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Guidelines for the development of

**Country Contingency Plans for Desert Locust
Plague Control Campaigns.**

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This Guide applies to a situation of recession with infrequent short-lived plagues. That has been the case since 1962. If a persistent plague develops any Plan would need to be modified but not fundamentally altered.

This Guide deals essentially with actions and dispositions before the start of control operations. After control has started rigid planning becomes impossible.

1 Introduction

1.1 The Desert Locust

The Desert Locust (*Schistocerca gregaria* (Forskål 1775) can infest an area stretching roughly from Mauritania to India and from the Mediterranean to the equator in Africa. Nearly all the countries within that area maintain locust units and the Food and Agricultural Organisation (FAO) plays a co-ordinating role. In addition donors provide large sums in times of need. For example, during 1988 and 1989 some \$200,000 was given and 12 million litres of pesticide in Ultra Low Volume formulation supplied, according to FAO. This shows that the Desert Locust is regarded as a serious pest.

The Desert Locust can exist in two behavioural states although there are transitional forms. In the solitary the locust behave as the term implies as individuals. However, if numbers increase the behaviour changes; gregariously behaving locusts form bands of nymphs (hoppers) and swarms of flying adults. The presence of a great number of bands and many swarms, some of which are large, is considered to constitute a **Plague**. During a plague solitary behaving locusts are absent or at least unimportant. Plagues are separated by recessions when bands and swarms are at most few, small and transient.

The end of a recession is marked by an **Outbreak**. This is characterised by small gregariously behaving units each of a few thousand nymphs (hoppers) clustered at the base or within a clump of vegetation. These are often called “patches” or in French “taches”. The Outbreak may be followed by further successful generations of breeding in which case a Plague will eventually exist. The build-up sequence is called an **Upsurge**. During an Upsurge the number, size and cohesion of the gregariously behaving units changes progressively but there are characteristically always a mixture of types of infestation. That makes an Upsurge both difficult to combat and difficult to plan for.

1.2 Control

The ultimate purpose of all Desert Locust activities is control. All other activities are secondary. If we cannot control the locust other activities – survey, reporting and so on - have little point. “Control” has three elements: we need a reliable method of treatment, we need to be able to find the infestations and demarcate the target, and we need to be able to deploy sufficient resources to “contain” the infestation. Contain probably means to destroy at least half the locust in a major sector of a seasonal breeding area. That might seem imprecise but as a rule only one or two relatively discrete sectors are infested in a particular season. Thus an Outbreak is likely to occur in only one sector of some thousands of sq km, within the many millions of sq km that comprise the recession area.

Almost all control now uses the Ultra Low Volume (ULV) “incremental” spraying technique, applying pesticide in small droplets of a concentrated formulation along well-spaced tracks. The method requires a steady wind to spread the pesticide over a wide swath; the deposit is built up “incrementally” from overlapping swaths. That means the target block must be relatively large.

Application will give a good kill with recommended pesticides if carried out properly. Control failure is often blamed on the pesticide but very seldom correctly. “A bad workman always blames his tools.” The patches of an outbreak are too small to treat incrementally but the total amount of pesticide needed in a campaign is so small that economical treatment is not important. The ULV method of treatment is dealt with fully in the FAO Desert Locust Guideline – Control.

1.3 Control systems.

There are essentially three types of sprayer; hand-held, vehicle mounted and aircraft.

These differ in many ways. One of these is the height of the spray head; that influences the swath width and hence the minimum target size. This is especially important for band control by aircraft. The ULV block must be much larger than even the largest band so a block needs to contain a number of bands. That is usually expressed as the % band infestation. The intractable problem of band block demarcation is dealt with in a separate simulation¹. Small individual bands can be dealt with on foot and larger ones by vehicle. Vehicle sprayers can in addition be used to treat blocks containing a number of bands. It is also possible to treat a large hopper infested area with very widely spaced tracks if a highly persistent is available. This is usually called “barrier” spraying although that is not a good term; it implies a well-defined band of dosed vegetation whereas even with tracks 1 km apart, most of the area will receive some pesticide. With tracks 500m apart or less the whole area will be dosed although not dosed evenly. That is important since widely spaced true barriers will not be effective unless the bands are mobile; the band needs to reach the dosed vegetation that the hoppers and then eat. The problem of defining the area to be treated is similar to that with the treatment of blocks. Since the mean % infestation would be less, defining on the basis of search for bands would be even greater. In practice areas would probably be defined using various sources of information; distribution of rain and green vegetation, reports of hopper bands, reports of mature and laying swarms and so on. “Barriers” are usually applied by aircraft, partly because of the difficulty of laying down long parallel tracks by vehicle.

Swarm control is currently attempted only when the swarm is settled. Roosting swarms can in theory be treated by vehicle. But that means finding the swarm, getting equipment to the site and spraying before the swarm departs. Even in situations where swarms remain settled, aircraft treatment is more usual.

