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VOLUME I: DARFUR REGION

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ACRONYMS

BCG	Bacillus Calmet-Guerin vaccine for tuberculosis
CDD	Control of Diarrheal Diseases Program
DOO	District Operations Officer
DPT	Diphtheria-Pertussis-Tetanus vaccine
EPI	Expanded Programme of Immunization
FIC	Fully immunized child
FTE	Full time equivalent
LS	Sudanese pound
MOH	Ministry of Heath
MSF	Medicins Sans Frontieres
MT	Mobile team
NGO	Non-governmental organization
OPV	Oral polio vaccine
PHC	Primary health care
PHCU	Primary health care unit
POO	Provincial Operations Officer
RDMS	Regional Director of Medical Services
RHSP	Rural Health Support Project (USAID)
ROO	Regional Operations Officer
TT	Tetanus toxoid vaccine
UNDP	United Nations Development Program
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

EXECUTIVE SUMMARY

In March and April 1989, a cost and cost-effectiveness study of the Expanded Programme of Immunization (EPI) was undertaken in Darfur Region. The study was conducted in collaboration with the Government of Sudan, the EPI, UNICEF and USAID/REACH. The overall objective of the cost-effectiveness study was to: 1) determine and compare the costs of delivering EPI services through mobile teams and fixed facility strategies; and 2) determine the cost of the program at different levels of the health system. A survey approach with questionnaires was used to collect data on inputs into the program as well as to document program outcomes. Questionnaires were developed for mobile teams, health facilities, District Operations Officers (DOO) and Regional Operations Officers (ROO). The cost-effectiveness study was conducted in tandem with the coverage survey, and used the location of the clusters for the coverage survey as a way of randomly selecting mobile teams and health facilities corresponding to the target population interviewed for the coverage survey. In this manner, program costs for 1988 corresponded with gains made in coverage during 1988.

This study estimated that it costs $17,000 (LS 75,000) per year on average to operate a mobile team in Darfur, compared to $1,195 (LS 5,300) for health facility operations. In contrast, the mobile teams have higher levels of immunization activity annually by a factor of six: 15,000 doses per team versus 2,300 doses per health facility. The number of fully immunized children (FIC) is also higher for each mobile team on average than the health facilities, from 2,000 to 130 FIC per year, respectively.

The cost per dose was lower for health facilities than mobile teams ($0.52 or LS 2.30 for health facilities compared to $1.44 or LS 6.40 for mobile teams). This difference was due primarily to the low annual cost of the health facility operations. On the other hand, the mobile teams had a lower cost per FIC ($18.24 or LS 81.17) as compared to health facilities ($21.24 or LS 94.52) due to higher numbers of FIC for the mobile teams.

Several factors were identified which influenced the cost and cost-effectiveness ratios of mobile teams and fixed facilities: specifically, the numbers and types of health workers, the density of the population, the proximity of the delivery site to district or regional headquarters, and the total volume of services delivered. Cost information was combined with operational data to arrive at performance and operational indicators for the teams and facilities. The number of doses administered per health worker per day was 123 for facilities and 20 for mobile teams. However, there were fewer immunization sessions offered per month for the facilities which resulted in lower volume of activity per person than for the teams.

Costs were estimated at district and regional level as well. District costs included those for managing and administering the program: the costs of maintaining district stocks of vaccines and supplies were not included in the totals for mobile teams or health facilities. The average annual cost at the district level was $87,856 or LS 390,960. The range in

district cost was three times from the least to the most expensive district. The report analyzes factors which lead to the wide differences in annual cost among districts. The average cost per dose was $2.14 or LS 9.52 and the average cost per FIC was $26.46 or LS 118. The cost per FIC was as high as $48 in one district.

At regional level, the total annual cost was $1.1 million for an average cost per dose of $2.09 and an average cost per FIC of $28.32 (LS 126). This figure is almost double the international average of cost per FIC ($15) but probably reflects the difficulty of immunizing children in a dispersed population and difficult climate and terrain.

The variations among mobile teams, facilities, and districts could be used in the future to set a "standard" of operation, whereby the performance of the other delivery sites and districts could be measured and evaluated. The variation shows that there is a large potential for improving the effectiveness (outcomes) and for reducing the cost (efficiency) of the program in Darfur. Some steps which could be taken include:

1. determine the minimum size of a village to be visited by a mobile team;

2. devise a more optimal routing and frequency of mobile team visits to all villages, especially those of smaller size. Mobile teams should not operate in urban areas where facilities could provide adequate services;

3. conduct an inventory of all health facilities to see which ones could be integrated into the immunization program at little additional cost;

4. train mobile team vaccinators to deliver other promotive and preventive health services;

5. improve financial management at regional level and decentralize the system to the district level; and

6. conduct outreach services from health facilities and have greater follow-up on children in urban areas.

Darfur should become a priority region for 1989-90 in order to strengthen the capability of facilities to provide services and to improve coverage and outreach to the population.

I. INTRODUCTION

In March-April 1989, the cost and cost-effectiveness study of the EPI was undertaken in four northern regions of the Sudan. The study was conducted by the EPI/Sudan and the REACH Project in collaboration with USAID and UNICEF.

This report covers the cost-effectiveness of the EPI in Darfur Region. The organization and design of the EPI in Darfur is described in Section II. The methodology for analyzing costs and effectiveness is described in detail in Section III. In brief, the approach was to use a combination of primary data collected using questionnaires during field visits by the team, and secondary data from EPI reports and other source documents (such as salary records and shipping reports) for information on the unit costs of supplies and equipment. Data on program effectiveness, such as number of doses administered, coverage levels and days worked by health staff, were collected based on records and through interviews with health staff and administrators. The study results are presented in Chapters IV and V. A description of the financial management system and EPI financing in Darfur is contained in Section VI. Recommendations and conclusions are found in Chapter VII. The study's findings indicate some measures that can be taken to improve the efficiency and effectiveness of the EPI in Darfur.

A. Purpose of the Cost-effectiveness Study

EPI began in 1976 in Sudan and has continued to expand services and improve coverage levels through mobile teams and fixed facility strategies. A significant amount of resources are being expended for the delivery of immunization services nationwide and support for the program comes from the Ministry of Health (MOH), District Councils, UNICEF, USAID, WHO, and non-governmental organizations (NGOs) in different regions. Until now, there has not been a complete analysis of the total annual cost of the program, nor have these costs been compared with program outcomes to determine the cost per FIC.

In October 1988, the MOH/EPI approved a study protocol for a cost and cost-effectiveness study of the national program to be conducted in collaboration with the Resources for Child Health Project (REACH), USAID, and UNICEF. A key input into the cost-effectiveness study will be the results from the national coverage survey conducted by the MOH; and therefore, the timing of the cost-effectiveness study was planned to coincide with field data collection efforts of the coverage survey team.

The overall objectives of the cost and cost-effectiveness study in Sudan are to: 1) determine and compare the costs of delivering EPI services through mobile team and fixed facility strategies; 2) compare cost figures with the numbers of fully immunized children as determined by the coverage survey; 3) assess and propose recommendations for improving the efficiency of services delivery for both strategies and for improving program management of EPI resources; and 4) estimate the contributions to the EPI by district councils and donor organizations.

The results from this study may be used to address some of the following questions:

1) What is the total cost of the national and regional EPI? What is the recurrent cost and what is the annual investment cost?

2) What are the individual cost elements of the national and regional program and what percent of total cost does each of these elements represent?

3) What are the contributions to the total cost of the MOH, USAID, UNICEF and other donor organizations?

4) What is the cost of delivering the EPI through alternative strategies: fixed facilities and mobile teams?

5) What is the average cost of delivering immunization services through different types of health facilities in Sudan (e.g., health centers, dressing stations, dispensaries, primary health care units, district hospitals, urban and rural facilities?);

6) What is the total effectiveness of the program (measured as the number of doses administered and the number of children fully immunized less than one year of age)?;

7) What is the cost-effectiveness of the national and regional program?

8) What will it cost next year to maintain current coverage levels?

9) What will it cost in the future to increase coverage levels by alternative strategies?

10) What would be the cost savings of integrating EPI services with other primary health care services?

11) What is the total foreign exchange requirement of the national and regional EPI?

12) How efficient are immunizations provided through different strategies and how can efficiency be improved?

13) How might the EPI be financed in the future by government or local resources?

B. Objectives of the Regional Study in Darfur

The purpose of this study is to document the total inputs into the regional EPI in Darfur from the Government of Sudan, District Councils and donor organizations and to compare the cost of these inputs with the number of doses administered and the number of fully immunized children less than

one year of age from the coverage survey. Data from Darfur Region will be compared with those from other regions to assess the variation in implementation of the EPI and the cost implications of different strategies.

Data from the cost-effectiveness study will be useful both for planning and management of the program. Cost information can be used to plan and budget future resource needs in the region for full and successful implementation of program objectives. In addition, this study generates a set of management data which shows the distribution of human and material resources among districts and compares this distribution with immunization activity. Management decisions can be made about how to allocate resources among districts in order to improve immunization coverage. A set of indicators of mobile team and health facility effectiveness have been developed for six districts and these can be used to manage and monitor each strategy.

II. ORGANIZATION OF THE EPI IN THE REGION

Darfur is the largest of the nine regions in the Republic of Sudan, covering an area larger than France and having a population of approximately four million (estimated 1989). The population is divided into urban, rural and nomadic population groups. Seventy percent of the total population lives in peri-urban areas and remote villages. Darfur region is divided into two provinces: North Darfur which has a population of 1.7 million and South Darfur with a population of nearly 2.4 million. Each province is further divided into six districts, for a total of 12 districts. The population of each district is presented in Table II.1.

TABLE II.1
POPULATION OF DARFUR REGION BY DISTRICT

DISTRICT	POPULATION	
El Fasher	360,050	
El Ginnaina	693,535	
Kutuum	194,298	
Mellit	130,928	
Kabkabia	206,718	
Umm Kaddadda	140,349	
North Darfur Total	1,725,808	(42%)
Nyala	600,000	
Idd El Ghanum	357,000	
Zalengei	400,000	
Garcila (Wadi Saleh)	300,000	
El Dein	400,000	
Buram	340,000	
South Darfur Total	2,397,000	(58%)
Total Population (estimate)	4,122,800	

Source: Northern Darfur estimates are from the POO; South Darfur estimates are also from the POO.

A. Goals of the EPI

The EPI began in Darfur Region in 1986. The primary goal of the program is to reduce the incidence rate of the six childhood diseases: primary pulmonary tuberculosis, diphtheria, tetanus, pertussis, measles and poliomyelitis. In addition, the program strives to protect newborns from tetanus through immunization of women of child-bearing age. To accomplish this goal, the program seeks to achieve a coverage rate of 70% by the year 1989 and 90% by the year 1990 for all doses of BCG, DPT, OPV, measles and tetanus toxoid.

B. Description of the Organization of the EPI

1. Regional Level

The delivery of immunization services is provided and managed through several levels in the health system. At the Regional level, the ROO for the EPI is responsible for coordinating all regional EPI activities with those of the MOH and other NGOs in the region. The ROO is responsible for ensuring proper and timely distribution of material resources for the EPI

by making requests to the MOH. The ROO also supervises EPI activities in the region by making regular tours to the provinces and districts to assess their success and know the constraints they face. On an annual basis, the ROO collects district plans of operation and formulates a Regional Plan, against which resources are disbursed from EPI Headquarters in Khartoum. Each month, the ROO collects district level monthly summary sheets of immunization activity and submits them, along with data on kilometerage for district vehicles to Headquarters. In addition, the ROO is responsible for financial reporting to Khartoum on a tri-monthly basis.

At the regional level the EPI is also supervised by the Regional Director of Medical Services (RDMS). He oversees the progress of the program and is directly responsible for financial management at the regional level. In Darfur, the RDMS would like to shift from mobile teams to static health facilities wherever it is possible. Plans are underway to equip facilities with solar cold chain equipment in the next few years.

2. Provincial Level

The main activities at this level include planning of approaches to improve urban and rural coverage according to population characteristics. In addition, the Provincial Operations Officer (POO) is responsible for distributing vehicles, equipment, vaccines, syringes and other materials according to the needs of districts. This is decided on the basis of supervision rounds and reports received from districts. At this level reports and records about budget, expenditure, coverage, and stocks level are kept as well.

3. District Level

The DOO is responsible for the EPI at the district level. The DOO determines the routing of mobile teams on the basis of the monthly reports for each team, which shows the route of the team for the previous month, what villages have been visited and what doses are to be given during the coming month. In addition, the DOO supports EPI activities in health facilities and those of mobile teams. The DOO is also responsible for the supervision of all EPI activities in the district, and he keeps records of equipment when there is no supply officer. The DOO also plans and negotiates District Council contributions and program support from NGOs.

C. Strategies of the EPI

In urban areas, the primary strategy is to provide immunization services through static health facilities or with the support of mobile teams which drop vaccine carriers on specified days during the month. None of the health facilities analyzed for Darfur could be considered "static;" having an independent cold chain and health staff providing immunizations. Most (nine) of the facilities relied on mobile teams to distribute vaccines, and some (five) facilities were used by the teams as a subcenter to give immunization. One of the surprising findings of the survey for the

cost-effectiveness study was the difficulty in locating classical static units for EPI.

In El Fasher district there are three hospitals, six health centers (all in town), 10 dispensaries (four in town), 63 Primary Health Care Units (PHCUs) (35 in town) and six dressing stations (all in town). In El Fasher, EPI services are provided in four out of six health centers, and four out of six dispensaries. There is no EPI provided in the dressing stations.

In rural areas, the delivery approach is through a mobile team. There are two mobile teams in each of El Fasher, El Ginnaina, Kutuum and one mobile team in each of Mellit, Umm Kaddadda and Kabkabia Districts. Outreach by a mobile team is only found in Sham El Nasiem health center in Nyala.

The purpose of the mobile team is to reach the population groups living in remote areas which do not have access to other health services. A mobile team usually consists of a vehicle, a seven-day cold box, vaccines, disposable syringes, vaccinators, a driver, assistant driver, and sometimes a team leader. A mobile team covers from 10 to 20 villages each month (one round), depending upon how far these villages are from each other and from the district office.

In Northern Darfur, mobile teams that use health facilities as subcenters are responsible for training health center staff and upgrading EPI service delivery capacity. In theory, the mobile team will provide EPI services and train the workers during the first three visits. Thereafter, a vaccine carrier will be dropped at the facility and it is expected that routine services will be provided. It was clear from our discussions with the POO and eventually the ROO that this approach was not being actively monitored. Moreover, it appears that alternative approaches for transporting vaccine (e.g., camel, donkey, and health facility vehicle) have not been planned. Relying on mobile teams for distributing vaccine seems to limit the ability of the teams to visit more remote areas to immunize the target population. There is too much reliance on the teams as a mode of transport rather than as a provider of services.

In addition, there were several districts (Mellit, El Fasher) which used mobile teams in urban areas where a more appropriate and less resource intensive strategy (i.e., outreach from health facilities or fixed site strategies) should be used.

The personnel in static EPI facilities are general health service workers who were given special training in vaccination. The mobile team and static health facilities maintain separate records of immunization activities and report to the DOO separately.

D. Differences between the North and South Provinces

In Northern Darfur, the EPI is operated in a more vertical manner, relying heavily on the mobile team. In Southern Darfur there are plans for a more integrated approach to the EPI with other Primary Health Care (PHC) services. One example is the PHC Project in Garcila District, supported by MSF/Belgium.

E. Donor Support for EPI at Regional Level

Besides MSF/Belgium in the South and MSF/Holland in the North, EPI also has cooperative relations with other NGOs, such as GTZ (German Technical Cooperation) and GOAL (Ireland) in supporting selected district operations. The Rural Health Support Project (USAID) has been working on PHC and child survival activities since 1985 in Darfur. The Project has supported regional advisors as well as technical advisors for EPI. In the future, RHSP intends to create a regional garage in Darfur which may also be used by the EPI. The EPI input could be in appointing a mechanic who will work with the RHSP mechanic. RHSP will probably assist the EPI in training of health workers for EPI through additional complementary teaching material. RHSP may also participate in the rehabilitation of EPI facilities. (ref. a report by Dr. V. Joret, 17 November 1987 Khartoum).

F. Progress of the EPI in Darfur Region

Presented below are data comparing coverage rates for the six immunizable diseases for the years 1985 and 1988.

TABLE II.2
COMPARISON OF COVERAGE RATES: 1985 and 1988

YEAR/ PLACE	NORTHERN DARFUR	1985	1988	SOUTHERN DARFUR	1985	1988
Target Population		3,100	65,286		5,000	86,710
Coverage Rates (percentages)						
BCG		23.0	23.7		74.0	49.0
DPT1		60.0	29.2		70.8	35.7
DPT2		29.0	21.4		47.0	36.3
DPT3		15.8	11.2		39.0	26.5
OPV1		61.0	28.8		71.0	51.0
OPV2		29.0	17.4		45.0	25.0
OPV3		12.5	10.3		33.0	26.5
MEASLES		---	11.3		31.0	31.0
Target Women			81,608			108,512
TT1			13.8			21.2
TT2			6.5			11.0

SOURCE: Rural Health Support Project, 1986. UNICEF, 2/20/89.

