PROGRAMME DOCUMENT

EMERGENCY PREVENTION AND RAPID REACTON SYSTEM (EMPRES)

Locust Component (Desert Locust) in the Western Region

Programme Proposal for Desert Locust Control in the Western Region of its Habitat Area

by

FAO Consulting Mission

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General context

The EMPRES programme, whose importance was acknowledged by the FAO Conference of October 1995, is responsible for long-term preventive control of cross-border pests and diseases of animals and plants, including the Desert Locust. The EMPRES programme was designed to help the countries exposed to this pest in their efforts of prevention and control and to further regional cooperation. A first programme is operational in the Central Region of the habitat area of this pest since 1996. The present proposal deals with the different aspects of the extension of the programme to the Western Region in West and North-West Africa as recommended by the FAO Conference of 1995. It is the result of a formulation mission carried out in September and October 1997 by Messrs. P. Martini, team leader, B. Chara, M. Lecoq, and L. Soumare. It has been discussed during a regional workshop held in Nouakchott in March 1998 and revised by Messrs. P. Martini and M. Lecoq in May 1998.

The document presents the nature of the Desert Locust problem in the Western Region, the present organization of monitoring and control, and the importance of the strengthening and improvement of a preventive strategy. It sets out a new framework for the organization of this mode of control (taking the recommendationsof the Desert Locust Control Committee (DLCC) into account), the main components to be put in place at the national, regional, and international levels, and, finally, the costs and the modes of financing, in the short term as well as the long term, and with a special concern for the sustainability of the proposed system.

Strategy

The approach to the extension of the EMPRES programme to the Western Region in the present proposal is based on the concept of preventive control, adopted by the Desert Locust Control Committee. The countries of the Western Region unanimously consider this strategy the only way to prevent major upsurges of the Desert Locust. This position was reconfirmed during the workshop in Nouakchott in 1998.

The programme will permit to perform survey and control operations as rapidly and as early as possible in the key areas of swarm formation. It is essential to maintain a calm locust situation (i.e., a recession) as long as possible and, in the event of the system's breakdown, to help organize emergency operations in a more rational manner than so far, in accordance with control plans laid down in advance and in clear detail for different levels of seriousness of the locust situation.

In this way the EMPRES programme will enable the countries concerned to perform their preventive control actions against the Desert Locust in a consistent and coordinated manner, at the national, regional, and international levels. It ought thus to be possible to confront in a rational way all foreseeable locust situations, always preferring those operations that carry the highest probability of success, i.e. those that are undertaken as early as possible.

Programme design

The main guiding ideas that have helped to shape the design of the programme and the ensuing proposals for its organization and financing are as follows.

1. Integration of the programme into the global preventive control system of the Desert Locust covering the total invasion area of the species and taking into account the geographical, biological, and historical peculiarities of the problem in West and North-West Africa.

2. Maximum responsibility of the front-line countries (i.e. those holding gregarization areas) and association of all countries in the invasion area.

The assumption of responsibility by the front-line countries is effected through a commitment at the highest level of the states concerned to adhere to the common policy and to support the executive

units of the preventive control system.

The implementation of the programme presupposes setting up and strengthening **national services** for preventive control of the Desert Locust, that are assured of the availability of their means of operation and financial autonomy, and have guaranteed financial resources through a specific paragraph in the national budget bringing out a permanent commitment of the states concerned at the international level.

3. Establishment of a **Platform for Regional Cooperation**, which brings together the different stakeholders of the Desert Locust problem in the Western Region: national services in charge of locust control, regional organizations, FAO, donors. Initially, this Platform will be backed up by the Regional Unit of the EMPRES programme. It should investigate ways and means of establishing a new simplified regional framework for cooperation, as well as assure for the long term the sustainability of the new control system (operational commitment of the front-line countries, financial commitment of the countries in the invasion area and of the international community).

4. Setting up links with relevant national and international institutions, capable of providing methodological and operational support to the programme, particularly concerning geographical information technology, associated research programmes, and short- and long-term training.

5. In addition to its duties inherent to Desert Locust control, including reconnaissance, information and warning, and early treatment of gregarizing populations, the system will have to draft, and make operational, emergency plans that are activated in situations beyond the system's capacities. These emergency plans, drafted according to different upsurge scenarios, must anticipate a high degree of utilization of all available national resources, between-country cooperation, and carefully considered mobilization of potential international support.

Financing

The mode of financing the programme is an integral part of the proposed strategy, which is characterized by two imperative fundamental aspects: the definitely international character of the programme and the necessary sustainability of the activities.

In addition to the financial contribution of the countries directly involved in the programme, the participation of the other countries in the invasion area constitutes a key element of the system. This contribution, justified by common interest, would provide material proof of their adherence to the programme and give them a say in its approach, management, and operation.

The institutions of international financing will find in this programme the opportunity to show coordinated international solidarity, in conformity with their objectives and their own strategy. This contribution should permit to firmly establish the initial financial basis of the programme.

Programmes associated with the EMPRES programme could appeal for their funding to specific contributions from various bilateral aid mechanisms, which would pass through the latters' own financial channels; however, the central coordination unit of the programme would be used as a platform for dialogue.

Conclusion

The document proposes a **new regional framework** for cooperation regarding the Desert Locust problem in the Western Region. It is coherent with the programme set up in other regions of the habitat area. It is designed to permit the **strengthening of the national control units** and the preservation of national competences in locust management. It offers realistic prospects because it should allow to lead quickly to a durable regional structure, works according to a clearly defined strategy shared by all participants, tries to reconcile short-term effectiveness with medium- and long-term profitability, and takes the protection of the environment into consideration. Emergency operations should rapidly become less frequent, more limited, better organized, and less expensive than they are now.

The success of the programme requires the commitment at the highest level of the states concerned and of the international donor community.

ESTIMATE OF TOTAL COSTS OF THE PROGRAMME FOR FOUR YEARS, US$

PROGRAMME ELEMENTS		National contributions (1)	External contributions (2)
National units for preventive control		**11,198,600**	**5,488,560**
Regional organizations		**1,793,840**	
CLCPANO (4 Maghreb countries)	States	572,000	
	FAO	560,000	
OCLALAV (contributions of 5 Sahelian countries)		480,000	
DLCC (contributions of 9 countries, Maghreb and Sahel)		181,840	
EMPRES support unit (temporary for 4 years)			**2,056,000**
TOTAL		**12,992,440**	**7,544,560**
FAO 13% (on external contributions)			980,793
GRAND TOTAL (for 4 years)		**12,992,440**	**8,525,353**

(1) or contributions from other sources; (2) to be covered by EMPRES

ACRONYMS AND ABBREVATIONS

ACMAD	African Centre for Meteorological Applications Development, Niamey
ADB	African Development Bank
AELGA	African Emergency Locust and Grasshopper Assistance (of USAID)
AFESD	African Fund for Economic and Social Development
AGRHYMET	Centre for Training and Application of Agrometeorology and Hydrology (of CILSS), Niamey, Niger
AID	Agency for International Development (USA)
APO	Assistant Professional Officer
CILA	Interministerial Committee for Locust Control (Comité interministériel de lutte antiacridienne), Algeria
CILSS	Standing Inter-state Committee for Drought Control in the Sahel (Comité permanent inter-états pour la lutte contre la sécheresse au Sahel)
CIRAD	Centre for International Cooperation in Agricultural Research for Development (Centre de coopération internationale en recherche agronomique pour le développement) (France)
CLAA	Locust Control Centre (Centre de lutte antiacridienne)
CLCPANO	FAO Commission for Desert Locust Control in North-West Africa (Commission FAO de Lutte Contre le Criquet Pèlerin en Afrique du Nord-Ouest)
CNA, CNLA	National Locust Control Centre (Centre national antiacridien, Centre national de lutte antiacridienne)
CNAR	National Centre for Support to Research (Centre national d'appui à la recherche), N'Djamena
CSE	Centre for Ecological Monitoring (Centre de suivi écologique), Dakar
DFPV	Department for Education in Crop Protection (Départementde formation en protection des végétaux) of CILSS, Niamey
DLCC	Desert Locust Control Committee (of FAO)
DLCO-EA	Desert Locust Control Organization for Eastern Africa, Addis Ababa, Ethiopia
DLIS	Desert Locust Information Service (of FAO)
DNAMR	National Directorate of Support to Rural Areas (Direction nationale de l'appui au monde rural), Bamako
DPV	Directorate of Plant Protection (Direction de la protection des végétaux)
DPVC	Directorate of Plant and Stored Product Protection (Direction de la protection des végétaux et du conditionnement) (Chad)
DRAP	Directorate of Agro-pastoral Resources (Direction des ressources agro-pastorales), Mauritania
DSA	Daily Subsistence Allowance
EMPRES	Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases

FAO	Food and Agriculture Organization (of the United Nations)
FMI	Maghreb Strike Force (Force maghrébine d'intervention)
GPS	Geographic Positioning System
ICIPE	International Centre for Insect Physiology and Ecology, Nairobi, Kenya
IDB	Islamic Development Bank
IFAD	International Fund for Agricultural Development , Rome
IITA	International Institute for Tropical Agriculture, Ibadan
INPV	National Institute for Plant Protection (Institut national de la protection des végétaux)
IT	Information Technology
MAE	Ministry of Agriculture and Livestock (Ministère de l'agriculture et de l'élevage) (Niger)
MDRE	Ministry of Rural Development and Livestock (Ministère du développement rural et de l'élevage) (Mauritania)
MDRH	Ministry of Rural Development and Water Management (Ministère du développement rural et de l'hydraulique) (Senegal)
METEOSAT	Meteorology Satellite of the European Space Agency
NOAA	National Oceanic and Atmospheric Administration, USA
NRI	Natural Resources Institute, Chatham, UK
OCLALAV	Joint Organization for Locust and Bird Control (Organisation commune de lutte antiacridienne et de lutte antiaviaire), Dakar
PCC	Central Command Headquarters (Poste de commandement central)
PRIFAS	French InterdisciplinaryResearch Programme for Acridoidea in the Sahel (Programme de recherche interdisciplinaire français sur les acridiens au Sahel), Montpellier, France
T/R	Transmission/reception (radio)
UNDP	United Nations Development Programme

TERMS OF REFERENCE OF THE MISSION

Under the supervision of the Senior Officer of FAO in charge of the Locust Group and in close cooperation with the FAO staff concerned as well as with the national counterparts and the regional organizations, the mission will complete the survey of 1995 and modify the proposal for the EMPRES programme for the Western Region in order to formalize the establishment of a strategic framework of preventive control.

The mission will give particular attention to a long-term management system and to the sustainability of government structures and of activities resulting from the proposed development efforts. In their official discussions with the governments, the members of the mission will emphasize particularly the issue of the regional sustainability.

In order to carry the reformulation through to a successful conclusion, the mission will refer to:

1) The existing national and regional capacities and constraints involved in early warning, monitoring, and control of the Desert Locust.
2) The results of previous missions to West Africa.
3) The earlier documents and projects prepared for preventive control in West and North-West Africa and the preliminary EMPRES document for West Africa prepared by FAO.
4) The conclusions of similar missions carried out by other organizations (for instance, PRIFAS).
5) The ongoing or planned activities of the EMPRES programme in the Central Region.

The mission will also meet the relevant representatives of Algeria and Morocco (unless members of the mission belong to these countries), and discuss the changes made in the formulation of the programme for West Africa with the Secretary of the Commission for Desert Locust Control in North-West Africa and the French Ministry of International Cooperation.

The mission will consist of four members with the following expertise:

1) Team leader, very experienced in the design of sustainable regional programmes, in the juridical and institutional fields as well as in the practical management of projects.
2) Research acridoidologist, very experienced in research on and control of the Desert Locust as well as in technical assistance programmes.
3) Desert Locust specialist very experienced in Desert Locust monitoring and control operations, with particular field experience in Sahelian countries.
4) Desert Locust specialist very experienced in Desert Locust monitoring and control operations, with particular field experience in North-West African countries.

It is conceivable that additional expert missions will be necessary at a future stage.

AGPP will prepare documents on the subject and make them available to the members of the mission before their engagement. These documents will cover the technical and organizational aspects of Desert Locust control, research, and the EMPRES programme; moreover, various preparatory documents relating to EMPRES and specific informations on the situation in the Western Region will be available.

A brief outline of the mission is as follows.

- Preliminary activities at FAO Headquarters.
- Visits of the countries of the Western Region (Mali, Mauritania, Niger, Senegal, and Chad).
- Consultation of Algerian and Moroccan locust control officers and of the Secretary of the Commission for Desert Locust Control in North-West Africa during the debriefing in Rome.
- Participation in a workshop aimed at exchange of views, planned in Nouakchott to discuss the Western component of EMPRES with all partners concerned.

INTRODUCTION

The Desert Locust is the economically most important species of the locusts and grasshoppers, because of its vast invasion area and the damage it can inflict. The devastation caused by this species is known since antiquity. Its plagues are a major, spectacular phenomenon. Their economic importance has, through the ages, never been doubted. The scale of the devastation during a full-blown plague can be so considerable that this is perfectly evident to all who have witnessed it. Since 1860, eight periods of (major) plagues have occurred: 1860-67, 1869-81, 1888-1910, 1912-19, 1926-35, 1940-47, 1949-62, and 1986-89 (Fig. 1). Moreover, three major upsurges have taken place: 1968, 1987-88, and 1993-95. Control of this pest is indispensable in order to protect the agricultural potential and to maintain the food security of the regions concerned. FAO and the affected countries (particularly those of the Western Region: Sahel and Maghreb) have adopted a preventive control strategy long ago.

During the last two decades, the resources implemented in applying this strategy, and even the strategy itself, have been widely questioned. Particularly the recent plagues, which occurred after a long recession interrupted only by two short upsurges, have caused serious worries in the affected countries as well as with the international community. The main concerns were the real economic importance of the insect, the very high costs of the control operations (US$ 315 million spent in 1987-88), the considerable quantities of pesticides used (32,000 tons), the potential danger of their application to human populations in the area, and the possible environmental impact. One has to notice that the capacities to take into account and to manage effectively the whole complex combination of problems associated with locusts are lacking in several services and organizations in the region concerned.

It was in this context that the FAO Council approved a proposal by its Director General regarding a new initiative, entitled Emergency Prevention System (EMPRES), responsible for long-term preventive control of cross-border pests and diseases of animals and plants, including the Desert Locust. The general approach of the EMPRES programme for the Desert Locust, and its component for the Central Region of its dispersion area, were drafted in 1994 and 1995.

In October 1995, the FAO Conference recognized the importance of the EMPRES programme and carried a resolution requesting the Director General to consider extending the EMPRES programme to other regions, particularly to the Western Region (Recommendation 7/95 of the FAO Conference dated 31 October 1995).

The present description of the EMPRES programme for the Desert Locust consists of a general document (FAO, 1995a) and a document describing its component for the Central Region (FAO, 1995b).

The present document describes the component of the programme for the Western Region of the dispersion area of the Desert Locust (Fig. 2).

It should be recalled that previous to the EMPRES programme, the reorganization of the preventive control system for the Desert Locust has been the subject of several initiatives. Under the aegis of FAO, a first workshop was held in Nouakchott in June 1988 (FAO, 1988). A first project document was drafted, several versions of which were prepared since. It was discussed in meetings of the partners in international cooperation but has finally come to nothing (FAO, 1989). In 1995, an FAO mission analyzed the capacities of the Sahel countries for regular Desert Locust survey and control operations and identified the necessary additional resources. A recent initiative of the European Commission undertaken at the same time has yielded some elements of a long-term strategy for locust and grasshopper control in the Sahel, including the Desert Locust (Launois-Luong & Launois, 1997).

The present proposal concerning the different aspects of the extension of the EMPRES programme to the Western Region integrates the most recent developments collected by four experts during a reformulation mission in September and October 1997, as well as the remarks made on a preliminary draft of the document discussed during a regional workshop held in Nouakchott in March 1998[1]. Of

[1]The formulation mission consisted of P. Martini, M. Lecoq, L. Soumaré, and B. Chara. The present

course it also takes into full account the recommendation concerning the extension of EMPRES to the Western Region made by the DLCC during its 34th Meeting, as well as the thoughts of the international community on the theme "preventive control of the Desert Locust" made public during the last ten years. The document also integrates numerous elements of previous proposals while adapting them to the general philosophy and the strategy of the EMPRES programme.

The present document is organized along the following main lines:

1. Concise description of the present status of the organization of Desert Locust control in the Western Region.

2. Account of the new strategic framework proposed by EMPRES for the organization of preventive control in the Western Region.

3. Implementation of the EMPRES programme in the region, including the additional research and training activities that should be undertaken to support the programme.

4. Estimation of the costs of the programme and its funding.

The annexes present details of the costs of the programme, a brief description of the basic elements of the biology and ecology of the Desert Locust, as well as an outline of the general context of preventive control of this insect, the problems it has encountered recently, and the way in which these could be addressed in the future.

The implementationof the EMPRES programme in the Western Region is planned for a period of four years, which should be sufficient for strengthening the national Desert Locust control units and for summarily defining a new, sustainable, regional framework for the control strategy of this insect.

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version of the report has been prepared during a revision by P. Martini and M. Lecoq in May 1998.

Figure 1. Main Desert Locust plagues since 1860

Figure 2. Invasion area of the Desert Locust. Twenty-nine million sq km (20% of the earth's surface), 65 countries, and 10% of the earth's population.

Figure 3. Recession area of the Desert Locust. Note that the gregarization areas of the Western Region are located essentially in Mauritania and in the border area of northern Mali, northern Niger, and southern Algeria.

Figure 4. Main areas to be surveyed during recessions (note the importance of Mauritania,Mali, and Niger during the summer breeding period).

1. THE DESERT LOCUST IN THE WESTERN REGION

1.1. Nature of the problem

The Desert Locust, ***Schistocerca gregaria*** (Forskål, 1775), is a devastating locust species threatening agriculture in a very vast zone stretching from North Africa to the Equator and from the Atlantic to South-West Asia, including the Near East. This zone extends over 29 million square kilometres (20% of the earth's surface), and embraces no less than 65 countries and 10% of the world population (Fig. 2).

Periodically, upsurges and plagues develop following sequences of favourable rains, which are a key factor for the reproduction of this desert and semi-desert species. These upsurges and plagues are interrupted by periods of relative inactivity, called recessions, during which the Desert Locust populations are represented by very low numbers only. During these periods, the low-density solitarious populations are normally restricted to a limited zone, called recession area. On the other hand, during upsurges and plagues, the high-density gregarious populations can occupy a much vaster area embracing more than 60 countries, called the invasion area (including the recession area). Upsurges and plagues are characterized by the presence of numerous hopper bands and locust swarms dispersed over the whole of the invasion area. If not controlled such populations can cause immense damage to crops, trees and forests, and grazing land in the countries concerned. The Desert Locust has a vary varied diet and can attack all kinds of crops and grazing land. Its strong capacity of migration over long distances is a basic characteristic of the Desert Locust. These migrations follow wind systems which can occasionally result in the rains that are indispensable for reproduction; they follow seasonal patterns linked to the climatic characteristicsof the various regions of the habitat area.

In the Western Region, during recessions, the Desert Locust lives in the solitarious phase in areas of the Sahara with less than 250 mm rainfall per year. Small populations survive in places with vegetation, in wadis and runoff areas. The permanent habitats are located particularly in north-east Chad (Tibesti, Ennedi), in the area where Mali, Algeria, and Niger meet (Hoggar, Timetrine, Adrar des Iforas, Tamesna, Aïr), in the south and the north of Mauritania, in south-west Morocco, in the Sahara in central Algeria, and in the Hamada-el-Hamra and the Fezzan in Libya. The areas of gregarization coincide by and large with those areas. The most important are, during summer breeding, the Adrar des Iforas, the Tamesna, the Aïr, and the central, south-eastern and south-western parts of Mauritania. During winter and spring breeding, the areas of gregarization are the Adrar and the Inchiri in Mauritania, the Ahmet, the Moudir and the north-eastern slopes of the Tadmait plateau in Algeria and the Hamada-el-Hamra in Libya (Fig. 3). Two factors characterizing the areas of gregarization are their location in zones where summer breeding areas to the south and winter/spring breeding areas to the north meet, and where particularly favourable hydrological conditions exist (relief with considerable runoff potential).

During plagues, when the locusts are in the gregarious phase, the spring breeding zones are located in the Maghreb countries, whereas the summer breeding areas are located in the Sahelian countries. The winter breeding areas are located in Mauritania, in southern Morocco, and in the area where Mali, Algeria, and Niger meet. As a rule, swarms move from spring to summer breeding areas in a north/south or north-west/south-east direction. The movements from the summer to the winter and spring breeding areas go from south to north, east to west, and south-east to north-west. Furthermore, there is a less important southern route of migration, in spring/summer, from north-west to the south and the east, which affects the West African countries south of the Sahel. (Fig. 2: general map of the breeding zones and of the most important migration routes of swarms during plagues, showing the regional and interregional relationships.)

