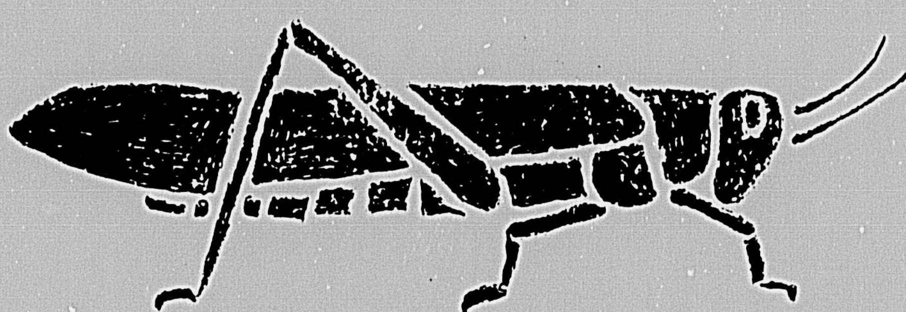
SUDAN MULTI-DONOR LOCUST/GRASSHOPPER CONTROL

designs for
A 1987 Emergency Campaign
and for
A Medium Term Project



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GLOSSARY

AID	The United States Agency for International Development
APLC	Australian Plague Locust Commission
AvGas	Aviation gas or Fuel
BHC	Insecticide mixture of isomers of hexachloro cyclohexane (also called HCH)
DLCO	Desert Locust Control Organization for East Africa
EC	Emulsifiable Concentrate
EEC	European Economic Community
FAO	Food and Agriculture Organization of the United Nations
HCH	See BHC
MALT	Management and Logistics Team of MAL Logistics Consultancy, the Netherlands
M.T.	Metric Ton
PPD	Plant Protection Department of the Government of Sudan
RTO	Sudanese Road and Transport Organization
ULV	Ultra Low Volume spray control

I. SUMMARY AND INTRODUCTION

The 1986 emergency campaign was only a partial and temporary solution to the locust and grasshopper problem in Sudan. Experts expect that, based on the number of locust escapes that may have survived in various areas, within and outside Sudan, the 1987 breeding season might be even more severe than the 1986 season. Unless control activities are organized quickly and efficiently, Sudan could face a continuation, or even an increase in the intensity, of locust infestations in the next few years. On the other hand, grasshopper infestation levels are likely to decline somewhat, even without large control measures being taken.

This paper proposes a program of U.S. $7,975,000 for a 1987 emergency campaign. Of that amount, $4,525,000 are hard currency emergency needs, primarily pesticides; a further $450,000 is for local emergency costs; and the remaining $3,000,000 is for rehabilitation of pesticide stores which, while urgent, cannot be considered an emergency need.

Also proposed is a three year project at a cost of U.S. $7,400,000. The project design budgets for two experts to be based in Sudan for the life of project at $765,000 as well as seventy person months of short term technical assistance at a cost of $675,000. Commodities, primarily pesticides, will cost $4,128,000; and other costs, primarily the hire of aircraft and vehicles, is expected to cost $1,847,00. It should be noted that the pesticide storage facility rehabilitation mentioned in the previous paragraph is expected to occur starting during the 1987 emergency campaign, but of necessity, the rehabilitation of existing stores and construction of new ones will extend into the period covered by the follow on project.

The goal of this proposed multi-donor assistance is to combat locust and grasshopper outbreaks in Sudan and locust invasions from other countries, thus protecting Sudan's crops and preventing locust emigration to neighboring countries.

The purpose of the proposed emergency assistance, and of the three year medium term assistance, is to provide emergency requirements to combat locusts and grasshoppers and to increase the effectivness of Sudan's Plant Protection Department (PPD) (in relation to grasshopper/locust control) by upgrading skills, and by improving PPD's management and organization. The project will permit several donors to coordinate their assistance to Sudan for the 1987 emergency, and for the next three years. There is an emergency requirement for supplies and technical assistance needed between May and November 1987. There is also a need to provide medium term assistance to the PPD. The medium term assistance will be in the form of continued technical assistance training, pesticide storage rehabilitation, and supplies. The technical assistance will concentrate on providing practical on the job training for PPD's staff.

The proposed assistance is fully in consonance with the United States Agency for International Development's Africa Bureau draft strategy for locust and grasshopper control; the current FAO strategy for Africa's locust and grasshopper control; and, the Dutch government developmental aid priorities. It is expected that these, and other donors, will fund the foreign exchange costs of proposed project.

The four person design team worked in Sudan during early February 1987. The project design officer, Stephen Klaus, is employed by the U.S. Agency for International Development (AID); T. van den Dool*is a director of VGL Logistic Consultancy (Dutch firm); Jan H. Oudejans is a plant protection expert employed by the Directorate for Agricultural Development Cooperation, Ministry of Agriculture and Fisheries of the Netherlands; and, Philip Symmons (formerly Director, Australian Plague Locust Commission) is an European Economic Community consultant. The following project design was jointly prepared, and reflects the views of all of them.

The design team made field visits and carefully considered earlier reports especially those of Ashall, Oudejans/Hemming/van den Dool, and Schnabl, as well as assessments and reports of PDD. The team carefully analyzed the underlying aspects of the problem, especially the problem of desert locust control in Sudan in way the earlier reports do not. It is in part for this reason, that the recommendations and conclusions of the team differ materially from those earlier, in particular those of Ashall. In part though, the more modest and more cost-concious approach adopted here reflects the changed locust situation. Earlier it seemed likely that a full scale plague of African migratory locusts would occur; so the creation of a large organization appeared necessary. A plague of that locust has not occurred, perhaps because of actions undertaken. The design herein is the most comprehensive analysis of Sudan's current locust and grasshopper problems and so its recommendations and conclusions can be considered to supersede those of earlier consultants.

In this paper particular account has been taken of the likely ability of PPD to supervise and direct ultra low volume (ULV) spraying. Most experts recommend a move to ULV spraying by aircraft to control locust swarms. It should be noted that aerial ULV spraying is powerful and less expensive than ground control for locusts; but this method can be unsafe, wasteful, and ineffective if not carried out with knowledge and care.

The control methods included for both the emergency assistance and for the three year medium term project propose the use of substantially less insecticides and vehicles than proposed earlier by others, and substantially less than requested by the government of Sudan, but includes substantially increased technical assistance and research. This approach is both environmentally and fiscally more responsible than the 1986 emergency campaign approach, or than the approachs recommended by earlier consultants..

II. PROJECT DESCRIPTION

A. Background and Statement of the Problem

Locusts and grasshoppers have plagued Sudan throughout recorded history, but major infestations have occurred only periodically. The key factor is rain; either the return to normal rains after an extended period of drought, or in the desert locust case, a sequence of good rains in linked breedings areas. Thus, following upon the severe drought of 1984-85, Sudan experienced in 1986, the most serious upsurge of grasshopper and locust activity in twenty years. However the long recession period and the competing demands on scare government resources has caused the needs of the Plant Protection Department's

* This consultant left Sudan early for personal reasons and did not participate in preparation of the final draft.

(PPD) Locust Control Section (the government department responsible for locust and grasshopper control and coordination) to fall low on the government's list of priorities. Consequently, when warnings about the potential outbreak of locusts and grasshoppers was received, the PPD was ill-prepared to mount an effective campaign. A multi-donor effort was mounted which included the United States working through its Agency for International Development (AID), the Netherlands, and the European Economic Community (EEC) as the principal donors. The emergency effort, which lasted from August to December 1986, was succesful in that (a) equipment and sufficient amounts of pesticides were delivered to Sudan in time, and were distributed efficiently to field stations in time to undertake the required control measures, and (b) continuous monitoring by FAO hired consultants and Steering Committee members ensured that the PPD continued to receive the necessary support to implement its program, thus preventing major crop damage.

However, the 1986 campaign was only a partial and temporary solution to the locust and grasshopper problem. Experts anticipate that, based on the number of locust escapes that may have survived in various areas, within and outside Sudan, the 1987 breeding season may be even more severe than the 1986 season. Unless control activities are organized quickly and efficiently, Sudan could face a continuation, or even an increase in the intensity, of locust infestations in the next few years. On the other hand, grasshopper infestation levels are likely to decline somewhat.

The importance of locust control in Sudan is well-recognized by international experts. Sudan is a preferred breeding area for the desert locust, an insect which has a potential invasion area extending as far west as Mauritania, east into India and Pakistan, north to southern Europe, and south to Central Africa. Sudan has been gradually recovering from the devastating drought and famine of 1984-85. Harvests in 1985 and 1986 were above average, with encouraging signs that many traditional farmers are regaining self-sufficiency. Furthermore, many donors are supporting increased agricultural production through research and the introduction of improved varieties of sorghum and millet. These trends and development activities can only continue if the locust threat is controlled, for a plague of locusts can easily destroy the hard work of farmers and researchers alike.

B. Goal and Purpose

The goal of this project is to combat locust and grasshopper outbreaks in Sudan and locust invasions from other countries, thus protecting Sudan's crops and preventing locust emigration to neighboring countries.

The purpose of the project is to provide emergency requirements to combat locusts and grasshoppers and to increase the effectiveness of the PPD (in relation to grasshopper/locust control) by upgrading skills, and by improving PPD's management and organization.

The project will permit several donors to coordinate their assistance to Sudan for the emergency, and for the next three years. There is an emergency requirement for supplies and technical assistance needed between May and November 1987. There is also a need to provide medium term assistance to the PPD. The medium term assistance will be in the form of continued technical assistance training, pesticide storage rehabilitation, and supplies. The technical assistance will concentrate on providing practical on the job training for PPD's staff.

This paper spells out a strategy for dealing with Sudan's locust and grasshopper problems over the short and medium term. It is based upon the proposition that, given the periodic nature of major infestations, actions taken durings the next few years are critical to both: (a) the containment of the current emergency, and (b) the reinforcing of Sudan's PPD to cope with the long term control and management of the pests.

Thus, the primary purpose of this paper is to provide a framework for the provision of donor assistance in averting or reducing crop damage over the short and medium term - the period between now and 1990. This paper calls for:

building upon the control and survey activities (and lessons learned) by Sudan and donors in 1986; and

expanding and enhancing those activities in the next few years in order to:

(a) establish standards and criteria for determining when and where to apply stategies for control of the pests;

(b) provide needed resources (technical, financial, and material) for timely efficient (and cost-effective) pest survey and control activities, that fully take environmental concerns into account; and

(c) train and develop a Sudanese human resource base that can help to reassert and subsequently, maintain control of the threat posed by locusts and grasshoppers.

C. Expected Achievements

1. The creation of a Locust Survey and Control Unit capable of carrying out: (a) all locust survey; (b) ground control at times of minor activity; (c) direction and supervision of both ground and aerial locust control in periods of greater activity.

The Unit will in addition:

(a) develop and test methods of ground control and test ground spray equipment,

(b) assess the effectiveness of control for both individual targets and campaigns,

(c) keep the locust situation under constant review within and outside Sudan and issue both regular and special assessments,

(d) inform the Minister of Agriculture of the likelihood or existence of an emergency requiring additional resources, and

(e) keep records of stocks and usage of all equipment and supplies especially pesticide.

2. The establishing of a reserve of trained field officers to be seconded to the Unit at times of emergency.

3. The establishment of mechanisms to declare an emergency and to either build up or procure quickly additional supplies especially of vehicles, pesticides, aircraft, ground sprayers.

4. The establishment of adequate pesticide storage facilities and methods of stores procedure both for pesticides and other supplies.

5. The development of improved methods of ULV ground control for both locusts and grasshoppers.

6. The practice of sound methods of locust survey and reporting.

7. The introduction of sound practices of ULV aerial drift spraying.

8. The practice of proper methods of pesticide application for both locusts and grasshoppers having due regard to type of target and weather conditions, and the need for the application of an accurate area dosage.

9. The practice of safe management and handling of pesticides and regular cholinestease tests for all exposed staff.

10. The development of a system for the repair and maintenance of equipment especially of ground sprayers.

11. An assessment of locust and grasshopper mortality from spraying pesticides.

12. The establishment of criteria (threshold levels), which can be used easily for control of grasshoppers infestations in crops.

13. A determination of the underlying causes of African migratory locust upsurges in Sudan.

14. An assesment of the environmental impact of both baiting and spraying control of locusts and grasshoppers.

15. A testing of the effectiveness of baiting substitutes for BHC and estimates of the feasibility of large scale baiting campaigns for for both locust and grasshopper control.

III. FACTORS CONCERNING PROJECT SELECTION AND DESIGN

A. Beneficiaries

The beneficiaries of this project will be the entire population of Sudan, on a virtually equal basis. The project will limit crop damage and will prevent locust outbreaks from developing into a plague. If a locust plague did develop the resulting food crisis would impact on the entire Sudanese population, indeed it would impact on several neighboring countries as well.

B. Economic Benefits

The aim of desert locust control is to contain any upsurge and to prevent a plague. This is not only of benefit to Sudan, but to countries throughout the invasion area. In the same way Sudan benefits from control elsewhere, especially control in the Arabian peninsula. Desert locust control is an international obligation.

Various 'experts' have calculated that since an adult locust will consume approximately two grams per day, that a medium size swarm can consume 80,000 M.T. of food per day. They go on to say that this amount of food is enough to support a human population of 100,000 for a period of one year. This is falacious reasoning because: 1) what an adult locust consumes in a laboratory may not be what it consumes in a wild swarm, and 2) much of the food consumed by a swarm is not food that humans can consume, or even grazing needed to support stock.