The data from 1985 and 1988 show the following trends:

i) In North Darfur in 1988 the target population was 21 times greater than it was in 1985, while in South Darfur the target population in 1988 was 16 times its previous size due to changes in immunization policy.

ii) BCG coverage rates remained the same in both North and South Darfur for the years 1985 and 1989.

iii) The coverage rate increased for measles in North Darfur whereas in South Darfur it remained the same.

iv) The coverage rates in 1985 are more than in 1988 because there was an increase in target population in 1988.

vi) The coverage rates in South Darfur are higher in all cases in both years than in North Darfur.

Table 3 shows the coverage survey results for all of Darfur in 1988. Compared with the rest of Sudan, Darfur continues to lag behind in coverage for all antigens. The coverage for fully immunized children less than one year of age for all of Sudan (six regions) was estimated to be 33%; whereas, the rate for Darfur was 23%. Total coverage represents the data collected

from the coverage survey. Coverage of children less than one year of age is calculated based on the number of doses administered before the age of one.

TABLE II.3
COVERAGE INDICATORS FOR A SAMPLE OF 210 CHILDREN IN DARFUR
(percentages)

Antigen	Total Coverage	Coverage before 1st birthday	Coverage after 1st birthday
BCG	58	45	13
DPT1/OPV1	60	50	10
DPT2/OPV2	50		
DPT3/OPV3	41	32	9
Measles	41	32	9
Fully Immunized	34	23	11

Coverage based on history and card information. Figures rounded to nearest whole number.
Source: EPI National Coverage Survey, Regional Report for Darfur Region, April 1989.

G. Constraints for the Implementation of the EPI in Darfur

The cost-effectiveness study team was able to met with the ROO of Darfur in Khartoum to obtain an overview of the review. The team noted that the following constraints to the program:

1. There are significant differences between north and south in the view of the role of EPI in primary health care. This makes overall management within the region more difficult. The POO also expressed the need for more trained staff at the regional and provincial levels.

2. Shortages of health workers, such as nurses, community health workers and health visitors, affect the implementation of a fixed facility strategy. Efforts to train individuals in EPI are thwarted by the high turnover rate of health workers.

3. Material resources for EPI (vehicles and equipment) are used outside of the program which affects their longevity and utility to the EPI. There are repeated shortages of spare parts, especially for vehicles and generators.

4. Preventive maintenance of vehicles and access to trained mechanics needs to be improved. Too many vehicles lie "off-road" and cannot be used to deliver EPI services.

5. District Officers are not of equal competence and managerial capacity. More training should be organized for DOOs in program management.

6. The strategy of integrating EPI into facilities after three to four rounds of the mobile team is not working because incentives to work are unequal and a shortage of trained staff.

7. The distribution of the population into scattered settlements makes providing services difficult. Immunization is also not thought of as a priority by families.

8. There is a shortage of health facilities.

9. Supervision is not strong enough to provide guidance and direction for the program at all levels.

10. Security problems have prevented service delivery in some districts, affecting coverage levels.

In addition to these constraints, the cost-effectiveness team identified the following:

i) The large size of the region and difficult roads make reaching the target population difficult.

ii) Rainy season between July and September disrupts provision of services and causes delays in planning due to communications and transportation difficulties. EPI stopped for four months last year in some districts.

iii) The seasonal migration and low density of the population makes them difficult to reach with immunization services,

iv) Due to high illiteracy rates, especially in rural areas, parents are unaware of the benefit of immunization for their children's health.

v) Vehicles do not last for a long time due to difficult roads and careless driving.

vi) Shortages in disposable syringes in 1989 interrupted EPI activities in some districts.

vii) Security problems have hindered EPI activities in certain areas of the region.

III. METHODOLOGY

The methodology which was developed for the study was founded on providing the EPI with practical and relevant results in order that financial and economic information about the programme could be used for better planning and management in the future. The approach combined the use of operational data collected in the field by the study team, with cost data obtained both from the Districts and Regional Headquarters in Kordofan, and from the National Headquarters, UNICEF and other organizations in Khartoum. This chapter describes the data collected during field visits, the methods used for estimating EPI costs, the sampling process, and limitations of the methodology.

A. Questionnaires

The field data were collected using structured questionnaires, developed and field tested in Khartoum Region, which were designed to collect information on:

1) the numbers and types of personnel working on EPI at each level, and the hours per week spent on EPI;

2) the numbers and types of vehicles and equipment used in the last year for EPI, and how many of each type was not working at the time of the interview;

3) the numbers of supplies (syringes, needles, Road to Health cards, cold chain monitor cards, etc.) used in the programme;

4) the number of kilometers traveled for different immunization activities, such as mobile team rounds, publicity, meetings and replacement of stock; the mode of transport used in each case;

5) information on the type and quantity of fuel, oil and other lubricants used for the programme in the last year;

6) the number of doses of each antigen administered to children, by age (under and over one year of age) and dose, and to pregnant women (by dose);

7) the catchment population and the number of fully immunized children;

8) the number of training courses and the number and type of staff trained during the last year;

9) the amount of local radio and television time for EPI publicity;

10) the size and age of buildings used for EPI, and the percent of time for which this space was used by the programme.

The questionnaires were pretested in the National Capital Region with the help of the ROO and the DOO for Khartoum District. Through the pretest, it was determined that the reference period for number of doses, supplies and fuel should be the previous month (February 1989) instead of the previous year, because of the incompleteness of records and problems of recall.

B. Costing Methods

The methods used for calculating costs are those developed by Creese (1976) and revised by REACH (1988) and WHO (1988). Cost calculations are standard for cost and cost-effectiveness studies of the EPI. The methodology of this study uses not only budgetary and price data, but also an analysis of the operations of the programme's delivery system.

Personnel costs were based on the number of hours spent working on EPI by different cadres of health staff. Hours worked per week on EPI was divided by the number of hours in a full-time week to estimate the number of full time equivalents (FTEs) in each staff category working on EPI. These estimates were multiplied by the monthly gross salary (including transport allowance, working allowance, housing and social security) for each member of staff; if exact salary data were not available, the average for that person's cadre was used. Per diem costs were based on reported rates received in the field per month by health workers and administrative personnel. In some Districts, the Councils were paying additional benefits for overtime and travel allowance. Staff support, an additional payment from the EPI, was paid to some staff at Regional level. Average salaries for staff working on EPI in Darfur are shown in Appendix 4.

Vaccine costs were based on the number of vials of vaccine used during February 1989, multiplied by 12 to estimate annual doses consumed. The approach of costing vaccine consumption rather than doses administered accounts for wastage, which is a real cost to the immunization programme. Stock data on doses issued (i.e. consumed) were taken from the monthly reports at District and Regional levels. For mobile teams and health facilities, stock data were not always available, and vaccine consumption was estimated by the staff being interviewed. The cost per vial for each antigen was estimated from UNICEF and MOH shipping reports of all vaccines received in 1988; since EPI National Headquarters receives vaccine shipments every quarter, the shipping reports for 1988 represented all vaccine needed for the Sudan in a 12-month period. Costs per vial were: BCG $0.760; DPT $0.732; OPV $0.678; measles vaccine $1.137; TT $0.199. International freight charges, which were another 14% in addition to the value of vaccine, have not been included in the costs per vial at regional level, but are included under transportation costs at National level. Details of all these vaccine costs are given in Appendix 4. The precision of the costs obtained is discussed in Section III.E below.

The cost of supplies was also based on the number of each item used during February 1989, multiplied by 12 to estimate annual use. The unit price of each item (e.g. 1 cc syringe, 2 cc syringe) was multiplied by the

annual quantity of that item used, to obtain the total annual cost of supplies (see Appendix 4).

Transportation cost was estimated from the number of kilometers traveled in the last month (or if available, the last year), the number of kilometers traveled per gallon of fuel, and the price per gallon of fuel. If data on distances traveled by the mobile team were not available (e.g. the log book was out with the vehicle), the number of kilometers was estimated by tracing the team's routes to obtain kilometers per month, then multiplying by the number of rounds per year, which varied between five and twelve. For transportation at District level, the kilometers traveled by each vehicle in the last year could usually be obtained. The DOOs were asked about the number of gallons of fuel, oil and lubricants used each month and the price per gallon (or per can). There was some variation in prices between districts, reflecting the cost of transporting the goods to more remote areas. These data were used to estimate the annual cost of fuels, engine oil and lubricants.

Maintenance and operation of vehicles could not be obtained from records of repairs undertaken, as damaged vehicles were sometimes shipped to the Regional or National Headquarters for repairs, or vehicles were mended with parts cannibalized from others. Thus maintenance costs were estimated using two sources. One was an analysis undertaken by the Cold Chain Section, National EPI Headquarters. The second was the total value of spare parts purchased in 1988, divided by the total number of vehicles in the fleet. This came to 23% of the annualized cost of the vehicle, excluding the cost of oils and lubricants. A separate study of vehicle maintenance costs in Niger estimated a figure of 24%, corroborating the methods used for the Sudan (see Appendix 4).

Capital investments for vehicles, buildings and equipment last for periods longer than one year. The total purchase price cannot be allocated to the year of purchase, but is spread over the useful life of the equipment. Economists also adjust for the fact that money today is worth more than money in the future, and therefore the purchase price of a vehicle or equipment or the construction cost of a building is not spread evenly over its lifetime. An interest rate (r) is needed to make this adjustment. For this study, the official interest rate of 25% was used, representing the level of administrative charges levied on loans to Sudan from other Islamic countries.

This procedure for calculating the annualized value of capital investments gives an annual capital cost which is used in estimating the total annual cost of the programme. For Sudan, the useful life of capital equipment was determined in collaboration with EPI staff, and by using data from this study's inventories which showed the proportion of vehicles which were out of order. The use-life of vehicles is assumed to be five years; for large cold chain equipment it is five to ten years, and two to eight years for cold boxes and vaccine carriers. (A sensitivity analysis in Chapter V shows the effect on costs of reducing the use-life of vehicles to three years.) Details of the purchase price of each type of vehicle and equipment, its use-life, and the annualized cost are given in Appendix 4. Costs are repeated in U.S. dollars. An exchange rate of LS 4.45 was used to convert the purchase price of locally

procured items into U.S. dollars. This rate of exchange was the average of the UN rate (LS 4.40) and the official rate in 1988 (LS 4.50). A sensitivity analysis shows the effect of using the 1989 market exchange rate of LS 12 on programme costs at Regional level (see Chapter V).

Building costs were estimated by measuring the amount of space (square meters) used by the EPI, and collecting data on construction costs per square meter. If the space was not used all the time for EPI, a proportion of time for EPI was estimated (hours per week for EPI divided by full-time hours at that facility). Construction costs were amortized over the expected life of the building. Fired brick and cement buildings were assumed to have a 25 year use-life, sun-dried brick structures (usually self-help or cooperatives) were assumed to have a 10 year use-life, and grass structures were assumed to last for five years.

For each service delivery strategy (mobile teams and fixed facilities) and for District and Regional levels of the programme, cost per dose was calculated using the total annual cost divided by the number of doses (all antigens, all ages) given per year (based on February 1989 reports).

Cost per FIC was estimated for the EPI at Regional level using the data from the 1989 Coverage Survey. Two figures were estimated: cost per FIC for children who completed their immunization schedule of eight doses before the programme's targeted age of one year, and cost per FIC including "out of target," that is, children (age 12-23 months) who had completed their immunizations by the time they were sampled in the coverage survey. (Note that this is not the same as fully immunized children under two years of age, because none of the children surveyed had yet reached their second birthday, and some were only a month or two past their first birthday.)

The number of children fully immunized was estimated by multiplying the target population from the EPITrack information system (itself an estimate based on the 1983 Census) by the percentage of FIC from the April Coverage Survey:

$$\text{Number of FIC} = \text{Target Population in Region} \times \text{\% FIC Less Than One Year of Age from Survey}$$

The annual cost attributable to child immunizations was calculated by using the percent of all doses that had been administered to children and taking this share of total annual cost:

$$\text{Cost of Immunizing Children} = \left[\frac{\text{Doses given to children}}{\text{All doses given}}\right] \times \text{Total Cost}$$

This cost was then divided by the number of children fully immunized, to give cost per FIC:

$$\text{Cost per FIC} = \frac{\text{Cost of Immunizing Children}}{\text{Number of FIC}}$$

This approach was also used at District level. Cost per FIC for mobile teams and health facilities required a modified approach, and these are described in Chapter IV.B.

Data were entered onto Lotus 1-2-3 spreadsheets; each cost category (e.g. personnel, vaccine, supplies, and transportation) had an individual worksheet and separate set-ups for calculating the line items within each category. The final cost figure for each category was imported into a summary table for each level or strategy. Results are shown in Chapters V and VI.

Limitations in the methodology, which emerged during the analysis, are discussed in Section III.E below.

C. Sample Selection

Because the cost-effectiveness study evaluated mobile team and facility strategies, several regions which had varying degrees of coverage and approaches to service delivery were surveyed in order to capture the range of experience found in Sudan. Darfur Region was included because of its reliance on mobile team strategy and its low coverage rates and population density.

In order to improve upon the methods of previous cost-effectiveness studies, this cost-effectiveness study aims to match the investments and resources used for the delivery of EPI services at different levels of the health system, with program outcomes as measured by the coverage survey. To do this, the study team sampled mobile teams and facilities from clusters which had been randomly selected on a population-proportional basis for the April 1988 coverage survey. It was believed that "following" the coverage survey would provide a random element in the selection process, though the final facilities and mobile teams surveyed depended in large part on logistic capabilities, security status and whether or not a cluster was served by a team or facility.

Each field team was encouraged to select sites on the following basis:

1) sample half of the districts within a region;

2) sample half of the mobile teams within the region; and

3) sample 15 facilities providing immunization services, with a balance between urban and rural.

Sampling half of the districts and mobile teams would provide enough representation of the range of performance, immunization activity, and use of resources possible within the Sudan. The selection of 15 facilities per region (60 total) was based on previous facility costing studies (Wouters, Nigeria 1988 and Dunlop, Sudan 1984). A sample of 50 facilities would be sufficient to test for significant differences among delivery sites.

For security reasons, it was impossible to include any of the three southern regions in the study. In addition, logistical difficulties prevented the inclusion of the Eastern Region (Kassala). Because the size of

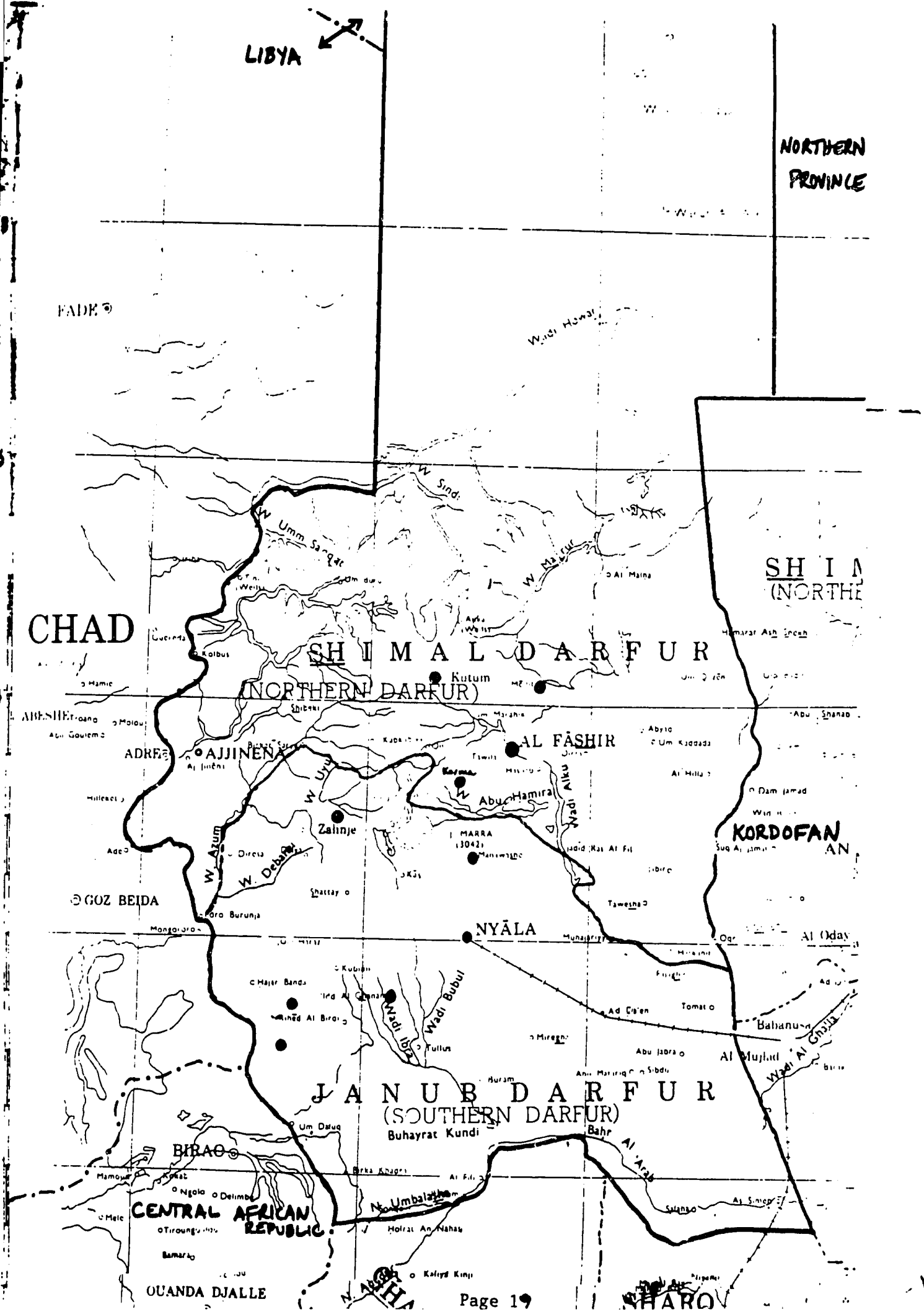
the team did not permit data collection in all of the five remaining regions, it was decided to conduct fieldwork in Darfur, Kordofan, Central and National Capital regions. The Northern region was not included because of the idiosyncratic nature of population distribution in the region, which would make it difficult to generalize findings there to the country as a whole.

