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1. Project / Subproject Number 677-0056	2. Contract / Grant Number	3. Publication Date April 1991
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4. Document Title / Translated Title
Supplementary Environmental Assessment of the Forest/ Grasshopper Control Program in Chad

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- *USAID/ CHAD*
- *The Government of Chad*
- *AFR / TR / ANR*

7. Pagination	8. Report Number	9. Sponsoring A.I.D. Office USAID / CHAD
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10. Abstract (optional - 250 word limit)

Please use the Document's Preface for the Abstract

11. Subject Keywords (optional)

1.	4.
2.	5.
3.	6.

12. Supplementary Notes

13. Submitting Official <i>Atise Laroché</i>	14. Telephone Number 703-235-5419	15. Today's Date 5/18/94
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16. DOCID

17. Document Disposition
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English

SUPPLEMENTARY ENVIRONMENTAL ASSESSMENT

OF

THE LOCUST/GRASSHOPPER CONTROL PROGRAM

IN CHAD

US Agency for International Development
(USAID)

in cooperation with the Government of Chad

N'Djamena, CHAD

April 1991

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PREFACE

This SEA was prepared by an interdisciplinary team provided by USAID/Chad, AFR/TR/ANR, and the GOC Ministries of Agriculture, Environment, Interior, Health and Livestock. This team interacted with staff within its respective agencies as well as with staff of other agencies; and with resources in the GOC, non-government bodies and other donor organizations. Appendix A lists members of this team, as well as contact persons in Chad.

The document has been reviewed by USAID/Chad, AID/W, and the Government of Chad. It reflects the best current description of future directions for the locust/grasshopper control program; and the best estimates of human health and environmental risks and benefits. Commitments for any possible future program are contingent on future needs for grasshopper or locust control and on a decision by A.I.D. to provide assistance.

LIST OF ACRONYMS AND ABBREVIATIONS

ACDI	Agence Canadienne du Developpement International (CIDA)
ADO	Agricultural Development Officer
AELGA	African Emergency Locust/Grasshopper Assistance project, A.I.D. Africa Bureau (AFR/TR/ANR)
AGRHYMET	Agro-Hydro-Meteorology, a CILSS institute
AID/W	U.S. Agency for International Development, Washington, DC
A.I.D.	Agency for International Development
APHIS	Animal and Plant Health Inspection Service of U.S. Department of Agriculture
BSA	Bureau de la Statistique Agricole
BSPE	Bureau des Statistiques, Planification et Etudes
CBLT	Lac Chad Basin Commision.
CEFOD	Centre d'Etude et de Formation pour le Developpement.
CFR	U.S. Code of Federal Regulations
ChE	Cholinesterase, an enzyme involved in nerve impulse transmission, inhibition of which can indicate pesticide exposure.
CILSS	Comité Inter-Etat de Lutte Contre la Secheresse dans le Sahel (Permanent Committee to Counteract Drought in the Sahel)
COPR	Centre for Overseas Pest Research, now Overseas Development and Natural Resources Institute (ODNRI), U.K.
CPS	National Crop Protection Service NPV in Chad
EA	Environmental Assessment
EEC	European Economic Community
EPA	U.S. Environmental Protection Agency
FAC	Fonds d'Aide et Coopération Française
FAO	Food and Agriculture Organization (United Nations)
GOC	Government of Chad
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Assistance Agency, Fed. Rep. of Germany)
ha	hectare
IFAD	International Fund for Agricultural Development
IITA	International Institute of Tropical Agriculture
INSAH	Institut du Sahel, a CILSS institute
IPM	Integrated Pest Management
IRTC	Institut de Recherche du Coton du Tchad
ITCZ	Intertropical Convergence Zone (equiv. to Front Intertropical [FIT] in French)
km	kilometer
LMR	Limite Maximum de Residus
mg/kg	milligram per kilogram body weight
OCLALAV	Organisation Commune de Lutte Antiacridienne et de Lutte Antiaviaire.
ODIK	Opération de Développement Intégré fu Kaarta
ODIPAC	Operation de Developpement Intégré des Produits Arachidiérs et Céréaliérs
OICMA	Organisation Internationale contre le Criquet Migrateur Africaine (now defunct)

OPSR Opération Protection des Semences et Recoltes
 (predecessor organization to SPV)
 PEA Programmatic Environmental Assessment for Locust and
 Grasshopper Control in Africa/Asia (TAMS, 1989)
 ppm parts per million ambient concentration
 PRIFAS Programme de Recherches Interdisciplinaires Françaises
 sur les Acridiens du Sahel. French grasshopper/
 locust research center in Montpellier, France
 RAMSAR UNESCO's Convention on Humides Areas.
 REDSO Regional Economic Development Support Office (REDSO/WCA
 for Western and Coastal Africa)
 SEA Supplementary Environmental Assessment
 SMPC Société Malienne des Produits Chimiques (pesticide
 formulation plant in Bamako)
 STT Societe Textile du Tchad
 UNDP United Nations Development Program
 USAID/ A.I.D. Mission to Chad, located in N'Djamena
 Chad (USAID/N'Djamena is also used)
 USDA U.S. Department of Agriculture

1.0 EXECUTIVE SUMMARY

This report is a supplement to the Programmatic Environmental Assessment (PEA) for Locust and Grasshopper Control. It was developed to provide particular, country-specific details in Chad in order to allow AID assistance to Chad in its Locust and Grasshopper Control Program. It is therefore a supplement to the PEA for Locust and Grasshopper Control and is, as such, an integral part of it.

The information contained in this document is intended for use by USAID/Chad and the Chad CPS for environmentally sound locust and grasshopper management. However, the discussions herein should not be limited to these specific pests. Additional relevant information should be added to this SEA as needed, as it is a dynamic, rather than static document. As part of the PEA, both documents should be consulted during all planning and operational stages of implementation.

Survey and immediate treatment operations are considered foremost in preventing locust or grasshopper outbreaks. Prevention is the key to reducing crop loss and pest control operation costs. Early season intervention requires considerably less pesticide than late season emergency operations, and therefore has less impact on the environment.

Environmental awareness is emphasized. Fragile ecological areas need to be protected from pesticides, as the impact can be both dramatic and long lasting. Buffer zones of at least 500 meters surrounding fragile areas should be supported in all control operations.

Any control program must embody principles of Integrated Pest Management, which uses all available control methods to achieve the most economically and environmentally sound management program. Major pests are identified, intervention thresholds are established, the appropriate mix of control methods selected and used correctly, insect populations monitored, and training programs organized for farmers and extension workers.

Pesticide management must be a priority in control operation programs. Because misused pesticides impact both the environment and crop production in terms of increased costs, any control program must consider possible consequences carefully. Pesticide container disposal must be conducted so as to eliminate food or water storage in used containers. In this regard, supportive legislation and regulations must exist to promote sound management practices.

The GOC should also be encouraged in its current efforts to implement legislation on pesticide regulation. Legal mechanisms are required that will promote pesticide quality control; and the importation, sale, and use of approved pesticides only.

Training should be part of any USAID assistance program. Pesticide safety and the environmental effects of pesticide use and misuse should be conveyed to both CPS personnel, and the general public through training and public awareness campaigns. Village Brigades are an important part of control operations, and should be stressed.

If possible, the Chad CPS should work towards a laboratory analysis program to monitor pesticide formulation quality and environmental residues. While a lack of supportive infrastructure may prevent such analysis in Chad, it is possible to use laboratories in other African locations. Analysis of blood cholinesterase testing in pesticide handlers and applicators is supported.

2.0 PURPOSE AND PROCEDURES

2.1 Background

With the latest major upsurge of desert locusts (*Schistocerca gregaria*) in Africa beginning in late 1986 and lasting into 1989, and extensive grasshopper (various species) outbreaks throughout the Sahel from 1986 through 1989, the U.S. government was called upon by concerned African nations to assist with technical expertise and needed materials. In 1987, the Administrator of the U.S. Agency for International Development declared an emergency waiver of the agency's environmental procedures governing the provision of pesticides in connection with development assistance. The waiver permitted the Asia/Near East and Africa bureaus and the missions to provide assistance for procurement and use of pesticides for locust/grasshopper control without full compliance with the Agency's environmental procedures until the waiver expired on August 15, 1989. A requirement associated with the waiver was that a Programmatic Environmental Assessment (PEA) be produced. The PEA was completed in mid-1989 (TAMS/CICP, 1989). Any future A.I.D. assistance for procurement and use of pesticides must fully comply with the Agency's environmental procedures. The PEA, and country-specific Supplemental Environmental Assessments (SEAs) serve as the basis for these procedures. The SEAs detail specific environmental concerns in each of the Sahelian countries, and provide guidance on environmentally sound management procedures. In addition, the SEAs address the 38 recommendations made in the PEA in the context of country-specific conditions.

Given the periodic nature of locust outbreaks, and the cyclic populations of grasshoppers, locust and grasshopper control campaigns are likely to continue indefinitely in Chad and elsewhere. These insects are part of the ecology of the Sahel and Sahara, and will readily take advantage of agricultural crops. Control exercises must manage problematic insects at economically reasonable levels, rather than try to achieve extermination. Because of the periodic abundance of locusts and grasshoppers, and their subsequent impact upon food supplies, it is likely that requests for A.I.D. technical assistance, aerial application services, commodities, equipment and/or insecticides will continue to occur. It is expected that for the near term, most of these requests will be related to the use of chemicals for control operations, either directly or indirectly. For A.I.D. to fill such requests, the Environmental Procedures in Regulation 16 (22 CFR 216) will have to be followed. Along with the PEA, this document fulfills those requirements in order for the U.S. government to provide assistance to Chad.

2.2 Scoping Procedure

A.I.D. Environmental Procedures (22 CFR 216.3(a)(4), commonly referred to as "Regulation 16", describes the scoping

process to be used in identifying the major issues to be addressed in an Environmental Assessment. The rationale and approach for the country-specific Supplemental Environmental Assessment [SEA] are outlined in cables 89 State 258416 (12 Aug. 1989) and 89 State 275775 (28 Aug. 1989).

After a detailed draft outline for the Supplemental Environmental Assessment (SEA) and a partial list of sources of information were developed, USAID/Chad contracted an Agricultural Development Officer Assistant (ADO/A) to serve as project manager of the SEA. The ADO/A oversaw the scoping process, wrote parts of the SEA, and organized all needed reference documentation.

Following the development of the scope of work, through a series of brief meetings between the ADO and the Director of the Crop Protection Service of the Ministry of Agriculture, it was agreed that a scoping committee be formed to facilitate implementation of the scope of work and to ensure that all relevant partners be consulted for the implementation of the SEA.

The ADO and the ADO/A met twice with the Director of the Crop Protection Service to further discuss the SEA, its chairperson and the memberships of the committee. It was agreed that the CPS would be the logical agency to chair the committee and thus Mr. Bamtoboin Mborode was named chairperson. It was also decided that membership should include the Ministry of Tourism, Environment and Natural Resources, the Ministry of Public Health, the Ministry of Livestock and Animal Resources, and the Ministry of the Interior and the Administration of the Territory.

On December 29, 1989, USAID/Chad sent a letter to the Minister of Agriculture explaining the need for the SEA and officially requesting that the committee be established. The ADO and ADO/A then scheduled meetings with each of the Directors General of the relevant Ministries to discuss the purpose of the Environmental Assessment and to request names of individuals that would represent their ministries. The individuals assigned as members of the scoping committee, and to contribute to writing the SEA are listed as Preparers in Appendix A.

The first meeting of the Scoping Committee was held on the 28th of December 1989. Other meetings were scheduled for the 5th, 12th, 19th and 26th of January. The sixth and final meeting was held February 2nd. In addition, special meetings were held with committee members at the beginning of April.

The Scoping Committee at its initial meeting introduced the draft outline of the SEA, presented the need for including each topic in the assessment, and noted the required information. In addition, they discussed the need for a legal basis in dealing with pesticides in Chad, the need to control pesticides that are sold openly on the market, and the desirability of establishing a national pesticide-testing center in Chad to which samples of all

imported pesticides would be sent prior to distribution in the country. Also in this meeting, the detailed scopes of work were distributed to initiate implementation of specific tasks assigned to members.

The Scoping Committee concluded that continued use of pesticides in Chad may impact on human health and the environment, that a Supplemental Environmental Assessment should be conducted and a report written to characterize the program and to determine the extent of the risks, benefits, and the various activities that may be needed to minimize or mitigate risks. This was in accordance with the "N'Djamena Manifeste" of August 14 1976. (Appendix D).

Preparation of background papers and related documents were performed by a team of five GOC technical specialists: Mr. Taher Abderamane Adar (Ministry of Interior and Administration of the Territory), Mr. Amat Agala (Ministry of Tourism and Environment), Mr. Pascal N. Digambaye substituting for Mr. Kinder (Ministry of Public Health), Mr. Mborode Bamtoboin (Ministry of Agriculture, CPS), Mr. Djembete Le Soromian (Ministry of Livestock and Animal Resources) and the USAID/Chad ADO Kurt Fuller and ADO/A Noubassem N. Namde. This team was then joined by an AID/W (EPA) representative Ronald A. Stanley. The team also interviewed individuals at USAID/Chad, the Government of Chad, some regional institutions, CBLT, CEFOD, NGOs, and private enterprises. Refer to Appendix A for a complete list of team members and contacts.

2.3 Previous Assessments

The previous assessment concerning this subject, and the primary supportive document is the *Programmatic Environmental Assessment for Locust and Grasshopper Control in Africa/Asia* (TAMS/CICP, 1989) (PEA). The PEA covers grasshopper and locust control operations in Africa and the Near East. 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 addressed in the PEA.