There are no reliable figures of locust or grasshopper damage anywhere in the world, based on either samples or on crop surveys, with the sole exception of part of Australia during the Spring of 1984. Such figures as exist for the damage that occurred in 1986 in Sudan are little more than guesses. That is not surprising since few reliable country wide figures of crop loss are available even in developed countries. Nevertheless, there is little doubt in anyone's mind that a major locust plague would cause severe loss and perhaps even a continental scale disaster. Losses would certainly be equivalent to hundreds of millions of dollars worth of crop damage and perhaps thousands of millions. These losses would be suffered mainly by subsistance farmers for whom crop failure can mean starvation. Thus, it can be seen that locust and grasshopper control is far more cost effective than supplying donor food assistance as was necessary in 1984 and 85.

A further point to be borne in mind is that even in a minor outbreak a desert locust invasion can completely destroy a farmer's crop overnight. An individual farmer is unable to cope with such an invasion, and for him the result can be starvation or ruin. It is little comfort to him that the total damage over the whole country may not be great. Other pests which take only a portion of the crop are acceptable, even though the total loss over the country may be considerable and occur every year.

African migratory locusts, as a rule, and tree locusts and grasshoppers present a less dramatic problem. Grasshoppers especially infest very large areas, but by gregarious locust standards at relatively low densities. Incidence varies from year to year but does not remotely approach the variation between locust plagues and recessions. This group of pests are a national, not an international problem. No reliable estimates of country-wide grasshopper damage to cereals can be substantiated, but over small areas damage can be severe. However, control of grasshoppers and nonswarming African migratory locusts is probably not always cost effective. Only when infestations reach an economic threshold should control be carried out, but such threshold levels have not yet been developed for Sudan. Grasshopper control on range grassland is almost certainly not economically justifiable.

C. Economic Considerations of Control Options

Before assessing what is needed in Sudan it is necessary to analyze the nature of the migratory pest problem and indeed the philosophy of migratory pest control. Then the tasks which need to be performed, and finally the organization and resources required can be determined. If that is not done, recommendations and conclusions are little more than assertations; and requirements no more than a shopping list.

It is often assumed that the control of every migratory pest poses a generally similar problem so that all are best tackled by one organizational structure. That is not so. A fundamental distinction should be made between pests which either can or must be tackled by general population reduction and those where control in infested crops is the only practicable method.

Locusts supply the classic cases where overall population reduction is required, but not all locusts can be tackled in that way. Further, one species can pose more than one type of problem. For example, major plagues of the African migratory locust do occur but this locust can also be a purely local pest especially in sugar cane. This locust poses a peculiarly difficult philosophical problem in Sudan since in 1985 it seemed likely that a plague would arise from local breeding not from the recognized outbreak areas in Mali and Chad. This problem will be returned to later.

For overall population reduction to be feasible, virtually the whole population must be concentrated in a relatively small area of target. That can be true with most locusts, it may be true at times with the Armyworm Spodoptera exempta but is almost certainly not so for grasshoppers like Aiolopus and Oedeleus senegalensis, both of which are of economic importance in Sudan.

1. Migratory Pests

a. Desert Locusts (Schistocerca gregaria)

The desert locust is by far the most important of the migrant pests in Sudan. It, like all locusts, can exist at low densities as a 'solitary' living insect. Again like all locusts if numbers and densities increase the locusts 'learn' to behave gregariously and form massed nymphal (hopper) bands and migrating adult swarms. Swarms usually breed gregariously and this may lead to a plague, with large numbers of bands and swarms. Desert locust swarms may well cover several hundred km^2 and move 100 km downwind in a day. The desert locust can produce several generations in a year.

Desert locusts can infest a huge area from Mauritania in the west to India in the east and from Iran in the north to Tanzania in the south. Different parts of this area are infested at different seasons but migration is far from completely regular. Non-swarming solitary locusts exist only in the drier central band of the infestation area but, as with the gregarious phase, occupy different parts at different seasons. Swarms and bands form after good breeding caused by a sequence of good rains in areas which the locusts occupy in successive generations.

A plague of the desert locust lasted certainly from the end of last century when reliable records start, until the early nineteen sixties. Indeed many experts thought the plague was permanent and that the species survived through the gregarious phase. This view has not been credible for many years. The usual situation is now one of recession with large areas almost certainly infested at barely detectable densities and with the irregular formation of small bands and small swarms. Some of these are controlled and some die out naturally. On three occasions during the last 20 years, major upsurges have occurred which seemed likely to develop into a full plague. None did, but whether wholly because of control is uncertain.

The thesis that control can so reduce the population that plagues will be a thing of the past, is invalid. It is a truism in Australia and in South Africa that the time to worry is at the end of a drought when you can scarcely find a locust. For example, in February 1984 at the end of the worst drought on record, only a few tens of insects were found in transect counts by ten field officers of the Australian Plague Locust Commission over a period of about a fortnight. Yet little more than a year later, Australia was in the middle of the worst locust outbreak for 50 years. Densities after the drought were in the order of at most one per ha; this is undetectable in the sense that you cannot feasibly test to see if a given km^2 is infested at such a density. To prevent the plague at least a million km^2 would have to have been sprayed; that is environmentally and economically out of the question. And of course in February 1984 a plague could not be predicted with certainty. A key area in desert locust upsurges is often the Empty Quarter (Rub al Kali) of the Arabian Peninsula, which at the start of the build up sequence is virtually uninfested.

Sudan is a key area in the population dynamics of the desert locust. The Red Sea coastal plain is a high frequency winter-spring breeding area which has played a key part in the early stages of previous upsurges. The central and northern parts of the country are summer breeding areas which may be critical in upsurge continuation. So desert locust control in Sudan is of importance for the whole potential invasion area.

However, the desert locust should still be regarded as being in recession as it has been for some 25 years. Thus, the recession and upsurge situation is the one we have to plan for; not for a plague. This means a need for the following:

1. regular surveys of the Red Sea coastal plain between October and April inclusive.

2. regular surveys of the central and northern belt especially the western part of the central belt (Darfur) June to October inclusive.

3. Small scale control of bands and small swarms on the Red Sea coastal plain from local breeding (perhaps 1 year in 3) and in the summer breeding area (perhaps 1 year in 5).

4. Larger scale control of bands and swarms in the same areas (perhaps 1 year in 6 or 1 year in 10).

5. Major control following invasion and/or escapes from winter/spring breeding in Sudan, and subsequent breeding, mainly but not exclusively in central and western Sudan between June and September (perhaps 1 year in 10 or 15).

As recently as late January 1987 FAO were warning of the risk of a plague-producing upsurge triggered by winter breeding then in progress on the coastal plains of the Red Sea. Countries throughout the infestation area were urged to assess their immediate requirements. That threat has declined somewhat, perhaps because of timely control especially in Sudan and Saudi Arabia. Of course an upsurge may still occur because of a successful breeding by an undetected current infestation on good future rains and following breeding by locusts which must have survived in substantial numbers after the winter spraying on the Red Sea coasts.

This much reinforces the arguments advanced in this paper. Donors may provide more for desert locust control than will in the event be needed. On the other hand, if aid is not forthcoming countries will be in no position to combat an upsurge if one does occur. It is very difficult to predict locust developments with confidence more than say two months ahead. For example, in Botswana a large scale spring hatching in late 1986 of brown locust followed by invasions from South Africa in early 1987 seemed almost inevitable. The hoppers in Botswana died and a much smaller than expected infestation in South Africa has been contained. It now seems likely that virtually none of the $5 million of aid provided by donors will be used to kill locusts.

A way to reduce this 'donors risk' of providing aid which turns out not to be needed without running an unacceptable 'consumers risk' of refusing aid which turns out to be necessary, is by contingency planning, allowing very rapid expansion of control capability when the need arises. The project proposals are designed to go some way towards achieving this.

b. African Migratory Locusts

The last plague of the African migratory locust lasted from 1929 to 1944 and at one time or another during that period almost all Africa south of the Sahara with the exception of the rain forests, was infested. The plague had its origin in the relatively small flood plain grasslands of the middle Niger in Mali. It was thought a plague could arise only by the formation of swarms in this 'outbreak area' and their escape and subsequent gregarious breeding. It is possible that theory is correct, although a widespread outbreak in Sudan during 1985 and to a lesser extent in 1986 has weakened the theory. A short lived but quite severe outbreak occurred in the Republic of South Africa during 1982. In addition to its plague capability, the African migratory locust can produce economically important local infestations usually in sugar cane. Infestations have occurred in Kassala, Sudan in Hippo Valley and Triangle of the Zimbabwe low-veldt and on grasslands in the Republic of South Africa.

There is no reason to suppose that there will be a widespread African migratory locust outbreak in Sudan during 1987. Locally important infestations may well occur but these are most likely to be confined to commercially cropped lands. Control should be carried out only at the request of the farmers and on a repayment basis. Emergency provisions for African migratory locust control in 1987 are not justified.

However, it is not possible to be sure about African migratory locust control in Sudan in the medium and long term. If another plague were to occur as the last one did there would be several years of build up in West Africa before Sudan was invaded; time enough to prepare. On the other hand, it is not possible to decide if a local minor plague similar to that of 1985 will occur again and if so under what circumstances. Since there is no reason to believe such a plague is an immediate risk it is recommended that research on the 1985 situation be undertaken before a policy is determined.

c. Tree Locusts

The tree locust is a minor economic pest of trees which produce gum arabic. The locusts' migration pattern has not been studied nor has its control. Infestation levels fluctuate but not to the extent of producing even minor plagues. Control of gregariously behaving infestations is probably worthwhile. There is no need for emergency action in 1987 however.

d. Grasshoppers

As mentioned earlier, grasshoppers present a very different problem from locusts. At their worst, grasshoppers infest very large areas but by locust plague standards, at low densities. Losses are considerable in total but are widespread. General population reduction is quite out of the question. On the other hand, crop protection is difficult; a crop infested at the adult stage can be treated, only for the crop to be reinfested in a matter of days. Crops at the sprouting stage can be destroyed by quite light infestations. Although grasshoppers do not have plagues and recessions, there are wide variations in numbers between years. Years of good rain tend to be years of high grasshopper numbers, but also of good crops. Fortunately in years of poor rain, grasshopper numbers are always low.

Grasshopper control is a crop protection activity and ill fits with locust survey and control. Hence the later recommendation for a special Locust Unit. Economic threshold levels for control need to be determined for Sudan. Grasshopper control is difficult to limit and such is of somewhat doubtful economic benefit. Large sectors are believed to have been sprayed in West Africa during 1986 which were almost certainly not infested densely enough to justify treatment. Many treated areas were densely infested but the means and criteria to distinguish these from areas for which treatment was not cost effective were lacking.

2. Control Options

a. Mechanical and Biocontrol

As virtually no biocontrol or effective mechanical method of control are yet known, the main control efforts used to control locusts remain aerial and ground spray applications. All informed scientists agree locusts are bad candidates for biological control. Trenching, burning and swatting are not effective means of control of locust swarms.

b. Baiting

Baiting for grasshopper control and for locust hoppers can be both effective and cheap. However, bait is bulky so many vehicles are needed to transport it

and many laborers to spread it. It cannot be used, with rare exceptions, against swarms. The logistic difficulties mean that baiting has never made a substantial impact on a large locust infestation. Therefore, the method cannot be relied upon for locust control.

In short, baiting is well suited to grasshopper control where quickness of response and deployment are less critical than for locusts. Also, for grasshopper control where control measures are mounted only in infested crops, the farmer's labor can be available on the site and can be used for bait spreading.

c. Ground Control of Individual Locust Bands

Hopper bands can be attacked by ground teams with relatively simple equipment such as knapsack sprayers and by baiting but such methods are not suited for large infested areas. Too vast are the problems of deploying, supplying and supervising large teams of mainly newly recruited, scantily educated laborers.

There are moreover two technical problems with ground control of individual bands. Firstly, it is difficult to search an area on a front; many bands are likely to be be missed. This project plans research to find out the proportion of bands present which are in fact located by the current somewhat haphazard methods. Secondly, with the current insecticide of choice, fenitrothion, the insects should be in contact with the sprayed vegetation for a considerable time, say 24 or better 48 hrs. But a mobile band may only be in the sprayed area for a matter of minutes unless a very large area surrounding the band is treated. To achieve a contact kill requires an order of magnitude increase in area dosage. This was not a problem in years past since even with ground control, large blocks were barrier sprayed with dieldrin. Little research has been carried out since the days when dieldrin was the insecticide of choice. Thus, research is needed, and planned for in this paper, on the most effective means of applying today's different insecticides.

Synthetic pyrethroids offer a possible solution since they act very rapidly; brown locust hoppers stop marching, seek shade, and climb grass and shrubs. However, synthetic pyrethroids are expensive and many of the sprayed insects can recover. A 'cocktail' of a synthetic pyrethroid and fenitrothion has been suggested by some; the pyrethroid to disorient and the fenitrothion to kill. Sumitomo, in fact, market a cocktail for domestic fly control. This problem of individual band control has been ignored but it is clearly urgent. It is probably at the root of the 'overdosing' of fenithrothion which appears to be common. This is not a trivial matter as fenithrothion costs about U.S. $10 per liter. Quite possibly as much as five times the dosage of fenitrothion is needed to kill by contact as would be needed if the hoppers remained within a sprayed area.

Insecticide is the major cost in a large campaign. Nevertheless, no data have been recorded on the rate at which treated bands are being killed since the days when dieldrin was the pesticide of choice.

In ground control emulsifiable concentrates (EC) and ultra low volume (ULV) formulations are sprayed. Using EC formulations requires ample supply of water and more laborers and vehicles than ULV formulations. The latter,

however, require spraying by equipment which disperse the insecticide in small droplets in a limited size range. Spinning cage (Miconair) or spinning disc Micro Ulva) applicators are desireable, but none of the types presently available are wholly satisfactory. ULV spraying demands a well trained operator and should be carried out only in a steady wind.