At the district level, each team attempted to collect information at 50% of the districts in their respective regions. The districts studied were chosen for a variety of logistical and security reasons. In Darfur region, for example, several districts (El Genaina, Kabkabia) had to be eliminated from the sample because of security problems, while others (Umm Kaddadda) were too distant, making it logistically impossible to visit them within the ten days available for fieldwork in that region.

At the delivery site level, whenever possible facilities or mobile teams operating near clusters visited by the coverage survey team were chosen. It was hoped that this would improve the comparability of costs and coverage figures. However, many health facilities exist which do not correspond directly to clusters visited during the coverage survey. Some of these facilities were sampled as well. As a result, facilities had to be chosen based on logistical reasons and the existence of EPI services at these facilities. Within those constraints, however, an attempt was made to correlate facilities and mobile teams studied with sites chosen by the cluster survey.

Upon arrival in Darfur, a meeting was held with the POO of Northern Province to select the districts, mobile teams and facilities. The study team examines maps of the province and of each of six districts to locate the clusters selected by central headquarters. Three districts in the North (El Genaina, Kabkabia, and Umm Kaddadda) were eliminated because of security and logistic reasons, leaving Mellit, Kutuum, and El Fasher districts. It was decided to visit an El Fasher mobile team in an outlying village which corresponded to a cluster (Karma). EPI facilities in El Fasher town were visited on Monday, on immunization day. While Mellit district had one cluster (Malha), there were no EPI services to the team visited the district capital (Mellit town) and outlying areas. Kutuum District corresponded to several clusters but was a long distance from El Fasher.

The sampling process was repeated in Southern Darfur with the assistance of the POO. Because Nyala District corresponded to several clusters, there was heavy sampling there. It was unfortunate that Garcila District was inaccessible because of security reasons. Although Buram and El Dein Districts corresponded with clusters, long distances prevented travel to these areas. The following map illustrates the distance covered by the cost-effectiveness team.


LIBYA
NORTHERN PROVINCE
FADE
Wadi Howar
W. Sindi
W. Umm Sangar
W. Marur
Al Maina
SH I M
(NORTHE
CHAD
SH I M A L D A R F U R
(NORTHERN DARFUR)
Kutum
Kolbus
Hamic
ABESHR
Abu Goulem
ADRE
AJJINENA
AL FĀSHIR
Abu Hamira
Wadi Alku
W. Azum
W. Debarai
Zalinje
MARRA
(3042)
KORDOFAN
Dam Jamad
Al Hilla
GOZ BEIDA
Goro Burunja
Shattay
Tawesha
NYĀLA
Al Oday
Hajar Banda
Wadi Bubul
Wadi Ibra
Tullus
Ad Dien
Tomat
Babanusa
Al Mujlad
Wadi Al Ghalla
J A N U B D A R F U R
(SOUTHERN DARFUR)
Buhayrat Kundi
Bahr Al 'Arab
Um Dafuq
BIRAO
Mamoura
Ngolo
Delimbe
CENTRAL AFRICAN REPUBLIC
N. Umbalasham
Holrat An Nahas
Salanso
Kaliyd Kinji
OUANDA DJALLE
N. Abssi
CHA
NHARO

D. Descriptive Statistics of Sample

The Darfur team interviewed two provincial operations officers, six district operations officers and visited eight mobile teams and 14 health facilities. Among the health facilities, nine were supported by mobile teams dropping vaccine carriers and five were part of a mobile team routing with health workers not participating in the delivery of service. For this reason, these five facilities are not included in the comparison of EPI facilities across regions.

Six of the facilities visited were health centers, three were primary health care units, five were dispensaries. One hospital was visited but it could not be included in the analysis because of the poor quality of data.

Correspondence with clusters occurred in 71% (12/17) of mobile teams and facilities analyzed which is excellent considering the security and logistical constraints posed during the survey. Table III.4 describes the sample selected in Darfur Region. Some of the delivery sites sampled were not included in the analysis because of lack of sufficient data on costs or outcomes.

Table III.1

DELIVERY SITES SAMPLED FOR THE COST-EFFECTIVENESS STUDY IN DARFUR

Districts Visited	Interviews Conducted					
	POO	DOO	Health Facilities		Mobile Teams	Clusters/ Interview
			Urban	Rural		
El Fasher	1	1	2	2	1	2/5
Mellit		1	1	2	1	0/4
Kutuum		1			2	1/2
Nyala	1	1	3	2	1	6/6
Zalengei		1	1		1	2/2
Idd El Ghanum		1		2	2	1/4
Total	2	6	7	8	8	12/22*

* Only 17 analyzed for the study.

E. Limitations of the Methodology

During data collection and analysis phases of the study, several limitations were noted.

Questionnaires

First, the implementation of EPI was found to be more focused towards mobile team strategies than previously envisioned during the pre-test of the questionnaires in the National Capital Region. This resulted in a sampling of

facilities which were drop-off points for mobile teams, and these did not fit the definition of fixed facilities (static with refrigeration equipment).

Reference period

The analysis of costs and outcomes was based on a reference period of one month to improve the respondent's ability to recall information and to limit the amount of data which needed to be collected during an interview. It was believed at the start of the study that the month of February was an average month of activity for the EPI and therefore did not place a bias in the study results.

Second, it was discovered during field data collection that there had been shortages of syringes in some districts which affected the total level of immunization activity in the reference month of February. This would have resulted in an underestimation of activity for the district for the year (as February data were multiplied by 12). However, in some districts January activity was used instead of February. Increasing conflict in Zalengei made it impossible for the mobile teams to visit all locations. January was selected because February was considered unrepresentative of monthly activity. At regional level, the total level of immunization activity was taken from yearly records, rather than for February, to correct for variations in activity in the cost analysis.

Changes in salary payments

In July 1988, salary raises were given to health workers and administrators though the raises were not paid until September 1988. The level of pay raise was not uniform across categories of staff. To estimate the average annual salary of a particular category of staff, the average pay increase for that category was applied to the monthly base salary of each individual. The base salary figures were used during the first seven months of the year, and the new adjusted rates were used for the following five months.

Quality of data

There was considerable variation in the quality of the records kept at district and provincial levels. Data on doses received and used during the month (as reported on monthly summary sheets) did not always tally with stock remaining at the end of the month. In many cases, negative wastage rates were reported which shows that the worker or DOO is not clear about which figures should be included in the form. DPT and OPV doses given were considered to be the same in all cases and therefore there was not an active counting of OPV activity.

IV. RESULTS FOR MOBILE TEAMS AND FIXED FACILITIES

This section presents the results of the analysis for mobile teams and fixed facilities. Costs are calculated for eight categories of total cost: personnel (wages and benefits), per diem, vaccines, supplies, transportation, maintenance and operation of vehicles, and the annualized values of equipment and vehicles. The Appendix 3 provides more detailed tables of the results and Appendix 4 provides data on the unit prices and wages used in the analysis.

A. Mobile Teams

1. Average Annual Cost

The average annual cost for the eight mobile teams in the sample was $16,900 (LS 75,205). This cost figure ranges by a factor of two, from $24,927 (LS 110,925) in El Fasher to $12,215 (LS 54,356) in Mellit. Recurrent costs represented 73% of total cost, and capital costs were 27% of total cost. The annual value of vehicles accounted for the greatest proportion of total cost (26%). Among recurrent costs, transportation and per diem were the largest components of total cost at 20% and 19%. It is interesting to note that per diem costs were higher than personnel costs (wages and benefits) in all districts.

Several cost components were relatively constant across the eight mobile teams in the sample. For example, the annual value of vehicles and maintenance and operation of vehicles were similar for all teams. The variation in average annual cost is due to several factors:

1) The number of composition of the mobile team significantly influenced the total cost of the team. For instance, the most costly team in El Fasher had three vaccinators and two drivers (five staff). The mobile team in Zalengei had a similar composition. The fewest number of staff was found for the Nyala mobile team, which also had one of the lowest personnel cost.

2) The number of kilometers driven by the team and the unit cost of fuel influenced transportation costs. The mobile teams in Zalengei and El Fasher traveled the greatest distances of the sample (2,278 and 2,328 kilometers per month) and had the highest transport costs.

3) Per diem was highest for El Fasher and Idd El Ghanum and lowest for Kutuum and Mellit. However, per diem did not always correlate with the amount of days spent overnight and the number of personnel on the team. For example, the number of overnights for El Fasher (nine) was less than for Mellit (16), though the per diem costs for El Fasher were nearly double that for Mellit. The figures suggest that per diem is not only paid for staying overnight outside headquarters, and this practice is inflating the annual cost of the mobile team strategy.

4) Vaccine and supplies costs were directly linked to the level of immunization activity of the mobile team. Those teams with the greatest activity (El Fasher and Nyala) had the highest vaccine and supplies costs.

Vaccine costs were also related to the wastage rates found for the mobile teams and these are reported in the next section.

TABLE IV.1

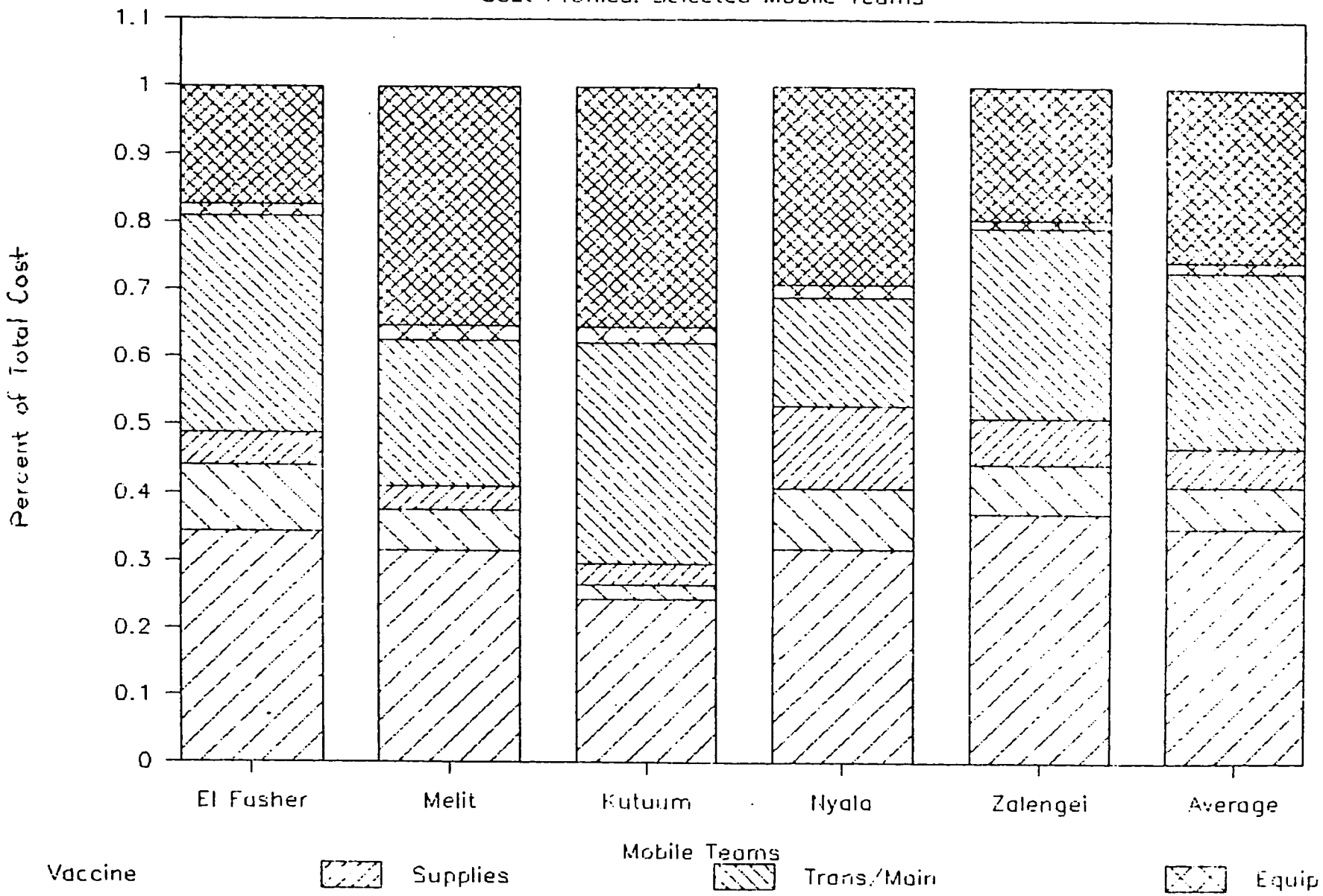
COST OF THE EPI FOR MOBILE TEAMS IN DARFUR REGION

COST CATEGORY	AVERAGE COST	PERCENT	MINIMUM	PERCENT	MAXIMUM	PERCENT
RECURRENT COST						
1. Personnel	$2,732	16.2%	$1,025	8.5%	$4,173	16.7%
2. Per diem	$3,196	18.9%	$1,915	15.8%	$4,557	18.3%
2. Vaccines	$1,040	6.2%	$267	2.2%	$2,409	9.7%
3. Supplies	$927	5.5%	$370	3.1%	$1,781	7.1%
4. Transportation	$3,403	20.1%	$1,406	11.6%	$7,012	28.1%
-Fuel	$3,217	19.0%	$1,216	10.0%	$6,731	27.0%
-Oil	$185	1.1%	$88	0.7%	$281	1.1%
5. Maintenance/Op of Vehicles	$992	5.9%	$992	8.2%	$992	4.0%
TOTAL RECURRENT	$12,289	72.8%	$7,530	62.1%	$20,183	81.0%
CAPITAL COSTS						
1. Equipment	$287	1.7%	$184	1.5%	$429	1.7%
2. Vehicles	$4,315	25.5%	$4,315	35.6%	$4,315	17.3%
TOTAL CAPITAL	$4,602	27.2%	$4,499	37.1%	$4,744	19.0%
TOTAL COST	$16,891	100.0%	$12,118	100.0%	$24,927	100.0%

DOSES ADMINISTERED	14,821	$3,537	$35,210
COST/DOSE	$1.44	$0.71	$3.54
PERCENT TT DOSES	11.5%	7.3%	16.5%
TOTAL CHILD COST	$14,933	$10,392	$22,725
TOTAL COST	$28,969	$10,793	$45,450
COVERAGE (FIC)	2,005	816	3,975
COST/FIC	$14.44	$6.59	$20.20

Figure IV.1

Cost Profiles: Selected Mobile Teams



2. Number of Doses

The number of vaccinations administered by dose, antigen and age was collected from monthly records for February 1989. All figures reported here were based on EPI records as they were kept in the field. The total doses administered annually by the eight teams ranged from 35,200 to 3,500: a 10-fold difference. The average number of doses administered per month was 1,433. For some teams, there were more second and third doses of DPT and OPV administered than first doses, presumably because of efforts to reduce the drop-out rate.