Without control, Desert Locust plagues, known for thousands of years, can follow one another with high frequency (Fig. 1). The recessions are usually short whereas the plagues may last a decade or longer.

The damages caused by **a Desert Locust plague** in the whole North and North-West African region can occur over considerable areas. **The total complex of the agricultural production systems (in the general sense) is jeopardized**.

Neither the number nor the extent of invading swarms in the absence of control measures can be predicted, **but the risk exists and is real, as age-old experience has borne out.** When a plague develops vegetations of all kinds can be affected. Annual rainfed crops can very well be affected: after summer breeding in the Sahelian zone, and after spring breeding in North Africa. Perennial cultures (tree crops) and irrigated crops are even more sensitive to attack because they are exposed all year long. Grazing land is also severely damaged because total biomass production as well as its palatability for livestock is affected. The development during the last decades of extensive irrigation schemes on the fringes of the Sahara increases the economic impact of plagues. Finally, the fact that plagues occur particularly in times of good rains, favouring crop growth, also tends to increase the economic impact.

It is extremely difficult to make an estimate of the damages in absolute figures because they are influenced by a considerable number of economic, technical, and phenological factors. A classical economic study of costs versus benefits is tricky. The entire potential production of agriculture, forestry, and livestock in the sixty-plus threatened countries has to be taken into account to get an idea of the possible extent of the damage. The data presently available on losses are not sufficient to assess the risk. They are no better than an incomplete estimate of the losses that control measures have not been able to prevent. The figures of losses incurred during major plagues in the past are impressive, even though they are of an incidental nature only. Even though they refer to the past, one should not brush them aside. It would be absurd to refrain from control and let nature take its toll unhindered only to experience once again the damages that the affected countries suffered before the arrival of effective means of control.

The Desert Locust problem is real and for over a century research and development activities have tried to provide an appropriate solution.

Control operations to eliminate upsurges and plagues, however, always require enormous resources and entail the use of considerable quantities of insecticides, high costs, and obvious environmental risks. The preventive approach implemented progressively has the potential of resolving these difficulties while mastering the problem of plagues in a better way.

A swarm of 10 km^2 consists of some 50 million locusts per km^2 and destroys some 500-1,000 tons of green matter per day. This, if continued for one or several years, entails irreparable crop loss. In one year such a swarm - which is of medium size and density for the Desert Locust - eats the equivalent of 1,000 hectares of biomass.

In 1988 only, during a major upsurge, 14 million hectares have been treated at total costs estimated at over US$ 100 million.

During 11 years (1985-1995) Desert Locust control has cost US$ 250 million, i.e. on average US$ 23 million per year, and this while there were only four years of upsurges during this period and none of a really major plague.

1.2. Monitoring and preventive control

1.2.1. A brief history of the preventive approach to control

Developments in Desert Locust research since the beginning of this century have provided a gradually improving understanding of the factors triggering plagues, and permitted to design a preventive control strategy implemented since the late fifties, particularly in the Western Region.

After B.P.Uvarov had discovered the phenomenon of phases in locusts in the twenties, the main areas of gregarization of the Desert Locust were found in the thirties; they were localized more accurately later on. In the fifties, the development of aerial control, the use of persistent insecticides (Dieldrin), the development of ultra-low volume spraying techniques, as blanket sprayings or as barrier sprayings against larval populations, permitted a considerable improvement of the organization of Desert Locust control. Finally, since the sixties and thanks to a long period of recession, the dynamics of natural solitarious populations became better known.

Unfortunately, research efforts slowed down in the seventies and eighties and, mainly for financial reasons, the preventive control system also degraded, particularly in the Western Region. It took the major upsurge of the late eighties for the international community to become interested again in the Desert Locust and to realize that the preventive control system had to be revived.

The key elements of a system of Desert Locust upsurge and plague prevention are worth noting. With this species, the existence of areas of gregarization and the sequence of upsurges and recessions allows to conceive of control aimed at prevention of upsurges in their early stages. An upsurge or plague, once started, is very difficult to overpower, even with intensive stopgap operations; moreover, considering the extent of the areas affected, the latter are environmentally very hazardous.

During recessions, most of the locusts are present in low densities; they migrate during the night between seasonal complementary breeding areas. The initial process of gregarization is most liable to occur in certain geographicallywell-defined zones: the gregarization areas. Between these regions (or groups of regions) a regular exchange of solitarious populations occurs resulting, in certain favourable years, in strong gregarizations which can trigger a widespread upsurge. The places where gregarization actually occurs (that is, where the hopper bands and the initial swarms form) within a gregarization area make up the gregarization centres. So, the gregarization area of a locust species coincides with the geographical extent containing all local centres of gregarization. In the case of the Desert Locust, the total of the gregarization areas consists of several specific regional entities, the most important of these being located on the coast of the Red Sea and of the Gulf of Aden, along the edge of certain mountain ranges in the Sahara, and on the India-Pakistani border. Details of the gregarization areas in the Western Region are given in the previous section (1.1).

The first stages of phase transformation, which can lead to a major upsurge, occur essentially in the gregarization areas. The Central Region seems to play a very special part and the most recent upsurges essentially originated there. The other Regions (Western and Eastern), however, represent an important potential for gregarization, deserving a standing capacity for monitoring and preventive control operations.

These concepts of gregarization areas and centres of gregarization have helped much when organizing monitoring and control. They allowed to design a preventive control strategy, which was implemented since the beginning of the sixties (particularly in the Western Region) and, at that time, was exemplary of both regional and international cooperation. It owed its effectiveness to its homogeneous and complementary operations undertaken in the entire affected area.

1.2.2. Principles of preventive control

The basic principle of this strategy is the understanding that, in order to overpower the beginning of an upsurge and the phenomenon of gregarization - which, as it becomes more pronounced, becomes increasingly difficult to control - it is necessary to take action as early as possible. Action must start at the very beginning of phase transformation, by destroying locust populations exceeding a critical density threshold (set at 500 adults or 5,000 hoppers per hectare), or populations that constitute a potential danger because of the area they cover.

The objective of preventive control therefore is to detect and eliminate a maximum of those locust populations able to contribute significantly to a local increase in numbers or to phase transformation. Everything has to be done to prevent the onset of the gregarization cycle. The early control operations have to be performed in the gregarization areas, located in desert zones, sparsely populated, far from agricultural areas. These gregarization areas are fairly precisely known, even though they are spread out over a vast area; they are relatively restricted and overall well delimited.

The effectiveness of preventive control depends on the early detection and immediate elimination of populations showing beginning signs of phase transformation. The local operations are all the more limited as they are early and all the more rare as a maximum of potentially dangerous populations in the habitat zone of solitarious locusts can be controlled. One must not wait till larger, denser or more mobile populations are to be controlled, for then the resources required can easily be beyond those available.

In fact, it's a matter of staying continuously vigilant, and of always favouring actions that carry the best chance of success, that is those that are undertaken as early as possible.

So Desert Locust preventive control consists of three essential steps:

- Monitoring of ecological conditions in potential breeding and gregarization areas (meteorological data, satellite imagery); it is generally accepted that any significant rain in the gregarization areas is favourable for the development of the Desert Locust and for the vegetation the insects need for food and shelter. Successive periods of abundant widespread rain in the gregarization centres favour the development of an "upsurge" which, subsequently, can develop into a plague, if it is not contained in time.

- Organizing surveys: it's a matter of rapidly detecting all important populations present in or at the edge of the gregarization areas.

  Because of what is known of locust biotopes, favourable habitats are not searched for randomly; this strongly increases the chance of finding dangerous populations in need of elimination. Most of these areas actually are already well known, described and inventoried. The potential of each biotope for the Desert Locust is known and expressed in terms of its potential for locust reproduction and gregarization. This knowledge is in part formally available, but part of it is also engraved in the memory and the experience of surveyors and all field staff. It's essential that this knowledge is not lost and that operational teams are maintained, so contributing to the training of new generations of surveyors as well as to the improvement of the knowledge of locust biotopes of gregarization areas.

  As well, real-time monitoring of ecological conditions (rainfall, vegetation) can permit to orient surveys more efficiently, i.e. only to biotopes that have become temporarily favourable. In fact, this is being done already right now, with the use of traditional meteorological facilities and all kinds of sources of near-real time information on the areas concerned (nomads, army). The operational utilization of remote-sensing from space should bring considerable improvements to locust monitoring in the near future.

- Control of all locust populations exceeding a certain level (either in terms of density, or of total numbers). All practical control people recognize a density of 500 adults per hectare in several hundreds of hectares as a population warranting control. The control operations must, however, be performed with common sense. Small populations under favourable ecological conditions have to be controlled, whereas senescent adults need not be controlled even if the density threshold is surpassed. In case of treatment of hoppers, control operations can be performed using the barrier spraying technique, permitting to treat vast zones quickly, to use less chemical, and to save the environment.

In practice, the first appearances of ***transiens congregans*** (i.e. locusts in the beginning of phase transformation) are not all detected in time. It is often necessary to spray hopper bands or even swarms; it is essential then to keep these first gregarious formations within the gregarization area (if possible within the gregarization centre) and to prevent their uncontrolled spreading over much vaster territories, which could be the beginning of a new upsurge of the pest and subsequently of a new

plague.

The basic objective is to erode the locust populations in order to keep them below the threshold that would allow them to massively exploit ecological conditions favourable for dangerous phase transformation; the latter usually requires breeding under favourable conditions for three or four successive generations.

If the objective of containing the "gregarizing" formations (in the general sense, including various degrees of ***transiens*** and fully gregarious locusts) fails in the areas of their origin (gregarization areas), the situation can quickly degenerate, with control resorting to a curative strategy, and subsequently very quickly to stopgap action, which essentially is aimed at locally protecting crops where-ever this is possible. Experience has shown that control efforts are quickly overwhelmed in these cases due to the very great mobility of Desert Locust populations and the vast geographical areas concerned. Protection of crops under these conditions is a strategy of undeniable economic interest but it has usually only little effect on the overall locust situation. In the elimination of a plague climatic factors play a more important role than the factor "control" from the moment that the preventive strategy has failed and there are no options left but to conduct the best possible stopgap control.

This is the concept of preventive control that has gradually shaped the organization of Desert Locust control in the Western Region.

1.3. Present organization of control

Two kinds of structures are involved in Desert Locust control in the Western Region:

- National locust control units in charge of survey and control operations, each one in its own territory.

- Regional organizations, responsible for coordination, for distribution of information, for promotion of research activities, and for training.

Moreover, several donor countries provide regular or occasional support to Desert Locust control. Finally, FAO has a mandate from its member countries for the coordination of survey and control activities.

1.3.1. National Units

Each of the countries affected by the Desert Locust in the Western Region has a more or less independent national locust control service. Those of the North-West African countries were established long ago; on the other hand, setting up those of the West African countries has begun only since 1989 and the restructuring of OCLALAV. The present situation in each country is as follows.

Algeria During recessions, Desert Locust control is the sole responsibility of the Department of Locust Control (Département Lutte Antiacridienne) of the National Institute for Plant Protection (Institut National de la Protection des Végétaux, INPV; institute administered by the Ministry of Agriculture and Fisheries). For its survey and control operations, this department has 25 specialized academic and technical staff, two main bases (Algiers and Tamanrasset), a secondary base (Adrar), and four substations (Béchar, In-Salah, Silet, and Tindouf).

During major upsurges, control is placed under the patronage of the Interministerial Committee for Locust Control (Comité Interministériel de Lutte Antiacridienne, CILA). This committee is chaired by the Minister of Agriculture; it is responsible for designing a national locust control programme and for collecting the resources needed for its implementation.

The organization of control is regulated by an interministerial directive which makes provision for the establishment, in times of major upsurges, of a Central Command Headquarters (Poste de Commandement Central, PCC), and of Wilaya Command Headquarters (Poste de Commandement

de Wilaya), in charge of the coordination of control at the national and the local levels respectively. The survey and control operations are performed by the specialized INPV staff and the local branches of the Ministry of Agriculture, under technical supervision of the Department of Locust Control. The control resources available at the INPV are largely sufficient for preventive control of the Desert Locust and represent a good strike force in times of major upsurges.

Chad Desert Locust control is the competence of the Division of Plant Health Monitoring and Control (Division de la Surveillance Phytosanitaire et de l'Intervention) of the Directorate of Plant and Stored Product Protection (Direction de la Protection des Végétaux et du Conditionnement, DPVC) of the Ministry of Agriculture. Chad has no service nor specific resources for Desert Locust control; however, if necessary, all resources of the DPVC can be mobilized to address outbreaks of this pest. The DPVC has a base at Abéché and a substation at Faya-Largeau, old OCLALAV infrastructures used at present for locust control.

Libya Locust control in Libya is placed under the supervision of the National Standing Committee for Locust Control in Tripoli. This committee coordinates the control operations at the national level; it consists some 15 high-level staff of several departments of ministries. Local locust control committees covering the whole territory of Libya perform monitoring and control operations. Resources available for control are sufficient for preventive control in Libya.

Mali All plant protection and locust control activities come under the authority of the National Directorate of Support to Rural Areas (Direction Nationale de l'Appui au Monde Rural, DNAMR), which has eight plant protection bases spread out over the whole territory. The DNAMR comes under the authority of the Ministry of Rural Development and Livestock (Ministère du Développement Rural et de l'Elevage, MDRE); it has several divisions including one for Prevention of Risks and Plagues and Plant and Animal Protection (Prévention des Risques et des Fléaux et Protection des Animaux et des Végétaux). Part of this division is the section Plant Protection, which is in charge of locust control in general. One of the eight plant protection bases (at Gao, in the north of the country) is responsible for locust control during recessions. It has a director with a staff of three surveyors and support personnel, and needs some small repairs and workshop equipment. The Aguelhoc substation also requires some repairs; on the other hand the Tin-Essako substation has to be reconstructed elsewhere due to its advanced state of disrepair and the unhealthiness of the premises (the walls and the ground floor are completely soaked with pesticides, including Dieldrin and others). A national coordinating committee, with representatives from relevant national services, FAO, and donors convenes whenever necessary (upsurge or plague).

Morocco Desert Locust control is the competence of the National Centre for Locust Control (Centre National de Lutte Antiacridienne, CNLA) at Aït Melloul, which comes under the General Direction of Disaster and Emergency Services, Ministry of the Interior and of Communication (Direction Générale de la Protection Civile, Ministère de l'Intérieur et de la Communication). The CNLA is managed by the Centre's chief, who is assisted by some ten high level staff, surveyors, and support staff (administrative personnel, mechanics, labourers). The CNLA is financially autonomous.

During plagues the survey and control operations are coordinated by a Central Command Headquarters (Poste de Commandement Central, PCC), which is under the authority of the High Command of the Royal Gendarmerie. The PCC mobilizes the material resources necessary for control and coordinates the field operations of the specialised services.

The material resources available to the different participants (CNLA, Plant Protection, Royal Gendarmerie) permit effective survey and control operations during recessions and make an excellent strike force during upsurges.

Mauritania The Ministry of Rural Development and Livestock (MDRE) has created the Centre for Locust Control (Centre de Lutte Anti-Acridienne, CLAA)in 1995, by ministerial order. It is responsible for locust monitoring and control wherever in the territory of Mauritania. The Centre comes under the authority of the Directorate of Agro-pastoral Resources (Direction des Ressources Agro-pastorales, DRAP). It is managed by a director based in Nouakchott, assisted by several high level staff, surveyors, and support personnel. The main base is located at Aioun El Atrouss, in the south-east of the country. The CLAA has some vehicles at present which belong either to the Mauritanian state or to the FMI (Force maghrébine d'intervention, Maghreb Strike Force; see below). These resources, which have been put to harsh use for a shorter or longer time already, cover part of the needs for

preventive control in Mauritania. Like in Mali, Mauritania also has a coordination committee which convenes regularly in times of upsurges or plague.

Niger Desert Locust control is entrusted to the National Locust Control Centre (Centre National Antiacridien, CNA), in Agadez, created by order of the Ministry of Agriculture and Livestock (Ministère de l'Agriculture et de l'Elevage, MAE). It comes under the Directorate of Plant Protection (Direction de la Protection des Végétaux, DPV). The latter is one of six directorates of the MAE. The Centre has autonomy in the management of its finances and a bank account at BIAO, in the name of "Centre Acridien". Since 1992, the Centre has managed to perform only occasional survey and control operations, due to lack of funds and security problems in the north of the country. CNA staff has been reallocated to other plant protection activities. Staff of the CNA actually consists of the director and a surveyor. The other infrastructures for Desert Locust control are the In-Abanggharit substation, which is in an advanced state of disrepair. Like the other Sahel countries, Niger has a coordination committee which convenes if and when necessary.

Senegal This is not a front-line country; however, its geographical proximity to the summer breeding areas of Mauritania makes it vulnerable to incoming swarms, even during beginning upsurges. Its participation in the exchange of information and in the logistic support in the context of the EMPRES programme is highly recommended.

The Directorate of Plant Protection (Direction de la Protection des Végétaux, DPV) of the Ministry of Rural Development and Water Management (Ministère du Développement Rural et de l'Hydraulique, MDRH) has no specialized unit for locust control. However, if necessary, the DPV can mobilize a strong strike force for controlling this insect. Locust control in Senegal is supported by an important project initiated by FAO in 1990 with Dutch funding, aimed at evaluating the impact of pesticides used for locust control: the LOCUSTOX project.

Tunisia Like Senegal, Tunisia has no gregarization areas, but it can also be exposed to incoming locusts, when spring breeding is considerable and uncontrolled in the central Algerian Sahara and in the Hamada-el-Hamra in Libya. Tunisia has a locust control service under the Sub-Directorate of Crop Protection (Sous-Direction de la Défense des Cultures), the latter being placed under the General Directorate of Agricultural Production of the Ministry of Agriculture.

The Tunisian plant protection service has sufficient human and material resources for addressing the initial outbreaks that might invade its territory.

1.3.2. Regional coordination structures

Two sub-regional structures coordinate Desert Locust control at present: OCLALAV (Organisation Commune de Lutte Antiacridienne et de Lutte Antiaviaire; Joint Organization for locust and bird control), covering the West African countries, and CLCPANO (Commission FAO de Lutte Contre le Criquet Pèlerin en Afrique du Nord-Ouest; FAO Commission for Desert Locust Control in North-West Africa), which ensures coordination in the North-West African countries.

Members of **OCLALAV** are: Benin, Burkina-Faso, Cameroun, Côte d'Ivoire, Chad, the Gambia, Mali, Mauritania, Niger, and Senegal. According to the amendment made to its mandate in 1988, its responsibilities are:

- to collect, analyze, and distribute information on the Desert Locust and on other migratory pests;
- to give technical support to training, to organization and coordination of control operations, and to the identification of operational problems and efforts towards their solution;
- to monitor pesticide stocks, in consultation with the countries;
- to assume, fully or partially, the planning, construction, and management of locust control and research bases, through conventions concluded with the countries and organizations concerned.

OCLALAV has headquarters in Dakar; it has an annual budget of US$ 240,000 financed by the ten member countries.

In fact, lack of financial resources greatly impedes the execution of its mandate and limits the role of the organization to acting as an instrument of coordination and as an executing agency of regional assistance programmes.

The members of **CLCPANO**, the FAO commission for the countries of North-West Africa, are Algeria, Libya, Morocco, Mauritania, and Tunisia. CLCPANO's main responsibilities are the following:

- collection, analysis, and distribution of locust information;
- training at all levels of personnel involved in survey and control operations. Since its creation in 1971, CLCPANO has enabled several scientists to obtain a doctor's degree in acridoidology and organized many training courses for field staff;
- promotion of research efforts aimed at reinforcing the preventive control strategy;
- regional and inter-regional coordination; in this context, more or less narrow relations exist between CLCPANO, OCLALAV and the other FAO commissions for the Middle East and South-West Asia.

CLCPANO has a permanent secretariat in Algiers. The annual budget is $US 143,000. These funds are raised out of the members' contributions and deposited into a trust fund administered by FAO. Furthermore, FAO pays the costs of the secretariat estimated at US$ 140,000.

Following the major plague of 1987-89, the CLCPANO has created the Maghreb Strike Force (Force Maghrébine d'Intervention, FMI), aimed at strengthening cooperation among the North-West African and West African countries and at helping Mali, Mauritania, and Niger to perform preventive control operations in the summer gregarization areas.

At the moment, the FMI has equipment for control operations (all-terrain vehicles, including some fitted with spraying machinery). These have been put to a severe test in control campaigns run since 1989 but could still be used in two or three campaigns, provided they are revised and would receive periodic maintenance thereafter.