Fogging machines are not recommended because these produce very small droplets with negligible terminal velocity. Even in a good wind such droplets will not impact and in still air the droplets will hang and will slowly be displaced great distances before coming to rest. The Exhaust Nozzle Sprayer was used successfully with dieldrin but there are doubts about the stability of other insecticides in the hot exhaust gas. It has not been used in locust control to apply other chemicals.

In summary, ULV ground control is almost exclusively used against locust hoppers but is suitable for adult and nymphal grasshopper control too. EC ground control, in general, should only be attempted against locust hopppers. ECs are well suited for grasshopper control in crops because quickness of response and deployment are less critical than for locusts.

d. ULV Ground Control of Swarms

There remains a technical problem of small scale swarm control by ground methods. This has not been tried routinely but very good kills should be achieved if a small droplet spray cloud is drifted through the roost site as the locusts are milling before departure. The problem is locating the roost site and getting a ground team there early in the morning before the locusts depart. The study of this is suggested as a research priority. Deploying an aircraft - at present the only feasible means of control - is scarcely justified for small, low-density swarms.

e. Aerial ULV Control

This is well tried and well proven. However, as with ground ULV, spraying locust band and grasshopper control should be attempted only in a steady wind. Only large blocks (at least 1 km^2) can be sprayed. Spinning cage (Micronair) atomizers are essential. No aircraft should be accepted without a variable restrictor, a flow meter and an in flight flow regulation. One cannot guarantee that a loucust target will be near an airstrip so the aircraft must have at least 4 1/2 hrs. endurance. Large insecticide carrying capacity is not needed. In an average, four hour sortie it would be possible to apply only about 300 liters of technical fenitrothion at 300 ml/ha. even using a track spacing as large as 100m. Locust swarm control is much less understood, but good kills can be achieved reliably by spraying the roost site in the early morning even though winds are light then. Spraying of swarms in flight needs modified aircraft.

Spray aircraft are essential for large scale control (5) and may well be needed for medium scale activity (4) also (see previous section III C 1 a for explanation).

The Aerial Aviation Section of PPD is in poor shape and beyond the scope of this project to resuscitate it. DLCO have appropriate aircraft and the situation under which Sudan would require aircraft are precisely those

stipulated in the DLCO charter. Nevertheless, it is not clear whether it is Sudan or DLCO who decide if aircraft are needed, and again not clear who pays the additional cost. It is therefore recommended first to obtain the services of DLCO aircraft, and also to let 'period' contracts for hire of suitable aircraft with a locally operating firm (see financial plan).

Aerial and ULV ground control can, of course, be used against grasshoppers but their use, especially the use of aircraft, requires careful justification in each case in terms of likely damage prevention.

In summary, aerial control is the only method currently available for reliable locust swarm control. It is also the cheapest method of hopper control in terms of cost/ha treated but not necessarily per locust killed. Aerial control is much easier to organize than ground control and much easier to ensure accurate area dosage and optimum application technique. It alone can cope with large outbreaks. But hopper target delimitation and detection is difficult and the method is unsuited to small targets. There is a doubt about the efficacy of current ULV ground control at acceptable area dosages.

f. Remote Sensing

Desert locusts will occur and breed only in green areas although not all green areas will contain locusts. Rainfall returns, synoptic meterological charts and aerial survey can all help to guide locust surveys to suspect areas. Remote sensing can also be an aid but there are problems. LANDSAT is the most powerful tool but the product is expensive. Green areas show up as magenta on the standard false color product. But the response of the most important perennial grasses (e.g. Panicum with desert locust, and Mitchell grass (Astrebela) with Australian plague locust) may be undetectable because of the dominance of the bare ground between the grass clumps; certainly undetectable without sophisticated computer analysis of the digital computer record. The digital tape is an order more expensive again and this technique is still very much at the experimental stage. Because of the expense of LANDSAT there is a move to cheaper and more frequent but less precise satellite output as is available for example from NOAA and METEOSAT. But this is still very experimental in the detection of green areas. A critical element in the development of the use of satellites is the provision of 'ground truth'. This requires the maintenance of a network of automatic stations recording continuously factors such as temperature, reflectivity, soil humidity over long periods and a large area. This type of investigation is considered to lie outside the scope of the Project.

The use of remote sensing for locust survey guidance has been and is being investigated by FAO and by the Australian Plague Locust Commission (APLC). If and when remote sensing becomes a proven operational tool for locust survey it should be deployed by FAO for the desert locust region as a whole, not for an individual country. This is in part because sophisticated processing and expert interpretation will be needed; and in part because for the satelites whose product is cheap enough for routine use, a single scene is of continental scale. The project might provide a means of supplying vital ground truth data for the development of remote sensing uses, but this requires liason with FAO outside the design team's terms of reference.

3. Pesticides

a. Types

Fenitrothion is currently the most widely used pesticide for locust control. Between 100 and 150 M.T. of technical material would be needed to cope with a major upsurge. It is effective, it has some residual effect (it has a 'half life' under hot dry conditions of about 3 days), it is reasonably cheap, it is not highly toxic to humans and, if applied properly, does not harm the environment.

Diazinon has been used in considerable amounts but it is slightly less effective, is less persistent and usually slightly more expensive. It has no advantages over fenitrothion.

Both fenithrothion and diazinon can be applied directly as technical material.

Malathion is cheap and safe but it is not very effective. About one kg. active ingredient per ha. is needed which will almost certainly make it more expensive in real terms than fenitrothion.

Phoxim, according to laboratory test, is highly toxic (roughly 6 times as toxic as fenitrothion) to locusts by contact, but is expensive and not field tested. The synthetic pyrethroids are promising especially for ground control because of their effect on behavior (see III C 2 c). They are at present extremely expensive although the area dosage (for deltamethrin about 12g. active ingredient per ha. for brown locust hoppers) required is very low. Nevertheless, at current prices they are still more expensive than fenithrothion at the recommended area dosage. They have very low mammalian toxicity.

Both propoxur and bendiocarb are thought to be good pesticides to mix with bait, as now BHC is not generally environmentally acceptable. Their use, however, requires further investigation; and this will be done as part of the project.

There are no other acceptable pesticides which have been sufficiently field tested for locust control i.e. none for which area dosages for effective treatment are known.

b. Formulation

The pesticide should be stored as an ultra low volume formulation, in the case of fenitrothion as technical material (@ 95% active ingedient vol/vol). Technical material is less in volume and thus cheaper to transport and has a longer shelf life the the formulated product. Reformulation as an emulsifiable concentrate (EC) to be used mixed with water, which is necessary with many ground sprayers, is easy for the supplier but the reverse process cannot be carried out. Reformulation can be performed in Sudan.

D. Implementing Agency

1. Present Situation

a. Organizational

The Plant Protection Department (PPD) of the Ministry of Agriculture, Food and Natural Resources has a number of responsibilities among which the control of national pests such as rodents, weaverbirds, locusts, grasshoppers and army worm. The control of pests in cash crops such as borers in cotton and sugarcane is carried out by boards of irrigation schemes, estates, and farmer cooperatives.

The PPD of the Sudan is a large organization with a staff complement of almost 3000; of which 55 are entomologists, 655 technical staff and some 2,370 others. The organogram (fig. 1) shows a Central Directorate at Khartoum with ten specialized sections and a network of twenty provincial main stations in five regions and Khartoum province (but not in the Equatorial South) and the pesticide laboratories at Wad Medani.

The Sections for Locust Control, Birds and Rat Control, Disease Control, etc, at Directorate level have a small expert staff, whereas the field stations are responsible for the control of pests in food crops and public foodstores throughout, for storage of pesticides and for logistics and transport. In emergencies field stations may be called upon to provide assistance in other regions as in the case of locust control.

This project deals in particular with the Locust Control Section and the newly almagamated section for administration, finance, planning and development. Under the latter come the sub-sections for transportation, controller of stores, controller of finance and workshops (vehicles). Financial management is carried out centrally with section heads operating on funds which may be liberally adjusted to the needs.

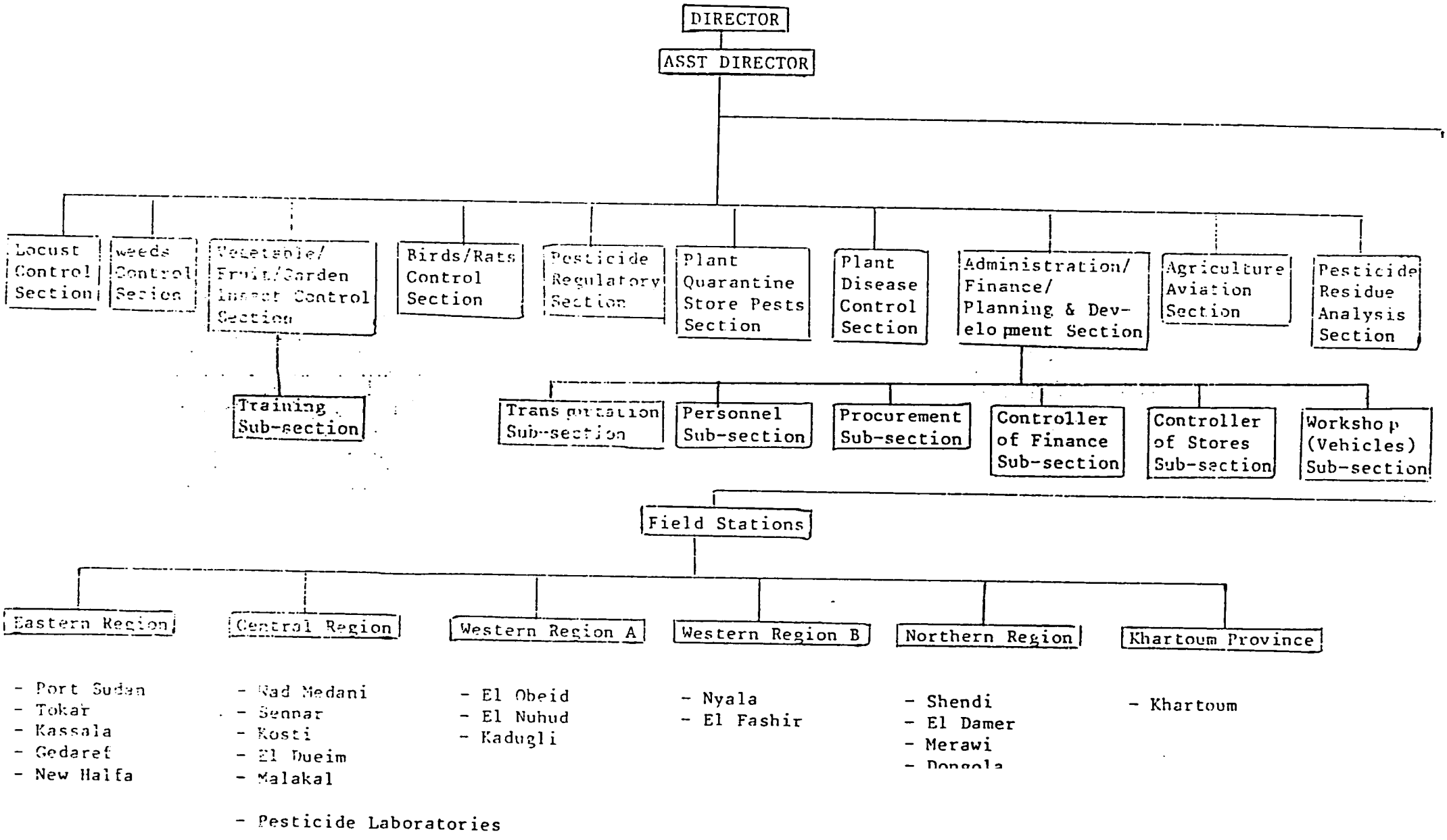
Training levels of PPD staff vary enormously but graduates holding degrees from international or national (Khartoum and Wad Medani) universities are relatively few. Several hundreds of technicians with agricultural school certificates and many others of lower education fill the ranks. Generally, knowledge and skills are insufficient to meet the demand of modern plant protection methods and means. This becomes all the more apparent as pest problems reach national dimensions and call for sophisticated, synchronized control, as in the case of locust.

b. Budgetary

Because the present PPD budget is divided into heads for the PPD as a whole; there is no locust budget or Locust Section budget (see Appendix B). This does not encourage a responsible use of resources. There is no way of finding out what was spent on locust control or on grasshopper control last financial year; that is clearly unsatisfactory.

figure 1

PLANT PROTECTION DEPARTMENT ORGANIZATION CHART



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The present field allowance of 4LS per day paid to PPD when they are in the field in niggardly. It does not, nor is it intended to, compensate for long hours of work under difficult conditions. Similarly, it does not and is not intended to reward officers for the technical knowledge they must have and the responsibility they must bear.

c. Stores and Pesticide Waste

The PPD operates pesticide stores in 20 provincial stations (including Khartoum) and a central store at the Khartoum Directorate. Construction of a new store is going on in Suakin. Many more semi-permanent field stores hold small stocks of pesticides and bait during crop seasons; they are supplied from the provincial stores.

The provincial stores are without exception in an urgent need of rehabilitation. The main faults in their present state are: poor management, very serious contamination, chaotic storing, a bad state of repair of the structures, an abundance of redundant pesticide, and waste and hazardous conditions.

Items of storage are: more than 30 kinds of pesticides, 8 different kinds of fuel, oils and grease, vehicles spares, ground spray equipment of various makes and cylinders of methylobromide gas. These, and more items, are kept without proper organization and inventory checks within and outside the undersized storage structures.

The present storage situation is hampering the execution of the locust and grasshopper campaign as well as other PPD activities. Therefore, the project includes a stores rehabilitation component which consists of repair or new construction as appropriate. Store rehabilitation is to be carried with maximum usage of Sudanese inputs with expatriate consulting advice. While the need for new stores is not in question, it is however, a matter affecting PPD generally and not only the Locust Section. This is not regarded as an emergency need, having the same urgency, for example, as the supply of pestices. Thus, it would be prudent to put out the upgrading of the storage facilities to tender.