TABLE IV.2
INDICATORS OF ACTIVITY FOR THE MOBILE TEAMS IN DARFUR

INDICATOR	AVERAGE	MINIMUM	MAXIMUM
Cost per Dose[1]	$1.44	$0.71	$3.54
Doses per Mobile Team per Day[2]	54	12	132
Doses per Staff per Day[3]	20	6	53
Doses per Site per Month[4]	62	14	134
Days per Round	20	18	25
Returns to HQ per Round	6	4	9

[1] Total annual cost divided by total doses administered per year.
[2] Monthly doses administered by team divided by number of days per round.
[3] Monthly doses administered by team divided by number of staff (excluding drivers) divided by the number of days per round (month).
[4] Monthly doses administered by team divided by the number of sites visited.

a) Cost per dose

For the eight mobile teams in the study, the average cost per dose administered was $1.44 (LS 6.40). The level of activity of the mobile teams influenced the range in the cost per dose from $3.54 (Kutuum) to $0.71 (El Fasher). The second mobile team in Kutuum administered 162 doses per month, as compared with the El Fasher mobile team at 2,382 per month, which is nearly a 15-fold difference in level of activity. Table IV.1 illustrates these results and provides other indicators of mobile team activity based on doses.

b) Doses per team and per health worker

Table IV.2 illustrates the wide range in level of activity by mobile team and per staff member (excluding drivers) among the eight mobile teams sampled in Darfur. The average number of doses administered per team per day in the field was 54; whereas, the average number of doses administered per staff member (excluding driver) was 20. The mobile teams having the highest output per day were El Fasher and Idd El Ghanum. The teams having the least output per day were Kutuum, Mellit and the second Idd El Ghanum team. Doses per person per day ranged from 132 in El Fasher to six in Kutuum, which is a 20-fold difference in output. Appendix 3 contains detailed information on all the teams.

These data could be interpreted in three principal ways. First, the number of eligible children and women for immunization is too low for some of the mobile team routes and this is why the output in some areas is low compared to others. Thus, the frequency and location of the mobile team routes should be redesigned to maximize the number of eligibles per day. Second, the number of staff per team is too high to result in a high output per person and therefore the staffing patterns should be re-examined to lower cost and improve cost-effectiveness. Finally, the mobile team staff are not reaching enough children and are not performing to a high enough level. Strategies to improve the motivation of the staff to seek out eligibles should be developed and the use of the loudspeakers improved.

c) Doses per site (subcenter)

Table IV.3 shows that for the sample of mobile teams, 193 different subcenters were used. Most of the subcenters were primary health centers (57%), followed by private homes (16%), dispensaries (13%) and health centers (5%). Thirty-three of the total (17%) were sites which offered routine immunization in addition to mobile team activities.

The mobile team questionnaire also collected data on proportion of time spent by team workers during an immunization session in a village. On average, 48% of the total time was spent giving immunizations, 24% of time was spent traveling to the village, 14% was spent taking rest and restoration, 12% was spent on mobilizing the population, and 7% was spent preparing the mobile team vehicle for departure to the village. The greatest variance in these patterns was for traveling time, with some teams spending as much as 50% of their time (Zalengei) or as little as 4% of their time (Nyala). A second element of variation was restoration and rest, with some teams taking as much as 38% of their time (Nyala) and others taking only 3% of their time (Idd El Ghanum). See Appendix 3 for details.

TABLE IV.3
SITES FOR MOBILE TEAM ACTIVITIES IN DARFUR

TYPE OF SITE	NUMBER	PERCENT	EPI	PERCENT by Site
Health Center	9	4.6	9	100
Dispensary	26	13.4	12	46
Dressing Station	6	3.1	1	17
PHC Unit	110	57.0	9	8
Secondary Hospital	2	1.1	2	100
Houses	31	16.1	0	0
Schools	3	1.6	0	0
Tree	6	3.1	0	0
TOTAL	193	100.0	33	17

The average number of doses administered at one mobile team site in a village per month was 62. The range was 14 doses per village in Kutuum to 134 doses per village in Idd El Ghanum. These figures suggest that either the villages are too small to make continued use of mobile teams at monthly intervals financially worthwhile, or that not enough children and women are being reached during each session. In addition, the number of doses administered to children greater than one year of age ranged from 26.5% in El Fasher, 38.3% and 46.1% in Kutuum, and 52.3% in Mellit.

These data suggest that the cost per dose could be reduced by:

1) making sure that all eligibles, particularly those who are less than one year of age, come for immunization during the mobile team session in order to maximize the output of the team;

2) reducing the size of the mobile team staff to be more appropriate for immunization in smaller villages in order to optimize the productivity of each worker;

3) visiting larger villages in order to capture more eligibles at one time;

4) visiting villages less frequently in order to increase the number of eligibles at any one time; and

5) spending more time mobilizing the population effectively to come for sessions.

3. Number of Contacts for Immunization

The number of contacts is defined as the number of children who come in contact with immunization services. The routine reporting system does not contain records of the number of contacts and DPT1 was used as a proxy for number of first contacts. DPT1 was the thought to be more representative than BCG because the number of doses of DPT1 were consistently higher than for BCG.

a) First contacts

The average number of first contacts per month ranged from 472 in El Fasher to six in Nyala. The range in performance may be due to previous ability of the team to reach children less than one with DPT1, a higher concentration of eligibles in each area, and better attention to age at administration. The records in Southern Darfur did not segregate doses by age (less or greater than one year).

b) Kilometers per contact

The average number of kilometers traveled per dose (how far the teams travel to reach children) was 2.8, ranging from one kilometer for several teams (El Fasher, Zalengei, Idd El Ghanum) to nine kilometers in Kutuum. These figures suggest differences in population density in different regions.

The number of kilometers per first contact is an estimate of how hard the team must work to find children eligible for immunization and how close these eligibles live to the headquarters of the team. The average number of kilometers driven for a first contact was 24, with a high of 62 kilometers in Kutuum and 61 kilometers in Zalengei, and a low of six in Nyala and El Fasher. The two teams traveling the fewest kilometers to make first contacts with children were located in urban areas. The higher population density in these areas may explain the difference in distance traveled.

Another factor influencing the number of kilometers per contact is the frequency of visits to a particular site. If the frequency is high, then there will be fewer children eligible to receive DPT1 then if the teams visit the site less often.

c) Kilometers per dose

Another indicator which measures the level of effective activity is the number of kilometers driven per dose administered. When the number of kilometers per dose is large, this may be a reflection of the dispersion of the population, or the vehicles are being used for other purposes than immunization. When the number of kilometers per dose is low, the team does not travel far to reach large numbers of children. For the sample of mobile

teams, the average number of kilometers per dose was 2.8, with a range of one kilometer per dose in Zalengei to nine kilometers per dose in Kutuum. In general, the urban mobile teams have low ratios between kilometers traveled and doses administered, from 1.1 in El Fasher and 1.4 in Nyala.

4. Number of Fully Immunized Children

The number of fully immunized children less than one year of age is not routinely reported for the national program. The major sources of data were coverage survey results for Darfur Region, the target population of each district (from the national EPITrack reporting system) and the estimated annual mobile team cost per district. If one mobile team was surveyed out of two, then the mobile team cost was multiplied by two and divided by the total number of fully immunized children in the districts accounted for by mobile teams.

The coverage survey estimated that 23.1% of children less than one were fully immunized against all EPI-target diseases. Based on an analysis of the clusters selected for the coverage survey, it was estimated that 75.5% of the total number of children fully immunized received their services through mobile teams; 14% received immunizations through health facilities, and 10.6% received immunizations from facilities who are supported by mobile team distribution of vaccine. There were few children receiving services through other strategies in Darfur.

The average cost per FIC was $14.44 and ranged from $20.20 in El Fasher to $6.59 in Nyala. These figures reflect the range in performance of the EPI among the mobile teams more than any other factor.

One limitation to this method is that it assumes that all districts fully immunize the same proportion of children less than one year of age (23.1%).

The coverage survey also reported that 34% (of the sample age 12-23 months) of children were fully immunized by the time of the survey. Using this figure, the number of fully immunized children increases on average to 2,952 and the cost per FIC is reduced to $9.81. This difference between $14.44 and $9.81 represents what could be gained in effectiveness of service delivery if children were immunized before their first birthday.

5. Drop-out rates

Data from monthly reports were used to determine the drop out rates between doses for DPT, OPV and TT. Table IV.4 illustrates these results.

TABLE IV.4
DROP OUT RATES FOR MOBILE TEAMS
COMPARED WITH COVERAGE SURVEY RESULTS
(percentages)

MOBILE TEAM	DPT1-DPT2 OPV1-OPV2	DPT2-DPT3 OPV2-OPV3	DPT1-DPT3 OPV1-OPV3	TT1-TT2
El Fasher	38	20	50	62
Mellit	-28	49	34	-7
Kutuum	-47	88	82	-33
Kutuum	-11	76	73	
Nyala	17	11	26	52
Zalengei	nil	-15	-14	27
Idd El Ghanum	25	-34	nil	23
Idd El Ghanum	40	7	44	74
Coverage Survey			26	30

Negative drop-out rates imply that more subsequent doses were given. The highest drop-out rate for DPT1-DPT2 was found in El Fasher; the highest for DPT2-DPT3 was in Kutuum which also had the highest DPT1-DPT3 rate. The drop-out rates for DPT1-DPT3 and TT1-TT2 for the six northern regions estimated from the coverage survey were consistently lower than from the reporting system.

6. Wastage

The data collected on doses administered also provided a means for analyzing wastage rates for individual antigens for each mobile team. Results shown in Table IV.5 show that there is no consistent pattern of wastage among the mobile teams or between antigens. Wastage was estimated from the monthly records of doses issued, doses administered and stock remaining at the end of the month. The following formula was used:

$$\text{Wastage} = \frac{\text{Doses of Vaccine Issued} + \text{Stock on Hand} - \text{Doses Administered}}{\text{Doses of Vaccine Issued}}$$

TABLE IV.5
VACCINE WASTAGE RATES FOR SELECTED MOBILE TEAMS IN DARFUR
(percentages)

ANTIGEN	EL FASHER	NYALA	IDD EL GHANUM
BCG	43	8	7
DPT		23	16
OPV		28	
MEASLES	26	3	
TT	43	10	

Although the data are incomplete, they show the wide variation in conservation of vaccine and have cost implications for the mobile teams.

7. Summary of Mobile Teams

The analysis of the cost-effectiveness of eight mobile teams in Darfur has highlighted several operational aspects which could affect the total cost and the performance of the teams.

It is interesting to note that high cost of the mobile teams does not necessarily mean the least cost-effective. The following matrix was developed which categorizes the teams by their total cost and number of fully immunized children, as well as by their costs and number of doses administered.

TABLE IV.6
CLASSIFICATION OF MOBILE TEAMS IN DARFUR BY COST/FIC

OUTCOMES	HIGH COST	LOW COST
HIGH	El Fasher Zalengei	Nyala
LOW	Kutuum	Mellit Idd El Ghanum

The teams in the low cost/high outcome group are the most cost-effective, while those in the high cost/low outcome group are the least cost-effective. This characterization of teams according to level of cost and outcome can be used by the ROO and DOO to identify which mobile team:

1) is the most cost-effective and why in order to develop a standard of performance and use of resources; and

2) could become more cost effective by increasing the outcome or by decreasing their costs and to plan how to move the mobile teams within these cells away from the high cost/low outcome scenario.

The following matrix highlights the characteristics of mobile teams found in each of the four cells:

TABLE IV.7
COMPARISON OF MOBILE TEAMS IN DARFUR REGION

	HIGH COST	LOW COST
	CASE 1	CASE 2
HIGH OUT-COME	Days out per month is high, with many returns to HQ Many centers, far apart, with large target pop. Kilometers (& fuel) high Large team spends time on identifying eligibles, following up drop outs	Days out per month is high, with few returns to HQ Few centers with large target population Short distances Small team of health workers High utilization by eligibles Community enumerates and follows up
	CASE 3	CASE 4
LOW OUT-COME	Size of team exceeds that needed for the workload Many returns to HQ for restocking/rotating staff Many centers, far apart, with small target pop. Low utilization Ineffective follow-up	Small team of health workers Few days per round Few rounds per year (low per diem) Few centers are visited, with small target populations Low percentage of eligibles is contacted; no follow-up

B. Health Facilities

1. Average Annual Cost

The cost-effectiveness study team surveyed 15 facilities: nine mobile supported facilities, five mobile team subcenters (dispensaries and health

centers) and one hospital. The total annual cost of providing immunization services through facilities is found in Table IV.8. Only 10 out of the 15 facilities sampled had sufficient data to be included in the analysis. None of these facilities had refrigeration equipment which belonged to the center; they all relied on the mobile team to distribute vaccine in a vaccine carrier. The average annual cost was $1,195 or LS 5,317.

Recurrent costs accounted for 80% of the total cost, and the annual values of vehicles, equipment and buildings accounted for 20% of the total. Personnel costs were the highest cost category at 41%, followed by buildings (17%) and vaccines (16%). Transportation, equipment and vehicles costs were not significant cost elements of fixed facility operations.

There was a 22-fold difference between the annual operating cost of EPI in facilities, between HF 10 (Zalengei) which had an annual cost of $4,331 (LS 19,273) and HF5 (Mellit) which had an annual cost of $200 (LS 890). The difference in cost is accounted for by the large difference in personnel costs (see Appendix 4). The Zalengei maternal and child health (MCH) unit had a total of 2.33 full-time equivalents working for EPI compared to Mellit (0.07 FTE) and an average of 0.26 for all facilities.

The average annual cost over all facilities for vaccines was $192 (LS 854). Variation in vaccine costs was due to differences in the level of output and wastage of vaccine. The range in vaccine cost was from $45 (LS 200) in HF 15 (Idd El Ghanum) to $337 (LS 1,500) in three facilities in El Fasher and Nyala.

Supplies cost also varied by facility from nearly $500 (LS 2,220) in Nyala to $24 (LS 107) in Idd El Ghanum. The low cost in Idd EL Ghanum is due to the two-month operation of the facility rather than low productivity.

Variation also occurred in transportation costs, from $5 in Nyala to $262 in Idd El Ghanum. These costs included the cost of transporting the vaccine to the health facility by the mobile team vehicle, the travel cost of mobilizing the population, and community outreach costs.

Building costs also varied because of the size of the vaccination area. Two facilities provided vaccines outside under a tree and therefore, had no building costs. The annual value of buildings ranged from $0 to $1,091 (LS 4,855) in El Fasher.

2. Number of doses

The average annual number of doses administered for the sample of facilities was 2,300. Vaccination activity varied by facility from 540 in Idd El Ghanum to 8,076 in Nyala. These figures are confounded by the fact that months of operation were different for the facilities (from two to twelve months).

TABLE IV.8
COMPARISON OF HEALTH FACILITY COSTS FOR DARFUR

COST CATEGORY	AVERAGE	PERCENT	MINIMUM	PERCENT	MAXIMUM	PERCENT
RECURRENT COST						
1. Personnel	$493	41.3%	$21	15.5%	$3,748	59.3%
2. Vaccines	$192	16.0%	$45	33.2%	$337	5.3%
3. Supplies	$162	13.6%	$24	18.1%	$499	7.9%
4. Transport	$72	6.0%	$5	3.5%	$262	4.2%
5. Rent	$34	2.8%	$0	0.0%	$337	5.3%
TOTAL RECURRENT	$953	79.7%	$95	70.4%	$5,184	82.0%
CAPITAL COSTS						
1. Equipment	$15	1.3%	$6	4.4%	$26	0.4%
2. Vehicles	$24	2.0%	$24	17.6%	$24	0.4%
3. Buildings	$204	17.1%	$10	7.5%	$1,085	17.2%
TOTAL CAPITAL	$243	20.3%	$40	29.6%	$1,135	18.0%
TOTAL COST	$1,195	100.0%	$135	100.0%	$6,319	100.0%
NUMBER OF DOSES	2296		540		8076	
COST PER DOSE	$0.52		$0.13		$1.34	
PERCENT TT DOSES	21.2%		0.0%		49.1%	
TOTAL CHILD COST	$834		$152		$3,413	
NUMBER FIC	134		5		744	
COST/FIC	$21.24		$1.07		$67.26	

a) Cost per dose

The average cost per dose was $0.52 (LS 2.31). This figure ranged from $0.13 in Nyala to $1.34 in El Fasher. This represents a 2.5-fold difference in the cost per dose among the sample of facilities.

b) Doses per day and per FTE/hour

Table IV.9 provides data on the number of doses administered per staff, per day and per hour for the sample of 10 facilities. On average, 123 child immunizations are given during each immunization session day, which translates to 21 doses administered per hour. The range of doses per day was between 45 and 337 per immunization session, and the range in doses per hour was between four and 84. The number of doses per hour represents a 20-fold difference in immunization activity among health facilities. This difference could be due to differences in sizes of the target population as well as differences in levels of staff motivation to immunize. The highest figures were for an urban health center in Southern Darfur; however, not every urban facility had high levels of activity which suggests that there is an unexplored potential for higher levels of activity in these centers.

The number of TT immunizations administered per day ranged from five to 1.5 with an average of 3.3. The number of TT immunizations per hour was two. Urban health facilities had lower rates per hour than rural for TT vaccination.

The number of doses per staff per hour averaged 24 in the sample, with a range between one and 175. The high figures for Sham Naseem health center could be due to its focus on MCH activities and a well-organized immunization session which serves most of Nyala town.