Swarms can be sprayed while they are flying; flying swarms may either form a relatively low sheet (“stratiform”) or pile up to a considerable height (“cumuliform”). Swarms may also be treated when settled or when “milling” either before settling in the evening or before departure in the morning. Settled swarms can be treated in the same way as hoppers and the same dosages will almost certainly be effective. The settled swarm is likely to be large enough to form a ULV aircraft treatment block. However, swarms may well be settled during daylight, only in the late afternoon and the early morning. Then there is often too little wind for effective ULV spraying. Flying locusts are however very efficient collectors of small droplets since the insect always moves through the spray cloud at its flying speed. Almost certainly much less pesticide would be needed to treat a flying swarm than to treat the same swarm when settled, but there have been no trials to find an optimum dose. Trials would be very difficult. There is some evidence that spraying “milling” swarms can be very effective and very efficient.

The control systems and types of target are set out in Table 1. It is not easy to operate several control systems in the same area; an area in which teams are treating individual bands should not be “barrier” sprayed – something that can easily occur.

2 Contingency Plans and the Guide

2.1 Contingency plans for Plague Control Campaigns

Control Campaigns can be divided into 3 types; those against Outbreaks, those to combat Upsurges and those to deal with Plagues. *This Guide deals only with Plague campaigns*².

A “contingency” is considered to be an event whose nature can be predicted but one that occurs irregularly and with limited warning. An invasion by swarms during a plague fits that definition. It would be impractical and certainly wasteful to keep a constant capability – large

¹ The computer programme can be obtained from the FAO Locust and Migratory Pest Section in Rome.

² There is a note on Outbreak and Upsurge Campaigns in Appendix 2.

stocks of pesticide, a fleet of spray aircraft and so on- to deal with an event that might occur once a decade or even less often. An international task force has often been proposed but is not a practicable proposition. The only feasible solution is to develop plans for individual countries, perhaps with some regional backing or exchange of resources and expertise, that can be put into effect when a plague threatens.

2.2 About the Guide

Every country is different, with a different infrastructure and facing different risks. Some countries are large; some are small. Some are poor; some relatively rich. Some have a valuable cash crop agriculture; others have mainly graziers and subsistence farmers. Every country will decide how best to deal with a plague infestation. One plan will not fit all. But the same matters will need to be considered for all countries although the answers may differ.

Some matters essential for the operation of control may lie outside the scope of the plan; availability of pesticide is the most obvious. A Plan must envisage a control system or systems. For example, a Plan that relied on individual band treatment would be radically different from one that relied primarily on "barrier" spraying. There is no agreement about which systems should be relied upon. In the Guide as far as possible specific answers are assumed. The alternative would have been a Guide that dealt in generalities.

The Guide deals with a Plan for a large country that has a permanent autonomous locust Unit. Such a country will normally lie within the recession area. The Guide will then deal with modifications to the Plan likely to be needed for countries largely outside the recession area, where locust operations are carried out within the Plant Protection Department by officers with other duties (Appendix 1). The Guide also deals with Plan modifications for Countries wholly outside the recession area where locust operations are needed only during a plague (Appendix 1).

3 Basic considerations

3.1 The Locust Unit.

There is no standard Unit. On the other hand all Units should be small enough to be reasonably occupied during recessions and when there is no campaign. The Unit should be small enough to be maintained during such periods and provided with enough funds to operate. Every Unit must have a Director, a Senior Field Officer, an Administrative Officer and an Information Officer. A Unit might have say 10 Field Officers and appropriate support staff. Such a Unit should have a pick-ups for each Senior Officer and each Field Officer, and at least 1 truck. There should be a radio network (HF – SSB). There should be a radio at H Q, at any field bases and in all vehicles. All technical staff should have a satellite global positioning device (GPS).

3.2 Scope of Unit Director under a Plan

The Director of the Locust Unit must be in sole charge of operations under the Contingency Plan. All staff including seconded officers should be answerable to him. Once the Plan is in operation the Director should not have to obtain permission from higher authority to act within the scope of the Plan.

A locust control campaign is like a military campaign in many ways. The campaign will not be effective if operations come under regional authorities with the Director of the Unit playing merely a co-ordinating role. This is crucial and must be made clear within the Plan and agreed at Ministerial level when the Plan is adopted.

3.3 Ultra Low Volume application

No other system of control is currently practised on a significant scale. High volume application, dusting and baiting will not be considered.

3.4 Ground and aerial control.

Many ground teams are needed to achieve as much as one aircraft³. To run a major campaign without aircraft would require a very large fleet of vehicles equipped with ULV sprayers. Such would be very difficult to assemble, train, equip, deploy, and direct. It would not be wise to use the small number of experienced officers likely to be available solely for ground control. Ground control has played only a minor role in recent major plague campaigns.

3.5 Band and swarm control.

Currently only settled swarms are attacked. This does not happen often because of swarm mobility; it is difficult to locate the swarm and carry out control before the swarm takes off. Furthermore, ULV spraying is ineffective in still air that is usual in the early morning with a temperature inversion and in the late afternoon. However, aerial control of bands requires much more pesticide and many more aircraft, and is unlikely even in theory to be able to treat all the bands of a plague breeding. Spraying flying swarms is said to put the aircraft at risk but there is no evidence that this has been so in the past.

Such circumstantial evidence as exists and also theoretical studies³ suggest that spraying bands alone with the resources that could be deployed effectively would not be sufficient to contain a plague population. In the Guide both band and swarm control is envisaged.

