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CAMEROON LOCUST CONTROL PROGRAM:

SUPPLEMENTARY ENVIRONMENTAL ASSESSMENT

UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

IN COLLABORATION WITH

THE GOVERNMENT OF CAMEROON

Yaounde, Cameroon
April 1991

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PREFACE

This Supplementary Environmental Assessment, was prepared by USAID/Cameroon and an interdisciplinary team including specialists provided by AID/W (Africa Bureau), and the Cameroonian Government. The team worked with USAID/Cameroon staff, with Ministerial representatives of the Government of Cameroon (GRC) and with regional and local institutions. Annex A contains a list of GRC team members and consultants, as well as a list of people contacted in Cameroon.

This document has been reviewed by USAID/Cameroon, AID/W, and the Government of Cameroon. It reflects the best current description of the future directions of the control program for locusts/grasshoppers, best estimates of environmental risks and benefits, improved health and environmental protection and other mitigation. The commitments for any possible future program are contingent on the future needs for grasshopper or locust control and on a decision by A.I.D. to provide assistance. While the document primarily concerns grasshopper and locust control in the Extreme North and North Provinces of Cameroon, it may also serve to guide control efforts for other pests in other regions of the country, given the gathering of appropriate additional information.

1.0 EXECUTIVE SUMMARY

This assessment is a supplement to the Programmatic Environmental Assessment (PEA) for Locust and Grasshopper Control in Africa and Asia. It was developed to provide particular, country-specific details in Cameroon in order to allow AID assistance in regard to Locust and Grasshopper Management. It is therefore a extension of 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/Cameroon and the Cameroon CPS to guide environmentally sound locust and grasshopper management in the Extreme North and North Provinces. However, the discussions herein need not be limited to these specific pests or regions of the country, provided that consideration is given to the extreme climatic, biological, and environmental diversity of Cameroon. Additional relevant information should be added to this SEA as needed, as this is a dynamic, rather than static document. As part of the PEA, both document should be consulted during both 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 reduce crop loss and pest control operation costs. Early season intervention requires considerable 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 2 kilometers surrounding fragile areas should be supported in any U.S.-funded control operation.

Pesticide management must be a priority in control operation programs. Because misused pesticides effect 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 be enforced to promote sound management practices.

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 education and public awareness campaigns. Farmer training and Village Brigades can be an important part of management operations, and should be stressed.

If possible, the Cameroon CPS should work towards a laboratory analysis program to monitor pesticide formulation quality, and environmental residues. 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 the Desert Locust (Schistocerca gregaria) in Africa beginning in late 1986 and lasting into 1989, and extensive grasshopper (numerous 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 the management of these insects. 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. The waiver permitted A.I.D. to provide assistance for procurement and use of pesticides for locust/grasshopper control without full compliance with the Agency's environmental procedures. The Administrators waiver expired on August 15, 1989.

Any future A.I.D. assistance for procurement and use of pesticides must fully comply with the Agency's environmental procedures. In 1989, a Programmatic Environmental Assessment (PEA) was completed. The PEA, and the country-specific Supplemental Environmental Assessments (SEAs) will serve as the basis for these regulatory procedures. The SEA contain specific environmental information for each of the Sahelian countries, and provide guidance on environmentally sound management procedures.

Given the periodic nature of locust outbreaks, and the cyclic population fluctuations of grasshoppers, control campaigns for these insects are likely to continue indefinitely in northern Cameroon and elsewhere in the Sahel. Both locusts and grasshoppers are part of the ecology of the Sahel and Sahara, and will readily take advantage of agricultural crops. Control measures must manage problematic insects at economically reasonable levels in regard to crop loss, rather than try to achieve extermination.

Because of the both periodic and cyclic abundance of locusts and grasshoppers, and their potential 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. It is likely that most of these requests will be related to the use of chemicals for control operations, either directly or indirectly. For A.I.D. to positively respond to such requests, the Environmental Procedures in Regulation 16 (22 CFR 216) must be followed. Along with the PEA, this document fulfills the requirements necessary to allow A.I.D. to provide assistance to Cameroon. Because most serious problems with locusts, and especially grasshoppers, have occurred in the northern provinces, this SEA emphasizes, but does not restrict itself to, those regions of Cameroon.

2.2 Scoping Procedure

A.I.D. Environmental Procedures (22 CFR 216.3(a)(4), describes the scoping process to be used in identifying 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).

A draft outline for the Supplemental Environmental Assessment (SEA) and a list of sources of information were developed by USAID/Cameroon and AID/W TA. The USAID/Cameroon Agricultural Development Office (ADO) oversaw the scoping process, wrote parts of the SEA, and organized all needed reference documentation.

USAID/Cameroon, with the assistance and participation of the Director of the Crop Protection Service within the Ministry of Agriculture, worked cooperatively to facilitate the drafting of the SEA, and to ensure smooth implementation of the this guidance document. The individuals members of the SEA committee, as well as those who contributed to the writing of the SEA are listed in Appendix A.

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 in regard to l/g 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) *Provisional Report on the Handling of Pesticide in Anglophone West Africa*. (Youdeowei, 1989, FAO Conference report, Accra , Ghana);

(3) *Provisional Report on Pesticide Management in Francophone West Africa*. (Alomenu, 1989, Report to the

FAO Conference at Accra, Ghana);

(4) *Country Paper on Pesticide Management for the Republic of Cameroon.* Cameroon National Report, 1989, FAO Conference on Pesticide Management, Accra, Ghana, 33 P. + Annexes;

(5) *Draft Environmental Assessment of the Tunisia Locust Control Campaign.* (Potter et al, 1988);

These documents have been used freely in the preparation of this assessment and are often relied on without citation. Internal USAID/Cameroon data are used without citation. Other relevant documents are cited in the text when supportive data is used.

2.4. Environmental Procedures.

It is A.I.D. policy to ensure that any negative environmental consequences of an A.I.D.-financed activity are identified prior to a final implementation decision. This document covers specific environmental consequences involved with pesticide use, and necessary safeguards and mitigation for any future control programs.

