

REPORT OF THE

Held in Rome, Italy
3-7 October 1977

**TWENTY-FIRST SESSION
OF THE FAO DESERT LOCUST
CONTROL COMMITTEE**



FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

Meeting Report No.
AGP/1977/M/6

REPORT OF
THE TWENTY FIRST SESSION OF THE
FAO DESERT LOCUST CONTROL COMMITTEE

held in
Rome, Italy
3 - 7 October 1977

Plant Production and Protection Division
Food and Agriculture Organization of the United Nations
Rome, 1977

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INTRODUCTION

The Twentieth Session of the FAO Desert Locust Control Committee, which was held in Rome from 25 to 29 October 1976, recommended that the next Session of the Committee should be convened in early October 1977. Accordingly, the Director-General invited the following Governments to be represented by Delegates at the Twenty First Session.

Afghanistan	Niger
Algeria	Nigeria
Bahrain	Oman
Benin	Pakistan
Cameroun	Portugal
Central African Empire	Qatar
Chad	Saudi Arabia
Egypt	Senegal
Ethiopia	Sierra Leone
France	Somalia
Ghana	Spain
Guinea	Sudan
India	Syria
Iran	Tanzania
Iraq	Togo
Israel	Tunisia
Ivory Coast	Turkey
Jordan	Uganda
Kenya	United Arab Emirates
Kuwait	United Kingdom
Lebanon	United States of America
Libya	Upper Volta
Mali	Yemen Arab Republic
Mauritania	Yemen, People's Democratic Republic of
Morocco	

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He also invited the representative of the Desert Locust Control Organization for Eastern Africa (DLCO-EA), Organisation Commune de Lutte Antiaoridienne et de Lutte Antiaviaire (OCLALAV), International Afriocan Migratory Locust Organization (OICMA), the League of Arab States and the Arab Organization for Agricultural Development as observers. In addition, he invited the representatives of the United Nations Development Programme (UNDP) because of their continued involvement and interest in the Desert Locust programme and the World Meteorological Organization (WMO).

The Session was opened by Dr. D.F.R. Bommer, Assistant Director-General, Agriculture Department, who, on behalf of the Director-General of FAO, welcomed all the participants to the Session and reviewed in brief some of the important features and significant developments of the locust programme since the last Session of the Committee. He specifically pointed out the serious locust situation which existed in some of the countries during the past year and thanked the Member Governments and various regional organizations for taking prompt action to contain it and stated that this would not have been achieved without the active cooperation of and concerted effort by all concerned. He, however, warned that experience had shown that under favourable ecological conditions the existing locust populations could multiply and assume swarming proportions over a short period of time. There was, therefore, a need for continued vigilance to detect and destroy locusts before they reach the critical threshold of a plague.

He emphasized the need for more field research, training of staff in latest methods of survey and control, proper upkeep and maintenance of equipment and safe use and proper storage of insecticides. He stated that FAO for its part would provide all possible assistance to encourage and promote such activities. He informed the Committee about the encouraging results obtained in the second phase of the satellite project and the need for testing these results on an operational scale to cover one or more regions. Likewise, he acquainted the participants with the progress of the FAO/DANIDA and FAO/SIDA projects. At the end he assured the Committee that the various recommendations, which would be made during the Session, would receive full consideration of the Director-General.

Officers of the Session

Chairman : Farid Uddin Ahmad (Pakistan)

Vice-Chairman : Azim Zomorodi (Iran)

Drafting Committee : The Delegates of Egypt, Iran, Kenya, Morocco and Nigeria and the FAO Secretariat. Mr. J. Roy and Dr. J. S. Gill acted as Technical Secretaries and Mr. Gurdas Singh as Consultant.

Acknowledgements

The Committee unanimously expressed its warmest appreciation for the most impartial and courteous manner in which the Chairman had conducted the deliberations of the Session. This had contributed greatly to the success of the meeting of the Committee. The Delegates also thanked the FAO Secretariat for the efficient way in which it had performed its various duties.

Obituary

The Committee learnt with great regret about the death of Dr. Abbas Davatchi of Iran and observed a one minute silence as a mark of respect. His death has deprived the countries concerned with the locust problem of one of its eminent entomologists, best known for his pioneer work in the field of Desert Locust.

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AGENDA

1. Opening of the Session
2. Election of the Chairman and Vice-Chairman
3. Adoption of the Agenda
4. Election of the Drafting Committee
5. The Desert Locust Situation during 1976/77 and Forecast
6. Anti-Locust Measures Undertaken by Various Countries and Regional Organizations (October 1976 to September 1977)
7. Report on Pilot Project on Satellite Application for Improving Locust Survey and Control Techniques
8. Follow-up Action on Training Project and Future Outlook
9. Progress Report on FAO/SIDA and FAO/DANIDA Projects
10. Trust Fund 9161 - Contributions and Expenditure
11. Status of various Desert Locust Regional Organizations
 - (a) South-West Asia
 - (b) Near East
 - (c) Eastern Africa
 - (d) North-West Africa
 - (e) West Africa
12. Any Other Business
13. Date and Place of the Next Meeting
14. Adoption of the Report

SUMMARY OF DISCUSSIONS

The Desert Locust Situation - October 1976 - September 1977

General

1. The main feature of the locust situation since the last Session of the DLCC was the general decline in locust activity during 1977 over almost all the major breeding areas. Earlier, the build-up of locust populations which started in 1972 reached a peak in 1976, but the vigilance exercised by the Member Countries and the various regional organizations to detect those populations, and the timely control measures adopted prevented the locust situation getting out of hand. It was necessary to carry out control operations over 26,000 square kilometres using 267,000 kg/litres of insecticides and 237,000 kg of poisoned baits in seventeen countries. Consequently, by the end of 1976 only small scale swarming populations were found in parts of North-West and West Africa, Algeria, Libya and Niger. Nevertheless, scattered adults and small concentrations of locusts which persisted in several countries could have given rise to widespread breeding and rapid multiplication in the event of adequate rainfall.
2. Ecological conditions in many parts of the winter-spring breeding areas were unsuitable for breeding. The rains were generally light or below average, consequently, locust populations already reduced by repeated control measures declined and dispersed further: no gregarious populations, apart from small pockets in Libya, Sudan and the United Arab Emirates, were reported from any of the locust areas from January 1977 onwards.
3. The multiplication of locusts during the winter-spring season in Mekran and adjoining areas of Afghanistan, Iran and Pakistan was on a much reduced scale compared with 1975-76. In spite of widespread and well distributed rainfall received in the summer breeding areas of the Indo-Pakistan sub-continent in 1977, locust populations continued to be low.
4. Except for small scale locust concentrations discovered in association with other grasshopper species in the United Arab Emirates in April-May and in the Yemen Arab Republic in February, the locust situation in the Arabian Peninsula remained quiet.
5. In Eastern Africa, control operations in the Red Sea coastal areas of Sudan and Ethiopia were carried out against hopper bands and adult groups from December 1976 to June 1977; otherwise no major populations were found in that region.
6. The locust activity in North-West and West Africa was also limited mostly to scattered populations. Some gregarious populations reached Algeria and Libya in late October and early November and were controlled. Again in Libya small scale gregarious populations were recorded during March to June 1977 and, thereafter, no significant development was reported from this region until the end of September.

South-West Asia

7. In India, control operations against gregarious infestations of both hoppers and adults concluded by the end of October 1976. The locust population decreased during November and December as most of the remnants migrated to winter-spring breeding areas of Mekran. Solitary adults in low numbers persisted during January to July with a maximum population of 1,500 adults/km² in April 1977. From August onwards, favourable ecological conditions continued to prevail throughout the desert area but there were not sufficient numbers of locusts present to produce gregarious populations.
8. In Pakistan, extensive control operations were carried out in the summer breeding area during August and September 1976. In October, fresh adults in appreciable numbers were observed in Khipro and Cholistan deserts and loose groups were found in Mauripur and Drigh Road areas of Karachi. These areas were sprayed in October/early November. No significant

locust activity was reported after November and only low density scattered adults were observed in Kharan, Lasbella and Makran districts. There were good rains in January 1977 but light and isolated during February-May. The ecological conditions in the winter-spring breeding areas were mostly unfavourable. The migration of locusts to the monsoon breeding areas in India and Pakistan was, therefore, on a much smaller scale than during the previous years. The maximum population of adults during January to July 1977 was 1,500/km² in March. In spite of widespread rainfall in the summer breeding areas of Pakistan, the locust population continued to be low from August onwards.