Summing up, all four Maghreb countries (Algeria, Libya, Morocco, Tunisia) may be considered to have well-equipped locust control services able to address the preventive control activities necessary in their respective territories. However, the Desert Locust control services in the Sahel countries (Chad, Mali, Mauritania, Niger, and Senegal), if they exist, are not very operational due to the chronic lack of resources of these countries. This situation has contributed to the upsurges which have occurred during the last two decades and has reduced to next to nothing preventive control activities which were difficult to perform anyhow for the following reasons:

- the gregarization areas are located in the Sahara, far away from agricultural areas and cities;
- the slight resources available in the front line countries of the Sahel are often used for protection of, and close to, crops;
- the international community makes only limited resources available for preventive control of the Desert Locust but contributes considerable funds during upsurges and plagues.

1.3.3. International assistance

In addition to these national and regional resources, other institutions and various donor countries contribute regularly or occasionally to Desert Locust control in the Western Region. The following organizations and countries should be mentioned:

- **UNDP** has regularly supported and financed Desert Locust control actions.
- The **European Union** has contributed considerably to Desert Locust control during the last decade, in the countries of West Africa as well as those of North-West Africa. However, its help is connected with emergencies.

- **France** contributes for a long time already to Desert Locust control in the Western Region, during recessions as well as during plagues. The support given to OCLALAV is a case in point. France has helped all West and North-West African countries, particularly during the plague of 1987-89. Since 1988, she has set up the ECOFORCES facility which has an operational task against the Desert Locust and grasshoppers, more in particular in the agricultural zone between the 13th and the 16th parallel north latitude. This facility has its own ground logistics intended for supporting, if necessary, control operations performed by one or several aircraft.

- **Germany** contributes since 1988 to Desert Locust control in West and North-West Africa.

- **Japan** helps mainly by providing insecticides.

- **Canada** is also one of the important Desert Locust control donors in West and North-West Africa. Canada actually prefers a regional approach and has consequently supported locust control in Mauritania and Senegal through OCLALAV in 1994-95.

- The **United States of America** support locust control since ten years or so through their programme "African Emergency Locust and Grasshopper Assistance" (AELGA).

- The **African Development Bank** (ADB) and the **Islamic Development Bank** (IDB) have contributed considerably to the Desert Locust control operations in the Western Region, particularly during upsurges (1987-89 and 1993-96).

1.3.4. FAO's position and mandate

FAO, mandated by its member countries, essentially coordinates survey and control activities against the Desert Locust.

The International Institute of Agriculture established the "International Convention for Locust Control" in Rome in 1920. Since 1950, FAO has always and in different manners promoted international cooperation in locust control, particularly through its Group "Locusts and Other Migratory Pests".

The FAO Conference, in its 8th Session (4-25 November 1955), has authorized the Director General "to continue his policy of coordination of the international measures against the Desert Locust (...) and to take measures in order to draft a long-term policy of investigations and inquiries aimed at preventing plagues".

FAO has created the Desert Locust Control Committee (DLCC), in which about 60 states are represented in 1995. Its task is to guide and to coordinate locust-related activities at the international level. The DLCC consists of representatives of all countries affected by the Desert Locust and of those countries that participate actively in control campaigns[2]. Its mandate (as modified by the FAO Council in October 1968) is as follows:

- to keep the Desert Locust situation under review;
- to coordinate the Desert Locust control campaign in the Arabian Peninsula and in other affected areas;

[2]The following countries contribute at present to DLCC: Afghanistan, Algeria, Saudi Arabia, Bahrain, Cameroun, Chad, Djibouti, Egypt, the United Arab Emirates, Ethiopia, the Gambia, Ghana, India, Iran, Iraq, Jordan, Kenya, Lebanon, Libya, Mali, Morocco, Mauritania, Niger, Nigeria, Oman, Pakistan, Qatar, Senegal, Somalia, Sudan, Syria, Tunisia, Turkey, Uganda, and Yemen.

- to promote the overall coordination of work by various national and regional anti-locust organizations and commissions;
- to promote the coordination of national and international policies and preventive measures in Desert Locust control and research;
- to provide the Director General of FAO with technical and scientific advice on the Desert Locust situation and on the measures required to keep it under control.

The member states of DLCC contribute annual fees to an international trust fund (no. 9161, Desert Locust). The theoretical annual budget is US$ 207,300.

DLCC has, among other things, fostered the creation of three regional commissions (Near East, South-West Asia, and North-West Africa) and of an inter-state organization,the Desert Locust Control Organization for Eastern Africa (DLCO-EA). These organizations have enjoyed and are enjoying support from FAO; OCLALAV also has received continuous technical support since its creation.

FAO also plays an important role in Desert Locust early warning by running the central service for forecasting and warning (Desert Locust Information Service, DLIS), which prepares bulletins presenting the locust situation as well as a forecast, using various informations from the all countries in the habitat area (on locusts and their environment). These bulletins are sent to the countries and the services concerned by mail, electronically or by fax; at the moment they are also on the Internet.

Finally, FAO plays an important role in coordinating the financial contributions during major upsurges and plagues.

1.4. The problems of preventive control and its possible improvements

Certain developments interfered with the correct application of preventive control in the eighties, favouring the major upsurge of 1987-88. The following factors explaining the failure of control have been cited:

- Inability to access and effectively spray the initial outbreak areas due to security problems (Eritrea, Ethiopia, Mauritania, Sudan, Chad).

- Weakened organizations for monitoring and preventive control south of the Sahara (difficulties of OCLALAV and DLCO-EA) and too few well-trained staff.

- Late start of control operations as a result of lack of reaction to warnings given by experts as early as 1986; the donor countries waited to get going until the plague was well under way.

- Inability to use Dieldrin, on whose effectiveness the preventive control strategy depended to a large extent. This insecticide was prohibited because of its deleterious environmental effects; the substitute insecticides used instead precluded barrier sprayings and necessitated repeated treatments of areas of passing swarms due to their short persistence.

All these factors have actually prevented strict application of the preventive control strategy during recent years and contributed to the fact that recent upsurges (1987-88 and 1993) were not contained early enough. However, it is not the strategy itself here which is basically to blame but the temporary impossibility of applying it correctly for the various reasons cited above.

In spite of the recent practical difficulties in its application, exactly the preventive control strategy has permitted to properly prevent beginning plagues during the long recession of 1962 till 1987. One may wonder if climatic changes during this period and the drought of the seventies might have contributed to the reduced frequency of Desert Locust outbreaks. It is a fact that the adoption of the preventive control strategy since the early sixties, in conjunction with the introduction of new control techniques (aerial treatments, ultra-low volume spraying, barrier spraying, general use of exhaust nozzle sprayers), has coincided with the end of the last major plague and a relatively calm period that has continued for about 25 years. Right from the moment that this strategy was not applied correctly anymore, the beginning of a plague arose, in 1987-88, following an upsurge that had not been

suppressed, and subsequently another upsurge occurred, in 1992-94. It would seem that this is more than a simple coincidence and that the preventive control strategy, for a certain time, has fully played its role. The old world has probably saved itself a major plague, even in spite of the difficulties in applying the strategy properly.

None of the experienced Desert Locust control experts in the Western Region have the slightest doubt concerning the effectiveness of the preventive control strategy. The significance of this approach was strongly reasserted by one of the great Desert Locust specialists of our time, G.B.Popov, during the 34th Session of the DLCC. His remarks were approved by all DLCC participants (para 45 of the report). The significance of the preventive approach was reaffirmed at the EMPRES workshop for the Western Region in Nouakchott, in March 1998.

Therefore, the standpoint of the countries of the Western Region is clear: they are of the unanimous opinion that only preventive control is able to prevent major Desert Locust upsurges.

All countries of the Western region feel that curative actions, such as those in 1986-89, should be avoided. In their view the preventive strategy is the most effective and economic. This is obvious when comparing the costs of preventive control operations carried out with common sense, with the costs of curative or stopgap control operations under conditions of emergency and great haste (Table 1). In 1987-88, the latter actions have cost the international community some US$ 250 million, and entailed the pollution of several millions of hectares because of blanket spraying of chemical insecticides. Moreover, as such curative control operations are very costly in insecticides, they can only be profitable in agricultural systems able to afford these costly inputs and to organize and supervise their proper application, particularly regarding the protection of the environment and of human and animal health.

Some studies have coined the idea of an insurance system for farmers. This is only conceivable for high added-value cash crops, solidly integrated in a monetized and organized economic system. The extent of the damage and the risk of a general impact has more in common with a natural disaster than with the kind of accident usually covered by insurance and reinsurance systems. Many countries in the invasion area have a mainly subsistence type of agriculture and lack the financial resources for this sort of protection. It would be difficult to implement, one drawback being that it could easily jeopardize existing structures for locust control and plant protection.

A control system aimed simply at eliminating upsurges without trying to prevent them could quickly be overwhelmed and be more expensive and more polluting on top of that.

In fact, the rehabilitation of an effective preventive control system is the only option according to all countries of the Western region.
This rehabilitation:

- remains justified because of the importance of the Desert Locust (even though the precise assessment of its potential damage remains difficult);
- corresponds to the will of the countries of the region;
- will permit to restrict the costs of control, the quantity of insecticides used (which will be used in a more rational manner) and the pollution of the environment (which, in addition, will only affect areas with little or no habitation);
- is the sole approach capable of obtaining continuously the informations from the field needed for the timely assessment of the seriousness of the situation in the whole region and for organizing control in a rational manner;
- is the sole approach capable of preserving the necessary capabilities at the national level in the region, by maintaining a surveillance system;
- is, moreover, at present technically and economically conceivable and will be more effective than in the past thanks to recent technical progress:
  - electronic communication networks now available in the area;
  - new insecticides reopening the possibility of barrier spraying;
  - prospects of biological means of control;
  - availability of geographic positioning systems (GPS);
  - early detection of favourable areas through remote-sensingfrom space very certainly possible in the near future, etc.

The uncertainties associated with insecurity zones come and go and are occasional and cannot call the general value of the strategy into question.

A special feature of the Western region should be emphasized; it makes the maintenance of services dedicated exclusively to the Desert Locust here more indispensable than elsewhere. The habitats of solitarious populations - the areas where the gregarization process is liable to begin, and therefore the areas that should be monitored - are located in desert or semi-desert areas far away from agricultural areas and population centres. This is a major difference with the Central Region. This implies that without specific actions in these areas, there is a serious risk that: (1) useful information on dangerous locust populations may not be obtained in time and (2) personnel capable of performing operations in these poorly accessible areas, where operational problems are many and can only be solved at the last moment, will not be available. Operating and running effective control campaigns in these areas requires competent staff, continuously trained, who know the area and the operational conditions. All this cannot be improvised at the last moment by mobilizing part of the ordinary resources of the plant protection services.

Permanency of the actions is necessary, even during recessions.

This is the only way to guarantee the availability of competent national staff in time of emergencies, capable of managing efficiently the local resources as well as any international assistance.

Table 1. Extent of annual treatments expected during recessions and upsurges for the seven countries of the Western Region holding gregarization areas, under different control systems.

Control system	Area (ha)	Treatment type	Insecticide (l)	Cost (US$)	Relative costs
PREVENTIVE CONTROL					
Recession	<50,000	Barriers	5,000	100,000	1
		Blanket spraying	25,000	500,000	x 5
CURATIVE CONTROL					
Start of upsurge	500,000	Blanket spraying	25,000	5,000,000	x 50
Upsurge	10,000,000	Blanket spraying	5,000,000	100,000,000	x 1000

N.B. The costs of chemical control from 1986 to 1992 calculated (in C.A.Herok and S.Krall, 1995) at 11,4 US$ per ha, is considered an acceptable estimate; for ease of calculation a cost of $10/ha was used for blanket spraying and of $2/ha for barrier spraying.

These figures are given as an example. The areas treated during recessions can well be less than 50,000 ha (for instance only 2,000 ha were treated in 1991). Moreover, the costs of insecticides depend on the chemicals used. Finally, the costs of barrier treatments depends on the distance between barriers, which still needs to be assessed for the new chemicals now available.

2. THE EMPRES PROGRAMME: TOWARDS A NEW FRAMEWORK FOR PREVENTIVE CONTROL OF THE DESERT LOCUST

2.1. Justification of the programme

All countries of the Western Region consider the rehabilitation of an effective preventive control system the only realistic way to solve the Desert Locust problem.

Besides the accord on the strategy that should be followed, there is also agreement on some other fundamental issues:

- The countries of the recession area must maintain small but well organized locust control units, in order to:
  - ✶ continue the necessary monitoring;
  - ✶ keep up the indispensable know-how in the countries, even during recessions.
- A regional facility for cooperation and dialogue is necessary.
- A central information and forecasting service needs to be maintained.
- Rapid access to aircraft and insecticides in emergencies must be ensured, based on reserve funds and pre-prepared contracts (emergency plans).
- The countries from the whole invasion area and the donors have to provide assistance.
- The present early warning system lacks reliable data on the rainfall and the vegetation of potential breeding zones of the Desert Locust. Information on these matters is necessary for better guiding the surveys.
- Additional research on the biology and ecology of the Desert Locust in its solitarious phase as well as on the development of new methods of control is necessary.

All these issues are covered in the present programme proposal, which tries to resolve the constraints hindering a more rational organization of Desert Locust control and the establishment of an effective system of early control enabling to prevent plagues.

The programme ought to provide the indispensable framework for the adoption of a coherent plan of action and for the coordination of the efforts and contributions. As a matter of fact, many donors and regional and international organizations have contributed to locust control in the recent past. The considerable number of participants requires a well-considered action plan and an effort to coordinate and integrate the actions off all those involved.

The participation of donors in the programme is justified because of the following considerations:

- Many affected countries where the necessary facilities for this preventive approach should be put in place don't have the necessary resources.
- The preventive actions undertaken by each country are not only for their own benefit but are also to the advantage of the other countries of the Western Region and of the counties of the whole invasion area, because of the complementary nature of the breeding zones.
- The costs entailed by the operations of early control intended to prevent upsurges and invasions are much smaller by far than the economic, social, and environmental costs associated with curative control (suppression of upsurges and plagues). **It is fair to estimate that the annual external assistance requested from the donors represents less than 1% of the costs of control operations in a plague year.**

- The preventive control programme will not fail to permit the appeals for emergency assistance made to the international community to become less frequent and less costly . It will not fail to preserve competent national cooperation partners, capable of managing efficiently any emergency assistance.

The preventive control strategy of the present programme proposal should, in the long term, not cost more than US$2.8 million per year for the whole Western region (including US$1,7 million covered at present already by the states). It should permit to detect and check upsurges in their early beginnings and to limit pollution of inhabited and agricultural areas and of fragile desert and semi-desert environments to a minimum.

In fact, the rehabilitation of a preventive control system can be considered as an insurance policy against Desert Locust plagues; it is the only realistic way of addressing this natural calamity.

2.2. Beneficiaries

The programme's beneficiaries are:

- the **farmers and stockbreeders** of West and North-West Africa;
- the **inhabitants of the other regions** of the invasion area of the Desert Locust, who will be protected by successful preventive control actions in the Western Region;
- the **donors**, who should experience a marked decrease of the frequency of requests for emergency assistance and find emergency operations better organized;
- the **national** Desert Locust control **units**;
- the **regional coordination** of control;
- **locust control personnel**, who will benefit from training activities.

2.3. Participating countries

The countries participating will be those having gregarization areas on their territory and those where continuous preventive action needs to be implemented, i.e. Algeria, Chad, Libya, Mali, Morocco, Mauritania, and Niger (front-line countries) as well as the countries most directly affected by beginning upsurges: Senegal and Tunisia.

One single regional coordination facility for all these countries is indispensable for the success of preventive control.

The international assistance of the programme will be focused mainly on Chad, Mali, Mauritania, and Niger. The other countries involved in the programme - which are sufficiently equipped already - commit themselves to maintain preventive action on their territories according to the joint strategy; they will benefit directly from the programme and from the new organization set up through the joint planning of the operations, the improved systems of early warning, communication, and exchange of information, and, generally, through the prevention of upsurges.

2.4. Objectives of the programme

The long-term objective of the programme is to diminish the economic and environmental impact of damage by major Desert Locust upsurges or plagues by:

- reducing the risk of upsurges;

- improving the organization of control, based on early warning and on improved knowledge of the locust situation;

- minimizing the costs and the environmental hazards resulting from large-scale operations, which are inevitable in the event of major upsurges or plagues.

In particular, the programme aims at developing a successful system of preventive Desert Locust

control in the Central Region including plans for different levels of intervention corresponding with different levels of seriousness of the Desert Locust situation.

The system will be based on strong national locust control units, cooperating efficiently at both the regional and international levels.

At the regional level, the EMPRES programme will strive to further the creation of a regional platform for coordination and dialogue.

Very special attention will be given to the sustainability of the proposed system of preventive control, to be achieved by an appropriate institutional and financial arrangement.

2.5. Overall strategy of the programme

2.5.1. General concept

The strategy of the EMPRES programme for the Desert Locust is based on two fundamental considerations.

First, **it rests on the concept of preventive control**, which aims at preventing major upsurges and plagues. This concept is fully shared by all countries of the Western Region, which has a long experience with this approach. To revive the preventive control system in light of the experiences of the last ten years, it is necessary to improve the system of monitoring of ecological conditions, forecasting, warning, and early intervention. Emergency plans also should be adopted, in order to be able to address rapidly any major upsurges that might occur in spite of the preventive measures. To accomplish these tasks, the capacities of the countries in the region (and particularly those of the four sahelian front line states: Chad, Mali, Mauritania, and Niger) have to be strengthened. Concurrently, the cooperation among the countries and the exchange of information must also be reinforced. A new regional framework for cooperation and dialogue on the Desert Locust must quickly be created.

Secondly, **"learning" is an important aspect of the proposed strategy.** This is based on the firm belief that, even though certain concrete measures must and can be taken immediately to improve the effectiveness of the control system of the Desert Locust, there are still many gaps in the understanding of the ecology of the insect as well as weaknesses in the methods of control and forecasting. Improvements in these fields must be sought and could have consequences for the results of the proposed programme. So the strategy must be adaptable; based on existing knowledge, but taking advantage of whatever new knowledge becomes available. The improvement of the strategy for managing the Desert Locust takes effect through the integration of progress in locust research (achieved outside the context of EMPRES), the analysis and evaluation of measures taken within the framework of the programme, the furthering of discussion on crucial aspects (including those on the effectiveness of control strategies), the initiation of research projects within the framework of the programme, and through support to separate research activities aimed at increasing existing knowledge on locusts.

2.5.2. Characteristics and operational requirements of preventive control of the Desert Locust in the Western Region

The preventive control system of the Desert Locust has a number of characteristics and operational requirements which set it apart from other plant protection activities. The most significant of these in choosing the types of organization and methods of management are briefly mentioned.

The stakes are international; failure of one country involved in control can sometimes cause much greater damage in neighbouring countries than in the failing country. Therefore, each country involved in control is responsible to the whole area at risk. Adhesion to the programme brings out this commitment.
Guidance of teams operating in the field should not only be by local informations but also by informations from preventive control units of neighbouring countries and from international networks or systems (meteorology, satellites). The methods of gathering information, of presenting field data,

and of transmission and interpretation must therefore be standardized. This standardization should be a task of one single platform, covering all countries of West and North-West Africa, and be harmonized for the whole area of involvement of EMPRES.

The methods of interpretation of the informations needed for programming and managing field operations ought to be refined, in order to improve the efficiency of field operations on the basis of a better knowledge of the zones that need to be surveyed, their ecology, and the bio-ecology of the Desert Locust. This requires pluridisciplinary scientific work, aimed at better utilizing available data, particularly in the fields of meteorology, characterization of biotopes, and the use of satellite imagery accurately calibrated for the entire region.

The permanent habitat and breeding zones of the Desert Locust, where the preventive control operations take place, **are situated outside agricultural and inhabited areas** which are the classical theatre of crop protection. These zones are often far away, of difficult access, economically and socially not very attractive. The effectiveness of preventive control depends on the professional conscience of the survey and control teams and on the stringency they impose on themselves in their work, remote as they are from any immediate supervision. It also requires permanency of action, continued rigorously, even when a prolonged period of recession evokes a demotivating sense of immediate uselessness.