These activity indicators suggest that the cost per dose could be reduced by increasing the level of immunization activity per session, either by improving publicity for the session or by undertaking outreach activities in urban areas. Immunization staff should be able to administer at least 24 doses per hour, if the session is scheduled correctly and the population has been informed. These data also suggest that there should be different standards for urban and rural facilities, with more emphasis on increasing the volume of services provided in urban areas where the population density is greatest and the transmission of disease more likely.

3. Number of contacts

Information was collected on the target population of each facility and matched against the number of children receiving DPT1 (a measure of access of the population to immunization services) and matched against the number of pregnant women receiving their first dose of tetanus toxoid. The EPI policy is now to immunize all women of childbearing age, but his policy went into effect in late 1988. The target population for both infants and pregnant women was determined by multiplying the catchment population of the facility by 4%.

TABLE IV.9
INDICATORS OF ACTIVITY AT HEALTH FACILITIES IN DARFUR

INDICATOR	AVERAGE	MINIMUM	MAXIMUM
Cost/Dose(a)	$0.52	$0.13	$1.34
Child Doses			
per Day(b)	123	45	337
per Hour(c)	21	4	84
TT Doses			
per Day(d)	3.3	1.5	5.0
per Hour(e)	2.0	0.8	3.8
Doses/Staff(f)	97	29	337
Doses/Staff			
per Hour(g)	24	1	175

(a) Total annual cost divided by total doses per year.
(b) Total doses given to children per month divided by the number of immunization days per week.
(c) Child doses per day (b) divided by the number of hours per clinic.
(d) Total TT given to women per week divided by the number of immunization sessions per week.
(e) TT doses per day (d) divided by the number of hours per session.
(f) Doses per week divided by the number of staff giving immunizations.
(g) Doses per week divided by the total working hours per month, multiplied by the FTE per month for immunization.

TABLE IV.10
CONTACT WITH THE ELIGIBLE POPULATION OF FACILITIES IN DARFUR

INDICATOR	AVERAGE	MINIMUM	MAXIMUM
First contact:DPT1			
<1 year	21	5	74
Any age	6	3	8
Percent of Target Contacted (a)	3.6%	0.6%	9.3%
First contact with women:TT1	23	2	94
Percent of Pregnant Women Contacted (b)	3.9%	0.3%	11.8%

(a) Total population served by the facility multiplied by 4%.
(b) Total population served by the facility multiplied by 4%.

a) Percent children less than one year contacted

Table IV.10 shows that on average 4% of the target population received their first dose of DPT last year. The range was less than 1% to 9%. The two extremes were represented by urban facilities, with the highest being located in Nyala and the lowest located in El Fasher.

b) Percent of pregnant women contacted

The population of pregnant women was reached at about the same rate as infants by health services in Darfur (4%) with the range between less than 1% to 11% of the target population. These data, particularly for urban areas which should be services primarily by facilities, that there is room for improving the contact between the health services and the population.

4. Number Fully Immunized Children

The number of FIC is not routinely recorded on the monthly immunization records. To collect this information, the survey team reviewed the registers of the facility to determine how many children less than one received their last required dose within the previous month (February). This figure was multiplied by 12 to estimate the annual number of children fully immunized. Two of the facilities had not been in operation for a full year. Their monthly immunization activity was multiplied by the number of months in operation to obtain the pervious years' activity.

For the sample, the average number of FIC was 134 per year. This figure ranged from five and nine in the two Idd El Ghanum facilities to 744 in the Nyala facility. The number of FIC is influenced by the density of the population. The Nyala facility population is located in a peri-urban area compared to the Idd El Ghanum facility which is in a remote rural area.

Using the number of FIC, it was estimated that the average cost per FIC in the sample was $21.24 (LS 94.52). This figure ranged from a low of $1.07 in Nyala (LS 4.76) to a high of $67.26 (LS 299.30) in Idd El Ghanum. This wide range is most likely due to the range in the number of FIC reported. If the two facilities in Idd El Ghanum had been in operation for the entire year, the cost per FIC would be reduced to $2.38 (HF15) and $8.60 (HF16).

5. Drop-out Rate

The drop-out rate between different doses of vaccine are illustrated in Table IV.11. From these data it is difficult to draw conclusions about patterns in drop-out rates. However, it appears that the rates for DPT and OPV are much higher in facilities sampled in Northern Darfur; whereas, the rate for TT drop-out is higher in Southern Darfur. Negative wastage rates are either a reflection of poor record-keeping or immunization efforts to reduce drop-outs. In Mellit, there were 300% more doses of DPT3 given than DPT2 during the month used as a reference period (January).

TABLE IV. 11
COMPARISON OF DROP-OUT RATES FOR HEALTH FACILITIES IN DARFUR
(percentages)

HEALTH FACILITY:	DPTP1-DPTP2	DPT2-DPT3	DPT1-DPT3	TT1-TT2
HF2: El Fasher	33	70	80	19
HF3: El Fasher	-180	29	-100	31
HF5: Mellit	91	-300	64	-20
HF7: Nyala	15	2	16	40
HF9: Nyala	17	17	32	
HF12: Nyala	-67	72	53	-50
HF15: Idd El Ghanum	40	-100	-20	71
HF16: Idd El Ghanum	46	33	64	72
Coverage Survey			26	30

6. Wastage Rate

Wastage rates were based on the number of vials consumed during a month, compared with the number of vials stocked and left on hand. These data were only available for four facilities, as the other facilities did not keep stock records or accurate information (i.e., some facilities reported negative wastage). The wastage rates are shown in Table IV.12 below:

TABLE IV.12
COMPARISON OF WASTAGE RATES AMONG SELECTED FACILITIES IN DARFUR REGION
(percentages)

ANTIGEN	Facility 2	Facility 3	Facility 7	Facility 9
BCG	88	88	20	
DPT	75	75	9	25
OPV	88	75	9	25
Measles	88	75		25
TT	63	63	20	

The only conclusion which can be drawn is that there is a wide variation in the wastage rates which may be an artifact of how well records are maintained. Rates over 80% are extremely high and attention should be paid to the reasons for these high figures.

7. Summary of Results for the Fixed Facility Strategy

The most cost-effective health facilities were those which had the highest level of immunization activity. Table IV.13 organizes the facilities

into the cost and outcome matrix shown earlier for mobile teams. Those in Cell 2 are the most cost-effective. Those in Cell 3 are the least cost-effective. Those in Cell 1 can be made more cost-effective by decreasing the facility cost at the same or greater level of outcome.
Those in Cell 4 could be improved by increasing their level of outcome without increasing the cost of providing services at the same rate.

TABLE IV.13
CLASSIFICATION OF HEALTH FACILITIES IN DARFUR BY COST/FIC

	HIGH COST	LOW COST
HIGH OUTCOMES	Nyala	Nyala Nyala
LOW OUTCOMES	Zalengei	Idd El Ghanum 15 Idd El Ghanum 16 El Fasher 2 El Fasher 3 Mellit 5 Nyala 12

These results suggest that the health facilities in Darfur (at least the ones in the sample) are not being used to their fullest potential and that immunization activity could be increased by either actively recruiting eligible children during immunization sessions or by publicizing immunization sessions more effectively. The two urban facilities in Cell 4 should be able to provide more immunization services, thereby reducing the cost-effectiveness ratio.

Qualitatively speaking, Table IV.14 illustrates the characteristics of health facilities.

TABLE IV.14
HEALTH FACILITIES: INDICATORS OF COST AND EFFECTIVENESS

	HIGH COST	LOW COST
	CASE 1	CASE 2
HIGH OUT-	Resupply uses EPI vehicle Large staff spends time on enumeration & follow-up of defaulters EPI sessions occupy a large space Many sessions held, well attended	Minimal equipment Small staff Few sessions per week High utilization, follow-up done by community
	CASE 3	CASE 4
LOW OUT-COME	Resupply with EPI vehicle Large staff, low utilization, low activity EPI occupies a large space Many sessions held, poorly attended Time spent on social mobilization is not effective	Minimal Equipment Low utilization by target group, low activity Passive approach to follow-up of drop outs Small staff

C. Comparison of Alternative Strategies

Table IV.15 compares the two strategies by annual cost, cost per dose and cost per FIC less than one. This table shows that the mobile teams had a higher average annual cost by 93% over fixed facilities; number of doses and number of fully immunized children were also higher on average for the mobile teams by 85% and 93%, respectively. The cost per dose for health facilities was lower by 64% than mobile teams, presumably because of the difference in annual cost. However, the cost per FIC was less for mobile teams which suggests that this strategy is more effective in completing a child's immunization series than the fixed facilities. The data also suggest that fixed facility activity could be greatly improved.

TABLE IV.15
COMPARISON OF ANNUAL COSTS BY STRATEGY

INDICATOR	MOBILE TEAMS	FIXED FACILITIES	DIFFERENCE
Annual Cost	$16,891	$1,195	93%
Number of Doses	14,821	2,296	85%
Number of FIC	2,005	134	93%
Cost per Dose	$1.44	$0.52	64%
Cost per FIC	$18.24	$21.24	-16%

Because of the wide variability in the data among mobile teams and among health facilities, no conclusions can be drawn about whether one strategy or another has a higher or lower wastage or drop-out rates. It does appear that drop-out and wastage rates are somewhat higher for fixed facilities, though this may be due to the quality of the data rather than any definite trend.

Fixed facilities and mobile teams should be serving different population groups and as such, they do not represent real alternatives to each other. However, in urban areas, it is clear that mobile teams are providing the bulk of the immunization services which may not represent the most optimal use of that resource. Facilities could increase their cost-effectiveness by increasing the volume of services they provide during an immunization session. Mobile teams could decrease their costs by restricting the size of the villages they visit or by decreasing the frequency of the visits to smaller villages in order to increase the number of eligibles at any particular point in time.

V. RESULTS AT DISTRICT AND REGIONAL LEVELS

In addition to comparing alternative delivery strategies (fixed facilities and mobile teams), the cost-effectiveness study included an analysis of district and regional level costs and cost-effectiveness. Costs at these levels include the cost of administering and managing the program, as well as costs of social mobilization and supervision. These costs were excluded from the previous analyses because of the inability to allocate administrative costs to the sample of facilities and teams. Contributions of the District Councils are also included in this analysis.

A. District Level

1. Average Costs

The district level analysis demonstrates how effective and efficient the operations of all strategies are provided and managed by the DOO. Table V.1 illustrates the results of the district analysis. More details are found in Appendix 3. The average annual cost of the immunization program at district level was $87,856 or LS 390,960. The most costly district was El Fasher at $132,334 and the least costly district was Mellit at $50,548. The range in annual cost is nearly three times from least to greatest.

Recurrent costs accounted for 77% of total cost, with personnel costs representing 40% of the total. Transportation costs were the second largest cost category at 20% of total, followed by the annual value of vehicles (16%).

Variation in total cost is due to several factors. First, there was a wide variation in the numbers and types of personnel working for EPI (at both headquarters and within the district), and the amount of time they spend on the program. In Idd El Ghanum, it was estimated that 8.5 full time equivalents work for the EPI each month, followed by 13.2 FTEs at Zalengei and 15.3 in Mellit. Monthly wages also varied between Northern and Southern Darfur (see Appendix 4) which influenced the range in personnel cost.

Second, there was a wide variation in transportation costs, which was largely influenced by fuel consumption and fuel prices. The lowest transport cost was found in Nyala ($8,045 or LS 35,800) and the highest was in Idd El Ghanum ($37,938 or LS 177,724). Transportation costs included contributions from the District Councils for fuel, oil and other lubricants. The price per gallon of petrol varied as well, from LS 33 in El Fasher to LS 7.75 in Nyala which reflects the price of transporting fuel to the region.

The third factor influencing the total cost was the volume of immunization activity in each district. Vaccine costs by a factor of three, from $1,238 of LS 5,509 in Zalengei to $6,942 (LS 30,892) in El Fasher. Wastage of vaccine also had an influence on vaccine cost and this issue will be addressed later in this section.

TABLE V.1
COMPARISON OF DISTRICT COST AND COST-EFFECTIVENESS IN DARFUR REGION

COST CATEGORY	AVERAGE	PERCENT	MINIMUM	PERCENT	MAXIMUM	PERCENT
RECURRENT COST						
1. Personnel	$35,157	40.0%	$18,616	46.4%	$61,304	35.5%
Salary/housing	$15,681		$9,932		$22,257	
DC allowance	$2,445		$593		$3,371	
Per Diem	$15,105		$4,517		$29,935	
Staff support	$1,156		$202		$2,157	
Overtime	$2,989		$449		$6,361	
2. Vaccine	$3,024	3.4%	$1,238	3.1%	$6,942	4.0%
3. Transportation	$17,337	19.7%	$8,045	20.1%	$37,938	22.0%
-Fuel	$14,246		$5,059		$28,286	
-Oil	$3,091		$427		$9,653	
4. Supplies	$3,865	4.4%	$980	2.4%	$11,398	6.6%
5. Training	$3,338	3.8%	$120	0.3%	$9,300	5.4%
6. Maintenance	$3,862	4.4%	$1,985	4.9%	$6,560	3.8%
7. Other/Running Cost	$1,264	1.4%	$334	0.8%	$2,027	1.2%
Subtotal	$67,847	77.1%	$31,318	78.1%	$135,468	78.5%
CAPITAL COSTS						
1. Vehicles	$13,909	15.8%	$4,315	10.8%	$28,520	16.5%
2. Equipment	$3,981	4.5%	$3,274	8.2%	$5,265	3.0%
3. Buildings	$2,219	2.5%	$1,200	3.0%	$3,359	1.9%
Subtotal	$20,109	22.9%	$8,789	21.9%	$37,144	21.5%
TOTAL COST	$87,956	100.0%	$40,107	100.0%	$172,612	100.0%
TOTAL DOSES	41,155		3,447		110,796	
COST PER DOSE	$2.14		$0.90		$14.66	
PERCENT TT	13.6%		10.4%		19.9%	
TOTAL CHILD COST	$76,020		$44,664		$116,173	
TARGET POPULATION	12,438		5,059		24,651	
NUMBER FIC	2,873		1,169		5,694	
COST PER FIC	$26.46		$14.02		$48.01	

Supplies costs varied significantly among the districts, from $980 (LS 4,361) in Mellit to $11,398 (LS 50,721) in El Fasher. This cost component was affected by the availability and distribution of supplies from Provincial headquarters, and as such, supplies costs are highest in the districts which overlap provincial offices and which are in urban areas.

The annual value of vehicles also varied greatly among the districts sampled, from $4,315 in Mellit to $28,520 in Nyala. Again, the districts with the highest costs overlap with Provincial Headquarters and have greater numbers of vehicles.

2. Number of Doses

The average number of doses administered per year per district was 41,155. The average cost per dose in the districts (6) was $2.14 or LS 9.52. This figure ranged from $14.26 (LS 65.24) in Mellit to $0.90 (LS 4) in Nyala. Although Mellit District had the lowest overall cost of any district in the sample, it had the highest cost per dose, which is a reflection of lower than average levels of immunization activity most probably due to low population density.

3. Cost per Fully Immunized Child

The average cost per FIC was calculated based on the number of children fully immunized in the district less than one year of age and the target population of children less than one estimated by the EPITrack system. A figure of 23.1% was used as the percentage of children fully immunized based on the April 1989 coverage survey. This rate was applied to all of the districts. As mentioned in Section III, the study assumed that this rate was constant across the districts sampled. The average number of children fully immunized was 2,873 for the sample. This figure ranged from 3,224 to 1,169 (a two-fold difference among districts).

The average cost per FIC was $26.46 (LS 118). The average cost figure ranged from $48.01 (LS 214) in Kutuum to $14.02 (LS 62) in Nyala. The high cost-effectiveness ratio in Kutuum may reflect the difficulty of access to the population given the mountainous terrain and security problems in the area. The low cost-effectiveness ratio in Nyala may reflect the level of follow-up of second and third doses in this district. It is interesting to note that the least costly district (Mellit) is not necessarily the most cost-effective: this district was ranked fifth among the sample of six. The example illustrates the point that the level of outcome has a great affect on the cost-effectiveness ratio.

The following matrix is used again to characterize the districts in the sample:

TABLE V.2
COMPARISON OF DISTRICTS IN DARFUR

OUTCOMES	HIGH COST	LOW COST
HIGH	Nyala El Fasher	Zalengei
LOW	Kutuum	Mellit Idd El Ghanum

TABLE V.3
DISTRICTS: INDICATORS OF COST AND EFFECTIVENESS

	HIGH COST	LOW COST
	CASE 1	CASE 2
HIGH OUT-COME	High equipment costs High personnel cost High level of activity	High personnel cost High level of activity
	CASE 3	CASE 4
LOW OUT-COME	Low output High transport cost High personnel cost	High transport costs Low output Low personnel cost

4. Drop-out rates

The following table describes the drop-out rates for DPT and TT for the six selected districts in Darfur. These data result in figures similar to those estimated for the coverage survey in the region.

