THE COST OF AERIAL AND GROUND CONTROL OPERATIONS OF DESERT LOCUST (*Schistocerca gregaria* Forsk) IN THE SUDAN

(WINTER CAMPAIGN 1997/98 RED SEA)

By:

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INTRODUCTION:

The preparations for the winter campaign started in mid-September, 1997 up to mid October. During this period all the available resources like vehicles, application equipment, pesticides, fuel, radios and the labour force requirements were assessed, estimated and budgeted. Unfortunately, there was a great shortage in vehicles which were non-functional, labour force was short and there was no strategic supplies of av-gas and petrol and oil for aircraft and vehicles. This resulted in a humble start of the campaign with two teams for survey and control after two vehicles were prepared to get them in running conditions. The initial work-plan was not approved by PPD and was modified according to the available resources and funds to cater for the two teams only, or the campaign around Suakin and Tokar. Further developments in the locust situation and climate led to the deployment of aircraft and more ground teams to address for the consequent migration and breeding of Desert Locust. The northern sector of the Red Sea coast was not taken into consideration because of the

inadequacy of resources and funding. Hence, the operations were limited to the Tokar and Suakin sectors only (final PPD report 1997/1998).

2- Identification of resources and quantities mobilized:

2-1 Man-power (October - March 1997/98):

2-1-1 Personnel:

Campaign leader	1
Team leader	1
Locust Officer	4
Drivers	9
Radio operator	2
Store keeper	2
Accountant	1
Trained labour	14

2-1-2 Casual labour:

October 97	Nil
November 97	10
December 97	26
January 98	30
February 98	35
March 98	19

2-1-3 Watchmen (Stores):

The average number/month	21

2-2 Spraying equipment:

2-2-1 Aerial spraying:

Aircraft Antinov	3	
Thrush Commander	1	

2-2-2 Ground spraying:

ULVA-Mast	3	
Motorized sprayer	20	(6 new)
Motorized dusters	12	(new)
Wheel burrows	10	(used)
Pneumatic knapsack	5	(used in vegetable farms)

2-3 Pesticides:

No	Name of Pesticide	Unit/Quan.	Stock drums	Q.used drums	Remainder drums
1	Marshall 20% ULV	drum/25L	1600	211	1389
2	Malathion 96% ULV	drum/25L	999	999	Nil
3	Malathion 57% EC	drum/25L	800	141	659
4	Malathion 96% ULV	drum/200L	26	26	Nil
5	Decis 1.25% ULV	drum/25L	200	133	67
6	Fenitrothion 100% ULV	drum/200L	10	Nil	10
7	Fenitrothion 96% ULV	drum/200L	5	Nil	5
8	Diazinon 90% ULV	drum/200L	140	24	116
9	Propuxor 2% Dust	Sack/25kg	4056	726	3330
10	Bendiocarb 1% Dust	Sack/25kg	52	52	Nil

General remarks:

1. The pesticides stores are located outside Suakin and Sinkat away from habitation and water resources. They are newly built but they need an urgent ceiling proofing to prevent wild pigeons from refuge inside them and spreading their corrosive droppings on pesticide drums and sacks.
2. Fenitrothion 96% ULV was not used in the campaign because the stocks were old and solidified and the drums were corroded. This stock is to be disposed off.
3. Malathion 96% ULV drums of 200 litres capacity were used completely and nothing is carried over.
4. Malathion 96% ULV drums of 25 litres capacity was used and nothing remained in stock.
5. 52 sacks of Bendiocarb 1% dust was used completely and no stocks were carried over.
6. Diazinon 90% ULV was used earlier in the campaign and the results were not satisfactory as the stock is old (over 2 years) and the stock remaining is to be disposed off.
7. Malathion 57% EC stocks have a limited use and that is only in vegetable farms and where water is available. It is suggested that the stock be transferred to areas where it can be properly used and where water availability is not in dispute.

2-4 Hired support:

2-4-1 Aircraft:

Four aircraft were hired and they have been listed under spraying equipment 2-2-1 otherwise no resources were reported as hired during the campaign.

2-4-2 Offices and Rest Houses:

Offices and rest houses in Tokar, Suakin and Sinkat. Their cost will be reflected under 3-3.

2-5 Vehicles:

Load carriers	2
Pick-ups	9

2-6 Fuel and oil:

2-6-1 Aircraft:

	Stock	Consumption	Balance
Avgas in drums	135	130	5
Oil in gallons	330	251	79

2-6-2 Vehicles:

No records are available but the total cost is given monthly, mostly diesel fuel and its funding was inadequate.

