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A FIELD TEST REPORT OF IMPLEMENTATION PLANNING AND A COST-BENEFIT MODEL FOR GUINEA WORM ERADICATION IN PAKISTAN

WASH FIELD REPORT NO. 231

MARCH 1988

Prepared for
the Office of Health,
Bureau for Science and Technology,
U.S. Agency for International Development
in collaboration with the Centers for Disease Control
WASH Activity No. 364

WASH Field Report No. 231

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by

John E. Paul

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TABLE OF CONTENTS

FIGURE

TABLE OF CONTENTS

TABLES | **Page**

APPENDIX TABLES

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GLOSSARY OF ACRONYMS

BCR	Benefit-cost ratio
CBA	Cost-benefit analysis
CDC	Centers for Disease Control
GDP	Gross domestic product
IRR	Internal rate of return
NIH	Pakistan National Institute of Health
NPV	Net present value
NWFP	North West Frontier Province
UNICEF	United Nations Children Fund
WASH	Water and Sanitation for Health Project

EXECUTIVE SUMMARY

From August 4 to August 28 and December 4 to December 18, 1987, the author worked with the Guinea Worm Elimination (dracunculiasis) Program of the Pakistan National Institute of Health to field-test a cost-benefit model for the control of guinea worm disease. The model was developed by the Water and Sanitation for Health (WASH) Project (see WASH Technical Report No. 38, "Cost-Effective Approaches to the Control of Dracunculiasis"). The Pakistan field test was sponsored by WASH and funded by the U.S. Agency for International Development, and was assisted by the Parasitic Diseases Branch of the U.S. Centers for Disease Control and the Global 2000 Project's Pakistan Health Initiative.

Given the different rates of guinea worm disease prevalence, socioeconomic conditions, and the intervention strategies in the guinea worm endemic areas in Pakistan, three separate planning and cost-benefit models were developed based on the three strategies in the endemic areas. The models focused on epidemiological surveys, health education, and chemical treatment of water sources--i.e., cisterns in the Northwest Frontier Province, ponds in the Punjab, and "terais" (rainwater collection depressions) in Sind. Program designs and estimated costs for possible guinea worm intervention programs were prepared for each of the three endemic provinces. The estimated costs reflect different assumptions regarding the number of endemic villages and the intervention strategy "mix."

Program design and cost data were gathered from discussions with guinea worm program staff and based on experience to date in the pilot villages. Further data were obtained from other Pakistan government and bi- and multi-lateral donar agency officials.

The microcomputer-based implementation model linked the planning aspects in the design and cost spreadsheets with spreadsheets projecting cost and benefit flows over time, each prepared according to the three strategies in the endemic provinces. Data relating to lost productivity was obtained from Pakistan Government census and agricultural output estimates. Cost-benefit ratios were found favorable indicating investment in the program will realize a positive return, within the limitations of the program assumptions and the available data. A basic sensitivity analysis was also conducted to test effects of changes in certain parameters in the model.

Overall, the field test indicated the modeling process and cost-benefit simulation presented in WASH Technical Report No. 38 could be applied under actual field conditions and to an actual guinea worm control program. The implementation model can serve as a framework for further guinea worm intervention program design and elaboration. The results of the cost-benefit analysis can serve as a basis for a more comprehensive economic analysis of guinea worm disease in Pakistan and may also be useful to policy makers. Current estimates and assumptions, however, must be considered open to refinement.

Chapter 1

INTRODUCTION

1.1 Cost-Effective Approaches to the Control of Guinea Worm (Dracunculiasis)

WASH Technical Report No. 38, "Cost-Effective Approaches to the Control of Dracunculiasis," proposed activities, developed cost estimates, and presented a cost-benefit analysis (CBA) of "modular" strategies for the control of guinea worm disease.

