. This SEA strongly recommends that any future NRMS study be incorporated into an update of this SEA.

This SEA also recommends that existing planning documents, such as the "Plan for Supporting Natural Resources/Management in sub-Saharan Africa (PNRM)" and the "Sahel Sub-Regional Natural (Resources Management Assessment Report (SSRA)" be/used for USAID pesticide planning efforts in Mauritania. The PNRM, approved by Africa Bureau in February 1987, focuses on achieving sustainable increases in agriculture and rural income while recognizing that such production is directly linked to the long-term maintenance of soils, vegetation, and biologically diverse habitats. The SSRA examines farmer-based initiatives having enduring impacts and describes the conditions under which the I initiatives occur. The SSRA identifies the principle of local control that is consistent with the use of traditional methods of control by farmers. The SSRA also examines the social, political, institutional, and resource inter-relationships, and may provide valuable insight into establishment of a regional pest control strategy for Mauritania.

An additional document which provides information of potential, use for planning l/g control operations is "Assessment of Environmental Effects of Proposed Developments in the Senegal River(Basin" (Hudgins et al., undated). The wealth of information in this document has not been completely assimilated into this SEA but should be considered in future dates.

Figure 5. Wetlands of Mauritania.

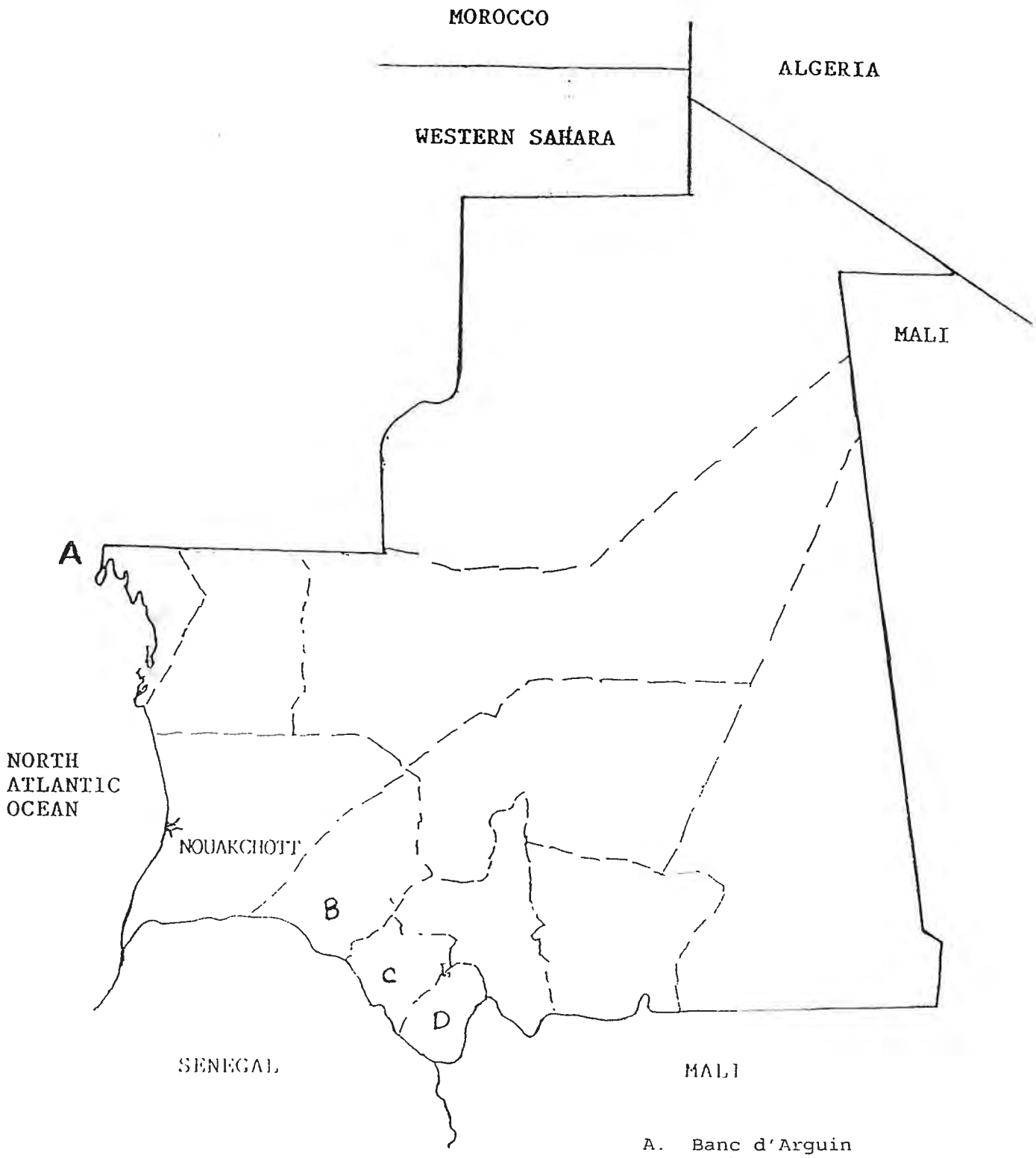


A. Banc d'Arguin
B. Lac d'Aleg
C. Lac de Male
D. Tamant Naaj
E. Mar de Mahmouda
F. Diawling

Table 4. Environmentally Sensitive Areas in Mauritania.