2-7 Radios:

ICOM	1	unit (fixed)
Yeasu	8	units (fixed)

3- Assessment of the cost of the mobilization of the above resources:

3-1 Storage charges:

The number of watchmen is variable and this is reflected in the field operations while in the permanent stores the number is 21. The cost is as follow:

1- October 97	Ls	511,280	US$	309.87
2- November 97	Ls	562,990	US$	341.20
3- December 97	Ls	557,760	US$	330.43
4- January 98	Ls	488,040	US$	284.41
5- February 98	Ls	440,790	US$	252.75

6- March 98	Ls	488,040	US$	273.72
TOTAL	**Ls**	**3,045,900**	**US$**	**1,792.38**

3-2 Operational running expenses:

These are costs pertaining to the daily running of the campaign in form of petty cash to cover the cost of bus tickets and telephone calls etc.

1- October 97	Ls	130,000	US$	078.79
2- November 97	Ls	300,000	US$	181.82
3- December 97	Ls	250,000	US$	148.10
4- January 98	Ls	150,000	US$	087.41
5- February 98	Ls	300,000	US$	172.02
6- March 98	Ls	240,000	US$	134.60
TOTAL	**Ls**	**1,370,000**	**US$**	**802.74**

3-3 Offices and Rest Houses (Rent):

These are to be considered as fixed costs.

1- October 97	Ls	256,990	US$	155.75
2- November 97	Ls	256,990	US$	155.75
3- December 97	Ls	256,990	US$	152.25
4- January 98	Ls	324,950	US$	189.36
5- February 98	Ls	324,950	US$	186.32
6- March 98	Ls	324,950	US$	182.25
TOTAL	**Ls**	**1,745,820**	**US$**	**1,021.68**

4- Assessment of mobilized manpower including assistance staff:

4-1 Hardship and subsistence allowance:

This allowance is paid only to those who are assigned to the desert locust control operations and will be stopped at the end of the campaign.

1- October 97	Ls	1,249,000	US$	756.97
2- November 97	Ls	5,477,410	US$	3,319.64
3- December 97	Ls	6,742,650	US$	3,994.45
4- January 98	Ls	6,057,290	US$	3,529.89
5- February 98	Ls	6,584,610	US$	3,775.58
6- March 98	Ls	5,351,660	US$	3,001.49
TOTAL	**Ls**	**31,462,600**	**US$**	**18,378.02**

4-2 Casual labour cost:

This fund is required to cover the cost of ground surveys and labour required in the control operations.

1- October 97	Ls	Nil	US$	Nil
2- November 97	Ls	0,449,900	US$	0,272.67
3- December 97	Ls	1,729,740	US$	1,024.73
4- January 98	Ls	0,929,700	US$	0,541.78
5- February 98	Ls	0,979,650	US$	0,561.73
6- March 98	Ls	0,464,810	US$	0,260.69
TOTAL	**Ls**	**4,553,800**	**US$**	**2,661.60**

4-3 Campaign technical staff cost:

This technical staff is composed of one campaign leader, one team leader, five locust officers, two radio operators, two store-keeper, one accountant, nine drivers and

fourteen trained labourers. Their salaries and benifits are paid by the Government (fixed cost):

1- October 97	Ls	900,800	US$	545,94
2- November 97	Ls	900,800	US$	545,94
3- December 97	Ls	900,800	US$	533,65
4- January 98	Ls	900,800	US$	524,94
5- February 98	Ls	900,800	US$	516,51
6- March 98	Ls	900,800	US$	505,22
TOTAL	**Ls**	**5,404,800**	**US$**	**3,172,20**

5- Assessment of the operational costs:

5-1 Fuel, oil and lubricant cost:

There is lack of information and the existing data is not detailed; it was not easy to determine the quantities of diesel or petrol fuels. However, it is estimated that 90% of the fuel is diesel and the rest is petrol. Moreover, the expenditure is directed mainly to the running of the vehicles and load-carriers, which were used in the transport aspects required in the running of the daily operation and mobility of staff and labour.