Although Cameroon does not have 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, Cameroon 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 Cameroon.

2.5.1. Control of Pesticides in Cameroon.

To facilitate the proper and safe use of pesticides, regulatory laws are necessary. These regulations cover the importation of pesticides, the distribution to agricultural areas, the actual use of the pesticide, and the disposal of unwanted pesticide and used containers. The current laws that govern pesticide use in Cameroon include: Decree 77/171 of 3 June

1977, and Law 66/9/COR of 18 June 1966. These laws mandate governmental authorization prior to the importation of any chemical, including pesticides.

The Department of Agriculture must screen pesticides for both efficacy and toxicity before granting a permit for importation. Pesticides that are hazardous or dangerous are banned. Pesticides that are banned for either import or use in Cameroon are (Order No. 0002/MINAGRI/DIRAGRI/SDPV):

dinosebe acetate	aldrin	binapacryl
captafol	cyhexatine	dieldrin
dinosebe	heptachlor	2,4,5-TCP

Pesticides which are recommended to be added to this list are: alachlore, chloramphenicol, chlordane, DDT, DDD, DDE, endrin, hexachlorophene, HCH, lindane, chloral hydrate, paraquat and toxaphene.

The Cameroon Crop Protection Service (CPS) is currently drafting a set of regulations and procedures to more fully cover the pesticide registration process. This decree will require a pesticide manufacturer to first submit technical data and a sample of the pesticide for testing and analysis in Cameroon. only after the CPS has thoroughly analyzed the material, and deemed it safe and effective, may the pesticide be sold and used in Cameroon. While these regulations will not solve the problem of monitoring and enforcement, they will set forth a very strong base for further management actions. This SEA is encouraged by these actions, and supports the CPS in this effort.

A U.S. pesticide contribution to Cameroon, or a U.S.-funded pesticide purchase in Cameroon will be controlled not only by applicable Cameroonian laws and regulations, but also by U.S. pesticide regulations and procedures, as described in the PEA. In this regard, only those pesticides listed in the PEA, or amendments thereof, are acceptable unless this SEA is amended to cover possible environmental impact which may result from the use of that particular pesticide. Pesticides used in a U.S. operation are to be used according to label instructions only. Used pesticide containers and any unwanted pesticide resulting from a U.S.-funded operation must be disposed of properly and safely. No U.S. funds shall be used to purchase, transport, or apply any pesticide that has been banned in the United States.

2.5.2. Other Environmental Regulations in Cameroon.

Responsibility for environmental protection is divided among several different Ministries in Cameroon. The Ministry of Agriculture has legislative authority for protection and management of the forests of Cameroon, while the Ministry of

Tourism is responsible for protection and development of the National Parks and Faunal Reserves. The Ministry of Planning and Regional Development is concerned with broad environmental issues such as pollution, climatic change, deforestation, and toxic waste. A directorate in the Ministry of Mines, Water, and Power does environmental impact studies for large projects.

While Cameroon has adequate regulations on pesticide use, the Crop Protection Department of the Ministry of Agriculture 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.

2.6. Other Natural Resource Protection Laws

In Cameroon, forests, wildlife and fisheries are protected by Law No. 81-13 of 27 November, 1981. This law defines forest reserves, faunal reserves, and national parks. It specifies that forests must regenerate (and must have management plans to ensure regeneration), that habitat in natural parks and fauna reserves must remain undisturbed, that buffer zones must surround national parks, and that a total of 20% of the Cameroonian territory is to be protected as state forests. Unfortunately, few forests have management plans, (Gartlan, 1989) and only about 5% of the area of Cameroon has any kind of protected status (Hazelwood and Stotz, 1981). Management plans of the scale drafted by Gartlan (undated) for Korup are desirable for the more important areas; lower priority areas could have plans that are somewhat scaled down.

Law 83/170 provides additional protection for national parks. Parks are designated for fauna, flora, and soil conservation. Agricultural, grazing and forestry activities are prohibited. In addition, pesticide use in or around national parks, protected areas, and wildlife reserves, is not allowed. While these regulations exist, improvement is needed in developing adequate definitions of protected areas, enforcement of current regulations, and in increasing both environmental awareness and effectiveness of public information oriented to agriculture workers.

Any USAID/Cameroon-funded programs involving pesticide use for the control of locusts or grasshoppers should follow Cameroonian regulations concerning the protection of designated areas. In that regard, this SEA supports the GRC commitment to protect the natural environment, and adopts any GRC mandated conditions limiting the use of pesticides, and also follows the designated zones that are protected from pesticide use.

3.0 DESCRIPTION OF PROJECT SITE

3.1 Agricultural Resources

3.1.1 General Description

Cameroon is an agricultural country with a large rural population involved in vegetable, fruit, cereal, and animal production, in addition to supporting several extensive export crops. Cameroon is classified among the middle-sized states of Africa, and is located on the western coast of central Africa, covering an area of 475,442 square kilometers, with a population of more than 11 million. It occupies a fairly central position on the African continent and shares a common boundary with six other African countries. It also has about 200 kilometers of coastline. Cameroon is a bilingual (French and English) country.

Agriculture plays an important role in Cameroon's economy, with about 66% of the Cameroon population engaged in agricultural activities (Ministry of Agriculture, 1986). Nearly all of the production is on small family-owned farms averaging about 2.5 ha. Only about 5% of the land under cultivation is in large plantations. Agriculture provides about 50% of Cameroon's exports, with petroleum accounting for an additional 40%. Coffee is the major export crop and cotton is next in importance. Numerous other export crops are grown, including oil palm, cocoa, bananas, sugar, and tea. Pesticides are extensively used on export crops, which account for about 80% of all pesticides used in Cameroon. The remaining 20% is used in domestic agriculture, with only 5% of that used on village food crops. The country is fairly self-sufficient in food. Food crops include millet, sorghum, maize, rice, groundnuts, beans, plantains, cocoyams, yams, cassava, sweet potatoes, vegetables and various fruits.