The provincial PPD stores all contain an amount of redundant pesticides in various quantities, old containers and thoroughly contaminated soil inside and around the buildings besides large stocks of e.g. 40,000 litres of liquid DDT over 25 years old and a substantial volume of dimethoate. There are old drums of unknown content and lots of cakes powders everywhere. Floors are invariably covered with a layer of dust and spills.

This situation creates a permanent hazard and an obstacle for improvement of storage. The project, therefore provides for the removal and safe disposal of this chemical waste in an environmentally sound way. This project activity includes the collection of chemicals, waste and contamination, repacking and removal, transport and destruction by incineration at high temperatures at Shell's Chemical Plant at Wad Medani or elsewhere if Shell's facility is found to be environmentally unsound.

PPD and Shell are now conducting a country-wide inventory in order to assess quantities for destruction, the chemical problems involved and the need for chemical expert assistance. Preliminary estimates are that PPD's various stores have:

100 M.T. redundant chemicals.
150 M.T. contaminated soil and waste.

Based on this estimate, a price of U.S.$100,000 has been quoted by Shell to move and decontaminate the wastes; however, details of the contract are subject to negotiation.

Storage practices in PPD stores are far out of line with internationally recognized requirements for storing hazardously toxic chemicals, combustable fuel and deadly gases. The almost complete lack of apprehension about safe handling in stores and in the field calls for consistent training in pesticide management.

The system for storage administration is a simple one. Monthly stock list's record stock leftover, entries, stock issued, and balance to be carried forward. Provincial lists mentioning main and sub-stations stocks are sent to the Directorate's Controller of stores together with way-bills and issuing orders for purpose of compilation of overall stock position.

The system does not function because field stations are much behind in sending in monthly stock lists. Further, because of the lack of standard forms reporting is incomplete and fanciful. Thus, at no time is accurate information for procurement and distribution planning available.

The PPD has clearing officers at Khartoum and Port Sudan and a standard procedure for regular supplies and individual donations, although lengthy delays in clearance of goods is common.

2. Recommended Changes

a. Organizational

Clearly unless the major outbreaks can be dealt with, desert locust control in Sudan will be largely futile. It would, in theory, be possible to maintain a force sufficient to cope with a more major outbreak. However, maintaining a large strike force which is seldom needed would be wasteful. A large force, large in terms of hitting power if not necessarily in numbers, would not be maintained in practice. Inevitably and understandably, resources would be taken from locust control so that when action was needed, aircraft would lack spares, insecticide would be short, vehicles would be old and unreliable, and staff would be ill trained. Consequently, a Locust Unit should be formed within the Locust (and grasshopper) Control Section; the Unit should deal with the more regular aspects of the desert locust problem. Within this brief, however, very different approaches are possible.

It is necessary before considering these alternatives to look at the nature of locust survey and control. Locust control has often been likened to war. There is the same alternation of periods of low activity (peace) with the spells of intense activity. There is the same need for rapid response with little warning; the same need for rapid deployment and redeployment. In both

cases the gathering of information, its rapid transfer and analysis, and immediate decision are vital. There is perhaps in locust control an even greater reliance than in an army, on decision and judgment by the officer in the field. This can be achieved with a small well trained highly motivated unit. Even then maintaining enthusiasm at times of low locust activity is difficult. It is difficult to produce an elite unit in a developing country but there is no workable alternative. There is a relatively small centrally based locust unit in several other countries, notably in Saudi Arabia. Successful large scale locust control cannot be achieved by labor intensive methods.

The locust control should be sperated from grasshopper control. The Locust Unit should, of itself, be capable of carrying out the survey and minor control duties (1, 2 & 3 as listed in III C 1 a). Items 4 and 5 on this same earlier list will be dealt with later. These basic duties are themselves seasonal. They can be tackled by setting up field bases each responsible for an area. This has drawbacks. Even the officer in charge will be likely be relatively junior; supervision will be needed but is likely to be lacking. There will be little or nothing to do in any given area for a good half of the year. A relatively large number of vehicles will be needed; even if these are supplied initially, they are unlikely to be well maintained or replaced when they should be. The alternative is to have a smaller unit based in Khartoum and going out from there. This has clear advantages. The disadvantages are the time lost in travelling to the suspect areas, the difficulty of getting to the areas in the rains (although difficulties of ground movement will occur whatever scheme is adopted), and staff dissatisfaction due to the amount of time away from home base. On the last point it must be realized that locusts occur in the field and anyone who works in a locust unit must accept that the field is where one must spend most of the time. The scheme can be funded by donors initially as we indicate in detail below. But, it should be emphasize that in the long term the Government of Sudan must accept the need for priority equipment and funding. There will still be a marked saving in the proposed reorganization but it will be easy to forget this. The responsibility for pointing out the need to maintain the favored position of the Locust Unit will rest on the head of the Locust Section; it will not be a simple task.

However, medium and large scale control would both be beyond the resources of the Unit recommend herein. It is recommemded that the increased number of field staff for medium and large campaigns should be supplied by short term secondment from within PPD. There must be a mechanism for the declaration of a locust emergence and definition of the action which follows. The staff liable for such duty should be designated, trained and retrained. A pool exceeding the likely maximum need, should be built up. Equipment for seconded staff must be provided and such provision through a stock pile built up with donor aid should not prove difficult; with the key exceptions of vehicles and insecticide. It would be easy to say vehicles, like people, should be provided for a short period from other sections of PPD. PPD vehicles are old, with the exception of those supplied under the 1986 emergency campaign, and in short supply so this is not a likely solution in practice. Nor is it likely the Unit itself would be allowed to retain and 'moth ball' extra elderly but still roadworthy vehicles. Vehicles could however, be hired locally.

It would be unwise to be dogmatic concerning the size of the Unit. A sensible composition might be a Head, an Information Officer (this position already exists), a Pesticide Applications Officer (to assure proper methods were used and to field test new methods, new pesticides, and new equipment), approximately eight Field Officers (to carry out survey and minor control and to head teams of seconded officers in time of need), and an appropriate complement of drivers. For comparison, the Australian Plague Locust Commision (APLC) keeps an area roughly twice the size of the desert locust area of Sudan, under constant surveillance during the locust season (September to April inclusive) with ten Field Officers (no drivers); APLC needs seconded officers only to cope with major plagues. The (unpaved) roads are much better in Australia, but movement is little easier than in Sudan after rain. Nevertheless, the suggested number of well-trained dedicated officers should be able to do the job in Sudan.

The Field Officers could be posted to regional bases provided they remained wholly within the Locust Unit. But there should be no more than three bases (say coastal, central and western) with one more senior and two junior Field Officers at each base. There would need to be a considerable amount of seasonal redeploymernt between baeses. The Head of the Unit would have to travel for much of his time in order to maintain standards and morale.

Something along the proposed lines is already occurring in the Red Sea coastal area. There PPD officers from other regions have been seconded to work directly under an officer of the Locust Section who is in charge of operations.

b. Budgetary

A Locust Budget which can well be subdivided into the heads now used is recommended. The Head of the Locust Unit would have to estimate for the year ahead and the estimate would be subject to higher scrutiny and revision. If the Unit was short, a good case would have to be made for additional funds. This is the essence of accountability.

It is very important indeed that some means be found to increase the remuneration of officers when they are in the field. The reward could, perhaps, be expressed as a 'campaign salary supplement' and be paid when an officer spends more than a week in the field. It would compensate them for their long hours of work under difficult conditions.

c. Stores and Pesticide Wastes

Provision needs to be made (in a Memorandum of Understanding, or in a Project Agreement between the Government of Sudan and the donors) to ensure that binding conditions concerning exclusive use of vehicle spares, pesticides, avgas, diesel, oil and grease, and any other goods supplied by the donors will be used soley in the locust/grasshopper control campaign.

The project will address the stores problems by training PPD's staff in storage system administration, safe handling and inspection within an overall logistic training module to be designed and taught by the Stores Management,

Administration and Logistics expert. The toxic nature of pesticides and product knowledge need to be emphasized.

The training for selected stores officers should be as similar as possible to the training presently being conducted by MALT because this organization has been conducting logistic training in Sudan for two years, which has been made compulsory for government staff in this field. The training program needs to be adjusted to also include specific knowledge and skill improvement items related to pesticides. This is an urgent matter.

It is recommended that PPD's present storage section and transport sections be united into a new Logistical Unit to deal with all storage and transport of purchases, imports, distribution, etc. in order to establish greater efficiency and cost savings. Further, it is recommended that as soon as feasible a well-trained, competent logistics manager be appointed by PPD at the head-of-department level who would also serve as counterpart to the Stores Managment, Administration and Logistics expert (perhaps one of the Sudanese trained during the past few years by the MALT team could be recruited). This new manager should work with the expert to design appropriate stock keeping records for such donor supplied items as pesticides and vehicle spares.

Lastly, attention needs to be given to adequately strengthening clearing in 1987 and including this subject in logistical training.

E. Sudan's Experience with Recent Similar Projects

A limited amount of locust survey and control work has always been carried out during the recession period. This work has been carried out during the winter season in the Red Sea coastal area where desert locusts congregate every year for breeding. However, the explosive increase of grasshoppers and African migratory locust populations in 1985 and 1986 overstretched Sudan's capacities in terms of management, outfit, supplies, and resources. The threat of an upsurge of desert locust possibly leading to a major plague was very real. The international consequences of an uncontrolled large scale outbreak of African migratory locust and desert locusts forced the donors to react quickly with funds and donations in kind. Since Sudan would not have been able to meet the 1986 emergency with its own resources, it requested donor assistance. Several major donors responded in a collaborative manner and FAO acted as lead agency for the crisis. In executing and coordinating the emergency assistance campaign in 1986 a Steering Committee and Task Force made ample use of donor organizations and services (see the following section for a more complete description of these two bodies).

Major donors were the Netherlands, EEC, and the United States. Among other donors were the British, Swedes, Spanish, Greek, Finnish, Japanese, and Yugoslavs. Their inputs for last year's emergency caused a sudden influx of a huge and varied volume of donations between August 25 and September 4, 1986. The distribution of donations started on September 1st with the aid of 14 Mercedes trucks on loan from the Sudanese Road Transport Organization (RTO). An officer of MALT, the Dutch Management and Logistics Team working in the logistics of food-aid, took over management responsibility for transport and forwarding was completed within one month. The RTO trucks were loaned free, but FAO paid the salaries of drivers and maintenance and EEC provided 400 MT fuel. Additional trucks (2) were loaned by Oxfam for a short period.

Under the 1986 campaign, procurement of donations was carried out through Luxconsult on behalf of EEC, through FAO's Procurement office and probably by national purchasing organizations for some donations in-kind. FAO contracted for an administrative officer to assist FAO's regular clearing agents.

This project proposes an extension to be executed in the same ways and means adopted for the 1987 locust emergency assistance program.

F. Contracting and Coordinating Entities

During the 1986 locust and grasshopper emergency campaign a constructive collaboration of Sudanese authorities and donors allowed quick decisions and gave freedom to allocate funds to immediate needs. Consultants, equipment, vehicles and insecticides could be put to work in the field within weeks of their arrival. Thus a rapid pace was maintained throughout the campaign from last August until now. Further, the Steering Committee and Task Force continue their discipline of frequent meetings and efficient operation.

This project, therefore, envisages continuation of the proven management through the Steering Committee, subcommittee and Task Force with the FAO Locust Other Migratory Pests and Emergency Operations Section, as the lead agency.

1. Food and Agriculture Organization (FAO) and EEC

In early 1986 the Plant Protection Department turned to the Food and Agriculture Organization (FAO) of the United Nations for financial and technical assistance to control the migratory locust and very heavy grasshopper infestations.

FAO, Rome, organized several technical and multilateral meetings to raise funds for a concerted locust and grasshopper emergency control campaign throughout Sudan-Sahelien Africa in 1986. Several donors contributed to the FAO - Emergency project in the Sudan. Two major donors, EEC and USAID, contracted with FAO Rome for a joint operation to assist the PPD of the Sudan. The Netherlands and Sweden soon followed and negotiated the transfer of their funds from FAO into a joint donor account. For a complete listing of all donors to the 1986 emergency campaign see Appendix C.

The EEC will be requested to again act as contracting agency for collaborating donors towards FAO, Rome and to assume accountability for the administration for local and foreign cash and in-kind contributions.

FAO's involvement in the project needs to be continued with the dual purpose of strengthening the international approach in fighting the migratory locust threat on the long term and of deriving maximum benefit of the expertise of the Locust Section of FAO, Rome. It will furthermore, serve to prevent the locust infestation in the Sudan becoming an isolated national affair as the tendency seemed to be at the predominatly Franco-Sahel oriented locust and grasshopper meetings at FAO Rome in 1986.

Ways of emphasizing FAO's involvement are subject to negotiation. Provision of contracts for project manager and locust expert consultancies (possibly on bilateral fund in trust contributions) would be an effective instrument provided these contractors would be commissioned to the Steering Committee. Contracting for other assistance might better be undertaken by EEC through

Luxconsult on behalf of the Steering Committee. Individual donors should be allowed to post junior experts to the project on bilateral terms for the purpose of passing expertise to a younger generation.

2. Steering Committee

The PPD implemented the 1986 project under the close direction of a Steering Committee Comprising representatives of the Government of the Sudan and of donor subscribers:

Government of the Sudan	Donors
Undersecretary Min. Finance and Economic Planning	EEC
Undersecretary Min. of Agric. and Natural Resources	USAID
Ministry of Defense	Netherlands
Director Plant Protection Department	FAO
Commissioner - Relief and Rehabilitation Commission	

Chairman: Charge' d' Affairs, Royal Netherlands Embassy
Alternate: Delegate of the European Economic Commission

The Steering Committee operated through a sub-committee for the preparation of terms of reference, budgets and workplans.