9. Locust activity in Afghanistan remained generally low: 33 adults and one solitary hopper were found in May 1977 during a special survey of South-Western Afghanistan. In Iran, from September to December 1976, low density adults were reported from Baluchistan-Sistan and Jiroft areas. Winter rains were good in January but scanty during February to June 1977. Only scattered adults and a few hoppers were observed in Southern Iran from January to June 1977, and no locusts were reported thereafter.

10. There were sufficient numbers of locusts, both in hopper bands and swarms, in the Indo-Pakistan sub-continent during the summer breeding period of 1976, necessitating large scale control operations. The success of such operations was evident from the fact that there was no major influx of locust populations into Makran or Pakistan, southern Iran and eastern Arabian countries, which otherwise would have taken place and, after multiplication, returned in much larger numbers during the following year. Events during 1977 proved that this did not happen, thus confirming once again the value of timely and effective control operations.

Near East

11. Widespread and heavy rains were reported from Jizan, Qunfidah and Taif areas of Saudi Arabia during September: rains were average in the Tihama, Hijaz and Asir mountains in October and November, and again heavy in December in many locust areas. But the ecological conditions were mostly unfavourable during February to September: rains were light and isolated and vegetation had largely dried up outside cultivated areas. No significant locust populations were observed in Saudi Arabia during September 1976 to July 1977, and only low density scattered adults were reported from the known breeding areas; a few hoppers were seen in February.

12. In the south-west of the Arabian Peninsula, solitary locust populations were reported during October 1976 to July 1977 from the Yemen Arab Republic and the People's Democratic Republic of Yemen. Rains began to fall on the Tihama of the Yemen Arab Republic in August and by September 1976 green vegetation was present. Further rain fell during October to January 1977, creating favourable breeding conditions. Groups of adults and bands of hoppers were discovered in areas of Al-Jarf, Al-Jalaheif, Al-Teena and wadis Hayran, Sheba and Habil. Patchy infestations over 15 km² were controlled using 2,000 kg of BHC dust. The rains were isolated and light during February to June and ecological conditions were not favourable for locusts. Because of continuing dry conditions over most of the breeding areas in the People's Democratic Republic of Yemen, the locust situation remained calm.

13. In the United Arab Emirates, the Pakistani Locust Team reported scattered locusts in February and March, which developed into medium density patchy adult and hopper concentrations in areas in Ajman and Ras al Khaima during April and May. Control operations were carried out against 200 small adult concentrations and 3,500 bushes harbouring hoppers were treated with BHC or dieldrin. The situation was reported calm in June. Scattered adults were observed in Oman during November 1976 and February 1977: a special survey during April-May 1977 did not report the presence of locusts in the Batina coastal plains, El Zahirah and El Shargiya areas. The rainfall in Oman was generally deficient, but certain areas received rain from a tropical storm in mid-June.

14. No locust activity was reported from other countries of the Near East region.

Eastern Africa

15. During October, very few locusts were observed in Sudan. In November, groups of adults and fledglings were found and laying was seen in the Tokar Delta. Control began in December against groups of I to V instar hoppers and fledglings; 25,000 kg of poisoned bait 30 litres of malathion and 500 kg of BHC dust were used. Rains during December produced good growth of vegetation and groups of mature locusts were copulating. The southern sector of the coastal areas continued to be infested with low to medium density adult concentrations and groups of hoppers of all stages during January and control was continued; 109,800 kg of bait, 360 litres of malathion and 1,500 kg of BHC dust were used. Because of continued favourable breeding conditions, copulation and laying were observed in February in the central and southern sectors. Bands of I and II instars were found in March, and all stages in April. Scattered adult groups were also found. Control operations carried out from December to April reduced the population, and in May only scattered adults were reported from the southern sector. Locusts in low numbers were reported to have moved into the summer breeding areas but no significant breeding was observed.

16. In Ethiopia, scattered adults were reported during October 1976 and from December 1976 to June 1977 from northern coastal areas. These areas were not normally accessible to survey teams but nomads were said to have observed locust activity in localities adjoining the Sudanese border, especially around Wadi Karora. Stray adult locusts were also caught at light in Asmara, indicating the presence of locusts in that province. Rains in the Harar province were heavy during March to May and pools of water were reported from Dira Dawa in March. In Somalia, low density adults persisted from October 1976 to July 1977. Heavy rains were reported during February to May but no extensive breeding was found in the coastal areas, which were surveyed regularly by ground and air teams. In August, scattered adults and late instar hoppers were reported in a number of localities in northern Somali Republic.

17. No locust activity was reported from Djibouti, Kenya, Tanzania and Uganda.

North-West Africa

18. In Algeria, rains fell from July to September 1976, and breeding continued in the extreme south. Hopper bands were formed in a few areas during October to December. Rains also fell at the end of September in Ahnet area of central Algeria and surveys during October reported scattered adults there. A swarm, one kilometre in extent, was reported in Tassili N'Ajjer near the Libyan border in November; hatching was reported in the area at the end of December. Thus, at the end of 1976, the conditions for development of locusts in the central and southern Sahara were favourable and a number of populations persisted in these areas. However, the rains during January to June fell mostly as light showers except that areas north of In-Aménas and east of the Grand Erg received good and soaking rainfall during the end of March and the beginning of April. The southern Sahara was practically dry except parts in the extreme south. A few locusts were found in the central Sahara; the situation was also calm in the western parts. In May, ecological conditions in many places east and north-east of the plateau of Tademait were favourable and a significant population was reported in Djokhane, Timersal and Souf. These locusts dispersed in June and the situation was reported to be calm.

19. Because of the frequent rains, the ecological condition in some parts of Libya remained favourable for locusts throughout 1976. In October, gregarious populations were reported from Ghat and Mourzouk; and groups of locusts were controlled using 6,000 kg of bait in Mourzouk. The country was reported free of locusts in December and January. Heavy rains fell in January, February and April. Scattered adults in a density of 50/ha. were reported in February from several places: Aghahr, Millan, Wan Abduh, Alfartas, Wan Heshes, Wan Debni, Wan Khaleel and Wan Wel Ghazayyal. Mature and immature groups of adults were observed in Hamada El Hamra region in March, and scattered adults persisted in Khor El Geefa, Wadi Megharghar and Grarat Thuma in April. Bands of I - IV instar hoppers were

discovered in Wadi Megharghar and Wan Limned on 10 May, and groups of immature adults in Wadi Megharghar were found in June. Control operations were carried out against locusts during March to June 1977 using 57,625 kg of BHC poison bait.

20. In south-east Morocco a few scattered adults were found in January and March. Scattered maturing adults were reported from the extreme south of Tunisia during April, but no breeding was reported.

West Africa

21. The rains in West Africa were near normal during August-September 1976 and green vegetation was reported over wide tracts of eastern Mali and western Niger. No significant rain was reported in November and December but several areas stayed green. In the last quarter of 1976, considerable locust activity was reported from Mali, Mauritania and Niger. There was an unconfirmed report of a swarm in Mali and a swarmlet in Niger in October: adult groups and hopper concentrations were controlled from October to December. In Mali, 16,095 ha. were treated using 12,460 litres of dieldrin in Tadjoudjement, Timetrine, Zaouaten and Tamesna; and in Niger operations covered 49,560 ha. with 44,020 litres of dieldrin in Tassadet, Ajir and parts of Aïr.

22. During the first six months of 1977 the rains were generally below average and vegetation dried out in most of the breeding areas, with the consequent dispersal and decrease in locust numbers. In Mauritania, there were unconfirmed reports of a swarm and hopper bands in January; isolated hoppers and scattered adults were reported from several localities south of 19°N during January-February, and in March a few isolated adults were present east of Boutilimit, in Trarza. In April, rainfall was reported from Aioun El Atrouss, and in Bassi Kounou and Aioun on 21 and 31 May respectively. It resulted in small patches of green vegetation in May. A few adults were seen at Tin Goumbou in south-western Hodh in May. There was light rain to the south of 17°N in June. Six adults were collected from Tamchakett area on 21 June. In Mali, the rains in May and June resulted in the sprouting of vegetation in several areas. Solitaries in small numbers were reported during March to June, but the general situation was calm. In Niger, light rains were recorded from April to June, but an aerial survey of areas in Tamesna and Aïr in late June indicated that the vegetation was mostly dry. Solitary adults were caught on 6 and 23 May at Arlit (1856N-0728E) and Aguelal (1845N-0805E). Above average rains fell between 15 July and August in the Adrar des Iforas in Mali and in the Massif of Aïr in Niger, thus creating favourable ecological conditions resulting in good vegetation. Nevertheless, only scattered locusts were found in these areas by the end of September.