Livestock represents about a third of the total agricultural production. Cattle, sheep, and goats are the major stock raised, and most production is in the North and Extreme North Provinces. Farther south, the tsetse fly has made cattle production difficult, and sheep and goats predominate.

Agricultural production systems in Cameroon broadly fall into three agro-ecological zones. Cereal production predominates in the northern Sahel and Sudan savanna zone. The central hilly grasslands that form a transition zone between the forest zone and the savannah also present an agricultural transition from cereal crops to root and tuber crops. Root and tuber crops are produced in the southern forest region, as are fruit crops. 75% of the people in Cameroon live within the hilly grassland or forest zones (Fig. 1).

Total cereal production in the North and Extreme North provinces of Cameroon averages 194,000 metric tons per year (Table 1), with about 75% produced in the Extreme North. Most of the cereal production in the North and Extreme North is millet or sorghum. Beans and groundnuts are also grown in significant quantities in the North and Extreme North: about 13,000 metric tons of beans and 33,000 metric tons of groundnuts (Table 1). About 2/3 of the beans and 40% of the groundnuts are grown in the Extreme North. The growing season ranges from May to September for sorghum, groundnuts, rice and maize, but starts later in some regions. Millet is grown from July through September, and green beans from May through August.

Table 1. Production (metric tons) of Major Food Crops in the North and Extreme North Provinces of Cameroon in 1984 (Ministry of Agriculture, 1987)

Crop	Extreme North	North	Total
Sorghum/millet	143,000	41,000	184,000
Maize	6,800	13,100	19,900
Rice	470	1,700	2,710
Total Cereals	150,000	56,000	206,000
Beans	9,800	3,300	13,100
Groundnuts	14,000	18,800	33,000

3.1.2 Agricultural Production Data

With assistance of USAID/Cameroon, the Ministries of Agriculture, Livestock and Planning are proceeding with two programs designed to enhance the gathering and analysis of information on agricultural production, cultivated land, and farming population. The first phase of this effort began in 1979 with the Agriculture Management and Planning project (AMP), and it continued in 1989 with the Cameroon Agriculture Planning and Policy project (CAPP). These programs were conceived to establish methodology in data gathering and analysis sufficient to provide sound economic analysis for Cameroon. Assessments indicate the projects have made important contributions to the GRC's capacity to carry out data collection and processing. Current efforts are working to streamline data-gathering

methodology in the field, improve the quality of data available, and enhance analytical and planning capabilities of the GRC.

3.2 Locust and Grasshopper Characteristics

3.2.1 Distribution and Feeding Habits

The insects considered in this document are grasshoppers and locusts. There are numerous species of grasshopper which are considered pests in Cameroon, principal are the species Oedaleus senegalensis, and Zonocerus variegatus. However, there are several other grasshoppers which can become serious pests depending on environmental conditions. In regard to locusts, the primary pest species are the Desert Locust (Schistocera gregaria), and, to a lesser extent the African Migratory Locust (Locusta migratoria).

Locusts generally do not breed in Cameroon, but will migrate throughout the Sahelian and Saharan Zones. Locusts are a periodic problem, with migrating gregarious swarms moving into Cameroon on a very erratic basis. Several years of intense locust infestation activity may be followed by ten to fifteen years of virtually no locust sighting at all. Conversely, grasshoppers will be found in Cameroon at varying levels of infestation every year. Grasshoppers can be found throughout the northern regions, and can sometimes move into more southern areas.

The area susceptible to desert locust and grasshopper impact lies primarily in the Sahelian and Northern Sudan zones of Cameroon; in the North and Extreme North Provinces. Nearly 90% of the millet and sorghum grown in Cameroon is produced in this area, as are significant amounts of rice, beans, groundnuts (30%), and maize (10%). Cotton and peas are grown almost entirely to the south of this area. Sorghum, grown in smaller quantities, is usually susceptible only at the seedling stage. Millet is among the cultivated crops most threatened by both locusts and grasshoppers.

3.2.2 Level of Infestation

Grasshoppers and locusts vary over a range of population levels in their natural habitat, depending upon rainfall and other environmental conditions. A migrating infestation of locusts can, depending upon wind conditions and movement patterns, have a significant impact on agriculture. For grasshoppers, crop infestation levels depend upon the numeric

density and life stage of the insect. In Cameroon, grasshoppers in the northern regions will be a problem every year to some degree. Locusts, however, are widely periodic and will fluctuate greatly over time periods of ten to twenty years.

For management planning purposes, impact on ultimate crop yield has been divided into four infestation levels. Note that these levels are quantified in relation to the intervention threshold level. The intervention threshold (also called economic threshold) is very specific to the crop, life stage of crop, insect species, and insect life stage. This concept is discussed in more detail in section 4.1.3 of this document.

Level 0 describes a "normal" density of grasshoppers. Locusts are not considered at this level. In this regard, grasshopper density levels will below the intervention threshold level for a given species. Crop losses from this level of infestation are minor and localized. The Crop Protection Service is capable of carrying out any needed treatment programs without donor assistance.

Level I describes a situation with locust or grasshopper populations at levels which will require additional donor assistance to avoid crop loss. In this case, pest densities will be at or slightly above the intervention threshold levels. The CPS will likely need assistance to cover additional costs, including materials and equipment needed to reduce population levels.

Level II describes high locust or grasshopper densities with large numbers in both crops and pasture lands. Here, l/g densities will exceed the intervention threshold level. Significant crop loss is probable without additional donor assistance and possibly intervention.

Level III describes a situation involving very high locust or grasshopper populations extending over a large area. Again, densities exceed the intervention threshold. 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. At each level, assistance which builds sustainable infrastructure would be most appropriate.

3.2.3 Crop Loss Assessment

In light of regional data variability and possible uncertainty concerning the reliability of data, both regional and

national l/g damage level estimations can often be problematic. However, Cameroon is comparatively well off in this regard. 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, especially in the extreme north, may experience high losses. Costs of grain transport over long distances may be more prohibitively expensive than those of a 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.