TABLE V.4
COMPARISON OF DROP-OUT RATES FOR DISTRICTS IN DARFUR
(percentages)

DISTRICT:	DPTP1-DPTP2	DPT2-DPT3	DPT1-DPT3	TT1-TT2
El Fasher	19	26	40	36
Mellit	-28	49	34	-7
Kutuum	-46	65	49	46
Nyala	10	-11	nil	44
Zalengei	18	-7	12	nil
Idd El Ghanum	23	1	24	44
Average			27	27
Coverage Survey			26	30

5. **Wastage**

Wastage rates varied for all antigens among the six districts. These figures were based on monthly summary sheets for February 1989. Data on Mellit could not be used because their figures resulted in negative wastage rates. Table V.4 illustrates the results.

TABLE V.5
COMPARISON OF WASTAGE RATES AMONG DISTRICTS IN DARFUR
(percentages)

DISTRICT	BCG	DPT	OPV	Measles	TT
El Fasher	64.5	61.6	63.6	63.2	78.8
Kutuum	93.3	57.1	58.1	65.7	73.1
Nyala	14.3	5.5	5.5	13.8	7.4
Zalengei	8.3	25.7	39.5	70.0	61.5
Idd El Ghanum	12.5	3.8	5.6		5.6
Average	38.5	30.7	34.5	53.2	45.3

These figures show a wide range in wastage rates, though there are several trends that emerge. First, BCG wastage is higher Norther Darfur than for the districts sampled in Southern Darfur. Second, TT wastage rates are among the highest, with the exception of Nyala and Idd El Ghanum districts. Measles wastage rates are also consistently high, with the exception of Nyala.

B. Regional Level

1. Costs at Regional Level

At regional level, all administrative costs for the program, such as salaries of program managers and contributions by the District Council, were included in the calculations. This analysis also includes the contributions made by NGOs and other donor organizations to the regional effort. The annual cost for 1988 for the EPI was over $1 million (see Table V.5). The total cost for child doses (total estimated annual cost minus the fraction attributable to tetanus toxoid doses) was just under $1 million (LS 4.4 million). The greatest share of the resources was contributed by EPI/Headquarters through UNICEF cash assistance to the region at 41% ($456,371 or LS 2 million). The MOH contributed 19% of total cost ($205,868 or LS 916,000), mostly for salaries and some transportation expenses. MSF/Belgium contributions was approximately 3% overall ($35,020 or LS 156,000). District Council contributions were limited and amounted to 7% of the total cost ($74,839 of LS 333,000).

As expected the greatest cost component was for personnel costs (50% of total cost). Per diem accounted for 4% of total cost, and vaccine was 6% of total cost. Recurrent costs accounted for 74% of total cost. Capital costs, of which vehicle costs were the greatest share of total costs (15%) represented 26% of all resources used to deliver immunization services last year in Darfur.

2. Number of Doses

The total number of doses administered last year in the region was 528,376 according to the EPITrack system. This results in an average cost per dose of $2.09 or LS 9.30.

TABLE V.6
TOTAL COST OF THE EPI AT REGIONAL LEVEL IN DARFUR

CATEGORY	MOH	DISTRICT COUNCIL	EPI/ UNICEF	USAID RHSP	MSF/ BELGIUM	TOTAL	PERCENT
RECURRENT COST							
Personnel	$131,053	$49,073	$59,156	$34,702		$547,969	49.7%
Salary/Benefits	$131,053			$34,702		$439,740	39.9%
Per Diem			$46,682			$46,682	4.2%
Staff Support			$12,474			$12,474	1.1%
Overtime		$49,073				$49,073	4.5%
Vaccine			$65,923			$65,923	6.0%
Supplies			$41,828			$41,828	3.8%
Transportation	$40,143	$10,500	$15,621	$796		$67,059	6.1%
Fuel	$33,806	$10,500	$15,621	$796		$60,722	5.5%
Oil	$6,337					$6,337	0.6%
Maintenance/Oper.	$1,213	$3,067	$36,204	$14,442		$54,927	5.0%
Cold Chain						$0	0.0%
Vehicles		$3,067	$36,204	$2,062		$41,334	3.7%
Buildings	$1,213			$12,379		$13,593	1.2%
Training			$16,170	$1,501		$17,670	1.6%
Social Mobilization						$0	0.0%
Other funds		$12,199	$12,396	$718		$25,312	2.3%
SUBTOTAL RECURRENT	$172,409	$74,839	$247,298	$52,158		$820,688	74.4%
CAPITAL COST							
Equipment			$51,663		$29,198	$80,861	7.3%
Vehicles			$157,410	$4,462		$161,872	14.7%
Buildings	$33,459				$5,822	$39,281	3.6%
Other							0.0%
SUBTOTAL CAPITAL	$33,459	$0	$209,073	$4,462	$35,020	$282,014	25.6%
TOTAL COST	$205,868	$74,839	$456,371	$56,620	$35,020	$1,102,702	100.0%
PERCENT	18.7%	6.8%	41.4%	5.1%	3.2%	100.0%	

Total doses	528,376
Cost per dose	$2.09
Percent TT	9.8%
Total Child Cost	$995,094
Target population	152,095
Number FIC (23.1%)	35,134
Cost per FIC	$28.32

3. Cost per Fully Immunized Child

The total number of fully immunized children was estimated from the coverage survey results (23.1% of children less than one year) and an estimate of the target population in the region (152,095 based on EPITrack). The total number of FIC was estimated to be 35,134.

The average cost per FIC was approximately $28 or LS 126. This figure may reflect the difficulty in providing EPI services to a scattered and remote population. However, some investigation as to the efficiency of the mobile team strategy should take place in order to maximize returns on resources used for the program.

4. Drop-Out Rate

At regional level, the drop-out rate between DPT1 and DPT2 was 40%, and between the first and third doses of DPT, the rate was 44%. The drop-out rate for TT1 and TT2 was 41%. These rates are slightly higher than those estimated by the coverage survey.

5. Wastage

Wastage rates were calculated based on the reported number of vaccine doses received, used and remaining at the end of February 1989. Wastage for BCG was 68%, for DPT, 19% for OPV, 77%, for measles, 75% and for TT, 71%. Significant cost savings would result from better conservation of vaccine in the region.

6. Sensitivity Analysis

A sensitivity analysis was conducted on the principal assumptions made in the analysis in order to determine how the cost per FIC changes when these assumptions are altered. A sensitivity analysis can also show what would happen to total regional cost and outcomes if certain programmatic changes were made. Table V.6 presents the results of the sensitivity analysis.

a) Exchange rate

The cost-effectiveness study used an exchange rate of 4.45 Sudanese pounds per U.S. dollar, which is an average of the official rate (LS 4.50) and the United Nations rate (LS 4.40) for the first ten months of 1988. All donor assistance funnelled through UNICEF is subject to the 4.40 exchange rate and therefore, it was felt important to average the two rates for the study. Because the exchange rate for the U.S. dollar rose from 4.50 to 12 in October, the regional analysis was conducted using the more recent figure. This results in a 30% reduction in the cost per FIC less than one to nearly $20 or LS 90.

b) All children fully immunized

The coverage survey calculated that 23.1% of the children in the sample had been fully immunized by their first birthday; however, 34% of the total sample were fully immunized. This sensitivity analysis uses the figure of 34% to assess what the impact would be on the cost-effectiveness ratio if children had been immunized earlier. This results in a 32% reduction in the cost per FIC to $19 or LS 86.

TABLE V.7
SENSITIVITY ANALYSIS OF THE COST EFFECTIVENESS OF THE EPI IN DARFUR REGION
(in U.S. $)

SCENARIO	DESCRIPTION	TOTAL CHILD COST	NUMBER FIC	COST/FIC	PERCENT CHANGE
	Original estimate	995,094	35,134	28.32	
A	Exchange rate of 12 Sudanese pounds/1 USD	698,779	35,134	19.89	-29.8
B	All children fully	995,094	51,712	19.24	-32.1
C	Donor inputs extracted	653,841	35,134	18.61	-34.3
D	Vehicle life reduced to three years rather than five years	989,629	35,134	28.17	-0.5

c) Donor inputs withdrawn, except for UNICEF cash assistance

This analysis was conducted to show the effect on the study results of removing MSF/Belgium and USAID contributions to the EPI in the form of equipment, vehicle and training assistance to the region. Much of the equipment was in storage at the time of the survey. This analysis results in a 34% reduction in the cost per FIC to $18.31 or LS 81.

d) Vehicle life of three years

This final analysis shows that there are minor implications to the original cost-effectiveness estimates of reducing the useful life of vehicles from five to three years to more accurately reflect the road and driving conditions in Darfur. There is almost no change in the cost per FIC.

In conclusion, this sensitivity analysis shows very little impact on cost-effectiveness ratios when useful life of vehicles is altered. The figures change by 30% when the current (April 1989) market exchange rate of LS 12 is used. Also, the analysis shows the impact of increasing the productivity of the EPI on reducing the cost-effectiveness ratio in Scenario B.

VI. FINANCIAL MANAGEMENT OF THE EPI IN THE REGION

The ROO or the RDMS, after development of an annual plan of operations, can request cash advances from central EPI headquarters from which to operate immunization services at the regional and district levels. Cheques are written from headquarters for training courses, per diem, staff support, fuel and miscellaneous expenses. These cash advances are usually made on a quarterly basis. The ROO is responsible for reconciliation of the cash advances to the EPI Headquarters every three months (with a 30-day grace period). These accounts must be settled in person with vouchers for each expenditure.

Last year, five cheques were written to Darfur for a total of LS 458,700 or $103,079 for operations. Total expenditures, according to the accounting office of the MOH in Darfur were LS 282,589 or $63,500. Out of total expenditures, 26% was for training (transport costs, training, per diem expenses); 25% was for fuel; 17% was for per diem and 14% was for staff support. Running costs (miscellaneous expenses) accounted for nearly 1/5 of the total expenditures. The account balance (as of December 31, 1988) was estimated at LS 27,611. It appears that the expenditure figures do not reconcile with total advances to the region for last year.

The accounting system at the regional level needs to be strengthened. When the cost-effectiveness study team requested an accounting of the advances made to the region in 1988, it required four days of additional work on the part of the accounting staff in the MOH. Part of the delay was due to the absence of the EPI accountant; however, the account balance should be maintained on a monthly basis so that any of the MOH accountants can document EPI expenditures.

Most of the financial resources remain at the regional level despite the budget allocation from central EPI of 65% of total funds for district operations. Financial resources should be decentralized to district level with DOOs filing monthly reports on amount and types of expenditures.

VII. CONCLUSIONS and RECOMMENDATIONS

The difficulty of implementing and accelerating the EPI in Darfur should not be underestimated and the coverage results are encouraging for the region. This cost-effectiveness analysis has demonstrated there is a wide variation in the performance, the resource use and the outcomes of health facilities, mobile teams and districts. These variations should be used at the regional and district level to find practical ways of reducing costs and improving outcomes of delivery strategies. Some possible future steps include:

1) Determination of the minimum size of a village to be visited by a mobile team. If mobile teams are traveling long distances to reach few children, the EPI needs to decide if this is worth the investment and the opportunity cost of not using the same level of resources elsewhere.

2) Mobile teams should not operate urban areas which are easily served by fixed facilities. Mellit District mobile team drops vaccine at a hospital which is less than 100 meters from the District Operations Office. A system using vaccine carriers should be instituted.

3) An inventory should be made at district level of all of the health facilities which have refrigeration capabilities and all of those which have trained health workers so that these facilities can be integrated into the EPI service delivery strategy.

4) Mobile team members could be trained to provide other health services, such as vitamin A prophylaxis, malaria prophylaxis and treatment, and CDD to name a few.

5) The financial management system from central to regional level needs to be revised and strengthened immediately. Additional accounting information should be requested from Darfur to clear up apparent reconciliation problems.

6) Finances should be decentralized to the district level so that DOOs are not prevented from providing services and running the EPI because they do not have resources to finance small expenses.

7) Our team found a wide range in the quality of records being kept at all levels. There is not much record-keeping on the activities and resources being used for mobile teams. In some districts, the number of doses used by the teams per round is not tracked separately from total district activity. Health facilities often did not keep their own records of immunization activity.

At the district level, stock records were almost non-existent and travel logs were not being kept on a routine basis. At the regional and district levels, there was no apparent analysis of the data being sent to Headquarters every month. It is unclear whether these data are ever fed back to the regional level once an analysis is undertaken in Khartoum.

An in-depth evaluation should take place on what the data requirements are at the district and regional levels, as well as for the mobile teams and facilities. This evaluation should construct a new reporting system which uses management indicators, such as the number of doses per person per month or the number of kilometers per FIC, to evaluate performance and correct and improve service delivery.

8) Darfur should become a priority region for 1989-90 in order to raise coverage levels and improve the management and distribution of resources. It appears that management of the EPI is stronger in the South, which may account for higher coverage rates. The most productive and least costly districts should be analyzed from an operational point of view to find out what they are doing better than other districts. These factors can then be exported elsewhere in the region in order to strengthen the program and bring all districts up to a certain standard.

APPENDIXES

APPENDIX 1	ITINERARY OF FIELD ACTIVITIES IN DARFUR
APPENDIX 2	PERSONS CONTACTED
APPENDIX 3	SUMMARY TABLES
APPENDIX 4	BACKGROUND TABLES

APPENDIX 1

ITINERARY OF FIELD ACTIVITIES IN DARFUR

APPENDIX 1

ITINERARY OF FIELD ACTIVITIES IN DARFUR

The cost-effectiveness study team arrived in El Fasher, Darfur by plane on 10 March and held an informal meeting with Dr. Rashid, Regional Director of Medical Services to discuss the purpose of the study and the immunization program in the region. Determination of the sample frame was made in collaboration with the Provincial Operations Officer on March 11. During this initial meeting, discussions were held as to the location of the clusters for the coverage survey and the correspondence of these clusters with health facilities and mobile teams providing immunization services. Based on the location of facilities, security considerations and logistic requirements, the team planned the data collection process and study team itinerary for the following nine days with the Provincial EPI. Unfortunately, the ROO was not in Darfur during the duration of the cost-effectiveness study team visit.

Data collection in the field began on 12 March; the team traveled to the town of Korma in El Fasher district and collected information from a mobile team operating in that area. On 13 March the team visited two health facilities providing EPI services in the town of El Fasher and continued collecting regional, provincial, and district level cost information in that town. The District Council was also visited to collect information on their contribution to the EPI in El Fasher District.

On 14 March, the team traveled to the district of Mellit and collected information from the DOO, the District Council, two health centers, the hospital, and the mobile team. Despite a dead battery and two flat tires, the team managed to travel to Kutuum district and collected information from the DOO and two mobile teams.

On 16 March, the team completed data collection at the MOH in El Fasher and traveled to Nyala, the provincial capital of South Darfur. An informal meeting was held with the Deputy Director of Health Services and the Provincial Operations Officer on the organization of the EPI in the southern province and on the data collection requirements for the study.

Data collection began and was completed in Nyala District on 17 March, including interviews with the POO, DOO, four urban health facilities and two rural health facilities and the regional radio station. Data were collected on salary rates and MOH expenditures for the program. Although preparations were made to travel to Garcila District the following morning, the itinerary was changed because of security precautions and travel time. The last day, March 18, the study team divided into two, with one group traveling to Zalengei District and one team visiting Idd El Ghanum District. The team returned to El Fasher that evening to depart the following morning to Khartoum by UNDP plane.