It is this permanency of action which guarantees that alertness is maintained and gives confidence that any potentially dangerous situation is detected. It is also **this permanency of action which is needed to guarantee the countries that the know-how to conduct effective Desert Locust control operations is maintained.**

Neglecting preventive control and replacing it by control at a later stage entails the obvious risk of competent teams fading away; teams that are the only ones with hands-on knowledge of the insect, its biotopes, and the operational difficulties of actions in desert areas. This applies particularly to the Western Region as the key biotopes are located in the desert zone. When the will to undertake early control is lacking, the resources will necessarily dissipate into the national plant protection services which, when the need arises, won't have the capabilities to intervene deliberately in Desert Locust habitats and manage locust emergencies effectively. The result can only be another waste of indispensable massive international assistance.

2.5.3. Outline of the required organization

The EMPRES programme aims at helping the countries to strengthen national preventive Desert Locust units and at redefining a single regional cooperation framework.

Two levels of organization are necessary:

- **the national Desert Locust control units,**

- **the regional cooperation platform.**

The support of the EMPRES programme to these two levels of organization will be achieved through a EMPRES Regional Support Unit.

The national units and the regional platform are conceived as permanent structures whereas the regional unit is a temporary structure essentially connected to the first four-year phase of the EMPRES programme in the Western Region.

It is anticipated that beyond this four year phase the two organizational levels have been strengthened sufficiently for their further autonomous functioning and that modes of long-term funding will have been devised.

The support of the FAO EMPRES programme to Desert Locust control in the Western Region could be much more limited from then on.

2.5.4. National Units of Desert Locust Control

To be run effectively, preventive Desert Locust control needs special, highly qualified, and extremely mobile teams. So in each country the organization of preventive control requires a strong Locust Control Unit with maximum autonomy.

2.5.4.1. Purpose of the National Desert Locust Control Units

The tasks of the units are to ensure the maintenance and permanent availability of preventive Desert Locust control, to perform survey and control operations in the field, to organize the transmission of information among the field and the institutions concerned, inside the country (pluridisciplinary contacts) as well as outside it (coordination facilities, Desert Locust control units of neighbouring countries).

2.5.4.2. Organization of the National Desert Locust Control Units

Preventive control depends primarily on surveys; it must proceed in each country according to a master programme, which is prepared in advance and adapted from day to day and immediately to information obtained from the field or from external observers, either national, from other countries, or from geographical information systems installed by the programme. So the National Desert Locust Control Unit responsible for the implementation of preventive control must be able to react quickly to any information that might necessitate modification of its immediate strategy of operation. This implies that the decision-making nucleus should be very close to the implementing branch.

The National Desert Locust Control Units ought to have, within the plant protection service or within any other parent organization, a clearly defined autonomy as to their status, equipment, infrastructures, and budget. They ought to have their own strictly defined financial resources, an exclusively earmarked budget, and funds available through a special account limited to their exclusive use.

Their staff appointments will be guaranteed contractually and statutorily; the competences and training of staff will have to be in accordance with the anticipated tasks. Competence and performance of staff will be evaluated regularly. Initial basic training and subsequent in-service training will be taken care of by the programme. A system of bonuses and promotions should maintain staff motivation.

The effective and exclusive availability of the infrastructures and equipment necessary for the implementation of preventive control of the Desert Locust is a crucial requirement of the programme, particularly regarding the vehicles, radios, and spraying equipment. Even if their full-time, year-long use is not justified and their use is seasonal only, they must absolutely not be used for anything but the original purpose.

The international character of preventive control of the Desert Locust implies legal and statutory regulations to facilitate the relations of the national control units with neighbouring countries and to integrate the units into a joint regional cooperation framework. The units should be able, on short notice, to intervene in support of neighbouring countries, just as they should be able to receive support from neighbouring national units when joint action appears necessary. Permanent travel authorization and accreditation should be granted statutorily to those in charge of control in order to permit ongoing contacts with other national units.

All these regulations should be laid down legally, by a decree or a law on the creation and the regulation of the functioning of the National Desert Locust Control Units, which should explicitly give these units administrative and financial autonomy and facilitate their international involvement.

2.5.4.3. Tasks of the National Desert Locust Control Units

The National Desert Locust Control Units have the following tasks:

- Monitoring of the locust situation and of the ecological conditions in the gregarization areas of the Desert Locust at the national level. This has to be achieved through regular surveys in the

main recognized breeding and gregarization areas of the locust. The surveys must be performed according to a rigorous plan, taking the seasonal suitability for reproduction of the various breeding areas into account.

- Undertaking control operations against any locust population whose density and/or extent make it potentially dangerous (preventive control operations in the strict sense).

- Coordination of control operations in the event of a beginning upsurge according to emergency control plans.

- Collecting, storing, analysis, and transmission of Desert Locust information and of the condition of its biotopes.

- Taking care of the secretariat of the National Desert Locust Coordination Committee.

2.5.5. Regional Cooperation Platform

The characteristics and requirements of preventive Desert Locust control as set out above speak well for establishing a Regional Platform of Cooperation and dialogue for all countries in the region involved in control. This Platform will be the permanent and supreme authority responsible for directing Desert Locust control in West and North-West Africa.

The various activities of a Desert Locust preventive control facility make up a coherent system which must be put to work in its entirety and in accordance with the adopted strategy. Therefore strict coordination of all activities of the countries and the existing regional structures is necessary. This coordination should be provided by a Regional Platform.

The Platform will be limited to preventive Desert Locust control, act as an exchange house of informations and centre of cooperation and dialogue for the stakeholders involved in the problem of the Desert Locust in the Western Region (countries, subregional organizations, FAO, donors). It will have to procure the external support - financial, organizational, and technical - deemed necessary for its proper functioning.

It will consist of:

- the representatives of the countries concerned (Algeria, Chad, Libya, Mali, Morocco, Mauritania, Niger, Senegal, and Tunisia), and possibly any neighbouring country feeling involved;
- officers in charge of the EMPRES Regional Support Unit which will take care of the secretariat;
- officers in charge of the subregional organizations, OCLALAV and CLCPANO;
- representatives of FAO;
- representatives of donors involved.

The Platform will convene at least once per year and will:

- Further national and international actions aimed at combatting the Desert Locust.

- Act as an intermediary for the exchange of practical experiences among countries, for improving methods and for liaising with research organisations and with institutes in the field of geographical information.

- Further the activities of support programmes (training, research).

- Organize joint training sessions.

- Supervise the activities of the EMPRES programme in the Western Region and prepare its discharge at the end of the first four year phase. During the four year phase, the Platform will also act as the regional technical steering committee of the EMPRES programme and help with the annual programming of the activities of the programme in all countries involved.

The Regional Cooperation Platform will also have to give thought to the status of its subregional

components. In this regard, the resolutions of the 33rd and the 34th Meetings of the DLCC ought to be put into effect as soon as possible. These resolutions relate to a meeting of OCLALAV and CLCPANO to be arranged under the auspices of FAO.

Ideally, those involved would seek to simplify the existing situation as soon as possible. Eventually (and if possible well before the first four year period of the EMPRES programme), the Platform could be given a status equivalent to an FAO Commission.

This FAO Commission for the Western Region would in that case be assisted by an officer of the Organization. Its annual meetings would bring together in one single meeting:
- the representatives of the countries concerned;
- the representatives of FAO;
- the representatives of the various donors, as observers.

It would be wise to add the officer in charge of the EMPRES Regional Support Unit to this list, as long as this programme will continue. For the sake of economy and to avoid duplication of work, this officer could be the officer in charge of the new FAO Commission for the Western Region. The new headquarters of this commission should be established in accordance with all parties involved.

This FAO Commission (which conceivably could be similar to CLCPANO with a mandate extended to the whole region) would be the single, essentially technical instrument for regional cooperation managed jointly by the parties involved. This Commission would:

· permit economies of scale (one regional organization instead of two subregional organizations; one and the same officer in charge of the Commission and the management of the EMPRES programme);

· better match the nature of the problem, because the gregarization areas straddle the Sahelian and Maghreb countries;

· permit the Sahel countries (which are directly concerned with the task of monitoring but by and large destitute of the necessary resources) and the Maghreb countries (which have less terrain to monitor but have more resources, and are the first to be involved in case of upsurges) to cooperate better, to their mutual benefit;

· guarantee the Maghreb countries active participation in the organization in the entire Western Region and permit without doubt mobilization of additional funds from these countries.

2.5.6. EMPRES Regional Support Unit for the Western Region

2.5.6.1. Objectives

The Unit will be temporary. During a period of four years, it will help establish the Regional Cooperation Platform and deploy the resources necessary for the stengthening of the national units. This assistance will be organizational and technical. It will also regard methods of collecting and transmitting locust information and the organization of possible exterior support in related fields (remote-sensing, meteorological information, applied research). Concerning the latter issues, the Unit will make sure to enlist the cooperation of organizations competent in these fields.

2.5.6.2. Tasks

The EMPRES Regional Support Unit will be responsible for the following.

(1) Administering and managing the programme. In cooperation with the National Desert Locust Control Units, it will set up the preventive control system. It will help mobilize and transfer the necessary financial resources, in collaboration with FAO Headquarters in Rome, the FAO representations, and the officers in charge of the national services and their parent organizations.

(2) Implementing and monitoring the programme.

⇨ National level

- Ensure that National Desert Locust Control Units are strengthened.
- Help countries draft modular emergency plans according to different scenarios of threat.
- Help countries prepare technical, juridical, and budgetary measures aimed at achieving sustainability of the preventive system and durability of its interventions.
- Help National Desert Locust Control Units organize their survey and preventive control task, by:
  - ✶ harmonizing the methods of surveying, collecting and assembling of data, and of analysis, transmission and storage of information;
  - ✶ planning their survey and control operations;
  - ✶ coordinating the survey and control resources (regional redistribution, if necessary, of teams according to the situation, rational management of insecticide stocks at the regional level to prevent stock formation of obsolete pesticides);
  - ✶ liaising continuously and directly with FAO Headquarters (DLIS) and the EMPRES programme for the Central Region.
  - ✶ ensuring, in general, the deployment and proper functioning of all national elements of the system of early warning and rapid intervention.

⇨ at the regional level:

- Help the regional organizations (CLCPANO, OCLALAV) perform their tasks, by:
  - ✶ acting as an intermediary for the exchange of practical experiences among countries and for the improvement of their methods; ensuring liaison with research organizations and specialized institutes of geographical information;
  - ✶ furthering the activities of support programmes;
  - ✶ organizing joint training.
- Support the Regional Cooperation Platform and carry out its secretariat;
- Make evolve the preventive control system towards greater sustainability seeking to achieve, in particular, a simplification of the regional cooperation system and the rapid implementation of the resolutions of the 33rd and 34th Meetings of the DLCC (see Section 2.4.4.).

⇨ at the international level

The Empres Support Unit associated with DLCC will ensure the collaboration of the programme for the Western Region (West and North-West Africa) with the other units of regional components of the programme.

2.5.6.3. Location

The location of headquarters of the Regional Support Unit of the EMPRES programme for the Western Region should be selected in joint consultation of the parties involved.

2.6. System of locust monitoring and early warning

The system of Desert Locust monitoring and early warning hinges on information regarding:

- the suitability of the environment for the Desert Locust,

- the level, status, and distribution of locust populations.

This information is necessary for the regular monitoring of the situation, for directing surveys, and for early warning in case of an upsurge.

This is basically information from the field; it has to be transmitted as rapidly as possible (i.e., electronically) to the Desert Locust Information service of FAO. In return, this service must send back to the countries the interpreted information and high quality forecasts which can be entered into the national databases.

The information is collected by national locust survey teams. Both observations on the locusts and on the locusts' environment are needed, the two fundamental parameters being rainfall or better still, humidity of the upper layer of the soil, and the phenological condition of the vegetation. These informations can be completed by meteorological data provided by synoptic, agrometeorological,and climatological stations existing in some of the countries concerned and by services operating at the global level (Météo-France, for instance).

Regarding the environmental data, the network for measuring rainfall is notoriously insufficient in the desert zone (with the exception of southern Algeria). Installing a sufficient number of automatic weather stations for Desert Locust monitoring is not a viable option because of the high costs of investment and maintenance (every opportunity to augment their number should, however, be seized upon). For the short to medium term, the only realistic manner to have real-time information on the condition of Desert Locust biotopes in the entire habitat area is by using remote-sensing information: from METEOSAT satellites for rainfall and NOAA satellites for vegetation.

Satellite data do not yet permit fully satisfactory interpretations in terms of actual rainfall and of suitable vegetations for the Desert Locust. Research on difficulties in interpreting satellite images is ongoing. Recent work done by the Locust Group of FAO within the framework of the RAMSES project is yielding promising results. Satisfactory operational use of satellite information in locust control seems possible within three to five years. Applied research in this field must be conducted parallel to the present programme, in order to extend the applicability of the RAMSES methods to the Western Region.

Three categories of users are likely to integrate the various kinds of information on locusts and their environment, to interpret the complex of data available, and to use them or transmit them to their clients:

- the National Desert Locust Control Units,

- the Desert Locust Information Service of FAO, and

- the Regional Cooperation Platform.

The EMPRES programme should promote standardized collection of good quality information and its rapid distribution. The implementation of EMPRES should facilitate the following tasks.

(1) National Locust Control Units

- Collection of field information using standardized methods and protocols in accordance with DLIS.
- Extensive use of informal networks of information and data collection (efforts will be made to increase their reliability and the speed of transmission of the information).
- Capture of basic national information using RAMSES software permitting capture according to a standard format, which will gradually be used all over the habitat area of the Desert Locust.
- Setting-up national databases.
- **Electronic transmission of information directly to DLIS (FAO Headquarters) and, at the same time, to the Regional Cooperation Platform.** Each country will receive the equipment necessary for electronic capture and transmission of data, if possible directly from the field

bases.

- Local analysis of information using the RAMSES system (display of topical data, past locust situations, maps of locust biotopes at the national scale and, possibly and at a later date, of satellite data).
- Electronic reception of data, information bulletins, and forecasts transmitted by DLIS.

Research test zones will be identified close to field bases or substations. These zones will be monitored more intensively to be used, among other things, for the calibration from remote sensing data (estimates of rain parameters, from METEOSAT, RADARSAT, and NVISAT, and vegetation parameters, from NOAA). The network of rain gauges will be strengthened at this level (with one or two automatic stations). The research programmes that can make use of these zones, thanks to operational support from renovated facilities under EMPRES, should rapidly be able to contribute significantly to the monitoring and early warning system.

(2) Desert Locust Information Service of FAO Headquarters

- Participation in the standardization of methods of collection and transmission of information.
- Reception of directly, electronically, transferred field data by national units.
- Reception of additional environmental data (satellite imagery, meteorological data).
- Setting-up databases.
- Interpretation of data (SWARMS software, trajectory and development models).
- Electronic return of interpreted information on a global scale by DLIS to the national units of the countries concerned and the Regional Cooperation Platform.

(3) Regional Cooperation Platform

- Reception of electronically transmitted field data from the national units.
- Reception of additional data on the environment (satellite imagery, meteorological data).
- Setting-up regional databases.
- Local analysis of information using the RAMSES system and contribution to the interpretation of the data at the regional level.
- Rapid, electronic communication of the interpreted information to the countries concerned and to DLIS at FAO-Rome.

It should be noted that the active participation of the regional level in the interpretation of information is in accordance with a recommendation of the DLCC stating that the locust situation and the forecasts should be prepared by DLIS after reception of national and regional reports.

2.7. Emergency plans

2.7.1. Justification

The experience of the recent past shows that a preventive control system can't be guaranteed to be 100% effective. The habitat area of the Desert Locust is vast. Many uncertainties can weaken the system or part of it. So the possibility of upsurges must be considered.

The objective of the EMPRES programme is to create an institutional framework enabling the monitoring and control system to function under any locust situation, preventively against the first outbreaks but also in case of upsurges.

It is essential that, at any level of intervention, the full effectiveness of the system is guaranteed, by anticipating the evolution of the situation as much as possible and by avoiding last minute improvisations which always cost extra time and money and add to the environmental impact.

To achieve this guarantee of effectiveness, efforts must be made to create as mobile a system as possible, and particularly to prepare emergency intervention plans corresponding with different degrees of seriousness of the locust situation.

In fact, experience shows that the mobilization of the required facilities should not be done in a helter-skelter rush, but rather stepwise as information becomes available, permitting interventions to

be prepared timely, so as to optimize their costs and maximize their results.

2.7.2. Intervention levels

Three levels of seriousness of the locust situation can be envisaged. In fact, these levels are oversimplified and should be refined, country by country, in the course of the programme.

Level 1: recession

This level corresponds with the presence of solitarious locusts only, scattered over the territory. Some populations showing beginning gregarization may break out locally, in limited regions whose total area should not exceed five square degrees (as a rough estimate) per country.

Monitoring and control during recessions require the deployment of the minimum resources (supplemented by all resources available at the national level if surveys in the Sahara need to be undertaken).

Control operations should not exceed 15,000 ha per country and per year. They should be terrestrial and performed by national survey and control teams.

The EMPRES programme should permit to install or to strengthen the basic survey and control capacity, which should be available permanently at the national level, and should serve to bring down all beginning outbreaks during recessions.

Level 2: beginning upsurge

Level 2 is associated either with favourable conditions for breeding over more extensive areas of the country, causing outbreaks on more than five square degrees, or with incoming swarms from neighbouring countries.
Control operations should not exceed 50,000 ha per country and per year. They would require a gradual mobilization of resources according to the seriousness of the situation. At first, the mobilization of terrestrial reserve teams within the country will be considered, as well as a reinforcement by teams from neighbouring countries (from front-line countries or from countries second in line such as Senegal, Morocco, or Tunisia). The mobilization of additional terrestrial and aerial resources at the national level will also have to be considered; clearly defined procedures and conditions negotiated in advance should be part of the intervention plan.

At this level, all necessary resources should be either available or rapidly mobilizable within the framework of the system that EMPRES will be permitted to strengthen and reorganize at the national and regional levels.

Level 3: upsurge and plague

Level 3 is either linked to very favourable conditions for breeding becoming widespread over a large part of the gregarization areas in the country, or to forays of many swarms coming in from neighbouring countries or regions. The areas to be treated can very considerably exceed 50,000 ha per country and per year.

Addressing this kind of situation requires:
- the mobilization of the National Desert Locust Control Units;
- additional national resources already anticipated at level 2;
- appeals to internationalassistance for insecticides, spraying equipment, technical assistance, etc.

Appeals should be made in a carefully considered manner, according to explicitly designed procedures in the emergency intervention plans. The latter will clearly state the most probable locust situations and the additional resources needed to address them (at the local, regional, and international levels), the logistical, administrative and financial channels to be activated, and the potential donors to appeal to. An emergency intervention fund should be envisaged to meet the first needs.

The level 3 plans could involve the Ecoforces facility, an arrangement for deploying survey and aerial control resources including ground logistical support run by the French Ministry of International Cooperation. If it would, it would be advisable to adapt the facility to the new situation created by the EMPRES programme.

In any case, the mobilization of resources will depend on the assessment of the overall situation by the officers in charge of the National Units, in accordance with the officer in charge of the Regional Cooperation Platform.

In this manner, the EMPRES programme should permit to face level 1 conditions thanks to the National Control Units as well as level 2 situations (beginning upsurge) by the rapid mobilization of additional resources at the national level and thanks to considerable mobility of control teams at the regional level. Level 3 (upsurge and plague) will require the intervention of additional resources and an appeal for emergency assistance, according to procedures to be laid down during the programme. The emergency plans (Table 2) ought to be contractual documents deposited with all governments concerned and with the main donors.

The first two levels will be taken care of by the preventive control system that is to be strengthened by the EMPRES programme. Level 3 will involve the appeal to emergency plans and additional resources to be made available by the states and the international community.

Table 2. Locust situation and intervention levels of the programme and of donors.

Population level	Warning level	Action taken by
Recession Localised outbreaks	Level 1	Regional preventive control facility (strengthened by EMPRES)
Beginning of upsurge	Level 2	
Upsurge Plague	Level 3	Emergency programs (*)

* Drafted by the countries with help of the EMPRES support unit

2.7.3. Resources needed during emergencies

In case of emergencies - i.e. hopper infestations over extensive areas that control has not been able to cope with at an earlier stage, and swarms coming in from outside the region, etc. - extensive control operations will be necessary. The use of aircraft will then very certainly be indispensable.

These emergency operations have not been costed in the context of the present programme because they will become occasional as their frequency should diminish through the proper application of the preventive control strategy.

One of the objectives of the first phase of four years of the EMPRES programme for the Western Region will be to prepare such emergency plans, country by country and according to an outline of some typical locust situations. These plans should be sufficiently detailed and in particular include a precise description of the situation and the zones involved. The resources to be deployed in each case and the procedures for rapidly releasing the necessary funds will be spelled out with the donors who will be depositaries of these emergency plans.

The implementation of these plans will be all the more efficient as the competent national staff will be kept on thanks to the preventive control programme.