3.2.4 Survey and Control Preparations

In order to keep locust and grasshopper population numbers below levels where crop loss is imminent, it is important to survey early in the season, and to implement control activities immediately. The main elements to be included in locust or grasshopper survey 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.

The headquarters of the Cameroon Crop Protection Service is in Yaounde, and there are Operations Bases in each of the ten provinces. The Bases serve as the main pesticide storage and distribution centers for the CPS. Divisional Brigades are located in provincial divisions, and Field Bases at the subdivisional level provide extension services. Field Bases are usually located in towns and serve Village Brigades in the

surrounding area by providing training, pesticides, equipment, and assistance with control operations.

Survey and monitoring personnel in Cameroon include CPS staff, other government workers, and local farmers. In some instances, FAO, USAID, and other donor consultants may be involved in the activity. Assistance has also been provided by UTAVA, a local organization which was formed to monitor and treat locusts and grasshoppers. CPS Field Bases in ten provincial towns are charged with responsibility for monitoring locust/grasshopper levels, and the Field Bases are linked by radio. Training courses are periodically available for CPS survey personnel on a regional basis.

Prior to the main agricultural season, the CPS should ensure that each Field Base is equipped and prepared to face a normal level (level 0 in section 3.2.2) of grasshopper management. Adequate preparation would include: a working radio system, operating vehicles and application equipment, protective clothing and safety equipment that are clean and ready to use, and the needed amount of pesticides carefully stored and ready for use. In addition, any Field Bases supporting Village Brigades should ensure that farmers are ready, both technically and materially, to face the coming season.

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 Cameroon regards these chemicals a useful part of agriculture. Unfortunately, pesticides can be misused by both farmers and CPS agents, presenting hazards to the human environment and the natural ecology. Some pesticides in Cameroon are marketed illegally and fraudulently. Pesticides intended for agricultural or public health purposes may be misused for fishing, hunting, and general household insect control.

In addition to the potential for unsafe application, pesticides may also affect public health by being stored improperly. It is important to keep stored pesticides in good condition, away from humans and other animals. Any unwanted or leaking pesticides must be repacked or disposed of as soon as possible. Because pesticides have the potential for misuse, it is essential that existing legislation on pesticide use be enforced. While abuse may still occur, implementation of regulations will provide a sound base for promoting public health and environmental integrity.

3.3.2 Applicator Safety Training

A.I.D. has supported CPS pesticide safety training in the past by building a Regional Pesticide Training Center. This center has the potential to train CPS agents in all phases of crop protection techniques. Unfortunately, the training center has been used infrequently by the CPS. It is important that well trained CPS agents are available to work with any U.S.-funded pesticide donation.

The incorporation of hands-on pesticide safety and application training courses into the academic course in agronomy and other agricultural degrees is essential. This approach will allow trained individuals to interact with the actual users of pesticides.

Properly trained CPS agents and agricultural extension agents are encouraged to work with farmers and Village Brigades in "Train-the-Trainer" programs. This type of training will allow essential information on pesticide safety and application to reach all who may be working with pesticides. This type of training is strongly encouraged by A.I.D..

An additional approach is an emphasis on pesticide safety training among private suppliers of pesticides. Cameroon is an affiliate of several pesticide organizations, and would likely work well with the private sector in ensuring the correct use of imported pesticides.

3.3.3 Public Health Care System

Primary health care is delivered through a network of health centers and village health posts. Health centers are defined as either elementary (serving 5,000 people) or developed (serving 10,000 people, and including some maternity and inpatient beds). In practice, there is little distinction between the two types of facilities. The best estimate of the number of functioning public health centers in Cameroon is between 600 and 800. For village health posts, communities contribute resources and build health units out of local material. Community Health Workers (CHWs) are selected by the village and trained at a subdivisional hospital. The community is responsible for remuneration of CHWs, and the government considers health posts to be outside of the public sector.

Full service hospitals offering specialty care are located in the provincial capitals. General hospitals which do not offer specialty services are located in divisional and subdivisional capitals. Tertiary care is available in four large referral hospitals located in Yaounde and Douala. There are approximately 55 maternal child health centers in the country, many of which

are attached to provincial hospitals. There are about 100 pro-pharmacies, Ministry of Public Health-recognized community-owned drug stores, in areas where there are no commercial outlets.

The local health care delivery system in Cameroon may not be equipped to handle a serious case of poisoning, which, if it occurs, is most likely to involve an applicator. Therefore, application crews need to be self-sufficient in handling medical emergencies. Supervisors must be familiar with safe handling of pesticides and be able to administer any needed first aid, including antidotes for pesticide poisoning. All who are working with pesticides should be familiar with the early warning signs of poisoning. Workers must be removed from contact with pesticides at the first signs of poisoning.

3.4 Natural Resources of Cameroon

3.4.1. Physical and Climatic Features

The North and Extreme North Provinces constitute the Sudanian region of Cameroon, and comprise two major domains, the Sahel (extending over 35,000 square kilometers and consisting of Acacia woodlands and seasonally flooded grasslands) and the Sudan (extending over 191,000 square kilometers and consisting of broadleaved wooded savanna). The region is typically hot and dry, with rainfall dropping to 600 mm toward Lake Chad. Annual rainfall is concentrated in a five-month season from May to September at Garoua and in a shorter season northward near Lake Chad. For the rest of the year, this region is influenced by the dry Harmattan winds. The ecology of these Provinces of Cameroon was affected by several successive droughts which have occurred in these sub-Saharan regions since the late sixties, and appear to continue. These fragile ecosystems have been stressed to an even greater extent by an increasing concentration of human and animal activity. The increasing rate of desertification and extent of deforestation are aggravated by overgrazing, burning, soil degradation and loss, and population growth.