3.6 Outlining band block targets.

The only practicable method is to outline blocks from the air. This can be done successfully when the bands are visible. The method is not currently practised. Aerial block demarcation has the additional advantage that once pilots have been shown what constitutes a target block they can carry out control independently. That presupposes that some Unit staff have experience of aerial band block demarcation (see below).

3.7 “Barrier” spraying.

This is a very powerful method of band control allowing very large areas to be treated rapidly with relatively little pesticide. The method needs a highly persistent pesticide. Here fipronil appears to be an adequate replacement for dieldrin. Probably areas for treatment could be outlined adequately using information from a variety of sources; band reports, distribution of rain and green vegetation, distribution of parent swarms. That has not been attempted; the method of demarcation would need to be checked. But more important is the matter of possible environmental impact. Donors and FAO are unlikely to be willing to supply fipronil, though of course a country could itself buy fipronil and apply it.

³ See Resources for Control Campaigns – a series of analyses obtainable from The Locust and Migratory Pest Section, AGP, FAO, Via delle Terme di Caracalla, Rome 00100 Italy.

3.8 Resources.

Theoretical estimates³ and major plague campaigns in Australia suggest that the Unit envisaged with some seconded officers (see below) could run c 10 aircraft and apply at most 200000 litres of pesticide (see below). To supply more aircraft and more pesticide would almost inevitably mean aircraft being under-utilised or being used inappropriately.

3.9 Aircraft

3.9.1 Spray aircraft

Ideally the need is for a relative long range, a modest spray load and a place for an observer. Most commercial spray aircraft have a short range, a large spray load and only a place for the pilot. It is important to know what might be available since that affects the Plan. For example, if only short-range spray aircraft are likely to be available, possible airstrips must be located and setting up airstrips must be envisaged. It is easier to organise a campaign using a few commercial airstrips but that means having relatively long-range spray aircraft.

3.9.2 Survey/communications aircraft.

There will be a requirement for "spotter" aircraft especially if the spray planes cannot carry an observer. These will be needed especially to detect and outline band block targets. Experienced observers may need to demonstrate what constitutes a target to less experienced Field Officers and pilots new to locust control. These aircraft could also be used to transport Senior Officers to and from the field. Many light aircraft would be suitable and in most countries should be available locally.

"Spotter" aircraft can lead to the more efficient use of more expensive spray aircraft. Further, a Field Officer in a "spotter" can assume the responsibility for target demarcation that it is not fair to load on the pilot.

The number of "spotter" aircraft envisaged depends on how it is intended to use them. If used fully 1 "spotter" for every 3 spray aircraft would be reasonable.

3.9.3 Helicopters

Helicopters should be envisaged only if a specific requirement is foreseeable such as control in narrow valleys or perhaps search for low flying swarms.

Spraying costs roughly eight times as much per unit area treated by helicopter as when treated by aircraft.

3.9.4 Differential Global Positioning Systems (DGPS)

Such systems permit precise track spacing Equally importantly they allow the precise recognition of the spray block boundaries, and the recording of the location block corners and hence of the area of the block.

DGPS is on great value. Consideration should be given to making the equipment mandatory in spray aircraft contracts.

Consideration of the proper use on DGPS and indeed of proper spray application generally lies outside the scope of the Guide. But those are matters of fundamental importance.

3.9 Choice of pesticide

There may be little choice. The pesticide may be a product available in the country normally used for other purposes. Pesticide supplied by a donor may be a product chosen by the donor. Where a preference can be registered that should be for a product with some persistence (since that compensates for unevenness in deposit) and for a formulation

effective at c 0.5l/ha rather than 1l/ha. It is claimed that a dosage 0.5 l/ha gives too few droplets to produce a sufficiently even deposit. That is unlikely and rates as low as 350 ml/ha have been used successfully. Doubling the volume application means roughly doubling the number of aircraft and doubling the supply trucks. Apart from the extra cost the extra aircraft may not be available.

3.10 Technical assistance and training

During the last 40 years there have been perhaps only 2 upsurges that reached plague status and neither lasted long. Very few officers have had plague campaign experience. Further, the plague campaigns were inevitably improvised, and no attempt was made to assess what was treated and with what success.

There are 2 requirements; for Seniors especially the Unit Director who will run the campaign, training in campaign organisation and execution, and for Field Officers training in finding, defining, demarcating and treating targets. Training course for both lie outside the scope of the Plan since both require external experts. Both are jobs primarily for FAO. However, a training course is no substitute for practical experience. The Senior Field Officer or his deputy should be detached to work within a campaign in another country when ever and where ever a major campaign is mounted. That again is probably a task for FAO.

The Plan should envisage assistance in the form of consultants with campaign organisation and execution experience. Once more that is a matter for FAO.

Because there have been so few major campaigns there will be a need for technical advice from a consultant with campaign organisation and prosecution experience during the campaign and in fact starting well before the date of the forecast invasion.

3.11 Secondment

No more officers should be seconded to the Unit during a campaign than the Unit can use. Even officers who have received some training are unlikely to be able to function completely independently. The Unit should run a training course in locust biology and behaviour, and in the theory and practice of ULV application at regular intervals. Officers available for secondment should join a Unit survey.