Designation	Name	Region
Wetland area	Lac d'Aleg	Brakna
	Lac de Male	Brakna
	Mare de Mahmouda	Hodh Chargui
	Banc d'Arguin	Nouadhibou
	Diawling	Tagant
	Tamourt Naaj	Tagant
National park		
	Banc d'Arguin	Nouadhibou
Forest Reserves		
	Dar El Barka	Brakna
	Ganki	Brakna
	Lopel	Brakna
	Olo Ologo	Brakna
	Silbe	Brakna
	Tessem	Brakna
	Walade	Brakna
	Das	Gorgol
	Dindi	Gorgol
	N'Djorbirol	Gorgol
	N'Gouye	Gorgol
	Boully	Guidimaka
	Kalignoro	Guidimaka
	Saidou	Guidimaka
	Wed Jrid	Guidimaka
	Dioli	Trarza
	Gani	Trarza
	Keur Mour	Trarza
	M'barwadja	Trarza
	M'boul	Trarza

Figure 6. National parks and forest reserves of Mauritania.



A. Banc d'Arguin
B. Brakna
C. Gorgol
D. Guidimaka

7.0 USAID OPTIONS FOR INVOLVEMENT IN L/G OPERATIONS

At some point in the future, USAID may be requested to assist the Mauritanian CPS in l/g control efforts. Assistance levels will depend on both the level and intensity of the outbreak, and USAID's programmatic intentions. The two options discussed here are in relation to actions that the USAID/ Nouakchott may wish to consider. Any future USAID role would undoubtedly be a combination of the points presented here.

7.1. No Direct Action

Although the USAID Mission in Mauritania would watch any future infestation carefully, the Mission would not be an active participant in control assistance efforts with the CPS. Should a serious locust or grasshopper outbreak occur, possible emergency assistance though OFDA would likely be available. This option would also allow USAID/W to fund Mauritanian control operations through an organization, such as was done with the FAO in 1989. Again, the Mission itself would play a passive role, but could be called upon should infestation levels reach a critical point.

7.2. Direct Action

role of AELGA? FAO?

This option would allow the Mission to play an active role in support of CPS control efforts by providing any or all of the following: fund and material assistance, training assistance, pesticide donations, and TA. Such an assistance program would be run out of the Agricultural Development Office, and would be considered part of the USAID Mission's developmental support. A thorough evaluation of past projects and the current CPS status should be conducted prior to the implementation of such a project. As with the "no action" option, should infestation levels reach a critical point, additional outside assistance could be necessary through the OFDA. Future staffing limitations in USAID/Mauritania precludes implementation of this option.

The risks and benefits of pesticide use in l/g campaigns must be assessed not only in light of environmental or crop loss concerns, but also within the long-term developmental process. Both the risks and benefits of such an undertaking contain subjective and judgmental components as wee as policy and political ones. The acceptability of a risk/benefit decision depends to a large degree on the way both the probabilities of risks and benefits are communicated to those who are at risk and/or to those who may benefit. The following risk/benefit analysis, therefore, should be viewed with both uncertainty

the subjectiveness inherent in such analyses. They are primarily intended to assist USAID and the CPS with the formulation of actions (or lack of actions), fully realizing that under any actual future conditions the components and magnitudes of the risks and benefits might be different. For reasons of simplicity, only two scenarios, the normal preventative operations and the emergency situation, are addressed. Risks and benefits in other situations are believed to have a similar sliding scale relationship.

7.3 Preventive Operations

Due to the high population growth potential of both grasshoppers and locusts, the best control strategy is the prevention of outbreaks before they happen. Prevention is best accomplished by diligent and continuous survey, followed by rapid and precise control operations. Without such a policy and practice, uncontrolled populations can reach an outbreak threshold in a surprisingly short period of time, leaving donor emergency actions as the only operational option.

The prevention of l/g outbreaks in-Mauritania is the recommended normal operational mode. Early season control should be emphasized and post-harvest control operations minimized. Village-based farmer brigades have been effective to some extent in other Sahelian nations. Prevention of insect outbreaks has long been considered to have high benefits and low risks. In addition to reducing the potential for dramatic crop loss, pesticide use (and subsequent effects and environmental impacts) is greatly reduced.

From a functional standpoint, the Mauritanian CPS is currently unable to fulfill the preventative role in either survey or control operations. This is because of (1) the vast size of Mauritania, and (2) the current deficiencies within the CPS. Any preventative survey and control operations would have to be conducted by donors. Costs of maintaining a functional survey operation, and a ready control operation in a vast and logistically devoid country like Mauritania, are high. Thus, preventative-type operations, while impressive in theory, are both difficult and expensive to implement.

Role of Morocco? Non-traditional donor assistance + funding T.A. for survey, etc.