3.4.2. Flora and Fauna

3.4.2.1 Fish Resources

Cameroon has considerable diversity in fishing resources. The economic natural resources of Lake Chad and the Chari-Logone River systems 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 entire region and provide

indirectly affected by pesticides used in locust or grasshopper control operations because of direct toxicity to aquatic invertebrate fauna (Keith, 1989).

3.4.2.2 Endangered Species and Their Habitats

The North and Extreme North Provinces are rich in mammals and birds, many of them at the northern limit of their distribution. Seasonal wetlands, swamps, and rivers of the area are particularly important for migrating birds and are generally under-protected from human disturbance. At least 110 species of Palaearctic migrants have been recorded in the Provinces, and wetlands such as Waza serve as habitat for Palaearctic raptors (16 species), waders (30 species), and at least 32 species of passerines. Cameroon has a number of mammals, birds, reptiles, and amphibians which are considered endangered (Tables 3 and 4). It is critical to consider the importance of these habitats, and the direct vulnerability of birds to pesticide toxicity, in implementing any locust or grasshopper control operations involving pesticide spraying (Keith, 1989).

Table 2.

ENDANGERED FAUNA OF CAMEROON

ENDANGERED MAMMALS

CHEETAH
LEOPARD
MANDRILL
GORILLA
RED-EARED NOSE-SPOTTED MONKEY
BLACK COLOBUS
BLACK RHINOCEROS
AFRICAN WILD DOG
SCALY ANT EATER
CAMEROON CLAWLESS OTTER
WHITE-COLLARED MANGABEY
L'HOEST'S MONKEY

ENDANGERED BIRDS

EURASIAN PEREGRINE FALCON
GRAY-NECKED ROCK FOWL
MT. KUPE BUSH SHRIKE

ENDANGERED REPTILES

SLENDER-SNOUTED CROCODILE
NILE CROCODILE

ENDANGERED AMPHIBIANS

CAMEROON TOAD
AFRICAN VIVIPAROUS TOAD

Table 3

THREATENED FAUNA OF CAMEROON

THREATENED MAMMALS

ELEPHANT
MOUFLON
GIRAFFE
LION
TIGER CAT
WARTHOG
BUFFALO
CEPHALOPUS

DORCAS GAZELLE
DERBY ELK
SITATUNGA
CIVET
STRIPED MANGUE
ZORIL
SPOTTED HYENA
HIPPOPOTAMUS
GREATER KUDU

AARDVARK
ADDAX
ORYX
CHIMPANZEE
WILD CAT
POTAMOCHOERUS
BUBAL
ORIBI
REED BUCK
WATER BUCK
WHITE-MANTLED COLOBUS
HARNESSED ANTELOPE
HYRAX
MONGOOSE
SAND FOX
WEST AFRICAN MANATEE
STRIPED HYENA
COMMON JACKAL

THREATENED BIRDS

SERPENT EATER
OSTRICH
HERON
WHALE-HEAD
STORK
TANTALUS
SACRED IBIS

VULTURE
PELICAN
CATTLE EGRET
CROWNED CRANE
SENEGALESE JARIBU
MARABOU

4.0. DESCRIPTION OF PROPOSED PROJECT

4.1 Pest Management Operations

4.1.1 Base Program

The Cameroon Crop Protection Service (CPS) is capable of carrying out insect management and crop protection activities when locust or grasshopper population levels are low (level 0, section 3.2.2). Through the development of a yearly action plan, the CPS can have materials and equipment prepared and ready for early season survey and control operations. Although assistance programs may be provided to the CPS at this level, particularly in the form of training, the goals of any such assistance is to increase the sustainability of the CPS infrastructure. With vigilant survey and management programs, locusts, and grasshoppers in particular, can be maintained at low population levels.

The philosophy of vigorous survey and early season management will save valuable funds and resources over the long-term, compared with costs of short-term emergency operations. Additional donor assistance may be required if high infestation l/g levels 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 observed and reckoned with in project design and implementation.

By developing a strong base of trained personal and a well maintained fleet of sturdy vehicles and equipment, the CPS will be able hold impending grasshopper outbreaks, and invading locust swarms to a minimum. This will result in considerably less pesticides being used than if these pests are allowed to reach high population levels. It this regard, it is especially important to involve villagers and framers living in invasion areas in early season control endeavors. These types of efforts, combined with improved legislation and regulations will greatly lessen potential negative environmental of pesticide use. Any assistance A.I.D. can offer to build such a institution, with full participation and involvement of the Cameroonian CPS, will be a far greater investment than the immense amounts which have been spent on past emergency operations (with little effect on sustainable infrastructure).

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 choose to participate in an assistance program, it is important that support be coordinated with other donors and the GRC to achieve a reasonable and balanced program. Assistance for such a program should emphasize the principles of IPM (as discussed in section 4.1.3), in that all available management resources should be considered. While probable crop loss will be a criterion for A.I.D. involvement in control efforts, 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.

The level of USAID/Cameroon participation in a l/g management program should not only be related to the extent and severity of the problem, but also to the extent such assistance will the CPS more sustainable. 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.

Prior to the implementation of l/g assistance, a through analysis of needs is necessary. In evaluating areas of assistance, USAID/Cameroon should be responsive not only to the requests of the GRC, but must further ascertain what materials the CPS already has, and what other donor supported programs are planned or implemented. Supplying the CPS with an overburden of pesticides, unneeded materials, or poorly planned training will not assist in managing locusts or grasshoppers. In addition, an independent verification of pest identity, density, and potential impact should be made by a qualified technician prior to fund committal and allocation.

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 over operation 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 levels on 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.

CPS 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 encouraged and incorporated into the overall l/g management program. If villagers can be recruited as participants in control efforts, such as a Village Brigade, a field can be protected with a minimum of pesticide use and expense.

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 biointensive 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 may be appropriate for the northern regions of Cameroon, where there are large numbers of Neem trees. Additional research on Neem is needed, especially in its use against locusts and grasshoppers.

Other fruitful research areas might include use of *fungal Beauvaria* 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 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.