23. No locust activity was reported from Senegal, Gambia, Chad and Cameroun.

24. A summary record of locust activity and reported rainfall is given in Appendix I.

Forecast

25. There had been a general decline of locust populations over almost all the major breeding areas in late 1976 and early 1977. The ecological conditions in many parts of the winter-spring breeding areas were not very suitable for development of locusts. The rains were generally light and deficient, consequently, the locust populations already reduced by persistent control pressure, dwindled and dispersed further. In spite of widespread and well distributed rainfall in some of the major summer breeding areas, there were no confirmed reports of swarms of hopper bands in the first nine months of 1977.

South-West Asia

26. In the Indo-Pakistan summer breeding areas, the locust population was much less in numbers than in 1976. These areas have, however, received very heavy and widespread rainfall, which continued as late as the end of September. There was, therefore, a possibility of a

late monsoon generation. The resultant population might move, in due course, northwards and overwinter and breed in the Punjabs of India and Pakistan in the following spring. At the same time, the possibility of movement of a part of the locust population into usual winter-spring breeding areas of Pakistan and Iran could not be ruled out.

Near East

27. In Saudi Arabia, isolated adults were present in the southern Tihama and in several other widely spread areas. Ecological conditions in general were not very favourable for further breeding. In the wake of expected winter rains, the situation could, however, change rapidly, leading to extensive breeding, particularly in the Tihamas. In the Tihamas of Yemen Arab Republic and in the breeding areas of the People's Democratic Republic of Yemen, scattered locusts were present. These were likely to breed further, should there be widespread and sufficient rainfall during the coming months

Eastern Africa

28. In Eastern Africa, isolated adults in small numbers would occur along the Gulf of Aden and the Red Sea coastal plains of Ethiopia and Sudan as far as Port Sudan. Breeding might occur in many localities but the first generation was unlikely to be on a scale sufficient to produce hopper bands. However, if winter rainfall was protracted, hopper bands might occur in the second generation. In the Somali Democratic Republic, scattered adults were present along the northern coastal areas and were likely to breed on winter-spring rainfall. Some hopper bands might occur in the second generation. The Committee learnt with some concern that there were certain important breeding areas in Eastern Africa which, at present, were not being surveyed normally and from where certain unconfirmed reports of the presence of locust breeding were received. In view of this, it was considered important to keep a strict watch in the neighbouring areas of Sudan, Ethiopia, the Somali Republic and northern Kenya during the coming months. The Committee requested FAO to write to the Governments of Ethiopia and the Somali Republic to facilitate survey and control of the Desert Locust in their respective countries

North-West Africa

29. Isolated adults were present in central and western Algeria but the conditions were no longer suitable for breeding. However, in the wake of rainfall and immigration from summer breeding areas, breeding might be widespread in the spring. Locusts in small numbers were likely to occur in southern Morocco, where breeding might also take place.

West Africa

30. Scattered young adults were likely to result from breeding in south-eastern Mauritania, in western Adrar des Iforas or Mali and in Niger in east Tamesna and Afr. These locusts would move northwards and start breeding in the vicinity of Ahaggar mountains and some might reach northern Mauritania and even southern Morocco. It was expected that some locusts would persist in north-eastern Mali and north-western Niger. Breeding would continue in the areas where ecological conditions were at present favourable, especially in Afr and Tamesna (Niger), in south-west and the north of Adrar des Iforas (Mali) and in Tagent (Mauritania). If further rainfall was received at the end of 1977, the situation could worsen in the above-mentioned breeding areas.

Anti-locust Measures Undertaken by Various Countries and Regional Organizations (October 1976 to September 1977)

31. During the period under report, recession conditions continued, although a number of countries had infestations of the kind which, if not controlled, would have given rise to a number of swarms. There had been locust breeding against which control operations were undertaken, notably in Libya, Mali, Niger, Pakistan, Sudan, United Arab Emirates and Yemen Arab Republic. On the whole, a total of 528,345 ha. of infested area was treated by using 65,635 litres of liquid insecticide, 368,675 kg of BHC bait and dust. Details are given in Appendix II.

Pilot Project on the Application of Remote Sensing Techniques for Improving Desert Locust Survey and Control

32. Based on the results obtained during the first phase of the Project, the Committee at its Twentieth Session (Report, paragraph 41) recommended to extend this work with the object to further develop the designed methodology of using remote sensing techniques for improving current Desert Locust survey methods. Accordingly, the second experimentation was carried out in the spring of 1977, again over areas of the North-West African region. As recommended by the Committee a more detailed investigation was undertaken on the monitoring of vegetal growth from the Landsat imagery using different analytical techniques. The study of historical rain data and cloud patterns for preparation of regression models to estimate rainfall with the help of weather satellite imagery, which was limited to breeding areas in southern Algeria in 1976, was extended to the whole of the North-West African region. Using the data from the meteorological satellite in combination with ground observations, regression models were constructed for monitoring of the occurrence and level of precipitation for the experimental areas. A light aircraft was used to select suitable areas of vegetation for detailed studies on plant species, coverage and related phenological/physiological aspects.

33. The Committee considered the results achieved and noted with interest that the Landsat data could be used for detection of vegetal growth relevant to the development of the Desert Locust, for the mapping of Desert Locust habitats and for an assessment of the consequences of run-off of precipitation to the following degrees of accuracy:-

- a) A nearly 100% correlation was found between the analysis of the multispectral data and the actual observations made in the field with regard to the detection of vegetation over stations which ranged in size from 2 - 500 ha. and had coverages of 20% to 90%. A vegetal coverage of 10% could possibly also be detected with the known techniques.
- b) With simple image analysis and interpretation techniques (e.g. visual comparison and colour additive viewing) using standard data products for the analysis, this correlation was determined to be about 85%.
- c) The correlation can be improved to about 95% with first generation photographic inputs being used for the additive viewing technique.
- d) By application of digital analysis techniques considerably more detailed and comprehensive information regarding the size and coverage of an area with vegetation could be obtained. The detection of the presence of small areas (2-3 ha.) with vegetation coverage as low as 20%, could be enhanced by performing a principal components analysis on the multispectral data using the characteristic differences in spectral signatures of desert vegetation and desert surface materials. Several classes of vegetation coverages and surface materials were obtained by application of another digital technique (i.e. supervised maximum likelihood classification) with a high degree of accuracy when compared to the field observations.
- e) The potential of Landsat data for monitoring the development of vegetal growth using multitemporal data was evaluated to be highly significant. The development of vegetation after sufficient precipitation and its subsequent decline could be closely followed on the satellite imagery. Moreover, through the synoptic detailed view of the Landsat sensors (1 image covers 3,500,000 ha.) key areas where locusts were likely to concentrate, when conditions for feeding deteriorated, could be indicated. This might reduce field operations both for survey and control to a considerable extent.

34. As regards the use of weather satellites, it was found that the rainfall mapping method developed and tested in the project was capable of distinguishing between areas of rain and no-rain. This finding offers the possibility of considerably narrowing down the area to be surveyed for locust breeding and development since, in the desert, the areas of rain are normally only a fraction of the size of the areas of no-rain. Furthermore, it was

possible to rank and evaluate rainfall events within the areas where rain had been interpreted to have fallen, and make a quantitative estimate of precipitation. This implies that within the rainfall zone priority areas for survey could be indicated.

35. Ecological studies of selected vegetation areas had shown, as expected, that the composition of plant communities varied according to soil type and other ecological conditions. It was not possible to determine differences at the species level from the present day satellite imagery. It was, however, possible to distinguish between different plant formations and bare surface areas. Also, plant communities could, perhaps, in future be interpreted on the basis of chlorophyll types according to their response to different wavelengths of light. On the basis of this study the technique of using Landsat false colour composite imagery for the mapping of phytogeographic features could be used to prepare "potentiality" maps of the locust breeding areas at a relatively low cost. These maps can divide areas into different categories, with possibilities of suitable ecological conditions such as vegetation and soil moisture for locust breeding. Also, they can significantly improve the operational aspects of a Desert Locust survey programme largely based on satellite information by narrowing down the areas of search.