Dracunculiasis is a parasitic infection caused by human ingestion of a larval nematode contained within the body of a copepod vector, the water flea commonly known as "cyclops." Copepods are typically found in shallow pools, ponds and stepwells used for drinking and washing in rural areas of developing countries. Within the body the larvae are released, molt twice, and mate when mature, approximately 3 months after initial ingestion. The male worm(s) die at about 6 months of age, while at about 8 months of age the female worm(s) migrate to the subcutaneous tissue, 85 percent of the time in the lower extremities. Approximately one year after initial infection, the female worm is ready to emerge and emit larvae, and the disease symptoms first become apparent to the infected individual.

Dracunculiasis is recognized and well known by local names in endemic areas. Symptoms begin with a characteristic painful blister caused by a secretion from the emerging worm. Secondary symptoms caused by host reaction to the worm antigens include urticaria, nausea, vomiting, diarrhea, asthma, giddiness, and fainting. Later symptoms may be produced by secondary bacterial infection after the blister bursts. Finally, if the worm is injured or lacerated while lying in the subcutaneous tissue, additional local and systemic reactions may occur. The affected area often becomes extremely painful, inflamed and edematous. Cellulitis may result from secondary growth of staphylococci and streptococci, and gangrene is not uncommon. Arthritis, synovitis, epididymitis, contraction of the tendons, and ankylosis of joints are among the crippling conditions that may ensue. In a small percentage of cases death can result due to systemic bacteremia or tetanus.

The disease cycle is perpetuated through release of hundreds of thousands of larvae by the female worm when the ulcer with the protruding worm is immersed into water by the infected individual when fetching water or to relieve the pain and burning sensation. The released larvae are then ingested by copepods where they go through additional development stages. In approximately 14 days the third-stage larvae contained in the cyclops are able to reinfect humans and produce another generation of worms which will emerge on year later.

The WASH report presented assessments of the potential of existing water supply and sanitation projects, primary health care projects, and other projects to select modules, or parts of modules, that could serve as cost-effective guinea worm control adjuncts. These four modules were epidemiologic surveillance, health education, improved water supplies, and vector control.

The approach was comprehensive in order to serve as a planning tool for programs focused exclusively on guinea worm disease. Data for the original report came from a variety of sources, mostly West African. Cost estimates and the CBA were a simulation of a hypothetical two-year program to benefit an estimated 50,000 people in 100 villages. In developing the simulation, program design assumptions were not based on actual field conditions but rather on an amalgam of situations, approaches, and likely program contexts.

The simulation took into account detailed costs for several program configurations, estimates of disease prevalence, costs of medical care for the disease (if assumed available), estimates of intervention effectiveness, lost productivity of those affected, and other factors. Costs and benefits were discounted over a ten-year horizon and resulting benefit-to-cost ratios were found to be favorable.

A follow-up task by WASH was proposed to test the simulation model under actual field conditions. The field test was conceived primarily to examine the usefulness of the model as a planning tool for the design and implementation of guinea worm control programs. To the extent possible, it was also intended that the field test produce a planning model and cost-benefit model for use by program planners, policy makers, and others.

This report presents the results of the field test carried out with the Pakistan National Institute of Health (NIH) Guinea Worm Eradication Program in August and December of 1987 as well as a brief overview of the program.

1.2 Overview of Economic Effects of the Disease

Guinea worm disease occurs mainly among older children and adults and can have a severe affect on economic productivity because the symptoms, which are often completely debilitating, characteristically appear during the season of greatest agricultural activity. On average four to six weeks may elapse before an uncomplicated lesion completely heals. Assuming that 40 percent of those afflicted are completely disabled for a period of approximately 40 days, Ward (1984) has calculated that for every six percent of the population aged 15 to 44 affected by the disease, one day of productivity per worker is lost annually. As an example of the extent of this loss, in a village where 12 percent of the population aged 15-44 is affected, and where the productive population is, for example, 300, the calculation of the number of lost productive days would be as follows:

$$\frac{\text{12 percent affected}}{\text{6 percent}} = \text{factor of 2}$$

2 x 300 potential productive workers x 1 day
= 600 expected days of lost productivity.