The terms of reference of the Steering Committee do not require to be amendment unless new elements will be included under the extended locust control project.

3. Task Force

The day to day execution was carried out by a Task Force consisting of:

Head of Locust Control Section of PPD; Dr. Karrar
FAO Coordinator: Dr. J.T. Awad
FAO Administrator: Ms. B. Schnable

The composition of the Task Force needs to be revised to include the Head of the Locust Control Unit of PPD, FAO locust project officers, as well as medium and short term expatriate expert assistance to the project. Its terms of

reference are to be amended accordingly. The subcommittee should submit new function profiles and terms of reference for approval by the Steering Committee.

G. Regional Organizations (DLCO)

The Charter of the Desert Locust Control Organization for Eastern Africa (DLCO) organization requires it to assist the national units of member states at times when the locust situation, especially the desert locust situation, is beyond the resources of the national unit. However, DLCO has of late had insufficient operating funds to supply aircarft and insecticide to meet all the calls upon its resources. Experience in 1986 suggests the amount of help that can be relied upon from DLCO is limited. It is hoped DLCO will be able to make an aircraft available provided support costs are forthcoming from Sudan both in 1987 and in any future desert locust emergency. DLCO may be able to provide technical advice and assistance, especially in the evaluation of ground sprayers, and that would be welcome. However, as with aircraft it would be unwise to assume DLCO will be able to help unless the additional costs are covered.

H. Cooperation with Non-Governmental Organization

During the 1986 emergency campaign various non-governmental agencies e.g. CARE and Save the Children provided valuable locust information and even provided support for surveys. Others, such as Oxfam, provided lorries for pesticide positioning at field stations.

It is to hoped that such assistance will continue. It will be part of the function of the Locust Unit to let such agencies know what information is needed and to contact officers in the field during surveys. Because such NGOs operate small agriculture projects in remote areas, they have a vested interest in providing information on locust outbreaks.

IV. PROJECT ELEMENTS

This section mainly details the suggested inputs for a three year project starting on or about December 1, 1987. The inputs for the 1987 emergency campaign are detailed in section V.

A. Commodities and Storage

1. Pesticides

a. Review of Present Position

During 1986 the PPD used a very wide variety of at least 21 different pesticides for the control of grasshoppers and locust regardless of their being tested or recommended for particular methods and rates of application.

Attempts to pull together statistical data on aerial and ground spraying in the summer campaign 1986 from Field Monitor Reports and Weekly Locust Reports show a minimum total consumption of EC and ULV pesticide formulations of 230,000 liters or 321,000 ha by aerial and on 32,500 ha by ground spraying (Farnsworth). The areas are likely to have been estimated from the pesticide used on the questionable assumption that the recommended area dosages were adhered to.

Of these, the consumption of fenitrothion ULV ranked highest, (over 110,000 liters) followed by diazinon ULV (46,026 liters) and diazinon EC dispersed by air (26,363 liters) (Hemming). These figures should only be taken as indicative ones.

It is impossible to predict the proper quantity of insecticide needed for locust control six months in advance; on the other hand, to hold a stock worth say U.S.$1.5 million which might become useless before it was required, is to be avoided if at all possible. The shelf life under tropical conditions is probably no more than 3-4 years under the present storage conditions, and a year or so more in a purpose-built store of the type envisaged under this project. Disposing of outdated insecticide is a major problem. Thus, no more than thirty M.T. of technical fenitrothion should be held in the country for desert locust control after the present emergency. A further one hundred M.T. could be bought, but held in the country of manufacture by the supplier.

All liquid pesticide should be supplied in drums of about 100 liters. A 200 liter drum of technical fenitrothion weighs about 280 kg; it needs a strong man merely to stand it up on end. Despite the use of a cushioning tire, ten out of a sample of 180 large drums were ruptured during unloading, a loss of about $20,000 in that instance alone as well as a severe safety risk.

The cost of fenithrothion technical material is about U.S.$10/kg. The delivery time to Sudan from the sole two manufacturers in Germany and Japan is about 4 months; if money for purchase must come from donors that would rise to at least 6 months. A general warning of a locust upsurge can be given up to 6 months ahead but often warnings that far ahead can prove to be false alarms. Also not all potentially dangerous situations can be spotted; some occur in unsurveyable areas such as Tibesti or the Libyian/Chad border. A reliable warning can be given only about 2 months in advance. (These are rough figures; some sequences can be forecast further ahead and more reliably than others).

A possible solution is for the pesticide to be bought but stored overseas at no cost by the manufacturer, and shipped or even air freighted to Sudan when needed. The manufacturer, subject to agreement, would sell from this stock and then replace it or ensure as part of the contract, that the insecticide would be 'turned over' within its shelf life. In essence, that is what the Australian Plague Locust Commission do; with the modification that the pesticide is bought from and stored by the Australian subsidiary of the manufacturer. Preliminary contact with suppliers suggests that for a large order (say $1x10^6) such terms will be accepted. If airfreight is used, the pesticide could be in the country within two weeks. FAO have obtained air freight terms of about $1.50/kg Europe to Africa. In summary, air freight should be considered in certain circumstances to prevent overstocking and its inherent dangers, even though the cost is substantially higher than sea freight.

A further reason for this recommendation is that in Sudan pesticide bought for locust use is stored with other PPD pesticides and, quite understandably, there is no way in which the use of locust pesticide for other purposes can be prevented. Of course the 'borrowed' pesticide should be replaced when used for other purpopses, but that is unlikely. ULV material can only be applied with special equipment. It is not suitable for most crop protection purposes. A move to technical material might reduce the risk of 'locust insecticide' being used for other purposes.

It is appreciated that the bulk of the pesticides have been sprayed on crops for the control of grasshoppers, an annually recurring non-gregarious pest. It is imperative to distinguish clearly between grasshopper and locust control as the two require a different approach in control even though populations of grasshoppers and African migratory locust may get mixed occasionally. The PPD of Sudan has the responsibility of grasshopper control for which it receives hardly any financial support from more prosperous farmer cooperatives in the Eastern and Central Regions. The clear distinction of locust control at Directorate level is not maintained at provincial level, where pests directly threatening farmers crops take priority over national problems of locust containment. Further, present storage practices make it impossible to reserve certain pesticides for specific use in locust control. Thus, unless a specialized and expanded locust control unit with far reaching authority is organized, it would be difficult to supply pesticides for the sole use against locusts.

This is particulary true for the use of pesticide powders in bait prepared from crushed groundnut husks. The bait is traditionally spread around and in between emerging crops to control early grasshopper infestation. Baiting is regarded as the cheapest and most effective way of controlling this pest. Baiting against bands of locust hoppers in wild areas is logistically non-feasible under Sudan conditions. Still, the project envisages to continue supply of dust formulations for bait preparation as an efficient protection of national grain crops and as a means of preventing complete exhaustion of locust pesticide stock on grasshopper control.

For 1986 some 194 M.T. of HCH (BHC) powders were supplied by Greece and Spain, probably as Agrocide 7 formulation. Since then supply of HCH powder has been banned from the aid program and will be substituted for with bendiocarb 1% powder and propoxur 2% powder for bait preparation.

Baiting has fallen out of use elsewhere with the introduction of newer pesticides and methods, and Sudan is the only country where baiting is known to be still used as a standard control measure for grasshoppers or locusts. In the Sahelian countries dusting is used on grasshoppers. Because of this, there is no known data on the efficacy of using bendiocarb or propoxur for baiting. Thus, the project includes a systematic assessment of baiting to protect sorghum and millet from grasshopper and locust damage.

A PPD assessment of their present stock of pesticides which can be used for locust control as of early February 1987 is:

	At Field Stations	Tokar Campaign
Fenitrothion 50 EC	2,016 liters	30,000 liters
Fenitrothion ULV	1,140 liters	1,800 liters
Diazinon 50 EC	2,796 liters	4,420 liters
Diazonon ULV	471 liters	0 liters

Aerial spraying of winter breeding sites of desert locusts in the Red Sea Coast area, in particular within and south of the Tokar delta was in process as this paper was being prepared in February 1987. Thus, left over stock of locust pesticides will be very low at the onset of the 1987 summer emergency campaign and early replenishment is essential.

b. Additional Non-Emergency Requirements

(i) Locust outbreak control.

Provision has been made for one major outbreak. It is recommended (a) that most of the insecticide is not held in Sudan; (b) not all of the insecticide is bought immediately as fenitrothion, and investigation of synthetic pyrethroids for ground control is envisaged.

Note: Chemical companies are keen to participate in trials and can be relied upon to provide test chemicals, technical staff and local support.

(ii) Locust minor control and grasshoppers non baiting.

A small provision has been made for ULV insecticide for minor control of locusts likely to be needed in non plague years and for small scale control of the most severe grasshopper infestations using ulv methods.

(iii) Grasshoppers

It is likely that the recent grasshopper upsurge is associated with the end of the drought. Whether the drought returns or normal rains continue, the grasshopper outbreak is likely to subside. We also expect an introduction of threshold infestations levels for control and better supervision of dosages to produce a saving. For 1987 we have allowed for powder sufficient to make up 8,500 M.T. of bait (roughly half that provided under the emergency for 1986). In succeeding years powder sufficient to make up less bait has been allowed for (1988 4,675 M.T. and in 1989 and 1990 3,100 M.T. of bait each year).

2. Vehicles and Spares

In an enormously vast country as the Sudan with little infrastructure in place the availability of a sufficient large number of vehicles of proven durability, of spares and maintenance facilities is a pre-condition to execution of country wide projects. In this respect PPD effectiveness is continuously hampered by lack of transport.

The acquisition time could be much shortened if a donor would agree to supply vehicles immediately under specific circumstances. An alternative is local hire. In the past the problem has been solved by a combination of these methods; and a combination of these methods will probanbly have to be used in any emergency campaign.

The PPD Directorate has a section which provides trucks, selects and prepares the goods for transportation and issues way-bills. However, this PPD section will be insufficient in capacity and capability for this year's campaign. Additonal capacity will need to be hired from private transport companies. The MALT organization will be in a position to provide assistance in managing the transport and contracting souk lorries as was the case in 1986.

The project foresees training on transport management, safe handling and the economics of transport within the framework of overall logistics training.

* List of vehicles at PPD field stations as of 15 February 1987:

Type	Brand	In service	Off the road	
			Repairable	Non-repairable
Pick up *	Toyota	5	1	-
	Landrover	24	8	3
Station wagon	Toyota	9	8	
	Landrover	3	1	1
Trucks	Unimog	16	23	18
	Commer	8	4	10
	Daf	6		
	Others	5		
		76	45	32

* Donated under 1986 donor assistance program.

Pick-up	Toyota	6
	Landover	22
Station wagon	Landrover	3
Trucks	Bedford	6

* Note: This list for PPD field stations does not include the Khartoum Directorate. Furthermore, it is not clear if the vehicles assigned to the locust winter campaign on the Red Sea Coast are included in the record

In 1986 transport of pesticides, avgas, diesel and other locust campaign materials from Khartoum and Port Sudan clearance points to field stations was carried out by lorries of Sudanese government organizations PPD, Motor Transport Organization (MTO) and Relief and Rehabilitation Commission (RRC). In past emergencies non-governmental organizations such as Oxfam provided lorries. Also, the services of private transport companies can be hired (souk lorries).

Private sector transport has proven to be reliable when addressed by professionals. However, funds need then to be reserved for hiring of private transport. Funds need to be provided for vehicles for a Locust Unit and for consultants.

In view of the new emergency in the Western region it is important that the Locust Control Unit hangs onto any vehicle presently under its control. The provision of new transport for incoming expatriate assistance to this project is critical and has been budgeted for.

Under the 1986 program spares were delivered with all new vehicles, but the total amount was meager. The logistic assistance expert will need to take account of past usage, present stocks, and the manufacturer's recommendations before ordering. It is <u>not</u> recommended that spares be purchased with <u>each</u> vehicle as was done last year; instead the spares order should be based upon the fleet's needs. Otherwise, this means that seldom used spares are never ordered, e.g. in 1986 a critical shortage of windscreens for Landrovers was apparent. Also, tires need to be ordered, but should not be purchased from the vehicle manufacturers; as it is less expensive to purchase them separately.

PDD field stations have very limited workshop facilities, and the same is true of the Khartoum headquarters. However, regulations direct all government department to the Motor Vehicle Transport Organization for repair and maintenance. The quality and promptness of repairs is said to be acceptable, provided spares are available. Thus, it is recommended that the Locust Control Unit maintain their own stock of spares.

Reliable vehicles are essential. It is a false economy to try to run vehicles for more than 70 or 80000 km (2 years) on tracks and off road. Allowance has been made for equipping and re-equipping the Locust Unit and providing vehicles for consultants. A substantial number of vehicles have been given to PPD and no further provision for vehicle supply to PPD in general has been made in this paper. Instead, provision is made for local hire to cope with a desert locust upsurge. Further, provision has been made for spares for the Locust Unit only.

For the project, twenty 4x4 pick up or station wagons are budgeted for, as well as two 2x4 trucks. All new trucks should be supplied with hydualic lift tailgates. These are invaluable when handling heavy loads such as drums of pesticide.

3. Protective Clothing

Generally, awareness of the need for caution in handling pesticides is very low throughout PPD. Particularly in sensitive areas such as pesticide stores, bait mixing areas, and air strips. The absence of any safety standards and disciplinary procedures are evident. Adequate protective clothing is missing almost everywhere.

One should be realistic about the usefulness of existing sophisticated protective apparel given the climate and illiteracy in the Sudan. Only four target groups will be singled out for provision of protective clothing.