36. Having considered the results obtained during the Pilot Project carried out in Algeria during 1976 and 1977, the Committee considered that:

- a) The data available from earth-orbiting satellites, i.e. weather satellites and earth resources satellites, could considerably improve current methods of Desert Locust survey and control.
- b) The methods developed both for mapping rainfall and monitoring vegetal growth seem to be capable of being implemented in an operational scheme, the successful application of which is likely to considerably reduce field operations and overall survey costs.
- c) There was a strong need to further develop both the technical and organizational aspects of the findings in a fully operational context. This should be done preferably in a region with local receiving facilities and cover larger areas and a complete annual insect cycle.
- d) Only on the basis of such a large scale project could a detailed assessment of the cost/benefit ratio for these types of operations be made and subsequent action for restructuring the current survey and control methodology be decided for implementation.

37. The Committee appreciated the efforts put in by the FAO Remote Sensing Unit and for the valuable results obtained over such a short period. Nevertheless, the Committee noted that there was need to further improve the quality of interpretation of satellite imagery, which could be brought about by additional equipment and recommended the provision by FAO of adequate funds for the Remote Sensing Unit to purchase such equipment.

38. Based on the conclusions drawn (paragraph 36) the Committee considered the proposed project (Appendix III) and requested FAO to submit it to DANIDA for funding. At the same time the Committee noted that it would be useful if, in the meanwhile, satellite work related to utilization of data obtained could be continued in Algeria. FAO should explore the possibility of funding such a project either from the North-West African Commission's Trust Fund or some other source.

Follow-up Action on Training Project and Future Outlook

39. The Twentieth Session of the Desert Locust Control Committee reviewed in detail the progress of the UNDP/FAO Training Project in Crop Pest Control with Special Reference to Desert Locust Control, which was terminated prematurely on 31 July 1976 because of UNDP financial difficulties. In that Session, the Committee, whilst appreciating the work done during the short life of the Project, was of the opinion that there was scope for further improvement in the programme, and made several recommendations for organizing future

training (Report, paragraphs 24 - 30). The Committee also emphasized the lack of trained manpower, which acted as a great impediment towards agricultural progress and plant protection in particular, in developing countries.

40. The Committee was informed that the Programme of Integrated Pest Control, which is being developed and coordinated by FAO on a worldwide basis under a UNEP project, is planned to include a comprehensive element on training in plant protection and extension education, and it was hoped to include lectures on locust control when necessary. The programme had made some progress in certain regions, notably the Sahel, and was at various stages of development in other countries and regions. However, it would take some time before it became operational. Meanwhile, the essential requirements of training in locust control were to be met through internal resources of the anti-locust organizations. Pending the improvement in the availability of international aid funds, and as per recommendation of the last Session of the DLCC (Report, paragraph 29) immediate requirements of training were met by using the balance of the Trust Fund component of the erstwhile training. In the main these included the contribution towards long-term fellowships already awarded under the Project, radio operation and maintenance, three exchange visits and organizing an Arabic training course in Oman from 9 to 29 April 1977, in which 23 trainees participated.

41. Noting that a large number of fellowships were awarded during the Project and realizing that the cost of such studies in the developed countries had gone up, the Committee considered that in future such awards should be curtailed and, wherever possible, efforts should be made to find facilities for training in developing countries. Such training would also have the advantage that the research fellow could work on research problems more relevant to the working conditions in his home country. Greater emphasis was necessary on practical field training on a national and regional basis and on the award of short-term fellowships utilizing the facilities of national institutions. To keep pace with the fast developing technological developments, it was also considered desirable to sponsor suitable candidates under short-term fellowships to selected institutions in the West, especially in the U.K. and France, for training on specific problems such as residue analysis, remote sensing, aerial application, etc.

42. The balance in the Trust Fund 9462 of the Training Project at the end of 1976 was \$281,364, (including commitments for long-term fellowships). \$216,498 were used from 1 January 1977 to 1 August 1977 from these funds, being the expenses (\$57,104) and the commitments (\$159,394) during this period. The balance, therefore, amounts to \$64,866. The proposed expenditure of the remaining funds until the end of 1978 is given below:

	<u>Funds Available</u> <u>31.12.76</u>	<u>Expenditure</u> <u>at at 1.8.77</u>	<u>Commitments</u> <u>as at 1.8.77</u>	<u>Proposed</u> <u>Expenditure</u> <u>Remaining Funds</u> <u>Until end 1978</u>
	\$	\$	\$	\$
Personal Services (Training Consultants)	29,684	10,374	1,110	18,200
Travel (Training Consultants)	24,587	5,623	3,664	15,300
Contracts (Printing)	3,000	-	-	3,000
Operating Expenses	1,597	99	698	800
Supplies and Equipment	4,056	86	170	3,800
Training				
Fellowships	167,329	20,652	134,177	12,500
Courses	16,545	13,245	-	3,300
Total	<u>246,798</u>	<u>50,079</u>	<u>139,819</u>	<u>56,900</u>
Project Servicing Costs (14%)	34,566	7,025	19,575	7,966
Grand Total	<u>281,364</u>	<u>57,104</u>	<u>159,394</u>	<u>64,866</u>

Progress Report on FAO/SIDA and FAO/DANIDA Projects

FAO/SIDA

43. The Project continued its work to test new compounds which could replace BHC and dieldrin, most commonly used for locust control. A number of synthetic pyrethroid compounds were tested, notably decamethrin and fenvalerate, which gave promising results. Similarly, Etrimphos was considered as another promising material as an alternative to fenitrothion, but further trials on its stability and safety were considered necessary.

44. Bendiocarb was found as a possible alternative to BHC for use in baits. In addition propoxur and cyanofenphos was also tested in baits, found to be adequately stable but slower than bendiocarb in obtaining kills. Preliminary tests with fenvalerate were very promising.

45. The use of additives (stickers) caused a noticeable increase in the persistence of the deposits of some insecticides which were reflected in higher kills when insects were exposed to the treated vegetation.

46. Based on the data currently available the following insecticides merit further study in the field:

(i) as alternatives to dieldrin, i.e. for the control of nymphs:

decamethrin
cyanofenphos
chlorpyrifos
fenvalerate
propoxur

(ii) as alternatives to BHC, i.e. for use in baits or dusts largely against nymphs:

bendiocarb
cyanofenphos
fenvalerate
phoxim
propoxur

(iii) as alternatives for the control of locusts by contact action, i.e. swarm spraying using aircraft for which fenitrothion is already suitable:

Etrimphos
phoxim
salithion
decamethrin
fenvalerate

47. The Committee learnt with interest that at the end of the FAO/SIDA Project in 1978, the work could be carried on by the technical staff of the DLCO-EA who had been trained as part of the Project programme. In addition, the DLCO-EA was to appoint another expert to assist in insecticide work. It was understood that at the time of closing the Project the entire laboratory equipment would be handed over to DLCO-EA to facilitate continuation of the work carried out during the Project. The delegates appreciated the work undertaken by Mr. MacCuaig and wished him well in his future.

FAO/DANIDA

48. The Project continued its work of monitoring of pesticide residues, in areas sprayed with dieldrin and BHC. Soil and vegetation samples were collected from a number of places in India, Iran and Pakistan from areas sprayed with dieldrin or dusted with BHC. These were analysed and results obtained were studied in detail. The following tentative conclusions could be drawn on the basis of the work done so far:

- a) All the surveys of residues remaining after spraying dieldrin for locust control had shown, so far, only very small, almost negligible residues persisting in the soil and plants.
- b) Similar results had been found for BHC. Although less BHC samples had been analysed it was expected that BHC would evaporate more rapidly than dieldrin because dieldrin had a much lower vapour pressure. (Aldrin persistence had not been checked by analysis because it was more volatile than BHC and, in any case, it converts to dieldrin in time). The loss was believed to be due to evaporation because of desert climatic conditions; and it is planned to confirm by analysis of air samples collected above a sprayed area.
- c) In the case of vegetation the rate of loss due to evaporation was probably greater than that from the soil because of the greater surface area exposed to the action of winds. There was unlikely to be any serious hazard to animals grazing on vegetation treated three or more months previously under the normal application rates used for Desert Locust control.
- d) More detailed studies would be conducted on rates of loss from vegetation when all the results from the experimental treatments had been obtained and interpreted.