2.7.4. Role of aircraft

In preventive control, mobilization of aircraft is generally not necessary. However, a leeway of some tens of hours of flight has been planned to facilitate surveys in certain areas of difficult access. On the other hand, aircraft are essential during emergencies (see Section 2.7.3.).

The use of local aircraft (planes of plant protection services or otherwise) will be favoured whenever possible.

The costs of aerial treatment of a hopper infestation covering 100,000 ha are roughly $US 750,000 - 1,200,000 according to the situation and the equipment used (figures for information only). Though rough estimates, these figures show that the costs can differ considerably according to options (plane or helicopter, blanket or barrier spraying, chemical used, etc.).

A more detailed study of the advantages and the drawbacks of each option should be made under the programme. A study on the use of helicopters is particularly advisable, because the costs, even though high per hour of flight, decrease appreciably with increase of use. Moreover, if used generally, the helicopter option would permit to have, at the same time,

- an effective survey tool permitting access to regions of difficult approach by terrestrial means,
- the possibility to survey regions posing security problems for terrestrial means,
- a permanently and immediately available big spraying capacity enabling to address any beginning upsurge.

Two helicopters (with the associated human and material resources) would probably be enough to

provide a significant support to the whole Western Region. If funding were available such a facility could be tested in part of the region to demonstrate its technical and financial feasibility. It could, however, in no way replace the terrestrial facilities, for these only can guarantee the maintenance of national know-how; but it would complete it and make it more effective in permitting to address a greater variety of situations.

2.8. Conclusion

The extension of the EMPRES programme to the Western Region will permit to set up a revived and updated regional system of preventive control of the Desert Locust.

The National Desert Locust Control Units will form the basis of an operational facility (monitoring ecological conditions in potential gregarization areas, performing well-targeted surveys, and having adequate control capacity) which should be able to address in a rational way all foreseeable locust situations, favouring at any time actions carrying the best chance of success, i.e. those initiated as early as possible.

The regional cooperation on the locust problem will be strengthened and simplified. One regional coordination framework will be aimed at, in view of the special characteristics of the Western Region.

FAO will continue to fulfil its commitments in locust control, particularly in coordination and forecasting, in accordance with its mandate.

The strategy to be followed is clearly set out and endorsed by all participants. It will permit to manage the locust situation at reasonable cost, preventing emergency operations (which should rapidly become less frequent, more limited in extent, better organized and less costly than now), limiting damage, restricting pesticides and using them more rationally, and protecting the quality of the environment. Obviously, it is advisable to examine during the programme whether this new control system fulfils its promises.

Sustainability of the system may reasonably be anticipated. It requires, however, a long-term commitment at the highest level of the states concerned as well as of the international donor community.

Finally, for the strategy to be fully effective, it is necessary that control is performed properly in the Central region, so that invasions coming in from the east into the Western Region are prevented. So the EMPRES programme for the Central Region has a key role to play.

3. RESOURCES NEEDED FOR THE EMPRES PROGRAMME

The programme provides what is necessary and sufficient for the efficient implementation of the preventive control strategy.

This means that, particularly, the proposals seek to avoid any equipment redundancies (of infrastructures and equipment) but, at the same time, aim at "humanizing" the work of preventive control staff by creating living conditions in keeping with staff's activities in a harsh environment. In this respect, it is clearly so that the human aspects of the implementation of the Desert Locust preventive control programme will weigh more heavily than the purely material aspects for its success in the long term. The governments concerned must be fully aware of this.

The description of the required resources is based on the structure presented above, consisting of:

- the National Desert Locust Control Units,
- the Regional Support Unit of the programme, and
- the Desert Locust Information Service at FAO Headquarters.

3.1. National Desert Locust Control Units

In all countries of the region structures responsible for crop protection in general and locust and grasshopper control in particular are existent. Some of them have created units specialized in Desert Locust control.

As the Desert Locust problem exceeds the national scope, it must be taken care of by specific national units that must have a certain autonomy relative to the other sectors of crop protection.

3.1.1. Resources of the national units

The officer in charge of the National Desert Locust Control Unit (the title and the administrative position may vary among countries) will be the local representative of the EMPRES programme.

This unit, as has been noted before, should have administrative and financial autonomy.

The National Desert Locust Control Unit will have headquarters in the capital, a principal base located close to the scene of the operations, and one or more substations right in the gregarization areas that need to be monitored (Tables 2 and 3).

Besides its officer in charge, the unit's staff should consist of a certain number of survey and control teams, the number of which will vary from county to country, in accordance with the importance of the gregarization areas.

These teams should perform their activities within their country, but should also be available to reinforce temporarily the national capacities of a neighbouring country, at the request of that country or of the regional coordination. So these teams should have a considerable international mobility, which should be acknowledged statutorily and legally.

The typical structure and composition of a basic locust control team are given in Table 4.

The activities of the teams consist of combined survey and control operations. The teams consist of a surveyor, three drivers, a guide, and two labourers. They are equipped with two all-terrain vehicles, one of which is fitted with spraying machinery. This typical composition is indicatory only; in reality, it can vary according to its task and to terrain conditions.

The functioning of the national units requires personnel specially trained in locust control, with a good knowledge of the ecology and the behaviour of the Desert Locust and a perfect knowledge of the zones of intervention. These are desert or semi-desert zones with harsh living and working conditions. A perfect knowledge of the terrain is indispensable, improvisations don't work here. That is why it is necessary to train and maintain national units capable of performing survey and control operations in these remote regions, and to provide these units with the material and psychological

conditions enabling them to accomplish their task for the benefit of the national community, but also of the regional and international communities.

Table 3. Location of main bases and substations, and number of teams.

Country	National units	Main bases	Substations	Survey teams (*)	Maintenance teams
Algeria	Algiers	Tamanrasset	In Salah, Bordj Badji Mokhtar	4*	
Libia	Tripoli	Mizda	Ghat, Ghadames	3*	
Mali	Bamako	**Gao**	**Aguelhoc, Tin-Essako**	3	1
Morocco	Aït Melloul	Aït Melloul		3*	
Mauritania	Nouakchott	**Aloun-el-Atrouss**	**Atar**	6	1
Niger	Niamey	**Agadez**	**In Abangharit**	2	1
Chad	N'Djamena	**Abeche**	**Fada**	2	1
Total		7	8	23	4

Bold face, infrastructures and teams financed by the Programme

(*) The number of teams is the minimum necessary for the implementation of preventive control and for maintaining national know-how in the countries of the region. The countries are free, of course, to add more teams at their own cost if deemed necessary; this applies especially to Morocco, Algeria and Libya (for which the maintenance teams have not been mentioned).

Table 4. Composition and equipment of a standard survey and control team.

Personnel	Equipment
1 surveyor	1 light 4x4 vehicle; pick-up type
2 drivers	1 UNIMOG truck
2 labourers	spraying equipment and protective clothing
1 guide	survey and camping equipment (including GPS, radio)

N.B. The composition of the preventive survey and control teams to be strengthened by the programme has been established in close agreement with the local officers in charge in the countries visited. For every mission, the composition may be adjusted to the national customs, the tasks and the difficulties of the terrain.

3.1.2. Infrastructures

As the survey and control operations against the Desert Locust are carried out in uninhabited desert zones, far from large urban centres, three levels of infrastructures are necessary:

- a national coordination centre,
- a main base, and
- substations.

The national service responsible for Desert Locust control will house the national coordination of the EMPRES programme, in order to permit a better transmission of information.

The main base should be located as close as possible to the areas of operation of the teams and will make up the logistic support of the field operations. It will be provided with human and material resources necessary for preventive control. The proximity of the areas of activity should allow to reduce the costs of transport and wear and tear of the vehicles.

The substations will be located in the gregarization areas and serve as starting and fallback points for the survey and control teams during their seasonal periods of activity and as temporary storage facility for equipment and chemicals.

The bases and substations for each country have been chosen according to the needs of the programme (Table 3). The programme will assist in the restoration of some of the infrastructures.

3.1.3. Personnel

Each country must make available to the programme the staff necessary for the proper functioning of the National Desert Locust Control Unit. The salaries of this personnel must be provided by the national budget. The EMPRES programme will only pay the operational costs (daily subsistence allowance and general expenses).

The officer in charge of the National Desert Locust Control Unit is the local representative of the programme and the National Coordinator.

Help will be given within the framework of the programme to train and install the following teams:

- six (6) survey and control teams in Mauritania,
- three (3) teams in Mali,
- two (2) teams in Niger,
- two (2) teams in Chad.

Each country will have a maintenance team in support of these survey and control teams.

The number of teams for each Sahelian front-line country has been determined in accordance with the national officers in charge, taking into account the extent of the gregarization areas and the duration of breeding in these areas.

3.1.4. Equipment and insecticides

3.1.4.1. Equipment

The equipment plans were drafted taking the actual capacities of each country into account.

National coordination headquarters of each country must have powerful communication facilities for their liaison with the main base, the field teams, the regional coordination, and the other partners involved in the early warning system. These equipments, which form the basis of the system of collection and rapid transmission of information, will be provided by the programme.

The main bases and the substations will be equipped appropriately for them to be able to fully play their role. In order to do this, an exhaustive inventory of available equipment has been made. The programme will provide the complementary equipment needed. This will consist basically of vehicles, ground sprayers, equipment for communication, information, positioning, and navigation, and survey and camping materials. These equipments will be renewed according to a schedule that has to be drafted; for instance, the light terrain vehicles will have to be replaced every five years and the trucks every ten years. However, lifetime of vehicles depends on their proper maintenance. Funds for maintenance will be budgeted in the programme.

Use for preventive Desert Locust control only of equipment obtained for this purpose will be a necessary condition for success of the programme. In this context programme vehicles will carry the EMPRES logo and will be serviced, repaired, and kept at the National Desert Locust Control Unit. The Government will guarantee their use for preventive Desert Locust control only.

3.1.4.2. Insecticides

The national units will need a small quantity of locust insecticides (security stock) to cover the needs of preventive control actions undertaken during recessions and beginning upsurges. The quantities will differ according to country, the extent of the gregarization areas, the strategic position of the country, and the number of survey and control teams. As the areas to be treated are estimated at 5,000 to 15,000 ha per country during recessions and beginning upsurges, security stocks varying between 5,000 and 15,000 l per country and per year will be provided by the programme. For hopper control, barrier sprayings will be favoured, which will allow the quantities of insecticide to be reduced.

The EMPRES Regional Support Unit will carefully manage stocks of insecticide - which, once again, will be very limited - to avoid stocks of obsolete pesticides building up.

During upsurges and plagues, additional equipment and locust insecticides will be mobilized according to the seriousness of the situation, and in accordance with the emergency plans prepared under the programme.

3.1.5. National Coordination Committee

Since the last upsurge (1987-89) a National Coordination Committee for Desert Locust Control has been created in each of the countries concerned. These committees still exist but take action only during upsurges. To meet the permanent needs of preventive control, their functioning during recessions is also necessary; they are to be reactivated by the national officers in charge.

3.1.6. National elements of the early warning system

All field teams will be connected with the main base by radio. The main base can communicate with the national unit by radio or electronically to transmit the field information on the locust situation rapidly and in a standardized format.

Each national unit will have a microcomputer with electronic liaison option (e-mail and Internet access). RAMSES software should be installed at each national unit. This software permits standardized capture of field information, creation of databases, exchange of data files between national units and coordination units. When the software is fully operational, these data will be integrated in a geographical information system, which will permit to visualize the field data on the situation, to superpose any relevant base map, any past locust situation from a data base of locust archives, and any relevant satellite image (NOAA for instance, once the data will have been calibrated for the Western Region).

This complex of options will give every national unit the possibility to process its own data quickly and at the same time allow very rapid transmission of data to the Desert Locust Information service at FAO Headquarters. Conversely, the return of information to the national units will be easier and stronger. The relations between the national units will also be easier.

3.2. EMPRES Regional Support Unit

To operate effectively, the EMPRES Regional Support Unit must be given certain human and material resources and have a flexible set of regulations adapted to the special needs of preventive control.

The Unit's set of regulations will serve later as a reference for the functioning of the Regional Platform for Cooperation and dialogue.

3.2.1. Infrastructures

Required to be close to the zones of action, the EMPRES Regional Support Unit must have headquarters in one of the front-line countries. It must also have offices adequate for its needs. Such offices should be made available by the country extending hospitality to the headquarters of the unit. Funds are budgeted for restoration, if necessary.

3.2.2. Personnel

The EMPRES Regional Support Unit will consist of:

- A regional coordinator, in charge of the management of the programme and of assistance to the Regional Cooperation Platform.
- A deputy coordinator, in charge of administration and finances in particular.
- A secretary, a driver, a labourer, and a watchman.

This personnel, employed by the programme, could be assisted by assistant professional officers (APO) specialised in information technology and in remote-sensing, who would contribute to setting up an effective system of collection, storage, analysis, and transmission of information, and to the calibration of satellite imagery in the gregarization areas of the Desert Locust. They will cooperate closely with staff of the Desert Locust Information Service.

Missions of consulting locust experts for help with surveys are also anticipated; national and regional expertise will be favoured. Their mandates would cover, among other things: establishing appropriate procedures such as action plans; the collection, analysis, storage, and transmission of data and preparation of reports; and in-service training of field staff. Four man-months per Sahel front-line country (Chad, Mali, Mauritania, and Niger) and per year, during four years, are necessary. More specific consultations could regard installation, maintenance, and repair of equipment for communication and transmission of information, and programme management during its initial phase. Twelve man-months are necessary during the four years of the programme.

3.2.3. Equipment

This concerns various items necessary for programme operation, including vehicles, office materials, information technology materials, training materials, and communication and positioning equipment.

Vehicles: two 4x4 all-terrain vehicles for activities of regional coordination.

Information technology (IT) materials: four complete IT units for installing databases and a system of early warning, for acquisition of satellite imagery, for word processing, and for electronic mail and Internet connection.

Training materials: for regional training courses, meetings, and workshops to be organized by the programme.

Office materials: consisting of office furniture, air conditioners, repro equipment (photocopier) and data transmission equipment (fax machine) for the offices of headquarters.

Communication and positioning equipment: two 200 watt transmission-reception (T/R) radios are necessary for continuous liaison with national units and survey teams in the field to monitor effectively survey and control operations in the countries with gregarization areas. Two mobile 100 watt T/R radios are also necessary for the 4x4 vehicles, for use during field trips. Global positioning systems (GPS) are indispensable during field trips by programme staff, APOs, and consultants.

3.2.4. Regional elements of the early warning system

In order to improve the existing information and early warning system, it is necessary to strengthen the regional capacity for reception, interpretation, and analysis of field and satellite data, as follows.

- Installation of a computer with RAMSES software.

- Acquisition of satellite data (NOAA/AVHRR, LANDSAT, and SPOT) from national services (CSE, CNAR, ONM), regional organisations (AGRHYMET, ACMAD), and international institutes (Météo-France) (for details on institutions, see Section 3.4.1.2.). These institutions will act as providers of services if necessary. A condition for this acquisition is positive results of research programmes on the use of remote-sensing from space in localizing locust biotopes.

The EMPRES Regional Support Unit should help install these regional elements of the early warning system.

3.3. Desert Locust Information Service

It will be necessary to strengthen the support given to the affected countries by the Desert Locust Information Service of FAO on the one hand, and to increase the quantity and the quality of the informations provided by the countries to DLIS, on the other hand. In particular, frequent routine transmission of information between the DLIS, the regional unit and the countries concerned, and vice versa, is desirable. The informations will have to be transmitted electronically to achieve rapid transmission in a standardized format.

3.4. Activities complementary to the EMPRES programme and cooperation in research and training

These activities are vital for the system that is being created and for its improvement. The EMPRES programme must develop, and use preferentially, regional competences in training and research (as well as services provided under contract, particularly those able to contribute significantly to early warning).

3.4.1. Research

3.4.1.1. A policy of cooperation

EMPRES will cooperate with any organization interested and competent in monitoring and control of the Desert Locust. Such collaborations can concern projects and activities not anticipated in the budget of the programme, but that could be realized using other funds and could contribute directly or indirectly to the objectives of the programme. These collaborations could take on different forms. It could be a matter of simple links between EMPRES and some associated activity, research project or training activity.

First of all, close links need to be developed with the EMPRES component for the Central Region, as well as with all research activities that might be developed within that framework. Particular efforts must be made towards compatibility of approaches and methods. The coordinators of the two components must liaise regularly.

3.4.1.2. Participating institutes

As far as external collaboration is concerned, many institutions, organizations, and projects would make particularly welcome cooperation partners. Some of these institutions could participate as simple providers of services (meteorological and environmental data, satellite remote-sensing, impact studies, etc.); others could act as associated partners in research projects.

EMPRES will seek to make maximum use of the regional capacities for research and training.

The following list of potential partners is for information only and does not pretend to be complete.
Western Region

- National meteorological services. Some have automatic weather stations located in the gregarization areas of the Desert Locust (southern Algeria, in particular). These stations could be used, within the framework of the EMPRES programme, for calibrating satellite data. Several meteorological services have units for remote-sensing.

- The Centre for Ecological Monitoring (Centre de Suivi Ecologique, CSE) in Dakar, Senegal, has a station for receiving NOAA-type satellite imagery covering all countries affected by the Desert Locust in the Western Region. CSE has the legal status of an association and is financially autonomous; it derives its resources from its activities in remote-sensing and geographical information systems. It has set up a system for ecological monitoring of Senegal, particularly for annual monitoring of vegetation biomass (it issues a ten days bulletin) and of bush fires (daily maps). As CSE has considerable capacity, it seeks to become a regional instrument for ecological monitoring. In the EMPRES context, it could provide services in calibrating NOAA imagery and in supplying maps of vegetation indexes that could be used for better guiding locust surveys.

- The National Centre for Support to Research (Centre National d'Appui à la Recherche, CNAR), in N'Djaména, Chad develops activities in geographical information systems and in remote-sensing using satellites. It could act as an EMPRES partner in mapping biotopes and environmental monitoring, in the same way as CSE and AGRHYMET.

- Although CILSS (Standing Inter-state Committee for Drought Control in the Sahel, Comité permanent Inter-états pour la Lutte contre la Sécheresse au Sahel) has no specific mandate regarding the Desert Locust, two of its structures, AGRHYMET (Centre for Training and Aplication of Agrometeorology and Hydrology) and DFPV (Department for Education in Crop Protection, Département de Formation en Protection des Végétaux) in Niamey, Niger, are involved in collecting and disseminating agrometeorological information and training in crop protection, respectively, the latter including locust control. They could provide remote-sensing and training services. Methodological research could also be considered.

- The LOCUSTOX project, in Dakar, investigatesthe environmentalimpact of large scale locust and grasshopper control operations. Getting close to its end, this project is going to be renewed, either as an autonomous self-financing laboratory or as a foundation. The project has installed well-equipped infrastructures for quality control of pesticides and for investigating their impact and has trained many, mainly Senegalese, staff in ecotoxicology. It also has a specialized computerized database. LOCUSTOX has, during its present phase, given helpful advice to the FAO Consultative Group on Pesticides regarding the ecotoxicology of pesticides used in locust control. In its future form it can be a means of performing a number of impact studies and/or quality control analyses of pesticides used in the context of the EMPRES programme.

- The LUBILOSA project, conducted by the International Institute for Tropical Agriculture (IITA) in Cotonou, Benin, in collaboration with DFPV and benefitting from various other international sources of financial assistance, has succeeded in elaborating the formulation of a "mycopesticide", with a fungus, ***Metarrhizium flavoviride*** as the active ingredient: ***"Green Muscle"***. This promising insecticide is now being tested in several countries and against several locust and grasshopper species.

International level

- The Natural Resources Institute (NRI), UK, has considerable Desert Locust experience, particularly in matters relating to technical expertise, historical databases, and training. It is working on several research and development projects within EMPRES's field of action. Particularly, it has recently helped in crafting a geographical information system (SWARMS) aimed at improving the management and interpretation of field data by FAO's Desert Locust Information Service.

- CIRAD's Research, Information, and Training Programme for Locusts and Grasshoppers (PRIFAS) in Montpellier, France, has extensive experience in operational locust research. It has been involved in particular in research projects on modelling of the dynamics of populations of the Desert Locust as well as of grasshoppers. It also has considerable experience in studying the environment of the Desert Locust and in training in acridoidology. Many competences in remote-sensing from space available at the AGROPOLIS education and research centre in Montpellier can also be mobilized.

- The German Organization for Technical Cooperation conducts an extensive Desert Locust

research and development project in Africa.

- Work on the use of remote-sensing from space for monitoring Desert Locust habitats is in progress at FAO, funded by Belgium.

