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PROGRAMME DOCUMENT

Emergency Prevention System
for Transboundary Animal and Plant Pests and Diseases
(EMPRES)

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Desert Locust Management in the Central Region

Food and Agriculture Organization of the United Nations

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SUMMARY

Background and justification

The Desert Locust is considered to be one of the most devastating pests of agriculture. Since 1987 large scale control operations have been carried out with few interruptions and have caused considerable concern in relation to their economic costs, the safety and environmental impact of the chemical pesticides used, and the capacity of existing organizations to deal with the problems in an efficient and effective manner.

The FAO Council in mid-1994 endorsed a proposal for the development of an Emergency Prevention System (EMPRES) for transboundary pests, with a major focus assigned to the Desert Locust. Given the importance of the Central Region as a source of many Desert Locust outbreaks and upsurges, it was proposed that the programme would begin in this region, focussing on countries on either side of the Red Sea, and expanding later into other regions. The current programme document deals with EMPRES (Desert Locust) activities in the Central Region. A comparable document has been prepared for the Western Region.

Detailed background information on the Desert Locust, analyses of the problems and difficulties associated with its control, as well as justifications for a preventive approach have been provided in Annexes I and II of the original version of the programme document. The programme is designed as a collaborative effort between key locust-affected countries, regional institutions, such as the FAO Desert Locust Control Commission for the Central Region (CRC) and the Desert Locust Control Organization for Eastern Africa (DLCO-EA), donors which have traditionally provided assistance to Desert Locust management, and FAO which has a mandate for overall monitoring and coordination of Desert Locust matters.

The EMPRES (Desert Locust) programme in the Central Region began as pilot activities in 1995 and 1996, after which a full donor-assisted programme started in 1997. A document for the full programme was prepared in October 1995. As requested by the Evaluation Mission (1999), the current document is a revised version of that document, prepared in early 2000 as part of the planning process for the Second Phase of the programme. The modifications incorporated take into account the experience gained during the first three years of the programme, as well as the evaluation of the EMPRES (Central Region) programme in July/August 1999, which concluded that certain aspects of the programme needed to be more clearly defined.

Programme goals and concept

The development goal of the EMPRES programme is:

To reduce the risk of Desert Locust plagues emanating from the Central Region of the Desert Locust distribution area in order to mitigate food security, economic, and environmental concerns in the Central Region and beyond.

The programme goal is:

To strengthen the capabilities and capacities of national, regional, and international components of the Desert Locust management system to implement effective and efficient

preventive control strategies based on early warning and timely, environmentally sound, early control interventions.

The strategy of the programme is built around two major axes. It has a strongly **preventive character,** which seeks to improve the effectiveness of dealing with Desert Locust problems as they arise. It also has a strong **learning** component, which includes activities related to regular evaluation of progress, training and research. The latter components will rely heavily on collaboration with existing and planned bilateral projects. (Section C)

The goals and objectives of the programme together with indicators and assumptions are summarized in a logical framework attached as Annex I. The current programme document describes the objectives, important outputs and institutional arrangements of the programme in general terms. More specific outputs and activities applicable to each of the following two programme phases foreseen will be defined in form of participatory workshops prior to each of the phases.

Objectives

1. To increase the level of coordination of Desert Locust monitoring, survey, and control activities in the Central Region by facilitating networking between national, regional, and international organizations and by strengthening information exchange systems (core programme)

   A regional EMPRES unit will be established in the Central Region for coordinating and organizing the activities of the programme. It will collaborate closely with the CRC. Coordination will involve the activities of national and regional counterpart organizations as well as associated FAO projects. Collaboration will be also sought with various organizations and bilateral projects which have an interest in the Desert Locust. An efficient information exchange system will be developed aimed at improving decision making and at rapid mobilization of control operations. (Section D-1)

2. To establish an improved Desert Locust early warning system based on meteorological, remote sensing, and field information capture and analysis

   Survey operations will be improved and an early warning system will be established in the Central Region, complementing FAO Headquarters activities, which will identify and monitor actual and potential outbreak areas. (D-2)

3. To strengthen and improve national preventive control capacities through (a) improved planning, training, provision of equipment and operational resources, as well as through (b) the field testing of new control technologies

   The early control capacity of key countries in the Central Region will be strengthened by reviewing and restructuring campaign organization and execution, by training and by providing technical assistance and equipment. Improved methods for monitoring the efficacy of control operations as well as the safe use and environmental impact of pesticides will be introduced. New control technologies, aimed at increasing efficiency and reducing environmental impact, will be field-tested and if applicable introduced at the operational level. (D-3)

4. To formulate improvements in the Desert Locust emergency prevention strategy through evaluating the effectiveness, efficiency and environmental soundness of current approaches and new technologies.

   The programme will introduce a procedure for analysing and evaluating current survey/control methods and procedures, establishing research priorities and recommending the adoption of modified strategies. Among others, this will include economic studies as well as modelling of the effects of various types of control interventions as components for improved strategies. (D-4)

Institutional structure

The following countries are participating in the EMPRES programme in the Central Region: Djibouti, Egypt, Eritrea, Ethiopia, Oman, Saudi Arabia, Somalia, Sudan and Yemen. While the collaboration of all these countries is needed for the success of the programme, there is at present great variability in the capabilities and resources available in these countries. Those efforts from EMPRES, which are directed towards strengthening national capacities, will be particularly directed towards overcoming this imbalance. On the side of FAO a Programme Coordinator will have the overall responsibility for coordination, technical development, budgeting, administration and personnel. The assignment of other staff will be considered as part of planning for each phase of the programme.

The EMPRES programme will collaborate closely with the CRC, to the extent that joint workplans are prepared, that many activities are jointly funded, and that both organizations closely coordinate their activities through regular and frequent contacts. The programme will further collaborate closely with the DLCO-EA. Five of the DLCO member countries are also participating in the EMPRES Central Region programme.

The management and coordination of the programme will involve two bodies:

(1) A Consultative Committee comprised of senior representatives of all participating countries, organizations and donors which either take part in the implementation of the programme or support it directly or indirectly. The Consultative Committee will meet approximately every year and will have a mandate to review EMPRES activities and results, to review the workplan and the budget, evaluate the constraints and problems, review coordination/collaboration and special issues, and make recommendations to FAO on necessary actions that should be taken.

(2) EMPRES liaison officers appointed by the participating governments and DLCO-EA who will meet once or sometimes twice a year with FAO staff and relevant experts. These workshops and meetings will be aimed at producing annual workplans and ensuring collaboration during the implementation of the programme.

Budget

For the first 4-year phase of the EMPRES Central Region programme, FAO and donors have allocated approximately $ 5.5 million in inputs. It is anticipated that comparable resources will be needed during subsequent phases.

Sustainability

It is expected that the EMPRES programme will need multi-donor support over three phases of 3 or 4 years each. However, each phase will involve modifications reflecting evolving knowledge and conditions as well as experience gained from the programme implementation. By the end of these phases, it is anticipated that national Plant Protection Services will have been substantially strengthened both materially and in terms of human resources to organize methodologies, technologies, and resources for Desert Locust survey and control in a more systematic manner. At the end of this period there may still be a need for continuing involvement of FAO in some areas such as operating the early warning system or providing ongoing support at a reduced level to some countries. The establishment of sustainable post-EMPRES institutional mechanisms for maintaining available on-going preventive strategies will be an essential objective of the programme. Merging the roles and mandates of CRC and EMPRES under one umbrella, is one of the options, which will be considered. The Consultative Committee has the mandate to review from time to time progress of the programme and to promote the long-term sustainability of its achievements in the light of national control policy statements. (Section H)

A. BACKGROUND AND JUSTIFICATION

The Desert Locust plague of 1986-89 and the more recent upsurges between 1992 and 1998, have caused considerable and widespread concern in locust affected countries, in donor countries and agencies. These concerns relate to the apparent increase in the frequency of such events, the economic costs of control, the safety and environmental impact of the chemical pesticides used, and the capacity of existing organizations to deal with the problems in an efficient and effective manner. A consensus exists that it is important to strengthen the early warning, monitoring, and control systems for the Desert Locust. Early detection of nascent problems would allow control to be undertaken at the earliest possible stage, thus minimizing the risk of significant expansion of important pest populations.

The programme and its justifications are based on a number of detailed analyses conducted since the 1986-89 plague. It builds on past and ongoing efforts by the international community to strengthen national and regional locust control services and to develop more efficient and environmentally acceptable control techniques. It is also based on the premise that affected countries and donors can consolidate and coordinate their efforts under EMPRES in a more effective manner.

The programme is based on the framework proposed by an EMPRES formulation mission which had visited key affected countries in Eastern Africa and the Near East in late 1994. This framework of EMPRES has been discussed and endorsed by a number of international meetings including the 33rd session of the Desert Locust Control Committee (January 1995) and the 4th session of the Desert Locust Technical Group (March 1995).

Background information on the pest, analyses of the problems and difficulties associated with its control as well as justifications for a preventive approach are provided in detail in Annexes I and II of the original version of the programme document.

Part of the difficulty associated with having in place an effective and efficient management system for dealing with the Desert Locust is the biology and ecology and especially the erratic nature of the pest itself. The capability of the Desert Locust for rapid multiplication and long-distance migration under favourable conditions results in highly variable population levels over space and time. This migratory ability means that the problem may shift from one location, country, or region to another in a short period. This has implications with regard to the level of priority given to it in different countries, and the importance of coordination of efforts between countries and institutions. Because of its rapid movement, there are limited windows for control, demanding high organizational and logistical capability. Finally, the Desert Locust covers a huge territory, and areas which need to be monitored, surveyed, or controlled are frequently remote or hard toaccess. This makes it extremely difficult to find and deal with the pest at an early stage in its development.

The history of Desert Locust plagues and upsurges is comparatively well documented and it is known that they originate in so-called gregarisation areas after these have experienced a sequence of favourable rains. During gregarisation Desert Locusts concentrate and multiply and finally form large swarms, which are a serious threat to agricultural production in locust-affected countries. The gregarisation areas along the coasts of the Red Sea and the Gulf of Aden are considered particularly important and the 1986-89 plague as well as recent upsurges have originated in that region. However in the past, gregarisation areas in South-West Asia and in West Africa have also played important roles during the origin and development of upsurges and plagues.

The system of Desert Locust management as currently practised by affected countries, regional control organizations and the international community suffers from a number of deficiencies which are interrelated and tend to reinforce each other. Those which need to be addressed most urgently are:

(i) The Central Region of the Desert Locust distribution area (Eastern Africa and the Near East) has not been sufficiently recognized as a major source of locust upsurges and plagues. Too much is assumed of the capacity of some of the key countries in that region to conduct the surveys needed to monitor the Desert Locust populations and give early warning of developing upsurges as well as take firm early and timely control measures. It needs to be better recognized that some affected countries will require considerable time and support before they will be able to sustain an effective monitoring and control capacity.

(ii) At the international level, FAO, as the key UN Agency for locust control, through its Regular Programme, is constrained by financial resources to support field operations, to promote, coordinate and monitor research, as well as to strengthen the activities of the Desert Locust Control Committee and the three Commissions for controlling the Desert Locust in North West Africa, the Near East, and in South-West Asia.

(iii) While some funds are available to FAO to handle emergencies, the majority of emergency funds comes from donors in response to the spectre of Desert Locust plagues. Frequently, these emergency funds cannot be allocated fast enough in order to intervene at an early stage, resulting in further breeding and migration of the locust and in an escalation of the cost of control. Management of the Desert Locust on an emergency basis, that is combating upsurges and plagues as they occur - in contrast to ongoing regular management oriented to prevention - appears not to be cost efficient, impedes development, increases the risk of adverse environmental impacts, and makes no sustained contribution to better scientific understanding of the Desert Locust and its control.

(iv) Insufficient attention has been paid to the organizational and logistical changes which were required by the switch in the 1970s and early 1980s from a control strategy using persistent organochlorines to a technically more demanding strategy based on less persistent pesticides. The consequences of this shift in strategies with regards to overall efficacy of control operations have not been analyzed thoroughly enough.

The constraints experienced during the last campaigns are outlined in more detail in Annex III of the original version of the programme document. In addition to the constraints in the current locust management systems, there is an urgent need to promote more vigorously research aimed at improving monitoring, forecasting and control methods, including the development of methods which could replace the currently used chemical pesticides. Although the current pesticides are less persistent they are still hazardous to humans and the environment.

Responding to the above, the FAO Council in mid-1994 endorsed a proposal for a Special Programme on the development of an Emergency Prevention System (EMPRES) for Transboundary Animal and Plant Pests and Diseases, with a major focus given to the Desert Locust. Given the importance of the Central Region as a source of many outbreaks and upsurges it was proposed that the programme would begin in this region, focussing on countries on either side of the Red Sea, and expanding later into other regions.

During the design of the programme it became clear that collaborative efforts by a larger number of partners would be needed to address the problems associated with Desert Locust management. Discussions with donors about such collaboration started in 1995 and a full donor-assisted programme started at the beginning of 1997. On its side, FAO has allocated Regular Programme resources to EMPRES which have been used in early 1995 to start urgently needed initial activities in key locust affected countries. These were aimed at establishing an early warning system in the Central Region and to strengthening the capacity to react quickly to build-ups of pest populations in critical areas. The pilot activities were integrated into the full Central Region programme when it became operational with FAO providing significant support to that programme as well.

A document for the full programme was originally prepared in October 1995. The current modified version of the programme document was prepared in early 2000, in connection to planning for the Second Phase of the programme. The modifications incorporated take into account the experience gained during the first three years of the programme, as well as the evaluation of the EMPRES (Central Region) programme in July/August 1999, which concluded that certain aspects of the programme need to be more clearly defined. In particular, the objectives were defined more precisely in order to enable the formulation of clearer and more focussed outputs. In addition, institutional and collaborative arrangements were described more specifically.

The programme deals with Desert Locust management in the Central Region. It should be noted that, while the Central Region is the main focus of EMPRES, some FAO and donor resources are also allocated for preventive control in West Africa and Southwest Asia, as well as for international components like improving forecasting and information exchange activities at FAO Headquarters. A comparable programme document for the Western Region was formulated in 1998. As of early 2000, implementation of the programme was still awaiting additional donor support. In the meantime, pilot activities are continuing in that region.

The inter-regional importance of preventive Desert Locust control is commonly recognized (see for example section 2 of Annex II of the original programme document). It is widely accepted that an effective system of preventive control requires not only adequate monitoring and early control capacities in the key countries of all regions but also close collaboration between all affected countries within and across regions. While FAO and many countries promote such collaboration it is necessary to remember, and if possible revive, the spirit of collaboration which we know from earlier Desert Locust campaigns. For example in the 1950s locust survey and control teams from Egypt, India, Iran, Iraq, Jordan, Pakistan, Saudi Arabia, Sudan, Syria, the U.K. and Yemen were actively involved for many years in the joint international Desert Locust campaign in the Arabian Peninsula.

B. PROGRAMME GOALS

The development goal of the EMPRES programme is:

To reduce the risk of Desert Locust plagues emanating from the Central Region of the Desert Locust distribution area in order to mitigate food security, economic, and environmental concerns in the Central Region and beyond.

The programme goal is:

To strengthen the capabilities and capacities of national, regional, and international components of the Desert Locust management system to implement effective and efficient preventive control strategies based on early warning and timely, environmentally sound early control interventions.

The goals and objectives of the programme together with indicators, assumptions and responsibilities are summarized in a logical framework attached as Annex I.

C. PROGRAMME CONCEPT

The EMPRES programme concept is designed to satisfy the following conditions:

- its components should contribute to economic and social justification for preventive control strategies,
- it should be environmentally sound ,
- it should be technically and financially feasible,
- it should be sustainable,
- there should be no duplication of existing efforts,
- it should rely and build on national systems,
- it should have the flexibility to adjust to changing conditions and an improved knowledge base,
- it must include a strong technical capability to review and advise on locust control strategies,

It is anticipated that the concept should have the strong support of locust affected countries at both senior policy and operational levels, and the strong support of donors.

On the basis of the various background considerations described above and in Annex I to III of the original programme document, a programme strategy is adopted here which calls for the assignment of FAO field staff in the Central Region. The staff will provide technical advice and support for locust monitoring, control, training and operational research and will include a Programme Coordinator with overall responsibility for coordination and management of the programme, supported by national and regional experts, by international and national consultants and if possible by Associate Professional Officers.

The EMPRES programme strategy adopted here is built along two major axes. Firstly, it has a strong **preventive character,** which seeks to improve the effectiveness of dealing with Desert Locust problems as they arise. This is to be achieved through an improved early warning and forecasting system, and through the strengthened capabilities and capacities of the locust control services in the region for monitoring, survey and control.

Secondly, the strategy has a strong **learning component**. This is premised on the belief that while certain concrete steps can be taken immediately to improve the efficiency and effectiveness of Desert Locust management systems, there are still many gaps in knowledge regarding Desert Locust ecology and management, which need to be addressed, and which may influence the outcome of any programme. There are also new technologies under development, which, if they prove feasible, may influence strategies. The implication of this is that the strategy must be an adaptive one, built on existing knowledge, but allowing for modification as the knowledge base expands.

Given the behaviour of the Desert Locust, the successful development and implementation of a preventive strategy depends also on many actors working towards common goals and objectives. A strong sense of ownership in the programme is needed by the benefiting institutions to ensure its success in the short-term as well as to promote its longer-term sustainability. The EMPRES programme strategy will therefore build on and encourage collaboration among all parties, ensuring that both enlightened self-interest as well as the good-will to participate in a joint strategy which benefits all, are recognized as motivating factors.