Twenty-two approved pesticides are in current use in Cameroon (Table 12) and a further six, which may be in use, should be retested for efficacy. All pesticide testing in Cameroon is carried out by the Institute for Agronomic Research (IRA). The authority that currently exists for the control of imported pesticides must be enforced so only approved materials will be available in Cameroon.

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, the ecology of the area to be treated, and the biology of the pest to be treated. Pesticide selection for locust/grasshopper control requires the following concerning the pesticide itself:

- Effectiveness at low application rates;

- Minimal effects on nontarget organisms, including people and animals, and specifically predators and parasites of locusts and grasshoppers;

- Minimum persistence of residues on and in native fauna and flora, water, soil, and crops;

- Low toxicity and ease of handling;

- Good storage capacity;

- Compatibility with existing application equipment.

Although a number of pesticides have been used in Cameroon 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, and should be referred to during both the planning and implementation of phases of l/g control

management. In addition, regulations governing the use of a particular pesticide, as set forth of the label, must be followed.

4.1.5 Village Brigades

Farmers can play a major role in a control campaign -- reporting population levels, destroying egg-pods, protecting crops from larval infestations. However, farmer and village training efforts must be made Both A.I.D. FAO has a high degree of success in this area with "Train the Trainer" programs. These have been implemented on a large scale basis since 1987 in areas where locust or grasshopper infestations are endemic. This has been applied successfully in Cameroon, and is encouraged to continue by this SEA.

Each Village Brigade typically includes 10 interested and enthusiastic villagers. The participants will receive 3 days of intensive training (covering the identification and biology of both local pest and beneficial insect species, the fundamentals of good survey techniques, and the safe handling and use of pesticides); and are then given a small quantity of pesticide, a set of protective clothing, and necessary application equipment. Village Brigade members are responsible for locust or grasshopper control at the village level and are supported by the CPS. An entire village may be trained during the year by members of a Village Brigade.

The continuing support of the CPS is essential in this to the Village Brigade. Once formed, the Brigade members must receive needed materials and technical support within a reasonable time frame to achieve crop protection. While a trained group may in theory be able to creatively defend crops against pests without resources, in reality, they will loose both enthusiasm and expertise without support.

4.1.6. Ground and Aerial Operations

The use of spray aircraft should be considered a last resort in a U.S.-funded locust or grasshopper management program. With a attentive survey program, combined with rapid deployment ground pesticide application teams, it is possible to conduct a management campaign without the use of spray aircraft. A.I.D. fully supports this concept, and needed training programs for survey and ground teams. In addition to the basics of survey techniques, pesticide safety and application, such training must encompass a through background knowledge on pest species that require control.

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 level of outside input; 3) Assumed use or use support by donors will result in less attention by the CPS to maintenance of a good survey and ground control system.

The Cameroon CPS has been provided with a variety of fixed-wing aircraft (Cessna, Turbo Thrush, DC3) and helicopters (Allouette, Bell 206) by various donors for its aerial spray operations. According to the CPS, aerial control operations in Cameroon 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 operations 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, it is important that the Government of Cameroon monitor both human health and the natural environment. In regard to protecting human health, it is necessary to train both the medical community and pesticide applicators of the potential hazards of pesticides, and steps to mitigate. Application of a pesticide in a given area should be preceded by public awareness and extension activities and education of the users. The Cameroonian public must be informed that pesticides are dangerous and that empty pesticide containers should be 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. 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 Cameroon. 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 GRC draft legislation on Approval and Control of Pesticides, including a legal framework that will require pesticide labeling and registration in Cameroon. A strong licensing and labeling program by the GRC 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.

Pesticide labeling in Cameroon tends to be quite variable. In general, pesticides in the original container carry a label with adequate information for application. Some labels, though not all, contained some information on first-aid or disposal. Unfortunately, much of the CPS stocked pesticide containers have either lost what labels did exist, or were rended illegible through handling and exposure.

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

4.2.3 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 GRC 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.

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. Thirteen National Parks and equivalent reserves of Cameroon cover approximately 2.5 million ha., or 5 percent of the country. The northern National Parks listed below collectively comprise a Sudan zone flora and fauna reserve (Fig. 4). In Cameroon, protected areas of the Extreme North and North Provinces should include:

- Waza National Park. 170,000 ha. of savanna dominated by *Acacia seyal* and grassland that is flooded periodically. Waza has been designated a Man and the Biosphere Program Reserve. Large numbers of mammals inhabit the park, including lion, elephant, giraffe, striped hyena, warthog, and a variety of antelopes. There is also a large and diverse bird fauna. It is the only National Park which contains Sudan zone floodplain habitat. The park is managed for tourism in the dry season from November to April.

- Kalamaloue National Park. 4,500 ha. of grassland with thorny scrub and swampy grasslands. Large ungulates are present, as are birds which are typical of grassland-savanna regions.

- Mozoko-Gokoro National Park. 1,400 ha. of savanna typical of the northern part of Cameroon. The area was protected primarily for its flora.

- Faro National Park. 330,000 ha. of *Isoberlina* woodland. A Fauna Reserve, with mammals including giraffe, buffalo, black rhinoceros, and a number of primates and antelopes.

- Bouba-Njidah National Park. 220,000 ha. of *Isoberlina* woodland. Large mammals similar to those on Waza National Park, but in smaller numbers. Birds are primarily woodland species instead of those found in savanna or wetland.

- Benoue National Park. 180,000 ha. of *Isoberlina* woodland. Mammals and birds similar to those of Bouba-Njidah National Park.

- Lake Chad (Fig. 5). It is an important fishery resource and its extensive wetlands are habitat for birds.

- The Chari/Logone River System. It is the only permanent river system in the Extreme North Province and is an important fishery resource.

- The Benoue River Basin. It is a fishery resource and its associated wetlands are habitat for birds.