Group	Kind of Protection	Qty
Bait mixing laborers	Simple cotton nose/mouth masks	10,000
Spraymen of locust control units	Coverall, caps, goggles	200
	Rubber gloves, shoes	200 pairs each
Store and airstrip Laborers	Coveralls, caps, goggles	1,000
	Rubber gloves and boots	1,000 pairs each

Any training on pesticide handling and application should emphasize that the best protection comes from thorough washing of body and clothes with plenty of water and soap as soon as possible after contamination.

4. Stores and Disposal of Pesticide Waste

To address the shortcomings mentioned in section III D 1, an extensive pesticide storage rehabilitation program will be required.

A survey was started in February 1987 by Shell to assess the amount of out dated pesticides which are stored in various PPD warehouses. During the survey, any leaking or damaged containers will be resealed or the out dated pesticides will be placed in new containers.

Next, all out dated pesticides, as well as any contaminated soil or flooring from the various PPD warehouses, will be removed to Shell's premises at Wad Medani. Then when the procedures have been found to be environmentally sound, the out dated pesticides and contaminated material will be destroyed or decontaminated.

After this has been accomplished, the store buildings themselves can be rehabilitated or replacements constructed as needed. This rehabilitation and construction work will need to be tendered for, and can probably be paid for in local currency, perhaps using counterpart funds. This rehabilitation and construction work has been preliminarily estimated to cost the equivalent of U.S.$3,000,000. It is included on the budget page for the 1987 emergency assistance, although most of the work will not be performed until later years because of the long lead time required to assess exact needs for each site and let the construction contract. One construction contract is recommended.

5. Spraying Equipment

There is a great deal of spraying equipment, much of it unserviceable, within Sudan. This should be brought to a satisfactory state and evaluated before more is bought. Nevertheless none of the equipment may prove suitable for ULV application so a small provision has been made for the purchase of new ground sprayers (aircraft should come properly equipped as a condition of the contract).

6. Aircraft

Provision has been made in the budgets for the hire of spray and reconnaisance aircraft for one major locust campaign, and for development and evaluation work, and Appendix A has suggestions for the aircraft hire contracts.

a. Spraying

It is desirable that the spray aircraft should be able to carry an observer on spray operations. At least until the pilots are used to the job. This is not usual and special permission may be needed from the Ministry of Aviation.

b. Survey (fixed wing)

A single engined (for reasons of cheapness) high winged aircraft is needed for survey. Survey is carried out for green areas where breeding may be occurring, for bands (although bands are visible only if large, and if in open vegetation) and for larger, high flying swarms.

c. Helicopter

This is essential only for the detection of low flying swarms in difficult country. Helicopters have not been considered essential for desert locust control (although vital in, for example, red locust and Australian plague locust control). Their use is not proposed for Sudan.

7. Radios and Other Equipment

A good SSB/HF radio network between Khartoum headqurters and the field is essential. Enough radios should be provided to equip vehicles of the proposed Locust Unit. The existing PPD network is adequate for grasshopper control and does not need more radios. SSB/HF radios are recommended for use between aircraft and ground observers also. They are not ideal for spraying directions, but VHF radios have such a limited range that they would be needed in addition to SSB/HF sets. (The aircraft must often be called in to a locust target as much as 100 km away.) Radio spares are needed, particulary to service the radios purchased in 1986 which have no local dealer.

Much camping equipment has been bought but it may still be necessary to equip the Locust Unit and provide a reserve for use in an upsurge. Under this budget line item are included large tents, water containers, overalls etc.

The research envisaged does not require elaborate scientific and survey apparatus but a modest sum has been set aside. It will be necessary to equip survey teams properly (sweep nets, vertimeters, binoculars etc.)

B. Technical Assistance

1. Long Term

a. Management (Team Leader)

Terms of reference: To be responsible for all aspects of the Project. To be accountable for all local disbursement of project funds. He will report in writing each six months to the Steering Committee. He will become a member of the Task Force. He will organise training courses. He will also assist and advise the Head of the Locust Unit on all aspects of locust and grasshopper activities and also Regional Entomologists on grasshopper control. He will be responsible for preparation of a Locust Handbook giving information on survey and control for field officers. He should expect to spend at least 100 days each year in the field.

Requirements: At least 8 years of supervisory experience, preferrably in migratory pest control, including locust control. Experience in directing field teams. Experience in running control campaigns. Experience in African conditions would be an advantage.

b. Applications and Spraying Techniques

Terms of Reference: To serve as Deputy Project Manager. To develop ULV ground application method for individual hopper band and small swarm control. To assess the effectiveness of ground control campaigns. To improve direction of aerial and ground control to ensure correct application techniques and area dosages. To field test new insecticides for locust and grasshopper control, and evaluate ground sprayers. To test the efficiency of baiting methods and the limitations of baiting for both locust and grasshopper control.

Requirements: At least 5 years experience with aerial and ground ULV control. Experience with a control organization during a major campaign. Preferably research experience in insecticide application methods.

2. Short Term

a. Stores Management, Administration and Logistics

(One two month vist in each year of project)

Terms of Reference: To develop and arrange for adoption of auditable, simple store management procedures to protect donor and PPD inputs. To train PPD's store managers, and transport personnel concerning proper receiving, issuing, stock control, and write off procedures. The training will emphasize the toxic nature of many goods PPD is responsible for; the safe handling of emergencies and environmental contamination. It will also emphasize the large value of other goods, e.g. vehicle spares. To visit stores for on-the-job training and review of procedures.

Requirements: At least three years experience in stores administration and management, including designing goods control systems.

b. Applications and Spraying Techniques

(One visit for 3 months in each year of project)

Terms of Reference: The same as for the long term expert of the same title, except will not serve as Deputy Project Manager.

Requirements: The same as for the long term expert of the same title,

c. Survey and Reporting

(Two visits of 3 months in each year of project)

Terms of Reference: To assist with training courses and to carry out on-the-job-training in methods of locust survey and reporting. To help to improve standards and thoroughness of survey.

Requirements: At least 6 years experience of locust survey, preferably including survey for desert locusts in Sudan.

d. Environmental

(One visit of 6 months, one visit of 3 months)

Terms of Reference: To evaluate the environmental impact of various methods of current locust control and the effect on the environment of overdosing. If possible, to evaluate grasshopper control similarly.

Requirements: Experience in assessing the environmental impact of pesticide application. It is recommended that a contract be let to a reputable institute versed in this type of reasearch, for example The Wildlife Institute of Denver University in Colorado, U.S.A. or to the Faculty of Ecotoxicology of Wageningen University, the Netherlands. The work would be likely to involve spraying a large block and some small blocks by methods used in locust control, assessing the insect and soil fauna before and after spraying and the time populations take to recover. Also, considered would be the decrease in

pesticide levels in the vegetation by analysis of samples; and the effects on stock, especially the pesticide residues in meat of stock kept in the spayed area.

e. Spraying Machinery

(3 months each year of the project)

Terms of Reference: To service and bring to operating standard ground spray equipment. To assist with training in operation and maintenance of ground sprayers.

Requirements: Thorough knowledge of ground spraying machinery, its maintenance and repair.

f. Biogeographer

(Two visits of 4 months)

Terms of Reference: To analyze the 1985-86 upsurge of migratory locust to attempt to determine the causes for its initiation and decline, with particular attention to the effect of control.

Requirements: Research experience in the biogeographical analysis of locust outbreaks. A working knowledge of synoptic meteorology.

g. Control Criteria

(Two visits of 4 months).

Terms of Reference: To determine threshold levels for the economic control of grasshoppers in various crops having regard for type of crop, stage of growth, yield despite damage, regrowth, reinfestation.

Requirements: Experience of estimation of damage, crop loss and control thresholds in the field on cereal crops.

h. Logistics

(On an as-needed basis, expected to be no more than two months the first project year and one month each succeeding year)

Terms of Reference: To assist in clearing donor provided inputs through customs. To schedule distribution according to PPD planning. To repack goods into appropriate consignments for distribution. To obtain transport and issue consignment notes. To supervise safe loading and transport. To keep records of goods arrived and transport documents and expenditures.

Requirements: This expert would be locally hired, and perhaps the MALT organization could fulfill this function.

C. Training

A major task for all consultants should be on-the-job-training.

1. In-country

A training course should be carried out by consultants and others on the spot in each year of the Project covering survey and control methods, safety, operating procedures etc.

A training course should be carried out each year of the project by consultants and Locust Unit staff in regions subject to locust or grasshopper incidence (a) to train a pool of people to be seconded to the Locust Unit in times of upsurge, (b) to improve methods of grasshopper control.

The courses should be extended to cover grasshopper control but officers not liable to be called on for locust control should not attend the full course. It is essential to keep course numbers small (maximum of 15) otherwise it is impossible to make the course predominantly of practical work; not lectuers.

Note: Regional staff scheduled for possible secondment should, as far as possible, be given on-the-job-training as well, by being included in Unit surveys and in minor control activity.

2. Overseas

The senior officer in charge of the Locust Unit should make a visit to study locust control in other countries. This should include Saudia Arabia and Australia.

D. Research and Evaluation

1. Research

The major technical problems have been indicated in earlier sections. They are summarized and listed below:

a. Desert Locust

(i) Development of reliable cost effective methods of ULV ground control of individuals bands.

(ii) Development of ULV ground methods for control of small roosting swarms.

(iii) Assessment of effectiveness of ground control campaigns (proportion of population in bands; proportion of bands present, detected and treated; percentage kill in treated bands).

(iv) Methods of delimiting areas infested with sufficient bands to justify aerial drift spraying.

b. African Migratory Locust

A study of the 1985/6 upsurge to determine the causes of its initiation and decline and the likelihood of a repitition.

c. Grasshopper Damage and Control Threshold Levels

(i) Development of simple methods for determining threshold infestation levels justifying control, bearing in mind type of crop, its stage of development, the level of production (i.e. whether despite damage in a good year an average yield will result), reinfestation.

(ii) Testing of new powders for mixing with bait, cost effectiveness of control, and the liminations of baiting; this applies to locust control as well.

d. General

(i) Ground spray machinery: an evaluation of equipment in terms of: output drop spectrum, robustness, ease of operation, ease of maintenance.

(ii) An evaluation of the environmental impact of locust control will be attempted. It will almost certainly be necessary to spray seperately for this purpose only. No additional provision has been made for insecticide and aircraft hire.

2. Evaluation Plan

a. Evaluation of Medium Term Assistance

An interim review should occur near the end of the first year of the three year project assistance; and a futher evaluation should be scheduled approximately six months before the project's end. The first would be early enough to allow modification of the project, and the second would allow enough time to consider a possible extension.

Both evaluations should be carried out by two consultants over a period of about three weeks. The evaluations should carefully compare the project's expected achievments with what has actualy been accomplished. One of the consultants should be an expert on locust control, and if possible grasshopper control, and control organizations with particular attention to aerial control and should have considerable relavant field research experience. The same person should, if possible, serve on both evaluation teams. The second consultant should be concerned with logistic and supply matters. One of the experts for the final review should be a member of the Locust Other Migratory Pests and Emergency Operations Section of FAO. Since FAO will be the implementing organization, it will have a responibility for the proper execution of the project.

The evaluation teams would work closely with the Task Force and would report, initially, to the Steering Committee; the written report would, of course, be submitted to FAO who would distribute it appropriately.

The team would concern itself with all aspects of the project, both technical and organizational, would recommend project modifications, and in the final evaluation make immediate and long term recommendations for locust and grasshopper control in Sudan.

b. Mock Campaign

If during the project there has not been a major desert locust campaign, a mock campaign excercise should be run in the project's final year. The aim would be to test whether the project has succeeded in its main purpose; namely to make PPD capable of combatting a major upsurge. The exercise would mimic a real upsurge in every respect including the degree of warning, except of course that actual insecticide would not be used. Such an exercise was devised by FAO for DLCO in 1985/6 but was shelved because of a shortage of funds. Provision has been made in the budget for a consultant to plan the problem. The consultant would devise mock monthly FAO Bulletins and mock survey reports, and with the help of one of the project staff create 'swarms' and 'bands'; and of course adjudicate disputes and assess the success of the mock campaign.

V. 1987 EMERGENCY CAMPAIGN INPUTS

Sudan may be in the early stages of a desert locust upsurge. A further stage comprising larger infestations than those of winter/spring 1986-87 may occur in central and western Sudan during summer autumn (June to October inclusive) 1987. A full scale plague infestation will not occur then; however, it is of vital importance the upsurge should be halted.

We suggest the following items be funded for the 1987 campaign:

A. Technical Assistance

The Terms of Reference will not materially differ from those proposed for the three year project and are found in section IV B.

1. Management (Team Leader)

The support recommended for the 1987 emergency is a substantial program justifying a Manager to oversee the implementation. The Manager will liase with PPD and oversee, in association with the Head of the Locust Section, concerning all aspects of locust and grasshopper operations, e.g. procurement, logistics, survey, and spraying (April to November, 8 person months).

2. Application and Spraying Techniques

Two application experts will be needed to organize and help direct aerial control, to develop ground control methods, to check effectiveness of treatment and area dosages applied (one May to October and one August to October, 9 person months).

3. Survey and Reporting

Two survey and reporting experts will be needed to improve survey methods, information collection and information transfer (one May to August and one August to November, 8 person months).

4. Spraying Machinery

A spraying machinery expert will be needed to repair and service the considerable amount of ground spray equipment (July to Sept, 3 person months).

5. Stores Management, Administration and Logistics

A stores management, administration and logistics expert will be needed to review current stores and transport procedures, practices, facilities, and to recommend changes as well as train selected stores and transport managers (April to November, 8 person months).

6. Environmentalist

An environmentalist will be needed to evaluate the environmental impact of various methods of current locust control and the effect on the environment of overdosing. If possible, to evaluate grasshopper control similarly (May to September, 5 person months).