7.4 Disaster Level Operations

With rapid l/g population growth, an insect outbreak m/ quickly reach, moving control operations to an emergency/di/ level. Where a locust or grasshopper outbreak has occurre/ pesticides are usually widely applied, which substantially

ed

increases related risks. However, some benefits also may exist, particularly since some crop loss may be prevented. If the recommendations of the PEA and the SEA are followed, significant and generalized human and environmental risks are not likely to occur even under conditions of increased pesticide use. However, it is extremely unlikely that such recommendations would be followed without strict TA at all phases of pesticide storage, transport, application, and disposal. The high probability of an increased rate of accidents is a likely consequence of high pesticide spray activity. The most important function of the GIRM under these conditions, in addition to conducting safe and sane control operations, is to communicate effectively with the affected population, to describe the necessity of the emergency measures, to assure to the extent possible the safety of the population and the environment, while effectively combating the locust or grasshopper infestation.

Reference to likely role of FAO?

8.0 REFERENCES

USAID 1989a. Locust/Grasshopper management, Operations. Office of Foreign Disaster Assistance Agency for International Development, Washington, DC, USA.

USAID 1989b. Implement n Plan for Government of Niger to Reduce Hazard of Surplus and Unusable Insecticides Acquired Use in the Locust/Grasshopper Control Program. Agency for International Development, Washington, DC, USA.

Alomenu, H.S. 1989. Provisional Report on Pesticide Management in Francophone West Africa. Food & Agriculture Organization, Accra, Ghana, 58 pp.

Appleby, G., W. Settle and A. Showler. 1989. The Africa Emergency Locust/Grasshopper Assistance Mid-term Evaluation, Tropical Research & Development, Inc., Gainesville, Florida, 146 pp.

Boberschmidt, L., S. Saari, J. Sassaman and L. Skinner. 1989. Pesticide Background Statements, Volume IV, Insecticides. Agriculture Handbook No. 685, US Forest Service, Washington, DC, USA, 578 pp.

Dynamac. 1988a. Results of the Mali Pesticide Testing Trial Against the Mauritanian Grasshopper. Dynamac Corporation, Rockville, Maryland, USA, 111 pp + Appendices.

Dynamac. 1988b. Results of the Locust Pesticide Testing Trials in Sudan. Dynamac Corporation, Rockville, Maryland, USA, 84 pp + Appendices.

Loken, E. R. 1988. Environmental Assessment Update - Morocco Locust Control Project Paper Supplement (Annex B), Agency for International Development, Rabat, Morocco.

Morgan, D.P. 1989. Recognition and Management of Pesticide Poisonings. 4th Edition. EPA-450/9-88-001. Environmental Protection Agency, Washington, DC, USA, 207 pp.

Potter, C.S., M.G. Rutanen-Whaley, H. Khoury and A. Messer. 1988. Draft Environmental Assessment of the Tunisia Locust Control Campaign. Agency for International Development, Tunis, Tunisia, 48 pp.

Rutanen-Whaley, M.G., G.E. Cavin, R.W. Dyer, J.J. Drea, R.G. Hellyer and R.S. Stryker. 1988. Environmental Assessment of the Morocco Locust Control Project. Agency for International Development, Rabat, Morocco, 30 pp + Appendices.

(PANOS. - See page 6)

Schwartz, T;K., M.F. Speers, G.P. Owens, J.B. Hannum, O.M. Ali, A. Gamal and S. El Bashir. 1988. Environmental Assessment of the Sudan Locust Control Project. Agency for International Development, Khartoum, Sudan, 62 pp.

Shaikh, A., E. Arnould, K. Christophersen, R. Hagen, J. Tabor, and P. Warshall. 1988. Opportunities for Sustained Development, Successful Natural ResourCes Management in the Sahel. Agency for International Development, Bureau for Africa, Sahel Office, Four Volumes.

Shannon, M. et al. 1987. Rangeland Grasshopper Cooperative Management Program, Final Environmental Impact Statement. Animal and Plant Health Inspection Service, US Department of Agriculture, Washington, DC, USA, 251 pp + Appendices.

Showler, A.T. 1989. Scientific Protocol for Ecological Monitoring in Insecticide-Treated regions of North Africa, and the Sahel During Locust/Grasshopper Campaigns. USAID/OFDA, Washington, DC, 28 pp.

Stanley, R., et al. 1989. Draft Supplementary Environment Assessment of the Senegal Locust Control Project.

Steedman, A. (ed.) 1988. Locust Handbook. 2nd edition. Overseas Development Natural Resources Institute, London, England, 180 pp.

TAMS/CICP, 1989. Locust and Grasshopper Control in Africa/Asia, A Programmatic Environmental Assessment. TAMS Consultants, Inc. and Consortium for Integrated Crop Protection, Arlington, Virginia, USA, 305 pp + Appendices.

APPENDIX A.

PREPARER: William B. Thomas, l/g Program Coordinator USAID/Mauritania

REVISED AND FINALIZED BY: Drs. Yene T. Belayneh, Ecotoxicologist, and Alan C. Schroeder, Assistant Technical Advisors, AELGA Project, AID/AFR/AA/DRC, Washington, DC

LIST OF PERSONS CONTACTED

Galledou Tahara, Chief of Mauritanian Crop Protection; Service

Dahmoud Merzoug, Director of Nature Protection.Directorate

Ahemed Haidara, Head of Institutional Support, National Protection Directorate

Thiam Ibrahima, Chief of Reforestation and Wildlife Management

Denise Daly, FEWS Field Representative, USAID/Mauritania

Dr. Son Nguyen, Agricultural Development Advisor, USAID/Mauritania

Mr. Volkhar Leffler, GTZ/Nouakchott

APPENDIX B.