1- October 97	Ls	0,500,000	US$	0,303.03
2- November 97	Ls	1,551,000	US$	0,940.00
3- December 97	Ls	4,991,590	US$	2,957.10
4- January 98	Ls	3,442,350	US$	2,006.03
5- February 98	Ls	4,639,000	US$	2,659.98
6- March 98	Ls	0,600,000	US$	0,336.51
TOTAL	**Ls**	**15,723,940**	**US$**	**9,202.65**

5-2 Maintenance and spare parts cost for vehicles:

The expenditure incurred is projected as a lump sum and not detailed as per vehicle and was very difficult to trace:

1- October 97	Ls	3,000,000	US$	1,818.18
2- November 97	Ls	3,000,000	US$	1,818.18
3- December 97	Ls	0,671,440	US$	0,391.28
4- January 98	Ls	0,500,000	US$	0,291.38
5- February 98	Ls	2,941,000	US$	1,686.35
6- March 98	Ls	0,300,000	US$	0,168.26
TOTAL	**Ls**	**10,412,440**	**US$**	**6,173.63**

5-3 Food supplies costs:

These are costs of food supplies which are purchased on a monthly basis from a grocery and was settled in February.

1- February 98	Ls	2,042,000	US$	1,170.87

5-4 Hired aircraft:

5-4-1 Cost of flying hours / aerial operations (Tokar):

1- Antinov ST-AKZ:

	Ferry hours	Survey/control hours:min.
- Tokar 19/11 - 27/11/97	6 : 43	10 : 23
- Tokar 27/11 - 30/11/97		06 : 05
- Tokar 2/12 - 18/12/97		20 : 19
- Tokar 19/12 - 22/12/97		03 : 39
- Tokar 10/1 - 24/1/98		17 : 58
- Tokar 25/1 - 23/2/98	5 : 30	11 : 07

TOTAL of AKZ	12 : 13	69 : 31

2- Thrush Commander ST-AER:

	Ferry hours	Survey/control hours:min.
- en-route Hasehesa - Tokar		
25/2 - 1/3/98	12 : 35	00 : 00
- Tokar 11/3 - 20/3/98	_____	01 : 45
TOTAL of AER	12 : 35	01 : 45

5-4-2 Suakin operations:

3- Antinov ST-ALT:

	Ferry hours	Survey/control hours:min.
- en-route 29/10/97	06 : 00	
- Suakin 1/11/97		01 : 10
- Suakin 2/11/97		01 : 20
- Suakin 4/11/97		01 : 45
- Suakin 8/11/97	_____	01 : 15
TOTAL ALT	06 : 00	05 : 30

4- Antinov ST-ALZ:

	Ferry hours	Survey/control hours:mint
- en-route Suakin 9/11/97	01 : 20	01 : 00
- Suakin 11/11/97		00 : 40
- Suakin 13/11/97		00 : 53
- Suakin 8/12/97		00 : 40
- Suakin 13/12 - 30/12/97		17 : 35
- Suakin 3/1 - 24/1/98	01 : 20	13 : 10
TOTAL ALZ	01 : 40	33 : 58

5-4-3 Cost of total flying hours:

Aircraft	Flying hours	Survey/control hrs:min.
ST-AKZ Antinov	12 : 13	69 : 31
ST-ALT Antinov	06 : 00	05 : 30
ST-ALZ Antinov	02 : 40	33 : 58
ST-AER Thrush Comm.	12 : 35	01 : 45
TOTAL	**33 : 28**	**110 : 44**

1- Cost of ferry hours 33 : 28 hrs x US$ 930.00 = US$ 31,124.00

2- Cost of survey/control hours 110 : 44 hrs x US$ 1,200.00 = US$ 132,880,00

Total cost **US$ 164,004.00**

5-4-4 Cost of aerial operations per hectare:

1- Number of hectares sprayed in Tokar 37,650

2- Number of hectares sprayed in Suakin 13,525

TOTAL hectares **51,175**

3- Cost of aerial control per hectare = US$ $\frac{164,004.00}{51.175}$ = US$ 3.20

6. Cost of Insecticides for aerial operations:

(Rate one US$ = Ls 2,175)

6-1 Tokar operations:

6-1-1 Marshal 20% ULV:

1- application rate 0.5 litre per hectare.

2- price per litre Ls 21,000.

3- total cost of insecticide = $\frac{7250 \text{ hectares x Ls } 21,000}{2}$ = Ls 76,125,000

= US$ 35,000.00

4- cost per hectare = Ls 10,500 = US$ 4.83

6-1-2 Malathion 96% ULV:

1- rate of application per hectare one litre.