Other assessments that have been performed include:

- (1) *The Africa Emergency Locust/Grasshopper Assistance Mid-term Evaluation* (with specific-country case studies for Chad, Mali, Niger, Mauritania, and Cape Verde) (Appleby, Settle & Showler, 1989);
- (2) *Draft Environmental Assessment of the Tunisia Locust Control Campaign* (Potter et al, 1988);
- (3) *Provisional Report on Pesticide Management in Francophone West Africa* (Alomenu, 1989, Report to the FAO Conference at Accra, Ghana);

- (4) *Supplementary Environmental Assessment of the Senegal Locust/ Grasshopper Control Program* (Cavin, Engler, Powers and Stanley, 1989);
- (5) *Supplementary Environmental Assessment of the Mali Locust/ Grasshopper Control Program* (Cissé, Diarra, Doumbia, Keita, Knäusenberger and Stanley, 1990).

These documents have been used freely in performing this assessment and are often relied on without citation. Internal USAID/Chad data are used without citation. Other relevant documents are cited in the text when data from them are used to support the assessment.

2.4 Environmental Procedures

It is A.I.D. policy to ensure that environmental consequences of A.I.D.-financed activities are identified and considered by A.I.D. and host governments prior to a final implementation decision. Furthermore, such environmental consequences shall be weighed heavily in the outcome of decisions and shall be used to design environmental safeguards and methods of mitigation. This document covers both the specifics of how environmental consequences were weighed in making decisions about possible continued support of pesticide use, and the commitments to safeguards and mitigation for any future control programs.

Chad has no procedures equivalent to the National Environmental Policy Act (NEPA) or A.I.D.'s Regulation 16 requiring environmental documentation which would influence decision-making in locust and grasshopper control campaigns. Chad does have regulations governing the substance of such programs. These are covered in the following section. Procedurally, A.I.D. Environmental Regulations are likely to be controlling for the present because they are more comprehensive and more applicable to A.I.D. programs and projects.

2.5 Regulations and Standards for Pesticides in Chad.

2.5.1 Control of Pesticides in Chad

Aside from Decree No. 75/66/PR of April 16, 1966, regulating the importation, possession, manufacture, transportation, marketing, and use of poisonous substances, Chad lacks pesticide legislation, labeling regulations, and mechanisms for enforcement of the current law.

Much of the delay in the development of pesticide regulations comes from the fact that these products are mainly used on cotton, which is the only major crop produced for sale on the world market. Crops produced for consumption are sporadically treated, except during locust and grasshopper outbreaks when considerable donor assistance is available. The

Institut de Recherche du Coton du Tchad (IRTC) was the institution designated to deal with approval of pesticides because it is the agency that receives pesticide samples and fact sheets. Ideally, pesticides are tested during two or three control campaigns and compared with products already being used in the country. If the products are shown to be effective, IRTC, with the help of the extension service, distributes them to farmers for use on a trial basis before nationwide marketing. Currently, Chad does not have the financial means to test and select the needed insecticides.

In recent years, a certain anarchy seems to have developed regarding the distribution and sale of these products. Moreover, foreign, unknown, and prohibited products are being imported illegally and distributed. This sad situation demonstrates the urgency of drafting a law for control of plant protection products. A decree for the control of importation, marketing, distribution, possession and use of plant-related chemicals has already been drafted by CPS. The draft decree is to be submitted to the government for approval as soon as possible so that application orders ("Arretes") can be issued to address issues of pesticides in Chad.

2.5.2 Other Environmental Regulations and Standards for Chad

Even though Chad has few regulations on pesticide use, the CPS regularly consults international regulations in making decisions. Other sources of information are the European Economic Community (EEC), Food and Agriculture Organization (FAO), The World Bank, and other countries such as the U.S. and France.

2.5.2.1 Master Plan for Desertification Control

Chad has developed, with the help of CILSS, a comprehensive report on anti-desertification that covers fish, fauna and soils as well as vegetation (Kane et al, 1987). The Master Plan for Desertification Control defines a control strategy and proposes action plans. This official document also serves as a general guide to support the Ministry of Tourism, Environment and Natural Resources plan for natural resources management.

2.5.2.2 DDT Prohibition with "Arrete" No. 163 of the Ministry of Health.

This "Arrete", initiated by the Ministry of Health on November 16, 1989, prohibits the importation and use of "Cock Brand" insecticide in Chad. This product was outlawed in Chad because it contains DDT, which is harmful for humans and the environment. Although other DDT-based pesticides are still used in Chad, the legislation is an important step in the direction of banning all DDT-based products. A law is being drafted on

general hygiene measures which defines general conditions for use and disposal of all products which may present hazards to human health or the environment.

2.5.2.3 Chadian Environmental and National Park Legislation

In Chad, legislation often has little influence on the public because the public is not usually involved with its development and because the means are lacking for publication of needed documents. For such information to be disseminated and to be of benefit, public participation is needed in the management of the environment and its resources.

The government prohibits use of pesticides in or around national parks or protected areas. In wildlife reserves, some human activities are permitted, but use of toxic materials that might threaten the genetic and biological integrity of the designated areas is not allowed. Much improvement is needed in the area of enforcement, and in environmental awareness public information oriented to agriculture workers.

The practice of fishing with pesticides or other toxic compounds is prohibited, not only because of effects on aquatic ecosystems, but because of ultimate repercussions on wildlife. The substances contaminate pastures and wetlands where they eventually accumulate in the food chain, resulting in reduction of animal populations over an entire region. Even though environmental effects of pesticides used in locust and grasshopper control may not seem obvious, possible impact of these products remain after treatment.

Specific legislation includes Decree No. 56 EFPC, 19 March 1965, creating *Le Parc National De Manda* and Decree No. 86 T/EFC, 7 May 1963, creating *Le Parc National De Zakouma*. National Parks in Chad are to have a level of protection roughly similar to those of the United States, but even more stringent. They were created to multiply, conserve and protect wildlife and plants for scientific, public, educational and recreational purposes. Hunting, fishing, or any disturbance of wildlife is prohibited. Gathering of wood, fruit and food is not allowed; nor is habitation permitted in the Parks. Tourists and scientists with proper authorization are allowed in provided they are accompanied by an armed Ranger. However, enforcement of these regulations is often insignificant or ignored, especially in cases of pesticide use. This is due both to lack of resources available to the Ministry of Tourism and the Environment, and low public awareness concerning the need for environmental conservation. In addition, the current economic situation in Chad may force populations in desperate need to use resources contained in National Parks and fragile areas.

Other specific legislation includes decrees establishing fauna reserves at Aboutelfan (1983), Bahr Salamat (1964), Lac Iro (1967), Binder-Lere (1974), Fada-Archei (1967), Mandelia (1983), Ouadi Rimé-Ouadi Achim (1969), and Siniaka-Minia (1961); and Ordonnance # 14/63 of 1963 which regulates hunting in Chad and addresses conservation issues. Although the legislation emphasizes protection of fauna and their habitat, the areas have traditionally been managed as hunting preserves with little consideration given to sustainability of animal populations.

This SEA is consistent with the GOC commitment to protection of the natural environment. It presents aspects of the program designed to limit pesticide use and it designates areas for protection from pesticide use.

2.5.2.4 International Conventions on Protection of National Parks.

Lake Fitri is one of the most important ecosystems in Chad, and the government has recognized the need to improve its organizational bases for management of the lake's natural resources. Because of its international importance, and as habitat for large number of migratory and aquatic birds during the European winter, it has been recognized as one of UNESCO's Biosphere Reserves and Sites of International Importance under the Convention of Humid Areas (RAMSAR Convention, 1989).

The RAMSAR Convention is an international instrument designed to help governments conserve and manage aquatic areas. Exceptional sites such as Lake Fitri are treated with particular attention under this convention, setting it somewhat apart from the National Parks.

3.0 DESCRIPTION OF THE PROJECT SITE

3.1 Agricultural Resources

3.1.1 General description

The actual quantity of cultivated land in Chad is small, amounting to less than 1% of the total land area (Babcock et al 1986). Most fields are widely dispersed throughout the 13 southern administrative departments (Figure 1). Plantings are also dispersed in time: a substantial portion of the total agriculture is recession agriculture (residual moisture of lakes, rivers, ponds), allowing crops to be grown during both the dry and rainy season.

The majority of the people in Chad are engaged directly in agriculture. The population is distributed primarily in three areas: Moyer Chari, Logone Oriental, Tanjile, Mayo Kebbi and

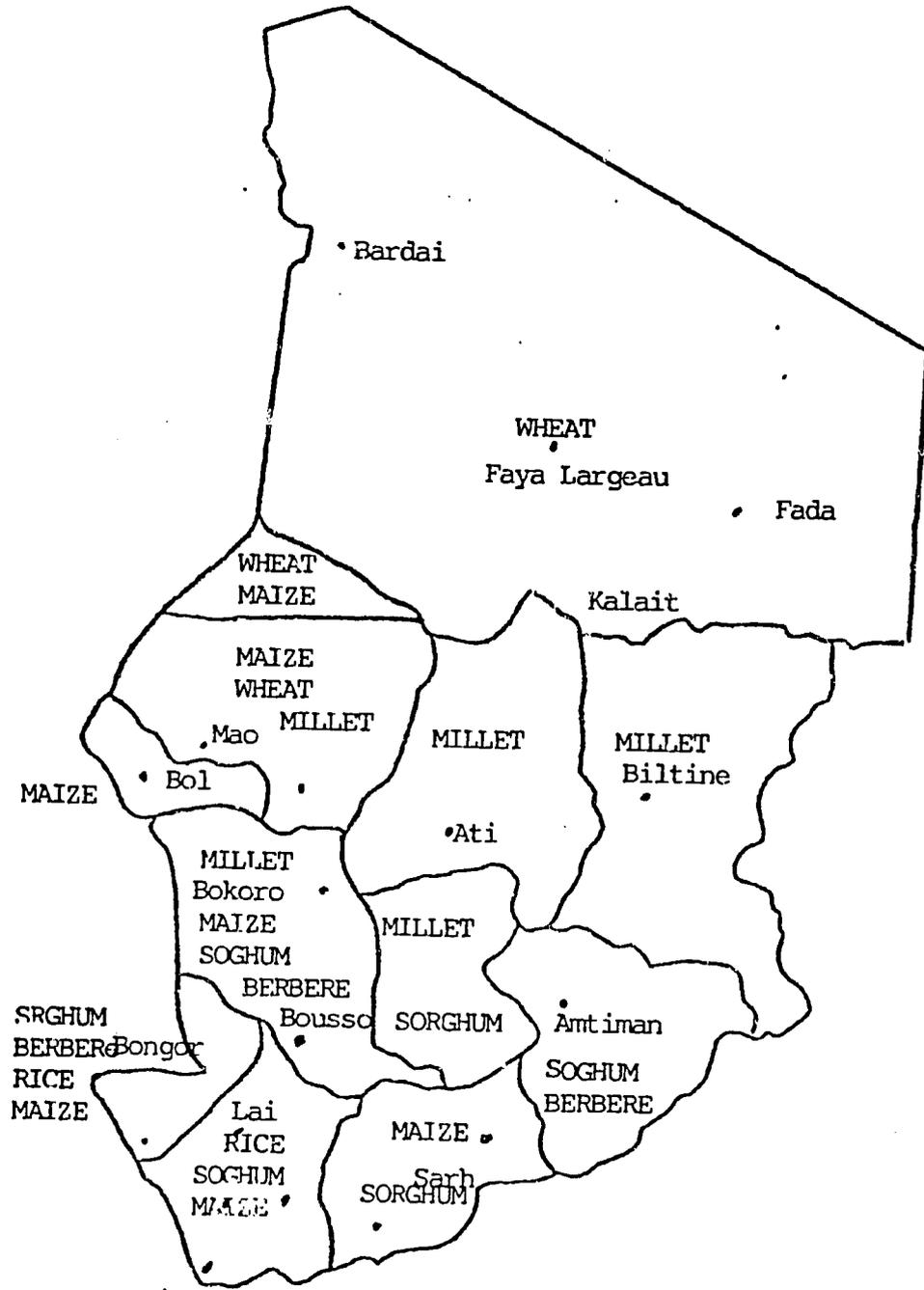


Fig. 1 Major Cereal Growing Areas in Chad.

Logone Occidental in the south (Sudanian Zone) ranging from 13 to 47 inhabitants per km²; Salamat, Kanem, Guera, Biltine, Batha, Ouaddai, Chari-Baguirmii, and Lac across the central part of the country (Sahelian Zone) ranging from 2 to 10 inhabitants per km²; and Borkou Ennedi Tibesti in the north (Saharan Zone) at 0.2 inhabitant per km² (1988 official estimates based on 1964 census).

Total cereal production in Chad is usually about 700,000 metric tons per year (Table 1 and FEWS, 1990). In some lower production years, food needs of the population are met with cereal imports. Although the Sahel often faces food deficits, production in other years may be more than adequate to meet the needs of the population.

Major cereal crops in the Sahelian Zone, in decreasing order of production (approximate amounts based on 1989 data): are pearl millet (53%), sorghum (25%), berbere (18%), maize (4%) and rice (1%).

Major cereal crops in the Sudanian Zone, in decreasing order of production (approximate amounts based on 1989 data): are sorghum (51%), pearl millet (34%), maize (3%), rice (8%), and berbere (4%).

A number of other crops are also grown in smaller quantities (peas, beans, sesame, peanuts and vegetables), and are generally for local consumption. Cotton production in recent years has exceeded 100,000 metric tons per year. There are about 10 million animals (sheep and goats are most numerous; cattle, and camels) in Chad, found primarily in grasslands.

Distribution of major crops is governed primarily by rainfall within each climatic zone. Sorghum is raised in the Sudanian Zone and in the southern half of the Sahelian Zone. Millet is grown mostly in the Sahelian Zone, though considerable overlap occurs with the Sudanian Zone. Peanuts are grown in the Sudanian Zone and extend well into the Sahel but largely to the east. Maize is grown in the western half of both the Sudanian and Sahelian Zones. Rice is grown in the western half of the Sudanian Zone. Peas, beans and sesame are concentrated in the Sudanian Zone but also found in parts of the Sahelian Zone. Cotton is grown in the Sudanian Zone.

The growing season is mainly May through September for sorghum, peanuts, rice and maize; although it may begin later in some areas. Millet is grown from July through September. Berbere, wheat, and vegetable crops are mostly grown from October through March and are not usually threatened by locusts or grasshoppers.