Geographically, the programme will focus on Desert Locust early warning and control in the Central Region but will promote the development of related activities in the other regions and will link up and coordinate with these once they become operational. In any case research activities promoted and supported should benefit all countries affected by the Desert Locust. The foreseen information exchange mechanism should be designed to be able to expand to cover other countries in West Africa and Southwest Asia.

D. OBJECTIVES AND OUTLINE OF OUTPUTS AND ACTIVITIES

The following sections describe the objectives of the programme and provide an outline of which outputs and activities are foreseen to be major contributing elements in achieving these objectives. Details of outputs and activities will be formulated when planning for each programme phase.

D-1. To increase the level of coordination of Desert Locust monitoring, survey, and control activities in the Central Region by facilitating networking between national, regional, and international organizations and by strengthening information exchange systems

The core component of the EMPRES (Central Region) programme will be a regional unit which collaborates closely with the CRC and which is responsible for the regional coordination of EMPRES activities as well as for increasing information exchange and collaboration between the EMPRES countries. This unit will also be responsible for ensuring smooth collaboration with other important partners like the DLCO-EA, donor agencies supporting EMPRES bilaterally, and relevant research institutes. The unit will further establish and maintain contacts with partners in other regions with the aim of exchanging experience and information. An EMPRES (Central Region) Programme Coordinator will head this unit and will be assisted by other staff.

To ensure the sustainability of the achievements of the EMPRES programme, it will be important to pay particular attention to the question of what elements of regional coordination and information exchange need to be maintained after the conclusion of EMPRES, and in which form. The establishment of an improved institutional mechanism for maintaining in the long-term regional coordination and information exchange will be an important output under this objective.

Important elements of this core component are expected to be:

- EMPRES **field offices** are established and maintained in a number of strategic locations within the Central Region. Criteria for establishing a field office in a given location include reliable communication facilities, frequent airline connections, easy access to important locust breeding areas and office space provided by the Government. At the beginning of the first phase of the programme, EMPRES field offices were established in Asmara (Eritrea), Sana'a (Yemen), Khartoum (Sudan), and Addis Ababa (Ethiopia).

- A regional network of EMPRES **Liaison Officers**, representing the participating Governments, CRC and DLCO-EA, is established. The Liaison Officers are considered the focal points during the implementation of the programme. They were nominated before the start of the full programme, but were replaced in several cases by the Governments due to staff changes. While the network of Liaison Officers has been functioning for some time, it is necessary that they take on more responsibilities during the implementation of the programme and collaborate more closely among each other.

- A **Consultative Committee** is established, which consists of senior representatives from the Governments of the participating countries (at a level above the Liaison Officers), DLCO, collaborating donor agencies and relevant FAO staff. The Committee will have the mandate to monitor, review and evaluate the programme periodically, making appropriate recommendations to FAO for necessary actions, and to encourage adequate policy and financial support from all partners. The Consultative Committee has been established at the

beginning of the full programme and has met in 1998 and 1999. A third meeting is scheduled for the year 2000.

- A regional **communication network** is designed and established. It is linked to the Desert Locust Information Service at FAO Headquarters and aims at improving information exchange and at facilitating decision-making. The network has been designed and established at the beginning of the programme, but some improvements are still necessary. It is based primarily on e-mail connections. Depending on advances in communication technology in the region it will be desirable to further upgrade the network to enable the transfer of larger files (e.g. files with satellite images, several megabytes in size) through e-mail or FTP/Internet.

- Establish a **post-EMPRES institutional mechanism** for ensuring continuation of a coordinated emergency prevention programme in the Central Region. It is foreseen that some elements of regional coordination and information exchange need to be continued after the termination of the EMPRES programme in order to ensure that the regional capacity for preventive Desert Locust management is maintained at an adequate level. These post-EMPRES activities could be combined with the activities of the FAO Desert Locust Control Commission for the Central Region and could be supported financially in a similar way as the activities of the Commission. Discussions on such a mechanism have started during the first phase and need to be continued at a senior governmental level. Since this mechanism is likely to require formal intergovernmental agreements, considerable time will be needed to finalize it.

- Coordinate **bilateral projects** in regard to the EMPRES goals and objectives. Some donor agencies follow their own policies and have their own expectations concerning expected results. Others, e.g. research institutions, could offer special expertise in certain fields, which are complementary to the programme concept. EMPRES could provide the forum as well as the logistical support to donor and/or implementing agencies to contribute to the achievements of the EMPRES programme as a whole. Already in certain areas, e.g. remote sensing and the development of geographic information systems, such modalities of collaboration are taking place. This kind of bilateral cooperation may have particular importance in environmental investigations, in applied research projects as well as in the development of computer based models, and should further be supported.

D-2. To establish an improved Desert Locust early warning system based on meteorological, remote sensing, and field information capture and analysis

The importance of early warning of Desert Locust population increases cannot be overemphasized. Recent experience has clearly illustrated that there are serious gaps in the current early warning systems for Desert Locust population developments. Leaving aside the issue of a preventive control strategy, which is premised on the detection of early gregarising populations, it is evident that even highly gregarious populations, including bands and swarms are often not being detected to facilitate early control. The result is that major populations appear suddenly without warning and this, coupled with unpreparedness, cause lost opportunities for containment.

Mobile survey teams, well motivated, equipped and trained in standard procedures, are the most important elements of an efficient national early warning system. These teams need to receive adequate support from a special unit in the national Desert Locust service which can provide information on rainfall events, other ecological conditions, as well as on the likelihood of infestations occurring in a given area based on historical data and forecasts (national forecasts as

well as those provided by FAO). This unit should also analyze the survey records, format and transmit the data to FAO Headquarters, prepare national forecasts and, if necessary, translate the results into recommendations for control operations and the activation of specific contingency plans.

Survey operations need support in terms of equipment and training. In addition, the aspects of providing information on rainfall and vegetation distribution for guiding survey teams, as well as the procedures for translating survey records into forecasts and population estimates are currently little developed at the national level.

Remote sensing has long been considered as a promising tool for obtaining information on rainfall and vegetation distribution and has received special attention in the past. For example, satellite information is now routinely used to estimate rainfall events by the FAO Desert Locust Information Service in Rome and progress has been made in detecting, through satellite images, the scarce and scattered vegetation which can support Desert Locust breeding. Current technology offers possibilities of making this information available at the national level. Similarly there is a good prospect for improving the procedures for implementing surveys, the analysis and interpretation of survey result, as well as the processes of translating these results into forecasts and/or decisions to mount control operations.

It should be noted that the activities under this objective link up with several aspects of the next objective, which aims at improving preventive control operations:

- Experience during the first years of the EMPRES programme has shown that activities for analysing needs and filling gaps at a national level are best combined for both early warning and early control aspects. For this a Country Focus approach has been developed which is described below.
- Surveys are also done as part of control operations for finding and delimiting the target areas. Further development work is needed to clarify if, when, and how, surveys to find infestations and surveys to identify targets can or should be combined.
- Training often covers survey as well as control procedures.

It is foreseen that the programme includes the following aspects in order to achieve the current objective:

- Analysing and strengthening the **national early warning capacities** in the EMPRES member countries through Country Focus programmes. The EMPRES Country Focus programmes are designed to improve survey and control operations at the national level. They are being implemented for each country at different times. In 1998 and 1999 Country Focus programmes have started in Eritrea, Yemen and Sudan. At the beginning of a Country Focus programme, the national needs for staff, training, equipment and other aspects as well as potential areas for operational improvements are identified in a participatory workshop. A programme is then developed which attempts to fill these gaps, based on inputs from the country as well as EMPRES. Operational improvements will depend on the needs of individual countries and will cover a variety of aspects. For example there is often a need to establish a system to prepare regularly detailed national survey plans. The financial support of EMPRES to survey operations may also be considered in exceptional cases when critical situations develop, depending on available resources. Countries like Djibouti and Somalia need special attention because their national survey and early warning operations still need substantial development efforts. During the first 3 years of implementation, EMPRES has already made substantial progress in the area of strengthening national early warning capacities. However, it is expected that this work needs to be continued through all three phases of the programme.

- Provide **training** on survey operation, analysis of survey results and on forecasting. Training events will often be combined with training on control operations (see D-3). Improved training concepts and manuals will be developed, especially for training trainers. Considerable progress has been already made during the first 3 years of the programme. However, more attention will need to be placed on developing procedures for identifying training needs and for determining how training events contributed to improved survey and control operations. It is expected that during the three phases of the programme most training events will increasingly be handled self-reliantly under the auspices of the locust control services and will require little external support by the end of the programme.

- Improve procedures for **identifying priority areas for surveys**. National survey teams have currently little information available to guide them to the areas which have recently received rains and which can support the build-up of Desert Locust populations. They have to rely on their own experience as well as on information received sporadically through nomads, scouts or other channels. Often scarce resources are wasted on visiting areas where conditions for breeding are not suitable. Valuable information on meteorological events or vegetation distribution often exists but rarely becomes available to those who organize survey operations. There are a number of areas where improvement is likely to be achievable in the short and medium term. These include a) establishing a system for providing countries with satellite vegetation maps and other remote sensing data, b) establishing biotope maps based on ecological conditions and historical records of Desert Locust breeding, and c) establishing and improving systems for channelling relevant nationally collected information to persons organizing surveys (e.g. meteorological data, scouting schemes, etc.). EMPRES has already made significant progress in this area, particularly in capturing, analyzing and distributing remote sensing data. It is expected that these efforts will start to result in improved operational methods beginning with phase II of the programme.

- Establish **standardized data management systems,** which will facilitate data maintenance, exchange and analysis, as well as coordination. The most important data are records of survey operations, which need to be preserved, formatted according to FAO standards and transmitted to the FAO Desert Locust Information Service (DLIS) at FAO Headquarters. In collaboration with the Natural Resources Institute (NRI), the "Reconnaissance And Management System of the Environment of Schistocerca" (RAMSES) data management system has been introduced into Eritrea and Yemen. This system is technically advanced and is specifically designed to facilitate formatting, exchange and analysis of survey data. The data can be also retrieved as maps (GIS feature) and used readily for national forecasting and planning activities. Management systems need also to be developed for other types of data; these could include data on control operations, on equipment and pesticide stocks, as well as on literature, training and research activities. RAMSES is flexible and could be modified to include the management of other types of data as well.

- Improve procedures for conducting **surveys and analysing** their results. Current survey methods provide valuable information to forecasters and decision-makers. A weak aspect is how to translate survey results into numerical population estimates to enable more accurate forecasts as well as decisions on what level of control operations should be initiated or what type of contingency arrangements should be activated. Other areas of possible improvements include: a) developing improved procedures for locating swarms, b) bringing the Desert Locust trajectory model, which has been developed for tracking the origin of Desert Locust swarms from wind directions and other parameters, to an operational stage, and c) developing standard procedures for estimating increases and movements of Desert Locust populations based on

survey results, which would assist forecasters. Work has already started on several of the above aspects. Special attention has been given to aspects of sampling and population assessment in collaboration with the University of Wageningen. It is expected that this work will result in operational improvements during phases II and III of the programme.

D-3. To strengthen and improve national preventive control capacities through (a) improved planning, training, provision of equipment and operational resources; (b) the field testing of new control technologies.

The responsibility for implementing improved survey and forecasting systems as well as preventive Desert Locust control lies with the national Plant Protection services. DLCO member countries receive assistance through that organization, particularly for aerial control operations. However, effective preventive control operations require a minimum of indigenous capacity in adequately trained staff, as well as the necessary material and operational resources. EMPRES will analyze the needs and provide inputs according to its available resources. In order that control operations become more efficient, safer and environmentally acceptable, improved technologies need to be developed and adopted at the operational level. EMPRES will support and promote the field testing and operational introduction of such improved technologies. As part of the Country Focus programme described above, EMPRES will cover, for example, safer and more efficient pesticide application methods, as well as the use of environmentally benign pesticides such as mycopesticides.

It is expected that the establishment of improved early warning systems and the development of more efficient procedures for planning and implementing early control will reduce the need for large-scale control operations. However, situations may occur, where prevention is either not possible or is not successful and a critical situation may develop. While EMPRES is not designed to deal which such critical situations when they arise, some if its activities will be aimed at improving planning and preparations for Desert Locust control campaigns.

It is foreseen that the programme pays particular attention to the following aspects in order to achieve this objective:

- Analysing and strengthening **national early control capacities** in the EMPRES countries through Country Focus Programmes (described above under D-2). Desert Locust populations can quickly expand to a scale, which overwhelms the capacity of national services. Careful planning and training for control campaigns is essential. Among others, activities should focus on the following elements:
  - Staff is assigned to - and trained in - the regular preparation of contingency plans which include, if required, the mobilization of additional resources from Plant Protection Services, Ministries of Agriculture, as well as other parts of the Government.
  - Develop improved procedures and mechanism for analyzing critical locust situations and determining at an early stage those needs, which cannot be met at a national level.
  - Develop and establish procedures for systematically recording and reviewing control operations and campaigns.

  During the first three years of the programme, progress has already been made in meeting equipment needs, in the regular preparation of contingency plans and in campaign evaluation. However it is expected that this aspect will still require attention during all three programme phases.

- Provide **training** on ground and aerial control operations as well as on contingency planning and on organizational and management aspects in relation to implementing campaigns. In

many cases training events will also cover survey operations and aspects like training trainers and identifying training needs are described under that component (see D-2). These aspects have already received considerable attention during the first 3 years of the programme. It is expected that relatively few external inputs will be required after phase II of the programme,and that the responsible locust institutions will sustain regular training programmes.

- Develop improved procedures for **mobilizing external assistance** for control operations in case critical situations develop. During the course of the programme, it is expected that EMPRES can only allocate relatively small amounts of assistance to control operations. At the same time current procedures which evaluate the need for - and mobilize - external assistance often take too long to result in fast reaction in terms of field operations. Efforts will, therefore, be made during phases II and III to streamline, and if possible modify, current mechanisms of providing locust-affected countries quickly with external assistance for control campaigns, when needed.

- Develop improved and new procedures for monitoring the **impact of control operations**, in terms of efficacy and of the effect on the environment. Due to the urgency of Desert Locust control campaigns and lack of resources, aspects of monitoring the efficacy of control operations together with any adverse effects on the environment are often neglected. EMPRES will aim at developing simple practical methods for collecting relevant information. This aspect will also include studies on comparing the safety and environmental impacts of different pesticides (including biological pesticides) and different application methods. Some work has started under phase I in this field, but most activities are expected be implemented during phases II and III of the programme.

Develop improved **Desert Locust control methods** which are more efficient, safer and environmentally acceptable. Operational research on this aspect is a continuing process, which has intensified with the banning of dieldrin and the need to pay closer attention to safety aspects and environmental side effects. EMPRES will aim at moving to the operational stage a number of technological improvements, which have been under development for some time. These will include the use of mycopesticides and neem, the use of barrier treatments, and the use of differential GPS for aerial (and if possible also for ground) applications. During phase I of the programme work has started on several of these new technologies and is expected to continue during all three phases of the programme.

D-4. To formulate improvements in the Desert Locust emergency prevention strategy through evaluating the effectiveness, efficiency, economic and environmental soundness of current approaches and new technologies

Since the 1986-89 Desert Locust plague, discussions have intensified among experts on what is the most effective and the most efficient preventive control strategy (see also Annex II of the original programme document). There was, and still is, no overall consensus on whether "preventive control" should apply to the prevention of Desert Locust outbreaks, or upsurges or plagues, or simply the prevention of significant and large-scale crop damage. These discussions have covered various scenarios on when to intervene in the sequence of events ranging from the start of the gregarisation process to the development of outbreaks and upsurges. Related to these discussions were questions on what structure of Desert Locust control services would be required for different strategies, what resources would be needed for survey and control operations, as well as how the benefits of these different strategies would compare with the costs involved. Few

conclusions on strategies emerged from these discussions. The main constraint has been the lack of detailed information on actual Desert Locust population sizes, on what effect control operations had on these populations, and on what costs were incurred. A preliminary economic analysis conducted under EMPRES in 1996 and 1997 (published in 1998) assembled and reviewed the information available and used a modelling approach for examining different scenarios. It provided a valuable overview on aspects of costs and benefits but allowed few conclusions to be drawn with regard to strategies.

It has become clear that more systematic data collection will have to be done for some time, combined with the use of models before further progress can be made on the strategy question. Elements of data collection are incorporated in the other EMPRES objectives described above. The current objective aims at continuing relevant economic analyses and at establishing a process of analysis and evaluation which looks at new data becoming available and at new experience gained on the different methods and procedures related to strategies. This will link with the above-described efforts to improve early warning and early control procedures. A mechanism is needed for looking at the results of these efforts, for examining how they can contribute to improved strategies, and for providing feedback in terms of expert advice and recommendations. The development of improved strategies is a long-term process and it is unlikely that it can be completed within the lifetime of EMPRES. At the end of the EMPRES programme it needs to be considered whether certain elements of the evaluation and analysis process should be incorporated into a post-EMPRES mechanism of regional coordination and information exchange proposed under D-1.

It is foreseen that this objective will include the following activities , which will be addressed mainly during phases II and III of the programme.

- Conduct **economic studies** to provide more detailed quantitative information on the costs connected to Desert Locust management as well as on its economic and social benefits at the national, regional and inter-regional levels. The studies will include comparisons between different preventive control strategies. They will be based on the results of the "Preliminary analysis of economic and policy issues related to Desert Locust management" (FAO Desert Locust Tech. Series 1998), as well as on other relevant studies. The preliminary analysis has clearly identified areas were future work is needed.