- Finally, the International Centre for Insect Physiology and Ecology (ICIPE), in Kenya, and the International Centre for Biological Control in Darmstadt, Germany, should be mentioned; their research is aimed at alternatives of chemical control: pheromones, botanical insecticides, growth inhibitors, various pathogens, etc.

3.4.1.3. Research themes

The following research themes would deserve particular attention in the course of the EMPRES programme (the list is not exhaustive):

- environment and remote-sensing from space,
- dynamics of solitarious populations and origin of upsurges,
- characterization of gregarization areas (ecological mapping of habitats),
- modelling of locust phenomena aimed at supporting monitoring and forecasting,
- improved spraying techniques and reduced dosage of insecticides,
- barrier spraying methods using new insecticides,
- environmental impact of locust control and identification of vulnerable areas,
- alternatives to chemical control,
- economic, social, and environmental aspects of locust control,
- effectiveness, feasibility, and profitability of preventive control in the long term.

Each of these themes should be translated into specific research projects and presented for funding to the different donors. Research on some themes is ongoing and should continue. Other themes should be the subject of new projects. The theme "early localization of favourable biotopes through remote-sensing from space" certainly has priority.

3.4.1.4. Field research stations

The development of research and practical training activities implies the availability of facilities in the field permitting to carry out these activities.

The main bases and substations planned for monitoring and control operations are expected to provide the logistic facilities needed for research and training activities.

It is proposed that a trial area be selected in the neighbourhood of each main base, in accordance with the latter's importance for the Desert Locust, which would be used for research operations. These areas would serve particularly for calibrating satellite imagery, which is the most important step towards improvement of monitoring strategies. The dynamics of solitarious populations could also receive special attention in these areas.

As a general rule, any research activity intended to support the EMPRES programme through the improvement of the preventive strategy should be able to use these trial areas set aside for research. It should be a matter of reciprocal benefits: the only way for Desert Locust control to become more effective and economic is through the results of research, and research can only be done efficiently if supported through the logistic help of the national units and their field knowledge.

It is desirable, following this line of reasoning, that the research base of Akjoujt be gradually taken care of by the Mauritanian government. Two other trial areas could be set up in the neighbourhood of the bases at Gao in Mali and at Agadez in Niger. Logistics would be those of the bases and substations of the programme.

3.4.2. Training of field staff

Special attention will be paid to practical training of personnel involved in the programme. The permanent programme staff and the consultants will have an important task in this respect. Particular attention will be given to technical staff and their training needs in equipment maintenance and

repair, as well as to training on standardized techniques for monitoring and collection of information on the Desert locust and its environment.

This training task must have priority because it is indispensable for a good start of the programme and its activities (in-service training of staff involved in essential aspects of locust monitoring and control).

The project "Education in Crop Protection" (DFPV) of AGRHYMET in Niamey should be a preferred partner in this respect, but certainly not the only one.

The following activities in particular are anticipated.

Workshop at the start of the programme.

At programme headquarters. Participants: national coordinators and base chiefs. Duration one week. Objective: information on the EMPRES programme and its implementation. Goals, resources, and methods. The workshop aims to assure the proper start of the programme, proper coordination of activities and standardization of methods.

Training of surveyors.

At DFPV, Niamey; training given by consultants, for surveyors. Duration two weeks. Objectives: information on the EMPRES programme and its implementation. Goals, resources, and methods. Theoretical and practical aspects of the Desert Locust and the preventive control strategy (biology, ecology, behaviour, survey techniques, collection and transmission of information, control strategy, spraying techniques, correct use of insecticides, radio communication methods, use of GPS, etc.).

Training for insecticide application staff.

In each country. For drivers and labourers involved in spraying. Duration one week. Objectives: spraying techniques in Desert Locust control: adjustments, spraying methods, handling of equipment and chemicals, safety measures, what to do in case of poisoning, etc.

In-service training for new surveyors.

This training will be carried out through joint surveys of old and new surveyors and during visits of consultants able to participate in surveys so as to effectuate practical on- the-job instruction.

High-level long-term training

Long-duration high-level training will be considered on an ad hoc basis. At the beginning of the programme, the needs in formal training and grants for high-level education in acridoidology will be analyzed in consultation with the countries involved in the programme. This training will be realized in cooperation with the different training institutes competent in acridoidology. It will permit to increase the national capabilities in acridoidology and to have personnel able to participate in the research projects mentioned earlier.

4. FINANCIAL ASSESSMENT

4.1. Cost estimate of the programme

Cost estimates have been prepared for the following parts of the programme:
- the national components of preventive Desert Locust control;
- the regional support component of the EMPRES programme.

No estimate has been made of the associated components (research, long-term training) as these will be likely to attract separate financing for each case individually and will be carried out by organizations interested in certain aspects of the programme only.

The overall coordination of the programme within FAO is ensured by the general structure of the EMPRES programme and by the DLCC, both of which are financed from other sources. Tables 5 to 7 below summarize the outline of the financing.

Table 5. Budget for the EMPRES programme in the Western Region. In US$ for 4 years.

Budget line		**National contributions**	**(1)**	**External contributions**	**(2)**
National units for preventive control (9 countries)					
A. Infrastructures		3,398,000	(3)	408,600	
B. Investments (vehicles, etc.)		3,360,000	(4)	2,078,300	
C. National staff (base salaries)		2,746,200	(5)		
D. Technical assistance (consultants)				768,000	
E. Operations		1,626,400	(4)	1,803,660	
F. Contracts and sub-contracting		68,000	(6)	160,000	
G. Short-term training				270,000	
Subtotal		**11,198,600**		**5,488,560**	
Regional organisations (state contributions)					
CLCPANO (4 Maghreb countries)	states	572,000			
	FAO	560,000	(7)		
OCLALAV (contributions by 5 Sahel countries)		480,000	(8)		
DLCC (4 Maghreb and 5 Sahel countries)		181,840	(9)		
SubTotal		**1,793,840**			
EMPRES Support Unit (temporary for 4 years)					
A. Infrastructures					
B. Investments (vehicles, equipment, etc.)				160,000	
C. Personnel				1,070,000	(10)
D. External support (consultants)				200,000	
E. Operations				396,000	
F. Contracts and sub-contracting				200,000	
G. Short-term training				30,000	
Subtotal				**2,056,000**	
TOTAL		**12,992,440**		**7,544,560**	
FAO (13% on external contributions)				980,793	
GRAND TOTAL		**12,992,440**		**8,525,353**	

Notes to Table 5.
(1) National contributions or contributions from other sources. Estimates from FAO project document "Preventive Control of the Desert Locust"(1991). These numbers provide a fair estimate of the financial contributions for Desert Locust control agreed upon by the states of the region. Calculated for 4 years.

(2) Requested from donors. The financing of the secretariat of CCLPANO by FAO's regular programme ($ 140,000/year) has been included under contribution from other sources.

(3) Amounts the states expected to mobilize in 1991 for the construction, rehabilitation, and equipment of the bases and substations. These have been realised to date or are in progress. These numbers do not take into account the value of the real estate made available for preventive control.

(4) North-West Africa only.

(5) 100% covered in all countries.

(6) Maintenance of meteorological stations.

(7) The secretariat of CLCPANO is covered by FAO's regular programme.

(8) Since OCLALAV's mandate is wider in scope, the contributions to OCLALAV do not respresent contributions toward Desert Locust control only.

(9) 1996/97 contributions.

(10) Savings of $ 560.000 are possible by moving the post of secretary of CLCPANO to the EMPRES programme (coordinator). The additional cost of the support unit will then be reduced to $1.496.000 for the four years.

Table 6. Details per country of the financing requested for the national units for Desert Locust control for 4 years. US$

	EMPRES support unit	Algeria	Chad	Libya	Mali	Morocco	Mauritania	Niger	Sene-gal	Tunisia
A. Infrastructures	0	0	254,600	0	100,000	0	40,000	14,000	0	0
B. Investments	160,000	10,000	373,200	10,000	491,000	10,000	737,400	410,700	18,000	18,000
C. Personnel (salaries)	1,070,000	0	0	0	0	0	0	0	0	0
D. Technical assistance	200,000	0	192,000	0	192,000	0	192,000	192,000	0	0
E. Operations	396,000	25,000	352,040	25,000	365,980	25,000	599,000	361,640	25,000	25,000
F. Contracts and sub-contracting	200,000	0	40,000	0	40,000	0	40,000	40,000	0	0
G. Short-term training	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Total per country		65,000	1,241,840	65,000	1,218,980	65,000	1,638,400	1,048,340	73,000	73,000
Grand total	2,056,000	5,488,560								

NB. FAO’s administration costs (13%) are not included in this table.

4.2. Financing of the programme

The methods of financing of the programme during the four year period corresponding with the initial investments as well as permanently beyond that period are an essential part of the recommended strategy. Two aspects of this strategy are of fundamental importance: the emphasis on the international character of the programme and the necessity of sustainability of the actions. The financing methods must take two conflicting factors into account: the necessity for the national structures to commit themselves and the dramatically limited resources of most of the countries harbouring gregarization areas.

The implementation of the programme implies that a pool of financial resources from varied origins is put together, justified by the degree of involvement of the participants in the implementation of the programme and by the importance attached to the achievement of its technical, economic, and social objectives.

The national contributions of the countries where the preventive control operations are enacted (Mauritania, Mali, Niger, Chad, Algeria, and Libya and, to a lesser degree, Morocco) will be assessed according to their available resources. They will be limited, for the time being and for the four Sahelian countries, to the salaries of the national staff and to the use of infrastructures and existing equipment. The Maghreb countries involved in preventive control will, on the other hand, cover the financial needs of their own national systems, as they have done in the past. In the longer term the Sahelian countries should be able to cover their share or at least to do so partially.

The contribution of the countries in the invasion area in West and North-West Africa is a key element of the system in its initial phase but particularly so in later phases when they will have to pay an increasing part of the recurrent costs of the programme to ensure the durability of its operation. This contribution, justified by common interest, would provide material proof of their adherence to the programme and give them a say in its approach, its management, and its functioning. This contribution has been made evident in the past by the establishment of the Maghreb Strike Force (FMI). The integration of the FMI in the initial facilities of the programme can be seen as a first input by the countries concerned; it will permit to spread the new investments of the programme over the first four years of its operation.

The institutions of international financing will find an opportunity in the programme to demonstrate a coordinated international solidarity, in accordance with their own strategies and objectives, whatever these may be: regional (African Development Bank), geopolitical (IDB, AFESD), fight against rural poverty (IFAD, UNDP), institutional structuring (AID, World Bank), or the pursuit of decentralized food security (European Union, FAO).

This contribution should permit to create a solid initial basis for the financing of the programme. Certain donors have, as a matter of fact, already shown their interest in such a programme. It remains to assess and materialize their contribution, and to clarify its procedures, according to the allocation of the financial assistance to one or another component of the programme.

Finally, bilateral assistance has already contributed in the past, and will continue to do so, to actions that are an integral part of the proposed programme, or that are likely to be associated with it or to form its continuation. The programme would provide a platform for dialogue that would permit its coordination, aiming to save resources and to achieve maximum efficiency by avoiding redundancies and uncertainties inherent to the lack of emergency planning. The flexible and adaptive character of the programme would enable the bilateral contributions to maintain their specific nature through associated programmes or would permit the donors to show their positive attitude to coordination by participating in a trust fund managed by FAO for assuring the coherence and the coordination of the programme.

This is the background thinking basic to the outline of the programme's financing methods presented in Table 7.

The contributions of the different donors will be managed according to procedures specific to each country.

The programmes associated with the EMPRES programme could issue an appeal for specific

contributions from various bilateral assistance sources, channelled through the latter's own financial circuits. They could use the Support Unit of the programme as a platform for dialogue, at least during an annual meeting of donors interested in the funding of the programme or its associated sub-programmes (Regional Coordination Platform).

However, the fact remains that the sustainability of the programme is essentially based on the will of the states to finance their own control structures in accordance with their own interest and mutual commitments. The Regional Cooperation Platform, in which they participate of their own sovereign accord, plays the role, in this respect, of guarantor that the national commitments will be honoured. The sole support unit will help identify the needs and draft the requests for seeking possible external funding.

Table 7. Funding proposal

	Year 1 to 4	Subsequent years
1. National units for Desert Locust preventive control		
Investments	External donors Country contributions (FMI)	External donors Country contributions
Operations	External donors Country contributions Bilateral assistance	Country contributions Bilateral assistance (emergency plans)
2. Regional EMPRES support unit	**➔**	**Regional cooperation platform and support unit**
Investments	Regular FAO programme Contributions of external donors Bilateral assistance?	Regular FAO programme
Operations	Contributions of external donors	Country contributions (to be specified)
3. Associated programmes		
Long-term training Research Methodological support	Bilateral assistance	Bilateral assistance

4.3. Estimate of recurrent costs

The estimates (Tables 8 and 9) cover the costs of operation as well as those of renewal of the equipment. The contributions by the front-line states, the funds available at present on an annual basis, and the assistance requested from the donors are clearly indicated. This funding schedule may reasonably be expected to permit the proposed preventive control facility to be sustainable. What emerges clearly from this is that sustainability requires a regular and long-term commitment by the donors, to whom the assurance of less frequent, less extensive, and better prepared emergency

operations must be important.

The total of the annual recurrent costs is of the order of US$ 2,869,966, including US$ 2,224,506 for the national units and US$ 645,460 for the regional structures (Regional Cooperation Platform and DLCC). The total costs for the four countries supported by EMPRES are US$ 1,249,647. US$ 1,692,341 out of the total is covered by the contributions of the states (Table 9). The balance of US$ 1,132,341 has to be covered by external assistance.

This assistance consists of US$ 287,000 for the regional structure (a considerable part of which is already covered at present by FAO's funding of the CLCPANO secretariat) and US$ 845,165 for the national control units.

Out of this latter amount, the US$ 729,165 of external assistance needed for operations and investments could gradually and at least partially be paid by the states after the initial period of four years, in a manner to be defined later.

Assuming that part of this amount would have to be covered by the front-line states, partial coverage from a trust fund would also be conceivable. This fund would be fed by annual contributions from the states (just like the DLCC fund) and contributions from international donors (for instance annual dues amounting to 2.5% of the average of their emergency assistance for the last ten years). This option would permit to show both regional and international solidarity with the states whose work benefits everybody. It would also assure the national units that the special status necessary for carrying out their tasks would be maintained. Working this out should be on the agenda of the Regional Cooperation Platform.

Moreover, the "technical assistance" component of the Regional Cooperation Platform should be borne by FAO's regular programme, reducing accordingly the annual contribution of the countries in the invasion area.

Details of the estimated recurrent costs are given in the Annexes.

It is reasonable to expect that the cost can be cut down if the use of satellite imagery permits a reduction of the monitoring costs.

Table 8. Estimate of annual recurrent costs of the Locust Control system in the Western Region after the initial phase of four years; US$.

Budget lines	**Total costs**	**Costs Maghreb**	**Costs Sahel (including Mauritania)**
National units for preventive control (9 countries)			
A. Infrastructures (maintenance)	80,000	40,000	40,000
B. Investments (vehicles, equipment, etc.)	456,816	169,191	287,625
C. National staff (base salaries)	686,550	312,068	374,482
D. Technical assistance (consultants)	96,000	0	96,000
E. Operations	848,140	406,600	441,540
F. Contracts and sub-contracting	17,000	17,000	0
G. Short-term training	40,000	20,000	20,000
Total	**2,224,506**	**964,859**	**1,259,647**
Regional facilities			
New single regional cooperation platform (9 countries)			
Platform (meetings)	100,000		
Executive secretariat	300,000		
Joint services (research support, training, national teams, information)	200,000		
DLCC (9 countries Western Region)	45,460		
Total	**645,460**		
GRAND TOTAL	**2,869,966**		

Table 9. Proposed covering of annual recurrent costs after year 4; US$.

Budget lines	States	External
Recurrent costs of National Units		
Maghreb: all recurrent costs: 100% paid by state	964,859	
Sahel (including Mauritania)		
A. Infrastructures (maintenance): 100% paid by states	40,000	
C. Local personnel: 100% state-paid	374,482	
B. and E. Operations and renewal of investments: 100% external contributions		729,165
D. External support: 100% external contributions		96,000
G. Short-term training: 100% external contributions		20,000
Total	1,379,341	845,165
NB the $729.165 external support for B. and E. could be paid by the states incrementally, at least in part, after the first period of 4 years (f.e.year 1: 80% external+20% state --> year 4: 20% external + 80% state)		
Recurrent costs of the regional facility		
Regional Cooperation Platform:100 % paid by states	100,000	
Executive secretariat 83% external support (including transfer of the secretary of CLCPANO at $160.000 approx. and possibly one post at headquarters)		250,000
17%paid by states(infrastructures and local personnel)	50,000	
Joint services Participation of states to CLCPANO and OCLALAV, at current level of contributions (approx. $ 163,000)	163,000	
Possible requests from donors for specific actions		37,000
Total	313,000	287,000
GRAND TOTAL	**1,692,341**	**1,132,165**

To recapitulate: annual contributions of the states to:

CLCPANO (for the 5 Maghreb countries)	$143,000
OCLALAV (for the 5 Sahel countries)	$120,000
DLCC (9 countries concerned in western region)	$45,460

Lessons from the investigation
"Economic and policy issues in Desert Locust management: a preliminary analysis"

In the context of the EMPRES programme, the Locust Group of the Plant Protection Service of FAO has conducted an investigation on the economic evaluation of control of the Desert Locust in its entire habitat area.

Mainly utilizing previous work and existing expertise of NRI and data collected in the main countries affected by Desert Locust plagues, the authors of the study have built a simulation model (ELS) of the dynamics of the populations of the locust and of their economic impact (damage and control).

Using data on the probability of locusts being present in each square degree of the habitat area during each month from 1940 - 1969, the model can simulate locust situation scenarios. Next, it can assess the potential damage to crops if control is not undertaken, using a geographical information system of crop vulnerabilities (Crop Vulnerability Index).

The results of 100 stochastic simulations of five-year locust episodes show that, **in the Western Region only, the average damage if control is not undertaken is worth US$ 11 million per five year period, with extremes ranging from 0 to 170 million in the best and the worst case respectively (one time in 100).**

These are estimates of the damages most probably sustained if no control at all is undertaken; the amounts are both over- and under-estimates, according to the authors of the study. On one hand, data from countries whose agricultural areas are particularly exposed to locusts predominate in these calculations and the historical period studied (1940 -1969) is particularly full of plague episodes. On the other hand, damage to grazing lands has not been considered in the calculations, nor the locally sometimes very important impact of losses of subsistence crops and of interference with the economy of populations depending on climatically risky agricultural systems.

These damage figures should be compared with the costs of the EMPRES programme which, beyond the initial period of investments of four years, would be of the order of $2.8 million/year as compared to $2.2 million/year of average potential loss anticipated by the ELS model if control is omitted. Although the EMPRES programme would seem to result in a deficit, it has the advantage of being realistic insofar that none of the countries in the region will remain inactive when confronted with a locust plague that has not been suppressed by preventive control. In the latter case the environmental costs of large-scale control would also have to be considered as part of the damage by the locust populations, to say nothing of the locusts' impact should they invade neighbouring territories.

The same model permits to evaluate the average costs of control operations undertaken to keep the locust populations in recession during more than 80% of the same five years. **That system of control, which would be both preventive and curative, would cost US$ 53 to US$ 65 million for the Western Region only (with 1.49 - 2.28 million ha being treated), depending on the effectiveness of control.** Fixed costs of maintenance of the control facility (estimated at $6 million per year) are included in this figure.

These figures should be compared with those of the EMPRES system anticipating investments of about $21 million for four years ($ 5.25 million per year) and subsequent recurrent annual costs of $2.8 million, i.e. less than 24 million for the first five years and less than $38 million over ten years. The total expenses calculated by the ELS model for 5 years of control ($53 million) are reached by the EMPRES programme after 15 years only. Moreover, control in case of EMPRES is preventive only, implying many fewer hectares treated (50,000 ha/year), thanks to a much greater monitoring effort.

Study presented by S.Joffe during the Workshop "Economics in Desert Locust Management" organized by the FAO EMPRES programme (Cairo, September 1997).

5. SUSTAINABILITY OF THE PROPOSED APPROACH

This is a major concern. The aim is to help EMPRES evolve so as to find an institutional framework and the financial arrangement permitting, sooner or later, the continuity of the preventive control system.

The eventual solution should find a fair balance among the various sources of funding, with as the basic principle a strong involvement of the different states concerned.

The sustainability of the system must be based on finding a financial balance among:

- The countries on which preventive control depends (working for their own benefit, but also for the benefit of all countries in the invasion area).

- The countries of the invasion area, benefitting from the preventive control work carried out by the front-line countries.

- The international community, who may expect that the establishment of the preventive control system will permit appeals to emergency assistance to be less frequent and less costly, and actions to be better organized.