In any predominantly agricultural area with a relatively short growing season (four months or under), 600 days lost during the peak working periods could result in a considerable economic loss. Depending upon patterns of use of polluted water sources, the community-wide prevalence may, however, vary from only a few persons to up to 80 percent of the population in some countries in West Africa. Furthermore, villages with and without guinea worm may be found in the same geographic region.

In another calculation of economic loss specific to Burkina Faso, Guiguemde et al. (1983) consider both the cost of lost agricultural production and estimates of the costs of treatment for the disease. Age-specific prevalence rates, mean number of days of disability, and average annual family income due to agricultural activities are used to arrive at a cost figure for lost agricultural production of approximately US $18 per person over six years of age, regardless of whether or not they are affected by the disease. Costs of treatment were calculated for both uncomplicated and severe cases and were based only on the costs of drugs and dressings. These costs varied from US $17 to US $147. The total cost of the disease (with agricultural costs adjusted if treatment costs are incurred) was estimated as approximately US $9,332 per village per year in three study villages with populations between 3,000 and 4,000.

More general calculations place the global loss in production due to guinea worm disease between $210 million and $3 billion annually (National Academy of Sciences, 1983); using these figures and assumptions regarding the number of people at risk globally, indicates that these specific estimates of per person cost for Burkina Faso may, in fact, be quite conservative.

Finally, guinea worm disease can significantly affect school participation in endemic areas. Nwosu et al. (1982) calculated the rate of school absenteeism in 13 schools in endemic areas to increase from an average of 13.2 percent to nearly 60 percent at the height of the guinea worm season. Ilegbodu (1983) determined for a region in Nigeria that guinea worm is a leading cause of school absenteeism, with infected pupils out for an average of nine weeks. Often the same students are out year after year.

Chapter 2

MODEL FIELD TEST IN PAKISTAN

2.1 Guinea Worm Disease in Pakistan

Guinea worm disease has undoubtedly existed in Pakistan for a very long time. However, it has, as in so many other countries, been the "forgotten disease of forgotten people" with little recognition and few efforts to control it. The "Syncrisis Series" volume on health in Pakistan published in 1976 (USDHEW, 1976) entirely omits any reference to guinea worm or dracunculiasis in the discussion of health risks and problems in Pakistan. Guinea worm disease in Pakistan was brought to the attention of public health professionals in the late 1970s. Then and now, guinea worm disease has been restricted largely to the most remote and impoverished areas of Pakistan.

The disease and its connection with inadequate water supplies, however, is now generally recognized in endemic villages. This level of awareness offers great promise for the success of health education programs. It is also important to note that both villagers and professionals report that the distribution of the disease has been lessening over time, presumably due to development and, in particular, the installation of piped water systems.

2.2 Pakistan National Institute of Health/Global 2000--BCCI Guinea Worm Eradication Program

The Pakistan National Institute of Health (NIH), under a Memorandum of Understanding with the Global 2000--BCCI Project and with the cooperation of the Centers for Disease Control (CDC) in Atlanta, has undertaken an ambitious short-term program to eradicate guinea worm disease in Pakistan. The program began in February 1987 following discussions and planning both in Pakistan and the United States. Immediate activities, after the initial start up, included: (1) designing and implementing a nationwide survey of the census of villages in Pakistan (approximately 48,000) to determine the location and total number of villages affected by guinea worm disease; and (2) establishing two pilot control projects using the chemical ABATE (temephos) for vector control as well as introducing health education and water filters for personal prevention. A household survey was also conducted in the pilot villages. These initial efforts were driven by a sense of urgency to have them completed or under way during the 1987 transmission season, which was delayed in one of the two pilot villages because the rains were late. Subsequent activities have included case-counting prevalence survey as a follow-up of the initial nationwide search and extensive development of health education materials.