- Develop and test a mechanism of **analysing and evaluating** Desert Locust management methods and procedures, as well as research results, with the aim of formulating improvements in strategies. It is foreseen that a small body of experts is formed which meets periodically to review and discuss current knowledge and possible improvements in preventive control strategies. The mandate of this body could include:
  - propose and evaluate expert studies which review specific technical components of preventive control strategies;
  - propose and evaluate expert studies which model the impact of different control strategies in terms of efficacy in preventing Desert Locust upsurges, cost/benefit ratios, operational feasibility, and environmental impact;
  - evaluate the results of operational research efforts, particularly those supported by EMPRES;
  - recommend priority areas for operational research;
  - recommend new operational procedures for testing and adoption by the national Desert Locust control services.

  The findings and recommendations of this body of experts could be periodically discussed in regional workshops and/or in meetings of the DLCC Technical Group.

E. PROGRAMME IMPLEMENTATION AND INSTITUTIONAL FRAMEWORK

E-1. Participating countries and regional organizations

Two regional organizations, CRC and DLCO-EA, and the following countries are implementing the EMPRES programme in the Central Region: Djibouti, Egypt, Eritrea, Ethiopia, Oman, Saudi Arabia, Somalia, Sudan and Yemen. While the collaboration of all these countries is needed for the success of the programme, there is at present great variability in the capabilities and resources available in these countries. Those efforts from EMPRES, which are directed towards strengthening national capacities, will be particularly directed towards overcoming this imbalance. It is expected that the CRC will participate in EMPRES to the extent that joint workplans are prepared, that many activities are jointly funded, and that both organizations closely coordinate their activities through regular and frequent contacts. The CRC is currently considered the most suitable regional body for maintaining the coordinating aspects and advisory services after the end of the EMPRES programme. The programme will further collaborate closely with the DLCO-EA. Five of the DLCO-EA member countries are also participating in the EMPRES programme.

E-2. Achievements in different phases

As indicated above EMPRES is intended as a collaborative and participatory programme, which evolves on the basis of experience. The nature and extent of its achievements will therefore depend in part on priorities identified by the participants as well as on modifications in plans resulting from ongoing evaluation of its activities. In addition the political, economic, and ecological conditions prevailing in the region will influence programme operations. For example, locust conditions may determine the extent of research possibilities, political conflicts may have an impact on implementation of some programme activities, responsiveness to changing perceived national needs may influence programme inputs, etc. Notwithstanding this, the following achievements are expected in the three phases of the programme.

Phase I: A full field programme is established in the Central Region and the problems which need to be addressed are analysed at the national and regional level. Needs for training, research and other inputs such as equipment are clarified and quantified. An information exchange mechanism is established and operational. Collaborative mechanisms are developed and established. Approaches for providing training as well as initiating and supporting research are developed. Training, research and other inputs are under way and experience is gained in these approaches.

Phase II: Survey operations are significantly improved in terms of quality and efficiency. The preventive control capacities, especially in those countries needing most urgent strengthening, have been significantly increased through training, equipment and other support. Substantial operational improvements have been formulated through analyses, evaluations and research. Some of these operational improvements have been adopted on a trial basis. A concept has been developed for a long-term institutional framework promoting effective preventive control in the region.

Phase III: Agreement is reached on a regional system for maintaining preventive control strategies of the EMPRES countries in the long-term. Significantly improved national Desert Locust management structures are in place, which can effectively and efficiently follow and implement a sound preventive strategy. Such a system will include improved

procedures for initiating, organizing and implementing Desert Locust monitoring and early control activities.

During the course of the programme, the Consultative Committee will evaluate progress with respect to the above achievements and will, among others, recommend for how many years each phase should be implemented.

E-3. Detailed planning for the different phases

In chapter D the programme objectives are described together with an outline, in general terms, of possible outputs and activities. For phase I of the programme (1997 – 2000), details of outputs and activities (together with suitable indicators) have been developed as part of formulating individual Trust Funds projects supporting EMPRES, the biennial and annual workplans of FAO, a planning workshop held by the EMPRES Liaison Officers in May 1998, as well as during the preparation of the annual EMPRES (Central Region) workplans by the Liaison Officers. For phases II and III it is envisaged that a participatory planning workshop, held during the first half of the last year of the preceding phase, will determine the outputs for the coming phase together with indicators, responsibilities and funding sources. These workshops will involve the EMPRES Liaison Officers, FAO staff, donor representatives and representatives from collaborating organizations. Detailed workplans and activities will be planned, as before, in annual meetings with the Liaison Officers, again organized as participatory workshops.

E-4. Management Structure

EMPRES is designed as an FAO field programme based in the Central Region. On the side of FAO, the EMPRES Central Region programme will be primarily managed by a Programme Coordinator based in the region. His/her Terms of Reference are attached as Annex II. The EMPRES Programme Coordinator will provide day-to-day coordination and management of the programme under the overall supervision of the Senior Officer, Migratory Pest Group at FAO Headquarters. He/she will closely collaborate with FAO Representatives in the participating countries, with other relevant FAO staff as well as with EMPRES counterparts and collaborating organizations. Collaboration between the EMPRES Coordinator and the Secretary of the CRC will receive special attention in order to strengthen the above-described link between EMPRES and CRC.

Additional regionally and nationally assigned FAO field staff will be required for implementing the different phases. However, details of staff requirements will be determined in connection to planning for each phase. Selection of the duty stations of FAO field staff will be based on the following criteria: a) anticipated volume of EMPRES activities in an individual member country, b) proximity of important Desert Locust recession habitats, c) availability of office space and other support from the host country, d) frequency of airline connections to other EMPRES member countries, e) other considerations such as infrastructure (e.g. quality of telecommunication services) and security in the duty station.

The work of EMPRES will be integrated closely with that of the Locust Group at FAO Headquarters. The role of FAO Headquarters will be to provide supervision of the EMPRES Coordinator, take decisions on policy matters, provide certain administrative services and assist the Coordinator in technical and administrative matters when necessary and appropriate.

On the side of the participating governments and DLCO, the Liaison Officers, described under D-2, will be the focal points for planning, implementation and coordination of EMPRES

activities. During the first meeting of Liaison Officers, Terms of Reference have been prepared by the Liaison Officers and adopted (see Annex III).

As described under D-2, a Consultative Committee, composed of senior representatives from the participating countries, donors, other organizations and FAO, will have the mandate for monitoring and reviewing the programme, making recommendations regarding its directions and the necessary actions for FAO to take . The Consultative Committee will meet about once a year, but will determine its own schedule.

F. INPUTS AND BUDGET

F-1. Inputs by Participating Governments

The inputs by the participating Governments will be based on a restructured framework of their Desert Locust monitoring and control services. Such a framework will be prepared by the Governments in collaboration with FAO staff and will be based on the EMPRES Country Focus programmes. The framework will foresee inputs at two levels: Government inputs related to routine survey and control operations on a small to medium scale, and inputs related to critical and emergency situations when contingency arrangements are put into effect.

An outline of the current inputs by the participating Governments was provided as Annex VII of the original programme document. The following table provides a summary of these inputs by the participating Governments:

Country	Regular technical staff for DL work	Vehicles permanently available for DL work	Aircraft regularly available for DL work	Regular annual operational budget (US$)	Possible additional Government resources in years of upsurges (US $)
Djibouti	4	1	-	2,000	60,000
Egypt	183	72	-	1,091,000	847,000
Eritrea	15*	2	-	25,000	20,000
Ethiopia	9	2	-	110,000	800,000
Oman	10	22	1	217,000	85,000
Saudi Arabia	10	120	6	3,170,000	18,000,000
Sudan	100	20	4	300,000	1,600,000
Yemen	36	18	-	40,000	200,000
DLCO	38	50	7	1,000,000	-
Total	**514**	**304**	**18**	**5,955,000**	**21,612,000**

* Not full time for Desert Locust work.

In addition, EMPRES will benefit indirectly through the contributions of the participating countries to DLCO-EA and CRC. The memberships of these two organizations include all countries participating in the Central Region component of EMPRES (Sudan is a member of both organizations). A number of activities, particularly in the field of training and research, will be planned and implemented jointly together with the CRC and will be also jointly funded. The CRC funds are paid by the locust-affected countries into an FAO Trust Fund.

F-2. Inputs by FAO and Donors

The original programme document contained details of estimated inputs and budget resources. These estimates were necessary for planning and allocating resources for the first phase of the programme. For the planning of the following phases, a joint planning workshop involving

the participating countries and the donors will be used, during which outputs and required inputs will be identified. In order to give an overview of the required inputs and budget resources of the programme the actual and estimated expenditures during the first phase of the programme are listed in the following table. It is anticipated that comparable resources will be required for phases II and III.

Expenditures/budget during phase I of the EMPRES Central Region programme (US $)

Funding source	1997	1998	1999	2000	Total phase I
FAO Regular Progr.*	255,488	338,500	353,500	360,000	**1,307,488**
Belgium*	222,341	124,777	-	-	**347,118**
Germany**	182,207	345,706	338,900	150,000	**1,016,813**
Japan*	60,397	99,984	50,800	-	**211,181**
Netherlands*	-	220,404	505,900	510,000	**1,236,304**
Norway*	-	65,580	73,500	-	**139,080**
Switzerland	19,116	84,496	62,700	340,000	**506,312**
United Kingdom*	(in kind)	(in kind)	(in kind)	(in kind)	(in kind)
U.S.A.*	132,528	143,510	279,950	160,000	**715,988**
Total	**872,077**	**1,422,957**	**1,665,250**	**1,520,000**	**5,480,284**

* support also provided to other components of the EMPRES programme, outside the Central Region

** in addition, an Associate Professional Officer has been provided for 3 years

Apart from resources allocated by donors through Trust Fund projects, support in kind was provided for the development of remote sensing technology and data management systems. There is further a possibility that Sweden will provide an Associate Professional Officer in 2000. Several Trust Fund projects supporting EMPRES have already resources allocated which extend over the current end of the first phase. However, substantial additional resources will be required for phases II and III of the programme.

During a typical year (1999) of the first phase of the programme, approximately 40% of the budgetary resources were spent on staff and consultants, 15% on travel (including travel for training courses), 20% on equipment and contracts, and 25% on other items. It is expected that at the end of the first phase 7 professional staff will have served in the field, for an average of about 3 years. This includes 3 internationally recruited staff members, 2 nationally recruited staff members, an Associate Professional Officer, and an UN-Volunteer.

G. RISKS AND PRE-CONDITIONS

There are a number of risks associated with the successful implementation of the EMPRES programme. These are detailed below together with, where appropriate, suggested pre-conditions which would significantly reduce the risk(s).

G-1. Interdependence of countries in the region

There is a strong interdependence between locust-affected countries, which is related to the nature of Desert Locust outbreaks and upsurges. Desert Locust populations present in one country of the region are likely, unless effectively controlled, to have an impact on other countries through migration. It is therefore essential that **all** the "front line" countries of the region participate in the activities of the EMPRES programme especially in terms of regular surveys and information exchange. Unless they all do, the effectiveness of an early warning system and timely effective control may be compromised. This underscores the importance of obtaining high-level political support for the programme, as well as the commitment of participants at the operational level.

G-2. Diversion of resources to other pests

There is a risk that if the Desert Locust situation is calm and outbreaks of other pests occur within a country, the resources of the Plant Protection Services, perhaps including resources supplied under EMPRES, be diverted to such problems. Whilst this is understandable, it poses a risk for the EMPRES programme in that Desert Locust activities may be suspended. This could result in weakening of the early warning and control systems and in insufficient monitoring of Desert Locust breeding. It is important that the participating countries commit themselves to the permanent dedication of at least a significant proportion of EMPRES-supplied resources to Desert Locust activities.

G-3. Sustainability during long recession periods

Experience has shown that in long recession periods with little or no Desert Locust activity there is a tendency for the utility of monitoring and surveillance programmes to be questioned and their priority reduced. Similarly, if the EMPRES programme is successful in limiting the scale of Desert Locust activity in the long term, then again there may be pressure to reduce support as the "visibility" of the pest is reduced. Whilst at present, due to the recent Desert Locust upsurge of 1992-95, this is generally not applicable there will be an ongoing need to guard against such complacency if a long recession period occurs and/or EMPRES is successful in its objectives.

G-4. Political instability and insecure areas

There is a risk that the programme activities, and hence success, could be undermined by periods of political instability in an EMPRES member country, as well as by the development of Desert Locust populations in areas where access may be impossible or limited due to civil strife and insecurity. The response by EMPRES to such situations cannot be predicted in advance but will have to be decided on an ad hoc basis. FAO has in the past been able to work, albeit in a limited manner, in such situations.

G-5. Feasibility of improved early warning

The improved early warning system relies heavily on access to meteorological and remotely sensed data. For meteorological data there may be difficulty of access on a real-time

basis. A solution needs to be actively pursued with appropriate meteorological agencies and relevant organizations operating satellites.

Notwithstanding major advances in technology, there remain some questions about whether the detection of areas of potential breeding through the use of remotely sensed data is reliable. Promising research results using the SPOT satellite system indicate that the detection of such areas can be improved, but it remains to be seen whether further research can develop an operational system. The degree of risk is difficult to assess but there is little question that the research is worth pursuing.

H. PROGRAMME SUSTAINABILITY

The issue of long-term sustainability of the EMPRES programme and its achievements has two separate aspects. The first concerns the maintenance, over the long-term, of the capabilities and capacities of national programmes to undertake monitoring, survey and control operations at the levels required to sustain a "preventive" character. The second concerns the maintenance of EMPRES' own role and responsibilities in support of national and regional efforts and as coordinator and executor of external inputs.

There is the concern, expressed repeatedly by Plant Protection Services, that trained staff move on to other responsibilities. The national programmes and EMPRES will therefore have to ensure that enough experienced personnel remain to undertake further training as needed on a roll-over basis. With regard to equipment such as vehicles, sprayers, and radios, these will have to be replaced at regular intervals to ensure that a minimum capacity exists. EMPRES will be seeking to improve equipment maintenance capability which will prolong the useful life span of physical plant. The costs of both staff training and provision of equipment will therefore, it is hoped, be reduced in subsequent years.

The original EMPRES programme document foresaw that the EMPRES programme would need multi-donor support over about three four-year phases, which would involve modifications in each subsequent phase reflecting evolving conditions. By the end of these phases national Plant Protection Services will have been substantially strengthened both materially and in terms of human resources.

The early warning system will have been developed, put in place, tested, and much experience gained with its operations. As part of this system, the communications and information exchange mechanisms will have been designed and put in place. There may be a need for financing the ongoing operation of these activities. Although it is too early to predict the requirements for this on a regional level, there may be a possibility that they are small enough for the system to be maintained by the community of affected countries, for example under the auspices of the FAO Commission for Controlling the Desert Locust in the Central Region.

At the end of three phases significant advances should also have been made in improving Desert Locust control strategies, methods, and technologies and integrating them into an overall Desert Locust management system. This would reduce costs associated with the research component of EMPRES.

Thus, at the end of three phases there will be a continuing need for EMPRES to: (a) provide ongoing support, but at a reduced level, to national programmes, and possibly (b) support the operation of the early warning system and the communication network. Under objective D-1, EMPRES will look into the need and feasibility of establishing a post-EMPRES institutional mechanism, which could ensure that the capacity for preventive control is maintained in the region. The Consultative Committee will be mainly responsible for reviewing this topic and making recommendations on how to advance discussions on this matter.

I. REPORTING AND EVALUATION

The Programme Coordinator will prepare an annual report at the end of each year, and six-monthly reports for individual Trust Fund projects, as required. The annual reports will include:

- the actual, as compared to programmed, execution of the work plan;
- the identification of problems and limitations (human, technical and financial) that have arisen during execution and the identification of corrective measures;
- a detailed work plan for the coming year.

During the last year of each phase of the programme, the Programme Coordinator, in close consultation with national and regional counterparts, will prepare a draft report covering this phase and submit it to FAO Headquarters not later than 4 months before the scheduled end of this phase. This report will include a detailed evaluation of the degree to which the programmed activities have been implemented, whether they have produced the outputs expected and whether progress has been made in achieving the objective of the programme. The report should also include recommendations for possible elements to be covered by succeeding phases.

Reports, guidelines and other results produced by the programme will be regularly communicated to all participating countries in the region as well as to DLCO-EA, the CRC and to participating donor agencies. Those of more general interest will be distributed to other locust-affected countries and other regional organizations. Detailed progress reports will be also prepared for meetings of the Desert Locust Control Committee if they fall within the implementation period of the programme.

FAO, the donor agencies and the Governments of the participating countries will jointly monitor progress of the programme as part of the activities of the Consultative Committee. The Consultative Committee will also recommend programme evaluation missions which may cover the whole programme or specific subject areas.

Terms of Reference of the EMPRES Central Region Programme Coordinator

Under the general direction of the Chief of the FAO Plant Protection Service, AGPP, the overall supervision of the Senior Officer, Migratory Pests Group, in close collaboration with other relevant FAO staff, and with counterparts of national and regional locust control organizations, the Programme Coordinator will be responsible for the overall coordination of the EMPRES Central Region programme including operations, technical development, budgeting, administration and personnel. The Programme Coordinator will:

- prepare and submit an annual progress report on programme activities to FAO, together with six-monthly progress reports on certain Trust Fund projects, as may be required;
- prepare, in collaboration with the Liaison Officers and the Secretary of the FAO Commission of controlling the Desert Locust in the Central Region, joint EMPRES/CRC annual work-plans which can be dynamically revised;
- oversee and guide other FAO EMPRES staff;
- oversee EMPRES activities including training courses, research and field activities;
- stimulates and contribute to conceptual thinking and long-term planning regarding the programme and Desert Locust management;
- in consultation with FAO HQ staff, discuss contributions to the Programme with donors.