B. Vehicles and Spares

1. Four Wheel Drive Pick-ups and Station Wagons

Needed are six each 4x4 wheel drive vehicles (for Khartoum based staff, 3 pick ups and 3 station wagons). Also, six each 4x4 wheel drive pick ups for western areas which received few new vehicles last year.

2. Trucks

Five each 2x4 eight ton trucks with hydraulic tailgates are needed.

3. Vehicle Spares

A substantial quantity of vehicle spares is needed (provision of spares for vehicles supplied in 1986 was low and more spares are needed). Hydraulic tailgates should be purchased for trucks supplied in 1986.

C. Aircraft

AvGas will be needed and is budgeted for.

Provision has been made in the budget for approx. 1,500 hr. spray aircraft hire (this is the number of hours needed to apply the amount of fenitrothion being purchased). Also budgeted for is approx. 250 hr. of reconnaisance flying to locate locust swarms. Suggested contracts covering technical aspects of hire are attached (Appendix A) because provision is needed for spray equipment attachments (flow meter, inflight flow regulator) to ensure hired aircraft can be used efficiently to apply the stipulated area dosage.

D. Pesticides

It is unlikely that a locust campaign larger than one in which 130 M.T. of technical fenitrothion, or its equivalent, is properly applied, will be needed. It should be supplied in drums no larger than 100 liters each to ease handling. That amount would allow treatment of over 4000 km^2 of swarm or band. A medium sized swarm is one covering in the region of 20 or 30 km^2; an upsurge with very large swarms is unlikely as early as the summer of 1987. It should be borne in mind that number of swarm reports is not the same as number of swarms; sometimes swarms are missed but often the same swarm is reported many times as it moves from place to place.

The technical fenitrothion ordered for the 1987 emergency campaign is unlikely to arrive before June. By then it should be clear whether or not a major summer desrt locust campaign will be needed. A thorough analysis should be sought after the fenitrothion arrives from the FAO Locust Other Migratory Pests and Emergency Operations Section in Rome. The analysis should assess the desert locust situation and the possible risks to Sudan from that locust. If the analysis concludes that the risk of a major outbreak in the summer is negligible, the pesticide for desert locust control should be retained in Khartoum. In that event, it would form the reserve for the proposed follow on project, so reducing the cost of that project.

It is more difficult to determine the amount of pesticide which will be needed for grasshopper control. Bait spreading primarily be farmers is likely to be the most widely used method. A purchase of 20 M.T. of fenitrothion technical for grasshopper control which can be reformulated as EC if required, is suggested, and 190 M.T. bendiocarb and 400 M.T. propoxur, sufficient to make up 8,500 M.T. of bait.

Note: for 1987 the PPD purchased 8,500 M.T. of husks. Based on FAO recommended dosage rates of bendiocarb (@ 0.5g. active ingredient per kg.) and propoxur (@ 2.0g. active ingredient per kg.) the quantities of powder to be ordered are as follows:

Bendiocarb 1% powder	at $2.60/kg	190 MT
Propoxur 2% powder	at $1.50/kg	400 MT

6. Transport and Storage Facilities

The safe disposal of outdated chemicals and clean up of store compounds by removal of contaminated soil and wastes for decontamination is a matter of urgency. Based upon preliminary estimates from Shell a sum has been budgeted for this.

To the extent PPD is unable to do so with their existing resources, contracts will be needed for transport of Avgas and diesel vehicle fuel. Storage and disposal of outdated pesticides will be covered under a separate contract.

It is recommended that pesticide import and transport, and also dispersement of Avgas and vehicle fuel to field stores be dealt with as last year. This will require the provision of counterpart funds.

F. Training

The Project Manager should organize a training course for locust control team leaders in advance of the campaign using the other consultants and local experts. The accent must be on practical work, not lectures. Certain visual aids and equipment are likely to be needed.

The consultants concerned with survey and reporting, and application and spraying techniques should pay particular attention to on-the-job training. A second formal training course should be held at the end of the campaign (October) partly to discuss problems arising during the campaign.

The stores management, administration and logistics expert should organize a training course for PPD staff in charge of stores, transport and distribution. He should conduct another course for lower staff and laborers in field stations stressing the safe handling of toxic pesticides. The accent should be on practical training.

G. Other equipment

1. Radios

Budgetary provision has been made for 12 SSB/HF radios - 4 to be installed in Khartoum based staff vehicles, 2 for western region which is still short and 4 in reserve, e.g. for installation in aircraft.

Note: A manufacturer with a local agent is preferred. Sets should be crystallized not fully synthesized.

2. Protective clothing.

The following will be needed for the 1987 emergency campaign:

Simple cotton nose/mouth masks	10,000
Coveralls, caps, and goggles	1,200 each
Leather boots for field team	200 pairs
Rubber boots, and rubber gloves each	1,200 pairs of
Water containers, towels, and soap	as needed

3. Camping Equipment

Camp equipment and water containers will be needed for consultants and for reserve. Large tents for the field teams will also be needed. Some other items especially survey and control team equipment (sweepnets, ventimeters, binoculars, etc.), spray trial equipment (anemometer, cages, sampling quadrats, maps, insecticide pumps) will be needed (this requires both hard currency and local currency funding).

4. Spares for Ground Sprayers.

It does not appear that any additional sprayers are necessary, but additional spares need to be purchased for the ground sprayers already on hand.

H. Evaluation of 1987 Emergency Assistance

An evaluation team consisting of two people should visit Sudan towards the end of, but not after, the 1987 summer emergency campaign. This suggests a September to October timing. The Mission should consist of an expert well versed in locust control and organization of control campaigns who, preferrably, also has experience with grasshopper control. The second evaluation team member should be a logistics expert.

The evaluation team should review all aspects of the campaign including, finances, survey methods, information gathering, quickness of response, campaign organization, methods of control, supervision of control, distribution of supplies and storage, safety, and likely effectiveness of the campaign as a whole.

The evaluation team should work closely with the Task Force and should report to the Steering Committee. The team would be best organized by FAO, and the final report would go to FAO who would distribute it to donors.

VI. IMPLEMENTATION SCHEDULES

The 1987 summer emergency campaign will need to start in June. Thus, it is clear that action, especially in the ordering of pesticide and the recruitment of the Manager must be carried out at once. For example, fenithrothion ordered now (February) might still not arrive in time for distribution before the rains commence; much the same delivery time is likely for most of the other supplies. Probably the fastest and easiest way would be for donors to authorize EEC to act on their behalf. Further emergency action can await the sanction, support and perhaps modification of the proposal herein by FAO's Locust Other Migratory Pests and Emergency Operations section, provided that is available by mid-March. At the same time, review of this paper should be undertaken by donors. A means of initiating the required donor cooperation and coordination for the proposed assistance would be for FAO to convene a meeting, not later than April 1987, of potential donors with representatives of the Sudan government, to consider the recommendations proposed and to solicit support for the three year medium term project.

The ordering of minor items should be carried out by the Manager in consultation with the head of PPD's Locust Section. Following is a short synopsis of the major actions required for the 1987 emergency assistance and for the medium term project:

A. Implementation Schedule for 1987 Emergency Campaign

February:
(a) Emergency assistance project design completed.

March:
(a) Recruit Project Manager (preference should be given for someone who would be available for the proposed 3 year follow-on project).
(b) Order fenithrothion, bendiocarb, and propoxur.
(c) Order vehicles.

(d) Recruit two spraying applications specialists (for one of them, again preference should be given for someone who would be available for proposed 3 year follow-on project).
(e) Recruit short term consultants for 1987 campaign.
(f) Survey by Shell of outdated pesticides to be completed.

April:
(a) FAO holds donor coordination meeting to consider follow-on project, its funding and implementation.
(b) Start of removal of outdated pesticides to Wad Medani.
(c) Start of stores rehabilitation.
(d) Project Manager arrives and Sudanese counterpart assigned.
(e) Stores administration expert arrives and Sudanese counterpart assigned.
(f) Review of minor items and spares necessary for campaign - ordering of these items.
(g) Tendering of aircraft hire contract.
(h) Distribution of fuel and avgas.
(i) Preparation of transport schedule for distribution of equipment and supplies.
(j) Booking training facilities and ordering of training aids.

May:
(a) First application expert arrives, and his Sudanese counterpart assigned.
(b) Tour of field areas to assess state of preparedness.
(c) Equipment engineer arrives.
(d) Environmentalist arrives.
(e) Distribution of fuel and avgas.
(f) Arrival of bait, its mixing and distribution.
(g) Training of selected stores managers on record keeping, and others on safe handling of pesticides.

June:
(a) First survey expert arrives.
(b) Training course for officers likely to be in charge of field operations.
(c) Arrival of liquid insecticide.
(d) Distribution of liquid insecticide (but only after analysis of risks from the desert locust - if no major risk the liquid insecticide for locust control should remain in Khartoum).
(e) Start of regular surveys of summer breeding areas.

July:
(a) Second application expert arrives.
(b) Survey and control campaign in progress.
(c) On-the-job training of PPD staff in regions.
(d) Upgrading of Information Office in Khartoum...

August:
(a) Continuation of campaign and on-the-job training.
(b) Assessment of effectiveness of control methods.
(c) Monitoring of area dosages.
(d) Departure of application engineer and first survey expert.
(e) Arrival of second survey expert.

September:
(a) Continuation of campaign.
(b) Arrival of Review Mission.
(c) Departure of second application expert.
(d) Departure of environmentalist.

October:
(a) Completion of Review Mission.
(b) Senior staff training and review course.
(c) Planning for desert locust winter campaign.

November:
(a) End of summer campaign.

B. Implementation Schedule for Three Year Project

1987 December:
(a) Project Manager arrives (or continues)
(b) Distribution fuel/pesticide for winter/spring
(c) First Application expert arrives (or continues)
(d) Secretary/admin. assistant recruited
(e) Survey winter/spring breeding area starts
(f) Biogeographer arrives

1988 January:
(a) Survey expert arives
(b) Ordering of pesticide and equipment
(c) Second application expert arrives
(d) Continuation of survey and control
(e) Locust application and assessment trials

February:
(a) Spray equipment engineer arrives
(b) Continuation survey and control
(c) Locust application and assessment trials

March:
(a) End of winter/spring campaign
(b) Training course for seconded PPD officers
(c) Second application expert leaves
(d) Survey expert leaves
(e) Biogeographer leaves
(f) Spray equipment engineer leaves

April:
(a) Planning for summer campaign
(b) Stores Management, admin. assistant and biogeographer arrives

May:
(a) Preliminary surveys and breeding areas
(b) Distribution of materials for summer campaign

June:

(a) Survey of summer breeding areas
(b) Possible start summer locust control campaign
(c) Stores management administration and and logistics expert leaves
(d) Devlopment ULV methods for ground control/equipment and testing

July:

(a) Survey expert arrives
(b) Environmental impact assessment expert arrives
(c) Survey and control summer breeding areas
(d) Development and testing continued
(e) Control criteria expert arrives

August:

(a) Assessment of environmental impact locust and grasshopper control (summer conditions)
(b) Estimation of threshold levels for grasshopper control
(c) Summer campaign continues
(d) Continuation testing and of development ground control methods

September:

(a) Environmental impact assessment continues
(b) Estimation of threshold level continues
(c) Summer campaign continues
(d) Review of pesticide stocks and reordering

October:

(a) Training course for PPD seconded officers
(b) Survey expert leaves
(c) Environmental expert leaves
(d) Threshold estimation expert
(e) Project Manager leaves for recreation leave

November:

(a) End of summer campaign
(b) Senior staff training course and review

December:

(a) Planning for winter/spring campaign
(b) Biogeographer arrives for 2nd visit
(c) Preliminary winter/spring breeding area surveys

1989 January:

(a) Return of Project Manager
(b) Second application expert arrives 2nd visit
(c) Start of winter/spring campaign
(d) Interim evaluation missior arrives
(e) Arrival of survey expert

February:

(a) Continuation spring campaign
(b) Further development and assessment ground control methods
(c) Assessment of needs for summer campaign
(d) Ordering of supplies

March:

(a) Continuation spring campaign
(b) Arrival equipment engineer
(c) Training course PPD seconded officers

April:

(a) Overseas visit Head Locust Unit
(b) Survey expert leaves
(c) First application expert leaves for recreation leave
(d) Biogeographer leaves
(e) End of winter/spring campaign
(f) Application expert leaves on recreation leave

May:

(a) Planning for summer campaign
(b) Arrival stores management, administration and logistics expert
(c) Preliminary summer breeding area surveys
(d) Distribution of pesticide and supplies
(e) Equipment expert leaves
(f) Head of Locust Unit returns

June:

(a) Start of summer campaign
(b) First application expert returns from leave

July:

(a) Arrival of survey expert
(b) Arrival of damage threshold level estimation expert
(c) Assessment and development control methods
(d) Continuation of summer campaign
(e) Stores management, administration and logistics expert leaves

August:

(a) Continuation of July activities

September:

(a) Continuation of August activities

October:

(a) Training course for PPD seconded officers
(b) Damage threshold level assessment expert leaves
(c) Survey expert leaves

November:

(a) End summer campaign
(b) Senior staff review of years' activities

December:

(a) Environmental impact assessment expert arrives on 2nd visit for winter/spring spraying)
(b) Preliminary surveys winter/spring breeding area

1990 January
(a) Start of winter/spring campaign
(b) Arrival survey expert
(c) Arrival application expert
(d) Development ground application methods and equipment testing
(e) Environmental impact assessment

February:
(a) Continuation of January activities
(b) Ordering equipment and supplies summer campaign

March:
(a) Continuation of February activities

April:
(a) Application expert leaves
(b) Environmental impact assessment expert leaves
(c) Survey expert leaves
(d) End of winter/spring campaign
(e) Arrival of spray equipment engineer
(f) Training course for PPD seconded officers

May:
(a) Planning for summer campaign
(b) Arrival stores management, administration and logistics and expert
(c) Distribution stores and equipment
(d) Preliminary summer breeding area surveys

June:
(a) Start of summer campaign
(b) Refinement of ground application methods
(c) If no major changes had occurred, mock campaign will begin and expert to plan it will arrive

July:
(a) Survey expert arrives
(b) Stores management, administration and logistics expert leaves
(c) Continuation of June activities

August:
(a) Continuation of July activities
(b) Mock campaign ends and expert who planned it leaves

September:
(a) Final evaluation mission
(b) Training course for PPD seconded officers

October:
(a) Senior level training course and review

November:
(a) Final report presentation
(b) End of project

VII. FINANCIAL PLAN

The design team did not sufficient time to discuss the levels of PPD support likely to be expected for either the emergency program, or to the three year project. PPD's budget does not specifically provide for locust or grasshopper control activities (see Appendix B); and, it is not yet finalized for the proposed project years. However, the design team has been assured that sufficient budgetary provision will be provided for any emergency, as well as for all other project assistance proposed herein.