DISPOSITION OF THE 38 RECOMMENDATIONS IN THE PROGRAMMATIC ENVIRONMENTAL ASSESSMENT

BASIC PRECONDITION OF PROGRAM

Recommendation 1. It is recommended that USAID continue its involvement in locust and grasshopper control. Operationally, the approach to be adopted should evolve toward one of Integrated Pest Management.

Theoretically this recommendation is correct, and supported by this SEA. However, it is questionable whether or not the Mauritanian CPS can integrate needed long-term assistance at this point in time. The current racial/civil disturbances are having a negative influence on existing institution building programs. It is questionable whether anything but "emergency"-type programs will have any significant effect on locust or grasshopper population levels, as well as on crop protection in general. The failed IPM program of the early 1980's must be studied carefully before any similar program is designed. Any future donations to the CPS l/g control effort, be they pesticides or otherwise, should study the issue of potential material integration carefully, and be prepared to fund TA supervision.

INVENTORY AND MAPPING PROCEDURES

Recommendation 2. It is recommended that an inventory and mapping program be started to determine the extent and boundaries of environmentally fragile areas.

This SEA agrees with the need for such an inventory. However, currently there is no foreseeable U.S.G. program or project to do this. Even when such an inventory is established, the ability of the GIRM to protect fragile areas is debatable. Should USAID be re-instated in Mauritania, attempts should be made to implement this recommendation.

Recommendation 3. It is recommended that a system for dynamic inventory of pesticide chemical stocks be developed.

This SEA agrees with the need for a pesticide stock inventory, especially since Mauritania has such a poor system of management currently in place. Improvements in the system for managing pesticide stocks should be implemented, minimizing the chance of pesticide products becoming obsolete. Donor assistance will be essential for the implementation and maintenance of such program.

Recommendation 4. It is recommended that USAID take an active role in assisting the host country in identifying alternate use; or disposal of pesticide stocks. Refer to recommendation 14.

This SEA supports this recommendation for Mauritania. The stock of Dieldrin (60,000 liters) located in Aioun since 1962 should only be disposed of when a sound technology, appropriate to the local situation, has been developed. High priority should be placed on this recommendation to minimize the future accumulation of any unwanted, obsolete or outdated (ineffective) pesticide. It should be noted that the GIRM has yet to request any disposal assistance, and in fact, has said it does not want to dispose of the dieldrin.

Recommendation 5. It is recommended that FAO, as lead agency for migratory pest control, be requested to establish a system for the inventory of manpower, procedures and equipment.

This SEA supports the recommendation of having a lead agency in this aspect of pest control. However, such actions should rather be a joint venture in which regional/sub-regional organizations that are responsible for l/g control operations will fully participate to enhance the actual implementation abilities of FAO.

MITIGATION OF NON-TARGET PESTICIDE EFFECTS

Recommendation 6. It is recommended that there be no pesticide application in environmentally fragile areas and human settlements.

This SEA supports this recommendation for both U.S.G. pesticide donations and control operations in Mauritania. Any future U.S.G. donations of pesticides should be accompanied by a requirement prohibiting use in some areas, limiting use in others, and requiring appropriate buffer zones (2-5 km wide).

Recommendation 7. It is recommended that pesticides used should be those with the minimum impact on non-target species.

This SEA supports this recommendation. USAID has recently updated its list of anti-locust.grasshopper pesticide (see Appendix D) which it chooses to support for this purpose. Pesticide recommendations in the PEA should be followed until research results indicate that more environmentally safe pesticides are available for use. Promising biological and botanical pest control agents, the efficacy and environmental safety of which have been determined through research, and for which EPA approval has been obtained, can also be supported by USAID and used.

Recommendation 8. It is recommended that pre- and post-treatment monitoring and sampling of sentinel organisms and water and/or soils be carried out as an integral part of each control campaign.

This SEA supports this recommendation in theory, but must caution that any such study will have to be done entirely by donors. Both the cost of such monitoring and logistical considerations must be taken into account in assessing the feasibility for Mauritania. This SEA recommends that an environmental monitoring program be integrated into any U.S.G. pesticide donation.

APPLICATION OF INSECTICIDES

Recommendation 9. It is recommended that one of the criteria to be utilized in the selection of control techniques should be the minimization of the area to be sprayed.

This SEA supports this recommendation. However, past CPS performance indicates that unless all control operation procedures are supervised by someone who fully understands the concepts that support this recommendation, actual field implementation may not occur. With a U.S.G. donation of pesticide, a U.S. TA team may be appropriate. In addition, a number of operational procedures should be followed to minimize the area to be sprayed. First, emphasis should be on good survey, allowing preventive, early treatment. In some cases, crop protection treatments are necessary when economic thresholds are approached. Second, a program of identifying non-treatment areas and minimum treatment areas will be adopted; this will ensure that substantial areas will be excluded from most pesticide treatment. Third, training of all decision-making individuals should emphasize the importance of restraint in the use of pesticides.

Recommendation 10. It is recommended that helicopters should be used primarily for survey to support ground and air control units. When aerial treatment is indicated, it should only be when very accurate spraying is necessary, such as close to environmentally fragile areas or for localized treatment.