2.3 Pilot Villages/Intervention Strategies

The two pilot projects present very great contrasts in patterns of water usage. The first pilot village, in the North West Frontier Province (NWFP), has a large number of discrete water sources including over 300 potentially infected stepwells or virtually one per family compound. Filtering water to remove sediment is already common among the population, and provision of filters for removing the cyclops (assuming these filters are otherwise as "good" or efficient as those currently being used) could be very effective. The early distribution of filters to households in NWFP was well received. Finally, the prevalence of guinea worm even in the pilot village itself appears to be limited and a focused health education program to prevent persons with active lesions from entering the water supply could contribute to breaking the transmission chain.

The second pilot village is in Sind, an area much poorer than the NWFP and suffering from long-term drought. The guinea worm transmission season occurs when the rains come and fill up shallow depressions ("tarais") from which people gather their drinking water. These water sources have not been reliable for several years. The locations of the tarais apparently remain fairly predictable from year to year, however, indicating potentially effective use of ABATE as a vector control for the cyclops population. The use of filters and health education has also been tested in these areas. It should be noted that these areas border on known infected areas in India and that there may be imported (or exported) cases of the disease.

Although not part of the pilot study areas, endemic villages in Punjab appear appropriate for a third implementation model, combining the use of ABATE in ponds normally available year-round for drinking water with filter distribution and health education.

To summarize, three different strategies (corresponding to the three different endemic regions and including Punjab) have been developed and are described in further detail below. In NWFP, the use of filters and health education will predominate, with little or no use of ABATE. In Punjab, some additional use of ABATE will be feasible for the communal ponds. In Sind, the only currently known transmission sites are the seasonal tarais, which appear highly appropriate for treatment with ABATE. These different strategies are referred to in terms of the predominate water source for the villages, as follows:

1. NWFP -- "cistern-based" strategy
2. Punjab -- "pond-based" strategy
3. Sind -- "tarai-based" strategy.

2.4 Cost Assumptions

WASH Technical Report No. 38 proposed a comprehensive program relating to guinea worm control. For its application in Pakistan, however, many simplifications were made, usually because certain circumstances were not applicable to Pakistan (such as use of capped springs or gravity drinking water systems). In cases where no data were available, such as for per capita agricultural gross domestic product (GDP) by region, proxies were devised. (In this case, district-level production of the ten or so "most important" crops multiplied by the prevailing or government price was taken as the proxy for GDP.)

2.4.1 Intervention Options and Program Design

Four intervention options or modules were developed: epidemiologic surveillance, community health education, community water supply, and chemical treatment with ABATE. Separate strategies were developed for NWFP, Punjab, and Sind based on the different number of endemic villages and the differing conditions of these two regions. These separate strategies later provided differing input on the cost side of the cost-benefit analysis for each area. Design characteristics for each module were basically the same for all three areas. In addition, unit costs were assumed to be essentially the same unless region-specific data were available. Program design down to the activity and task level was a highly iterative process. Adding, modifying, and deleting activities or factors included in the original activity "shells" in WASH Technical Report No. 38 required a number of discussions among program staff. Contributions by other government and bi- and multi-lateral agencies were also useful.

Each activity had cost items broken out into the following areas:

- Technical labor
- Training
- Transportation
- Materials and support

Cost categories for all activities included estimates of salaries for three groups of personnel: senior professionals and local consultants, junior professionals, and clerical workers or drivers. Training costs relate to both technical personnel and village people. Transportation costs are for both on-the-job training and for transportation to and from training. Materials include all the "hardware" necessary to support the activity, such as forms, filter material, health education supplies, ABATE, etc.

Costs themselves were felt to be reliably available from the ongoing experience of the guinea worm program and from the expert opinion and knowledge of the professionals in the program. Restricting the number of cost categories to those above represents a trade-off between time and detail. It was felt that these categories were realistic and comprehensive for current needs. More detail and additional categories could, of course, be developed if they were felt necessary for subsequent planning purposes.

Program design components are shown schematically in Figure 1 (which also shows a simplified organization chart of the program) and are summarized in Table 1; program design assumptions are summarized in Table 2. The details and accompanying costs of the program designs are shown in the microcomputer-generated spreadsheets contained in the appendix.