4 The fundamentals of the Plan

4.1 Warning

Swarm migrations are relatively well documented and relatively regular. The occurrence and timing of a swarm invasion should be able to be predicted with fair reliability. But of course the further ahead the postulated invasion, the less certain the forecast. The possibility of a swarm invasion and the date of its occurrence within a "window" of say 8 weeks, can be forecast as much as 9 months ahead; that is on the basis of the progeny of the breeding before the breeding giving rise to the postulated invasion. If the swarm progeny survive, mature and lay, the forecast could be increased to "possible" and the invasion "window" reduced to perhaps 6 weeks. Once fledging in the source area is under way the forecast can be increased to "certain" and the time of invasion predicted within perhaps a 3 week "window". No development is totally certain but an invasion given young swarms in a source area is certain enough.

Scale is much more difficult to predict. It is very unlikely that a forecast could justify only a partial operation of the Contingency Plan.

In the Guide 3 stages are envisaged with specific actions at each stage;

- 1 *Possible*
- 2 *Probable*
- 3 *Certain*

This is fundamental to the Plan.

4.2 The Information Officer

The job of the Information officer under the Plan is to keep a check on the locust situation and in consultation with the FAO Desert Locust Information Service advise the Head of Unit when the situation justifies the activation of stages of the Plan.

5 Prerequisites for a Plan

5.1 Security and aircraft operating permission

There are security problems in some parts of some countries. That may rule out operations on the ground and make pilots reluctant to fly there. The pilot is the sole judge of aircraft safety. Flying may not be allowed in some other areas because of a perceived external threat. Both situations may change. The security situation will of course be under constant review as part of normal survey operations. It may though be necessary to seek permission for spray aircraft to operate in what are normally exclusion zones. The Minister should make a preliminary approach to the authority controlling air operations at the "Possible" stage and follow this with a specific request including dates at the "Probable" stage.

5.2 Provision of pesticide

There is currently no justification for holding large stocks of pesticide for locust control within a country; there would be storage and potential disposal problems. Both problems would occur if more pesticide was supplied to combat a plague invasion than was needed or than could be applied properly. A limited stock should be kept at all times but not more than some tens of thousands of litres.

It would be difficult to justify purchase of a large quantity of pesticide before an invasion was classed as "likely". That might be as long as 6 months where low temperature slows breeding but no more than 3 months in other situations.

If the country can purchase pesticide from its own resources, the warning period might be sufficient. If funds have to be found from donors through FAO or if pesticide has to be purchased directly by donors, the warning period would be insufficient. The solution in both cases is a "pesticide bank" where pesticide is purchased but held by the company and air freighted only when and where needed. That reduces delivery time to a few weeks. The company could with permission sell the pesticide and replace it so avoiding problems of "shelf-life" and disposal. Such a scheme would have to be funded by donors and probably operated by FAO. Richer locust affected countries could use the scheme on repayment.

In a few countries large quantities of pesticide are used regularly. Such might if of a suitable product, be diverted to locust control and replaced. The arrangements to do that would be specific to each country and have not been considered further in this Guide.

The matter of pesticide supply is crucial but in most cases will lie outside the control of the country and hence outside the Contingency Plan.

5.3 Provision of Aircraft

There are a number of ways aircraft might be provided: from another branch of Government in particular the military; by hire within the country; by hire from outside either with country funds or with donor funds which normally means through FAO.

The Guide deals mainly with the supply of aircraft from outside. That is likely to be the source of most aircraft in most countries.

Supplying aircraft should be quicker than supplying pesticide. Raising funds from donors will still take time. Then the constraints are finding a supplier and agreeing a contract.

FAO should keep an up to date list of potential suppliers with details of type and characteristics of aircraft potentially available. FAO should prepare a model contract or contracts to cover all aspects of hire for its own use as well as for use by countries. This should be done in collaboration with country representatives, those with experience of the use of aircraft for locust control as well as contract specialists. There needs to be decision about the aircraft characteristics and the fuel type (Avgas or JetA1). Companies whose aircraft fulfil the minimum requirements should be short-listed. Matters to be decided within the contract include the provision of fuel- whether or not within the hire, the spray load, the endurance, the spray equipment (rotary atomisers, in-flight flow regulator, flow meter) including satellite track guidance systems (DGPS), other equipment including pesticide and fuel pumps, and radios, especially linkage with the locust HF-SSB system. Should the installation of country supplied UHF radios (for air to ground communication at the spray site) be envisaged?

Hire can be arranged in a variety of ways. There is often a positioning charge, or a minimum usage. Where either are high the hourly rate may be relatively low.

Contracts can be and should be prepared in advance possibly in consultation with potential suppliers. This should mean that a good contract can then be let quickly when the need arises.

5.4 Import and movement restrictions

In many locust affected countries (LACs) importation is a slow and costly business. There must be agreement in advance that under the Plan import duties will be waived and immediate access allowed to the goods. It may be desirable to import pesticide by air directly to the areas most affected by locusts. This should be envisaged under the Plan.

5.5 Operating funds

Local currency. A fixed sum should be agreed to be provided at a stipulated stage for matters such as field allowance, fuel, local spotter aircraft hire etc.

Hard currency. For countries that are able to finance pesticide provision and spray aircraft hire a similar provision should be agreed to be provided at a stipulated stage. Provision through international assistance is unlikely to be in cash.

This is a crucial matter requiring donor and FAO decision and provision.