This SEA supports this recommendation. The treatment program in Mauritania should emphasize ground treatment applications. However, this is not always appropriate, as some areas, especially the central mountains, are inaccessible. Helicopters should only be used in areas which are inaccessible and when precision spraying is required.

Recommendation 11. It is recommended that, whenever possible, small planes should be favored over medium to large two or four

engine transport types (for application of pesticides). In all cases, experienced contractors will be used.

This SEA supports this recommendation for non-emergency control activities. However, the formidable size of Mauritania can necessitate the use of large aircraft simply to get from the only airport with logistical support (Nouakchott) to areas that need to be sprayed (often over 1000 km from the airport). In the case of grasshoppers, it may be that the only way to have a substantial impact on population numbers is to spray pasture lands with large aircraft. Environmental considerations must be measured, but the option of large aircraft cannot be ruled out for Mauritania.

Recommendation 12. It is recommended that any U.S.G.-funded l/g control actions which provide pesticides and other commodities, or aerial or ground application services, include TA and environmental assessment expertise as an integral component of the assistance package.

This SEA agrees with this recommendation. Until the CPS can demonstrate responsible pesticide use, such TA is essential in Mauritania. Eventually, it is hoped that a long-term program will be able to develop such expertise within the CPS.

Recommendation 13. It is recommended that all pesticide containers be appropriately labeled.

This SEA agrees with this recommendation. No pesticides should be donated unless the containers are clearly and completely labeled in French. Labeling in Arabic should also be sought. The labels must include appropriate warnings concerning adverse human health effects and environmental impacts, as well as clear directions for use and disposal of containers. Labels must be printed on material that will resist fading from sunlight, and must be firmly attached to drums. In addition, drums should be painted or stamped with words and symbols that will designate them as pesticide barrels even after the label has been removed.

DISPOSAL OF INSECTICIDES

Recommendation 14. It is recommended that USAID provide assistance to host governments in disposing of empty pesticide containers and pesticides that are obsolete or no longer usable for the purpose intended.

This SEA supports this recommendation. Mauritania's problem with obsolete dieldrin should be dealt with as soon as a suitable disposal method is available. In addition, Mauritania has an

apparent problem with improper uses of empty containers. USAID/Mauritania has encouraged the CPS to improve the control and monitoring of potential impacts of improper uses for empty pesticide containers.

PUBLIC HEALTH AWARENESS

Recommendation 15. USAID should support the design, reproduction and presentation of public education materials on pesticide safety (e. g. , TV, radio, posters, booklets). This would include such subjects as safely using effective pesticides, ecology, pest management of locusts and grasshoppers and the hazards of pesticides. The goal would be to help policy makers and local populations recognize potential health problems related to pesticide applications.

This SEA supports this recommendation. In 1987, USAID/ Mauritania produced several radio public service announcements concerning pesticide safety. These were translated in to the four major regional languages: Wolof, Hassanya, Pulaar, and Soninke. However, despite initial program technical assistance, and providing new tapes to the CPS each year since, few of the announcements actually were broadcast. This SEA recommends that the GIRM's CPS or a responsible body should continue these activities.

Recommendation 16. It is recommended that training courses be designed and developed for health personnel in all areas where pesticides are used frequently.

This SEA supports this recommendation. Personnel at the regional health centers should be trained and informed about potential pesticide poisoning, especially involving agricultural workers. In addition, Agriculture Extension, workers should be familiarized with all aspects of pesticide poisoning and necessary responses (See Rec. 23)

Recommendation 17. It is recommended that each health center and dispensary located in an area where pesticide poisonings are expected to occur should be supplied with large wall posters in which the diagnosis and treatment of specific poisonings are depicted. The centers and dispensaries should also be provided, prior to spraying, with those medicines and antidotes required for treatment of poisoning cases.

This SEA supports this recommendation in that it supports the concept that health centers must be properly informed and equipped to handle potential poisonings. This SEA further recommends a safe pesticide application program which includes training for the applicators to avoid environmental and

applicator poisonings.

Recommendation 18. It is recommended that presently available tests for monitoring human exposure to pesticides should be evaluated in the field. This includes measurement of cholinesterase (ChE) levels for OP pesticide groups in small samples of blood as a screening test.

This SEA supports the need for monitoring the human health impact of pesticide applications, and supports the use of ChE inhibition testing. In addition, this SEA favors the monitoring for actual symptoms (including the minor ones) of pesticide exposure. ChE testing should be limited to applicators, who should be tested at least two times before application and during and after pesticide use. Moreover ChE testing should be limited to applications of organophospates for which it is valid. It should be noted that such testing would have to be part of an overall assistance program with full technical assistance supervision on ChE testing. Note that there are currently no facilities or personnel in Mauritania to assist with such a program.

PESTICIDE FORMULATION AND MANAGEMENT

Recommendation 19. It is recommended that the specifications for USAID purchase of l/g insecticides be adapted for all insecticides.

This SEA supports this recommendation.

Recommendation 20. It is recommended that pesticide container specifications be developed.

This SEA supports this recommendation. Too often empty pesticide containers are utilized for water or food storage. Often these secondary users are unaware of the barrels' history. A specific marking incorporated into all pesticide containers would alert users of empty drums that pesticide had once been stored in the drums.