Table 1. Production of Crops in Chad *

Sahel Zone								
-----	1985	1986	1987	1988	1989	Total	Mean	% mea
Sorghum	42280	69217	58915	77212	81970	329594	65919	25%
Millet	117350	122680	106654	226882	143530	717096	143419	53%
Maize	18800	2737	1875	25302	8520	57234	11447	4%
Berberere	79800	24604	23260	63051	47040	237755	47551	18%
Rice	180	151	124	187	128	770	154	0%
Sesame	113	883	2488	2234		5718	1430	1%
Peanuts	6644	8420	13605	17721		46390	11598	4%

Total	258410	219389	190828	392634	281188	1342449	268490	100%
Sudan Zone								
-----	1985	1986	1987	1988	1989	Total	Mean	% mea
Sorghum	260846	229292	197077	180672	207405	1075292	215058	51%
Millet	234496	130341	110440	128794	113010	717081	143416	34%
Maize	16347	22556	16786	8567	7050	71306	14261	3%
Berberere	15477	17697	12981	21291	8960	76406	15281	4%
Rice	7644	14729	19373	73676	56700	172122	34424	8%
Peanuts	104862	95830	79134	81552		361378	90345	21%
Sesame	11415	10266	7525	5963		35169	8792	2%
Beans				3072		3072	3072	1%
Peas				19779		19779	19779	5%

Total	534810	414615	356657	413000	393125	2112207	422441	100%

* Source: DIAPER II/BSA. Data on Millet, Sorghum and Maize are underestimated because SODELAC' data in the Lac Prefecture and OMVSD' data on rice productions are not included.

3.1.2 Productivity Data Improvement Recommendation

While both crop loss assessment information and intervention (economic) thresholds are important concepts for IPM, field data must be reliable for proper and productive application. Regional productivity data within Chad tend to be variable and not always reported on a timely basis, and thus are not considered reliable. This poses a number of problems in applying IPM principles to locust or grasshopper management operations. Refinements in this area can result in significantly improved and less costly management operations, with less pesticide used, and therefore less environmental impact.

3.2 Locust and Grasshopper Characteristics, Damage Indications, and Management Operations

3.2.1 Distribution and Feeding Preference

Grasshoppers:

The area susceptible to grasshopper impact lies across the Sahelian zone of Chad, including parts of the following regions: Salamat, Biltine, Batha, and Kanem, and essentially all of Chari-Baguirmi, Lac, Guera and Ouaddai (Fig. 2). These are primarily millet growing areas, but include a substantial portion of the sorghum, maize and rangeland areas, and some peanut growing areas. Cotton, rice, beans and peas are almost entirely south of the "grasshopper belt".

Desert Locust:

Desert locusts generally breed in a zone slightly to the north of the main belt of grasshopper activity, but will migrate throughout the Sahelian and Saharan Zones of Chad and can move in from surrounding countries (Fig. 3).

African Migratory Locust:

African migratory locusts, the third species of potential concern to A.I.D., generally breed in more moist areas, primarily in the Lake Chad basin (Fig. 4).

Millet is among the cultivated crops most threatened by grasshopper and locust impact. Sorghum, grown in smaller quantities, is usually susceptible only at the seedling stage. Losses that occur to grasslands are largely unknown, although a recent focus of control efforts has been on grasslands immediately adjacent to crops. The grasslands are the primary reservoirs for grasshopper breeding and populations increase. After the rainy season, grasshoppers will move out of the drying grasses and into croplands. It is at this stage that crops may experience considerable damage. As the value of pasture biomass lost from grasshopper feeding is unknown, future research on crop loss assessment should also include information on pastures (G. Cavin, 1990, personal communication).

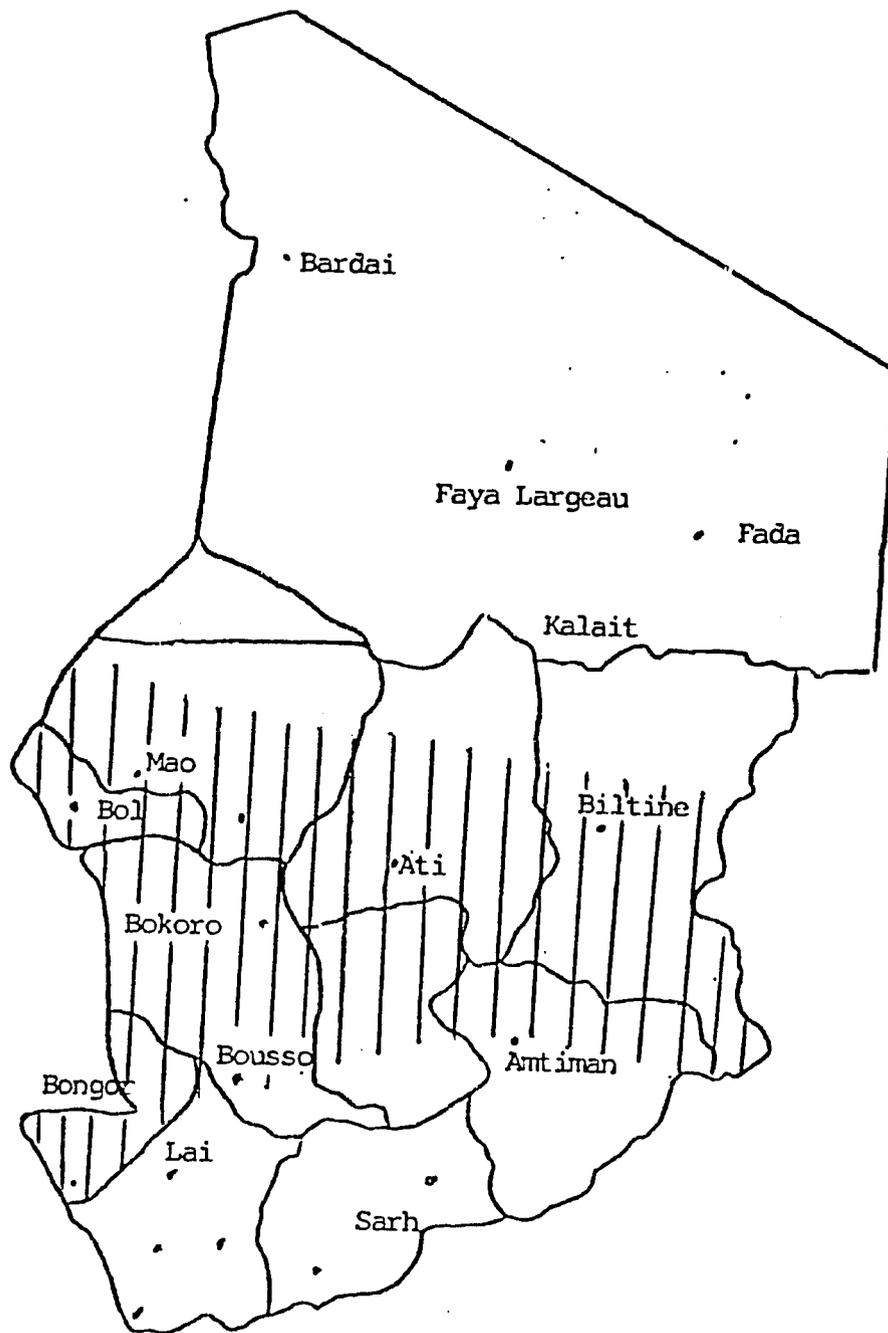


Fig. 2 Area Susceptible to Severe Grasshopper Attack.

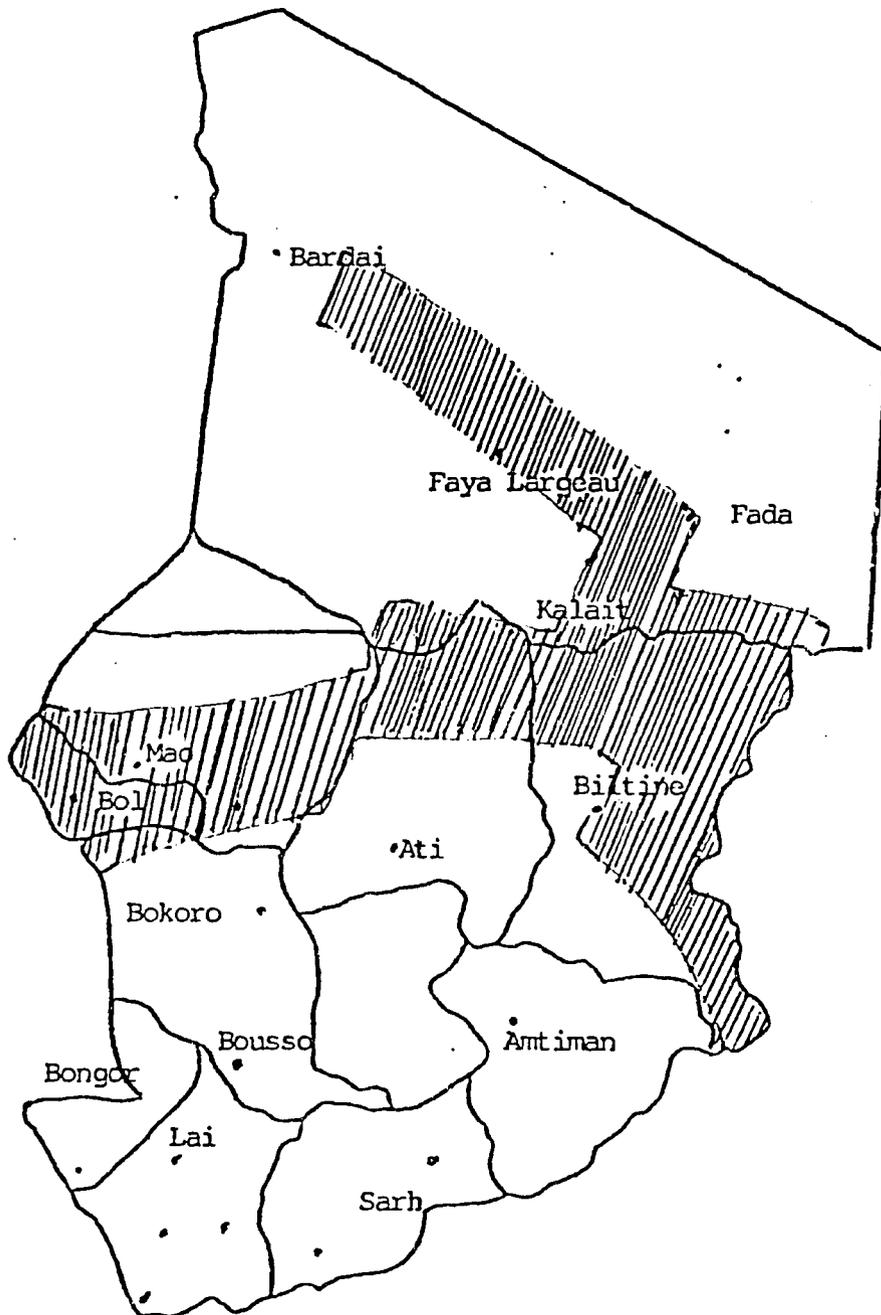


Fig. 3 Area Susceptible to Desert Locusts Attack

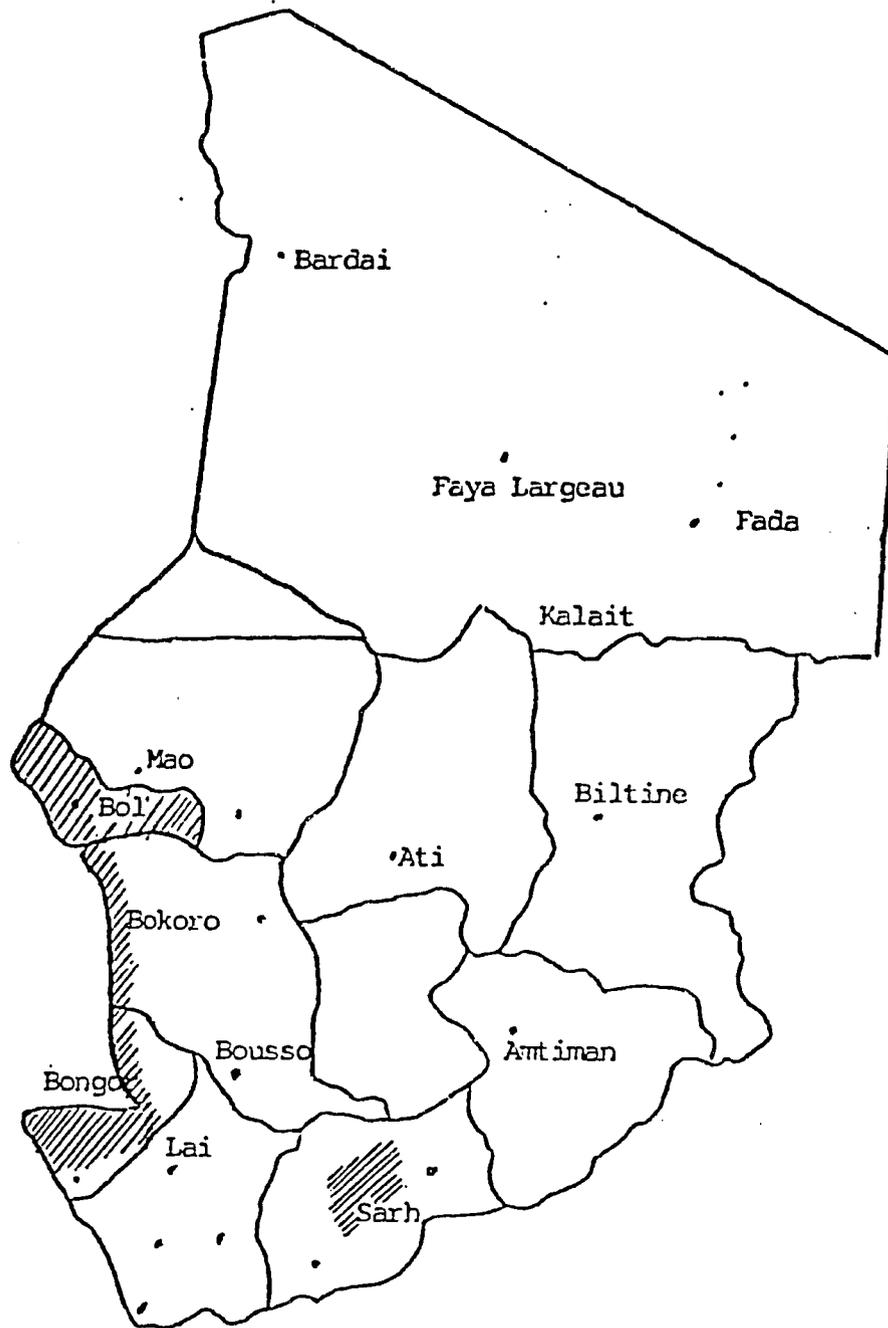


Fig.4 Zone of Usual African Migratory Breeding.