6 Before the Campaign

6.1 A donor "Steering committee"

A Committee made up of donor representatives and Seniors from the Locust unit has proved useful in the past. The Committee should not meet when there is no reason. It would be better to have the principle of a Committee endorsed by donors and ask a representative of a

leading donor to convene an initial meeting when the situation warranted, say at the "Possible" warning stage.

If committee meetings are called when there is little to discuss members will cease to attend. There is the other danger that the Committee will turn into a bunch of "arm-chair strategists" trying to run the campaign. The Committee should meet progressively more frequently as the situation develops.

6.2 A Campaign Newsletter.

An Information Sheet or Newsletter should be produced but not necessarily at a set interval and starting only at the "Possible" warning stage. This will set out the locust situation and what is being done and contemplated to meet the threat. The letters should become more frequent as the situation develops. The Newsletter should go to the Minister and with his permission to the media and to others, and to the Steering Committee members.

7 The campaign

7.1 The phases of the campaign, and the availability of pesticide and aircraft.

There are potentially three phases of a plague campaign: to combat the incoming parent swarms; to deal with the hopper bands that result: to attack the swarm progeny. These will overlap. Thus swarms are likely to arrive in several waves spread over a week or so. Many females will lay twice and some perhaps three times with at least a week between layings. So some parents are likely to be still alive when bands start to form.

There are 2 difficulties with a parent swarm campaign. Firstly, there is very little time between the forecast that an invasion is "certain" and the invasion, and only a limited warning of a "probable" invasion. Secondly, the exact date of the arrival of the first swarm will never be precisely predictable.

The former means that, assuming the decision to acquire pesticide can be made only at the "probable" stage, the pesticide may well not have arrived by the time of the invasion. The latter means that even if pesticide is available, hired aircraft arriving in time for a forecast invasion might spend several weeks on the ground before swarms actually arrived.

We suggest that the negotiated spray aircraft contract should not be activated, that is a call for aircraft should not be made, until the first swarms arrive. However, that means aircraft from outside the country would be unlikely to arrive in time to attack the parent swarms.

7.2 Campaign resource distribution

Supply of fuel, pesticide and support to bases will be critical for campaign operations. Movement may be very difficult during the campaign and just before, since the locust breeding season is in most cases the wet season also. Movement will be particularly difficult to and from airstrips in remote locations. On the other hand, commercial airstrips near towns of some size, may well be few and far from the locust targets. Furthermore spray aircraft with good endurance may not be available.

Even if substantial quantities of pesticide are available within the country, distributing pesticide and fuel to airstrips covering the seasonal breeding area might result in much being in the wrong place. Redistribution from one remote airstrip to another during the campaign would be very difficult indeed. But where pesticide must be bought with aid funds and then shipped, pesticide is unlikely to be available to distribute ahead of a swarm invasion anyway.

There is the further difficulty of accommodation for pilots at airstrips. Pilots do not demand luxury but they must be decently fed and housed if they are to do their job.

There is no simple answer to the distribution, supply and re-supply problem. The matter should be analysed carefully, if possible using a "war game" simulation (see below).

8 Responsibilities.

Clearly there can be no detailed campaign plan since each locust situation and each country is different. However, the duties and responsibilities of campaign staff should be considered, and also the matter of checks and records.

8.1 Head of Unit and Senior Field Officer

One or other should be in the field throughout the campaign. Only then can the operational problems be understood. If both remain at H Q decisions may be unrealistic and not implemented.

8.2 Information Officer

He should collate, plot and analyse all incoming data on a daily basis and discuss with the senior officer at H Q what dispositions should be made. These should be discussed immediately by radio or mobile phone with the senior officer in the field before being acted upon.

8.3 Officers i/c field bases

At all bases from which operations are mounted – normally the airfield from which spray planes function – one officer should be designated as being in charge. He should decide on daily operations from the base, brief and debrief pilots and any ground control or search teams, and keep a daily record of operations, especially of control targets attacked (see control forms).

9 Checks of targets and kills

It is of crucial importance that a sample of target treatments is evaluated. In the case of swarms and individual bands that means only % kill. But with band blocks an estimate of the % infestation, that is the % of the block that is occupied by the bands, is essential also. Estimating % infestation is time consuming.

9.1 Percentage Kill

Estimating numbers before and at intervals after spraying is difficult and it means revisiting the spray site. It would work only with bands that move little after spraying. Caging a sample is easier. Plastic flasks (c2l) with holes in the lid are quite satisfactory. A sample must be collected before spraying and caged with unsprayed grass to act as a control. Locusts collected after spraying should be caged with unsprayed grass. Hoppers should also be caged with sprayed grass since hoppers will stay in a sprayed area and may acquire pesticide by eating or contact with dosed vegetation. Three sets of flasks each with 20 –30 locusts

would be reasonable. Checks should be made at 24, 48 and finally 72h after spraying. The last check is the most reliable since with the earlier ones the cages must not be opened.

Swarm evaluation is possible only when the complete swarm is treated at one time and is not possible with high flying "cumuliform" swarms. Such swarms are common during a plague in east Africa but may be less usual elsewhere. Again locuists collected by sweep net immediately after spraying can be caged but since swarms move only with unsprayed grass.