A summary of the team itinerary is presented below:

Date	Activity
10 March	Departure for Darfur and meeting with Director of Medical Services
11 March	Data collection in El Fasher town
12 March	Data collection in El Fasher District, Village of Korma
13 March	Data collection in El Fasher town during immunization sessions
14 March	Data collection in Mellit District
15 March	Data collection in Kutuum District
16 March	Final data collection day in El Fasher town and travel to Nyala, Southern Darfur.
17 March	Informal meetings with the Deputy Director of Health Services and the Provincial Operations Officer.
18 March	Data collection in Nyala town
19 March	Data collection in Zalengei and Idd El Ghanum Districts. Travel to El Fasher.
20 March	Return to Khartoum

APPENDIX 2

PERSONS CONTACTED

APPENDIX 2

PERSONS CONTACTED

Northern Darfur
Dr. Rashid, Regional Director for Medical Services
Dr. Mohamed Ismail, Assistant Director for Medical Services
Dr. Abdall El Basher, Provincial Operations Officer
Mohamed El Ha'ag Aseil, Regional Operations Officer
Abdei'Wahed Abdulla Salih, Financial Inspector, Ministry of Health
Ahmed Adam Yousif, Director, District Council
Wadie Girgis, Controller, MSCI

El Fasher District
Abuker Ahmed, Medical Assistant, Korma Dispensary
Mohammed Abd El Rhaman, Vaccinator
Mimuna Ali, Health Visitor
Murtem Jubara, Vaccinator

Mellit District
Muhei El Din Omer, Director, District Council
Ali Saleh, District Operations Officer
El Tigani Marajan, Mobile team vaccinator
Immam Mohamed, Mobile team vaccinator

Kutuum District
Abaker Ibrahim, District Operations Officer
Ibrahim Abaker, Vaccinator
Isaa Hamdan, Vaccinator

Southern Darfur
Dr. Omar, Deputy Director of Health
Dr. Abdullah, Deputy Director of Health
Omar Awad, Provincial Operations Officer
Dr. Stefaan Van Der Borght, Medecins Sans Frontieres/Belgium

Nyala District
Dr. Abdulla Saleh, Coordinator
Abdullah Azim, District Operations Officer
Osama Mukhtar, Vaccinator
Mohamed Abdulla El Rahman, Medical Assistant
Adam Abdulla El Rahman, Vaccinator

Zalengei District
Awad Mohamed, Director, District Council
Abdalla Omer, District Operations Officer
Hameid Ibrahim, Vaccinator Nimat Hassan, Vaccinator

Idd El Ghanum
Mohammed Moctar, District Operations Officer

APPENDIX 3
SUMMARY TABLES

Appendix 3.1

COST OF THE EPI FOR MOBILE TEAMS IN DARFUR REGION

COST CATEGORY	EL FASHER TOTAL EPI	EL FASHER PERCENT	MELLIT TOTAL EPI	MELLIT PERCENT	KUTUUM TOTAL EPI	KUTUUM PERCENT	KUTUUM TOTAL EPI	KUTUUM PERCENT
RECURRENT COST								
1. Personnel	$4,173	16.7%	$1,808	14.8%	$1,025	8.5%	$1,991	14.8%
2. Per diem	$4,396	17.6%	$2,049	16.8%	$1,915	15.8%	$2,724	20.3%
2. Vaccines	$2,409	9.7%	$719	5.9%	$267	2.2%	$301	2.2%
3. Supplies	$1,201	4.8%	$434	3.6%	$370	3.1%	$676	5.0%
4. Transportation	$7,012	28.1%	$1,631	13.3%	$2,961	24.4%	$2,261	16.8%
-Fuel	$6,731	27.0%	$1,542	12.6%	$2,769	22.8%	$2,114	15.7%
-Oil	$281	1.1%	$88	0.7%	$192	1.6%	$147	1.1%
5. Maintenance/Op of Vehicles	$992	4.0%	$992	8.1%	$992	8.2%	$992	7.4%
TOTAL RECURRENT	$20,183	81.0%	$7,634	62.5%	$7,530	62.1%	$8,945	66.5%
CAPITAL COSTS								
1. Equipment	$429	1.7%	$266	2.2%	$273	2.3%	$184	1.4%
2. Vehicles	$4,315	17.3%	$4,315	35.3%	$4,315	35.6%	$4,315	32.1%
TOTAL CAPITAL	$4,744	19.0%	$4,581	37.5%	$4,588	37.9%	$4,499	33.5%
TOTAL COST	$24,927	100.0%	$12,215	100.0%	$12,118	100.0%	$13,444	100.0%

DOSES ADMINISTERED	35,210	10,566	3,537	3,798
COST/DOSE	$0.71	$1.16	$3.43	$3.54
PERCENT TT DOSES	8.8%	11.6%	14.2%	7.3%
TOTAL CHILD COST	$22,725	$10,793	$10,392	$12,456
TOTAL MOBILE TEAM CO IN DISTRICT	$45,450	$10,793	$22,848	
COVERAGE (FIC)	2,250	816	1214	
COST/FIC	$20.20	$13.23	$18.82	

Appendix 3.1 (cont'd)

COST CATEGORY	NYALA TOTAL EPI	NYALA PERCENT	ZALENGEI TOTAL EPI	ZALENGEI PERCENT	IDD EL GHANUM TOTAL EPI	IDD EL GHANUM PERCENT	IDD EL GHANUM TOTAL EPI	IDD EL GHANUM PERCENT
RECURRENT COST								
1. Personnel	$1,991	13.4%	$3,923	17.7%	$2,774	17.3%	$4,173	21.6%
2. Per diem	$2,724	18.4%	$4,342	19.6%	$2,858	17.8%	$4,557	23.6%
2. Vaccines	$1,325	8.9%	$1,586	7.1%	$831	5.2%	$879	4.5%
3. Supplies	$1,781	12.0%	$1,480	6.7%	$665	4.1%	$807	4.2%
4. Transportation	$1,406	9.5%	$5,252	23.7%	$3,351	20.9%	$3,351	17.3%
-Fuel	$1,216	8.2%	$5,011	22.6%	$3,178	19.8%	$3,178	16.4%
-Oil	$189	1.3%	$241	1.1%	$172	1.1%	$172	0.9%
5. Maintenance/Op of Vehicles	$992	6.7%	$992	4.5%	$992	6.2%	$992	5.1%
TOTAL RECURRENT	$10,219	68.9%	$17,575	79.2%	$11,471	71.4%	$14,759	76.3%
CAPITAL COSTS								
1. Equipment	$290	2.0%	$301	1.4%	$283	1.8%	$268	1.4%
2. Vehicles	$4,315	29.1%	$4,315	19.4%	$4,315	26.9%	$4,315	22.3%
TOTAL CAPITAL	$4,605	31.1%	$4,615	20.8%	$4,598	28.6%	$4,583	23.7%
TOTAL COST	$14,823	100.0%	$22,191	100.0%	$16,070	100.0%	$19,342	100.0%

DOSES ADMINISTERED	20,709	19,992	17,832	6,920
COST/DOSE	$0.72	$1.11	$0.90	$2.80
PERCENT TT DOSES	11.7%	16.5%	9.8%	12.3%
TOTAL CHILD COST	$13,087	$18,538	$14,498	$16,972
TOTAL MOBILE TEAM CO IN DISTRICT	$26,175	$37,075	$31,470	
COVERAGE (FIC)	3,975	2,013	1,765	
COST/FIC	$6.59	$18.42	$17.83	

Appendix 3.2

PERFORMANCE INDICATORS FOR THE MOBILE TEAMS IN DARFUR REGION

MOBILE TEAM/ INDICATOR	MT1 EL FASHER	MT2 MELLIT	MT3 KUTUUM	MT4 KUTUUM	MT5 NYALA	MT6 ZALENGEI	MT7 IDD EL GANUM	MT8	AVERAGE	STANDARD DEVIATION
Kms travelled per round	2,723	1,292	1,913	872	2,561	2,365	2,250	2,250	2028	599.0
Scheduled rounds per year	12	10	12	12	12	12	8	8	11	1.7
Actual rounds last year	10	6	9	9	9	12	8	8	9	1.6
Percent scheduled to actual rounds	83.3%	60.0%	75.0%	75.0%	75.0%	100.0%	100.0%	100.0%	84%	14%
Kms travelled per year	27,230	8,578	17,219	13,148	23,049	28,380	18,000	18,000	19,201	6,323
Sites visited/ro.	18	15	17	12	18	24	15	15	17	3.3
No. returns/ro.	8	6	7	4	4	9	4	4	6	1.9
Days per round	18	23	21	13	25	24	19	19	20	3.6
Staff per team	3	4	2	2	1	3	2	3	3	0.9
Doses given/mo	2,382	1,066		162		2,278	2,011	759	1,443	832
Doses given/yr	23,820	6,396	0	1,458	0	27,336	16,080	6,072	10,146	10,185
No. FIC/mo.	273	79	6	4			271	72	118	113
No. FIC/yr	2,730	474	54	36	0	0	2,168	576	755	1,010
Population served (1 year		5,239	1,988	1,988	3,000				3,054	1,327
Days/site	1.0	1.5	1.2	1.1	1.4	1.0	1.3	1.3	1.2	0.2
Kms/Dose	1.1	1.3		9.0		1.0	1.1	3.0	2.8	2.9
Kms/Contact (DPT1 under 1)	6	11	62	19	6	61	8	17	24	22
Kms/FIC	10	18	319	365			8	31	125	154
Doses/site/mo.	132	71	0	14	0	95	134	51	62	52
Doses/FIC/mo.	9	13	0	41			7	11	13	13
Doses/team/day	132	46	0	12	0	95	106	40	54	48
Doses/person/day	44	12	0	6	0	32	53	13	20	19
FIC/day	15.17	3.43	0.29	0.31	0.00	0.00	14.26	3.79	4.7	6.0
Kms/day	151.28	56.17	91.11	67.08	102.44	98.54	118.42	118.42	100.4	28.3
Dose/population		1.22	0.00	0.73						
FIC/population		0.09	0.03	0.02						

Kms per contact based on the number of kilometers per round (per month) divided by the number of DPT1 administered per round.

APPENDIX 3.3

COMPARISON OF EPI COSTS AMONG HEALTH FACILITIES: DARFUR REGION

COST CATEGORY	HF2	HF3	HF5	HF7	HF9	HF11	HF12	HF10	HF15	HF16	AVERAGE	PERCENT
RECURRENT COST												
1. Personnel	$228	$45	$52	$183	$314	$114	$199	$3,748	$28	$21	$493	41.3%
2. Vaccines	$337	$337	$69	$337	$217	$192	$129	$192	$45	$63	$192	16.0%
3. Supplies	$124	$108	$52	$490	$162	$162	$299	$162	$24	$31	$162	13.6%
4. Transport	$53	$27	$27	$5	$18	$35	$91	$61	$138	$262	$72	6.0%
5. Rent				$337							$34	2.8%
TOTAL RECURRENT	$742	$516	$200	$1,025	$711	$504	$717	$4,163	$235	$377	$953	79.7%
CAPITAL COSTS												
1. Equipment	$6	$6					$22	$26			$15	1.3%
2. Vehicles						$24					$24	2.0%
3. Buildings	$1,085	$64			$142	$28	$139	$142	$22	$10	$204	17.1%
TOTAL CAPITAL	$1,091	$70	$0	$0	$142	$52	$161	$168	$22	$10	$243	20.3%
TOTAL COST	$1,833	$563	$200	$1,025	$853	$555	$878	$4,331	$257	$387	$1,195	100.0%
NUMBER OF DOSES	1368	1404	684	8076	3228	2760	1776		540	828	2296	
COST PER DOSE	$1.34	$0.42	$0.29	$0.13	$0.26	$0.20	$0.49		$0.48	$0.47	$0.52	
PERCENT TT DOSES	49.1%	37.6%	23.9%	22.3%	0.0%	21.2%	3.5%	21.2%	20.0%	13.0%	21.2%	
TOTAL CHILD COST	$932	$366	$152	$796	$853	$438	$847	$3,413	$206	$336	$834	
NUMBER FIC	24	36	36	744	180	180	42	84	9	5	134	
COST/FIC	$38.85	$10.15	$4.22	$1.07	$4.74	$2.43	$20.17	$40.63	$22.88	$67.26	$21.24	

APPENDIX 34

COMPARISON OF EPI COSTS AMONG HEALTH FACILITIES: DARFUR REGION

(cost profiles %)

COST CATEGORY	HF2	HF3	HF5	HF7	HF9	HF11	HF12	HF10	HF15	HF16	AVERAGE
RECURRENT COST											
1. Personnel/Staff	12.4%	7.7%	26.2%	17.9%	36.8%	20.6%	22.6%	86.5%	10.9%	5.4%	41.3%
2. Vaccines	18.4%	57.4%	34.6%	32.9%	25.5%	34.6%	14.7%	4.4%	17.5%	16.2%	16.0%
3. Supplies	6.8%	18.4%	26.0%	48.7%	19.0%	29.2%	34.0%	3.7%	9.5%	7.9%	13.6%
4. Transportation	2.9%	4.5%	13.3%	0.5%	2.1%	6.4%	10.4%	1.4%	53.6%	67.8%	6.0%
5. Rent				32.9%							
TOTAL RECURRENT	40.5%	88.1%	100.0%	100.0%	83.4%	90.7%	81.7%	96.1%	91.4%	97.3%	79.7%
CAPITAL COSTS											
1. Equipment	0.3%	1.0%					2.5%	0.6%			1.3%
2. Vehicles						4.3%					2.0%
3. Buildings	59.2%	10.9%			16.6%	5.0%	15.8%	3.3%	8.6%	2.6%	17.1%
TOTAL CAPITAL	59.5%	11.9%	0.0%	0.0%	16.6%	9.4%	18.3%	3.9%	8.6%	2.6%	20.3%
TOTAL COST	$1,833	$586	$200	$1,025	$853	$555	$878	$4,331	$257	$387	$1,195

Appendix 3 5

COMPARISON OF COSTS OF THE EPI PER DISTRICT
BY CATEGORY OF COST IN DARFUR REGION

COST CATEGORY	EL FASHER	MELLIT	KUTUUM	NYALA	ZALENGEI	IDD EL GHANUM	AVERAGE	PERCENT
RECURRENT COST								
1. Personnel	$61,304	$19,834	$49,090	$38,697	$23,401	$18,616	$35,157	40.0%
Salary/housing	$22,257	$11,295	$20,304	$18,951	$9,932	$11,346	$15,681	
DC allowance	$593	$3,371	$3,371				$2,445	
Per Diem	$29,935	$4,517	$20,831	$18,003	$10,479	$6,866	$15,105	
Staff support	$2,157	$202	$1,888	$1,743	$539	$404	$1,156	
Overtime	$6,361	$449	$2,697		$2,451		$2,989	
2. Vaccine	$6,942	$1,438	$2,344	$4,620	$1,238	$1,562	$3,024	3.4%
3. Transportation	$15,007	$12,452	$13,496	$8,045	$17,087	$37,938	$17,337	19.7%
-Fuel	$13,401	$12,025	$11,984	$5,059	$14,722	$28,286	$14,246	
-Oil	$1,606	$427	$1,512	$2,986	$2,365	$9,653	$3,091	
4. Supplies	$11,398	$980	$1,135	$5,894	$2,001	$1,780	$3,865	4.4%
5. Training	$9,300	$120	$3,000	$2,205	$2,520	$2,880	$3,338	3.8%
6. Maintenance	$5,933	$2,925	$3,524	$6,560	$2,245	$1,985	$3,862	4.4%
7. Other/Running Cost	$2,027	$1,798	$899		$334		$1,264	1.4%
Subtotal	$111,910	$39,547	$73,489	$66,020	$48,825	$64,762	$67,847	77.1%
CAPITAL COSTS								
1. Vehicles	$16,905	$4,315	$15,323	$28,520	$9,760	$8,630	$13,909	15.8%
2. Equipment	$3,520	$3,327	$4,923	$3,274	$3,576	$5,265	$3,981	4.5%
3. Buildings		$3,359	$2,819	$1,919	$1,799	$1,200	$2,219	2.5%
Subtotal	$20,425	$11,000	$23,065	$33,713	$15,134	$15,094	$20,109	22.9%
TOTAL COST	$132,334	$50,548	$96,554	$99,733	$63,960	$79,856	$87,956	100.0%
TOTAL DOSES	63,180	3,447	13,200	110,796	19,068	37,236	41,155	
COST PER DOSE	$2.09	$14.66	$7.31	$0.90	$3.35	$2.14	$2.14	
PERCENT TT	12.2%	11.6%	13.5%	19.9%	13.7%	10.4%	13.6%	
TOTAL CHILD COST	$116,173	$44,664	$83,501	$79,841	$55,221	$71,518	$76,020	
TARGET POPULATION	13,955	5,059	7,529	24,651	12,486	10,948	12,438	
NUMBER FIC	3,224	1,169	1,739	5,694	2,884	2,529	2,873	
COST PER FIC	$36.04	$38.22	$48.01	$14.02	$19.15	$28.28	$26.46	

Appendix 3 6

ACTIVITY INDICATORS AT DISTRICT AND REGIONAL LEVEL

INDICATOR	AVERAGE	MINIMUM	MAXIMUM	REGION
Number of Doses Per Year	41,155	3,447	110,796	528,376
Doses to Children Less Than One Year	41,066	9,636	110,796	264,312
Percent of Doses Out of Target	12.2%	0.0%	34.4%	24.0%
Cost per Dose	$5.08	$0.90	$14.66	$2.01