PPD's contribution to the project has been assumed to be the usual support facilities, e.g. offices, vehicle maintenance, PPD staff salaries and per diem. It is assumed, also, that laboratory facilities for residue analysis will be available.

It is suggested that, if necessary, donors request PPD to provide a budget of the Sudanese government proposed inputs.

Budgets follow for the 1987 Donor Emergency Campaign, and for the proposed three year project. Please note that no provision has been made for inflation and that the contingency line item is conservatively planned to be less than 5% of the emergency campaign budget, and less than 8% of the three year project budget.

A. 1987 Emergency Desert Locust Budget

Item	Cost $US 000
Hard Currency Needs	
Consultants (total 41 person months)	
Project Manager (8 person months)	80
Applications Experts (total 9 person months)	90
Survey and Reporting Experts (total 8 person months)	80
Spraying Machinery Expert (3 person months)	30
Stores Management, Administration and Logistics (8 person months)	80
Environmentalist (5 person months)	50
Office Equipment and Supplies	5
Aircraft charters for personnel movement	80
Aircraft hire for survey and spraying	600
Vehicles	375
Vehicle spares, including tires	100
Other spares and equipment, including training aids and radios	80
Fenitrothion technical (ULV)	1500
Benciocarb 1% powder	500
Propoxur 2% powder	600
Protective clothing	10
Evaluation	15
Diesel fuel	20
Contingencies, including tents and other camping equipment	130
TOTAL	4525
Local Currency (in U.S. dollar equivalent @ 4SL=$1)*	
Secretary/Admin. Assistant	15
AvGas	80
Renovation of PPD laboratory at Wad Medani	50
Equipment and supplies	10
Clearing costs	75
Pesticide disposal and decontamination	100
Hire of vehicles for pesticide/fuel distribution, survey & control	100
Contingencies	20
TOTAL	450
Non-Emergency Requirements	
Provision of storage facility rehabilitation	
hard currency costs	500
local currency costs	2500
TOTAL	3000
GRAND TOTAL	7975

* This local currency budget is not comprehensive and does not include all local costs such as PPD salaries and per diem which it is expected PPD will cover.

B. Donor Project Budget in US$ 000 ***

Item	Year 1	Year 2	Year 3	Total
Technical Assistance				
Long Term				
Project Manager	120	120	120	360
Spraying Applications	120	120	120	360
Secretary/Admin. Asst.	15	15	15	45
Subtotal	255	255	255	765
Short Term				
Spraying Applications	30	30	30	90
Survey	60	60	60	180
Environmental	40	40		80
Spraying Equipment	30	30	30	90
Biogeographer	40	40		80
Control Criteria	40	40		80
Stores Administration	20	20	20	60
Logistics	5	5	5	15
Mock Campaign			20	20
Subtotal	265	265	165	695
Commodities				
Pesticides				
Fenitrothion*	1000	500		1500
Powders	600	400	400	1400
Others (depending on research)		500		500
Vehicles & Spares	150	150	225	525
Office Equip. & Supplies	5	5	5	15
Protective Clothing	10	10	10	30
Ground Sprayers & Spares	10	20	5	35
Radios & Spares	20	18	5	43
Camping Equipment	10	10	5	25
Research Equipment	15	10	5	30
Survey Equipment & Supplies	10	10	5	25
Subtotal	1330	1633	665	4128
Other				
Aircraft Hire**				
Survey and Transport	80	80	80	240
Spraying	600	200		800
Vehicle Hire for movement of pesticides/AVGas/Survey and control for locust campaign**	100	50	50	200
Evaluation	25		25	50
Research	25	15	15	55
Overseas Training		25		25
Contingency	140	156	162	442
Subtotal	970	1130	332	1812
Grand Totals	3320	2673	1417	7400

* May be less if savings in 1987 - aim should be at least 120 M.T. reserve fenetrothion technical or equivalent.

** Savings may be carried forward to next year(s).

*** The budget does not include rehabilitation of stores mentioned on the emergency assistance budget page.

Appendix A.

Suggested Aircraft Hire Contract Terms

1. Fixed wing aircraft for grasshopper and locust spraying.

(a) Requirements: Endurance: At least 4 h 30 min.

Spray Equipment: 2 or more Micronair rotary atomisers, flow meter, variable restrictor, inflight flow regulation.

Insecticide carrying capacity: At least 350 kg.

Other matters: (i) Facility for carrying a passenger on spray sorties.

(ii) Willingness to fit SSB/HF radio (radio supplied by PPD - fitting by supplier of aircraft.

Note 1: Supplier will be responsible for supply of insecticide loading, equipment (pumps) and supervision of loading.

2: PPD will supply fuel at field strips.

3: Aircraft must be of rugged construction able to operate from bush airstrips.

4: Pilots should be skilled in aerial application and willing to apply insecticide as directed subject to aircraft safety. Spraying will be under the direction of officers of PPD e.g. flow rate, track spacing, flying height, wind speed, Micronair blade setting.

5. The supplier will be reponsible for all maintenance and all insurance including passenger liability and third party.

Terms: Hire will be carried out under a contract operating for 4 months starting on 1 June, 1987. The contract may stipulate any minimum number of hours of hire so that the supplier will be under a legal obligation to supply. The contract will be for hire on an hourly basis with fractions of hours paid pro rata. The supplier should state whether there will be a different non-spraying (ferry) rate and whether a daily 'standby rate' will be charged whether the aircraft is used or not.

Payment: Payment will be made in local currency by the Regional Office of the Food and Agricultural Organization of the United Nations. However, to cover possible rapid inflation the contract will be let in US$ i.e. it will be paid for in local currency at the prevailing free market exchange rate at the time of submission of the account.

Forms will be provided in which time (engines on to engines off) will be recorded for each sortie. These will be signed by the pilot and the senior PPD or project officer on the spot. One copy will be retained by the pilot. These are the basis for payment and no payment will be made without the signed sortie forms.

Notes: (1) No payment will be paid for the return of aircraft to main base for servicing and repositioning in the field, unless repositioned at a different place.

(2) The supplier shall be responsible for per diem and other expenses of the pilot and others of his staff employed

2. Fixed wing aircraft for locust survey.

(a) Requirements: Endurance: At least 4 h 30 minimum; preferrably with a cruise speed of greater than 200 km/h; preferrably with a high wing configuration for good visability; and with a facility for carrying at least three passengers.

(i) Willingness to fit SSB/HF radio (radio supplied by PPD - fitting by supplier of aircraft.

1: PPD will supply fuel at field strips.

2: Aircraft must be of rugged construction able to operate from bush airstrips.

3: Pilots should be skilled in navigation by map.

4. The supplier will be reponsible for all maintenance and all insurance including passenger liability and third party.

Terms: Hire will be carried out under a contract operating for 4 months starting on 1 June, 1987. The contract may stipulate any minimum number of hours of hire so that the supplier will be under a legal obligation to supply. The contract will be for hire on an hourly basis with fractions of hours paid pro rata. The supplier should state whether there will be a different non-spraying (ferry) rate and whether a daily 'standby rate' will be charged whether the aircraft is used or not.

Payment: Payment will be made in local currency by the Regional Office of the Food and Agricultural Organization of the United Nations. However, to cover possible rapid inflation the contract will be let in US$ i.e. it will be paid for in local currency at the prevailing free market exchange rate at the time of submission of the account.

Forms will be provided in which time (engines on to engines off) will be recorded for each sortie. These will be signed by the pilot and the senior PPD or project officer on the spot. One copy will be retained by the pilot. These are the basis for payment and no payment will be made without the signed sortie forms.

Notes: (1) No payment will be paid for the return of aircraft to main base for servicing and repositioning in the field, unless repositioned at a different place.

(2) The supplier shall be responsible for per diem and other expenses of the pilot and others of his staff employed.

Appendix B

Statement of the budget approved for the fiscal year 1986/1987
Plant Protection Department

Station	No. of Personnel "Unclassified"	Total Wages Allowance	Items		Sum Approved for 1986/87
Headquarters	882	3,807,384	Item I:	Office & general expenditures	
National Capital	212	402,348		01/107/02/01/01 - Water, Electricity & hygiene services	12,000
Sennar	112	346,608		01/107/02/01/02 - Rents	36,000
Malakal	74	138,180	Item II:	Departmental Services	
Kassala	100	293,20		01/107/02/02/02 - Department of Mechanics	80,000
El Gedaref	120	391,376		01/107/02/02/02 - Railways	23,100
Juba	134	344,328		01/107/02/02/03 - Sudan Airways	14,250
Ed Damer	169	510,528		01/107/02/02/04 - Post & Telegram Services	82,450
Dongola	176	481,676	Item III:	Other Non-Department Services	
Kadugli	91	272,064		01/107/02/03/01 - Rents (Vehicles and transport agents of animal kind)	198,000
New Halfa	29	85,460	Item IV:	Repairment and maintenance services other than that which rendered by the Ministry of Work.	
Kosti	310	803,548		01/107/02/04/01 - Building maintenance	2,100
Shendi	225	516,168		01/107/02/04/03 - Road, bridges, channels and orchard maintenance	350
Port Sudan	145	1.475,400		01/107/02/04/04 - Maintenance of machinaries and other things of imporance	77,850
Wad Medani	205	882,388			
Ed Dueim	118	401,304			
Pesticide Laboratory "Medani"	21	113,940			
El Fasher	175	598,900		01/107/02/04/05 - Temporary labour and temporary work	120,000
El Obeid	267	697,236	Item V:	Maintenance and Supplies	
				01/107/02/05/03 - Fuel, oil and greasing oil	98,400
			Item VI:	Current payments (Agriculture fleet)	
				01/107/02/06/09 - Other current payments	200,000
			Item VII:	Miscellaneous	
				01/107/02/07/01 - Contingencies and special credit	31,000
			Item IX:	Special	
				01/107/02/09/06 - Pests eradication	2,800,000
				01/107/02/09//09 - Field pests control	350,000
				01/107/02/09/10 - Cotton cleaning	250,000

Appendix B (continued)

Development Budget

Japanese Aid	5,400 Million US$
Local Budget	3,415 Million LS

Appendix C

1986 Emergency Campaign Donor Assistance

SUDAN
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EEC

TOTAL: ECU 2,000,000 = 2,000,000

M+	50,000 l Fenitrothion	ECU 677,200
M+	5,000 l Fendona ULV	ECU 32,320
M+	10,000 l Diazinon	ECU 83,100
M+	12 sets camping equipment	ECU 12,940
M+	sprayers	ECU 17,640
M+	dusters	ECU 1,160
M+	400 mt diesel fuel	146,000
M+	14 vehicles and spare parts	ECU 18,880
M+	20 VHF radios	ECU 9,850
M+	technical assistance (through FAO)	ECU 107,120
M+	insurance	52,510

FAO TCP (TCP/SUD/6651)

TOTAL: 231,000

M+	25,000 l Fenitrothion	(++)
M+	90 flying hours	(++)
M+	operating costs	(++)
M+	technical assistance	(++)

FINLAND

TOTAL: (280,000)

B+	56,000 l Fenitrothion 50 percent	(280,000)

GREECE

TOTAL: (50,000)

B+	80 mt HCH	(50,000)

ITALY

TOTAL: (1,000,000)

B+	50,000 l Malathion	(350,000)

JAPAN

TOTAL: 102,000

M+	15,000 l Fenitrothion 96 percent ULV (through FAO)	102,000

NETHERLANDS (THROUGH FAO, ECLO/SUD/003/NET)

TOTAL: 1,000,000

M+	41,200 l Diazinon a/v	420,900
M+	5,000 l pesticide	40,000
M+	20 locust sprayers	50,000
M+	35 portapak sprayers	10,210
M+	200 Microulva sprayers	5,420
M+	camping equipment	27,640
M+	vehicle spares	6,000

M+	6 Toyota P/U	57,500
M+	6 Land Rovers	109,880
M+	2 load carriers	68,000
M+	35 radios	42,110

SPAIN

M+ 114 mt IRON (through FAO) TOTAL: 62,511 — 62,511

SWEDEN (TPR/DOB FAO)

TOTAL: 560,560

M+	25,000 l fertilization 96 percent DLV	272,810
M+	7 mt Progenur 15 percent	171,244
M+	pesticide	5,956
M+	6 [illegible] sprayers	42,220

[illegible]

TOTAL: [illegible]

M+	[illegible]	[illegible]
M+	[illegible]	[illegible]
M+	[illegible]	[illegible]
M+	[illegible]	[illegible]
M+	[illegible]	[illegible]
M+	[illegible]	[illegible]
M+	[illegible]	[illegible]
M+	[illegible]	[illegible]
M+	[illegible]	[illegible]
Br	[illegible]	[illegible]

YUGOSLAVIA

Br sprayers TOTAL: [illegible] (64,000)

TOTAL, SUDAN: 1,375,019