- All other open water areas in Cameroon: oases, wetlands, 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. 6). These areas can be designated as high priority areas for Village Brigade mobilization, intensive monitoring, and encouraging non-chemical methods of control. The areas would include buffer zones around all territories designated above as fully protected zones, given their sensitivity to indirect effects. The Sahel portion of Waza National Park should receive particular attention.

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, especially in regard to locust and grasshopper control.

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 to both humans and the environment. 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. Monitoring can indicate 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 an excellent way of monitoring, and 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 GRC 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 pesticide 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 each pesticide arrived at the facility, how long it stays in storage, and when it is removed for use. In addition, the storage requirements for each pesticide must be posted and known by the management staff. Stored pesticides must be tested periodically to insure that the active ingredient is as described on the

label, and that the formulation concentration is correct. Also the disposal of unused and obsolete pesticides, and the destruction of their containers, must be part of the management system.

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 Cameroon, 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 Yaounde. 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.

For the most part, the storage facilities in Cameroon are good. Most of the CPS warehouses have been constructed within the last five years. However unwanted stock accumulation is a very real problem, as discussed below. A lack of planning and coordination has resulted in stockpiles of pesticides at some Bases, and shortages at others. This seems to be a result of a lack of training in the managerial aspects of pesticide storage (Hunter, 1990).

In addition to management of the pesticides themselves, the CPS Field Bases must adequately manage pesticide application equipment. Due to inconsistent donor contributions, Cameroon has accumulated several different types and brands of spray equipment. This equipment is rarely interchangeable or compatible in regard to spare parts and repair. Nevertheless, the CPS Field Base must work to maintain what equipment it does have, and ensure that it is clean and in good working order.

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.

While the CPS has an overall well managed pesticide stock system, most Field Bases have some storage problems, usually due to the accumulation of pesticide stocks which were not used in the prescribed season, or chemicals which have been banned and cannot be used. In many cases, containers are deteriorating, and pesticides has leaked into the environment, necessitating either repacking or disposal. There are approximately 264,000 liters of unwanted pesticide in Cameroon, with about 127,000 liters in Bamenda (North West Province), and 66,000 liters in Abong-Mbang (East Province) (Table 6). The most common pesticides involved with storage problems are Callindem FC 320, Sumithion FC 200, Etrofolan HN 15, Gammophele 320 and Dursban 240 ULV.

There are stocks of three unwanted pesticides currently in Cameroon. Large amounts of Orthodifolitan are stored in Bamenda, Bafoussam and Banyo (Adamaoua). There are also stocks of Dieldrin in Garoua, and Aldrin in Nkolbisson. Unwanted pesticides must be carefully stored until disposal.

The general pesticide management practice is to keep stocks at the CPS Provincial Bases and to distribute to the Field Bases as needed. However, several Bases, particularly those in the North West Province, have notable amounts of unwanted pesticides. The three Field Bases in this area have a total of 41,400 liters of Sumithion FC 200, some of the stocks dating from 1982. These stocks are expected to be transported back to the main CPS Base at Bamenda. The general lack of a good pesticide purchasing and distribution policy has also contributed to the buildup of unused stocks.

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 6). As the majority of the obsolete chemicals are liquid products, one disposal method is high-temperature incineration at a suitable facility in Cameroon. Incinerators in Europe or neighboring countries (such as Nigeria) may also be used for disposal operations. Because of the current research in this area, and the potential for political ramifications, USAID/Cameroon should consult AID/W prior to any pesticide disposal assistance program.

There are numerous empty drums at most Bases, and with most needing to be disposed of. It is important to dispose of used drums immediately, as farmers will often convert pesticide containers into water barrels and food containers. The pesticide residues remaining in the drums will then contaminate the stored material.

The system of crop protection in Cameroon, in which all pesticides are the property of the state, should theoretically result in effective management and disposal of empty drums. All containers belong to the government and should be removed from the field when empty. The Department of Agriculture is ultimately in charge of drum disposal. However, the reality of the situation indicates that training in this area could be useful.

Table 4 : Pesticide Destruction Feasibility Options

Method of Destruction	Physical State of Product		
	Semi-Solid	Solid	Liquid
A. Incineration in mobile incinerator			
. on site	D	N.A.	F
. in isolated area	D	N.A.	F
B. Incineration in cement kiln	F	F	F
C. Incineration in vessel at sea	N.A.	N.A.	N.A.
D. Other incineration techniques	F	F	F
E. Burial in pit			
. at formulation state	N.A.	D	N.A.
. reformulated into solid product	D	F	D
. reconditioned in appropriate containers	N.A.	F	D
F. Detoxification on site	N.A.	N.A.	D
G. Long term safe storage	N.A.	D	N.A.
H. Used as directed or sprayed in formulation state	D	F	F
I. Used as indicated after reformulation	D	D	D
J. Using UV destruction unit	N.A.	N.A.	N.A.
K. Send to developed country			

. burial	N.A.	D	N.A.	
. transformation	D	D	D	
. incineration	F	F	F	
L. Deposit in ocean	N.A.	N.A.	N.A.	
M. Deep burial	N.A.	N.A.	D	

F = Feasible ; N.A. = Not Acceptable; D = Open to Discussion

Modified by WEC, 1987

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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 Cameroon. USAID/Cameroon 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/Cameroon involvement with assistance efforts. Maps should include specific areas to be protected, some with a total ban on pesticides for grasshopper or locust control and some with a high priority for restricted use of pesticides. Areas which may have potential for the testing of pesticide alternatives should also be included.

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

Because of past poor management practices in Cameroon, large stocks of pesticide have been allowed to accumulate and degrade. In addition, stored pesticides are not always handled carefully or tracked to insure correct use and disposal. Improvements in the system for managing pesticide stocks must be implemented to protect human health and the environment and to minimize chances 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. This should include the periodic testing of stored pesticide stocks to insure that the material is usable. Unwanted stocks in Cameroon should be disposed of only with technology that best fits the local situation. High priority should 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-coordinated activity, but considers it low priority as a direct USAID/Cameroon activity.