2- price per litre = Ls 15,000

3- total cost of insecticide = 21,000 litre x Ls 15,000 = Ls 327,000,000

= US$ 150,344.83

4- cost per hectare = 1 litre x 15,000 = Ls 15,000 = US$ 6.90

6-1-3 Decis 12.5% ULV:

1- rate of application per hectare = 0ne litre

2- price of litre = Ls 56,000

3- total cost of insecticide = 2,700 litre x Ls 56,000 = Ls 151,200,000

= US$ 69,317.24

4- Cost per hectare = Ls 56,000 = US$ 25.75

7- Cost of insecticides for ground operations

7-1 Tokar operations

7-1-1 Propuxor 2% Dust:

1- rate of application per hectare = 3 kg.

2- price of kg. = Ls 7,250

3- total cost of insecticide = 5,813 kg x Ls 7,250 = Ls 42,144,250

= US$ 19,376.67

4- Cost per hectare = 3 kg x Ls 7,250 = Ls 21,750 = US$ 10.00

8. Cost of insecticides for aerial operations:

8-1 Suakin operations:

8-1-1 Malathion 96% ULV:

1- rate of application per hectare = 0ne litre

2- price of litre = Ls 15,000

3- total cost of insecticide = 13,125 litre x Ls 15,000 = Ls 196,875,000

= US$ 90,517.24

4- Cost per hectare = 1 litre x Ls 15,000 = Ls 15,000

= US$ 6.90

9- Cost of insecticides for ground operations:

9-1 Suakin operations:

9-1-1 Propuxor 2% Dust:

1- rate of application per hectare = 3 kg.

2- price of kg. = Ls 7,250

3- total cost of insecticide = 13,500 kg x Ls 7,250 = Ls 97,875,000

= US$ 45,000.00

4- Cost per hectare = 3 kg x Ls 7,250 = Ls 21,750

= US$ 10.00

9-1-2 Bendiocarb 1% Dust:

1- rate of application per hectare = 3 kg.

2- price of kg. = Ls 8,500

3- total cost of insecticide = 1,300 kg x Ls 8,500 = Ls 11,050,000

= US$ 5,080.46

4- Cost per hectare = 3 kg. x Ls 8,500 = Ls 25,500 = US$ 11.72

9-1-3 Malathion 57% EC:

1- rate of application per hectare = 2 - 3 litre. Average 2.5 litre

2- price of litre = Ls 10,000

3- total cost of insecticide =1,160 litre x Ls 10,000 = Ls 11,600,000

= US$ 5,333.33

4- Cost per hectare = 2.5 litre x Ls 10,000 = Ls 25,000

= US$ 11.49

9-1-4 Decis 12.5% ULV:

1- rate of application per hectare = 0ne litre

2- price of litre = Ls 56,000

3- total cost of insecticide = 725 litre x Ls 56,000 = Ls 40,600,000

= US$ 18,666.67

4- Cost per hectare = Ls 56,000 = US$ 25.75

10- Total hectrage:

	Aerial treatment		**Ground treatment**	
1- Tokar	37,650	hect.	2,630	hect.
2- Suakin	13,525	hect.	6,880	hect.
Total hectrage	51,175	hect.	9,510	hect.

11- Cost of insurance for vehicles:

The vehicles insurance policy depends on their condition. Full insurance is applied to new vehicles and to those which are in good working condition. The old vehicles merit only for third party insurance policies and all the vehicles that had been commissioned to the campaign at the Red Sea fall in this category. Accordingly, the following cost of insurance have been calculated as follows:

11-1 Cost of Toyota Land Cruiser Pick-ups:

1- cost of third party insurance for one vehicle = Ls 22,610 per annum

2- total cost for all vehicles = 9 x Ls 22,610 = Ls 203,490

= US$ 93.56

11-2 Cost of Bedford load carrier:

1- cost of third party for one load carrier = Ls 133,110 per annum

2- total cost for load carrier = Ls 133,110 x 2 = Ls 266,220

= US$ 122.40

11-3 Cost of insurance for the campaign:

1- total cost = US$ 93.56 + US$ 122.40 = US$ 215.96

2- cost for six months campaign = $\frac{\text{US\$ 215.96 x 6}}{12}$ = US$ 107.98

12- Depreciation cost:

12-1 Vehicle depreciation:

The Mechanical Transport Department of Sudan old policy allows a 5 year life span for vehicles at the rate of 20% per annum for depreciation. Presently this policy has been abolished and a vehicle has got a value to which the cost of maintenance is added minus the depreciation cost. Accordingly, the value of any vehicle depends upon its working conditions and how it is being utilized.

Most of the vehicles that worked in the winter campaign at the Red Sea coast of Suakin are old and go back to 1989. Their records regarding their fuel utilization major and minor cost for maintenance are not available in the log-books and those are also not available. Therefore, any valuation and depreciation for them would be a well-considered figure.