Qualifications and experience:

- Ph.D. degree in Entomology or closely related subject;
- minimum of 10 years experience in plant protection, preferably with direct significant experience with locusts;
- demonstrated managerial abilities and proven administrative skills;
- ability to undertake field missions under arduous conditions;
- proven ability to cooperate and work with persons from diverse cultural backgrounds;
- good oral and written communication skills;
- English language (oral and written) essential with working knowledge of Arabic preferred.

Terms of Reference for EMPRES Liaison Officers

1. Serve as a focal point for the EMPRES Programme in his/her country.

2. Review, in collaboration with the relevant national authorities and EMPRES, annual survey plans in traditional breeding areas and areas of rainfall/vegetation.

3. Develop/review and update in collaboration with concerned national authorities and EMPRES a plan for campaign organization and execution.

4. Implement surveys and, where justified, control activities.

5. Request Government funds for the execution of appropriate locust activities in the country.

6. Follow-up on day-to-day activities of the EMPRES programme.

7. Ensure regular flow of information to all relevant parties on the Desert Locust situation and on the environmental conditions in the country.

8. Represent the country in the EMPRES Liaison Officers meetings.

9. Undertake national activities of the EMPRES Programme such as training etc.

10. Work closely with the EMPRES Coordinator in all issues concerning the EMPRES Programme in the Central Region.

11. Liaise closely with the Central Region Commission and DLCO on all issues concerning the EMPRES programme.

Programme Planning Matrix

Programme Title: Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES)
- Desert Locust Management in the Central Region -
Countries: Djibouti, Egypt, Eritrea, Ethiopia, Oman, Saudi Arabia, Somalia, Sudan, and Yemen.
Regional institutions: Desert Locust Control Organization for Eastern Africa (DLCO-EA), FAO Commission for Controlling the Desert Locust in the Central Region (CRC)
Estimated period: 01/1997 – 12/2009

Summary of Objectives and Activities	Indicators/Milestones	Sources of verification	Assumptions
Development Goal: To reduce the risk of Desert Locust plagues emanating from the Central Region of the Desert Locust distribution area in order to mitigate food security, economic and environmental concerns in the Central Region and beyond		- Statistics - Reports - Studies	- Desert Locust Control Services in the Central Region sustained and further components of preventive control strategies developed - The governments of the affected countries maintain support to the Locust Control Services during recession periods - External assistance in case of emergency provided in time
Programme goal: To strengthen the capacities and capabilities of national, regional, and international components of Desert Locust management system to implement effective and efficient preventive control strategies based on early warning and timely and environmentally sound early control interventions	- Up to 8 of the Desert Locust Control Services in the Central Region practice at least X essential components of preventive control techniques / methods as part of their Desert Locust management strategy in a sustainable way (end of the programme)	- Planning documents - Strategy papers - Reports	- All EMPRES member countries become part of the CRC - Donor agencies support the EMPRES programme

Objectives:			
D-1: To increase the level of coordination of Desert Locust monitoring, survey, and control activities in the Central Region by facilitating networking between national, regional and international organizations and by strengthening information exchange.	I.1.1. A network comprising all important stakeholders established in the Central Region and operational through regular meetings/visits, and suitable information and monitoring systems (1st phase)	- Minutes of meetings - Progress reports - Travel reports - Planning documents - Data bases	- Donors' contributions harmonize with EMPRES activities in time, nature and sort
D-2: To establish an improved Desert Locust early warning system based on meteorological, remote sensing, field information capture and analysis	I.2.1. At up to 8 of the Locust Control Services of the Central Region a Desert Locust forecasting and information unit established and fully operational (3rd phase) I.2.2. All important breeding areas in the key countries are known and routinely surveyed (end of programme)	- DL reports - DL data base - Various maps - Satellite imageries - Training reports - Statistics - Staff lists	- Remote sensing technology provides significant information; images provided sufficiently quickly. - Meteorological agencies provide real-time information
D-3: To strengthen and improve national preventive control capacities through (a) improved planning, training, provision of equipment and operational resources, as well as through (b) the field-testing of new control technologies.	I.3.1. At least 4 locust control services conduct regular and self-reliant (Survey & Control) training and re-training programmes for locust technicians at all levels (3rd phase) I.3.2. At least 5 of the locust control services introduced campaign and contingency planning procedures as a regular tool of proper DL management (2nd phase 2, 3rd phase 3) I.3.3. Up to 3 effective, economically sound and environmentally safe control techniques are implemented as part of the official control strategy in at least 5 of the Central Region countries (2nd phase 1, 3rd phase 2)	- National training curricula - Staff lists - Statistics - Campaign / Contingency plans - Trial reports - Recommendations - Strategy papers - Legal texts	- Locust situation suitable for conducting field trials (!)
D-4: To formulate improvements in the Desert Locust emergency prevention strategy through evaluating the effectiveness, efficiency, economic and environmental soundness of current approaches and new technologies.	I.4.1. Up to 8 national and 1 regional improved Desert Locust control strategy(ies), comprising different scenarios, components, procedures and approaches adopted by the member countries as reference for improved control management (end of programme)	- Strategy papers - Expert panel reports - Documentation - Data banks	- Policy makers of the member countries support ecologically and economically sound locust control strategies

Activities:			
1.1. Recruit and appoint EMPRES field staff	M.1.1. EMPRES staff appointed by early 1997		
1.2. Appoint EMPRES Liaison Officers	M.1.2. Liaison Officers appointed by early 1997		
1.3. Establish communication system	M.1.3. Regional communication system operational (1st phase)		
1.4. Coordinator conducts regular visits within the Central Region and beyond	M.1.4. Up to 6 visits per year		
1.5. Convene regular meetings according to agreements	M.1.5. Staff-meeting, ELO-Meeting, Consultative Committee Meeting, CRC Meeting etc. each at least once per year		
1.6. Establish modalities and mechanisms of cooperation with the CRC	M.1.6. Cooperation between EMPRES and CRC operational (1st phase)		
1.7. Prepare planning documents	M.1.7. Planning documents jointly developed through regular workshops (operational plans, annual workplans, budget plans)		
1.8. Supervise and monitor EMPRES activities	M.1.8. Reporting (1st phase) and monitoring (2nd phase) system in place		
1.9. Establish post-EMPRES mechanisms	M.1.9. Post-EMPRES mechanisms formulated and recommended (end of programme)		
1.10. Initiate and supervise specific Country Focus programmes	M.1.10. Up to 6 2-3 years Country Focus programmes conducted (1st phase 1, 2nd phase 3, 3rd Phase 2)		
1.11. Assure proper coordination and cooperation with bilateral projects / contributions to EMPRES	M.1.11. Meetings held and agreements reached with bilateral project organizers and other contributors		- Bilateral projects contribute significantly to the achievement of EMPRES goals
2.1. Review the existing forecasting / early warning system	M.2.1. Recommendations for improvements submitted and adopted by end of 2001		
2.2. Incorporate rainfall, vegetation and remote sensing data in the national forecasting systems	M.2.2. Meteorological, vegetation and remote sensing data are part of the forecasting procedures of up to 8 Forecasting & Information Units (1st phase 1, 2nd phase 3, 3rd phase 4)		- Locust control Services create and support F&I Units

2.3. Build up data management systems	M.2.3. In at least 8 of the Locust Control Services a Geographic Information System is introduced and operational (1st phase 2, 2nd phase 3, 3rd phase 3)		
2.4. Train forecasting / information officers	M.2.4. 100 % of all officially appointed information officers are qualified through at least 2 training opportunities per phase (1st phase 30%, 2nd phase 80%, 3rd phase 100 %))		
2.5. Conduct population dynamic studies in potential breeding areas	M.2.5. Important parameters for early intervention known (2nd phase)		
2.6. Identify priority breeding areas	M.2.6. All major breeding areas in the key countries are known, described and registered (2nd phase 50 %, 3rd phase 100 %)		
2.7. Strengthen self-reliant survey capacities in Somalia	M.2.7. Local authorities/local DLCO base in northern Somalia organize surveys and communicate results to DLIS-Rome (2nd phase at least 6 reports per year, 3rd phase at least 12 reports per year)		- The political situation remains calm
2.8. Improve survey, assessment and reporting procedures	M.2.8. Improved survey guidelines in place (1st phase)		
2.9. Improve national / international information exchange networks	M.2.9. At least 70 % of all locust information is comprehensive and forwarded in time to PPD HQ and FAO/DLIS (2nd phase)		
2.10. Prepare regular survey plans / schedules	M.2.10. Up to 8 of the Locust Control Services introduced improved survey planning procedures (2nd phase)		
2.11. Train survey (*& control*) personnel	M.2.11. At least 80 % of all officially registered survey (& control) personnel in the Central Region benefited from least 2 training opportunities (1st phase 20 %, 2nd phase 60 %, 3rd phase 80 %)		
2.12. Provide survey / radio communication equipment	M.2.12. At least 8 of the EMPRES member countries are sufficiently equipped with standard survey and communication material (1st phase 50 %, 2nd phase 100 %)		
2.13. Monitor effectiveness of national forecasting and early warning systems	M.2.13. Monitoring system in place (2nd phase)		
3.1. Review the present organization and conduct of locust control operations in the region	M.3.1. Compiled campaign assessment report produced (1st phase)		

3.2. Organize (*survey &*) control training courses on regional, national and local level	M.3.2. At least one **regional** ToT course per year (1st phase, 2nd phase); at least 1 **national** S&C course per year in at least: 1st phase 1 country, 2nd phase 3 countries, 3rd phase 4 countries; at least 2 **local** S&C courses per year in at least: 2nd phase 2 countries, 3rd phase 4 countries		
3.3. Introduce regular training schedules at national and local level	M.3.3. Up to 6 of the Locust Control Services organize regular (survey &) control training and re-training programmes for national locust operators in a self-reliant way (2nd phase 2, 3rd phase 4)		
3.4. Develop (on the basis of the FAO Guidelines) and introduce comprehensive training manuals as reference for national and local training events	M.3.4. Training manual (English, Arabic, Amharic, Tigrynia) developed and part of regular training courses (2nd phase)		
3.5. Organize seminars on campaign planning and management topics 3.6. Develop campaign and contingency plans	M.3.5/6. Appropriate campaign and contingency planning tools introduced as standard locust management and monitoring procedures at least at 6 Locust Control Services (2nd phase 4, 3rd phase 2)		
3.7. Develop and introduce procedures for efficacy and impact monitoring of control campaigns	M.3.7. Campaign monitoring and assessment mechanisms made standard procedures for at least 50 % of all control operations (2nd phase 20 %, 3rd phase 50 %)		
3.8. Reduce contamination with pesticides	M.3.8. Contamination of locust operators, environment and crops with pesticides reduced (2nd phase by 20 %, 3rd phase by 50 %)		
3.9. Identify, describe and protect ecological sensitive areas	M.3.9. At least 20 % of all identified ecological sensitive areas within the locust affected territory of the Central Region are protected and officially excluded from conventional control operations (end of programme)		
3.10. Develop improved procedures for mobilizing external assistance in case of critical situations	M.3.10. At least 3 Locust Control Units are in the position to develop and submit comprehensive and detailed requests to FAO HQ well in advance of the emergency situations (2nd phase 1, 3rd phase 2)		
3.11. Develop and introduce improved Desert Locust control methods / techniques	M.3.11. At least 8 promising locust control techniques and methodologies are field tested in collaboration with national and international research entities (1st		

	phase 1, 2nd phase 3, 3rd phase 4), and at least 6 are recommended and endorsed as standard components for improved Desert Locust management (3rd phase)		
4.1. Analyse and evaluate existing Desert Locust management methods and procedures 4.2. Assess and review the different components of preventive control strategies	M.4.1/2. Comprehensive analysis of the existing components and currently applied locust management profiles and procedures drafted, discussed and conclusions for promising preventive strategies formulated (2nd phase)		
4.3. Conduct socio-economic impact studies	M.4.3. A more realistic picture of socio-economic damage caused by Desert Locusts developed (2nd phase)		
4.4. Collect, analyse and compile field data and information relevant for improved decision making	M.4.4. Relevant data (economic, survey, control impact, climatic, population development, resources etc.) systematically documented and compiled (2nd phase)		
4.5. Initiate and supervise operational research projects	M.4.5. Potential research partners and their capacity known (1st phase) and at least 3 research projects per phase successfully initiated		
4.6. Evaluate the relevance of operational research results in regard to improved strategy development	M.4.6. Research results are periodically (at least once every phase) evaluated and discussed in a panel of experts and recommendations for further investigations formulated		
4.7. Recommend new tactical methods and procedures as part of improved national and regional management strategies	M.4.7. Recommendations for integration of new locust control technologies as part of the overall strategy formulated by the panel of experts (see 4.6)		

PROGRAMME DOCUMENT

Emergency Prevention System (EMPRES)
for Transboundary Animal and Plant Pests and Diseases
*****
Desert Locust Management in the Central Region

Additional Background Information

Annexes I, II, III and VII
of original version dated October 1995

*****

Annual Reports 1997 - 1999

Food and Agriculture Organization of the United Nations

Annex I

GENERAL BACKGROUND

1. Introduction

The Desert Locust, *Schistocerca gregaria*, is a widely distributed pest which poses a recurrent threat to agriculture throughout Africa north of the Equator, the Middle East and South West Asia. Periodically major population upsurges and plagues develop usually following a sequence of favourable rainfall which is critical for reproduction. Such upsurges and plagues are interspersed by periods of relative inactivity called recessions during which Desert Locust populations may remain at very low levels for a number of years. In such periods low density populations are normally restricted to the recession area as opposed to the wider distribution or invasion area, which may be affected by Desert Locust when high density populations occur (Fig. 1). Upsurges and plagues are characterized by the presence of large numbers of hopper bands and swarms in both the recession and invasion areas. Such populations, unless controlled, have the potential to cause substantial damage to crops and pastures.

Fig. 1. The Invasion and recession areas of the Desert Locust[1]

[1]Note: Figures 1 to 3 have been copied from the Proceedings of the Seminar "Desert Locust Control with Existing Techniques" held in Wageningen, The Netherlands, 6-11, December, 1993.

The species is capable of long distance downwind migration within and between countries on meteorological systems which may often produce the rainfall essential for reproduction. Typically, during an upsurge swarms will migrate within or between regions and, if favourable environmental conditions are encountered, reproduction will occur leading to exponential population growth. During an upsurge or plague a pattern of seasonal breeding and migration is usually followed, although specific occurrences depend on the actual seasonal distribution of favourable environmental conditions.

The Desert Locust is considered to be one of the most devastating pests of agriculture worldwide. The Desert Locust plague of 1986-89 and the more recent upsurge in 1992-95 have caused considerable and widespread concern in locust affected countries and in donor countries and agencies. These concerns relate to the apparent increase in the frequency of such events, the economic costs of control, the safety and environmental impact of the chemical pesticides used, and the capacity of existing organizations to deal with the problem in an efficient and effective manner. The document presented here is an attempt to address these concerns through the establishment of a programme in which affected countries, donor agencies and other concerned organizations collaborate in the development of an improved Desert Locust management system. The programme will initially focus on the countries bordering the Red Sea and the Gulf of Aden. However, it is anticipated that in a later phase key locust-affected countries in other regions will also participate in the programme.

2. Locust Biology and Ecology

2.1. General biology

Locusts are grasshoppers which have the capacity for physiological and behavioral changes in response to population density. At low densities locusts exist in the so-called solitarious phase. As the population density increases locusts exhibit a tendency, the degree to which varies between different species, to become gregarious and to remain in groups. This process, termed gregarisation, is also usually accompanied by physiological and morphological changes involving for example coloration and fertility rate. It reaches its ultimate expression in the formation of dense hopper or nymphal bands and adult swarms where densities can reach several hundred per square metre. The swarms so formed may migrate over large distances to infest areas several hundred or thousand kilometres from their point of origin.

Another characteristic of locusts is the highly variable nature of the population dynamics. For example, Desert Locust plagues have been known to last between four and 22 years, while recession periods have been recorded extending from one to ten years (Fig. 2). The highly variable nature of populations can be explained mainly by the species' dependence on rainfall for reproduction and its preference for desert or semi-arid areas where such rainfall is infrequent. Most locusts are thus opportunistic in terms of breeding and the ability to migrate to areas of rainfall increases their chance of survival.

2.2. Life cycle

The life cycle of the Desert Locust comprises three stages: egg, hopper and adult. The duration of each of these stages depends critically on weather and in particular on rainfall and temperature. Desert Locusts become sexually mature in response to favourable environmental conditions. Immature adults may survive for several months before such favourable conditions are encountered or, if conditions remain unfavourable, mortality will occur without any breeding. The

duration of the immature period and the exact factors causing maturation are not known with precision but maturation is associated strongly with rainfall.

Fig. 2. Periods of major plagues of the Desert Locust

Following copulation the female Desert Locust will select a site to lay her eggs. The female generally lays eggs in moist sandy soil at a depth of approximately 12-15 centimetres below the soil surface. The eggs are laid in an egg pod and each pod may contain between 20 and 100 eggs. Under field conditions females may lay more than one egg pod. Soil moisture is critical for egg development whilst the rate of development is dependent on temperature. The incubation period for eggs therefore varies according to seasonal variations in temperature. For example, during summer along the Red Sea coast the incubation period is likely to be 11-14 days whilst in winter this period may extend to 30 days. Under very cool temperature regimes, such as may occur at high altitudes in winter, the incubation period may take as long as 70 days in exceptional cases.