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 Cameroon should be accompanied by a requirement prohibiting use in some areas and limiting use in others and requiring appropriate buffer zones. The areas of total prohibition are designated wetlands, national parks, national forests, and fragile areas. Buffer zones and other reserves should restrict pesticide use, and encourage traditional and non-chemical methods. Villages, towns, cities, or any other human settlement will not be sprayed.

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/Cameroon activity. This SEA does not contain a list of pesticides because it accepts the pesticide selection 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 should be implemented to some extent if possible, but may be difficult to fully implement in Cameroon, due to both the expense and 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 target and non-target mortality, population numbers, and behavior should be made at locations involved in pesticides use.

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 an early and vigorous surveillance program, thus allowing early treatment operations and reducing the amount of pesticide used; 2) Crop protection operations should utilize economic thresholds to the extent possible; 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 use of pesticides; 5) Farmers and villagers should be included in training 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 Cameroon should emphasize early season ground application. However, during rainy season treatment operations, road conditions may necessitate the use of aircraft. In addition, many areas of Cameroon are inaccessible except by helicopter. The AID/W (Forest Service) Aerial Application Guidelines should be followed in any such operation.

Recommendation 11. It is recommended that, whenever possible, small planes should be favored over medium to large two- or four-engine transport types {for application of pesticides}. In all cases, experienced contractors will be used.

This SEA supports this recommendation. However, large aircraft may be needed in Cameroon 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 GRC to give high priority to pesticide legislation and implementation of laws requiring a good clear label. It is suggested that the GRC 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 on disposal programs for unwanted pesticides and empty containers. In addition, several pilot disposal projects are being implemented. USAID/Cameroon should follow such disposal guidance when available, and should continue to assist with proper pesticide management. Proper disposal of empty barrels is especially important.

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 pesticides, environmental awareness, pest management techniques of locusts and grasshoppers, and the potential hazards of pesticides. The goal would be to enable policy makers and local populations to recognize and avoid potential health problems related to pesticide applications.

Collaboration between the PPS 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 receiving 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 extremely 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 areas where pesticides are used frequently.

This SEA supports this recommendation and advocates inter-governmental collaboration in training programs.

Recommendation 17. It is recommended that each health center and dispensary located in an area where pesticides are used be provided with posters describing diagnosis and treatment of pesticide poisonings, as well as medicines and antidotes required for treatment of poisoning cases.

This SEA supports this recommendation, and advocates collaboration between CPS and the Ministry of Health in appropriate implementation.

Recommendation 18. It is recommended that presently available tests for monitoring human exposure to pesticides should be implemented in the field. This includes measurement of cholinesterase levels in blood as a screening and indicator test for pesticide handlers and applicators.

This SEA supports the need to monitor the health of pesticide applicators and handlers during control operations. It is especially feasible to monitor blood cholinesterase in individuals working with organophosphate pesticides. This should be implemented on a regular basis with pesticide handlers and applicators. In addition, this SEA favors behavioral monitoring for symptoms of pesticide exposure.

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 Cameroon-specific recommendation is included in this SEA as it is a central and regional 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. USAID/Cameroon may wish to support training and local research in this subject area.

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 Cameroon. The L/G Operations Handbook (A.I.D., 1989a) fills this need in part, as does the PEA and this SEA. Other materials include regional meetings and workshops, and short-term technical assistance.

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

This SEA supports this recommendation, and recommends that the high priority be given to training on the safe and appropriate application of pesticides. Training can take the form of courses, as well having as individuals work with outside technical 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. The overall preference is to have technical assistance teams with the needed technical expertise and sufficient language fluency for the tasks to be performed.

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. Implementation in Cameroon might consist of an agricultural productivity analysis along with an annual agricultural database program. This should include a research study on crop loss analysis.

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

Due to the erratic nature of these insects, along with potential for social impact, a valid economic threshold will require both the long-term collection of quantitative data, and research to determine

the extent to which agricultural productivity is threatened. In this light, it is important that intervention decisions, especially those involving pesticides, 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 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 improvement of pesticide labeling, including clear precautionary statements, specific use directions, and appropriate instructions for disposal of empty containers. In addition, policy must include an environmental monitoring program, with results used in the planning of future pesticide use operations, as well as detection of 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 GRC action. Such a pesticide inventory program, done in conjunction with good storage management, can prevent the build-up of obsolete stocks, and thereby reduce overall operations and storage costs.

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, and safety and mitigative measures. The Handbook should contain health, safety, and environmental assessments of pesticides that are likely to be used in Cameroon.

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 through analysis of actual needs, existing supportive infrastructure, and the ability of the PPS to manage a sustainable program.

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 Cameroon. Due the inadequate storage facilities that currently exist in Cameroon, support is for the Pesticide Bank concept. A through evaluation of storage facilities should be completed prior to project assistance.

FORECASTING

Recommendation 32. It is recommended that A.I.D. make the decision whether to continue funding forecasting and remote sensing or to use 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.

Although this is a valid activity for Cameroon, a lack of supportive infrastructure would require that such a research program be accomplished with outside expertise and facilities.

RESEARCH

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

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

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

Neem may be one of the most promising new bio-pesticides, and thus deserves additional field research. As additional funds are available, the most promising options should be pursued. If Neem extract shows promise, research efforts should continue.

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 Burkina Faso, Cameroon, Chad, Mali, Mauritania, Niger, Senegal, and Sudan. 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 Cameroon has been developed by the PPS. The country-specific plans of action will

be the backbone for guidance of 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/Cameroon level. In Cameroon, the PPS 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. Algérien 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 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

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 THE PROGRAMMATIC ENVIRONMENTAL ASSESSMENT (PEA) FOR LOCUST/GRASSHOPPER CONTROL IN AFRICA AND ASIA

FINAL ACTION FORM

COUNTRY: CAMEROON

DATE: April 1991

ACTION TAKEN:

Approved: ✓ Date 4/1/91

Disapproval: _____ Date _____

Bureau Environmental Officer: _____

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