APPENDIX 4
BACKGROUND TABLES

APPENDIX 4.1

BASE ESTIMATES FOR PERSONNEL COSTS: DARFUR REGION

SALARY SCALES:DARFUR	Base/Mo Old	Housing/m Old	Total/mo Old	%increase	New base/ month	Staff support	Subtotal	Per Diem	Total/Mo	Total/ Year LS	Total/ Year $$
Reg. DMS	2253		2253	0.166	2627	250	2877	350	3227	38729	$8,703
Asst Reg DMS	941		941	0.166	1097	250	1347	250	1597	19159	$4,306
Deputy Director Hlth	371	150	521	0.166	607	0	607	250	857	10290	$2,312
ROO	590	95	685	0.185	921	350	1271	315	1586	19032	$4,277
POO North	398		398	0.185	472	200	672	325	997	11960	$2,688
POO South	176	90	266	0.185	315	200	515	375	890	10683	$2,401
Average POO	287	45	332		393	200	593	350	943	11321	$2,544
DOO North	490		490	0.185	581		581	325	906	10868	$2,442
DOO South	286	80	366	0.185	434		434	286	720	8637	$1,941
Average DOO	388	40	428		507	0	507	306	813	9752	$2,191
Asst DOO	136	60	196	0.185	232		232	136	368	4419	$993
Vaccinator North	187		187	0.746	327	100	427	400	827	9918	$2,229
Vaccinator South	136	30	166	0.746	290		290	360	650	7798	$1,752
Average Vaccinator	162	15	177		308	50	358	380	738	8858	$1,991
Team Leader:N	253		253	0.548	391		391	360	751	9013	$2,025
Team Leader:S	250	80	330	0.548	511		511	400	911	10930	$2,456
Leader average	251	40	291		451	0	451	380	831	9972	$2,241
Statistician	209		209	0.487	311		311		311	3729	$838
Driver North	127		127	0.575	200		200	360	560	6717	$1,510
Driver South	122	30	152	0.575	239		239	300	539	6473	$1,455
Average Driver	124	15	139		220	0	220	330	550	6595	$1,482
Asst Driver:N	73		73	0.759	128		128	160	288	3450	$775
Asst Driver:S	80	30	110	0.759	193		193		193	2322	$522
Average Asst	76	15	91		161	0	161	80	241	2886	$649
Trans Off.:N	205		205	0.554	318	100	209		418	5015	$1,127
Trans Off:S	220	30	250	0.554	389		389	225	614	7367	$1,655
Average Trans	212	15	227		353	50	403	113	516	6191	$1,391
Accountant	209		209	0.439	301	100	401		401	4809	$1,081
Cold Chain Tech	236		236	0.436	339		339	270	609	7307	$1,642
Typist North	158		158	0.519	240	75	315		315	3775	$848
Typist South	76	45	121	0.519	183	75	258		258	3101	$697
Average Typist	117	23	139		212	75	287		287	3438	$773
Nurse	138	40	178	0.425	255		255	360	615	7381	$1,659
Midwife	200		200		200		200	300	500	6000	$1,348
Med Asst	255	45	300	0.425	427		427		427	5121	$1,151
CHW	127		127	0.425	181		181		181	2167	$487
Supply Officer	219	40	259	0.482	383	75	458		458	5497	$1,235
Sanitary Over.	300	80	380	0.425	541		541		541	6489	$1,458
Asst San Over	200	60	260	0.425	371		371		371	4453	$1,001
Guard	156	42.5	199	0.738	345		390		390	4680	$1,052
Medical Officer					955		955		955	11460	$2,575
Health Visitor					320		320		320	3840	$863

APPENDIX 4.2

COSTS OF VACCINE

The vaccine in the Sudan's EPI is procured through UNICEF. The amount spent on vaccine was determined from the UNICEF shipping reports; all invoices raised in 1988 were included in the cost of vaccine for that year. A total of 21 shipping reports were used in this analysis.

The shipping reports show the antigen, its value, and the cost of freight, in US dollars. The supporting documents from the manufacturer show how many vials of the vaccine were dispatched, cost per vial, and any special discounts (e.g. 0.3% discount for WHO testing). These supporting documents were needed in order to separate out the cost of individual antigens, since one-third of the shipping reports were a combined invoice for two different antigens. These are shown in the attached table.

For each antigen, an average cost per vial and an average cost per dose was calculated. These figures were then used in the spreadsheets containing data on stock movements and doses administered, to calculate the cost of vaccine administered, and the cost of vaccine used (i.e. including the cost of wastage).

There was a complication in choosing the average costs for BCG; the first two shipments were 10-dose vials which worked out to cost almost three times more per dose than the 20-dose vials. Since all of the 10-dose BCG had already been used, the cost of BCG in 20-dose vials was used in this analysis.

Freight charges have not been included in the calculation of the cost of vaccine at the levels of mobile team, health facility, district or region. The cost of freight was 14% of the value of the vaccine itself.

APPENDIX 4.2
(continued)

TYPE OF VACCINE	RECEIVED AT CC STORES DOSES	DATE LOGGED	VIALS	DATE OF UNICEF SHIPPING REPORT	VALUE US $	COST PER VIAL	COST PER DOSE	AVERAGE COST PER DOSE	FREIGHT US $	0=One vaccine, one invoice 1=1st vaccine, combined invoice 2=2nd vaccine, combined invoice	
BCG	600000	21-Jan-88	60,000	11-Mar-88	$46,200	$0.770	$0.077		$10,330	0 $0.77/vial	10 doses
BCG	600000	07-Mar-88	60,000	15-Mar-88	$71,596	$1.193	$0.119		$8,578	0 Y152/vial,less 0.3%	10 doses
BCG	800000	30-Jun-88	40,000	07-Jul-88	$29,110	$0.728	$0.036		$3,994	0 £0.425/vial	20 doses
BCG			20,000	18-Jul-88	$20,400	$1.020	$0.051	$0.012 Min	$4,035	0 Y133/vial	"
BCG	200000	19-Jul-88	10,000	07-Sep-88	$2,451	$0.245	$0.012	$0.119 Max	$2,253	0	"
BCG	600000	01-Sep-88	30,000	28-Sep-88	$21,537	$0.718	$0.036		$4,788	2 a UK £ BCG @ £0.425	"
BCG	400000	14-Dec-88	20,000	22-Dec-88	$21,738	$1.087	$0.054		$4,849	0	"
	3200000		3,600,000								
				Avg 10-dose BCG		$0.982 per vial		$0.098 per dose for 10-dose vial			
				Avg 20-dose BCG		$0.760 per vial		$0.038 per dose for 20-dose vial			
DPT	1000000	26-Jan-88	50,000	22-Feb-88	$35,659	$0.713	$0.036		$5,695	1 b Swiss Francs	
DPT	1000000	28-May-88	50,000	20-Jun-88	$34,074	$0.681	$0.034		$5,152	0	
DPT	500000	12-Jul-88	25,000	04-Aug-88	$14,935	$0.597	$0.030		$2,762	0	
DPT	500000	19-Jul-88	25,000	18-Jul-88	$24,823	$0.993	$0.050		$2,955	0	
DPT	1000000	20-Dec-88	50,000	03-Jan-89	$33,735	$0.675	$0.034		$13,301	0	
	4000000		4,000,000					$0.037 Avg			
				Avg 20-dose DPT		$0.732 per vial		per dose			
Polio	1250000	19-Feb-88	62,500	11-Mar-88	$24,375	$0.390	$0.020		$3,200	1 c YugoDinars	
Polio	1000000	13-Mar-88	62,500	19-Apr-88	$46,842	$0.749	$0.037		$10,293	1 d Ital.Lire	
Polio	1310000	02-Aug-88	62,500	26-Sep-88	$48,077	$0.769	$0.038		$5,812	1 e Ital.Lire	
Polio	600000	11-Dec-88	30,000	12-Oct-88	$24,158	$0.805	$0.040		$1,740	0	
	4160000		4,350,000					$0.034 Avg			
				Avg 20-dose OPV		$0.678 per vial		per dose			
Measles	500000	27-Jan-88	50,000	22-Feb-88	$70,796	$1.416	$0.142		$6,569	0	
Measles	625000	12-Mar-88	50,000	19-Apr-88	$60,778	$1.216	$0.122		$10,293	2 d Ital.Lire	
Measles	500000	02-Aug-88	50,000	26-Sep-88	$62,381	$1.248	$0.125		$5,812	2 e Ital.Lire	
Measles	125000	01-Sep-88	12,500	28-Sep-88	$8,515	$0.681	$0.068		$4,788	1 a UK £ (Vaccine-BCG)	
Measles	375000	20-Dec-88	37,500	19-Jan-89	$42,188	$1.125	$0.113		$6,164	0	
	2125000		2,000,000					$0.114 Avg			
				Avg 10-dose Msls		$1.137 per vial		per dose			
TT	400000	19-Feb-88	20,000	11-Mar-88	$4,200	$0.210	$0.011		$3,200	1 c YugoDinars	
TT	400000	19-Apr-88	20,000	29-May-88	$3,877	$0.194	$0.010		$1,018	2 f YugoDinars	
TT	400000	13-Jul-88	20,000	25-Aug-88	$3,877	$0.194	$0.010		$1,062	1 g YugoDinars	
	1200000		1,200,000					$0.010 Avg			
				Avg 20-dose TT		$0.199 per vial		per dose			
DT	40000	26-Jan-88	2,000	22-Feb-88	$1,256	$0.628	$0.031		$5,695	2 b Swiss Francs	
DT	40000	19-Apr-88	2,000	29-May-88	$2,453	$1.227	$0.061		$1,018	2 f YugoDinars	
DT	40000	13-Jul-88	2,000	25-Aug-88	$2,453	$1.227	$0.061		$1,062	2 g YugoDinars	
DT	40000	03-Sep-88	2,000	19-Oct-88	$730	$0.365	$0.018		$138	0	
	160000		160,000					$0.043 Avg			
				Avg 20-dose DT		$0.862 per vial		per dose			

TOTAL EXPENDITURE 1988 Vaccine $763,214 Freight $106,870 (106870/763214)= 14%

To cover the cost of freight, ADD 14% of the cost of the vaccine.

APPENDIX 4.3

TRAINING PROVIDED BY DARFUR REGION IN 1988

DISTRICT	NORTH DARFUR	SOUTH DARFUR	TOTAL DARFUR
NUMBER OF COURSES	14		
D.O.O.	0	0	0
MEDICAL ASSISTANTS	3	49	52
HEALTH VISITORS	1	6	7
VACCINATORS	0	8	8
COMM HEALTH WRKRS	10	126	136
SUPERVISORS	0	0	0
CERTIFIED NURSES	4	61	65
COLD CHAIN TECH	0	0	0
SANITARY OVERSEER	4	28	32
SISTER	1	6	7
HEALTH EDUCATOR	0	0	0
TEACHER	1	3	4
OTHERS	0	8	8
MIDWIVES	10	44	54
TOTAL PARTICIPANTS	34	339	373
LENGTH IN DAYS	4	8	
TOTAL DAYS TRAINING	136	2,712	2,848

NB: Basic EPI courses = 8 days;
refresher course = 4 days.

APPENDIX 4.4

COMPARISON BETWEEN MAINTENANCE ESTIMATES
BY ANALYSIS OF EXPENDITURES AND HYPOTHETICAL CASES

EXPENDITURE DATA	PRICE	ANNUAL COST	MAIN COST	% PRICE	% COST
Toyota DC	$11,604	$4,314.91	$398.16	3.4%	9.2%
Toyota SC	$10,649	$3,959.80	$398.16	3.7%	10.1%
Landcruiser	$18,000	$6,693.24	$398.16	2.2%	5.9%
Motorcycle	$1,000	$423.44	$303.96	30.4%	71.8%
Panda	$6,728	$2,501.83	$1,449.67	21.5%	57.9%
Average				12.3%	31.0%
HYPOTHETICAL CASE	**PRICE**	**ANNUAL COST**	**MAIN COST**	**% PRICE**	**% COST**
Toyota DC	$11,604	$4,314.91	$1,049.21	9.0%	24.3%
Toyota SC	$10,649	$3,959.80	$1,049.21	9.9%	26.5%	
Landcruiser	$18,000	$6,693.24	$1,049.21	5.8%	15.7%
Panda	$6,728	$2,501.83	$1,049.21	15.6%	41.9%
Average				10.1%	27.1%
AVERAGE MAINT/YEAR				11.2%	29.0%

APPENDIX 4.5

EQUIPMENT LIST FOR KORDOFAN, AND PRICES FROM VARIOUS SOURCES

Q. No.	Vehicles and Equipment		Local Proc ES	Best Estimate	Use-Life Years	Annualized Cost For r=25%
1	Toyota Hilux Double cab	LN65L-MRP, 2 L		$11,604.00	5	$4,314.91
1.1	Toyota Hilux Single cab	LN65L-MR, 2 L		$10,649.00	5	$3,959.80
2	Land Cruiser Pickup Diesel	BJ75LP-KR		$12,601.50	5	$4,685.83
2.2	Land Cruiser	Buffalo		$18,000.00	5	$6,693.24
3	Motorcycle 70cc	Honda 70		$951.00	4	$402.69
3.1	Motorcycle 80cc	Honda 80		$1,000.00	4	$423.44
3.2	Motorcycle Three-Wheeler	Three-wheeler		$1,244.56	4	$527.00
3.3	Motorcycle 125cc			$1,100.00	4	$465.79
4	Bicycles	Raleigh		$203.67	2	$141.44
6	Air conditioner	Westinghouse		$600.00	5	$223.11
7	Solar refrigerator BP	BP 50 ltr VR 50		$4,000.00	10	$1,120.29
8	RCW42 EK	E3/22		$920.00	10	$257.67
9	TFW 791	Icepack freezer		$700.00	10	$196.05
10	TCW 1151	Ice Liner		$1,295.00	5	$481.54
10.1	Admiral refrigerator	12 Cu ft	1	$1,011.24	10	$283.22
10.2	ColdAir refrigerator	12 Cu ft	1	$786.52	10	$220.28
10.3	Electrolux refrigerator	Kerosene		$1,115.00	10	$312.28
10.4	Philips Tropical fridge	IRE BA8Z3		$600.00	5	$223.11
10.5	Sibir	S2325		$900.00	5	$334.66
10.6	Step-in Refrigerator +3Deg	Huurre K60K-3		$4,000.00	15	$1,036.47
12	Admiral freezer	10 Cu ft		$1,573.03	10	$440.56
12.1	Electrolux Chest freezer	TC1850 (E3/10)		$420.00	10	$117.63
12.2	Vestfrost HF5201 T Freezer	(E3/14)		$182.00	10	$50.97
12.3	?Chest freezer (Sussex)	20 Cu ft		$600.00	10	$168.04
13	Vaccine Carrier 1.7 lts	Polyfoam E4/19		$14.60	3	$7.48
14	Vaccine carrier 3504/38	Thermos (grey)		$12.00	3	$6.15
15	Vaccine Carrier 0.3 lts	Model II E4/35		$9.00	2	$6.25
16	Ice packs for Model II	(E5/06)		$0.40	3	$0.20
16.1	Ice packs w/vial holes	Polyfoam E5/02		$0.38	3	$0.19
16.2	Thermos ice-packs (box)	100 per box		$77.00	3	$39.45
17	Dial Thermometer (probe)	EPI/V400/MP		$62.85	10	$17.60
18	Round Thermometer w/hook	Model 418 E6/07		$1.00	5	$0.37
19	Cold Box 20 litres	Savopak		$340.00	8	$102.14
20	Cold Box 8.5 ltr Model 2	Polyfoam		$96.50	5	$35.88
21	RCW 25 (911 1501.01)	"7-day"		$299.00	8	$89.82
21.1	Coleman Cold Box (E4/06)**	Snowlite 5255		$72.00	2	$50.00
22	Generator 4.5KVA	Lister LT1C-12		$1,300.00	5	$483.40
22.1	Generator 15 KVA	Lister TS3		$7,000.00	5	$2,602.93
22.2	Generator 12.5 KVA	Lister		$3,400.00	5	$1,264.28
22.3	Generator portable 0.5 KVA	Yamaha		$900.00	5	$334.66
22.4	Generator, portable	Honda		$900.00	5	$334.66
22.5	Generator 4.5 KVA Onan			$1,300.00	5	$483.40

APPENDIX 4.5 (cont)

EQUIPMENT LIST FOR KORDOFAN, AND PRICES FROM VARIOUS SOURCES

Q.No.	Vehicles and Equipment		Local Proc ES	Best Estimate	Use-Life Years	Annualized Cost for r=25%
23	Voltage Regulator(brown)	Alatrek		$264.00	5	$98.17
23.1	Voltage Regulator(orange)	StabilCite 91		$254.00	2	$183.33
23.2	Voltage Regulator (red)	ASKO T41103 UPO		$264.00	5	$98.17
23.3	Voltage Regulator	ClaudeLyons MVC		$264.00	5	$98.17
25	Public Address (Mobile)	Transistorized		$146.00	5	$54.29
25.1	Public Address (Fixed)			$446.00	5	$165.84
26	Megaphone			$50.00	5	$18.59
27	Tape recorder/Cassette	Multivolt/Batt.		$47.00	2	$32.64
29	Slide projector Hanimex	Syllabus 4000		$117.30	2	$81.46
30	Chair, metal frame		1	$40.45	5	$15.04
31	Chair, wooden		1	$33.71	8	$10.13
32	Table		1	$70.00	10	$19.61
32.1	Small table/stool		1	$15.73	10	$4.41
33	Desk with drawers, metal		1	$247.19	10	$69.23
34	Shelves		1	$107.87	10	$30.21
35	Filing cabinet			$176.00	5	$66.19
36	Cupboard		1	$247.19	5	$91.92
37	Duplicator Gestetner 4130	220V/50Hz		$683.00	5	$253.97
38	Typewriter Arabic	Facit		$450.00	10	$126.03
39	Typewriter English	Facit		$320.00	10	$89.62