Upon hatching and emergence onto the soil surface the hoppers cast off their skin or cuticle and begin to feed. At this stage vegetation is required for growth and survival. As the hoppers grow they normally shed their cuticle five times. The hopper stage is thus divided into five parts referred to as instars. The rate of development of the hoppers is also temperature dependent. Field data indicates that the shortest development period is usually in the vicinity of 24-30 days at high (summer) temperatures whilst under lower (winter) temperature regimes this can be extended to 45-55 days.

The final moult by fifth instar hoppers to the adult stage is referred to as fledging and the young adults thus produced are termed fledglings. Following the usually short fledgling period, during which the insect accumulates fat reserves and the flight muscles develop, immature adults are produced which are capable of strong migratory flight and, once suitable conditions are encountered, of breeding. The length of the immature period can also vary significantly. Sexual maturation is dependent on suitable conditions and, although the exact mechanisms are unclear, is linked to rainfall and green vegetation. Maturation and reproduction may therefore take several months. However, should the conditions be favourable, maturation can quickly follow fledging. The overall length of the life cycle (egg to egg) can vary considerably and may be as short as 2½ months or extend up to a maximum of five months.

2.3. Behaviour

Desert Locust behaviour differs significantly according to the phase of the insects but is also limited by environmental conditions in particular weather conditions.

The behaviour of Desert Locust hopper bands and swarms is governed to a large degree by diurnal variations particularly variations in temperature. It is relatively well-documented and for bands includes activities such as roosting, marching and feeding. Such behaviour can have potentially important implications for control. For example, roosting bands are normally of a higher density and smaller area than marching bands. Similarly, band density usually decreases as hoppers become older and the overall area of the band increases. In the case of swarms, flight is also governed to a large degree by weather and a knowledge of how changes in weather may affect swarm behaviour can also have important control implications.

2.4. Population dynamics

The development of Desert Locust outbreaks, which are marked increases in the population leading to the production of gregarious populations, is believed to involve a number of processes namely concentration, multiplication and phase change.

Concentration of individual (solitary) locusts can occur on two scales. Firstly, on the meso scale, individual locusts may become concentrated by large scale meteorological features such as wind convergence. Often such wind convergence features are themselves associated with rainfall which will favour locust reproduction. This general concentration of locusts may then be further enhanced by the settling of locusts in areas of recent rainfall and green vegetation. Secondly, within such favourable areas there is likely to be further concentration as females select sites for oviposition. Thus as eggs are laid the population has been concentrated significantly although at this stage there may not be any indication of phase change.

The multiplication of the population resulting from successful breeding and the accompanying increase in population density leads to phase change and gregarisation. The hoppers will tend to become further concentrated by the vegetation especially as the area begins to dry and the preferred areas of green vegetation become more restricted. The resultant adults, following fledging, retain this preference for group behaviour and cohesive adult groups or incipient swarms may form. Such groups or swarms may remain cohesive until suitable breeding conditions occur. Successive reproduction and multiplication results in further concentration and eventually high density gregarious populations will occur. These processes may occur sequentially in a succession of geographically distinct but inter-related seasonal breeding areas and should the expansion of the population through such a sequence of favourable environmental conditions and associated locust breeding go unchecked a plague is likely to develop.

While the general sequence of events leading to gregarisation, as well as the main factors involved in this process are known, the exact nature of the interaction between Desert Locust populations and ecological conditions are not fully understood. This lack of a precise understanding restricts the reliability of forecasting population changes and the ability to make accurate judgements on where interventions may be required and the likely scale of these.

It is important to note that whilst concentration and gregarisation may occur relatively frequently, upsurges, marking the start of plagues, are comparatively rare due mainly to the failure of a continuing sequence of successful breeding as a result of adverse ecological conditions.

Similarly, the decline of past plagues has been associated with the failure of breeding conditions and/or high natural mortality from migration into the ocean. Compared to other, particularly sedentary, insect pests, the Desert Locust is little affected by natural enemies in the upsurge or plague stages because of its fast multiplication rate, its tendency to migrate over long distances and its greatly fluctuating population density. In practice, it is often difficult to judge the effect of different factors such as control, natural mortality, and breeding failure on the collapse of populations. It is also virtually impossible to predict the failure of breeding or high natural mortality in advance since these are mainly driven by meteorological variables which themselves cannot be predicted with sufficient accuracy.

Historical records indicate that some parts of the Desert Locust recession area play a more important role than others during the development of outbreaks and upsurges. Such critical areas are found along both sides of the Red Sea coast and parts of the Arabian Peninsula, in West Africa and in South-West Asia. As indicated above, events of gregarisation are the start of upsurges and plagues and it is particularly important to monitor areas where gregarisation is known to have occurred in the past (Fig. 3).

Fig. 3. Sites of observed and deduced gregarisation (1926-1966)

3. Recent Pest Status of the Desert Locust

In 1986/87 a major upsurge of the Desert Locust developed in the Central Region which in geographical terms comprises the Arabian Peninsula and parts of East Africa (Fig. 1). The exact origins of this upsurge are unclear but it is suspected that the main outbreak started in Eritrea in the spring-summer of 1987 following which there was a migration to the summer breeding area of

western Sudan and adjacent parts of Chad where breeding was successful. In the autumn of 1987 these populations migrated across the Sahel and eventually large scale breeding occurred in western parts of the Sahara subsequently leading to the development of a generalised plague. In the spring and summer of 1988 massive populations were present in North-West Africa and control measures on a large-scale were implemented. However, many swarms escaped to cross the Sahara and reinfest the Sahel and parts of the Central Region. Again, despite substantial control measures being undertaken, many swarms survived and migration again occurred in the autumn of 1988 resulting in a major reinfestation of West Africa.

In late-1989 - early-1990 the plague collapsed as a result of extensive control measures, high natural mortality due to offshore migration into the Atlantic, and the failure of breeding due to the onset of adverse environmental conditions. During the upsurge and subsequent plague it is estimated that some 17.5 million hectares (ha) were treated and the cost of international assistance alone to these efforts was of the order of US$ 250-300 million apart from the substantial emergency resources provided by the locust affected countries themselves.

From the collapse of the 1986-89 plague until late 1992 the overall Desert Locust situation remained generally calm. However, in late 1992 swarms were reported invading the southern Red Sea coast of Sudan from Eritrea. In December 1992 swarms invaded the western Tihama of Saudi Arabia from across the Red Sea and by the early summer of 1993 a major upsurge had again developed in the Central Region. Swarms from the Central Region crossed the Sahel and invaded West Africa in July 1993 and large scale breeding ensued. Similarly, swarms from the Central Region migrated in an easterly direction to invade India and Pakistan which resulted again in large scale breeding. Substantial control efforts were undertaken in all the regions in 1993. The upsurge declined in early 1994, mainly due to control efforts, but flared up again in late 1994 and early 1995. A generalized map of the course of the upsurge until early 1994 is shown in Fig. 4. In 1993 and 1994 approximately 4 million ha were treated and the cost of international assistance to suppress the upsurge was estimated to be about US$ 40-50 million.

4. International Responses and Initiatives

The large-scale application of pesticides against Desert Locust during upsurges and plagues has generated much concern both in the donor community and the locust affected countries with regard to both environmental and health impacts as well as economic costs. Problems associated with the storage and disposal of obsolete and unused pesticides also add to these concerns.

Following the 1986-89 Desert Locust plague there were a number of initiatives taken by the international community in an attempt to develop alternative approaches to Desert Locust control. A UNDP funded project was implemented in 1989 which established a multi-donor Consultative Group on Locust Research whose objective was to fund research activities designed to develop alternative control strategies. Other research projects were initiated by donor countries such as the United Kingdom, the U.S.A., the Netherlands, Germany, and France or as multi-donor projects. Many of the efforts undertaken were concerned with the development of alternative control agents which would minimize potential environmental impacts. Other studies were undertaken on remote sensing, migration and improved forecasting. On the operational side a number of projects were proposed by FAO in cooperation with locust affected countries to develop improved monitoring and survey systems in the recession area and to improve the capability and preparedness of the countries involved.

Annex II

ANALYSIS AND JUSTIFICATION

1. Introduction

(a) The need for a new approach

With the resurgence of the Desert Locust in late 1992 and the need once again to provide substantial emergency assistance it was evident that despite the lessons learned in 1986-89 and the initiatives since, there remained much to be done in developing more efficient and effective national, regional and international Desert Locust management systems. Early warning systems had not been effective, no alternative agents for control had been developed to the stage of operational use, and the capacity of locust control organizations appeared to be little changed from 1986. Growing concerns regarding these deficiencies, the increased economic costs and environmental impact of control operations, and what may have appeared to be the ad hoc emergency response to Desert Locust, have led to renewed calls from donors and locust affected countries for a longer term management strategy to be developed.

The Desert Locust Control Committee of FAO at its 32nd Session in 1992 called for greater attention to recession period monitoring and the re-establishment of preventive control systems in all regions. These calls were repeated by the FAO Desert Locust Regional Commissions at recent sessions. Specifically, the FAO Regional Commission for the Control of Desert Locust in the Central Region (RCCR) at its 19th Session recommended that a long-term management approach be considered which would:

- contribute regularly to survey and control operations;
- have a technical and administrative framework;
- be sustainable;
- be implemented in coordination with DLCO-EA and the Regional Commission;
- provide modern survey and control techniques;
- ensure the availability of funds for emergency operations; and
- not substitute for national programmes.

Donors have also voiced increasing concern over the Desert Locust emergencies since 1986 and a group of donors wrote to FAO in March 1994 requesting FAO to strengthen its coordinating role and to further the development of an effective long term management strategy. These concerns were reiterated at a donor meeting convened in Rome in April 1994.

(b) The need for an analysis

While it may appear self-evident, it is important to articulate clearly that the developmental problem which EMPRES is being asked to address is the damage which the Desert Locust causes, and the cost and the environmental and health impacts of its control. What is being sought therefore are ways of increasing the efficiency and effectiveness of the overall Desert Locust management system as well as increasing the safety and reducing the environmental hazards of control methods.

To be successful, any programme or strategy with this objective must evolve from an integrated analysis of the Desert Locust problem. Using a systems approach, the causes of the problem need to be identified, and proposed solutions should take into account not only biological and technical, but also institutional, political, and economic elements.

The context within which improvements in Desert Locust management must be sought is extremely complex. It is described here in some detail with the express purpose that the components of the programme strategy emerge naturally from a full coverage of this context's various dimensions. In addition to the analyses and justifications given in the following sections, Annex III specifically outlines the constraints experienced in the last campaigns. The text for this Annex has been extracted from the report of the EMPRES formulation mission.

2. The Inter-regional Importance of Preventive Control

The textbooks refer to many well-documented cases of preventive Desert Locust control. These include, for example, the campaign in Western Pakistan in the spring of 1949, the successful prevention of further expansions of the 1967/68 upsurge in Northern Niger and Mali and southern Algeria, as well as the effective suppression of locust populations in India/Pakistan in 1993 during the most recent upsurge, to name a few. Due to the erratic nature of the pest and the complex interactions of the many parameters which govern the development and migration of locust populations, it will, of course, never be possible to be very confident on the scale of the expansion which has been prevented or on the countries the controlled populations would have invaded. This is particularly true, if, like in the case of the EMPRES programme, prevention is attempted at the beginning of upsurges and plagues.

While there is no disagreement among experts that some of the gregarisation areas shown in Fig. 3 are more important for the beginning of upsurges and plagues (e.g. those along the Red Sea area) than others (e.g. those recorded in Morocco), it is also accepted that upsurges and plagues can originate outside the Red Sea area. For example, the 1949-62 and 1941-47 plagues originated mainly in India and Pakistan and the breeding areas of Northern Mali, Northern Niger and Southern Algeria played an important role in the development of the 1967-68 upsurge and also during the 1986-89 plague. There is, therefore, clearly a need to develop at the earliest opportunity related programmes in key countries of the Western and Eastern Regions which would be closely linked to the programme in the Central Region.

3. The Need for an Initial Geographic Focus

A very important primary breeding area and source of upsurges and plagues is the Central Region of the Desert Locust distribution area (Near East and Eastern Africa) and particularly the Red Sea region encompassing Egypt, Sudan, Eritrea, Ethiopia, Djibouti, Somalia, Saudi Arabia, Oman and Yemen. Population upsurges in this region can easily expand to West and North-West Africa and South-West Asia through long-distance migration. The Central Region played a major role in the development of the 1986-89 Desert Locust plague and was the origin of the current upsurge which started in 1992.

Apart from the importance of the Red Sea and Gulf of Aden coasts for plague prevention, an initial geographic focus is needed:

- to develop and gain experience with new approaches of Desert Locust management;

- to demonstrate the feasibility and success of the system on a limited scale before expanding it;

- since initial external funding is restricted; an increase in financial support is likely to be linked to the achievements of the initial efforts.

It was therefore decided (see below) for EMPRES to address problems in the Central Region first while other regions would continue to receive close attention, including assistance to develop their own development programmes.

4. Economic and Environmental Considerations

4.1. Economic significance of the Desert Locust

In affected countries, the Desert Locust is perceived as a serious threat to agricultural production. This is based on past experience of catastrophic damage and reflects itself in attempts to prevent the expansion of populations at the earliest possible time. While it is generally believed that control campaigns have made significant contributions to the prevention of damage, there has been no definitive analysis of the overall actual and potential damage caused by Desert Locust in spite of the large amount of resources devoted to its control. There are also not many well documented individual cases of actual damage caused by the Desert Locust and the most spectacular examples go back at least 40 years when control efforts were less well developed and apparently less effective.

Apart from the need and urge to control first and estimate damage later, there are a number methodological difficulties in estimating damage which would have occurred if control had not been implemented. These are related to the highly mobile nature of the pest and the largely unpredictable development of upsurges and plagues. Also insufficient attention has in the past been paid to collecting detailed information on control operations and how these have influenced population levels.

With regard to the cost of controlling upsurges and plagues there are some reasonable estimates available from the recent campaigns. For example, as indicated above it is estimated by FAO that the cost of international assistance to the 1986-89 Desert Locust control campaign was US$ 250-300 million, in addition to considerable costs incurred by locust affected countries. The more recent campaigns in 1993 and 1994 are estimated to have required international assistance of approximately US$ 40-50 million.

Notwithstanding the methodological difficulties, the need for additional economic analysis of actual or potential crop damage caused by Desert Locust and of the costs and benefits of its control has been recognized as an important requirement for formulating a long-term Desert Locust management programme. In early 1995 FAO started to review currently available data and relevant previous studies. The topic was subsequently discussed in Rome by a group of experts (15-17 March 1995) and by the Desert Locust Technical Group at its 4th session (21-24 March 1995). The Technical Group recommended to initiate a collaborative project which would focus on four subject areas including a preliminary analysis to be accomplished within 6 to 12 months. It is expected that the first study will start in the 2nd half of 1995.

4.2. Environmental impact

Prior to the 1980s the persistent organochlorine pesticide dieldrin was generally used for control of Desert Locust hoppers. The use of this product whilst highly effective for control was generally discontinued due to concerns about its environmental and health impacts and in particular because of its accumulation in food chains. The replacement pesticides were mainly organophosphates such as malathion and fenitrothion together with synthetic pyrethroids such as deltamethrin which were used on a large scale in 1986-89 and again since 1993. The necessary adoption of organophosphates, pyrethroids and other similar products has had significant implications for the Desert Locust control strategy as discussed below. Substitutes for organochlorines also pose considerable risks to humans and the environment. The use of these pesticides on a large scale to control Desert Locust raises valid environmental and human health concerns.

The question of the effectiveness, safety and environmental impact of both existing and novel locust control methods was discussed during an FAO international workshop on research and planning for Desert Locust control held in Morocco in May 1993. The main environmental concerns voiced were risks to humans due to lack of precautions and training, the existence of obsolete and outdated stocks of pesticides in the affected countries, the possibility of polluting water bodies during campaigns, the effect on birds and non-target arthropods, as well as the possibility of still unknown long-term effects on humans and the environment.

Knowledge of the risks associated with pesticides currently in use has increased recently through research undertaken on the ecological, i.e. non-target, effects of locust spraying. The results already allow, to some degree, predictions to be made on environmental side-effects and enable some comparisons of risks associated with different methods of application and different types of pesticides. The evidence suggests that non-target damage may indeed be substantial, particularly to other insects which form the basis of the food chain for insectivorous birds and some small mammals. The impact on such birds and mammals depends to a large degree on the size of the area sprayed, the relative mobility of the animals and whether spraying is carried out during the reproductive period. At the same time the recovery of such habitats has been found in certain instances to be quite rapid although there remain questions about long term ecological disturbance. In this regard, it is important to note that research results from small scale experimental trials cannot be easily extrapolated to the large scale application of pesticides normally associated with Desert Locust control.

In terms of human and occupational health there is again only limited data regarding pesticide poisoning during locust control operations. The main concern is that such pesticides should only be applied, either by ground or air, by trained operators to minimize the environmental and human health risks. The products themselves are normally supplied as ultra low volume (ULV) formulations which are concentrated products and, as with any pesticide, need to be treated with caution.

Apart from the research on the environmental impact of pesticides there is a need to monitor more closely the use of pesticides in the field to ensure safe and appropriate application, to identify weaknesses of currently practised safety measures and to obtain additional data on environmental effects. Again, there is significant indirect information that pesticides are overused and misapplied. This needs to be more systematically documented so that appropriate actions to improve matters may be taken where required.