3.2.2 Levels of Infestation

Grasshoppers and locusts vary over a range of population levels in their natural habitat, depending upon rainfall and other environmental conditions. Crop infestation levels depend upon the numeric density and life stage of the insect. For management planning purposes, impact on ultimate crop yield has been divided into four infestation levels.

Level 0 describes a "normal" density of grasshoppers. Crop losses from this level of infestation are minor and localized. The Crop Protection Service should be capable of carrying out treatment programs without donor assistance. However, in practice this may not be possible in Chad, due to fiscal problems. Some donor assistance may be necessary to enable the CPS to cover salaries and normal budget items.

Level I describes a situation with l/g populations at levels which will require additional donor assistance to avoid crop loss. As with level 0, the CPS will likely need assistance to cover basic costs, with additional materials and equipment needed to reduce population levels.

Level II describes high l/g densities with high numbers in both crops and pasture lands. Significant crop loss is probable without additional donor assistance and possibly intervention.

Level III describes a situation involving very high l/g populations extending over a large area. This situation will require considerable donor assistance and intervention to avoid l/g outbreaks and substantial crop loss.

Because of the complex effects of crop loss, investments by donors at each of the four intervention levels may be justified. In most cases, assistance which build sustainable infrastructure may be appropriate.

3.2.3 Crop Loss Assessment Recommendation

In light of regional data variability and possible uncertainty about reliability of the data, both regional and national l/g damage level estimations are problematic at best. Loss estimates vary from 1.5% (FAO) to a high of 20% (Appleby et al, 1989). AID/W is currently supporting extensive research in Mali and Chad, as well as collaborative work with other donors and regional research organizations. Results are expected to improve l/g management considerably.

In addition to national aggregate crop losses, consideration also needs to be given to the social and economic costs of grain distribution even when losses to individual farmers or villages may be small. Even if the overall crop loss is low, some

localized areas may experience high losses. Costs of grain transport over long distances may be more prohibitively expensive than those of the locust/grasshopper control program.

Losses in grasslands are more difficult to assess than in crop lands, because the impacts are on wandering grazing animals, and thus indirect. If forage is generally present in excess during the locust/grasshopper season, losses to cattle production might be minuscule. This seems a reasonable assumption based on the rainfall requirements of grasshoppers and locusts, and the fact that they tend to move to cropland when the grasslands begin to dry. On the other hand, in years with marginal rainfall (especially following rainy years), populations of cattle and infestations of locusts and grasshoppers might both be high, and will compete for the same forage.

3.2.4 Surveillance and Preparedness

In Chad, the main elements to be included in locust or grasshopper surveillance and forecasting programs are:

- The physical and temporal distribution of pest species.
- Monitoring of environmental conditions and changes which might lead to increased numbers of pest species. This will require an adequate knowledge of pest species biology, the status of environmental conditions, and how these conditions can be augmenting or limiting factors.
- A vulnerability assessment in terms of crops threatened by the pest species, including relative importance of crops, and the crop stage of development.
- The availability of pest management support resources to be mobilized for control: pesticides, application equipment, as well as logistical and technical support.

Information from survey teams is reported to and compiled by area Crop Protection Bases. Regional information and data are reported to the central Crop Protection Service office in N'Djamena, where a national synthesis is executed. Periodic reports are issued--daily, weekly, or monthly--depending of the severity of the locust/grasshopper threat.

Although survey efforts are under way in Chad, there is considerable room for improvement. Survey equipment and laboratory facilities are inadequate, funding for survey operations is low, and there is a lack of qualified personnel. Intervention decisions in the past have been subjective because they have not been sufficiently based upon fixed criteria such as number of hectares infested, pest density, and insect life stage. Without good crop loss assessment information, it has been difficult to establish accurate thresholds for intervention. Communication difficulties also hinder the decision-making process, as does the severe limitation of operating funds. Without good survey operations, emergency intervention treatments will be likely, with large scale pesticide applications, and the associated increased risks to the environment and human health.

Because of the personnel and equipment limitations of the CPS survey structure, the CPS is attempting to develop a Decentralized Decision-Making System to assist in field operations. The system should be operational for the 1990/1991 program and will be made up of four decision-making levels: Village Brigades, CPS Field Posts, CPS Bases, and CPS Headquarters. There will be one CPS agent per Field Post and two CPS agents per Base, a total of 33 qualified agents in the field. At CPS Headquarters, 15 agents and the administration will handle emergency operations. CPS agents have recently received their station assignments.

3.2.4.1 Village Brigades

In addition to training by CPS personnel and extension agents, Brigades are provided with basic application equipment and minimal quantities of pesticide. Small areas of infestation can be treated by the Brigades, and thus reduce the need for costly intervention by a CPS treatment team. Treatment decisions can be made directly made by the trained village locust/grasshopper survey agents.

3.2.4.2 Crop Protection Service Field Posts

The Posts are located in the capitals of the Sous-Prefectures. There are Field Posts at Fada (Bet), Adre (Ouaddai), Lere and Bongor (Mayo Kebbi), Lai (Tandjile), Gore (Logone Occidentale), Guereda (Biltine), Bagasola (Lac), N'Guely and N'Djamena Airport (Chari Baguirmi) and Maro (Moyen Chari). Posts have the capacity for ground treatment of areas from 100 to 3000 hectares. In cases of infestations larger than 3000 hectares, the Posts request assistance from a regional CPS Base. In addition, Post survey and treatment personnel will give technical advice to the Village Brigades.

3.2.4.3 Crop Protection Service Bases

The CPS Bases are located in Prefecture capitals (except for Mayo Kebi Prefecture, whose Base is in Pala). Bases exist in Abeche, Faya, Mongo, Am-Timan, Ati, Mao, Bol, Sarh, Moundou, Pala, and N'Djamena. The Bases assist the Field Posts and serve as a liaison office between CPS Headquarters and the field. Most locust/grasshopper control materials and equipment is stored at the Bases.

3.2.4.4 Crop Protection Service Headquarters

CPS Headquarters supplies the field Bases and Posts with supplies, expertise, and information. Daily radio contact is usually made between the Headquarters and the Bases during the

agricultural season. When infestation levels go beyond the capabilities of a Base or Field Post, Headquarters may decide to provide reinforcements by requisitioning materials from other Bases, or sending needed supplies from the warehouse in N'Djamena. As a final resort, the CPS may call on the international community for assistance.

3.3 Safety and Health Care System

3.3.1 General Pesticide Safety Concerns

Because of the role pesticides can play in potentially increasing agricultural productivity, the Government of Chad regards these chemicals as a component of its food self-sufficiency policy. Unfortunately, pesticides are frequently misused by Chadian farmers, presenting hazards to both the human environment and the natural ecology.

There is concern within the Ministry of Public Health that pesticides are being misused both in rural and urban areas. There is a general concern within the Ministry of Tourism and Environment about the possible contamination of aquatic and terrestrial ecosystems, and potential incorporation of pesticide residues into food chains.

In addition, pesticides in Chad are often marketed illegally and fraudulently. Misuse of pesticides intended for agricultural or public health purposes include use for fishing, hunting and general household insect control.

Because pesticides are often misused, it is essential that legislation on pesticide use in Chad be instituted as soon as possible. While abuse may still occur, the implementation of regulations will provide a sound base to promote public health and environmental integrity.

3.3.2 Applicator Safety Training

Each year, the Crop Protection Service conducts training programs for CPS agents to be based in the field. Agents receive training on application techniques, application rates, proper equipment handling procedure, and appropriate safety precautions. In addition, a number of agents go through retraining programs each year to bring them up to date on newer developments.

3.3.3 Public Health Care System

The public health care delivery system in Chad is well structured, although the ratio of public health care personnel to population is below WHO-recommended norms. Organization of these services varies according to level within the entire system:

national, prefectural, sub-prefectural, administrative post, canton, and village. Table 2 shows categories of health personnel for each 100,000 inhabitants in Chad.

A three-level Health Pyramid organization of health districts is presently being implemented in Chad:

Health District Level I (Village): a first-aid house and pharmacy are available in each village. Pharmacy supplies, first-aid facilities, and personnel (hygienist, first-aid worker and traditional birth attendant) are available, but only on a very limited basis. These facilities would be of limited assistance in cases of pesticide poisoning. The personnel do participate in village awareness training, and can work to keep people and animals away from areas being treated and encourage compliance with safety measures.

Health District Level II (Sub-prefecture): the health center at the District Level II is managed by a physician, who is able to identify pesticide poisoning and perform needed first-aid procedures.

Health District Level III (Prefecture): facilities of this health center include a dispensary, maternity hospital, nursery, and sometimes a hospital. More severe poisoning cases can be transferred here.

These Health Districts can potentially identify and treat most cases of pesticide poisoning. In order to insure that all Health Care Institutions are fully prepared, a number of measures are recommended.

- Training on health aspects of pesticide use.
- Providing centers with materials and medicines required to treat pesticide poisoning.
- Participation by public health personnel in the organization of pesticide application campaigns, and collaboration with CPS agents.
- Participation by public health personnel in monitoring local people after treatment campaigns, in order to detect any acute or chronic poisoning symptoms.

Serious pesticide poisoning incidents may need attention on the higher levels of the health care system; while the lower levels, including the village level, may only be able to handle an emergency case. It is important that the entire health care system in regions where pesticides are commonly used receive information and pesticide use, public health safety measures, and symptoms and treatment of poisoning. Personnel in health care centers should also be given necessary training to recognize and treat pesticide poisoning cases.

Table 2. Regional Distribution of Health Personnel in Chad in 1988.

Number of Agents per 100.000 inhabitants

Region	Population (1000)	Density /Km2	Superior(1) Staff	Intermediat(2) Staff	Base Agents (3)
Batha	431	4.85	0.7	5.6	10.2
Biltine	216	4.61	0.9	7.9	14.8
BET	109	0.18	1.8	19.3	40.4
Chari Bagui	844	10.18	11	41.8	39.3
N'Djamena			13.8	61.8	15.8
C.B.Rural			0.5	12.8	12.8
Guera	254	4.31	0.9	7.9	22.8
Kanem	245	2.14	0.8	12.6	28.2
Lac	165	7.39	1.2	10.3	23.6
Logone Occ.	365	47.43	3.3	43.8	26
Logone Ori.	377	13.45	0.5	18	30.2
Mayo-Kebbi	852	28.3	1.4	11.3	21
Moyen Chari	646	14.3	2.6	29.7	37.6
Ouaddai	422	5.46	1.9	9.9	24.2
Salamat	131	2.08	0.8	9.9	21.4
Tandjile	371	20.56	0.5	13.7	19.1
CHAD	5428.00	11.80	2.67	19.77	26.15

Source: - Annuaire de Statistiques Sanitaires 1988.
 Ministry of Public and Social Affaires

- Ministry of Plan/BSPE

3.4. Natural Resources of Chad

3.4.1. Physical and Climatic Features

The ecology of Chad was affected by the successive droughts which have occurred in the sub-Saharan region since the late sixties and appear to continue. The most affected environmental areas include:

- The strip of land on the edge and between, the Logone and Chari rivers.
- The dunes in the Lake Chad basin.
- The dunes in the Kanem and Batha ouaddis, and in the southern BET region.
- The plains in Abeche,
- The areas around Ati and Oum Hadjer.
- The areas around Lake Fitri.
- The flood plains in Lai.
- The Timbéri forest reserve.

In areas of Chari-Baguirmi, Ouaddai, Kanem, and Batha Prefectures, some protected forest species such as *Acacia senegal*, *Acacia laeta*, *Balanite aegyptica*, *Eorassus aethiopicum*, and *Hyphaenethecaica* are threatened by drought conditions. Some tree species such as *Anogeissus leocarpus*, *Acacia nilotica*, *Acacia seyal*, are commonly used to make charcoal, and are thus threatened. The fauna is threatened by increased poaching due to economic stresses associated with civil unrest and drought, and some species such as the addax and oryx are close to extinction in the northern and north-western areas of Chad.

Fragile ecosystems have become even more tenuous in the last few years because of the increasing concentrations of human and animal activity around or close to a decreasing number of water points. The major factors that contribute to the continued desertification in Chad are overgrazing, which results in soil degradation and loss, and population growth, which contributes to deforestation.

3.4.2 Flora and Fauna

3.4.2.1 Fish Resources

Chad has considerable diversity in natural resources. One economic natural resource is the rich fishing industry at Lake Chad and the Chari-Logone rivers. These aquatic resources are reported to have over 160 fish species, and Lake Chad is reported to produce between 60,000 and 150,000 metric tons of fish per year. This protein source is reported to support over 10 million people of the region and provide employment to about 10,000 fishermen and about 150,000 persons associated with the fishing industry. Although production decreased drastically during the 1980's, presumably due to low water levels during the drought, it seems to be recovering (Nigeria 1990). In addition, Lake Fitri

and several major rivers contribute an additional but unknown quantity of fish.

3.4.2.2 Endangered Species and Their Habitats

Chad has a number of mammals and birds which are considered endangered (Table 3). One of the major concerns in regard to locust and grasshopper control programs is the effect of pesticides on birds. In addition, aquatic invertebrates are also sensitive to the pesticides most commonly used in grasshopper and locust control operations (Keith, 1989).