BIOLOGICAL CONTROL

Recommendation 21. It is recommended that Nosema and other biological agents such as neem be field tested under African and Asian conditions in priority countries.

This SEA strongly supports this recommendation. Entomopathogens that have high virulence against l/g, such as Beauveria and

Metarrhizium should be researched and ways and means should be explored to implement this option. Studies should be initiated to survey for indigenous entomopathogenic strains that have the potential to control l/g with an ultimate goal of regional and/or local production and marketing.

TRAINING

Recommendation 22. It is recommended that a comprehensive training program be developed for USAID Mission personnel who have responsibility for control operations. This will involve a review of existing materials and those under development in order to save resources.

This SEA supports this recommendation in principle. However, selection of biological and botanical pest control agents should be based on research results.

Recommendation 23. It is recommended that local programs of training be instituted for pesticide storage management, environmental monitoring and public health.

This SEA supports this recommendation. Currently such a program is not applicable to Mauritania. However, it is recommended that priority be given to such training should the U.S.G. make a pesticide donation to the CPS. Such training can ensure the safe and appropriate application and handling of pesticide products to minimize any health and environmental problems.

Recommendation 24. It is recommended that when technical assistance teams are provided they be given short-term intensive technical training (including language if necessary) and some background in the use and availability of training aids.

This SEA agrees with this recommendation. Technical assistance teams should have the best possible expertise and sufficient language fluency for the tasks to be performed. To the extent that any member has a notable gap in language or facility with training aids, short-term training is advisable to achieve expected performance. Of course, in an emergency situation, selection criteria would have to be adjusted to meet the urgency of the problem. Senior personnel should be coupled with junior technical assistants as much as possible in order to ensure sustainablity and benefit the latter.

ECONOMICS

Recommendation 25. It is recommended that field research be carried out to generate badly needed economic data on a country-by-country basis.

Economic data including cost/benefit analysis and crop loss assessments are very important in decision making processes. However, it is often difficult to obtain such data, particularly in countries where expertise and facilities are scarce. Mauritania being one of the countries where such scarcity is evident, immediate implementation of this recommendation is not realistic without donor assistance. Implementation of this recommendation and training of candidates will ensure sustainability in l/g control.

Recommendation 26. It is recommended that no pesticide be applied unless the provisional economic threshold of locusts or grasshoppers is reached.

Indiscriminate application of pesticides is more damaging than it is helpful. Therefore, l/g infestations should be assessed in terms of potential crop loss and expected benefits before embarking on pesticide application. In regard to locusts, the economic threshold is the presence of certain number of locusts. For grasshoppers, rangeland and cropland threshold data exists in USDA files. This data, however, for the most part, is not specific to Africa.

ENVIRONMENTAL POLICY

Recommendation 27. It is recommended that USAID provide assistance to host countries in drawing up regulations on the registration and management of pesticides and the drafting of environmental policy.

Mauritania does not have fully developed regulations on environmental protection or pesticide management. It is recommended that such regulations be drafted and that assistance be provide in the drafting process.

PESTICIDE USE POLICY

Recommendation 28. It is recommended that a pesticide use inventory covering all treatments in both agricultural and health programs be developed, on a country-by-country basis.

This SEA supports this recommendation. This should be a collaborative activity between the CPS and the national health unit.

PESTICIDE HANDBOOK

Recommendation 29. It is recommended that USAID produce a regularly updated pesticide handbook for use by its staff.

This SEA agrees with this recommendation. Availability of such handbook would greatly enhance the perceptions of USAID staff both in Washington as well as at the Mission level.

SUPPORT AND TRAINING

Recommendation 30. It is recommended that technical assistance, education and training, and equipment be provided to crop protection services of host countries with a view to making the services eventually self-sustaining.

While this SEA supports this recommendation, it should be noted that such a developmental assistance process has been in process in Mauritania for several years. This is part of USAID policy concerning long-term developmental assistance. Should USAID Mission to Mauritania be re-instated, these activities should be considered to ensure sustainability in l/g control operations.

STORAGE

Recommendation 31. It is recommended that more pesticide storage facilities be built. Until that occurs, emergency supplies should be pre-positioned in the United States.

Pre-positioning of pesticides, equipment, and supplies should be better organized and centralized. Regional pesticide and supply banks should be built in areas close to where they are needed most. At the time this SEA was drafted, the FAO was assisting with the construction of a storage facility in Nouakchott. The completion of that facility warrants pre-positioning pesticide in Nouakchott.

FORECASTING

Recommendation 32. It is recommended that USAID make a decision as to whether to continue funding forecasting and remote sensing or utilize FAO's early warning program.

This SEA recommends that forecasting and early warning should be done in collaboration with FAO and FEWS and that the U.S.G. should assist with long-term active technical assistance. greenness maps and other geographical information services should be used in conjunction with survey work for forecasting and early warning.

PUBLIC HEALTH MONITORING AND STUDY

Recommendation 33. It is recommended that a series of epidemiological case-control studies, within the countries involved in l/g control, should be implemented in areas of heavy human exposure to pesticides.