The end-use of pesticides supplied for locust control need to be monitored closely during campaigns. Procedures to achieve this are currently being developed by the FAO LOCUSTOX project and these need to be implemented in future campaigns. This monitoring will require additional funds and it has been suggested that in future FAO projects related to locust emergencies it will be necessary to include provisions for the regular field monitoring of human safety and environmental impacts. Such monitoring will include spray techniques, safety procedures, labelling of pesticides, equipment calibration, dose rate, control effectiveness, storage/disposal of containers, and the documentation of cases of poisoning and pollution.

5. The Current Institutional Framework

5.1. National level

At the national level the responsibility for Desert Locust monitoring and control normally resides with the Plant Protection Services (PPS) of locust-affected countries. There is a large variation in the capabilities and resources between the various PPS in the key countries of the Central Region. These range from relatively well-equipped and experienced Desert Locust units with dedicated resources, to PPS which have few staff, little equipment, and/or limited operational capability. There is a similar variation in terms of financial resources available on a recurrent basis and during emergency situations.

To varying degrees all the PPS of the front-line countries in the region with the exception of Saudi Arabia and Oman are constrained by lack of resources to undertake routine monitoring especially during recession periods. Lack of equipment, staff, or operational resources also constrain the execution of control activities, though additional government funds are usually made available during emergencies. Despite these constraints the overall financial contribution by locust affected countries on a regular basis has been and is substantial and there appears to be room in many cases for reorganizing the available resources in order to make more efficient use of them. A further important constraint is the quality and timeliness of information about environmental conditions, the Desert Locust situation in other countries, and control measures being undertaken by neighbouring countries. The need for, as well as the difficulty of, improved coordination of efforts is also widely recognized.

The following summaries of the capacities of national PPS are based on the report of the EMPRES formulation mission which visited the key countries of the Central Region in September and October 1994:

Djibouti

Djibouti has created an "embryonic" locust unit with responsibility for control. However, the operations of the unit are severely constrained by a lack of resources including trained and experienced staff, operational budgets, and equipment, particularly vehicle mounted sprayers.

Egypt

There are two organizations dealing with Desert Locust matters in Egypt namely the Locust Affairs and Agro-Aviation Department of the Ministry of Agriculture and the

Locust and Grasshopper Research Department of the Plant Protection Research Institute. The former is responsible for operational matters including monitoring, survey and control whilst the latter is responsible for research activities which are mainly laboratory based.

Constraints identified by the formulation mission include the lack of information on Desert Locust at the regional level, some shortages of equipment and the current inability to collaborate with Sudan in survey and control operations.

Eritrea

The responsibility for Desert Locust activities rests within the Plant Protection and Quarantine Branch (PPQB) of the Department of Rural and Agricultural Development, Ministry of Agriculture. At present there is no specialised Desert Locust or migrant pests unit. However, the government has submitted a project proposal to FAO for strengthening the Plant Protection Service and this proposal includes the establishment of a migrant pest unit. Desert Locust survey and control is currently the responsibility of PPQB. Since 1993 a Desert Locust Steering Committee comprising representatives of DLCO-EA, Eritrea and Ethiopia had been operational.

The PPQB is limited by a lack of experienced and qualified staff and although training had been carried out recently this needs to be continued. At present only limited resources in terms of vehicles, radios, and sprayers are available. Since there is at present no specialised section within PPQB for migrant pests there is no regular discrete budgetary allocation for survey and control although there is limited funding within PPQB for such activities. In the north-east of the country, which includes the locust winter breeding areas, ground access is limited by the presence of land mines.

Ethiopia

The Agricultural Development and Crop Protection Department of the Ministry of Agriculture has recently undergone a major reorganisation. The Department is composed of eight divisions with the Crop Protection Division having the overall responsibility for migrant pests including locusts and armyworm. At present, there are four professional staff involved in the management of locusts and other migrant pests based in Addis Ababa. The staff are responsible for coordinating monitoring and control activities. There are seven plant health clinics distributed regionally together with fourteen regional offices which are the focal points for monitoring and reporting of locusts. During emergencies a number of task forces operate at various levels within the government ranging from an internal task force within the Ministry of Agriculture to a Steering Committee comprising various government departments and donors.

The main constraint is the lack of a permanent locust survey and monitoring capability which could effectively utilise the existing system of field bases for assessing regularly the Desert Locust situation. To set up such a capability will require training and the provision of vehicles and communications equipment.

Oman

Desert Locust control in Oman is the responsibility of the Locust Unit of the Plant Protection Department in the Ministry of Agriculture. The Unit was established in 1991. A large two-story building dedicated to Desert Locust control in new premises in the Seeb area on the outskirts of Muscat was inaugurated in November 1993. This unit has

substantial permanent staff which monitor weather and receive reports on the locust situation from plant protection staff in regional offices throughout the country. Currently there are some 43 regional offices throughout Oman. Reliance is generally placed on routine reports from these offices to assess the locust situation. In addition, two major surveys are carried out each year by the Locust Unit. The survey teams are made up of two plant protection officers from each region and are coordinated by the Locust Unit. Each survey usually takes about three to four weeks. These surveys are also used as training/refresher courses for the regional plant protection officers. These plant protection officers are the first officers to be deployed in times of emergency by direct secondment to the Locust Unit.

The Locust Unit has considerable dedicated resources for Desert Locust survey and control. There are approximately 16 vehicles including two trucks for logistical support, six of which are equipped with ULV sprayers and radios. The new headquarters facility is an excellent one equipped with sophisticated computer, colour printing, and communications facilities, as well as rooms to lodge a number of staff or outside trainers. The authorities hope to expand this centre's use as an information, training and possibly research centre. There is a radio communications network between the field and headquarters. Additional work is being undertaken at the headquarters site to provide parking and storage facilities. The Locust Unit has an annual budget which appears adequate and which can be rapidly supplemented in times of emergency. Stocks of pesticide for Desert Locust control are maintained and rotated by use for other plant pests such as date palm insects thus ensuring no disposal problem eventuates.

Saudi Arabia

The Locust Control and Research Station (LCRS) located in Jeddah is the responsible authority within the Ministry of Agriculture for all Desert Locust activities in Saudi Arabia. The LCRS has a staff of professional officers responsible for overall coordination of Desert Locust activities. It also has the ability to mobilise substantial additional staff resources through the national agricultural extension system.

The LCRS has substantial resources available on an annual basis, most of which are dedicated to Desert Locust. Several hundred vehicles are retained for Desert Locust use and positioned at agricultural centres throughout the country. Staff at these centres could be mobilised at immediate notice by the Director General of the LCRS to undertake survey and control operations.

Annual contracts are established for both fixed-wing aircraft and helicopters for survey and control purposes. Fixed-wing aircraft are used for the delimitation of areas of potential breeding for subsequent ground survey. In cases of difficult access helicopters are used. The LCRS also had substantial numbers of modern ULV vehicle mounted sprayers and stocks of insecticides. The insecticide stock is used for all plant protection activities to ensure there are no disposal or obsolescence problems. The annual national budget averages about US$ 3.1 million for operations but in years of high locust activity this is normally supplemented, in some cases by up to US$ 18 million.

Somalia

At present there is no national institutional structure for Desert Locust survey and control in Somalia. Nevertheless, Somalia and in particular northern Somalia is potentially an important Desert Locust breeding area which requires ongoing monitoring.

FAO at present has a limited capability to undertake plant protection activities in the country. In 1993 survey operations were undertaken in northern Somalia albeit with difficulty. In 1994 and the first half of 1995 additional Desert Locust survey operations were undertaken as were control measures against Quelea quelea in the southern parts. DLCO-EA has also carried out limited activities in Somalia in recent times. Hence, whilst difficult, it is possible to implement essential survey and control operations in Somalia.

Sudan

Sudan has a substantial Plant Protection Directorate (PPD) in terms of staff and available resources. A Locusts and Grasshoppers Control Unit has been established in the PPD since 1986 with responsibility for Desert Locust survey and control as well as African Migratory Locust and Tree Locust control. The Tree Locust is an important pest in Sudan particularly in terms of its impact on gum arabic production. In general the PPD estimates that some 50% of its resources are allocated to Desert Locust on an annual basis during recession periods and perhaps up to 70% during emergencies. The Locusts and Grasshoppers Unit is under the Plant Protection Directorate which has other responsibilities like Plant Quarantine, Pesticide Registration, Plant Pathology, Field Crop and Horticultural Pests, Vertebrate Pests, Weeds, and Development and Training. A National Locust Steering Committee exists and usually meets on a monthly basis during recessions and more frequently during emergencies.

The PPD has a large professional staff complement comprising six PhD, 65 MSc, 130 BSc, and technical and administrative personnel, totalling approximately 2,500. There are nine main locust bases in the country namely Suakin, Kassala, Khartoum, El Obeid, Shendi, Ed Damer, El Fasher, Ed Duem and Dongola. One locust specialist, five locust officers and up to 15 locust technical staff are located at each base. Many of the locust staff have considerable experience acquired during the 1986-89 and 1992-93 Desert Locust campaigns together with regular experience from Tree Locust operations.

Many of PPD's vehicles are several years old and in need of replacement and/or lack spare parts. Much of the equipment including radios and sprayers, has been provided by donors since 1986. Although the Government provides regular inputs, substantial additional resources, particularly pesticides, are provided by donors during Desert Locust emergencies.

Yemen

The responsibility for Desert Locust matters resides within the Locust Control Centre (LCC) of the Plant Protection Directorate (PPD) of the Ministry of Agriculture. The LCC has a significant degree of autonomy within the PPD with dedicated resources comprising vehicles, sprayers, radios, and staff. The headquarters of the LCC are located in Sana'a with field branches based at Aden and Hodeidah. There is regular radio communication between headquarters, branch offices, and field survey teams.

The majority of the vehicles and other locust control equipment at the disposal of the LCC had been supplied by donors since 1989. Most locust pesticide stocks also have been supplied by donations. There is a strong capability within the LCC in terms of vehicles, sprayers and radios although during the civil war of 1994 a substantial amount of equipment and capital was lost or destroyed. In particular all resources and facilities, including premises, in Aden were demolished or lost and special efforts will be needed to replace and refurbish the physical plant.

A major constraint for the LCC is the limited operational budget which restricts survey activities although the government does supplement the budget of the LCC during emergencies. In addition a number of important traditional Desert Locust breeding areas in the southern part of the country have been mined during the 1994 conflict and therefore cannot be surveyed in safety by ground methods. The storage and disposal of obsolete pesticides is also a major concern for the PPD.

5.2. Regional level

At the regional level there are two main organizations concerned with Desert Locust in the Central Region, namely the Desert Locust Control Organization for Eastern Africa (DLCO-EA) and the FAO Regional Commission for the Control of Desert Locust in the Central Region (RCCR).

DLCO-EA was established in the 1960s to provide a regional capability within East Africa for Desert Locust control and to assist the national PPS in times of emergency. The current member countries are Djibouti, Eritrea, Ethiopia, Kenya, Somalia, Sudan, Tanzania and Uganda. The original mandate, which was confined to Desert Locust, was later modified to include other migrant pests in the member countries, including armyworm and quelea.

DLCO-EA provides pest situation reports to its members and supports their survey and control activities. The degree to which DLCO-EA assists its members is conditioned not only by the Desert Locust situation but also by the varying capacities of individual PPS. DLCO-EA has a fleet of aircraft for migrant pest survey and control. The headquarters are located in Addis Ababa but the organization has a substantial facility in Nairobi which serves as the principal maintenance base for the aircraft fleet. DLCO-EA also has a number of bases in the region including Asmara, Dire Dawa, Djibouti and Khartoum which, apart from providing logistical support for the aircraft, also serve as bases from which ground surveys can be carried out by DLCO-EA.

The organization has undergone substantial rationalisation in terms of staffing over the past few years and staff numbers have been reduced significantly. In addition to its aerial and ground operational capability DLCO-EA also has facilities and experience in areas such as pesticide residue testing and field trials, as well as in forecasting, the development of ground spraying equipment, training, and radio repair.

In recent years DLCO-EA has experienced severe financial strains mainly as a result of member governments' non or partial payment of annual contributions. These have had a serious impact on the organization's operations and response capability. In 1992 the Heads of State of the Inter-Governmental Authority on Drought and Development (IGADD) countries recommended that a merger between DLCO-EA and IGADD be studied and the matter is actively being considered at

present. DLCO-EA does not envisage that such a merger would result in a reduction in the range of its activities.

Notwithstanding its constraints, DLCO-EA has a number of important assets: its aircraft capability, its experienced pilots, as well as its staff's knowledge of and experience in Eastern Africa. The Central Region extends beyond the DLCO-EA membership and at the same time does not include all its member countries. Nevertheless, should it be possible, EMPRES can build on DLCO-EA's comparative advantages.

The RCCR membership includes both Desert Locust recession countries (Egypt, Oman, Saudi Arabia, Sudan, Yemen which participate in the EMPRES programme) and those which are only at risk during invasion periods (Bahrein, Iraq, Jordan, Kuwait, Lebanon, Qatar, Syria, and the United Arab Emirates). Following a recommendation from the RCCR and the FAO Council, approaches have recently been made by FAO to Djibouti, Eritrea, Ethiopia and Somalia to join the Commission to ensure full participation of all the frontline countries of the region. The RCCR is essentially a review, coordination and advisory body with no operational mandate in terms of Desert Locust survey and control. It provides a forum for the member countries to review and discuss the Desert Locust situation, coordinate their survey and control operations and to make recommendations to FAO, to the countries themselves and to donors with regard to Desert Locust matters affecting the region.

Generally the RCCR meets once per year although in times of emergencies more frequently. The Commission has a small annual budget of approximately US$ 250,000 which comes from the member governments' contributions. These contributions are paid into a Trust Fund administered by FAO. The RCCR also has some arrears in payments from member countries. The annual budget is generally used for the promotion of training activities and the purchase of limited quantities of equipment or pesticides. More recently the RCCR has allocated funds for small-scale research activities related to Desert Locust and funded workshops on the evaluation of ground spraying equipment and training programme development. The Secretariat of the RCCR is supplied by FAO with the FAO Regional Plant Protection Officer in Cairo currently acting as the Secretary.

A third regional organization which has recently indicated an interest in Desert Locust is the Arab Organization for Agricultural Development (AOAD). The AOAD has its headquarters in Khartoum, Sudan. It plans to establish a Centre for Information and Early Warning in Khartoum in the near future. This proposed facility will be equipped with remote sensing capabilities and staff. It will be funded from AOAD's core budget. AOAD has indicated that the Centre would include a Desert Locust component but the exact details of this are not yet known. However, it appears that the Centre would not be solely dedicated to Desert Locust early warning and that the wider emphasis would be on food security early warning. AOAD senior management has indicated to FAO its willingness to cooperate closely with EMPRES.

5.3. International level

FAO has a global mandate for the coordination of Desert Locust, and indeed most other migrant pest activities. FAO operates the Desert Locust Information Service from its Headquarters in Rome which collates locust and environmental information on a routine basis and provides short-term forecasts of locust activity through its regular monthly Bulletin. The FAO Migratory Pest Group also provides technical advice to member countries of FAO and provides overall

coordination of locust activities in times of emergencies. FAO further formulates and executes emergency projects funded by donors and directly by FAO through its Technical Cooperation Programme. Such projects typically consist of the provision of equipment, aircraft, pesticides, technical assistance and operational costs to locust affected countries.

The Desert Locust Control Committee (DLCC) is an FAO committee which has the global mandate to oversee all matters relating to Desert Locust. It is essentially a policy and review body and is not directly involved with programme implementation. The membership is open to all FAO members and currently comprises countries likely to be affected by Desert Locust, that is both recession area and invasion area countries, together with donors. FAO provides the Secretariat to the DLCC. The Desert Locust Technical Group consisting of 8 experts advises the DLCC and FAO on technical aspects of locust control.

The international donor community is also playing an active role in assisting Desert Locust emergency operations and research. In particular donors have provided substantial emergency resources to combat plagues and upsurges. Assistance for institutional strengthening of plant protection departments generally and Desert Locust organizations specifically, at the national and regional levels has also been provided. In addition donors have funded substantial research efforts particularly since the 1986-89 plague. These were mainly aimed at finding alternative control agents to minimize environmental impacts whilst allowing more effective control.

6. Current Control Strategies

6.1. Definition of terms

A major complicating factor during discussions of Desert Locust control strategies is the multiplicity of terms used to define the status of populations and the tendency to use these terms in an imprecise and even interchangeable manner. It is therefore necessary to refer here to the following definitions of the most commonly used terms which have been adopted by the EMPRES formulation mission:

> A Desert Locust **outbreak** is defined as a marked local increase in the number of locusts arising by concentration and/or multiplication and accompanied by gregarisation leading, unless checked, to the formation of hopper bands and swarms.
>
> An **upsurge** is defined as the presence of gregarious populations namely hopper bands and/or swarms within parts of a region derived from successful breeding by an unchecked outbreak or outbreaks.
>
> A **plague** is defined as a period marked by a very large increase in locust numbers and increased gregariousness in many populations, leading to the production of unbroken sequences of hopper bands and swarms that occupy an expanding area usually in more than one region.

6.2. Description of current strategies

The current strategy for Desert Locust control asserts that, in general, populations exhibiting or beginning to exhibit gregarious behaviour can and should be located and effectively controlled, thereby preventing the development of major population upsurges and plagues. This

strategy has been termed "preventive control" or sometimes more specifically "upsurge prevention". For the purposes of this document the term **"outbreak control"** will be used. Its critical aspect is that the targets of attack are any populations beginning to exhibit gregarious behaviour.