49. The Project had been extended until the end of 1979 and further work could possibly provide sufficient evidence to have some definite answer to the problem of pesticide residues.

50. The Committee recommended that, depending upon the facilities and funds available, bio-assay and biopsy studies and chemical analysis should be carried out on fat tissues of animals which had fed on the vegetation sprayed with dieldrin.

Trust Fund 9161 - Contributions and Expenditure

51. In accordance with paragraph 69 of the Report of the Ninth Session of the DLCC, the Committee reviewed the statement of accounts of the Trust Fund for the year 1976, the estimated expenditure for 1977 and annual budget (Appendixes IV and V) and found them in order.

52. The Committee noted that arrears of contributions of some Member Countries were still outstanding (Appendixes VI and VII) and requested FAO to take up this matter with the governments concerned for speedy payment. At the same time, the Committee requested the delegates to pursue with their respective governments the question of prompt payment in future.

Status of Various Desert Locust Regional Organizations

Commission for Controlling the Desert Locust in the Eastern Region of its Distribution Area in South-West Asia

53. The Twelfth Session of the Commission was held in New Delhi, India, 9 - 12 March 1977.

The Commission:

- (a) took note of the considerable breeding of locusts in the Indo-Pakistan desert areas in August-September 1976, and appreciated the timely control operations undertaken by anti-locust organizations of India and Pakistan. The locust populations present in the region during February-March 1977 were well below the locust numbers recorded during the same period in 1976. The locust activity was, however, likely to increase in the wake of subsequent rainfall;

- (b) re-emphasized the need for careful surveillance of the outbreak areas on a regular basis and to maintain adequate control potential for emergency control operations;
- (c) approved the undertaking of special surveys of south west Afghanistan, southern Iran and strategic desert areas along the Indo-Pakistan border;
- (d) discussed the research work being carried out at different stations within the region and made several recommendations to coordinate and improve research activities;
- (e) approved the programme of work and budget for 1977 and accounts for 1975 and 1976;
- (f) expressed its keen interest in FAO proposals to improve Desert Locust survey techniques by using Earth Satellites, and allocated \$10,000 as its contribution for these experimental studies;
- (g) stressed the need for transmitting information on locust incidence and rain expeditiously to the Regional Locust Officer to enable him to issue locust situation reports in time;
- (h) recommended that, in future training programmes, more emphasis should be put on short-term practical training, and that training in the fields of aerial spraying and radio maintenance should be continued at regional and interregional level. The training in aerial spraying techniques should include pilots, engineers and plant protection staff;
- (i) noted the preliminary findings of the FAO/DANIDA projects on monitoring of pesticide residues in areas sprayed for the control of locusts, and that a major portion of the dieldrin (75%) disappeared after the first year of treatment; and recommended that the use of dieldrin should be continued for locust control until such time as alternative effective and economical substitutes become available.

Commission for Controlling the Desert Locust in North-West Africa

54. The Sixth Session of the Commission and the Fifth Session of its Executive Committee were held in Rabat, Morocco from 30 March to 6 April.

The Commission:

- (a) noted that the locust situation was at present under control, but, with the expected monsoon rains, significant breeding may take place, and watch and vigilance should be exercised in such areas;
- (b) recommended that adequate arrangements should be made for effective surveillance and possible control operations;
- (c) approved the programme of work and budget for 1977 and the statement of account for 1976;
- (d) recommended that supplies provided by FAO to the member countries of the Commission should be standardized taking into account the working conditions for survey and control;
- (e) gave a favourable view of the EPPO's admission as observer to the Commission;
- (f) reviewed the progress of the satellite pilot project;
- (g) approved amendments to the agreement on the setting up of the Commission;

- (h) requested the FAO Secretariat to provide the services of an Arabic translator for documents and reports during future Sessions of the Commission, to be paid by the Trust Fund.

Commission for Controlling the Desert Locust in the Near East

55. The Seventh Session of the Commission for Controlling the Desert Locust in the Near East and the Sixth Session of its Executive Committee were held from 18 - 22 October 1976 in Rome, Italy. The main recommendations of the Session were reported to the Twentieth Session of the DLCC.

56. The Eighth Session of the Commission is due to be held in Doha, Qatar, from 6 to 13 December 1977, and its proceedings would be reported to the next Session of the DLCC. Meanwhile, the Commission's Secretariat in Jeddah continued the work of collecting information on locusts and rainfall and the issuing of monthly situation reports. A training course in Arabic was organized in Muscat, Oman, for trainees from the Gulf states. A special survey of strategic breeding areas of Oman was carried out by an FAO Locust Officer specifically appointed for this purpose. However, no major locust populations were found in the surveyed areas. The FAO Locust Officers in Hodeidah and Aden also continued the work of monitoring locust populations and assisting locust authorities in plant protection. The radio equipment in several Member Countries of the Commission was inspected and repaired by the FAO Radio Engineer (Consultant): necessary spare parts were also supplied.

The Desert Locust Control Organization for Eastern Africa (DLCO-EA)

57. The Twenty Second Session of the DLCO-EA Council was held in Nairobi, Kenya, from 11 to 13 May 1977 under the chairmanship of the Honourable Nyagah, Minister for Agriculture, Kenya. This meeting was also attended, in the capacity of observer, by Dr. J. S. Gill, on behalf of the Food and Agriculture Organization of the United Nations.

58. The Desert Locust Control Organization for Eastern Africa continued to survey the potential breeding areas, whenever it was possible, in order to carry out its operations efficiently for the control of the Desert Locust and other plant pests in Eastern Africa.

59. As authorized by its Council, the Organization carried out control against the bird pests, Quelea, quelea, and Armyworms in the Member Countries as and when requested. The Organization was assisted by donor countries to augment the existing resources in the form of motor vehicles, finance and aircraft which were expected to arrive shortly.

60. The Council approved the programme of work for 1977/78 and also approved the proposed budget of US\$ 1,963,518. The Food and Agriculture Organization maintained good relationships with the Organization in matters of Desert Locust survey and control. At the request of FAO the Desert Locust Control Organization for Eastern Africa supplied insecticides to North Yemen on a replacement basis.

61. The Food and Agriculture Organization cooperated fully with the Desert Locust Control Organization for Eastern Africa in the FAO/SIDA Project, which is to assist the region in finding alternative chemicals in the control of locust hoppers. During the year the 16th Session of the Technical Committee was also held in Nairobi on 6 September 1977.

62. The Committee noted with appreciation the renewed offer made by the DLCO-EA to make available its aircraft for undertaking surveys in the south western Arabian Peninsula, if so requested by FAO or directly by the countries concerned. At the same time, the Committee also noted with interest that DLCO-EA would continue to provide training facilities for locust officers from other regions on different aspects of Desert Locust survey and control.

Organisation Commune de Lutte Antiacridienne et de Lutte Antiaviaire (OCLALAV)

63. The Organization:

- (a) continued its survey and control activities against the Desert Locust, grasshoppers and grain-eating bird pests in Member Countries. Control operations against the Desert Locust were carried out in Mauritania, Mali and Niger during the year;
- (b) pursued research activities and extension work against grasshoppers, in a joint OCLALAV/COPR (Centre for Overseas Pest Research, London) project;
- (c) tested new insecticides against grasshoppers, and also against Locusta in collaboration with OICMA;
- (d) provided technical personnel for training of staff and organized about a dozen courses on various aspects of plant protection for the benefit of Member Countries with the financial assistance of the FAO/OSRO project and Canada

64. The meeting of the Administrative Council of OCLALAV was held in N'Djeména from 28 to 30 July 1977 and made the recommendations stated below in order of priority:

- (i) to reinforce national Plant Protection organizations;
- (ii) to reinforce regional organizations;
- (iii) training and research.

65. FAO continued to maintain its cordial relations with OCLALAV in matters of mutual interest, in matters of locust and bird control, and cooperation was extended to other related fields such as grasshopper control. Financial assistance was made available for locust survey and training as far as possible.

Any Other Business

66. The Committee requested that, as far as possible, working documents should be sent in time to the participants so that they could study them well before the meeting.

67. The Committee was informed that, at the request of OCLALAV and OICMA, an unofficial meeting was held at the time of the DLCC between the representatives of these organizations and experts from FAO. Different aspects of a possible merger between OCLALAV and OICMA were considered. FAO would be able to advise and assist these organizations in order to help them to achieve this common objective, should this be requested.