12-1-1 Depreciation of Toyota Land Cruiser:

1- Cost Duty Free in 1996 = US$ 20,000

2- Depreciation per annum = 20%

3- Value in 1998 depreciation = US$ 10,240.00

4- Cost of maintenance estimated = US$ 2,000.00

5- Value of the vehicle = US$ 12,240.00

6- Depreciation per annum = US$ 2,448.00

7- Total depreciation for vehicles = US$ 2,448 x 9 = US$ 2,.032.00

8- Total depreciation for 6 months of campaign =

$$\frac{\text{US\$ 22,032 x 6}}{12} = \text{US\$ 11,016 00}$$

12-1-2 Depreciation for Bedford load carrier (old vehicles):

1- Cost of one load carrier (estimate) = US$ 8,000.00

2- cost of maintenance (estimate) = US$ 2,000.00

3- total cost = US$ 10,000.00

4- depreciation rate per annum = 33.33 %

5- cost of depreciation per annum = US$ 3,333.34

6- total cost of depreciation = US$ 3,333.34 x 2 = US$ 6,666.68

7- total cost for 6 months of campaign = $\frac{\text{US\$ 6,666.68 x 6}}{12}$ = US$ 3,333.68

12-2 Depreciation for aircraft:

This has not been taken into consideration as it is already included in the cost of one working hour for the aircraft i.e. US$ 930.00 ferry and US$ 1,200.00 survey and control.

12-3 Cost of depreciation for spray equipment:

The depreciation of sprayers depends upon their handling, storage, transportation, climate, cleaning and above all the type of operations in the field. During desert locust campaign the utilization of sprayers at all levels of the operations is far from satisfactory due to the rough roads and the way workers handle them. The previously mentioned factors limit the life span of a sprayer to 3 years only, while the ULVA-

Mast sprayer, being differently handled and transported, would allow its life span to be limited to 5 years.

12-3-1 ULVA-Mast sprayer depreciation cost:

1- cost of one unit = US$3,000.00

2- depreciation % per annum = 20%

3- cost of depreciation per annum = US$ 600.00

4- cost of depreciation for 6 months campaign = $\frac{\text{US\$ 600 x 6}}{12}$ = US$ 300

5- total depreciation = 3 x US$ 300.00 = US$ 900.00

12-3-2 Motorized Dusters/sprayers depreciation cost:

1- cost of one unit = Ls 300,000

2- depreciation % per annum = 33.33%

3- cost of depreciation per annum = Ls 100,000

4- cost of depreciation for 6 months campaign =

per sprayer $\frac{\text{Ls 100,000 x 6}}{12}$ = Ls 50,000

5- total depreciation cost (32 sprayers) = 32 x Ls 50,000 = Ls 1,600,000

= US$ 735.63

12-3-3 Wheel burrow sprayers depreciation cost:

1- cost of one unit = Ls 1,000,300

2- depreciation % per annum = 33.33%

3- cost of depreciation per annum = Ls 333,433

4- cost of depreciation for 6 months campaign =

$\frac{\text{Ls 333.433 x 6}}{12}$ = Ls 166,717

5- total depreciation cost (10 w.barrows) = Ls 166,717 x 10 = Ls 1,667,170

= US$ 766.51

12-3-4 Pneumatic knapsack sprayers depreciation cost:

1- cost of one unit = Ls 80,000

2- depreciation % per annum = 33.33%

3- cost of depreciation per annum = Ls 26,667

4- cost of depreciation for 6 months campaign =

$$\frac{\text{Ls } 26.667 \times 6}{12} = \text{Ls } 13{,}334$$

5- total depreciation = 5 x Ls 13,334 = Ls 66,670

= US$ 30.65

13- Cost of radios depreciation:

13-1 ICOM radio:

One unit is available and has a life span of 5 years. The set was received in 1996.