Something like US$ 250 million has been spent in two plague years, 1987-89, by the international community only, which has to be compared with the annual costs of US$ 5 million of the present programme (including US$ 3 million covered by the affected countries) and, beyond the four year programme, with the annual recurrent costs estimated at US$ 2.8 million for the entire Western Region, including the countries and the regional and international cooperation institutions.

The annual costs of the programme to be contributed by the donors during the first four year phase (about US$ 2 million) are, in fact, not higher than just the management costs of the emergency assistance in crisis situations.

The issue of an intervention fund intended to rapidly address critical situations (level 3) ought to be given further thought in the context of the proposed emergency plans.

In fact, even if one would think that preventive control is not the proper strategy and that it would be better to await upsurges before trying to react (a standpoint unanimously challenged by all experts in the Western Region), it is clear that the proposed system would already be fully justified by the sole fact that it permits the emergency assistance to be better organized. It does so thanks to good information from the field, to well-trained teams knowing the intervention areas and the specific spraying techniques etc., all of which are indispensable conditions for the efficient use of the additional resources to be put into action in the face of a critical situation.

It is finally useful to note that the proposed system represents the minimum necessary for maintaining the know-how indispensable for Desert Locust monitoring operations in the Sahara. These essential competences cannot be improvised in a hurry at the last moment, in case of emergencies.

6. RISKS AND CONDITIONS FOR SUCCESS

6.1. Risks

Several risks are associated with the implementation and effectiveness of the EMPRES programme. They are discussed below together with measures that can be considered to try to reduce them.

6.1.1. Interdependence of the countries of the region

The countries affected by Desert Locust plagues are strongly interdependent. Populations present in one country can rapidly migrate to other far-away areas. For instance in 1988 swarms from Mauritania made it in a few days to the Caribbean on the other side of the Atlantic Ocean. That is why it is important that all front-line countries are included in the programme and can regularly monitor the population levels and exchange their informations. If not all countries participate, the effectiveness of the system of early warning and preventive control may fail.

This emphasizes the importance of support for the programme at the highest political level. Engagement of the State is essential.

Furthermore, the programme for the Western Region will only be fully effective if Desert Locust control is undertaken simultaneously in the other two regions of the habitat area, i.e. the Central and the Eastern Region.

6.1.2. Dissipation of resources to other pest problems

One risk is that the Desert Locust situation stays calm and other pests break out. The resources of the plant protection services, of which some may have been supplied under EMPRES, could then be diverted to address those problems. Understandable as this is, this course of action carries the risk of causing the system of early warning and preventive control to suspend its activities locally, thus weakening the total effectiveness of the system.

6.1.3. Sustainability during long recessions

Experience shows that during long recessions (resulting from unfavourable ecological conditions or from effective preventive control) people strongly tend to question the usefulness of maintaining a system of monitoring and preventive control. So, if the EMPRES programme achieves a long-term effectiveness of limiting the extent of outbreaks and upsurges, there will once again be a tendency to reduce the activities because the Desert Locust has become less conspicuous.

Those involved will be wise to beware of this natural tendency inherent to the human mind and to try and guard against it in case of a long recession and/or if EMPRES fulfils the expectations. The states (i.e. the front-line countries, those within the invasion area, and also the donor countries) must commit themselves for the long term, not for crisis management only. It must be a matter of a moral commitment to help an essentially rural community, destitute and not capable to address upsurges of this pest.

Would it be thinkable for people to pay for the fire brigade only in case of a fire? The Desert Locust is a public calamity and the problem is the same. Preventive actions must be permanent and it is proper for provisions for the necessary resources to be made in the regular budgets of the states, organizations, and donors involved.

6.1.4. Outbreaks and upsurges in high-risk areas; failure of a country to act

There is a risk of the activities of the programme and its success being jeopardized by Desert Locust populations developing in inaccessible areas due to security problems. Another risk is of a country being unable to play its role in the preventive system, momentarily and for various reasons.

In the case of a temporary security problem in a certain zone the states must commit themselves to protect the control system by reinforcing the monitoring of complementary breeding zones, in

accordance with the other countries of the region.

Moreover, it should be possible to get information on conditions for breeding in those inaccessible zones quite rapidly using satellite imagery, thus permitting to assess the probability of outbreaks and to strengthen surveillance in neighbouring accessible areas.

Finally, if it would not be possible to overcome the upsurge with the sole resources available to preventive control, the emergency plans should permit rapid action at limited costs to quickly strengthen the control system.

It should be noted that the survey teams should preferably be composed of autochthonous staff, familiar with the zones of the Sahara involved in preventive control. This is an indispensable condition for success of the programme, for technical reasons (knowledge of the region and the problem) and also to allow the teams to travel safely with the agreement of, and protected by, the local population.

6.2. Conditions for success

6.2.1. Feasibility of the information network

One of the fundamental elements of the early warning component of the programme is the development of an operational network for the exchange of information. It is now technically feasible to set this up. All countries in the region have access to electronic communication systems (E-mail) and to the Internet. All officers in charge of locust control at the moment are prepared to get such systems going, whose advantage is evident for effective preventive control.

6.2.2. Feasibility of detection of favourable areas by remote-sensing from space

The improvement of the early warning system is based to a considerable extent on access to reliable meteorological information and to remote-sensing data for assessing rainfall and vegetation development favourable to locusts. The meteorological data can be obtained from different national meteorological services, from the AGRHYMET Centre in Niamey , and from METEO-France.

The results of preliminary research show real possibilities of detecting potential Desert Locust breeding zones using NOAA-type satellite data (e.g. RAMSES project of the Belgian Cooperation). Moreover, new high-performance sensors will become available in the next few years. The availability of such tools for screening favourable zones for locust breeding in the desert region would be a considerable asset for the preventive control system because it would permit to undertake ground surveys only if there are clear reasons to do so. An operational system for the Western Region can certainly be anticipated rather quickly upon some additional investigations. The methods should be worked out for some trial zones and subsequently generalized for all gregarization areas requiring monitoring.

6.2.3. Other conditions for success

Availability of financing
Competence of potential staff
Interest of the states in the preventive control system

7. PROGRAMME REPORTING AND EVALUATION

The programme coordinator will prepare, every six months, a progress report of the activities, containing:

- actual implementation of activities compared to that planned,
- identification of problems met (human, technical, financial) and measures taken to overcome them,
- a detailed work plan for the following six months period.

The programme coordinator will prepare, during the fourth year of the programme, a terminal report in close collaboration with the national components and will submit it to FAO Headquarters at least four months before the anticipated final date of the first phase of four years. This report will assess in detail the extent to which the programme's scheduled activities have been carried out; it will mention whether the objectives have been accomplished or are well on the way to being accomplished. The report will also contain recommendations for the continuation of the Desert Locust preventive control programme in the Western Region. Particular attention will be paid to the financial and institutional arrangements necessary to offer this activity a reasonable promise of being continued at minimum costs fairly distributed among the different participants.

The documents prepared by the programme will be sent regularly to all participating countries in the region, as well as to all institutions and donors involved. Reports of more general interest will be sent to countries in the invasion area and to other regional organizations.

An evaluation of the programme's progress will be made every two years by a team of consultants commissioned by FAO. The programme's budget includes funds for two evaluations, half-way and at the end of the project, respectively.

Progress statements of the programme and the conclusions of the evaluations will be presented to the Regional Technical Steering Committee of the EMPRES programme and to the DLCC which will constitute, for FAO, the donors, and the Governments of the participating countries, the bodies supervising the programme's progress.

8. PRIOR OBLIGATIONS AND PREREQUISITES

8.1. Obligations

1. The nine participating countries must agree in principle to contribute to the realization of the activities anticipated under the EMPRES programme.

2. A prior obligation is the creation or the maintenance, by each Government, of a national Desert Locust preventive control unit, the recruitment of the necessary personnel, the inclusion in the budget of the funds necessary for the unit and, as far as possible, the provision of the equipment indispensable for setting up survey and preventive control teams as well as the construction or renovation of operational field bases.

3. The participating countries harbouring gregarization areas must accept the implications of the cooperation, of the coordination among the countries and the regional coordination agencies, and of the exchange of information among research staff and technical personnel of the participating countries.

4. Because regional and inter-regional coordination is a key element of preventive Desert Locust control, the participating countries must commit themselves to support the regional locust control organizations of which they are a member.

8.2. Prerequisites

1. Every country will give sufficient autonomy to the national unit for preventive Desert Locust control to enable it to fully fulfil its tasks.

2. The countries will make sure that the equipment of the units are strictly used for the purpose of preventive Desert Locust control only.

3. The governments will make sure that staff trained under the programme will be kept in the national unit's service.

9. ANNEXES

9.1. Details of funding

9.1.1. Resources of the Support Unit of the Desert Locust EMPRES programme for the Western Region

Regional Support Unit	Costs (US$)				
	Year 1	Year 2	Year 3	Year 4	Total
A. Infrastructures					
Made avalailable by the host state of the Support Unit					p.m.
B. Investments					
Headquarters of the programme (rehabilitation)	20,000				20,000
Equipment:					
Office equipment	25,000				25,000
Information technology equipment (computer)	15,000				15,000
Various equipment (radio, GPS...)	20,000				20,000
Vehicles 2 station wagons + 10% spare parts	80,000				80,000
C. Personnel					
Full time international staff (coordinator, deputy)	255,000	255,000	255,000	255,000	1,020,000
Support staff (1 secr., 1 driver, 1 labourer, 1 watchman)	12,500	12,500	12,500	12,500	50,000
D. Technical assistance					
Consultants (13 man months)	40,000	40,000	40,000	40,000	160,000
Information technology contractual services	10,000	10,000	10,000	10,000	40,000
F. Operations					
International travel	25,000	25,000	25,000	25,000	100,000
Office operations	15,000	15,000	15,000	15,000	60,000
Vehicle operational costs	15,000	15,000	15,000	15,000	60,000
Meetings and workshops	10,000	10,000	10,000	10,000	40,000
External services	15,000	15,000	15,000	15,000	60,000
Translators	10,000	10,000	10,000	10,000	40,000
Programme evaluation (1 consultant x 3 months)		18,000		18,000	36,000
F.Contracts and subcontracting					
Meteorology, satellite imagery, environmental impact	25,000	25,000	25,000	25,000	100,000
Cooperation with research projects	25,000	25,000	25,000	25,000	100,000
G. Training (regional)					
Initial training workshop	30,000				30,000
H. International coordination (FAO headquarters)					p.m.
Participation of DLIS forecaster					
Officers of headquarters					
Total Support Unit of programme	647,500	475,500	457,500	475,500	2,056,000

N.B. Budget lines for spare parts represent a reserve fund for 4 years.

9.1.2. Resources requested for the National Control Units

CHAD	**Costs US$**				
2 survey teams + 1 maintenance team	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
A. Infrastructures					
Infrastructures (Construction of a base at Abèche + water, electricity , phone and fax)	173,600				173,600
Construction of substation at Fada	81,000				81,000
B.Investments					
Information Technology equipment (computers x2)	10,000				10,000
Training materials	2,000				2,000
Vehicles					
Light all-terrain veh.s x 3 teams	69,000				69,000
UNIMOG x 3 prospection teams	150,000				150,000
Light 4x4 vehicle national coordinator	23,000				23,000
5 ton truck	50,000				50,000
spare parts	29,200				29,200
Spraying equipment (2 teams)	11,000				11,000
Survey and camping equipment (2 + 1 teams)	24,000				24,000
100W T/R radio for national unit	5,000				5,000
C. Personnel (salaries 100% state-paid)					p.m.
D. Technical assistance 4 man-months @ 12,000	48,000	48,000	48,000	48,000	192,000
E. Operations					
3 teams x 6 months	38,880	38,880	38,880	38,880	155,520
Insecticides (20,000 ha/4 years)	25,000	25,000	25,000	25,000	100,000
Travel national coordinator ($600 x 4 years)	600	600	600	600	2,400
Travel staion leader Abeche ($600 x 4 years)	600	600	600	600	2,400
Operation of vehicles of national unit ($1680 x 1 month x 4 years)	1,680	1,680	1,680	1,680	6,720
Daily costs of operation of national unit (office, phone, various additional programme costs)	10,000	10,000	10,000	10,000	40,000
Special support for operation of Abeche station	5,000	5,000	5,000	5,000	20,000
Participation in meetings and workshops	6,250	6,250	6,250	6,250	25,000
F. Contracts and sub-contracting					
Flying hours (25h/year x $400)	10,000	10,000	10,000	10,000	40,000
G.Training					
Short-term training	15,000	5,000	5,000	5,000	30,000
TOTAL Chad	**788,810**	**151,010**	**151,010**	**151,010**	**1,241,840**

MAURITANIA	**Costs US$**				
6 survey teams + 1 maintenance team	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
A. Infrastructures Infrastructures (rehabilitation Aïoun-el-Atrouss base)	p.m.				p.m
Atar substation (rehabilitation)	40,000				40,000
B. Investments Meteorological stations (x2)	24,000				24,000
Information Technology equipment (computers x2)	10,000				10,000
Training materials	2,000				2,000
Vehicles					
Light all-terrain veh.s x 7 teams		46,000	46,000	46,000	138,000
UNIMOG x 7 teams		110,000	110,000	110,000	330,000
Light 4x4 vehicle national coordinator	23,000				23,000
5 ton truck	50,000				50,000
spare parts	7,300	14,600	14,600	21,900	58,400
Spraying equipment (6 teams)		11,000	11,000	11,000	33,000
Survey and camping equipment (6 + 1 teams)	32,000	32,000			64,000
100W T/R radio for national unit	5,000				5,000
C. Personnel (salaries 100% state-paid)					p.m.
D. Technical assistance4 man-months @ 12.000	48,000	48,000	48,000	48,000	192,000
E. Operations 7 teams x 6 months for 4 years (3 months summer + 3 months winter surveys)	90,720	90,720	90,720	90,720	362,880
Maintenance weather stations	2,400	2,400	2,400	2,400	9,600
Insecticides (years 3 and 4) (calculation base 60,000 ha/4 years)			75,000	75,000	150,000
Travel national coordinator (600$ x 4 years)	600	600	600	600	2,400
Travel base manager (600$ x 4 years)	600	600	600	600	2,400
Operation of vehicles of national unit ($1680 x 1 month x 4 years)	1,680	1,680	1,680	1,680	6,720
Daily costs of operation of national units (office, phone, various additional programme costs)	10,000	10,000	10,000	10,000	40,000
Participation in meetings and workshops	6,250	6,250	6,250	6,250	25,000
F. Contracts and sub-contracting Flying hours	10,000	10,000	10,000	10,000	40,000
G.Training Short-term training	15,000	5,000	5,000	5,000	30,000
TOTAL MAURITANIA	**378,550**	**388,850**	**431,850**	**439,150**	**1,638,400**

MALI	**Costs US$**				
3 survey teams + 1 maintenance team	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
A. Infrastructures					
Infrastructures (rehabilitation Gao base)	40,000				40,000
Rehabilitation mechanical workshop	10,000				10,000
Rehabilitation substation Aguelhok and Tin Essako	50,000				50,000
B. Investments					
Meteorological stations (x2)	24,000				24,000
Information Technology equipment (computers x2)	10,000				10,000
Training materials	2,000				2,000
Vehicles					
Light all-terrain veh.s x 4 teams	92,000				92,000
UNIMOG x 4 prospection teams	200,000				200,000
Light 4x4 vehicle national coordinator	23,000				23,000
5 ton truck	50,000				50,000
spare parts	36,500				36,500
Spraying equipment (3 teams)	16,500				16,500
Survey and camping equipment (3 + 1 teams)	32,000				32,000
100W T/R radio for national unit	5,000				5,000
C. Personnel (salaries 100% state-paid)					p.m.
D. Technical assistance 4 man-months @ $12,000	48,000	48,000	48,000	48,000	192,000
E. Operations					
4 teams x 6 months surveys	51,840	51,840	51,840	51,840	207,360
Maintenance weather stations	2,400	2,400	2,400	2,400	9,600
Insecticides (years 2, 3 and 4) (calculation base 30,000 ha/4 years)		37,500	37,500	37,500	112,500
Travel national coordinator ($600 x 4 years)	600	600	600	600	2,400
Travel base manager ($600 x 4 years)	600	600	600	600	2,400
Operation of vehicles of national unit ($1680 x 1 month x 4 years)	1,680	1,680	1,680	1,680	6,720
Participation in meetings and workshops	6,250	6,250	6,250	6,250	25,000
F. Contracts and sub-contracting Flying hours (25h/year x $400)	10,000	10,000	10,000	10,000	40,000
G.Training Short-term training	15,000	5,000	5,000	5,000	30,000
TOTAL MALI	**727,370**	**163,870**	**163,870**	**163,870**	**1,218,980**

NIGER	Costs US$				
2 survey teams + 1 maintenance team	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Total**
A. Infrastructures					
Infrastructures (rehabilitation Agadez base)	2,000				2,000
Rehabilitation In Abangharit substation	12,000				12,000
B. Investments					
Meteorological stations (x2)	24,000				24,000
Information Technology equipment (computers x2)	10,000				10,000
Training materials	2,000				2,000
Vehicles					
Light all-terrain veh.s x 3 teams	69,000				69,000
UNIMOG x 3 prospection teams	150,000				150,000
Light 4x4 vehicle national coordinator	23,000				23,000
5 ton truck	50,000				50,000
spare parts	29,200				29,200
Spraying equipment (2 teams)	16,500				16,500
Survey and camping equipment (2 + 1 teams)	32,000				32,000
100W T/R radio for national unit	5,000				5,000
C. Personnel (salaries 100% state-paid)					p.m.
D. Technical assistance					
4 man-months @ 12,000	48,000	48,000	48,000	48,000	192,000
E. Operations					
3 teams x 6 months	38,880	38,880	38,880	38,880	155,520
Maintenance weather stations	2,400	2,400	2,400	2,400	9,600
Insecticides (20,000 ha/4 years)	25,000	25,000	25,000	25,000	100,000
Travel national coordinator ($600 x 4 years)	600	600	600	600	2,400
Travel base manager Agadez ($600 x 4 years)	600	600	600	600	2,400
Operation of vehicles of national unit ($1680 x 1 month x 4 years)	1,680	1,680	1,680	1,680	6,720
Daily costs of operation of national units (office, phone, various additional programme costs)	10,000	10,000	10,000	10,000	40,000
Special support for operation of Agadez station	5,000	5,000	5,000	5,000	20,000
Participation in meetings and workshops	6,250	6,250	6,250	6,250	25,000
F. Contracts and sub-contracting					
Flying hours (25h/year x $400)	10,000	10,000	10,000	10,000	40,000
G.Training					
Short-term training	15,000	5,000	5,000	5,000	30,000
TOTAL NIGER	**588,110**	**153,410**	**153,410**	**153,410**	**1,048,340**

ALGERIA	Costs US$				
4 survey teams	Year 1	Year 2	Year 3	Year 4	Total
A. Infrastructures Reinforcement of base at Tamanrasset					p.m.
Rehabilitation of substations at In Salah and Borj Beji Mokhtar					
B. Investments Information Technology equipment (computers x2)	10,000				10,000
C. Personnel					
D. Technical assistance					
E. Operations Participation in meetings and workshops	6,250	6,250	6,250	6,250	25,000
F. Contracts and sub-contracting					
G.Training Short-term training	15,000	5,000	5,000	5,000	30,000
TOTAL ALGERIA	**31,250**	**11,250**	**11,250**	**11,250**	**65,000**

LIBYA	Costs US$				
3 survey teams	Year 1	Year 2	Year 3	Year 4	Total
A. Infrastructures Construction of base at Mizda and substations at Ghat and Ghadames					p.m.
B. Investments Information Technology equipment (computers x2)	10,000				10,000
C. Personnel					p.m.
D. Technical assistance					p.m.
E. Operations Participation in meetings and workshops	6,250	6,250	6,250	6,250	25,000
F. Contracts and sub-contracting					
G.Training Short-term training	15,000	5,000	5,000	5,000	30,000
TOTAL LIBYA	**31,250**	**11,250**	**11,250**	**11,250**	**65,000**

MOROCCO	Costs US$				
3 survey teams	Year 1	Year 2	Year 3	Year 4	Total
A. Infrastructures Construction of 10 substations					p.m.
B. Investments Information Technology equipment (computers x2)	10,000				10,000
C. Personnel					
D. Technical assistance					
E. Operations Participation in meetings and workshops	6,250	6,250	6,250	6,250	25,000
F. Contracts and sub-contracting					
G.Training Short-term training	15,000	5,000	5,000	5,000	30,000
TOTAL MOROCCO	**31,250**	**11,250**	**11,250**	**11,250**	**65,000**