This SEA agrees with this recommendation, but notes that any such study would require both technical assistance and funds. The GIRM health infrastructure cannot currently support such a study. Institutional strengthening is one of the options for developing and ensuring sustainability in undertaking these activities.

RESEARCH

Recommendation 34. It is recommended that applied research be carried out on the efficacy of various pesticides and insect growth retardants and their application.

This SEA supports this recommendation. Any such research undertaking would have to be totally supported and carried out by donor technical assistance. The Mauritanian government research infrastructure is currently inadequate to support or undertake such a program and it needs to be strengthened.

Recommendation 35. It is recommended that applied research be carried out on the use of neem as an anti-feedant.

This SEA agrees with this recommendation in principle. Several recent studies conclude that neem is a promising botanical pest control agent. However, certain undesirable features, i.e., lack of stability and variations in the amount of the active compound found in kernels obtained from different trees, might reduce its

value as a viable agent for l/g control purposes. Although the fact that neem is locally available to farmers throughout much of the Sahel and earlier some research on neem has been conducted in Niger, Mali, and Mauritania, continued research efforts should be undertaken prior to any neem oriented program in Mauritania. Furthermore, neem supplies should be thoroughly evaluated.

Recommendation 36. It is recommended that research be carried out to determine the best techniques for assessing the impacts of organophosphates used for l/g control "in relation" to the use of these and other chemicals for other pest control programs.

This SEA supports this recommendation. Such assessments should not be limited to OP only, instead it should be expanded to carbamates, pyrithroids, and insect growth regulators.

ENHANCING AND ACCELERATING IMPLEMENTATION

Recommendation 37. It is recommended that USAID, on the basis of the previous recommendations, develop a plan of action with practical procedures to provide guidance in l/g control to missions in the field.

This SEA supports this recommendation. Should USAID decide to provide l/g assistance to Mauritania, it should promote proaction and prevention mode rather than the routine reaction response mode. It has been observed repeatedly that the latter mode is less effective, highly expensive, and environmentally unsafe as it heavily depends on pesticide use. Such action will give GIRM the necessary guidance to facilitate a rapid response. The material in this SEA should be referred to while planning locust control campaign operations and assistance in Mauritania.

Recommendation 38. It is recommended that detailed guidelines be developed for USAID to promote common approaches to l/g control and safe pesticide use among UN Agencies and donor nations. Coordination of efforts is becoming increasingly important because of the increasing number and magnitude of multilateral agreements and follow up efforts in subsequent years by various donors.

This SEA suggests that such coordination must occur at national, regional, and international donor level, and USAID should fully participate in the coordination and implementation processes should it choose to participate in national or regional l/g control operations.

APPENDIX C.

Pesticide Fact Sheet, issued by USEPA

Acephate	# 140	October 1988
Bendiocarb	# 195	June 1987
Carbaryl	# 21	March 1984
Chlorpyriphos	# 37	September 1984
Diazinon	# 96.1	December 1988
Fenitrothion	# 142	July 1987
Malathion	# 152	January 1987
Lindane	# 73	September 1985

U:\SEAS\MAURITAN.SEA

Appendix D.

APPR: ZH { }

DRAFT: YB { }

CLEAR: { }

UNCLASSIFIED

CLEAR: { }

CLEAR: { }

AID/AFR/ONI/TPPI:YBELAYNEH:YB
04/08/93 {703} 235-5411

CLEAR: { }

AID/AFR/ONI/TPPI:ZHAHN

CLEAR: { }

AID/AFR/ONI/TPPI:VDREYER{DRAFT}
AID/NE:GJACKSON{DRAFT}
AID/AFR/ARTS:JGAUDET{DRAFT}
AID/GC/AFR:ESPRIGGS{DRAFT}
AID/AFR/ONI/TPPI:ASHOWLER{DRAFT}
AID/POL:JHESTER{DRAFT}
AID/AFR/FHA/OFDA:GHUDEN{DRAFT}
AID/ASIA/DR/TR:MKUX{DRAFT}

ROUTINE AIDAF

AIDAC NAIROBI FOR REDSO/ESA; ABIDJAN FOR REDSO/WCA;
NE/ENA

E.O. 12356: N/A

TAGS:

SUBJECT: UPDATE ON A.I.D.-APPROVED LIST OF PESTICIDES FOR
LOCUST/GRASSHOPPER CONTROL

1. SUMMARY: AID/AFR/ONI IS IN THE PROCESS OF REFINING THE LIST OF PREFERRED PESTICIDES PRESENTED IN THE 1989 PROGRAMMATIC ENVIRONMENTAL ASSESSMENT {PEA} FOR LOCUST AND GRASSHOPPER CONTROL IN AFRICA AND ASIA. THE INFORMATION IN THIS CABLE UPDATES SIMILAR TABULAR DATA IN THE PEA, AND SUPERCEDES SIMILAR DATA IN A.I.D.'S 'REVIEW OF ENVIRONMENTAL CONCERNS IN A.I.D. PROGRAMS FOR LOCUST AND GRASSHOPPER CONTROL, PUBL. SERIES NO. 91-7'. THE INFORMATION ON PESTICIDES IN THIS CABLE SHOULD BE CONSIDERED TO BE AN AMENDMENT TO THE PEA. THE TABLE LISTING PESTICIDES IN THE ENVIRONMENTAL CONCERNS DOCUMENT WAS ONLY MEANT TO INDICATE PESTICIDES THAT CAN BE PURCHASED WITH A.I.D. FUNDS, BUT IT SHOULD NOT BE CONSIDERED AS GUIDANCE FOR PESTICIDE SELECTION, END SUMMARY.