DATE AND PLACE OF NEXT SESSION

68. The Committee recommended that the Director-General of FAO should convene the next Session of the Committee in October 1978 in Rome on a date to be determined by him.

DESERT LOCUST SITUATION SUMMARY

	1976			1977								
	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.
7. <u>YEMEN P.D.R.</u>												
Swarms												
Adults	+	+	+	+	+	+	+	+	+	+	+	+
Hoppers	+		+	+			+			+	+	+
Control										+		
Rainfall	L	L	Av	L	L	L	H	L	L	L	Av	Av
8. <u>OMAN</u>												
Swarms												
Adults		+			+							
Hoppers		+										
Control												
Rainfall	L	L	L	L	L	L	L	L	L			
9. <u>U.A.EMIRATES</u>												
Swarms												
Adults					+	+	+	+				
Hoppers							+	+				
Control							+	+				
Rainfall						Av	H	L	L			
<u>EASTERN AFRICA</u>												
10. <u>SUDAN</u>												
Swarms												
Adults		+	+	+	+	+	+	+			+	
Hoppers			+	+	+	+	+				+	
Control			+	+	+	+	+					
Rainfall	L	Av	Av	H	L	O	L	O	L	Av,L	H	
11. <u>ETHIOPIA</u>												
Swarms												
Adults	+		+	+	+	+	+	+			+	
Hoppers			+	+								
Control												
Rainfall	Av	L	L	Av	O	H	H	H	H	H	H	
12. <u>SOMALIA</u>												
Swarms												
Adults	+	+	+	+	+	+	+	+	+	+		
Hoppers	+									+		
Control												
Rainfall	L	L	L	L	H	H	H	H	Av	H	L	
<u>NORTH-WEST AFRICA</u>												
13. <u>ALGERIA</u>												
Swarms		+										
Adults	+	+		+	+	+	+	+	+			
Hoppers	+	+	+									
Control												
Rainfall	L	L&H	L&H	L	L	L&H	H	L	L	L&Av	L&Av	

DESERT LOCUST SITUATION SUMMARY

	1976			1977								
	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.
14. LIBYA												
Swarms		+										
Adults	+	+			+	+	+		+			
Hoppers								+				
Control		+				+	+	+	+			
Rainfall				H	H	O	H	L	L	L	L	
WEST AFRICA												
15. MALI												
Swarms	+(?)											
Adults	+		+	+		+	+	+	+	+		
Hoppers	+		+									
Control	+		+									
Rainfall	H	L	L	O	O	O	L	L	L	L	Av,H	Av,H
16. MAURITANIA												
Swarms												
Adults	+		+	+	+	+		+	+	+		
Hoppers	+											
Control												
Rainfall	Av	L	L	O	L	O	L	L	L	L		
17. NIGER												
Swarms	+											
Adults	+	+	+	+				+	+	+		
Hoppers	+	+	+									
Control	+	+	+									
Rainfall	L	L	O	O	O	O	L	L	L	L	H	H

Rainfall: H = Heavy; Av = Average; L = Light; O = Nil
Presence of locusts = +

APPENDIX II

ANTI-LOCUST MEASURES UNDERTAKEN BY VARIOUS COUNTRIES AND REGIONAL ORGANIZATIONS (FROM OCTOBER 1976 TO SEPTEMBER 1977)

LOCALITY	MONTH AND YEAR	TYPE OF INFESTATION (SWARMS, SCATTERED ADULTS, HOPPERS)	INFESTED AREA	INSECTICIDE USED				METHOD OF APPLICATION (AIR OR GROUND)
				P4C PINT IN KGS	LIQUID IN LITRES P4C THION	DIELDRIN	OTHERS IN LIT/KGS	
<u>Algeria</u> Wadi Terat	Dec. 1976	Adults	1 km ²	-	-	-	1000 kg, bait	ground
<u>Libya</u> Murzak, Ghaf Wan Limmed (2918N-1045E) Om El-Ruahil (2850N-1040E) Wadi Megharfhar (3003N-1033E) Wadi Megharfhar Wan Limmed	Nov. 1976 March 1977 April 1977	Adults Adults Mature adults	- 15 km ² 100 ha	- - -	- - -	- - -	6000 kg, bait 7000 kg, bait 3750 kg, bait	ground ground ground
Wadi Awal (3007N-1000E)	Mar. 1977 June 1977	Hoppers Adults (Immature)	89 km ² 10 km ²	- -	- -	- -	37,500 kg, bait 9375 kg, bait	ground ground
<u>Mali</u> North, north-west and north-eastern parts (Tadjoudj- met, Timetrine, Zaouaten) Adrar, Timetrine, Tamesna Adrar, Timetrine, Tamesna	Oct. 1976 Nov. 1976 Dec. 1976	Adults, hoppers Adults, hoppers Adults, hoppers	28,485 ha 22,860 ha 9,770 ha	- -	5805 1340	5% 20%	- -	air air air
					1600 1800	5% 20%	- -	
					400 1550	5% 20%	- -	

LOCALITY	MONTH AND YEAR	TYPE OF INFESTATION (SWARMS, SCATTERED ADULTS, HOPPERS)	INFESTED AREA	BHC DUST IN KGS	INSECTICIDE USED				METHOD OF APPLICATION (AIR OR GROUND)	
					MALATHION	BHC	LIQUID IN LITRES			OTHERS IN LIT/KGS
							DIELDRIN			
<u>Niger</u>										
Tassadet, Ajir	Oct. 1976	Adults, hoppers	16,610 ha	-	-	12300	5%	-	-	
Tassadet, Timmehtsoi										
Aghlan-Niklen,	Nov. 1976	Adults, hoppers	17,960 ha	-	-	13100	5%	-	-	
Maharas, Ehazangar										
Kazamat										
Air, wadis west of	Dec. 1976	Adults, hoppers	14,990 ha	-	-	3,630	5%	-	-	
Tamebna (1813-1825N										
and 0505-0556E)										
14,990										
<u>Pakistan</u>										
Khirpo, Cholistan,	Oct. 1976	Adults	277 km ²	-	-	dieldrin		-	air (preventive strip spraying)	
Karachi, Mirpur Mathelo										
<u>Sudan</u>										
Khori Baladat	Dec. 1976	Adults, hoppers	2,720 ha	500	174	-	-	25,200 kg, bait	-	
(1804N-3827E)										
Hale-i-bai	Jan. 1977	Adults, hoppers	2150 ha	1500	360	-	-	109800 kg, bait	ground	
(1754N-3827E)										
Meitili (1752N-3025E)	Feb. 1977	Adults, hoppers	870 ha	2006	-	-	-	117400 kg, bait	ground	
Ashat, Hoshiari and	March 1977	Adults, hoppers	350 ha	900	-	-	-	32400 kg, bait	ground	
areas along the Red										
Sea, especially	April 1977	Hoppers	-	-	-	-	-	-	ground	
southern parts										
<u>United Arab Emirates</u>										
Ajama (2520N-5525E)	April 1977	Adults, hoppers	500 ha	420	1200	-	-	18800 kg, bait	ground	
Rasul-Kheima (2545N-5555E) Fajira	May 1977	Adults, hoppers							450 BHC (WP)	ground
<u>Yemen Arab Republic</u>										
Al-Jarr, Al-Jalaheif,	Feb. 1977	Adults, hoppers	15 km ² (patchy)	2000	-	-	-	-	ground	
Al-Teena, Wadis Hayran Sheba and Hahl (1606N-5252E)										

PROJECT PROPOSAL

I. Title Application for Satellite Remote Sensing Techniques for Improving Desert Locust Survey and Control.

Symbol: TF/INT/— (DEN)

Recipient Country: Based in Teheran to serve the South West Asia Region (Afghanistan, India, Iran and Pakistan).

Cooperating Agency: Commission for Controlling the Desert Locust in the Eastern Region of its Distribution Area in South West Asia.

Donor Country: Denmark.

Donor Contributions: U.S. \$ 440,200.

Duration: Three years, starting October 1978.

II. Background

Crops worth 15-20 billion dollars over 30 million square kilometres in 60 countries, from Mauritania to India and Tanzania to Turkey, with a fifth of the world's population, are prone to ravages by the Desert Locust, estimated at \$20 million during a plague period. Over the past 25 years FAO has developed a scheme of prophylactic control by devising a three tier system, at national, regional and interregional levels, of surveillance and timely control. The recession in Desert Locust activity has entered its sixteenth year, against the previously known longest period of seven years, over 200 years of recorded locust history: an ample measure of success of the scheme.