4.0 DESCRIPTION OF PROPOSED PROJECT

4.1 Pest Management Operations

4.1.1 Base Program

The Chad Crop Protection Service must be able to carry out locust and grasshopper management activities when population levels are low (level 0, section 3.2.2). Although assistance programs may be provided to the CPS at this level, the goals of these activities are to ultimately achieve a sustainable infrastructure. With vigilant survey and management programs, both locusts and grasshoppers can be maintained at low population levels. This kind of management will save valuable funds and resources over the long-term, compared with costs of short-term emergency operations. Additional donor assistance will likely be required when infestation levels entirely exceed the capacity of the CPS. In regard to U.S. funded assistance involving pesticides, the information, recommendations, and regulations discussed in this SEA and the PEA must be adhered to.

4.1.2 Thresholds of A.I.D. Assistance

The CPS is expected to maintain an ongoing insect management program during periods of normal pest levels. This program should include efforts to reduce human health risk, protect environmentally sensitive habitats, and minimize pesticide use through use of cultural, biological and traditional means of control. In decisions on assistance to the CPS for locust or grasshopper management activities, A.I.D. will examine both the pest situation and the capabilities of the CPS. Decisions will be made in such a way as to minimize the amount of pesticide used.

If A.I.D. does participate in an assistance program, support will coordinate with other donors and the GOC to achieve a reasonable and balanced program. While probable crop loss will be a criterion for A.I.D. involvement in control efforts,

Table 3.

ENDANGERED AND THREATENED MAMMALS AND BIRDS OF CHAD

ENDANGERED MAMMALS

ELEPHANT(ELEPHANT)	MAMATEE(LAMANTIN)
ORYETEROPE*	SCALY ANT EATER(PANGOLIN)
BLACK RHINOCEROS(RHINOCEROS NOIR)	HIPPOPOTAMUS(HIPPOPOTAME)
WILD DONKEY(ANE SAUVAGE)	ORYX(ORYX)
MOUFLON A MANCHETTES*	ADDAX(ADDAX)
GIRAFFE(GIRAFE)	CHEETAH(GUEPARD)
SPOTTED HYENA(HYENE TACHETEE)	STRIPPED HYENA(HYENE
COMMON JACKAL(CHACAL COMMUN)	RAYEE)
COLOBE A MANTEAU BLANC*	GRAND KOUDOU*
DERBY ELAND(ELAN DE DERBY)	

ENDANGERED BIRDS

OSTRICH(AUTRUCHE)	PELICAN(PELICAN)
HERON(HERON)	CATTLE HERON(HERON GARDE
BEC EN SABOT*	BOEUF)
CRESTED CRANE(GRUE COURONNE)	STORK(CIGOGNE EPISCOPALE)
SÉNÉGALESE JARIBU	TANTALE IBIS*
MARABOU CRANE(MARABOUT)	SACRED IBIS(IBIS SACRE)

THREATENED MAMMALS

LION(LION)	JAKAL(CHACAL)
CERVAL(SERVAL)	WILD CAT(CHAT SAUVAGE)
WARTHOG(PHACOCHERE)	POTAMOCHERE*
CAPE BUFFALO(BUFFLE)	BUBALE*
DAMALISQUE*	CEPHALOPE*
OUREBI*	COB DE ROSEAUX*
COB DE BUFFON*	COB ONCTUELX*
DORCAS GAZELLE(GAZELLE DORCAS)	GAZELLE RUFIFRONS*
DAMA GAZELLE(GAZELLE DAMA)	ANTILOPE CHEVA*
GUIB HARNACHE*	ZORILLE*
SITATUNGA*	DAMAN*
CIVET(CIVETTE)	MONGOOSE (MANGOUSTE)
MANGUE RAYEE*	CYNHYENE*
SAND FOX(RENARD DE SABLE)	WEASEL(LOUTRE)

THREATENED BIRDS

SERPENTAIRE*	VULTURES (VAUTOURS)
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*Equivalent English names not known.

sustainable infrastructure development and cost/benefit ratio will also be considered. Participation by A.I.D. in emergency operations will be carefully tempered with an examination of what long-term benefits will be achieved in addition to an insect population decrease. Because the use of pesticides in Africa has increased over the last few years, A.I.D. will assist primarily with a program emphasizing good survey and use of non-chemical control methods.

If USAID/Chad decides to participate in a l/g management program, the level of response should be related to the extent and severity of the problem. Section 3.2.2 describes different possible levels of infestation and intervention. The actual level of intervention assistance will depend upon a number of variables, including insect density, crop conditions, CPS capacity, and environmental conditions.

4.1.3 Integrated Pest Management - IPM.

Integrated Pest Management utilizes all available control methods to achieve the most economically and environmentally sound management program. It is considered to be the preferred approach to pest control. IPM is not an alternative to the use of chemical pesticides; instead it is an integration of methods which may reduce use of pesticides by employing them more judiciously. Determination of intervention thresholds, correct timing of sprays based on pest population dynamics, and use of non-chemical control agents are among examples of modern and prudent pest management methods.

IPM can decrease pest losses, lower pesticide use, and reduce costs, while increasing crop yield and stability. Successful IPM programs have been developed for a variety of pests on various crops. Specifics of an IPM program will depend on the crop, cropping system, pest complex, economic values, social conditions, availability of personnel, and other factors and constraints. The following steps illustrate the development of an IPM program.

Step 1: Identify the Major Pests, and Establish Intervention Thresholds.

Dozens of potentially harmful species may infest a crop. However, only a few pest species cause substantial crop loss. The pests which recur at intolerable levelson a regular basis are known as primary pests, and are the focus of IPM programs.

The criterion that determines whether taking action to control a harmful species is profitable is called the intervention threshold (or economic injury level). The intervention threshold is the point above which control actions should be taken, and below which no actions are necessary. The economic injury level may be expressed in different ways depending upon the crop and the pest.

Examples of injury level indicators could be:

- Numbers of insects per plant.

- Percentage of fruit damaged by a given pest.
- Numbers of weeds per square meter.

Several factors will influence the intervention threshold for a specific pest: crop variety and stage of development, value of the crop, presence of natural enemies, cost of control measures, as well as external costs to health and the environment. The intervention threshold depends on the relationship between the pest intensity and the yield loss, and the economics of reducing the damage. It will therefore change as these variables change. The intervention threshold developed in one area will not likely be appropriate for use in another area.

Research is needed to determine the initial intervention threshold. This should be thoroughly tested in actual field conditions to verify effectiveness. The level can be refined as more information becomes available, and as it is used in the field.

Step 2. Select the Best Mix of Control Techniques.

All pest management methods and practices should be considered for an IPM program. First consideration should be given to use of preventive measures:

- Resistant crop varieties.
- Biological control (conservation or augmentation of natural enemies already present or introduced)
- Cultural control (cultivation, crop rotation, use of pest-free seed and planting stock, fertilizer management, and intercropping)

Farmers will likely already be using one or more of these preventive measures. It is therefore important to talk to the farmers before determining which measures are needed.

Pesticides should be used only if no practical, effective, and economic nonchemical control methods are available. Once the pesticide has been carefully chosen, it should be applied only to keep the pest below the intervention threshold. Pesticides will impact other organisms besides the pest, and may cause harm to humans, livestock, honey bees, natural enemies, and the natural environment.

Step 3: Monitor the Fields Regularly.

The growth of pest populations usually is related closely to the stage of crop growth and weather conditions. However, it is difficult to predict the severity of pest problems in advance. The crops must be inspected regularly to determine the levels of pests and natural enemies, and crop damage.

Crop Protection Survey personnel and agricultural extension agents can assist with field inspections. They can train farmers to separate pests from non-pests and natural enemies and to determine when crop protection measures, perhaps including pesticides, are necessary.

Step 4: Use All Control Methods Correctly and Safely.

Each pest control method has both advantages and disadvantages. CPS and Extension agents should learn as much as possible about each control method. Education programs should be

developed to teach farmers how to use the available control methods safely and correctly.

Step 5: Develop Education, Training, and Demonstration Programs for Extension Workers.

Implementation of IPM depends heavily on education, training, and demonstration to help farmers and extension workers develop and evaluate the IPM methods. Hands-on training conducted in farmers' fields (as opposed to a classroom) is a must. Special training for extension workers and educational programs for government officials and the public are also important.

4.1.3.1 Cultural, Biological and Traditional Control Methods

Numerous non-chemical methods exist for pest management in general, and have been used against locust and grasshoppers. For example, crop varieties which develop at different rates from the commonly planted varieties, or which show resistance to insect attack may be applicable in the long-term. Sorghum, for example, is more resistant to attack by grasshoppers than millet. Other cultural methods, such as trap cropping, residue burning, trench digging in front of locust larval path, and intercropping may well have merit as well. Simple techniques such as using protected courtyards for tree seedling nurseries or covering seedlings with mosquito netting can be effective in small scale and limited cases (George, 1989).

Farmer experience with traditional or innovative control methods should be incorporated into the overall l/g management program. If villagers can be recruited as participants in control efforts, a field can be protected with a minimum of pesticide use and expense. The CPS is planning to train Village Brigades for purposes such as this in time for the 1990/91 campaign.

Research on field use of microbial agents in locust and grasshopper control is currently being implemented by A.I.D. and other international organizations. The microsporidian *Nosema locustae* has been tested in the US and in parts of Africa for its control potential. Preliminary results from Mali indicate that *Nosema* may be an unlikely candidate for use in an emergency situation, but could be part of an overall bio-intensive program. Additional work will be needed to determine its specific usefulness in an IPM context for longer-term maintenance.

In working with microbial pest control agents, attention must be given to handling and application techniques. *Nosema*, for example, has a short shelf life and must be used soon after production. In addition, the field climatic and environmental conditions will impact the microbial control agent.

Another research recommendation is the search for local and possibly more species-specific pathogens. Large population explosions of locusts/grasshoppers might be conducive to the development of epidemics of endemic pathogens. At the time of population collapses a search for more effective pathogens would be appropriate. Such a search should be done in collaboration with laboratories familiar with pathogen isolation.

Using Neem tree extract as an antifeedant has potential for being a component of IPM and could possibly serve as a locally-controlled "cottage industry" in Chad (Strzok et al, 1989). Additional research on Neem is needed, especially in its use against locusts and grasshoppers.

Other fruitful research areas might include use of *Beauveria* spores and synthetic insect growth regulators. These types of agents are considered alternatives to conventional pesticides because of their different mode of action. However, there may be significant impact on non-target aquatic invertebrates.

4.1.4 Selection of Pesticides

There are many methods of g/l control, and the most commonly used is chemical pesticides. While pesticides kill these pests, they also affect other living organisms in the ecosystems in and around cropping areas. In addition, misuse or overuse of pesticides results in higher overall operational costs. This is not only because of the direct cost of the pesticide, but also because of reduction in natural enemies in the crop ecosystem.

To use a pesticide in a specific area at specific time, it is necessary to have detailed knowledge of the physical and chemical attributes of the product, as well as the ecology of the area to be treated. Pesticide selection for locust/grasshopper control requires the following:

- Effectiveness and application rates;
- Effects on nontarget organisms, including people, animals, and specifically predators and parasites of locusts and grasshoppers;
- Persistence of residues on fauna, flora, water, land and crops.

Although a number of pesticides have been used in Chad against locusts and grasshoppers in the past (See Table 4), any pesticide involved in an operation funded by the USG must be approved for use in the United States by the EPA. These chemicals are listed in the PEA.

4.1.5. Village Brigades

Farmers can play a major role in a control campaign -- reporting population levels, destroying egg-pods, controlling larval aggregations -- if efforts are made to train them.

Table 4, Stocks of Pesticides in Chad.

NAME	QUANTITY RECEIVED					
	1986	1987	1988	1989	Total	
I. ORGANO-CHLORES						
Dieldrine L(81-82)	3000				3000	
HCH (84) T	39				39	
Lindane (300 ULV(L)			35000		35000	
Lindane 5% PP (T)		20			20	
II. OGANO-PHOSPHORES						
Acephate 50% EC T		1			1	
Dursban 12 EC L		3000			3000	
Dursban 450 ULV L			60000	33480	93480	
fenitrophion 100 EC L	4000				4000	
fenitrophion 100 ULV L	3000	15000			18000	
fenitrophion 20% ULV L		10000			10000	
fenitrophion 3% ULV PP T		53			53	
fenitrophion 50% EC L	116000		8760		124760	
fenitrophion 50% ULV L		52800	52200	67700	172700	
fenitrophion 96% ULV L	40000	10600			50600	
Malathion 50% EC L				900	900	
Malathion ULV L		90000	3000		120000	
Penncap L				3000	3000	
III. CARBAMATES						
Ficam 2% ULV L			3850	2825	6675	
Naftil 50 PM(carb.) T		1			1	
Propoxur 2% PP T	310	70			380	
Sevin 4(Carbaryl) L	400	150			550	
IV. PYRETHRINOIDES						
Decis G1 ULV L		6300		90500	96800	
Fastac ULV L		4650			4650	
Fenvalerate L			1000	2800	3800	
Lambdacyalothrine					0	
Total	liters	141350	182673	189810	201205	525228
	tons	349	22	0	0	371

Training farmers, through "Train the Trainer" programs, have been implemented on a large scale basis since 1987 in areas where locust or grasshopper infestations are endemic. In 1988 a coordinated Village Brigade program was started. Each brigade typically includes 10 individuals selected during an awareness campaign. These participants then receive 3 days of intensive training; and are then given a small quantity of pesticide, a set of protective clothing, and application equipment. Brigade members are responsible for locust or grasshopper control at the village level and are supported by CPS. An entire village may be trained during the year by members of a brigade.

Brigade training is most active in smaller villages which may be inaccessible because of lack of useable roads. In 1989, about 2,000 Village Brigades from 13 prefectures were formed.