1- cost per unit = US$ 8,000.00

2- depreciation % per annum = 20%

3- value after 2 years (1996/97) = US$ 5,120.00

4- cost of depreciation 1998 = US$ 1, 024.00

5- cost of depreciation (6 months campaign) = $\frac{\text{US\$ } 1{,}024 \times 6}{12}$ = US$ 512.00

13-2 YEASU radio:

These are old radio sets and have a life span of 10 years. 8 units were used in the campaign:

1- cost per unit (estimate) = US$ 3,500.00

2- depreciation % per annum = 10%

3- value after 5 years (late 80s) = US$ 2,066.72

4- cost of depreciation per annum = US$ 206.67

5- cost of depreciation of 8 radios (6 months campaign) = $\frac{\text{US\$ 206 x 8 x 6}}{12}$ = US$ 826.68

13-3 Total cost of depreciation for the campaign radios:

Total cost of depreciation for the campaign for 6 months =

US$ 512.00 + US$ 826.68 = US$ 1,338.68

14- Assessment of areas sprayed:

1- Aerial operations = 51,175 hectares

2- Ground operations = 09,510 hectares

3- Ratio of aerial to ground hecterage = 17: 3

15- Assessment of campaign total cost (duration 6 months):

The costs of the campaign are divided into sections mainly are used to differentiate the expenditure incurred as follows:

i. Fixed cost: These are the costs incurred in the permanent running of the Locust Section, whether there are locust or not.

These cost cover the salaries of PPD staff, storage, rentals and insurance of vehicles etc..

ii. Variable cost: These are the costs incurred in the activity of Desert Locust control and they are variable and not occurring as a routine. Such costs cover the expenses like allowances for hardship and subsistence, contingencies, casual labour, food supplies, fuel supplies, vehicle maintenance, aircraft flying hours and pesticides consumed.

According to the above mentioned definitions of cost the following expenditure of the Desert Locust campaign of the Red Sea Coast Sudan is being reflected for the duration of 6 months.

15-1 Assessment of resources mobilization cost:

	Fixed costs	**Variable costs**
1- Storage charges	US$ 1,792.38	
2- Rentals (0ffices & rest houres)	US$ 1,021.68	
3- Running expenses	_____	US$ 0,802.74
Sub-total	US$ 2,814.06	US$ 0,802.74

15-2 Assessment of Mobilized manpower and assistance to staff cost:

	Fixed costs	**Variable costs**
1- Hardship and subsistence allowance		US$ 18,378.02
2- Casual labour		US$ 2,661.60
3- Food supplies		US$ 1,170.87
4- Technical and admintrative staff	US$ 3,172.20.	
Sub-total	US$ 3,172.20	US$ 22,210.49

15-3 Assessment of operational costs:

	Fixed costs	**Variable costs**
1- Fuel, oil and lubricants		US$ 9,202.65
2- Vehicle maintenance and spare parts		US$ 6,173.63
3- Aircraft flying hours		US$ 164,004.00
4- Pesticides consumed		US$ 438,836.44

5- Insurance	US$ 00,107.98	
6- Depreciation cost	US$ 18,121.15	
Sub-total	US$ 18,229.13	US$ 618,215.72
Grand Total	US$ 24,215.39	US$ 641,229.95

16- The average cost per hectare and analysis:

16-1 Separating the total cost of the campaign the fixed cost is US$ 24,215.39 while the variable cost is US$ 641,229.95. The components of the variable cost are primarily aircraft hours, pesticide sprayed and the operational expenses.

The operational expenses can be obtained by deducting the fling hours cost plus the pesticide cost from the variable cost and this would be as follows :

Total Variable cost = US$ 641,229.95 (1)

Pesticide cost = US$ 438,836.44

Flying hours cost = US$ 164,004.00

Total = US$ 602,840.44 US$ 602.840.44 (2)

∴ Operational expenses = (1)-(2) US$ 038,389.51

With reference to paragraph 14 in assessing the areas sprayed a ratio of aerial to ground hectares sprayed was found to be 17:3

∴ The total cost aerial operational and ground operations would be obtained as follows:

i- aerial operation cost = $\frac{\text{Total variable cost x 17}}{20} = \frac{641,229.95 \text{x } 17}{20} =$

= US$ 545,045.46

∴ cost per hectare for aerial treatment = US$ $\frac{545,045.46}{51,175}$ = **US$ 10.85**

ii ground operation cost = US$ $\frac{641,229.95 \text{ x } 3}{20}$ =. 096,184.49

∴ cost per hectare for ground treatment = US$ 096,184.49 = **US$ 10.11**
9,510

16-2 The costing obtained is an average one and does not depict the situation clearly because of the differences in the prices of insecticides and their application rates as well as the allocation of a percentage to the operational expenses which are US$ 38,389.51 whether aerial or ground operation. Moreover, the cost of a flying hours is constant and this has been calculated to be US$ 3.20 per hectare.