9.2 Percentage Infestation

In principle this is straight-forward. The sprayed area is crossed by a set of parallel transects and the proportion of each that cuts through band noted. However, it is not at all easy to decide where a band starts and stops. It is much simpler to stop at regular intervals and note whether one is in a band or not. Usually the transect will be by vehicle. The stops can be made at 0.1 km intervals. It is though important to make the stop on the basis of the odometer reading, and only then check to see whether there is a band below the observer's door. The % of points in band is a measure of the % band infestation. There is no set amount of transect but if stops are made at 0.1 km intervals transects should not be closer than 0.1 km apart. Such estimates will of course be subject to "error" as is the case with all sampling but at the moment we have no estimates at all of the % infestation in ULV treated blocks. It is of course important that the estimate is made immediately before or immediately after spraying.

10 Other matters

10.1 Information for pilots

Few pilots will have had locust control experience. A short booklet describing the targets and the control methods might be useful. There should be in addition, a 1 day course covering the same material and also matters relevant to the forthcoming campaign- location of bases, structure of the campaign team, responsibilities, communications and so on.

Spray pilots must be taken on an aerial reconnaissance with an experienced officer, to show what hopper bands look like from the air and roughly what constitutes a target block.

10.2 Detachment to campaigns in other countries.

When a campaign is mounted in another country, either the Head of Unit or the Senior Field Officer should visit and participate in field operations. **This must include aerial search for bands and aerial band block target demarcation.**

11 Review

After the campaign there should be a thorough Review of the campaign and also of The Plan. In the light of this The Plan should be revised.

12 Producing and testing the Plan

Each country is likely to need assistance and advise in the preparation of a Plan.

This should take the form of a Workshop where the items in this Guide are examined, followed by development of a Plan within the country

The Plan should then be tested as realistically as possible by a "war game".

The Workshop, provision of a consultant to help with Plan preparation and the development of a “war game” are matters for FAO.

An Outline Plague Campaign Contingency Plan

1 Fundamental

- 1.1 Ministerial approval should be sought for the concept of a Contingency Plan – to combat a Desert locust swarm invasion and the subsequent breeding. The aim would be general population reduction not immediate crop protection. The principle should be accepted that all operations under the Plan would be made by the designated officer in charge – the Head of the Locust Unit where a Unit exists.

This would not of course preclude local immediate crop protection by farmers or Plant Protection officers.

- 1.2 The plan is based on 3 levels of threat of a swarm invasion: **Possible, Probable, Certain**. The threat deals only with timing not with scale. There are 2 elements to timing; firstly the approximate time ahead when the invasion is predicted; secondly the dates, that is the “window”, within which the invasion is expected to occur. For example, an invasion of Sudan might be predicted as “Possible” in November to occur the following June or July. By March that might have become “Probable” to occur between early June and late July. By May an invasion might have become “Certain” to take place in June.

2 Basic

2.1 The Locust Unit.

The staff should comprise:- Director, Senior Field Officer, Information Officer, Administrative/stores Officer, Field Officers, support staff.

Each officer to have a 4 wheel drive vehicle.

HQ, all vehicles, any field bases, to have HF-SSB radios. (Permission must be secured in advance on a continuing basis not merely under the Plan).

All officers should have a Satellite Positioning System (GPS) device

Other resources required for routine Unit operations are not covered in this Guide.

2.2 Functions under Plan.

Duties and functions of Head of Unit, Senior Field Officer, Information Officer, Officers i/c bases.

2.3 Resources (reserve).

As little as possible should be held since items can be mislaid and even non-perishable items can deteriorate. Good storage buildings are not always available and stores are not always routinely checked.

Pesticide: Enough should be held to start operations but not so much that disposal might become a problem if no invasion occurs for many years. A pesticide that can be used for other crop protection purposes as well as for locust control would be desirable. This is no standard figure since much will depend on emergency arrangements by FAO and donors over which a country has no control. c 20,000 l effective at 0.5l/ha is a tentative figure.

Sprayers: Vehicle mounted ULV sprayers at 1 per 2 suitable vehicles. These are not likely to be critical to the campaign but should be held none the less.

Aircraft pesticide loading pumps: These may be supplied under the hire contract but it would be prudent to hold c 5 pumps.

Reserve HF-SSB radios: If fitting is feasible, enough should be held to equip (attached) vehicles for seconded officers. The time needed to fit the radios should be investigated.

UHF radios: Holding enough to equip teams and aircraft should be considered. However, air to ground communication at the spray site may not be critical. Alternatively suitable radios may be able to be acquired quickly when needed.

Camping equipment: The need will depend mainly on the decision about use of airstrips. If equipment can be bought locally purchase should not be made until there is a need. Camping equipment deteriorates in store. Moth and dust corrupt even if thieves do not break in and steal!

Other: The above is not a complete list. It should be added to as omissions come to be realised.

2.4 **Secondment.**

Suitable named officers should be designated for secondment. Such officers will need to have formal and on the job training (see below). It would be a mistake to second more officers than the Unit could use; that probably means no more than 1 seconded officer for each Unit Field Officer.

Each seconded officer must come with a suitable vehicle and a driver. A number of trucks – say 4 with drivers - should also be made available. Who –which Department - should provide vehicles and drivers should be specifically set out in the Plan. Officers should be named.