4.1.6. Ground and Aerial Operations

The use of aircraft in control operations should be considered a last resort in locust or grasshopper management programs. With a vigilant survey program, combined with rapid deployment application teams, it is possible to conduct a management campaign without the use of spray aircraft. A.I.D. fully supports this concept, and will assist with training programs for survey and ground application teams. In addition to the basics of survey techniques, pesticide safety and application, such training must encompass a thorough background knowledge on species that require control, and the best way to accomplish this.

While aircraft are management tools, and may be justifiably needed during locust or grasshopper outbreaks, they should be used with caution. This is because: 1) aircraft carry and spray larger quantities of pesticide than ground equipment, and therefore are more likely to have an environmental impact; 2) They are expensive to run and maintain, and are unlikely to be sustainable without a high degree of outside input; 3) Assumed use by donors will result in less attention by the CPS to support of its survey and ground control systems.

Since its creation in 1987, the Chadian CPS has been provided a variety of fixed-wing aircraft (Cessna, Turbo Thrush, DC3) and helicopters (Allouette, Bell 206) by various donors for its aerial operations. Aerial control operations in Chad have produced the following conclusions:

- large infested areas can be treated in a short time;
- inaccessible areas are more easily treated;
- aircraft logistical support is expensive, and large amounts of pesticides are required;
- pesticide drift is difficult to control;
- Landing strips for fixed-wing aircraft require frequent and expensive maintenance.

In light of these limitations concerning aerial control operations, the CPS policy is to use preventive ground control whenever possible. The components of ground operations are:

- training and equipping farmers and Village Brigades;
- early season egg pod surveys and localized destruction;
- increased survey and ground application teams;

4.2 Human Health Protection

4.2.1 Public Awareness

In conjunction with A.I.D. assistance regarding locust and grasshopper efforts, the Government of Chad will work to establish mechanisms to monitor both the human and natural environment. In regard to protecting human health, the GOC will expand efforts to develop appropriate and environmentally sound control methods. Application of a pesticide in a given area should be preceded by public awareness and extension activities and education of the users. Education is an excellent way of informing the Chadian public that pesticides are dangerous and that empty pesticide containers should not be used for food or water storage. A good public information program can include:

- information on the specific pesticides and labels;
- safe methods of pesticide transport and storage;
- measures in cases of container leakage;
- conditions for pesticide use;
- safe use of application equipment;
- prevention of pesticide poisoning.

Pesticide educational programs can be instituted by Health Engineering and Sanitary Service agents. These individuals are currently working to develop health education activities for both the rural and urban population. Health education and extension programs can also provide information on first aid in pesticide poisoning cases. The inherent toxicity of used pesticide containers is an important subject area, and should be specifically directed to women who might use the containers for cooking or holding water. Components of a pesticide public awareness program should include photographs, posters, and prints on cloth. These should be given to agents as visual aids to hang on walls of schools, dispensaries, and on large trees in villages and towns.

Radio broadcasts are an important part of a public information campaign, including pesticide awareness information in the form of brief safety announcements, musical programs, interviews, debates, and dramas. Discussions of pesticide regulations and legislation should also be presented, including information on which pesticides are legal and which are prohibited in Chad. This will allow potential buyers and users to know what pesticides should be accepted and what should be refused.

4.2.2 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. Part of the labeling process is pesticide registration by host countries. Both registration and proper labeling require good solid legislation at the national level. It is important that the GOC draft legislation on Approval and Control of Pesticides, including a legal framework that will require pesticide labeling and registration in Chad. A strong licensing and labeling program by the GOC 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.

While labeling must be specific to local needs and the social environment of Chad, the FAO has prepared very specific and unified guidelines which can assist a labeling program. In addition to enacting legislation, the GOC should insist that pesticide shipments from donor countries be labeled in comprehensive language as required by donor country law, and in both French and Arabic.

4.2.3 Collaboration with Health Programs

An effective locust or grasshopper control program in Chad will cooperate closely with the Ministry of Public Health. The MSP's mission is to assure the physical, mental, and social well being of the people of Chad. Examples of potential collaborative areas are:

- Assisting with the health aspects of pesticide legislation;
- Public awareness programs in rural areas;
- Information on protective materials and safety procedures;
- Establishing a toxic products list;
- Decision-making on pesticide acquisition, use, and storage;
- Risk evaluation.

4.2.4 Health Monitoring

Simple and effective health monitoring of those involved in pesticide handling, application, and storage is essential to a good management operation. This involves teaching all involved with pesticides what the symptoms of pesticide poisoning are, and

when first-aid might be required. It is especially important to use behavioral observation to decide if workers should be immediately removed from pesticide exposure.

The GOC should have the capability to monitor both behavioral symptoms of pesticide poisoning, and such blood-chemistry manifestations such as acetylcholinesterase (ACHE) inhibition. Testing for ACHE inhibition is fairly simple and inexpensive, and can be performed by trained health workers in the field. The background cholinesterase level for each person involved with pesticides must be determined prior to exposure, and testing should be performed at intervals throughout the season to ensure that no worker is being overexposed to pesticides.

Measurement of residue levels in the environment can also be a valuable source of information for assessing exposure and determining if modifications to treatment operations are needed. Because a residue laboratory is expensive to build and operate, and requires a high level of expertise, Chad may wish to share such a institution with another country.

4.3 Natural Resources Protection

4.3.1 Protected Areas

Because pesticides will impact both crop and natural ecosystems, some system of natural resources protection should be instituted. This can be accomplished by setting aside areas and zones where pesticides are not used, or severely restricted. Since birds and fish are very vulnerable to the direct and indirect impact of pesticides, some areas should be set aside that are protected from pesticide use no matter how great the need. In Chad, protected areas should include:

- Lake Fitri Biosphere Reserve. This is a valuable fishery resource and has rich diversity of birds, including a number of endangered species (Fig. 5);
- National Parc de Manda. This is a National Park and a refuge for the flora and fauna of the Sudan zone;
- National Parc de Zakouma. This is National Park and a refuge for the flora and fauna of the Sahel zone;
- Reserve de Faune de Mandelia. This is a wildlife reserve and part of a vulnerable fishery resource;
- Reserve de Ouadi Rime-Ouadi Achim. This is a unique habitat, and vulnerable to water contamination;
- All open water areas in Chad, such as Lake Chad, (Fig. 6) oases, and the rivers and streams. These areas are often fishery resources.

In addition to these protected areas, the CPS should take precautions in a number of other areas that have a lower level of sensitivity, but which are still vulnerable (Fig. 7). These areas can be designated as high priority areas for Village

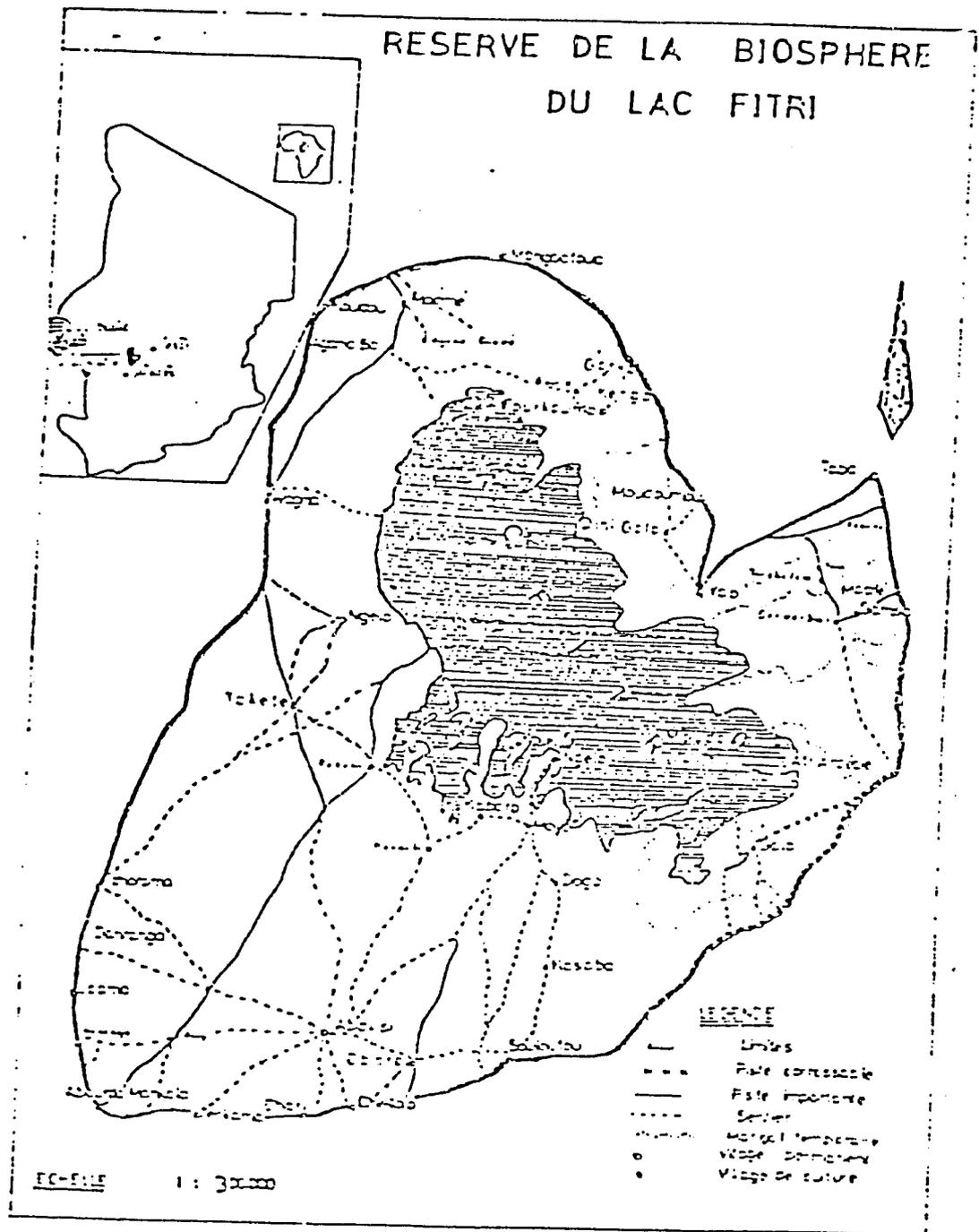


Fig 5 Lake Fitri biosphere reserve.

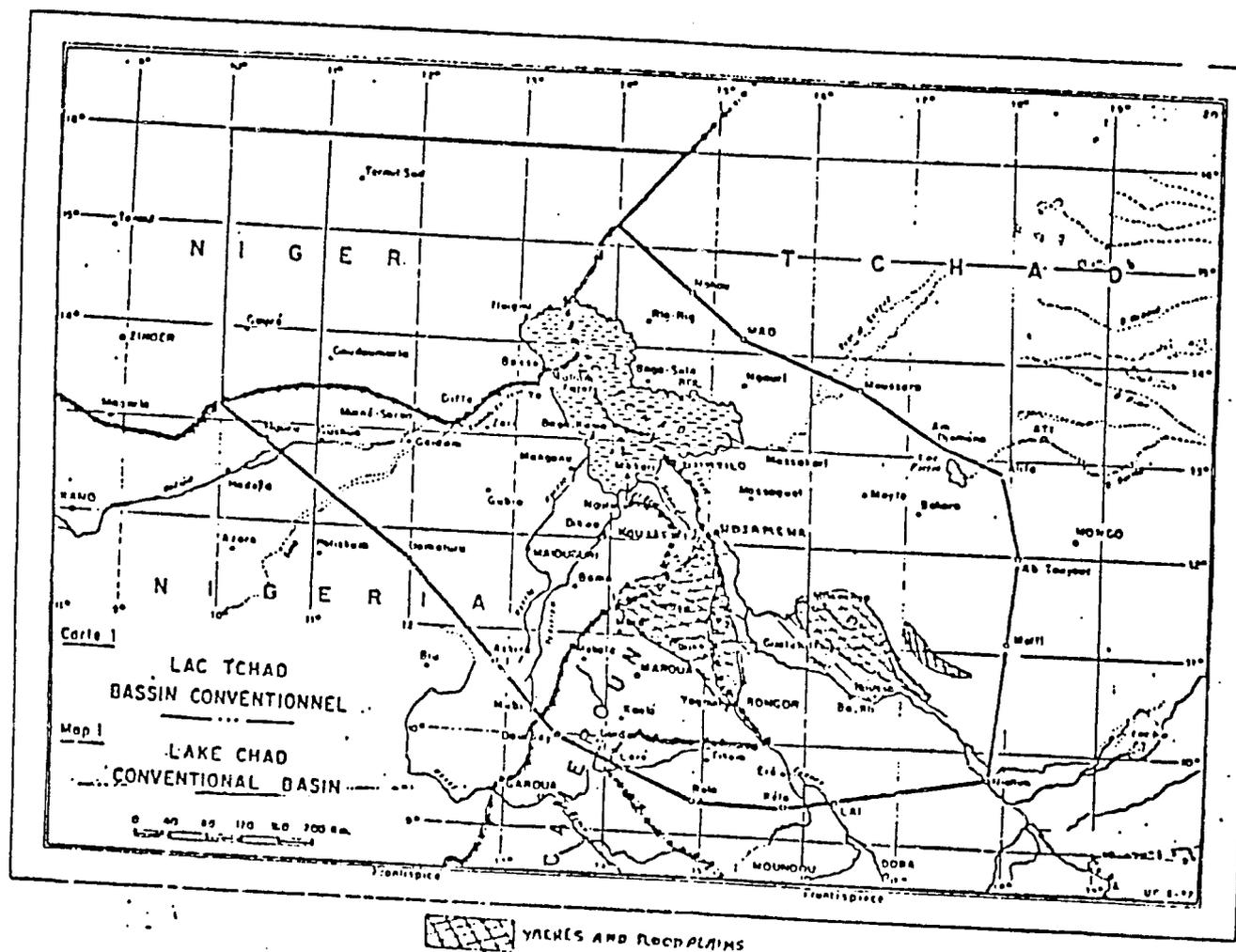


Fig 6 Lake Chad Conventional Basin

1. Zakouma
2. Manda
3. Barh Salamat
4. Siniaka Minia
5. Abou Telfane
6. Fada Archei
7. Ouadi Rime-Ouadi
8. Mandalia
9. Lac Tchad fiti
10. Binder Lere
11. Lac Tchad