2.4.2 Options and Cost Assumptions

The following discussion of program elements and costs as shown in the appendix are only related to the field and field-support aspects of the program of the Pakistan guinea worm control program. Central administration costs, particularly those for the Global 2000 Pakistan Health Initiative, are not included in the estimates. In addition, development costs for educational materials and the costs of the initial surveys and pilot programs are also not included. The remaining program costs are for mounting and supporting a village-level intervention program to eradicate guinea worm disease in Pakistan, given the preparatory work and the administrative structure and support already in place.

Continued Program of Epidemiologic Surveillance

The guinea worm eradication program in Pakistan is intended to be a short-term, intensive program and has an ambitious goal: the elimination of guinea worm throughout the country in three to five years. It is very important, therefore, that a good system of epidemiologic monitoring be established and maintained throughout the life of the program and continued for several years after the interventions have been completed in order to check for imported cases or infected areas which have been missed. It is likely that reported cases and numbers of infected areas will, in fact, increase as the program grows in visibility and people become aware of the effort. The experience with the national search indicates how difficult it is to mount a surveillance effort. The existing health reporting system and other district- and village-level agencies will of necessity become part of the reporting system.

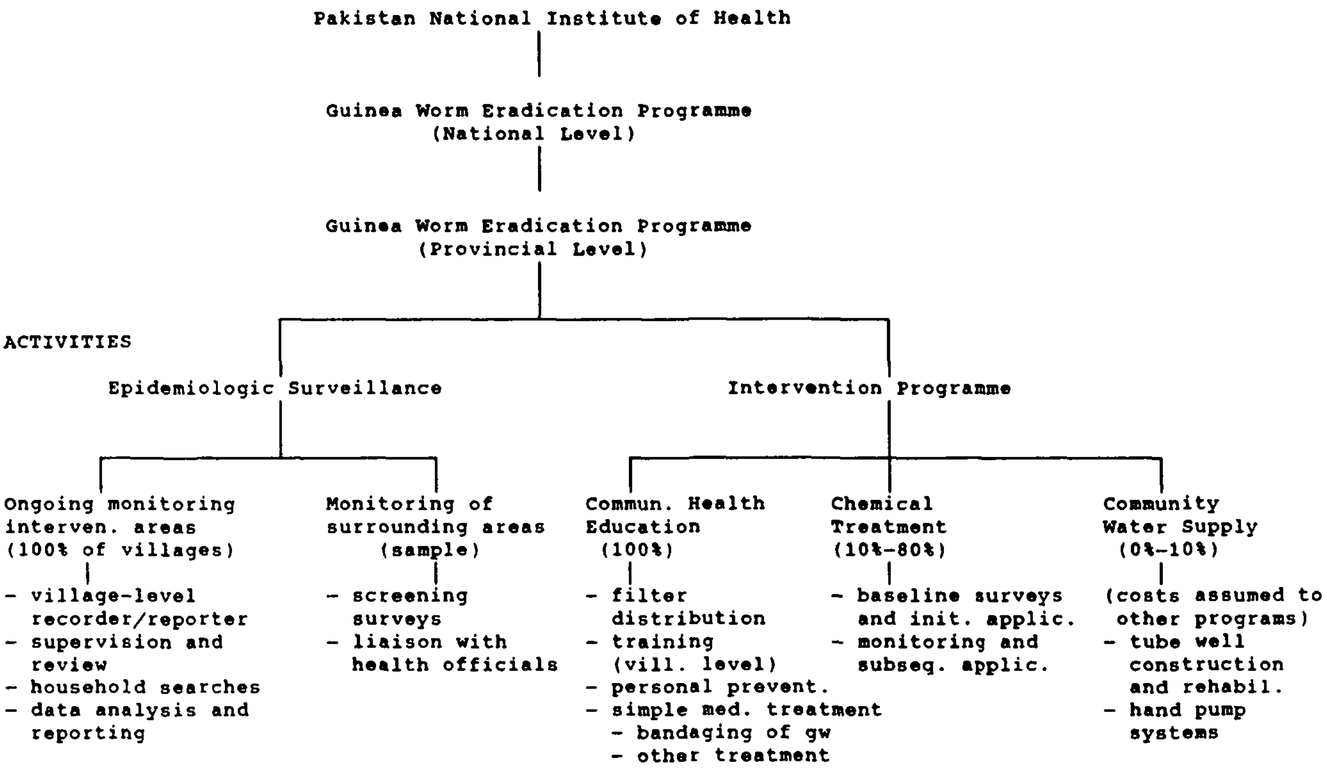
In the implementation spreadsheets (Section 1 of Appendix Tables 1, 2, and 3) in-depth epidemiologic surveillance for the purposes of case counting and monitoring the progress of program implementation is proposed for all endemic villages. A less intensive screening program is proposed and costed for surrounding, currently-not-infected villages. Additional activities include alerting and training health workers and other public officials and data analysis and reporting at the provincial and national level.