16-3 ∴ The operational expenses can be calculated as follows for each type of operation whether aerial or ground treatments based on the ratio of 17 : 3 , are as follows:

Operational expenses = US$ 38,389.51

Hence the cost of **aerial operational**: = US$ 38,389.51 x 17 = **US$ 0.64 per hectare**
9,510x 20.

and for **ground operations** = US$ 38,389.51 x 3 = **US$ 0.61 per hectare**
9,510x 20

16-4 The cost of insecticides per application rate per hectare have already been computed are given below:

1- aerial control:	Marshal 20%	US$ 4.83
	Malathion 96%	US$ 6.93
	Decis 12.5%	US$ 25.75
2- ground control:	Propuxor 2% Dust	US$ 10.00
	Bendiocarb 1% Dust	US$ 11.72
	Malathion 57% EC	US$ 11.49
	Decis 12.5% ULV	US$ 25.75

16-5 ∴ The cost of aerial control per application rate per hectare would be:

cost flying hours + operational expenses + insecticides cost

Accordingly for the aerial control cost per hectare would be as follow:

1- Marshal 20% ULV = US$ 3.20 + 0.64 + 4.83 = US$ 8.67

2- Malathion 96% ULV = US$ 3.20 + 0.64 + 6.90 = US$ 10.74

3- Decis 12.5% ULV = US$ 3.20 + 0.64 + 25.75 = US$ 29.59

16-6 For ground control the cost would be as follows:

1- Propuxor 2% Dust = US$ 0.61 + 10.00 = US$ 10.61

2- Bendiocarb 1% Dust = US$ 0.61 + 11.72 = US$ 12.33

3- Malathion 57% EC = US$ 0.61 + 11.49 = US$ 12.10

4- Decis 12.5% ULV = US$ 0.61 + 25.75 = US$ 26.36

16-7 But on the other hand, the operational expenses based on the ratio of aerial to ground operations i.e. 17:3, would be very deceptive for the above projected figures as more labour force is engaged in ground control operations. Hence the ratio of ground to aerial control operations is suggested as 3 : 2 i.e about 60% of the work force is engaged in the ground operations. Therefore, the operational expenses would be as follows:

- for aerial operations/hectare= $\frac{\text{US\$ 38,389.51 x 2}}{\text{51,175 x5}}$ = **US$ 0.15**

- for ground operations/hectare= $\frac{\text{US\$ 38,389.51 x 3}}{\text{9,510 x5}}$ = **US$ 0. 81**

16-8 Accordingly the following costs per hectare per application would be as follows and may reflect a better idea:

Aerial operations costs:

1- Marshal 20% ULV = US$ 3.20 + 0.15 + 4.83 = US$ 8.81

2- Malathion 96% ULV = US$ 3.20 + 0.15 + 6.90 = US$ 10.25

3- Decis 12.5% ULV = US$ 3.20 + 0.15 + 25.75 = US$ 29.10

16-9 As for ground operations the cost would be as follows:

1- Propuxor 2% Dust = US$ 0.81 + 10.00 = US$ 10.81

2- Bendiocarb 1% Dust = US$ 0.81 + 11.72 = US$ 12.53

3- Malathion 57% EC = US$ 0.81 + 11.49 = US$ 12.30

4- Decis 12.5% ULV = US$ 0.81 + 25.75 = US$ 26.56

17. Analysis of the Operations:

The under-mentioned table shows summary of survey and control operations of Desert Locust Campaign 1997/1998 of the Red Sea Coast of Sudan.

Month	Swarms		Hoppers		Solitary		Total area Infested HA	Area Controlled		Total Controlled HA
	No.	Area HA	No. Bands	Area HA	No. of Sites	Area HA		Ground HA	Aerial HA	
Nov 97	19	09,876	02	00,360	04	02,000	12,236	00,060	09,250	09,310
Dec 97	25	17,800	57	01,160	-	-	24,960	07,160	17,300	24,460
Jan 98	24	22,525	14	05,345	05	17,300	45,170	01,145	15,525	16,670
Feb 98	05	03,250	21	01,165	06	01,250	05,665	01,165	02,850	04,015
Mar 98	02	00,750	01	00,025	03	00,600	01,375	00,025	00750	00,775
Total	75	54,201	95	14,055	18	21,150	89,406	09,555	45,675	55,230

Source: Final report of the Desert Locust Campaign at the Red Sea Coast of Sudan Season 1997/1998 (In Arabic Language).