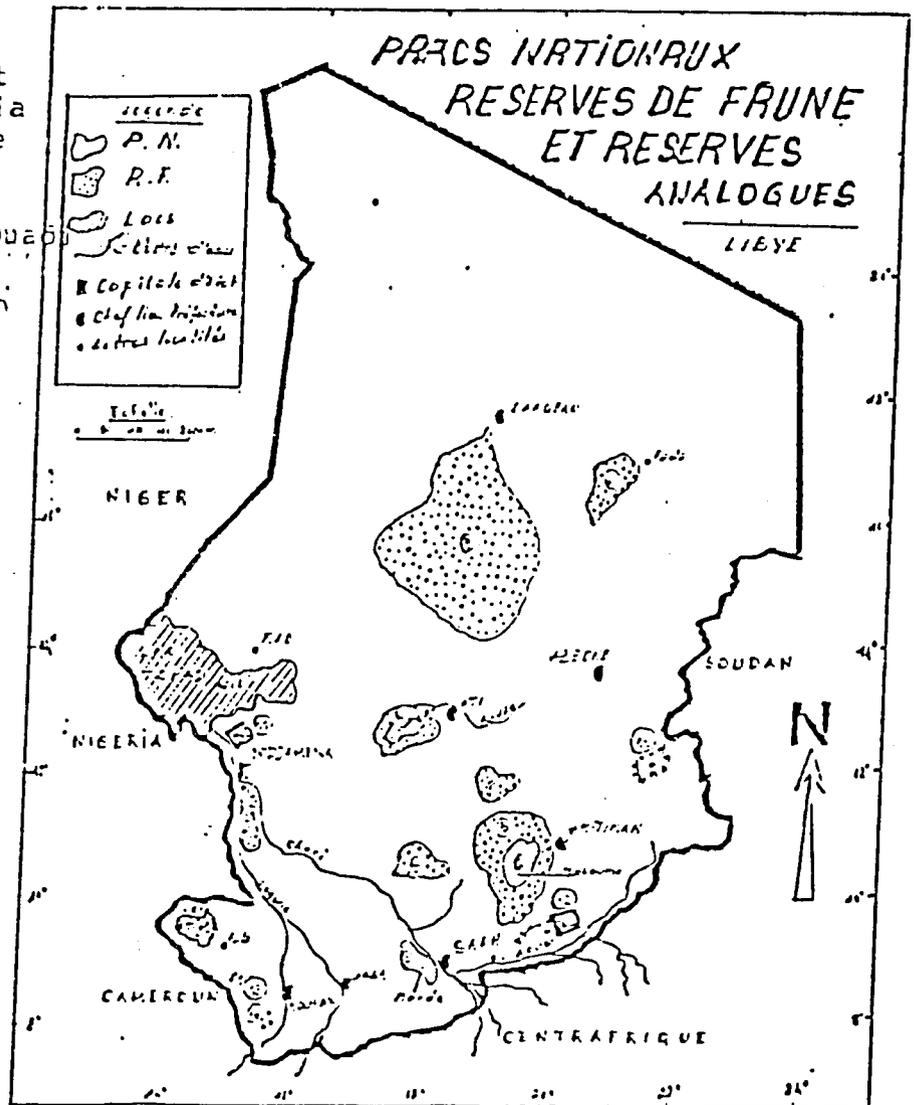


Fig.7 Location of Biotic Zones and Protected Areas in Chad.

Brigade mobilization, intensive monitoring, and encouraging non-chemical methods of control. The areas include:

- The entire Lac Prefecture and an equivalent area of the south shore of Lake Chad which is outside Lac. This is a vulnerable fishery resource;
- The remainder of Reserve de Faune de Mandelia, and the other reserves in the southern Sahel zone and the northern Sudan zone (Binder-Léré, Abou-Telefaun, Bahn-Salamat). These are ecological reserves and are vulnerable to potential indirect effects;
- Buffer zones should be set up around all areas designated as completely protected above, especially the wadis in the Reserve de Ouadi Rime-Ouadi Achim and the oases.

It is not entirely clear what level of protection will be provided Lake Chad by the restrictions above. In view of this uncertainty and the important economic role played both by the fisheries of Lake Chad and the crops on its shores (including recessional agriculture), a study of the relationship between productivity of the lake and the agricultural practices around the lake is urgently needed. There needs to be a particular focus on locust/grasshopper control in this study. Recent recommendations to FAO did not address this issue (Sagua, 1989). The GOC should explore the possibility of such a study with the CBLT, other member countries of the CBLT, and donors.

4.3.2 Buffer Zones

Protected areas should be surrounded by a buffer zones at least 2.5 km wide. These are needed to avoid accidental pesticide application and possible spray drift, and to will help to minimize indirect effects of pesticide use. Within buffer zones, a higher priority should be given to the use of alternatives to chemical pesticides, and a monitoring program so that non-chemical alternatives can be applied successfully. As the capacity of the CPS to provide training in non-chemical alternatives increases, the width of the buffer zones can be increased.

4.3.3 Pesticide Alternatives in Sensitive Areas

Farmers living in areas which have been designated as environmentally sensitive should receive training in IPM and the use of control methods which do not use chemical pesticides. These farmers should be encouraged to use traditional methods and should be informed as to how pesticides are dangerous. Farmers in such areas should be given individual attention, time to ask questions, and opportunity for discussion. CPS trainers should have a basic knowledge concerning food chains and the indirect effects of pesticides.

4.3.4 Environmental Monitoring

Part of the overall pest management system is monitoring treated areas for potential environmental effects of pesticides. This can prevent negative impacts on flora and fauna, as well as detect improper application methods which can impact human health and increase operations cost. Measuring pesticide residues in the environment is one method of monitoring, but will require a residue analysis laboratory for full implementation. Any donor which supports the use of pesticides should incorporate residue analysis into their project plans, and GOC should begin qualitative behavioral observations of non-target organisms near any pesticide target areas. Applicators must be trained to note unusual behavior among fauna of the area.

4.4 Pesticide Management

4.4.1 Managing Pesticide Stocks

A well maintained and secure pesticide storage facility is required for a U.S. pesticide donation. With a good pesticide management system in place, both donated and purchased pesticides can be controlled and utilized as needed. A good storage area should have a fenced and covered area for the pesticides. A storage warehouse should:

- 1) be isolated from dwellings in order to avoid fire, leakage, and water contamination;
- 2) be supplied with water in order to clean spills and fight fire;
- 3) be aerated to avoid toxic fume concentration;
- 4) have a current inventory of pesticide stocks;
- 5) have protection gear such as suits, boots, gloves, goggles and breathing masks;
- 6) have a first aid kit with antidotes;
- 7) be staffed with trained personnel who are familiar with measures to take in cases of poisoning.

A management system is needed to record the date the pesticide arrive to 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.

Success of locust and grasshopper campaigns depends on availability of pesticides in the areas which need treatment. Pesticides should be placed in safe and secure storage area as close as possible to agricultural areas which will likely need treatment. In Chad, pesticide storage areas are associated with the CPS Operations Bases and Field Posts. At the CPS Operations

Bases, a monthly inventory of products and materials should be made and sent to the Crop Protection Service in N'Djamena. Distribution of products to Bases is done according to need and severity of the locust/grasshopper threat, as well as the degree of isolation during rainy season. Pesticide stocks must be securely in place at Bases and in villages before the rainy season. During the agricultural season, needed pesticides can be transported from the main storage area in N'Djamena to the treatment area by road or air.

4.4.2 Obsolete Pesticides and Containers

Once the pesticide has been used, the management operation is left with an empty container. This container can be either reused or destroyed. If reused it should be only be used for the same pesticide or to store fuel. In addition, it can be flattened for use in construction. It should never, repeat never, be used to store water or food. Even though the pesticide is gone, enough is left to cause mild poisoning cases, especially in the very young or old. Further, small quantities of pesticides will make the human body more susceptible to other diseases.

4.4.3 Disposal of Unwanted Pesticides

When a pesticide is no longer needed, or is degraded chemically due to heat or time it will need to be disposed of. Several alternatives exist for disposal of old pesticides (See Table 7). As the majority of the obsolete chemicals are liquid products, one disposal methods is high-temperature incineration. It is currently impossible to incinerate pesticides in Chad Incinerators in Europe or neighboring countries (such as Nigeria or Cameroun) may be used for disposal operations.

A large quantity of unwanted pesticides, many of which are more than 10 years old currently exists in Chad. This includes: 3000 l Dieldrin ULV, 14290 l Lindane 5 % and 4400 l of Fenitrothion 60% ULV and 60% EC. Many chemicals are stored in drums which are deteriorating.

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APPENDIX A
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APPENDIX B

PEA for LOCUSTS/GRASSHOPPERS: SYNOPSIS OF ENVIRONMENTAL ASSESSMENT PRIORITIES

BASIC PRE-CONDITION OF PROGRAM

Recommendation 1. *It is recommended that A.I.D. continue its involvement in Locust and Grasshopper control. Operationally, the approach to be adopted should evolve toward one of Integrated Pest Management (IPM).*

This recommendation should be applied in the context of the specific needs of Chad. USAID/Chad supports IPM in the management of locusts and grasshoppers, as well as other insect pests.

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 recommendation can be part of future USAID/Chad involvement with assistance efforts. Maps should include specific areas to be protected immediately, some with a total ban on pesticides for grasshopper or locust control and some with a high priority for testing and applying alternatives. In addition, a special study of the Lake Chad area is recommended to determine if additional protection is needed.

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

Based primarily on poor management of large stocks of pesticide products that have accumulated in Chad, this is a needed activity, especially since Chad has a worse than average system of management in place. Improvements in the system for managing pesticide stocks must be implemented to protect human health and the environment and to minimize the chance of pesticide products becoming obsolete.

Recommendation 4. It is recommended that A.I.D. take an active role in assisting host countries in identifying alternate use or disposal of pesticide stocks.

A plan for managing obsolete stocks has been drafted with the support of A.I.D. Washington. However, the stocks in Chad should only be disposed of when the best technology, fitting the local situation, has been developed. High priority should also be placed on minimizing the future accumulation of any unwanted pesticide.

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 that recommendation as an AID/W activity, but considers it low priority for USAID/Chad.

MITIGATION OF NON-TARGET PESTICIDE EFFECTS

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

Any future spray operations or pesticide donations for use in Chad should be accompanied by a requirement prohibiting use in some areas and limiting use in others or requiring appropriate buffer zones. The areas of total prohibition are Lake Fitri Biosphere Reserve, national parks, national forests, and fragile areas. Buffer zones and other reserves should restrict pesticide use, and encourage traditional and non-chemical methods.

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

Pesticide recommendations in the PEA should be followed until research results indicate that more environmentally safe pesticides are available for use. Investigation of traditional and cultural methods of control are also strongly encouraged as a USAID/Chad activity. This SEA does not contain a recommendation on this issue because it accepts the pesticide selections in the PEA.

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 recommendation, while a priority in an ideal insect management operation, may be difficult to fully implement in the Chad, due to a lack of supportive infrastructure. A program of research monitoring is important both as a basis for design of operational monitoring and as a means of establishing statistically verifiable base line data. In addition, periodic "sampling" observations of gross mortality, populations and behavior should be made at locations of major use of pesticides.

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.

A number of operational procedures should be followed to minimize the area to be sprayed. 1) Emphasis should be on a vigorous surveillance program, thus allowing early treatment operations and reducing the amount of pesticide used. 2) Crop protection operations should utilize economic thresholds. 3) A program of identifying non-treatment areas and minimum treatment areas should be adopted. 4) Training of all decision-making individuals should emphasize the importance of restraint in the use of pesticides. 5) Inclusion of farmers and villagers in trainings and subsequent survey and application operations.

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.

The treatment program in Chad should emphasize ground application. However, this recommendation should be applied with discretion. Much of the treatment occurs during the rainy season and in many areas of Chad are inaccessible except by helicopter. Aerial application guidelines are currently being revised and will be followed when approved.

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 that recommendation. However, due the vast distances encountered in Chad, large aircraft may be needed to spray areas far from supportive infrastructure.

Recommendation 12. It is recommended that any USG-funded locust/grasshopper control actions which provide pesticides and other commodities, or aerial or ground application services, include technical assistance and environmental assessment expertise as an integral component of the assistance package.

This SEA agrees with this recommendation. In addition, this SEA strongly supports both long- and short-term training to be integrated with USAID provided technical assistance.

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

This SEA agrees with the recommendation and urges the GOC to give high priority to pesticide legislation and implementation of a good clear label. It is suggested that the GOC follow the FAO pesticide label guidelines.

DISPOSAL OF PESTICIDES

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

A.I.D. Washington is currently developing guidance concerning assistance to African countries with disposal of unwanted pesticides and empty containers. USAID/Chad should follow such disposal guidance when available, and should continue to assist with proper pesticide management. Especially important is the proper disposal of empty barrels.

PUBLIC HEALTH AWARENESS

Recommendation 15. A.I.D. 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.

Collaboration between the CPS and other ministries, begun with the writing of this SEA, should continue with the development of public and applicator education on pesticide safety, pesticide poisoning recognition, avoidance, and treatment. In addition to the dispersal of information on general pesticide awareness, the public should be made aware of the need to protect environmentally sensitive areas from pesticide misuse. Radio is an effective medium in this regard, and should be utilized to its fullest.

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 and advocates inter-governmental collaboration of training programs.

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 that recommendation and advocates collaboration between CPS and the Ministry of Health in deciding the appropriate way to implement it.

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 levels in small samples of blood as a screening test.

This SEA supports the need for monitoring the human health impact of pesticide applications and urges collaboration to

determine how to accomplish monitoring the individuals most exposed to organophosphate pesticides during the coming season. This should be implemented on a regular basis with pesticide handlers and applicators. In addition, this SEA favors the monitoring for actual symptoms of pesticide exposure, and environmental residues after pesticide applications when GOC is able to work out arrangements for a regional laboratory.