Effective surveillance of the breeding areas, which extend over the most arduous desert lands of the world, is the key to the success of locust control. The present methods of ground and aerial surveys are limited both in time and space, and can be undertaken in certain areas only in certain seasons. The use of satellite data to detect vegetation and rainfall, and thus the prospective breeding grounds, offers the possibility of confining the search to specific areas to which the survey teams could be sent directly, enhancing the effectiveness of survey and control operations considerably.

Accordingly, a pilot project was undertaken in Algeria during 1976 and 1977 to explore the possibility of using remote sensing techniques for locust survey, with funds provided by the Regional Locust Trust Funds. The results are highly encouraging: vegetation up to a ground cover of 20% can be detected with almost 100% accuracy; areas of rain and no rain can be differentiated easily and the level of precipitation monitored fairly accurately from the interpretation study of cloud patterns on weather satellite imagery. Using Landsat false colour composite imagery, landscape maps showing phytogeomorphic characteristics can be prepared for indicating potential breeding sites. These preliminary observations require to be tested further over a whole region and in depth to evaluate their practical feasibility.

The FAO Desert Locust Control Committee, representing some 60 countries and organizations interested in the control of the Desert Locust, examined the problem during its Twentieth Session held in Rome from 25 to 29 October 1976, and recommended that, in view of the satisfactory results achieved during the pilot project, a well planned, adequately staffed project was necessary to develop an international cooperation programme to provide rapid and comprehensive information on occurrence of potential Desert Locust breeding sites. Such a programme could be formulated to monitor vegetal cover and related data in different complimentary breeding areas.

III. Purpose

The immediate objective of the Project is to test the feasibility of using satellite data inputs to monitor prospective Desert Locust breeding areas, and to demonstrate the operational capabilities of such a scheme over complimentary breeding areas in South West Asia and parts of the Arabian peninsula.

The long term objective is to develop a cooperative international system of surveillance and control of the Desert Locust, which can provide comprehensive and accurate information on the prospective breeding sites economically on a routine basis. This will enable the directing of ground survey teams to well-defined areas to record locust populations and adopt timely control, obviating the necessity of searching at random vast areas of the desert. The improvement in surveillance and control will naturally result in effective control of incipient locust populations and prolong the recession in locust activity, saving crops worth billions of dollars from the ravages of a plague.

IV. Plan of Operations

There will be three major components of the programme of work:

- (i) Application and analysis of satellite data for monitoring of vegetal cover, its extent and distribution, both in time and space.
- (ii) Preparation of regression models from the study of historic precipitation and weather satellite data, cloud patterns from the imagery of meteorological satellites and, on this basis, to be used to delimit areas of rainfall and no rainfall and estimating the level of precipitation.
- (iii) Using the Landsat false colour composites, maps of the main breeding areas will be prepared showing major phytogeomorphic features of the landscape. In the event of rainfall, these maps can be used for defining potential breeding areas and directing the ground survey teams to them.

In addition to this, relevant remote sensing techniques becoming available in the near future (thermal sensing by Landsat-C, 1978, geostationary weather satellites, 1978) will be tested in the project regarding their possibilities of improving techniques available at present.

A system of communications between the Project Headquarters and the concerned authorities in the participating countries will be established to transmit data quickly to enable timely action by the field teams and vice versa. This is an important programme element and crucial for the success of the Project.

Contacts shall also have to be established with the national and international meteorological organizations for obtaining the data, and assistance in interpretation and analysis of results by using some of the sophisticated equipment normally not available locally. Likewise, imagery for studies involving the use of historic data shall have to be procured from NOAA and NASA.

The implications of a programme of surveillance and control of the Desert Locust based largely on a satellite information system, need to be studied in detail under practical conditions: the transmission of information to the field staff within a deadline period of 7 - 14 days, the accuracy of the information on vegetation, rainfall and attendant ecological conditions, the cost of the system in relation to present day ground and aerial survey facilities, especially in view of the fact that a part of the infrastructure has to be maintained for control operations. In short, the Project will aim at working out a cost/benefit ratio of the application of satellite techniques to locust survey and control.

For the above purpose, a laboratory with basic facilities of equipment for analysis and interpretation of data will be set-up at Teheran. The imagery will be procured from the receiving station being established in Teheran, so as to be operational by early 1978. The field support for the verification of interpreted laboratory results with the ground-truth data will be provided by the national anti-locust services.

The Project will be operated under the direct supervision of the Senior Officer, Locust Control and Emergency Operations in AGPP, with the technical cooperation of the Remote Sensing Unit, AGD, whenever necessary. The Regional Locust Officers in Teheran and Jeddah will also be closely associated with the execution of the Project for liaison with the participating governments. The Technical Officer in Teheran, with his Technical Assistant, will be responsible for executing the programme of work and its satisfactory progress. The study of historical rainfall data and its correlation with cloud patterns of meteorological satellite imagery will be mainly carried out with the help of a Consultant. Analysis of data requiring the use of sophisticated equipment (analog and digital image analysis systems) will need the cooperation of institutes like the Central Laboratory for Remote Sensing in Munich and the German Space Research Institute (DFVLD) and part of such work may be subcontracted to them. Light aircraft for undertaking field ecological studies may also have to be hired, more so in member countries which do not possess such facilities.

No potential role is foreseen for the volunteers at this stage; the provision of an associate expert may be considered later on to exploit the field potential of the Project more.

V. Description of DANIDA Inputs

Personnel support: will include one P.3 Technical Officer, one local Technical Assistant and six man months of consultancy (estimated at US \$ 210,000). The provision of a Technical Assistant is considered necessary to help the Technical Officer in routine analysis work and as general support staff during his absence from the Headquarters. Consultant(s) will be employed to prepare regression models for the monitoring of rain.

Contractual Expenses: are meant for the purchase of imagery from different receiving stations and organizations, subcontracting analytical work requiring sophisticated equipment and for the hiring of aircraft, in member countries where such facilities do not exist, to carry out general surveys to collect ground truth data (\$55,000).

Equipment and Supplies: the main items include:

Additive viewer	20,000
Analytic and draughting equipment	10,000
Photographic and projection equipment	7,000
Miscellaneous laboratory supplies	10,000
Landrover	8,000
	<hr/>
	US \$ 55,000
	<hr/>

VI. Government Inputs in Kind and Local Facilities: US \$ 350,000

Counterpart staff, drivers and local facilities for storage of equipment and supplies, and office accommodation. The national locust services will also undertake the collection of ground truth data by ground and aerial surveys.

DETAILS OF DONOR CONTRIBUTION IN US DOLLARS

<u>Code</u>	<u>PROJECT</u>	<u>mm</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>Total</u>
10	<u>Personnel Services</u>						
	(a) Technical Officer P-3	36	10,500	42,000	42,000	31,500	= 126,000
	(b) Technical Assistant G-5	36	4,500	18,000	18,000	13,500	= 54,000
	(c) Consultant	6		10,000	10,000	10,000	= 30,000
			15,000	70,000	70,000	55,000	= 210,000
20	<u>Official Duty Travel</u>		2,000	5,000	5,000	3,000	= 15,000
30	<u>Contractual Expenses</u>		5,000	20,000	20,000	10,000	= 55,000
40	<u>General Operating Expenses</u>		4,000	8,000	5,000	3,000	= 20,000
50	<u>Supplies and Materials</u> (Laboratory)		2,000	10,000	5,000	3,000	= 20,000
60	<u>Equipment</u> (Laboratory)		5,000	20,000	5,000	5,000	= 35,000
	TOTAL		33,000	133,000	110,000	79,000	= 355,000
90	<u>Project Servicing Costs (14%)</u>		4,620	18,620	15,400	11,060	= 49,700
	Inflation factor 10%		3,300	13,300	11,000	7,900	= 35,500
	GRAND TOTAL		40,920	164,920	136,400	97,960	= 440,200

INTERNATIONAL DESERT LOCUST TRUST FUND 9161

BUDGET AND STATEMENT OF ACCOUNT (Expressed in US \$ Equivalents)

	<u>Approved Annual Budget</u>	<u>Income and Expenditure 1976</u>	<u>Estimate 1977</u>
<u>Receipts</u>			
Balance brought forward (Reserve)		111,243	(31,323)
Contributions from Member Governments	80,916	53,342	100,000
Interest		483	
Less transfer to TF 9462 (Training Project)		(110,000)	
	<u>80,916</u>	<u>55,068</u>	<u>65,677</u>
<u>Cash Expenditure</u>			
<u>Code</u>			
10	Personal Services	10,000	12,500
20	Travel on official business	15,000	3,700
30	Contractual Services	10,000	10,000
40	General Operating Expenses	-	490
50	Expendable Supplies	4,100	10,000
60	Equipment	25,000	19,000
80	Fellowships and Training	5,000	(257)
90	Project Service Costs (14%)	9,674	8,077
	Total Expenditure	<u>78,774</u>	<u>65,767</u>
	Unallocated Balance	2,142	-
		<u>80,916</u>	<u>65,767</u>

The Director-General of FAO was empowered by the 14th Session of the DLCC, 1970, to change the allocation of sums allotted to different chapters in order to meet the changing needs of the locust situation, subject to the total annual expenditure not exceeding the total budget.