During the course of the operations 75 swarms, 95 hopper bands and 18 sites of solitary locust covering an infested area of 98,406 Ha were treated with different insecticides. It can be seen that the actual treatment either by ground or aerial application covered an area of 45,675 Ha, where compared to the area surveyed and reported as infested. Moreover, these figures differ from those ones on which the costing was derived and which are considered more reliable, because they were

extracted from the daily operational sheets for areas treated and the actual payment invoices to the aerial spraying company by March 1998 from the Accounting Officer (refer to Section 10).

18. The Economic Analysis of the Campaign cost and the targets achieved:

The main targets of Desert Locust control compiagn in the Red Sea State of the Sudan are:

i- to secure and protect the crops cultivated in the Red Sea State from Desert Locust attack. This state has a humble agricultural potential and loss of crops to Desert locust will not be tolerated from a food security point of view.

ii- to control the Desert locust population and prevent them from reaching the swarming the and migratory stage to the detriment of the other parts of the country in such a manner that a plague situation would be averted.

iii- by controlling these Desert Locust populations in the Red Sea of Sudan no swarms would be formed and hence no migration to neighbouring countries or crossing the Red Sea eastward.

18.1 The assessment of the campaign total cost was:

i- Fixed Grand total cost	US$ 024,215.39
ii- Variable Grand total cost	US$ 641,229.95
Total Ground cost	US$ 665,445.34

The variable cost would be representing the cost of the campaign at the Red Sea coast of Sudan (season 1997/98, refer to Section 15.1, 15.2 and 15.7).

18.2 The Agricultural Potential of the Red Sea State and Crops Cultivated:

The most important agricultural potential is the Toker Delta and it is cultivated by harnessing Khor Baraka flood waters through flush irrigation, so the greater the flood

the greater the area to be cultivated. Other areas are also under cultivation and are spread in the state. The crops grown are cotton (Acala) as a cash crop, Sorghum and Dukhun as staple crops plus vegetables e,g, tomatoes, okra, beans and potatoes. All these crops depend upon good rains, which are also conducive to Desert Locust breeding. In season 1997/98 the Desert Locust control campaign total variable cost was SU$ 641,229.95 but what was at stake was the following:

	Crop	**Area(hectare)**	**Yield**	**Value/Unit**	**Total value US$**
i	Cotton	02,772	17,625Quintal	US$ 080.00	US$ 01,410,000
ii	Sorghum	18,885	208,486 Sacks	US$ 013.00	US$ 02,710,318
iii	Dukhun	10,487	62,920 Sacks	US$ 019.00	US$ 01,195,480
iv	Vegetables	04,760	114,250 Tons	US$100.00	US$ 11,425,000
				Total	US$ 16,740,798

It is evident that the Red Sea State agricultural potential is rather weak and any loss in the production of the above-mentioned crops cannot be tolerated as this production represents a valuable portion in the food security system of the state. It can also be inferred most the cost of the Desert Locust Control Campaign of US$ 641,229.95 had contributed significantly in the protection of crops earning a revenue of US$ 16,740,798 and thus food shortages were averted at a cost/ benefit ratio of 1 to 26 and this is considered as favourable and successful control intervention.

18.3 It must be noted that the Red Sea Coast of Sudan is one of the most important Winter Breeding Areas and contributes greatly to the breeding os swarms as well as to the gregarization of solitary locust in the Central Region.

18.4 Successful breeding without any challenging strategy would result in the damage of the cultivated crops in the area of Sudan, and by April emerging swarms will

escape to the Central Breeding Belt of the Sudan where it will present a high risk to subsistence agriculture, where stable crops like sorghum, millet and cash crops like sesame and groundnuts are usually cultivated by farmers, who will be eventually socially disturbed due to failure of the crops as a result of locust attacks.

18.5 On the other hand, should such swarms move eastwards to Saudi Arabia and Yemen or northwards to Egypt or to Ethiopia to breed in the spring breeding areas, they will present a threat to agricultural production in these countries and especially high risk areas like Saudi Arabia.

18.6 The risks involved in the food production system in the Red Sea State are great and any crop loses are considered as very grave. Hence, the cost/benefit ratio of 1:26 is extremely significant and favourable to the Red Sea State of the Sudan and must have presented a food security factor to Egypt, Saudi Arabia and Yemen.

18.7 The success of the winter campaigns in the Central regions with appropriate strategy and tactics, especially in the red Sea Coasts of the Sudan, Eritrea, Egypt, Saudi Arabia and Yemen is very significant factor in the elimination of swarms and the creation of gregarization of solitary locust. This will lead to the elimination of swarms escaping to the spring and summer breeding areas and if they do occur they will be effectively controlled by the most suitable strategies and tactics available.