PESTICIDE FORMULATION AND MANAGEMENT

Recommendation 19. *It is recommended that the specifications for A.I.D. purchase of locust/grasshopper insecticides be adapted for all insecticides.*

This is an AID/W activity that should be implemented through a revision of A.I.D.'s Pest Management Guidelines, currently underway. No Chad-specific recommendation is included in this SEA because it is a central activity.

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

This is an AID/W activity that should be implemented through a revision of A.I.D.'s Pest Management Guidelines. A.I.D. is working with the EPA Pesticide Disposal Workgroup to achieve state-of-the-art pesticide container specifications.

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.*

AID/W is currently supporting research bio-pesticides in Africa. The need for carefully controlled studies in the area of biological control is stressed by this SEA. Other areas of research should be pursued, especially in regard to native populations of parasites, diseases and predators.

TRAINING

Recommendation 22. It is recommended that a comprehensive training program be developed for A.I.D. 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 that recommendation for Chad. The L/G Operations Handbook (A.I.D., 1989a) fills this need in part, and a workshop on control operations was held in Dakar in February, 1989. Other materials will be passed to USAID/Chad.

Recommendation 23. It is recommended that local programs of training be instituted for pesticide storage management, environmental monitoring and public health (see Recommendation 16).

While this SEA supports this recommendation, it recommends that the highest priority of training be given to ensure the safe and appropriate application of pesticide product. Training is an essential part of any assistance program, involving both actual training programs, individuals working with outside expertise. Train the trainer programs are especially effective in passing information with minimal expense.

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 supports that recommendation as an AID/W activity. An approach would be to select technical assistance teams which 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 will be provided. These teams should include at least one or more members with "senior" expertise; one or more others could be apprentices.

ECONOMICS

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

This SEA supports this recommendation in general. Implementation in Chad might consist of the agricultural productivity analysis documented herein, and a commitment to keep the database up-to-date on an annual basis.

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

We believe that a valid economic threshold cannot be established at this time, and recommend long-term collection of semi-quantitative data to determine the extent to which agricultural productivity is threatened and an effort to ensure that declarations of disaster are supported by valid professional judgement. This would ensure minimum pesticide procurement by limiting A.I.D. participation when a reasonable probability of substantial threat to crops does not exist.

ENVIRONMENTAL POLICY

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

This SEA supports that recommendation. AID/W and EPA are developing an assistance program to assist with pesticide regulations and policies, including human safety, environmental impact, and use, storage, and disposal. Implementation should include the improvement of pesticide labelling, including clear precautionary statements, specific use directions, and appropriate instructions for disposal of empty containers. In addition, policy must include an environmental monitoring program. Monitoring results should be used in the planning of future pesticide use operations, as well as to detect possible misuse or unexpected adverse results.

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 that recommendation, and considers this to be a topic appropriate for GOC action. Such a pesticide inventory program should prevent the build-up of obsolete stocks and contribute to a cost reduction in pesticide use in general.

PESTICIDE HANDBOOK

Recommendation 29. *It is recommended the A.I.D. produce a regularly updated pesticide handbook for use by its staff.*

This SEA supports that recommendation as an AID/W or REDSO activity. Among the relevant activities in this area are A.I.D. policies concerning pesticide use, efficacy and agricultural productivity, environmental impacts and health effects, safety and mitigative measures. The Handbook should contain health, safety, and environmental assessments of the pesticides that are likely to be in use in Chad.

SUPPORT AND TRAINING

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

This SEA supports this recommendation, but only with a thorough analysis of both actual needs, and existing supportive infrastructure.

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.

This SEA supports this recommendation, and considers this a valid activity for USAID/Chad. Due the inadequate storage facilities that currently exist in Chad, support is for the Pesticide Bank concept. A thorough evaluation of the storage facilities should be complete prior to project assistance.

FORECASTING

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

This SEA is in favor of continuing and improving forecasting as an AID/W or FAO activity.

PUBLIC HEALTH MONITORING AND STUDY

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

This SEA considers this recommendation to be currently inappropriate for Chad due to a lack of supportive infrastructure.

RESEARCH

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

This SEA supports this recommendation including the search for other microbial pathogens of locust and grasshopper species as a longer term priority. If disease organisms can be isolated,

they might be useful in future control programs. The capacity does not currently exist for conducting this research in Chad.

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

That Neem may be one of the most promising new bio-pesticide, and thus deserves additional field research. As additional funds are available, the most promising options should be pursued. If Neem extract continues to show promise, a major research effort should be devoted to it.

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

This SEA considers such comparative impact research an appropriate AID/W activity. A major international research effort has been launched in Senegal on the ecotoxicological effects of locust insecticides.

ENHANCING AND ACCELERATING IMPLEMENTATION

Recommendation 37. *It is recommended that A.I.D., on the basis of the previous recommendations, develop a plan of action with practical procedures to provide guidance in locust/grasshopper control to missions in the field.*

This SEA supports this recommendation. AID/W has a general plan of action that includes the development of Supplementary Environmental Assessments in the countries that are most critical for locust and grasshopper control. These countries include Chad, Mali, Mauritania, Niger and Senegal in the region for which the Africa Bureau is responsible. These Supplementary EAs will, in turn, contain commitments for future actions. Country-specific plans of action will be developed to implement those commitments when needed. Such a plan for Chad has been developed by CPS. The country specific plans of action will be the backbone of guidance for locust/grasshopper control activities.

Recommendation 38. *It is recommended that detailed guidelines be developed for A.I.D. to promote common approaches to locust and grasshopper 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 supports this recommendation. Coordination must occur both at the AID/W level and the USAID/N'Djamena level. At the country-specific level, the CPS is the major coordinating body but donors also discuss specific plans with each other. These efforts should be improved for the future.

APPENDIX C. Relevant Documentation.

FAO Pesticide Management Documents:

- a) International Code of Conduct for Distribution and Utilization of Pesticides.
- b) Guidelines for safe pesticide distribution, storage, and handling.
- c) Guidelines for pesticide disposal and container disposal.
- d) List of FAO approved pesticides.
- e) Pesticide storage and packaging guidelines.
- f) Guidelines for pesticide approval and management.
- g) Ecotoxicological guidelines.
- h) Ground and aerial application guidelines.
- i) Insecticide poisoning: prevention, diagnosis and treatment.
- j) Guidelines for effective labeling.
- k) Efficacy requirements for pesticide approval.

Other Documents on Pesticides and Locust/Grasshopper control:

- a) Guidelines for selection, procurement, and use of pesticides in World Bank-financed projects.
- b) Crop Protection Service Organization (D.310) T. 1. PRIFAS. Dec. 1988.
- c) Effectiveness of localized pesticide treatment. (D.309) T. 2. PRIFAS - Dec. 1988.
- d) Effects of locust and grasshopper control on the environment. (D. 308) T. 3. PRIFAS - Dec. 1988.
- e) Locust and Grasshopper Control - Interministerial Instruction No. 3 related to protection of man and environment. Algérie doc.- March 1989.
- f) First aid in cases of poisoning by locust and grasshopper control products. CIBA-GEIGY.

USEPA Pesticide Fact Sheets:

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

These are among the many Pesticide Fact Sheets issued by the U.S. Environmental Protection Agency, selected for relevance to locust and grasshopper control. They summarize the data known to EPA at the time of preparation of the Fact Sheet. They generally include information on acute and chronic toxicity to humans and other non-target organisms, handling precautions, and other instructions for use. They may be requested from:

Office of Pesticide Programs
US Environmental Protection Agency
401 M Street, SW
Washington, DC 20460 USA

MANIFESTE DE N'DJAMENA pour la conservation de l'héritage naturel du Tchad

LE GOUVERNEMENT DE LA REPUBLIQUE DU TCHAD

Pleinement conscient de la valeur culturelle, scientifique et économique de la nature et des ressources naturelles du pays (air, eaux, forêts, flore et faune) qui forment une partie intégrante de son patrimoine national.

Déclare formellement prendre ses responsabilités et entreprendre tout ce qui est en son pouvoir pour bien gérer et conserver cet héritage naturel pour le profit de l'ensemble du pays et pour le bien-être des générations futures.

Dans ce but, le Gouvernement du Tchad s'engage..

- à promulguer une législation et créer les structures gouvernementales et administratives nécessaires à la garantie de l'observation des principes écologiques comme base de toute planification et de tout développement économique..
- à incorporer la conservation de la nature et de l'environnement naturel dans les programmes scolaires à tous les niveaux et dans le domaine de l'éducation en général.
- à conserver et aménager par des Parcs nationaux, des Réserves de Faune, des Forêts classées et autres Réserves naturelles et des vastes espaces représentatifs de tous les milieux et de toute la variété des ressources naturelles du pays,
- à protéger la flore et la faune et surtout les espèces menacées d'extinction.
- à combattre la destruction ou la dégradation intentionnelle ou involontaire des milieux naturels vils, ainsi que la pollution de l'air, des eaux et du sol.
- à soutenir les efforts entrepris sur le plan régional et continental et à intensifier ses efforts pour promouvoir la conservation par tout autre moyen dont il dispose.

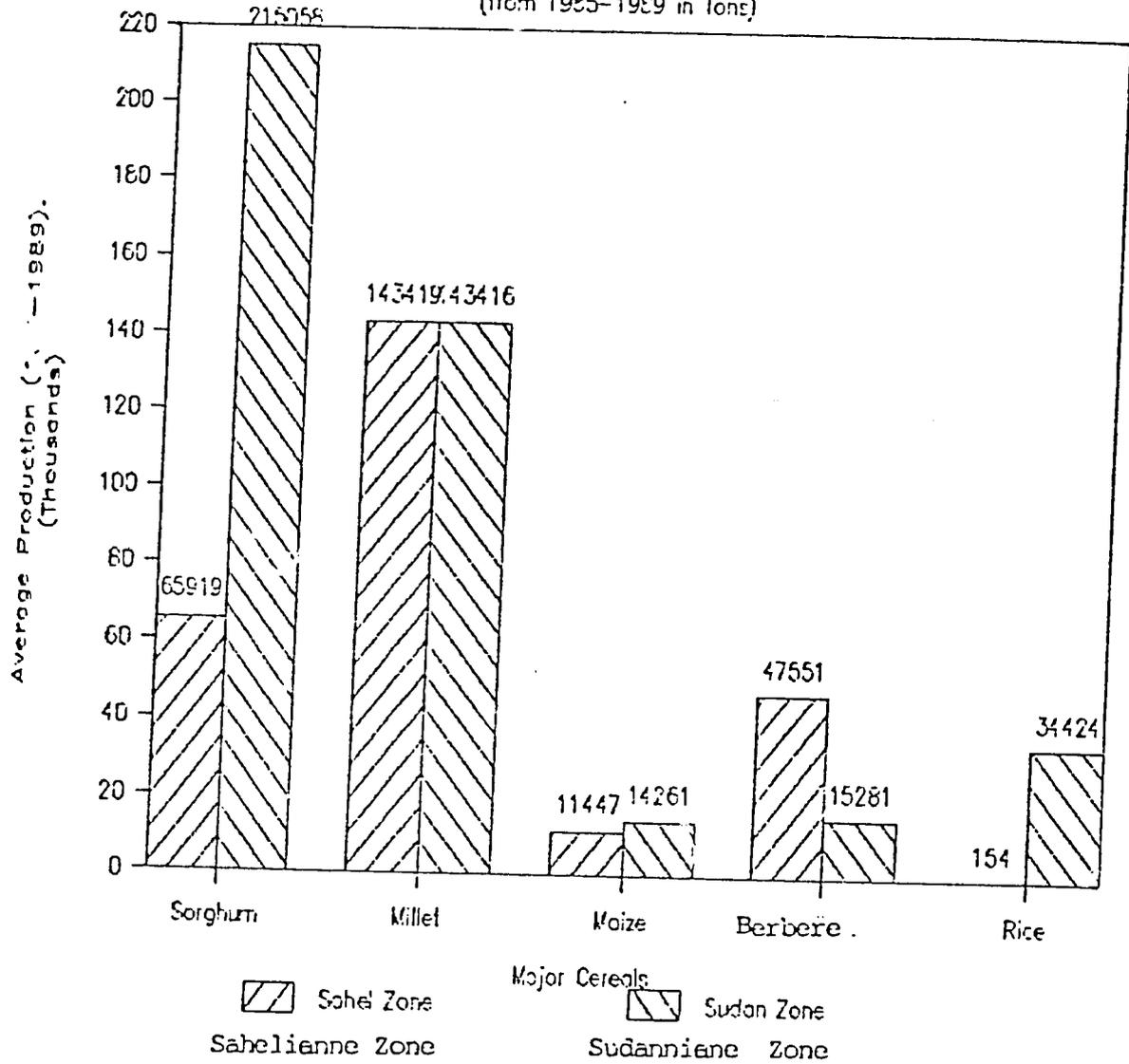
Dans la poursuite de ces objectifs le Gouvernement du Tchad se sent solidaire des Gouvernements des pays voisins et de tous les pays du continent Africain. Il compte sur l'assistance efficace des autres nations du monde et des organisations internationales qui travaillent pour la conservation de la nature pour l'homme à l'échelon mondial.

Fait à N'Djaména, le 14 Août 1976

Le Général Félix MALLOUM NGAKOUTOU BEY-NDI

Average Cereal Production in Chad

(from 1985-1989 in Tons)



**AGENCY FOR INTERNATIONAL DEVELOPMENT
BUREAU FOR AFRICA**

**Office of Analysis, Research and Technical Services/
Office of Operations and New Initiatives
AFR/ARTS-ONI**

COUNTRY SPECIFIC SUPPLEMENTARY ENVIRONMENTAL ASSESSMENT (SEA) TO
PROGRAMMATIC ENVIRONMENTAL ASSESSMENT (PEA)
FOR LOCUST/GRASSHOPPER CONTROL IN AFRICA AND ASIA

FINAL ACTION FORM

COUNTRY: CHAD

DATE: April 1991

ACTION TAKEN:

Approved: Date 4/1/91

Disapproval: Date _____

Bureau Environmental Officer: J. J. Gule

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