However, it is generally recognized that in practice the effective control of such populations may not be possible due to late detection, inaccessibility, or other reasons. In such cases, assuming that the outbreak population survives to breed successfully and produces hopper bands and/or swarms, the control is termed, for the purposes of this document, **"upsurge control"**. During the initial stages of an upsurge the target of attack is to a large extent hopper bands but as an upsurge progresses both bands and swarms are targeted.

Hence, it would appear that the most commonly adopted strategy is outbreak control but, in recognition of the practical difficulties involved, a secondary strategy of upsurge control is followed. The objective, however, of both strategies either individually or jointly is the prevention of plagues. Therefore, the current strategy can be considered essentially as a two-step approach comprising outbreak and upsurge control. If both these strategies fail a **"plague elimination"** strategy may be adopted as in the 1986-89 Desert Locust plague. In plagues a more restricted **"crop protection"** component may be introduced by some countries as the potential risk of serious damage increases.

The general aim of the current strategies is the overall reduction in Desert Locust population levels and not crop protection per se although by implication crops will be protected, particularly during plague periods when the risk of major crop damage increases.

6.3. Evolution of the present approach

The strategies described above were essentially evolved in the 1950s and were founded on the introduction of ultra low volume spraying techniques utilizing persistent pesticides such as the organochlorine compound dieldrin against the hopper stages. The logistical advantages of ULV spraying, the high efficacy of dieldrin against hoppers, combined with the low cost and robustness of the barrier spraying technique, resulted in effective and economic control of hoppers. This technique also had significant logistical advantages since it necessitated only the general delimitation of the overall infested area and not the identification of the individual hopper bands or targets within the general area of the infestation. Thus large areas could be treated quickly and effectively at low cost using only limited numbers of ground sprayers and/or aircraft. The strategy therefore targeted hoppers, or more correctly the vegetation on which hoppers would feed, obtain a lethal dose of dieldrin, and die. Any surviving swarms were then treated using other less persistent pesticides. Empirical field evidence indicates that a large percentage of the population could be destroyed in the hopper stage using this approach.

In the 1980s the use of organochlorines for Desert Locust control was effectively discontinued in nearly all countries for environmental reasons related mainly to the persistence of these products in the environment and their potential ecological impact through accumulation in the food chain. In the absence of dieldrin reliance for control has necessarily been placed on other available pesticides such as the organophosphates and synthetic pyrethroids. However, these replacement pesticides have a number of significant disadvantages when compared to the organochlorines. The replacements are more expensive but perhaps more importantly their lack of persistence necessitates a fundamental change in operational procedures. Since barrier spraying can no longer be employed as an effective hopper band control technique it is therefore necessary

to find individual hopper bands within the general infested area and to treat each target more or less on an individual basis. This approach also requires substantially more resources in terms of vehicles, aircraft and manpower to search for, locate and control bands. In addition, substantially more time is needed which is usually a critical limiting factor in locust control operations. Furthermore, there is a strong case to suggest that the current control techniques are less robust with a higher margin for error and failure, thus requiring staff with greater skill levels and training.

Despite these fundamental changes in methods the favoured strategy in locust affected countries has remained a combination of outbreak control and upsurge control largely focused on targeting hoppers.

7. Analysis of Desert Locust Management

7.1. Limitations of current management practices

The limitations of the current management practises have been described in some detail on page 6 of section A which covers background information and justification. They are mainly related to deficiencies in the capacities of affected countries and regional organizations, the reliance on crisis management and to the unavailability of fast and efficient control methods.

7.2. The debate over current strategies

The absence of dieldrin as an effective hopper control agent and the logistical implications of reliance on the less persistent and non-cumulative pesticides have raised concern about the effectiveness of the current control strategies. In this regard some experts have recently argued that without dieldrin, or a suitable replacement enabling barrier spraying, the effectiveness of hopper control is often low since only a small proportion of the hopper population is likely to be located and therefore treated. This is felt to be particularly true in the case of outbreaks where hopper targets tend to be dispersed. The high cost of search and logistical support required has been also highlighted.

In view of these constraints the argument appears to be that greater reliance needs to be placed on upsurge control when concentrated band and swarm targets are produced, with a consequent reduction in the infested area requiring treatment. It has been also noted that most outbreaks die out due to unsuitable environmental conditions before reaching the upsurge stage.

Discussions have further focused on the question of whether swarms can be controlled more efficiently compared to hopper bands. It is generally accepted that due to the high concentration of insects, swarms are very important targets which can be treated efficiently. At the same time opinions differ on whether it is easier to locate swarms or hopper bands. There is the added complication that delaying control until the swarm stage would necessitate the existence of highly sophisticated organizational systems to deal adequately with the situation in the reduced time available.

Overall it would, therefore, appear that the alternative strategy being advocated is firstly to recognize that outbreak control is now ineffective and should be discontinued and secondly greater reliance should be placed on swarm control during upsurges. Other than the target of control, the best method of controlling swarms is also being debated and it is being recommended by some that

greater reliance be placed on air-to-air control of flying swarms rather than controlling settled swarms from the air or ground.

In addition to the above debate on preventive control there has also been concern on the utility and effectiveness of plague elimination as a strategy. In the 1986-89 plague the effectiveness of large-scale control in areas such as the Sahel was questioned given the large number of swarms which survived and the logistical difficulties associated with operations in such areas. This has led to calls, mainly by donors, for the examination of alternative strategies during major plagues. The suggested alternatives to the current plague elimination strategy include crop protection and/or **"strategic control"**. The concept of strategic control advocates focusing control resources in specific seasonal breeding areas where the population concentrates at certain times of the year, particularly the winter, when there is an extended period in which to undertake control.

To date there has been only limited discussion of the strategy issue in the affected countries which often maintain that effective hopper control of outbreaks and upsurges could be achieved using existing techniques. Affected-countries also consider over-reliance on swarm control a high risk strategy due to the often limited time available for this type of control before migration occurred. In addition, in the view of affected countries, it is often difficult to detect swarms even using aircraft and a high aerial search to spray ratio is required.

Recently discussions on the topic of Desert Locust control strategies were held during the 4th session of the Desert Locust Technical Group (21-24 March 1995). The Group recommended to:

- give higher priority to rainfall monitoring in order to improve the detection of outbreaks;
- develop detailed decision criteria for initiating control operations (previously established criteria need to be revised);
- initiate case studies on previous upsurges and plagues which are aimed at evaluating the efficacy of campaigns and the possible impact of different control strategies.

The evaluation of the effectiveness of various control strategies is an unresolved issue which is extremely important and needs to be vigorously pursued. Since decisions on control strategies are taken by PPS, it is critical that those national entities setting locust control policy participate actively in the debate. EMPRES can and should play an active part and coordination role in the discussions on strategy.

At the same time there is a need to inject greater actual field data into the debate. Efforts have to be made to obtain such data from historical archives and this could be complemented with information generated through operational research during future outbreaks. More efforts are also required to collect and analyze locust population and control data from the recent upsurges to further the strategy issue. Again it is essential for EMPRES to have a major involvement in these undertakingsThe evaluation of the effectiveness of various control strategies is an unresolved issue which is extremely important and needs to be vigorously pursued. Since decisions on control.

7.3. Critical Points in Relation to Desert Locust Biology and Ecology

From what is known of Desert Locust biology and ecology the following points emerge as critical:

- population levels vary erratically in space and time;
- there is a lack of detailed knowledge on the processes leading to gregarisation;
- the Desert Locust has a highly developed migratory ability;
- there are limited time windows for control of both the hopper and swarm stages;
- effective control of the egg stage is virtually impossible;
- the areas over which potential breeding may occur are huge;
- many potential breeding areas are remote and difficult to access.

These characteristics and their implications for the design of any effective Desert Locust management system have constituted an important part of the considerations influencing the programme.

8. Analysis of Research Efforts

Quite apart from research related to answering questions about whether, when, and how to control Desert Locust using existing pesticides and technologies, as well as research aimed at understanding the environmental impact of locust control methods, there are also efforts being undertaken to identify alternative, more environmentally benign control agents and to reduce the need for chemical control by improving forecasting, monitoring, and survey methodologies.

In September 1995 IFAD organized a meeting on Desert Locust research for donor representatives and resource persons. The meeting reviewed current progress in research aimed at "The Development of Environmentally Acceptable Control Systems for the Desert Locust" and discussed possible mechanisms for promoting collaboration and coordination between different research groups. The establishment of a network was proposed which would strengthen links between groups engaged in Desert Locust research, would facilitate information exchange, identify research priorities and stimulate donor support. It was concluded that the network would function most effectively if it would be sub-divided into working groups which would focus on important individual research avenues like for example semio-chemical research, biological control, environmental impact or remote sensing.

It will be critical for EMPRES to be a major partner in this network, to assist in efforts of coordination and to strengthen the links between the research groups and the locust control services of affected countries. For example, EMPRES could provide linkages and opportunities to facilitate field testing of technologies where applicable. Through these links the affected countries would be able to better monitor and be aware of what research avenues are being explored and integrate promising results into their Desert Locust control strategies, if necessary with assistance by EMPRES.

It will be particularly important for EMPRES to be associated with the types of research activities described in the following sections:

8.1. Research on alternatives to harmful pesticides

Significant advances have already been made in recent years in developing environmentally acceptable control methods which are not based on the use of chemical pesticides. For example, a number of research groups have made progress in developing biological (more specifically microbial) control methods against locusts and grasshoppers which are based on fungal diseases of insects. The feasibility of using such mycopesticides as oil-based ULV formulations in

arid areas against grasshoppers and locusts has shown promise in field trials. An advantage of mycopesticides is that they can be applied with currently used ULV equipment and technology. Mycopesticides would appear to overcome the concerns on safety and environmental risks associated with chemical pesticides, though it should be noted that these new agents would have to be carefully stored, transported and applied, taking into account their biological nature, and are unlikely to be suitable for barrier spraying.

More research and development work is needed to adapt this technology and to determine its applicability to the scale and special requirements of Desert Locust campaigns. Further, considerable development work would be required for establishing production of high quality fungal preparations in the affected countries. There is a need to continue and expand such research and to evaluate mycopesticides against locusts, grasshoppers and other insect pests at the operational level. Although the scope of such research extends beyond the Desert Locust, EMPRES can serve as a field platform for such work and form a link to related activities.

Attention has also been paid to various other possibilities of developing novel control methods not based on the use of synthetic chemical pesticides. Apart from studies on different plant extracts which have repellent or insecticidal properties, important progress has been made on Desert Locust semiochemicals
(e.g. pheromones). These biological compounds modify, in very low concentrations, the behaviour of locusts. Among other properties, they can directly influence the processes of aggregation and gregarisation. This and related research has significantly contributed to elucidating the processes of phase changes and gregarisation and has provided valuable insight into physiological, biochemical, behavioral and genetic mechanisms involved. Chemicals have been identified which mediate gregarisation, sex attraction, oviposition and maturation of the Desert Locust. Scientists now see a possibility of using the acquired knowledge for developing methods which disrupt gregarisation or attract locusts for monitoring or control. Emphasis needs to be placed in the future on field testing and on translating the research findings into practical applications. In the Central Region semiochemical research is being vigorously pursued by ICIPE. There is a need for EMPRES to collaborate with this research, and in particular to facilitate field trials aimed at testing practical methods for attracting Desert Locust and the disruption of aggregation and maturation processes.

8.2. Improving Desert Locust monitoring and forecasting

A number of expert groups have emphasized the possibility of substantially improving Desert Locust monitoring and forecasting operations by developing a system which integrates, on a real time basis, detailed environmental data obtained mainly by remote sensing, precise knowledge on Desert Locust ecology and population dynamics, as well as current and historical data on locust sightings and movements. Progress has been made recently in this field. For example, research has shown the feasibility of detecting low and sparse vegetation in Desert Locust breeding areas with the aid of NOAA satellite images having a pixel resolution of 1.2 kilometres. This has been demonstrated to be possible if the satellite data are corrected for unspecific background reflections and are calibrated for the main Desert Locust host plants.

Further, a Geographic Information System for locust forecasters has been developed and has recently been installed for operational use at FAO and NRI. It gives forecasters instant access to historical data on locust sightings and population changes, as well as to meteorological data and various other information. The system provides a convenient way of managing the large amounts

of data relevant to Desert Locust monitoring and forecasting. It could also be expanded in the future to include the processing and analysis of satellite images. Further several models will be incorporated which have been recently developed to estimate development rates of Desert Locust from egg-laying to fledging and locust flight trajectories.

FAO in collaboration with experts has outlined the future potential of such research and development efforts in a document entitled "Reconnaissance And Management System for the Environment of Schistocerca (RAMSES)". The RAMSES document identifies activities which are required for developing such a system. It is not envisaged that all or even most of the activities would be executed by FAO, for example a project proposal on ecological research and modelling which has recently been formulated by ICIPE, UNDP and FAO is designed for execution by ICIPE. However, it will be necessary that EMPRES serves as an umbrella for projects implementing RAMSES components, assists in the overall coordination of RAMSES activities and becomes involved in translating promising results into operational procedures.

8.3. Improving chemical control methods

A workshop held in 1993 in Marrakech, Morocco has recommended various research areas which, in the short term, could make significant contributions to the development of more efficient and environmentally more acceptable chemical control methods. Among others, acceleration of research on the use of chitin-synthesis inhibitors against hoppers was recommended. This research has now reached the stage of field application in Madagascar against the African Migratory Locust (*Locusta migratoria*). Several compounds have been demonstrated to be suitable for barrier treatment against hoppers. Chitin-synthesis inhibitors show little toxicity against humans or livestock and can achieve better protection of the environment by acting highly specific against arthropods, through the treatment of only a small part of the total area infested (the barriers), and through the more selective action against immature and leaf-feeding insects. Large-scale testing of chitin-synthesis inhibitors against Desert Locust hoppers is urgently needed and would probably not require major resources. It will be essential for EMPRES to participate in such trials as well as in related research. Additional important research topics are the improvement of formulation and application technology and the development of systems for the airborne detection of hopper bands and swarms during control operations.

9. An Emergency Prevention System (EMPRES) for Desert Locust

9.1. Formulation of the programme

In May 1994 the Director-General of FAO presented a proposal to the FAO Council which called for a new initiative titled Emergency Prevention System (EMPRES) to deal with the management of transboundary pests on a long term basis. This initiative, which was endorsed by the FAO Council, recognized that, while considerable efforts have been made by the international community to strengthen locust control operations, the existing systems for both the early detection and control of such pests and also for emergency response mechanisms were still not adequate. The proposal outlined the components of an FAO field programme to address this situation together with a financial commitment from FAO itself to support such a programme. However, the Council document clearly indicated that FAO did not possess the financial resources to fully implement such a programme and that additional external assistance from donors would be required.

The Council document stated that the EMPRES programme would initially focus on Desert Locust with consideration given to other migrant pests such as armyworm at a later stage (a livestock component of EMPRES was also endorsed). Similarly, the geographical priority for Desert Locust within EMPRES was to be initially the traditional recession breeding areas of the countries of the Central Region in view of the importance of these as a source of both recent and past upsurges and plagues. The critical importance of the Red Sea coasts of both Africa and the Arabian Peninsula and adjacent areas was specifically mentioned. The programme would subsequently expand to other important Desert Locust breeding areas in West Africa and South-West Asia. Its was also envisaged that the
EMPRES programme would supplement the efforts of existing national and regional locust organizations in these countries rather than replace existing programmes.

Following the Council decision a Concept Paper was drafted by FAO. This paper outlines in broad terms the weaknesses of the current approach of reacting to emergencies and provides a rationale for a new initiative concentrated on early detection and early control of locust infestations before they would expand and would require large-scale interventions. The Concept Paper was distributed by FAO to locust-affected countries as well as to donors and a number of comments on it were received.

In September 1994, FAO commissioned a Programme Formulation Team, composed of three consultants, to undertake a mission to analyze the problems associated with Desert Locust management in the Central Region and to propose a framework for the EMPRES programme. The mission visited Eastern Africa and the Near East and prepared a detailed analysis of the capacities in the key countries to prevent Desert Locust upsurges. The mission further prepared a framework for the implementation of the EMPRES concept in the Central Region. A donor consultation discussed the EMPRES concept and the formulation mission report in December 1994. The meeting noted that insufficient information exists on the economic significance of the Desert Locust and recommended studies in this area in order to justify a long-term development programme. As mentioned above, the formulation of a project conducting such studies has started.

The locust component of EMPRES was further discussed in December 1994 in a special workshop with representatives from affected countries, during the 20th session of the Commission for Controlling the Desert Locust in the Central Region and in January 1995 during the 33rd Session of the FAO Desert Locust Control Committee (DLCC). The concept and the overall framework of a collaborative EMPRES programme for long-term Desert Locust management received general support in these meetings.

The DLCC meeting recommended that details of the EMPRES programme should be further discussed by the Desert Locust Technical Group which advises DLCC and FAO on technical matters. The DLCC further suggested to invite donor representatives as observers to the meeting of the Technical Group in order to promote long-term collaboration between affected countries and donors under EMPRES. In view of the recommendation of the DLCC not to delay the development and implementation of the EMPRES programme in the Central Region the Technical Group was convened in March 1995. The current programme specifically originates from the discussions of the 4th session of the Desert Locust Technical Group (21-24 March 1995). However, it also combines the results of other EMPRES meetings, reflects the EMPRES documents prepared by or on behalf of FAO and takes into account various other recent studies and analyses of the subject (e.g. evaluations of recent campaigns or the recent study by the World Bank). In particular, the document has adopted parts of the report of the EMPRES formulation

mission and of a background implementation document which served the Technical Group as basis for discussions on EMPRES.