SENEGAL	Costs US$				
	Year 1	Year 2	Year 3	Year 4	Total
A. Infrastructures					
B. Investments Information Technology equipment (computers x2)	10,000				10,000
Training materials	2,000				2,000
Various materials (communications, entomologie...)	6,000				6,000
C. Personnel					
D. Technical assistance					
E. Operations Participation in meetings and workshops	6,250	6,250	6,250	6,250	25,000
F. Contracts and sub-contracting					
G.Training Short-term training	15,000	5,000	5,000	5,000	30,000
TOTAL SENEGAL	**39,250**	**11,250**	**11,250**	**11,250**	**73,000**

TUNISIA	Costs US$				
	Year 1	Year 2	Year 3	Year 4	Total
A. Infrastructures					
B. Investments					
Information Technology equipment (computers x2)	10,000				10,000
Training materials	2,000				2,000
Various materials (communications, entomology...)	6,000				6,000
C. Personnel					
D. Technical assistance					
E. Operations					
Participation in meetings and workshops	6,250	6,250	6,250	6,250	25,000
F. Contracts and sub-contracting					
G.Training					
Short-term training	15,000	5,000	5,000	5,000	30,000
TOTAL TUNISIA	**39,250**	**11,250**	**11,250**	**11,250**	**73,000**

9.1.3. Summary of annual costs for the first four years

Country, Unit	Costs US$				
	Year 1	Year 2	Year 3	Year 4	Total
Algeria	31,250	11,250	11,250	11,250	65,000
Chad	788,810	151,010	151,010	151,010	1,241,840
Libya	31,250	11,250	11,250	11,250	65,000
Mali	727,370	163,870	163,870	163,870	1,218,980
Morocco	31,250	11,250	11,250	11,250	65,000
Mauritania	378,550	388,850	431,850	439,150	1,638,400
Niger	588,110	153,410	153,410	153,410	1,048,340
Senegal	39,250	11,250	11,250	11,250	73,000
Tunisia	39,250	11,250	11,250	11,250	73,000
EMPRES Support Unit	647,500	475,500	457,500	475,500	2,056,000
Total	3,302,590	1,388,890	1,413,890	1,439,190	7,544,560
FAO 13 %	429,337	180,556	183,806	187,095	980,793
GRAND TOTAL	**3,731,927**	**1,569,446**	**1,597,696**	**1,626,285**	**8,525,353**

9.1.4. Annual costs after the fourth year for the Sahelian countries; US $

	Chad	Mauritania	Mali	Niger	Ratio (1)
A. Infrastructures (Maintenance**)**	10,000	10,000	10,000	10,000	
B. Investments					
Office equipment	1,000	1,000	1,000	1,000	
Meteorological stations (x2)		2,400	2,400	2,400	10.0
Software (computers x2)	2,000	2,000	2,000	2,000	20.0
Training materials	400	400	400	400	20.0
Vehicles					
Light all-terrain veh.s x 7 teams	13,800	32,200	18,400	13,800	20.0
UNIMOG x 7 teams	15,000	35,000	20,000	15,000	10.0
Light 4x4 vehicle national coordinator	4,600	4,600	4,600	4,600	20.0
5 ton truck	5,000	5,000	5,000	5,000	10.0
spare parts	7,300	14,600	9,125	7,300	25.0
Spraying equipment	1,100	3,300	1,650	1,650	10.0
Survey and camping equipment	2,400	6,400	3,200	3,200	10.0
100W T/R radio for national unit	1,000	1,000	1,000	1,000	20.0
C. Personnel (p.m. state paid)					
D. Technical assistance (consultations)	24,000	24,000	24,000	24,000	12.5
E. Operations					
Survey and spraying teams	38,880	90,720	51,840	38,880	25.0
Maintenance weather stations		2,400	2,400	2,400	25.0
Insecticides	25,000	75,000	37,500	25,000	25.0
Travel national coordinator	600	600	600	600	25.0
Travel base managers	600	600	600	600	25.0
Operation of vehicles of national unit	1,680	1,680	1,680	1,680	25.0
Costs of operation of national units	10,000	10,000	10,000	10,000	25.0
F. Contracts and sub-contracting					
G.Training National level	5,000	5,000	5,000	5,000	12.5
TOTAL PER COUNTRY	169,360	327,900	212,395	175,510	
GRAND TOTAL		**US$**	**885,165**		

1) Applied ratio of yearly renewal

NB. The EMPRES Support Unit does not exist anymore beyond year 4. The national units must be sufficiently strong and autonomous by that time and cooperate effectiverly with one-another, supported by the cooperation platform and regional dialogue.

9.1.5. Costs of standard equipment for surveys and preventive control

	Costs US$
Equipment:	
Vehicles: Light 4x4 vehicle, pick up, duel tanks	23,000
UNIMOG	50,000
spare parts (10%)	7,300
Spraying equipment: (1 sprayer, 1 japy pump, 4 x protective clothing)	5,500
Survey and camping equipment: 3 tents	2,000
sleeping bags and cooking utensils (x 6 persons)	2,000
GPS and compass	1,000
radio	2,000
small equipment (entomology, meteorology, maps, etc.)	1,000
Personnel (salaries) 1 surveyor, 2 drivers, 2 labourers, 1 guide	p.m.
Operations: DSA (per team per month) surveyor (x1)	300
drivers (x2)	420
labourers (x2)	360
guide (x1)	180
Fuel (per team per month): light 4x4 vehicle 20l/100km x 30 days/0.5$	300
UNIMOG 30l/100km x 30 days x 0.5$	450
Maintenance costs (20% of fuel costs)	150
Total operations per team per month	2,160

Basis of calculations:

1 Team drives on average 100km/day
Price of fuel = US$ 0.5 per liter
Fuel consumption of light 4x4 20l/100 km (20l x 30 days x 0.5 = $300)
Fuel consumption of UNIMOG 30l/100km (30l x 30 days x 0.5 = $450)

The composition and the costs of a maintenance and logistical support team are the same. 2 Teams are anticipated in Mauritania (but only one UNIMOG) and one team in each of the other countries (Mali, Niger, Chad). The only difference is that the surveyor is replaced by a mechanic.

The use of insecticide has been calculated on the basis of the average surface to be sprayed during the recession period (level 1, strictly preventive control) and taking the existing stocks into account. Calculation base for 4 years: 60,000 ha in Mauritania; 30,000 ha in Mali, 20,000 ha in each of Niger and Chad). A financial reserve fund is anticipated with yearly replenishment of the actual quantities used and regional management of stocks.

9.1.6. Calculation basis for training

1. Workshop at start of project.

At headquarters of the programme. Meant for the national coordinators and the base chiefs. Duration 1 week. Objectives: information on EMPRES programme and its implementation. Goals, means, methods. 12 Participants + 4 participants from headquarters (+ consultants if any on consultant budget).

Coordinators and base managers:	
Per diem $140/day x 12 x 7	$11,760
Tickets $500 x 10 (2 on the spot)	5,000
Organizations costs, rent of hall	2,000
Secretariat, phone	1,000
Personnel from headquarters:	
Tickets Europe-Africa x 4	2,000
Per diem $140 x4 x7	3,920
Miscellaneous and unforeseen	2,500
Total	28,180

2. Training of surveyors

Instruction given by consultants. Duration 2 weeks. Objectives: information on the EMPRES program and its implementation. Goals, means, and methods. Theoretical and practical details on the Desert Locust and strategy of preventive control (biology, ecology, behaviour, survey techniques, collection and transmission of information, control strategy, spraying techniques, proper use of insecticides, methods of radio communication, use of GPS...). 20 Participants (surveyors) + 4 consultants + EMPRES coordinator and deputy.

Surveyors:	
Per diem $140/day x 20 x 14	$39,200
Tickets $500 x 20	10,000
DFPV costs of organisation	5,000
Secretariat, phone	1,000
Consultants:	
2 man months @$12000 /month	24,000
Tickets $1500 x 4	6,000
Miscellaneous and unforeseen	8,520
Total	93,720

3. Field training for local personnel.

In each country. Intended for drivers and labourers involved in spraying. Duration 1 week. Objectives: spraying techniques in locust control, machine settings, spraying methods, handling of pesticides, safety regulations, measures to be taken in case of poisoning etc. Participants: 28 drivers + 28 labourers.

Per diem $7/day x 56 x 7	$ 2,744
Miscellaneous costs ($250/country)	1,000
Total	3,744

4. In-service field training for new surveyors

Will be realised during joint surveys carried out with new and old surveyors and when visiting consultants can take part in surveys to provide practical on-the-job training. Budgetted at $5,000.

9.2. Persons met

1. During the EMPRES/ Western Region mission (September8 - October 16 1997)

Itinerary of the mission:

7 September	Arrival in Rome
8 to 13 September	Rome. Briefing at FAO. Study of reports. Planning of strategy of the mission in consultation with AGP
13 September	Travel Rome-(Paris)-Dakar
13 to 17 September	Senegal
17 September	Travel Dakar-Nouakchott
17 to 22 September	Mauritania
22 September	Travel Nouakchott-Bamako
22 to 28 September	Mali
28 September	Travel Bamako-Niamey
28 September to 3 October	Niger
3 October	Travel Niamey-N'Djamena
3 to 10 October	N'Djamena
10 October	Travel N'Djamena-Paris-Rome
11 to 16 October	Rome. Debriefing at FAO.

FAO Headquarters - Rome

Abdoulaye SAWADOGO: Deputy Director General of FAO
M.S - ZEHNI: Director AGP
N. VAN DER GRAAFF: Chief Plant Protection Service -AGPP
Abderrahmane HAFRAOUI: Senior Officer Locust and Migratory Pests Group - AGPP
Keith CRESSMAN: Desert Locust Information System (DLIS) - AGPP
Michael CHERLET: AGPP
Annie MONARD: AGPP
Allan SHOWLER: EMPRES Coordinator Central Region
Nazil MAHJOUB : Secretary CLCPANO

Senegal

E .K. TAPSOBA : FAO Representative Senegal
N'BODJ: Programme Officer FAO Senegal
Faustin DIATTA: Director Plant Protection Service, Ministery of Agriculture
Mahecor DIOUF: DPV
Seni DIEME: DPV
Ibou SANE: DPV
Mame N'DENELO: DPV
Papa Sam GUEYE: DPV
James EVERTS: Expert FAO - Project LOCUSTOX
Amadou N'DIAYE: Director General OCLALAV
Bakary TRAWALLY: Technical Director OCLALAV
Amadou Mocktar NIANG - Director Centre for Ecological Monitoring
Boubacar SOUMARE: Centre for Ecological Monitoring
Osmane BOCOUM: Centre for Ecological Monitoring
Babacar DIOP: Counsellor private enterprise / natural resources - CIDA
Ernest F. GIBSON: Agriculture Officer US-AID
Moribadjan KEITA: US-AID
François FAYE: US-AID
Takashi FUTAGI: First Secretary, Embassy of Japan
R.W. HYDE: First Secretary, Embassy of Great-Britain
Abdelkader JAOUHAR: First Secretary, Embassy of Morocco

Mauritanie

Noureddine KADRA: FAO Representative, Mauritanie
Secretary General, Ministery of Rural Development and Environment

Mouhamadou Youcef DIAGANA: Coordinator Sector Programmes, Ministery of Planning
Dr Ely: Director, Agro-pastoral Resources (DRAP)
Moctar FALL: Deputy Director, DRAP
Paul GINES: Counsellor EU at MDRE
Eric CLUA: Counsellor, DRAP
Mohamed Abdullahi OULD BABAH : Chief Centre for Locust Control, DRAP.
El Hadi OULD TALEB: CLAA
Jaafar Mohamed HASSEN: CLAA
Sidi OULD ELY: CLAA
Baba DIOP: Research Station Akjoujt
Amadou SY: Research Station Akjoujt
Ousmane BA: Research Station Akjoujt
Ahmedou Abdel WEDOUT: Research Station Akjoujt
Ambassador of Germany
Lois A. AROIAN: Chargé d'Affaires, United States Embassy
Jean-Jacques SOULA: Counsellor for Agriculture and Health, French International Cooperation
Lotfi SEBOUHI: First Counsellor - Embassy of Algeria
Ali ALOUSS: First Counsellor - Embassy of Libya
Mustapha DAKHLI: First Counsellor - Embassy of Tunisia
Abdelkader TALEB: First Secretary - Embassy of Morocco
Frank W. GREILING: Counsellor Rural Development, European Union
Volkart LEFFLER : Team leader GTZ

Mali Cheikh Bougadari BATHILY: Programme Officer, FAO
Mamadou GOÎTA: Secretary General, Ministery of Agriculture and Environment
Mory COULIBALY: Director Directorate of Support to Rural Areas (DNAMR)
Yaya TOGOLA: Deputy Directeur, DNAMR
Mamadou KANE: Chief of Division, Risk Prevention and Protection of Animals and Plants (DPRPAV)
Lassana SYLVESTRE: Programme Officer' DPRPAV
Tamadi DIALLO: Programme Officer, DPRPAV
Fakaba DIAKITE: Chief, Centre for Locust Control at GAO
Sombo CISSEY: Director, Institut du Sahel (CILSS)
Mamadou DIARRA: Institut du Sahel CILSS
Lomaibao NETOYO: Institut du Sahel CILSS
Yves BOULANGER: Ambassador of Canada
Robert de MILET: Counsellor, French International Cooperation
Hans Peter SCHADEK: Counsellor, European Union

Niger Jacques Wiame: FAO Representative, Niger
Maria COMIN: Administration Officer, FAO
Ousseyni KABO: National Consultant, FAO
Akoli DAOUEL: Minister of Agriculture and Livestock
Amadou ABOUBACAR: Chief of Division, Ministry of Planning
Cheferou MAHATAM: Director, Crop Protection
Moudy SANI: Chief Intervention Service, DPV
Sankung SAGNIA: Director DFPV
Herman VAN DE VOORDE: Chief Technical Advisor, DFPV
I. ALFARI: Expert remote-sensing, AGRHYMET
M. DIOUF: Officer in charge, Information Progranmme, AGRHYMET
D. NADAUD: Expert, Satellite Imagery, AGRHYMET
B. SIDIBE: In charge, Phytosanitary Monitoring, AGRHYMET
B. SOME: In charge, Climatology Databases, AGRHYMET
J.P TRIBOULET: Counsellor FAC, AGRHYMET
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Mohamed Sadek BOULAHYA: Director General, ACMAD
Olivier FAUGERE: Counsellor, French International Cooperation
Pramkerd HENRI: Counsellor - European Union
Salifou MAHAMAN: Programme Officer, World Bank
Mariam OUSSEYNI: Director Early Warning Systems (SAP)

Chad Hamidou DIAWARA: Resident Representative, UNDP
Mahamane Ali HASSEN: Programme Officer, FAO Chad
Amine ABA SIDIK: Chief of Staff, Presidency
Boubacar AMIDOU: Director General, Agriculture
Ahmed DORSOUMA: Director Protection of Crops and Stored Products (DPVC)
N'Doubaye TIGAYE: DPVC
Nekaou LAOUMAYE: DPVC
Mahamat DAKOUSSAL: DPVC
Abou PALOUMA: DPVC
Baba El HADJ MALLAH: Director National Centre for Support to Research (CNAR)
Nicolas FORNAGE: Counsellor, French International Cooperation
Marc WOLFF: Ambassador, European Union
Arty KYRAMARIOS: Agricultural Counsellor, European Union

2. During the EMPRES Western Region meeting at Nouakchott, 21 to 23 March 1998

Algeria
GUENDEZ Embarek, Algeria, delegate
BENCHEIKH LEHOCINE Nadjii, Algeria, delegate
France LEBLANC Emmanuelle, French Ministry of Cooperation
Libya ALIESH Mustafa, President CNPL, Desert Locust Centre
FARAG Karra, member, Desert Locust Centre
Mali SISSOKO Moussa, Chief, Section Crop Protection DNAMR
Morocco
GHAOUT Said, Chief National Centre Desert Locust Control, Inezgane
BEN HALIMA Thami, Director National School of Agriculture, Meknes
Mauritania
BAARD J., FAO/RIM
KADRA Nourredine, FAO Representative, Mauritania
Med LEMINE O/ Ahmedou, Research Officer
Dr FALL Mokhtar, Deputy Director DRAP
AHMED SALEM O/ Ahmedou, Technical Counsellor MDRE
EL ALEM O/ Ahmed Khalifa, Press Attaché, FAO
MED EL HACEN O/ Jaffar, Chief, Intervention Desert Locust Control
MOHAMED EL HADI Ould Taleb, Desert Locust Control Centre
MOHAMED ABDALLAH Ould Babah, Chief, Desert Locust Control Centre
Niger CHEFEROU Mahatan, Director Plant Protection Service
MOUDY Mamane Sani, Chief of Intervention Service DPV
Senegal
DIOP Ousseynou, Chief, Agricultural warnings, Plant Protection Service
Chad PALOUMA Abou, Chief, Protection of Crops and Stored Products
IDRISSA Brahim, Technical Unit, Monitoring and Evaluation
Tunisia
EL HANI Med Salah, Technical Director SONAPROV, Ministry of Agriculture
HAMDI Hafedh, Chief, Locust Section, DGPA, S/D Crop Protection
FAO Rome
HAFRAOUI Abderrahmane, Senior Officer, Locust and Migratory Pests Group
MONARD Annie, Locust Information Officer
FAO Consultants
SOUMARE Lassana, FAO Mali
CHARA Bachir, INPV Algeria
LECOQ Michel, CIRAD France
Observers
MAHJOUB Nezil: Secretary CLCPANO, FAO Tunisia
NDIAYE Ahmadou: Director General, OCLALAV
BAKARY B. Trawally: Technical Director, OCLALAV
SIDIBE Brahima: Entomologist, AGRHYMET, Niamey
GEROME Frank: European Union, Nouakchott
GREILING Dendura: European Union, Nouakchott
BENZAGHOU Mouradi: CTP Oasis Project (IFAD), Nouakchott

SOULA Jean-Jacques: Counsellor, French Internation Cooperation, Nouakchott

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Draft covering letter

In the context of the extension of the Desert Locust component of the EMPRES programme to West and North-West Africa, the Locust Group of FAO has prepared a programme proposal drafted by a consultation mission and subsequently presented to the countries concerned and to the potential donors during a workshop held in Nouakchott in March 1998. The recommendationsof that workshop have been incorporated in the present version of the document.

The economic appropriateness of the programme is based on two complementary approaches:

- Conducting preventive control during recessions in order to reduce the chance of upsurges.

- Improving locust intelligence in order to enhance the effectiveness of control if an upsurge occurs.

The effectiveness of a system of preventive control in the Western Region is substantiated by many arguments derived from knowledge of previous situations. This system is based on the long-established knowledge of favourable biotopes for the first outbreaks and on the ability of survey teams to attack them effectively.

However, even if preventive control would be found to be insufficiently efficient considering its costs and the resources needed, the proposed system would still be fully justified because it would provide real-time knowledge of the locust situation, permitting to calibrate modern survey methods using remote-sensing and eco-meteorological monitoring. This knowledge is indispensable for establishing a system of early warning as a prerequisite for curative or stop-gap control.

The regional programme proposed in the document covers West and North-West Africa. It is based on an operational capability for Desert Locust control in each front-line country, to be set up using experienced teams that have been formed and trained during the last several decades. These teams would receive logistic and human resources (additional training) within the framework of national units with well-defined statutes, tasks and structures guaranteed by a clear commitment expressed by the states concerned.

These national units and their parent institutions would set up a regional platform for cooperation and dialogue, which would guarantee the preparation of joint policies and methods of Desert Locust control.

This cooperation platform, in which all countries affected by the Desert Locust in West and North-West Africa would participate, would be supported by a light technical and operational support unit established under the EMPRES programme for a four year period. This unit would act as the permanent secretariat to the platform and would help with methodological issues and with seeking external technical and financial assistance, if necessary. In particular, the unit would, at the end of its mandate, prepare the establishment of a permanent structure, based on the sovereign accord of the states involved and represented in the platform. This structure would receive permanent assistance from the international community.

The total additional costs of setting up the entire facility are estimated at US$ 8,525,353; during a first phase of four years, this amount would be used for reinstating the national units and for assisting the cooperation platform. The additional budget allotment for the cooperation platform and the support unit could be reduced considerably by uniting the two organizations working at present at the subregional level (OCLALAV and CLCPANO) into one single regional authority.

After the first phase of four years it should be possible to limit the support from the international community (and in particular from FAO) to the assistance now given to the subregional organizations (CLCPANO) and to the participation of FAO's Locust Group. The recurrent costs would gradually be borne by the member states, possibly through a joint fund managed by the platform and to which the member states and possible donors from the international community would contribute.