INTERNATIONAL DESERT LOCUST TRUST FUND 9161

Breakdown of 1976 Expenditure

10	<u>Personal Services</u>		
	DLCC Session (interpreters, overtime, etc)	14,230	
	DLCO Aerial Services (Saudi Arabia) - DSA crew	1,770	
	OCLALAV survey DSA team	1,511	17,511
		<hr/>	
20	<u>Travel on Official Business</u>		
	DLCC Interpreters (travel)	923	
	Consultants (travel)	2,483	
	HQ Staff to International Sessions	2,789	
	Exchange Visit	521	6,716
		<hr/>	
30	<u>Contractual Services</u>		
	DLCO Aeroplane (Control operations in Saudi Arabia)	7,330	
	Printing	13,979	21,309
		<hr/>	
40	<u>General Operating Expenses</u>		
	OCLALAV survey	581	581
		<hr/>	
50	<u>Expendable Supplies</u>		
	Ethiopia (Land Rover parts)	986	
	OCLALAV (Survey supplies)	11,518	12,504
		<hr/>	
60	<u>Equipment</u>		
	Mauritania (radio equipment)	15,346	
	Somalia (meteorological equipment)	1,635	
	Ethiopia (generator)	2,072	
	Insurance & transport	996	20,049
		<hr/>	
80	<u>Fellowships and Training</u>		
	Credit	(257)	(257)
		<hr/>	
			<hr/>
			78,413
			<hr/>
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TRUST FUND No. 9161 - INTERNATIONAL DESERT LOCUST CONTROL PROJECT

Pledge Position at 30 September 1977

	Out- standing 1969-73	Out- standing 1973/74	Out- standing 1974/75	Out- standing 1975/76	Out- standing 1976/77	Out- standing 1977/78	Total Outstanding Contribution due
	\$	\$	\$	\$	\$	\$	\$
Afghanistan	-	-	-	-	-	1,910.00	1,910.00
Algeria	-	-	-	-	-	2,580.00	2,580.00
Bahrain	-	-	-	-	-	720.00	720.00
Chad	-	-	-	-	1,800.00	1,800.00	3,600.00
Egypt	-	-	-	-	-	-	-
Ethiopia	-	-	-	-	-	2,180.00	2,180.00
France (for Republic of Djibouti)	-	-	-	-	-	420.00	420.00
Ghana	-	-	-	-	-	(447.82)	(447.82)
India	-	-	-	-	-	10,000.00	10,000.00
Iran	-	-	-	-	-	3,690.00	3,690.00
Iraq	-	-	-	-	-	-	-
Jordan	-	-	-	-	1,730.00	1,730.00	3,460.00
Kenya	-	-	-	-	-	-	-
Kuwait	-	-	-	-	-	420.00	420.00
Lebanon	-	-	-	1,350.00	1,350.00	1,350.00	4,050.00
Libya	-	-	-	-	1,820.00	1,820.00	3,640.00
Mali	7,200.00	1,800.00	1,800.00	1,800.00	1,800.00	1,800.00	16,200.00
Mauritania	-	-	-	-	1,305.09	1,720.00	3,025.09
Morocco	-	-	-	-	-	2,990.00	2,990.00
Niger	-	-	-	-	-	1,800.00	1,800.00
Nigeria	-	-	3,650.00	3,650.00	3,650.00	3,650.00	14,600.00
Oman	830.00	830.00	830.00	830.00	830.00	830.00	4,980.00
Pakistan	-	-	-	-	-	5,860.00	5,860.00
Qatar	-	-	-	-	830.00	830.00	1,660.00
Saudi Arabia	-	-	-	-	1,830.00	1,830.00	3,660.00
Senegal	-	-	-	-	-	1,985.42	1,985.42
Sierra Leone	-	-	-	-	-	157.27	157.27
Somali Republic	-	-	-	-	-	968.33	968.33
Sudan	-	-	-	-	-	2,250.00	2,250.00
Syrian Arab Republic	-	-	-	-	2,010.00	2,010.00	4,020.00
Tunisia	-	-	-	-	-	1,990.00	1,990.00
Turkey	-	-	-	-	-	-	-
Uganda	-	-	-	-	1,200.00	1,650.00	2,850.00
United Arab Emirates	-	-	-	-	5,500.00	5,500.00	11,000.00
Yemen Arab Republic	1,360.00	1,840.00	840.00	1,840.00	-	1,840.00	7,720.00
Yemen, P.D.R. of	240.00	-	-	-	120.00	120.00	480.00
\$	9,630.00	4,470.00	7,120.00	9,470.00	25,775.09	67,953.20	124,418.29

Scale of Government Contributions to
the International Desert Locust Trust Fund No. 9161

<u>Country</u>	<u>U.S.\$</u>
Afghanistan	1,910
Algeria	2,580
Bahrain	720
Chad	1,800
Djibouti	420
Egypt	3,920
Ethiopia	2,180
Ghana	1,950
India	10,000
Iran	3,690
Iraq	2,480
Jordan	1,730
Kenya	1,800
Kuwait	420
Lebanon	1,350
Libya	1,820
Mali	1,800
Mauritania	1,720
Morocco	2,990
Niger	1,800
Nigeria	3,650
Oman	830
Pakistan	5,860
Qatar	830
Saudi Arabia	1,830
Senegal	2,010
Sierra Leone	358
Somalia	1,450
Sudan	2,250
Syria	2,010
Tunisia	1,990
Turkey	5,350
Uganda	1,650
United Arab Emirates	5,500
Yemen Arab Republic	1,840
Yemen, People's Democratic Republic	120
	<hr/>
	84,608
	<hr/> <hr/>

APPENDIX VIII

LIST OF WORKING PAPERS

- AGP:LCC/77/1 - Agenda
- AGP:LCC/77/2 - The Desert Locust Situation : October 1976 - September 1977
- AGP:LCC/77/3 - Anti-locust measures undertaken by various countries and Regional Organizations (from October 1976 to September 1977)
- AGP:LCC/77/4 - Status of the various Desert Locust Regional Organizations
- AGP:LCC/77/5 - Follow-up action on the Training Project and future outlook
- AGP:LCC/77/6 - Project activities of FAO/DANIDA Project June 1976 - July 1977
Monitoring of Pesticide Residues in Areas Sprayed for Control of the Desert Locust
- AGP:LCC/77/7 - Progress report on the FAO/SIDA Locust Project - Study of Toxicity and Residue Implications of using Alternative Chemicals for Locust Control
- AGP:LCC/77/8 - International Desert Locust Trust Fund 9161
- AGP:LCC/77/9 - Desert Locust Satellite Application Project Stage II - Rainfall Monitoring in the Region of the North-West African Desert Locust Commission in 1976-77 (Dr. E.C. Barrett)
- AGP:LCC/77/10 - Pilot Project on the Application of Remote Sensing Techniques for Improving Desert Locust Survey and Control - Summary of Results, Conclusions and Recommendations
- AGP:LCC/77/10bis - Pilot Project on the Application of Remote Sensing Techniques for Improving Desert Locust Survey and Control - Breakdown of Expenditure and Commitments
- AGP:LCC/77/11 - Report on the Activities for the Landsat Component of Phase II of the Pilot Project on using Remote Sensing Techniques for Improving Desert Locust Survey and Control (J.U. Hielkema)
- AGP:LCC/77/12 - Report on the Ecological Survey Undertaken in Algeria related to Satellite Use for Locust Control (W. Zeller) (text in French only)