2.5 **Control records forms.**

Forms to record each control operation should be prepared. A form that might be used can be found in the FAO Desert Locust Guideline – Control. This may not be suitable for individual band control. A form more suited to air operations is given in Appendix 1.

- ⇒ Booklet for pilots.
- ⇒ Arrangements for import and movement.
- ⇒ Local hire of spotter aircraft –availability and draft contract
- ⇒ Provision of spray aircraft- mechanism, source and draft contracts.
- ⇒ Provision of insecticide – mechanism, type and time delay.
- ⇒ Review of state and facilities at commercial airfields and possible airstrip locations.

3 **Regular annual**

- 1 Check stores and replenish.
- 2 Arrange for some “seconded” officers to join surveys.

4 **Regular biennial**

- 1 Training course for “seconded” officers.
- 2 Revision of aircraft hire contracts.
- 3 Review of control systems and developments.
- 4 Review of commercial airports and possible airstrips.

4 Every 5 years

Complete review of Plan and reaffirmation of all aspects of the Plan.

Virtual test-run of Plan.

Activation.

- 1 Information Officer informs Head of Unit invasion “Possible”**

Head of Unit informs Minister and heads of departments holding “seconded” officers, senior donor representative.

First “steering committee” meeting held.

Newsletter started (initially monthly).

Minister makes a preliminary approach to authorities dealing with flight operations giving the possible areas and dates
- 2 Information Officer informs Head of Unit invasion “Probable”**

Head informs Minister.

Minister declares Plan operational.

Minister requests specific aircraft operating permission with areas and dates

Second “Steering Committee” meeting held and regular future meetings agreed.

Mechanism for supply of pesticide operated.
- 3 Information officer informs Head of Unit invasion “Certain”**

Operating funds released. Hard currency funds released.

Spotter aircraft contract let-date of hire from predicted first invasion.

Spray aircraft hire contract let.-precise start date to be informed later.

Distribution of reserve pesticide.
- 4 Start of predicted invasion “window”.**

Arrival of Consultant(s) with experience of campaign organisation and prosecution.

Field teams deployed where incursions likely.

Local people and local officials alerted.

Aerial surveys for swarms instituted with spotter aircraft.

Pesticide arrives???
- 5 First swarms reported**

Pesticide and fuel distributed to field bases.

Spray aircraft called for.

All teams deployed in field to locate swarms and report laying.

Need for seconded officers and vehicles indicated with likely start date.
- 6 Spray aircraft arrive.**

Seconded officers and vehicles arrive.

One day course for pilots and seconded officers.
- 7 Start of control operations.**

Observation flights for pilots to demonstrate band block targets and perhaps control of last (parent) swarms.

Operation of campaign

1 Supplementary

- Secondment to other countries during campaigns especially to gain practical experience of aerial band block demarcation and swarm spraying.
- Theoretical activation of The Plan as a “War Game” to see as far as possible whether The Plan is feasible and what has been missed.

2 Action by FAO and donors.

Crucial aspects of a Plan depend not on the country but on FAO and donors.

These include:

- The efficient operation of the Desert Locust Information Service.
- The provision of pesticide and aircraft where and when stipulated.
- Arrangements for and possibly funding of LAC senior officer secondment to other campaigns.
- The provision of Consultants.
- The development of spray aircraft hire contracts.
- Keeping of a register of companies with suitable aircraft for hire.
- Preparation of a brief Guide for pilots.

There is the further fundamental underlying requirement for FAO to provide expert assessment and advice to countries, and to act as an intermediary between donors and countries. This means alerting donors. But it also means attempting to ensure that provision is appropriate both to need and ability of countries to use effectively.

The development of Plans will require FAO to organise Workshops where the matters in this Guide are analysed and discussed, and to assist countries in writing and testing country Plans.

Final

No Plan will be effective unless those operating the Plan know their job. That is of course obvious but can easily be overlooked. Locust control is about finding and killing locusts, and killing enough to make a difference. A Plan is merely a means to that end.

It is essential that methods to deploy aircraft effectively especially using DGPS and for swarm control, are fully understood and put into practice.

Appendix 1

Desert Locust Aerial Control Sortie Record

(to be completed by the pilot and signed by the pilot and the locust officer i/c base)

Date
Base Name
Time take off
Approx location of spray operations(lat:long)
Pesticide type and formulation.
Estimated pesticide used litres (total in sortie)

Pilot
Location(lat-long)
Time touch-down

Application conditions:

Wind
Calm / Light /Moderate –Strong
Steady/Variable
Flying conditions
Smooth/Bumpy (convection)

Complete (A) or (B)

(A) Hopper control

Location of target block

- (i) Prior to take-off:
General
OR
Precise location of block(s) corners (enter values)
- (ii) At spray site:
Ground party present
Yes
Block corners indicated
Yes
GPS values (enter lat: long of corners to sec or decimal of minute)/
OR
Flags or similar/
No
Target located and demarcated by “spotter” aircraft: Yes/No

Target located and demarcated by pilot: Yes/No
If DGPS enter lat:long of corners(to sec or decimal of minute)
And
Area of block(s) (ha)
If lat:long corners not known enter estimated block(s) area (ha)