While designing the collaborative EMPRES programme and pursuing discussions with affected countries, donors and experts, FAO decided to address the most urgent requirements by starting limited field activities in the Central Region. Two pilot projects were initiated in early 1995 using FAO Regular Programme resources. These pilot projects are entitled:

"Desert Locust Early Warning System in the Central Region"

"Early Reaction to the Threat of Desert Locust in the Central Region"

Some of the activities described below have started or are scheduled to start under these pilot projects. It is envisaged that the pilot projects will be integrated into the full programme once it has become operational.

9.2. Requirements for improved monitoring and early warning

Despite the current difference of views on strategy and the possibility of developing improved technologies there is a strong general consensus among those involved in various aspects of Desert Locust work that it is important to strengthen the early warning and monitoring systems for the Desert Locust. Early detection of nascent problems and the collection of environmental data would allow countries and the international community to prepare themselves for a critical expansion of locust populations. Also it would enable early reaction to dangerous build-ups aimed at preventing upsurges and plagues.

Regular surveys are required on a continuous basis concentrating, where appropriate, on seasonal locust breeding areas. The objective of such surveys is to establish whether any Desert Locust populations are present and, if so, to determine their size, density, behaviour and potential risk of developing into a population which may require control. Specific high risk areas receive priority for survey. Such surveys are the responsibility of the national Plant Protection Services and are normally undertaken by ground teams using vehicles. Such teams search the area for locust populations and report the results by radio to their respective headquarters for action as appropriate.

Aerial surveys by fixed wing aircraft are also used to verify initially that suitable breeding conditions exist in an area and to pinpoint specific areas for ground survey teams. It is virtually impossible to detect low density or early gregarious populations reliably from fixed wing aircraft. An alternative aerial survey method is to use helicopters particularly in areas which are physically inaccessible by ground means or where there is a security risk to ground teams. If a helicopter is available it is used in conjunction with fixed-wing aircraft which again pinpoints specific areas to be searched by the helicopter thus maximizing efforts and minimizing costs.

While the key countries in the region, with the exception of Somalia, are conducting regular Desert Locust surveys, these are often limited due to a variety of constraints. In general, survey programmes and schedules do not exist in sufficient detail or do not have enough flexibility to cover larger and non-traditional areas which might have become suitable for breeding. Adequate meteorological information or remote sensing data on rainfall and vegetation distribution are frequently inaccessible to persons directing survey operations. The introduction of certain new technologies will be unavoidable considering that the Desert Locust breeds over very large and poorly accessible areas.

There is also a need to improve the exchange of information, such as survey results, between countries and among regional and international organizations. Little use is presently made of modern communication technologies resulting in important information being passed on with much delay and in insufficient detail. For this information to serve as an effective tool for decision making it has to become available on a regular, almost real time, basis. Related to improving communication is the need to standardize reporting formats and to develop data bases into which this information can be entered. Persons involved in decision making in relation to locust activities need to have instant access to such databases which can later also become powerful tools for researchers for analyzing past events and drawing conclusions on the efficacy and economics of control campaigns.

9.3. Deficiencies in the early reaction to critical population build-ups

Although the prevention of plagues is a common strategy for all affected countries, it has not been possible in recent years to implement it effectively in many key countries due to a variety of constraints. Deficiencies in the early control capacities of countries bordering the Red Sea and the Gulf of Aden, where upsurges and outbreaks have frequently originated during the last 70 years, are of particular concern.

Since the 1986-89 Desert Locust plague, key affected countries in the Central Region have made efforts to strengthen their locust control operations which had been weakened due to priorities being reassigned during the extended recession period from 1969 to 1985. However, serious deficiencies still remain in terms of allocated resources, organizational structures and coordination between neighbouring countries.

While resources are often limited at the national level, there is also an urgent need to review and strengthen the existing organizational arrangements for deploying available resources and executing campaigns. Such a review would need to include the processes leading to decisions on control activities, the effectiveness and efficiency of the control operations themselves, and the precautions taken to ensure that any control measures are carried out safely with respect to both the environment and human health.

A review also needs to cover training requirements as well as analyses and discussions of current early control strategies. For example, a number of countries favour dusting of early instar hopper bands by farmers citing its efficacy and relative safety for unskilled operators. However, this approach has limitations if larger and remote areas have to be treated rapidly. For such operations ultra low volume (ULV) spraying of pesticides is often the only practical strategy. However, ULV spraying by aircraft, or for smaller infestations by ground, requires a high degree of operator skill and the availability of special equipment. Aerial control operations also require an efficient logistical support from specially trained ground teams. Other urgent training needs have been identified during recent emergency operations, e.g. in maintenance and calibration of equipment.

The efficient monitoring of control operations has been frequently neglected in the past. The inability to provide detailed and reliable information on this aspect has negatively influenced planning, the evaluation of campaigns and the identification of constraints. In addition to the efficacy of the actual control methods, there is a need to review and, where necessary, improve the organizational efficiency of control. This would include such aspects as ensuring that control resources such as spray aircraft are utilized most efficiently, e.g. through the provision of adequate ground logistical support and the deployment of ground survey teams to locate targets for aerial

spraying. The development of such organizational skills is difficult to achieve other than through direct experience of campaign management. Similarly, the relative merits of deploying teams to undertake surveys and ground control, as opposed to their deployment only for target search or control, needs to be investigated. If necessary, guidelines would need to be devised to assist in a more efficient allocation of resources under different control scenarios.

There is further a need to review the rapidity of response. As mentioned above, time is often a limiting factor in locust control owing to the rapid life cycle and migration capabilities of the Desert Locust. This time constraint necessitates rapid assessment of the overall scale of the population requiring control, the initial rapid deployment of control resources and the ability to reinforce the initial response quickly. Experience during Desert Locust emergencies over the past ten years has indicated that whilst initial control capacity may be adequate, there are often time delays in reinforcing this initial capacity and thus populations escape to breed, and upsurges and plagues develop. In other cases the initial capacity itself may not be adequate thereby placing more pressure on rapid reinforcement. Often the cause of such delays is the lack of immediately available reserves of pesticides or aircraft, or of funds to acquire these. The mobilisation of external funds even during an emergency requires several weeks by which time populations may have escaped and be breeding on a larger scale in an area several hundred or thousand kilometres from where the outbreak originated.

In order to improve this response it is necessary that a contingency fund be established to enable the rapid procurement of pesticides, hiring of aircraft and to cover operational expenses. It is recognised that a contingency fund would only provide a limited rapid deployment capability for critical situations. It would however provide an initial buffer while additional resources were mobilised if needed. On the assumption that appropriate pesticides which are registered nationally for locust ground and aerial control can be supplied within a short (5-7 day) time frame by air freight, their procurement would be preferable to a regional strategic pesticide reserve.

There is also a need for the establishment of a regional equipment bank under the EMPRES programme. This would enable small but nevertheless important quantities of equipment such as radios, global positioning systems, protective clothing and possibly ULV sprayers to be held centrally and utilized during critical situations.

9.4. Environmental aspects

There exists general appreciation of the importance of minimizing adverse environmental impacts of Desert Locust control. Nevertheless, it is important to translate these concerns further into operational reality. This needs to be undertaken partly through appropriate staff training and partly through field monitoring during control operations.

The research work of the LOCUSTOX project in West Africa will shortly provide environmental guidelines to be incorporated into operational control work. It is also expected that the programme will provide valuable data on the overall impact of locust spraying. It is necessary for EMPRES to incorporate into its activities the results and recommendations of LOCUSTOX and other relevant environmental research, in particular in training and the development and review of control tactics and strategy. Furthermore, there will be a need to ensure adequate monitoring of pesticide use and effectiveness during control operations to alleviate possible environmental and human health concerns.

9.5. The need for a continuous adaptive planning approach

The prospects that ongoing research within and outside the programme is likely to achieve major improvements in the methods of monitoring and controlling Desert Locusts, along with the fact that the institutional, political, and economic contexts within which Desert Locust management must be undertaken is fluid and evolving, mean that any programme strategy being proposed to improve overall Desert Locust management systems **cannot and should not** be fixed and rigid. Instead what is needed is a "continuous adaptive planning" approach wherein overall objectives and programme strategy are modified over time on the basis of experience and additional knowledge gained, while also taking into account changes in external conditions.

9.6. Training

All the above components are predicated on the continuing availability of well-trained staff in PPS, particularly at the field technician/operator level. Apart from various training efforts which have been implemented in the past by different organizations, there is a successful ongoing training programme pursued by U.S.A.I.D. in some countries of the region. The programme can build on such achievements and would need to coordinate training requirements with donors and regional organizations. A regional Training Workshop, held in 1994 Cairo, has identified long-term training requirements and its recommendations are a valuable basis for future activities. For example, as indicated previously, the reliance on currently used ULV pesticides necessitates a higher degree of operator skill and training. Specialist training in other areas such as campaign organization, forecasting and information, survey, and pesticide application and safety, are also required on an ongoing basis. Maximum use should be made of existing expertise in the region for training purposes.

9.7. Institutional considerations

The fact that there is such a variety of national, regional, and international institutions with mandates for or an involvement in Desert Locust work means that any EMPRES programme strategy has to take full account of their existence, the different roles they play, as well as their strengths and weaknesses. In other words institutional and organizational proposals cannot use a *tabula rasa* approach. EMPRES itself, while ensuring that its own work complements, and does not duplicate that of other agencies, can also play a broader coordination and catalytic role among different stakeholders.

There is the added consideration that there are a number of unknowns with regard to the future of several important organizations, necessitating a cautious and flexible approach. For example, DLCO-EA, the premiere regional organization in Eastern Africa with responsibilities for Desert Locust is, as indicated above, in difficult financial circumstances and its work is now severely constrained. The outcome of the proposed merger with IGADD is at present not clear nor is it known whether such a merger, should it go ahead, would solve the organization's financial problems. As the financial and institutional picture of DLCO-EA clarifies itself, and member countries reconfirm and reassert their financial commitments and obligations to the institution, EMPRES should make all attempts to collaborate with DLCO-EA and to build on its comparative advantages.

EMPRES also offers the opportunity to address the need for improved and more intensive collaboration between locust-affected countries, donors and FAO. There has been concern expressed from the side of donors on this matter and the establishment of a Consultative Group has been proposed.

9.8. Target beneficiaries

The farmers of more than fifty locust-affected countries, from India to Mauritania and from Algeria to Tanzania are the primary, although indirect, beneficiaries of the programme through the reduced risk of crop damage by the Desert Locust. The Plant Protection Services of the participating countries will benefit more directly from technical advise, training activities and other inputs of the programme.

9.9. Special Considerations

From the background and other information given above it is evident that there are a number of considerations which should have a direct bearing on the design of any programme strategy for improving Desert Locust management systems and which warrant highlighting.

(a) Considerations related to Desert Locust population dynamics

The episodic nature of Desert Locust outbreaks, upsurges and plagues poses a basic problem in trying to maintain sustainable organizational structures which are capable of both adequately responding to emergencies yet retaining physical and financial resources during potentially long recession periods. It is believed that the solution lies in maintaining small core units for Desert Locust survey and
control within national PPS. These would have the capacity to undertake regular surveys during recession period and provide the core resource for reinforcement during outbreaks and/or emergencies. The need to reinforce such units rapidly with trained temporary personnel would have implications for training programmes. The small nature of the units and their associated recurrent costs would enhance the prospect of sustainability during recession periods.

The rapidity with which outbreaks and upsurges can develop, the limited time available for concerted control action, and the ability of the Desert Locust to migrate over large distances, dictate that the organizational responses are rapid and flexible.

(b) Policy and strategy considerations

The debate on the most effective and economic Desert Locust control strategies is a legitimate exercise and one which needs to be continued. The implications of less effective hopper control due to the non-use of organochlorines should be pursued and the debate needs to be strengthened by the collection of more field data. There is a need to involve the locust affected countries to a larger degree since they after all are the ones who have to deal directly with the problem. The opinion of some experts that control measures should be delayed until the advanced stages of an upsurge may, at the present stage of the debate, prove to be politically unacceptable to those who would bear the immediate impact of failure of such an untested approach. The technical and organizational feasibility of alternative proposed strategies also needs to be carefully evaluated.

(c) Political considerations

By its very transboundary nature Desert Locust must also be considered in a political context. Recent conflicts and differences within and between countries in the Central Region (and indeed in other regions) have had an impact, at times serious, on the ability of locust survey and control organizations to undertake activities, and upon the overall coordination of such activities at

the regional or bilateral levels. Conflicts can coincide with locust outbreaks and upsurges and may prevent survey and control measures from being executed or constrain the flow of locust information.

There will be a need for the EMPRES programme to play a strong coordinating role, and possibly facilitate certain operations under United Nations auspices which may otherwise be difficult for the countries to undertake individually. FAO has had experience in coordinating and implementing locust activities in such situations, for example, in Somalia and Afghanistan in recent times.

Again, because of its migratory habits it is crucial that there be as full a participation as possible of countries involved in regional and inter-regional efforts at improving Desert Locust management systems, and support for this would be necessary from the most senior levels.

Annex III

Lessons Learned from Recent Locust Campaigns

The experiences gained by FAO, donors and locust affected countries from the 1986-89 and 1992-94 campaigns have been documented to a large degree. The following summary of lessons learned from these campaigns is based on the report of the EMPRES formulation mission and internal FAO evaluation reports.

(i) Information

Two major deficiencies in information can be identified namely data quality and timeliness. The provision of reliable, accurate and timely data on locusts, assistance provided, etc., is the foundation of coordination. If such information is lacking coordination of survey and control activities will suffer. Action to improve the quality and regularity of information is necessary as are improvements to current communications systems.

(ii) Survey

Regular routine surveys are essential to enable the early detection of populations in the outbreak stage to enable early warning and the implementation of precautionary measures. PPS need to be strengthened to enable them to undertake such activities.

The use of satellite data to try to identify possible locust breeding areas also needs to be further investigated and developed to assist national PPS in deployment to priority areas for survey.

During control there is a tendency to over-concentrate manpower and vehicles on control activities at the expense of ongoing survey. It is essential that even during major control a minimum level of resources be dedicated to survey. If not, there is a risk that significant infestations outside the main control area may not be discovered.

(iii) Control

In rapidly developing upsurges there is a need for a regional aircraft capability which could be rapidly deployed to reinforce national efforts particularly in those countries where no commercial aerial spraying resources are available.

Greater attention needs to be given to the provision of ground support to control aircraft both in terms of logistical support and target identification by ground teams.

There is a need for improved monitoring of control to ensure safe application and effectiveness of control.

(iv) Contingency Funds

A major constraint on the effective execution of control campaigns is the lack of immediately available resources. There are delays in the early mobilisation of funds from donors which limit, at times severely, the provision of essential inputs such as pesticide and aircraft hire. In addition, funds are often restricted to particular countries or regions and by the time they are received by FAO the major locust focus has moved to a different country or region. This results in more negotiations being required for additional funds or for a reorientation of funds already allocated.

The concept of a contingency fund has been discussed but no conclusions have so far been reached. The provision of contingency funds is seen as an essential component to effective control especially in the early stages of an outbreak or upsurge. Such a fund would provide a finance bridge to maintain field operations whilst additional resources are sought by FAO from donors.

(v) Pesticide and Equipment Banks

In the 1986-89 campaigns a number of donors established pesticide banks which facilitated the rapid air delivery of pesticide to locust affected countries bilaterally on a needs basis. Such a mechanism apart from minimising delays in supply also ensured to the maximum extent possible that no over-supply occurred which might result in eventual disposal problems. However, it was not possible to reactivate this mechanism again in 1993 and FAO was constrained in that campaign by the lack of a contingency fund and of donor funds for the supply of pesticides in particular. The funds which were available were quickly expended on pesticides thus adding additional strain on the funding of other essential operations such as survey and aircraft hire.

In the 1993 campaign FAO also instituted equipment banks for the rapid supply of items such as radios and sprayers. The experience suggested that in any future programme a reserve stock of such equipment should be maintained for rapid strengthening of PPS during emergencies either on a loan or replacement basis.

(vi) Environmental and Human Health Monitoring in Campaigns

Far greater emphasis needs to be placed on the monitoring of campaigns in respect of environmental and human health aspects. This would generally cover elements such as the proper application of pesticides, pesticide application rates, operator safety, minimisation of non-target damage, control effectiveness, pesticide storage and disposal of containers, etc. Environmental guidelines to be produced by the LOCUSTOX project need to be integrated into operations. To fund such activities it is recommended that all FAO/ECLO emergency projects contain a specific component to be used solely for these purposes.

(vii) Evaluation of Campaigns

There is a need for detailed campaign reports to be produced by locust affected countries which would describe the overall campaign, provide detailed statistics on control and resource use and also identify weak points and constraints. Such data would be of potential value for input to the strategy issue.

(viii) Strategy Considerations

There is a need to further the strategy issue by encouraging a dialogue between all the concerned parties. The need to further the debate by the incorporation of field data has been also identified as a priority.

(ix) Maintenance and Repair of Equipment

PPS have received substantial amounts of equipment, particularly radios and sprayers, during the 1986-89 campaign but in many cases a significant proportion of this equipment was not in working order during the subsequent campaign. There is a need to maximise the use of existing resources through maintenance and repair rather than supplying additional quantities of new equipment.

(x) Improved ECLO Response in Emergencies

The reports indicate that ECLO needs to respond more quickly in future emergencies by strengthening its own capabilities, particularly technical staff, as a priority. There is also a secondary priority to strengthen the capability of ECLO field consultants by provision of administrative and technical support and by vehicles. Consultants should also be provided with standard guidelines for reporting to ECLO from the field.