2. WITH MORE AND MORE INFORMATION ON PESTICIDES BEING GENERATED, AID/AFR FINDS IT NECESSARY TO REFINE ITS LIST OF A.I.D.-APPROVED ANTI-LOCUST/GRASSHOPPER PESTICIDES.

THE FOLLOWING IS AN ALPHABETICAL LISTING OF THE PESTICIDES APPROVED IN THE PEA. THE LIST INCLUDES RELEVANT INFORMATION ON TOXICITY, BIO-ACCUMULATION AND SIGNAL WORDS {TO INDICATE THE RELATIVE TOXICITY OF EACH INSECTICIDE}. THIS INFORMATION PROVIDES A SKETCH OF PROPERTIES OF THE A.I.D.-APPROVED ANTI-LOCUST/GRASSHOPPER PESTICIDES. ALL OF THE CHEMICALS LISTED BELOW ARE CURRENTLY REGISTERED EITHER BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY {EPA} OR ITS EQUIVALENT IN OTHER COUNTRIES FOR LOCUST AND GRASSHOPPER CONTROL.

	TOXICITY TO						
	FISH	INVER	BIRD	MAMML	BIOAC	PERS	SIGNW
1. ACEPHATE	L	L	L	M	L	L	C
2. BENDIOCARB	M	M	M	M	M	M	W
3. CARBARYL	L	L	L	L	L-M	L	C
4. CHLORPYRIFOS	M	H	M	M	M	L	C-W
5. DIAZINON	M	H	M-H	L	M	M	C-W
6. FENITROTHION	L	H	H	L	M	L	W
7. LAMBDA-CYHALOTHRIN	H	H	L	H	H	M	D
8. MALATHION	L	L	M	L-M	L	L	C
9. TRALOMETHRIN	H	H	L	L	H	M	D

LEGEND:

NON-TARGET ORGANISMS: FISH, INVERTEBRATES {INCLUDING HONEYBEES}, BIRDS, MAMMALS

BIOAC = BIO-ACCUMULATION, PERS = PERSISTENCE,

L = LOW; M = MODERATE; H = HIGH {APPLY TO TOXICITY LEVELS TO NON-TARGET ORGANISMS, BIO-ACCUMULATION AND PERSISTENCE; RELATIVE TOXICITY IS ALSO A FUNCTION OF FORMULATION AND ACTIVE INGREDIENT CONCENTRATION}

SIGNW = SIGNAL WORD: C = CAUTION; W = WARNING; D = DANGER {POISON}; {APPLIES TO THE RELATIVE TOXICITY OF PESTICIDES IN ASCENDING ORDER; RELATIVE TOXICITY IS ALSO A FUNCTION OF FORMULATION AND ACTIVE INGREDIENT CONCENTRATION}

SPECIFIC DOSAGES MUST BE WORKED OUT BY HIGHLY EXPERIENCED PERSONNEL FAMILIAR WITH THE APPLICATION EQUIPMENT, PESTICIDE FORMULATION, ETC., TO BE USED. FOR ELABORATION ON THE PROPERTIES OF A.I.D.-APPROVED ANTI-LOCUST/

GRASSHOPPER PESTICIDES, CONSULT THE PEA AND COUNTRY-SPECIFIC SUPPLEMENTARY ENVIRONMENTAL ASSESSMENTS {SEAS}.

3. IT IS IMPORTANT THAT ALL PRECAUTIONS INDICATED ON THE PESTICIDE LABELS, E.G., APPLICATION DOSAGES, SAFETY MEASURES, INSTRUCTIONS ON HANDLING AND STORAGE PROCEDURES, DISPOSAL OPTIONS, ENTRY BY UNPROTECTED PERSONS INTO TREATED AREAS, EMERGENCY GUIDELINES, ETC., BE CAREFULLY OBSERVED, AS OUTLINED IN THE COUNTRY-SPECIFIC SEAS.

4. AID/W WILL KEEP MISSIONS INFORMED OF FUTURE UPDATES ON THE LIST OF A.I.D.-APPROVED ANTI-LOCUST/GRASSHOPPER PESTICIDES.

ADDITIONAL CLEARANCES:

AID/AFR/EA:PGUEDET{INFO}
AID/AFR/CCWA:MGOLDEN{INFO}
AID/AFR/SWA:JGILMORE{INFO}
AID/AFR/SA:KBROWN{INFO}
AID/AFR/ARTS/FARA:WKNAUSENBERGER{DRAFT}
AID/RD/AGI:RHEDLUND{INFO}

—

ADDITIONAL CLEARANCES:

AID/AFR/EA:PGUEDET{INFO}
AID/AFR/CCWA:MGOLDEN{INFO}
AID/AFR/SWA:JGILMORE{INFO}
AID/AFR/SA:KBROWN{INFO}
AID/AFR/ARTS/FARA:WKNAUSENBERGER{DRAFT}
AID/RD/AGI:RHEDLUND{INFO}

—