Treatment

Track spacing m (if not 100m)
Spraying height (m)
Area of block(s) ha

(B) Swarm control¹

Location of target block

(i) Prior to take-off:
General
OR
Location (lat:long)

(ii) In flight:

Target located by ground party. Yes/No
Target located by “spotter” aircraft Yes/No
Target located by pilot Yes/No
“Spotter” aircraft at spray site Yes/No
Location of target swarm (lat /long-to minute)

Settled /Flying “Stratiform”/Milling

(Treat as block)

Track spacing (if not 100m)
Area(s) treated ha
Pesticide used (L)
Flying “Cumuliform”
Plan area of swarm- length 2 transects at rt angles
Pesticide used (L)

Pilot sign

Field Officer countersign

¹ It is difficult to be precise about swarm control. Settled and low flying swarms can be treated essentially like a hopper target block. With milling and high flying swarms covering the whole swarm is difficult and almost certainly not critical since the locusts will be changing position ie locusts will be entering and leaving the spray cloud where ever the cloud is within the swarm.

Delimitation of the target area is much easier than with hoppers since the swarm presents a single target whose boundaries are usually reasonably clear.

Appendix 2

Countries on the periphery of the recession area that have no permanent Locust Unit.

Where a Unit is in effect created each year to carry out seasonal surveys, the Plan needs little modification. The officers with the functions of a permanent Unit will exist and be named although they may have other duties for much of the year.

The Information Officer should however be constantly deployed to keep a check on locust developments. That need not occupy his time fully – perhaps only an hour a day – for most of the year. He should undertake the regular checking procedures.

The embryo Unit should however be deployed on a regular full time basis at or after the “Probable” stage.

Countries wholly outside the recession area with no locust deployment outside the Plan.

It is tempting to devise a modified Plan with the help of Consultants. This is a mistake. A Plan may lie dormant for several decades by which time it will be out of date assuming anyone remembers a Plan exists.

However, one reasonably senior officer should be designated as Head of Plan Operations. He should attend a Planning Workshop and should keep in general touch with locust developments. He should be seconded to countries where a campaign is in progress.

FAO (DLIS) should alert that person at the Possible invasion stage. Consultants should then help the country to prepare a Plan based on the Guide.

FAO should organise an in country Workshop for all officers likely to be involved in a campaign.

Appendix 3

Outbreak and Upsurge Campaigns

Outbreaks are confined to the recession area. Not all of that huge area is potential outbreak country but probably more is than has preciously been thought. Outbreaks cannot be forecast ahead of the rain that produces the conditions for successful breeding although an outbreak does not always follow rain. There will be no more than 4 or 5 weeks to prepare a campaign. That is too short a time to obtain outside assistance.

The only feasible method of control of the many "patches" of an Outbreak is by searching the suspect country and treating the patches found with hand-held sprayers. To have any impact requires many people and many vehicles but very little pesticide.

There is no scope for elaborate planning. However, the use of seconded officers and vehicles as set out in the Plague Contingency Plan should be considered. It would be necessary to hold a stock of hand-held or back-pack sprayers; enough for all Unit Officers and seconded officers with some in reserve.

Types of sprayer should be tested. Micron Sprayers ULVA is the hand-held device in most common use. It is light and cheap but it is an "incremental" spray device. It is not intended for treatment of a few square meters.

Upsurges come with progressively longer and more reliable warning as the upsurge develops. There may well be time to bring into operation a Plan that depends on outside help and internal deployment. The difficulty is to know what type of infestation, or more correctly what mixture of types of infestation, to expect. The control systems for different types of infestation are set out in Table 1. One might prepare for aerial control only to find that the hoppers failed to form cohesive bands and the adults failed to cohere into swarms.

That is it is difficult to decide in advance what type of resource to acquire as well as on what scale. Where pesticide and aircraft are available within the country the resources can be called upon only when the nature of the infestations becomes clear; but in most cases that is not possible.

All this is unhelpful. It is thus of the greatest importance that Upsurge campaigns are examined thoroughly and objectively so that we can hope to do better next time.

Table 1: Application, areas and types of target

Application				
Method	Area	Type of target	Incidental	targets (ii)
Hopper			Hopper	Adult
Hand/ back-pack	<2ha	Patches Groups Very small bands		
Vehicle	2 ha -1sq km ?	Individual bands Small blocks (i)	Groups Patches Scattered	
Air - block	1 -10 sq km	Bands	Groups Patches Scattered	
Barrier				
500 m -	>10 sq km	Mobile (larger) bands Less mobile (small) bands?	Groups? Patches? Scattered?	Defined swarms ? Ill defined swarms? "Flights"? Groups? Scattered?
1 km +	> 10 sq km	Mobile (larger) bands		
Adult				
Vehicle	<1sq km	Settled swarms (iv)		
Air	1-10 sq km (iii)	Settled swarms (iv)		
Air	1-10 sq km (iii)	Milling swarms		
Air	1-10 sq km (iii)	High flying swarms		
Air	1-10 sq km (iii)	Low flying swarms		
(i) Difficult to drive 1 km tracks c 35 m apart				
(ii) Types of target controlled in addition to targets justifying spraying.				
(iii) Maximum in 1 sortie. Most swarms need many sorties.				
(iv) Wind usually light in morning or evening when swarms settled. Control likely to be poor.				