Health Education/Distribution of Filters

An essential part of any health program is the community participation/health education that must accompany it. Health education is necessary to insure both the proper understanding and implementation of such a program, as well as to insure its continuity and success. Moreover, for the Pakistan guinea worm control program, health education and promotion of personal prevention have great potential for contributing to program success. Pilot program results in the endemic areas indicate a high level of awareness of the causes of guinea

Figure 1.

Simplified Organization of Implementation Activities
Pakistan National Guinea Worm Eradication Programme



COST CATEGORIES, all activities

I. Labor, Personnel
(salaries, TA/DA)
- senior professionals, local consultants
- junior professionals
- clerical, drivers

II. Training

III. Transportation
- on-the-job
- training

IV. Materials

V. Other

Table 1
Program Design Components

I. Epidemiologic Surveillance Module
- -- Screening surveys (villages surrounding endemic areas)
- -- In-depth surveys (treatment villages)
- -- Liaison with health workers and public officials
- -- Data analysis and reporting

II. Community Health Education/Personal Prevention Module
- -- health education regarding guinea worm disease
- -- filter distribution and instruction
- -- simple medical treatment

III. Community Water Supply Module
- -- Tube well construction and repair
- -- Borehole/Hand pump systems
- -- Maintenance requirements

IV. Chemical Treatment Module
- -- Baseline surveys
- -- Purchase of ABATE
- -- Storage and transportation
- -- Ongoing follow-up and support

Table 2

Program Design Assumptions

Province: Strategy:	NWFP "Cistern-based"	Punjab "Pond-based"	Sind "Tarai-based"
No. of affected villages	79	70	252
No. of surrounding villages to be monitored	16	14	50
Population per village	1,800	750	600
Feasible villages for community water supply interventions	10%	10%	0%
Feasible villages for chemical control intervention	12.5%	22%	80%

Note: All endemic villages are included for epidemiologic surveillance and health education/personal prevention, including distribution of filters.

Assumptions are based on information from the special search and pilot study activities.

worm disease (polluted water) and a high level of interest in and acceptance of filters. A follow-up on filter usage in the pilot villages indicates that the filters are holding up to regular usage, and demand for the filters in these areas has remained high. Properly implemented, a program to distribute filters (with simple but adequate instructions on use), coupled with focused health education to prevent those infected from entering the water supply, is very cost-effective and could contribute significantly to the control of disease transmission. (For the computerized analysis of health education and distribution of filters, see Section 2 of Appendix Tables 1, 2, and 3.)

In the endemic areas in NWFP and Punjab, the strategies proposed include health education for personal prevention as the major intervention, because improving water supplies or applying ABATE to water sources is not feasible. Improved water supplies are expensive and difficult to implement in these areas and generally require a long time. From the pilot studies it was learned that chemical treatment presents tremendous problems and is resisted by the local people.

For Sind, health education for personal prevention and distribution of filters is proposed more as an adjunct to chemical treatment, which will be the primary intervention in this area due to the accessibility of the tarais.

For all approaches, costs of the health education module include the services of health educators and supervisors, technical training, transportation, and materials and support. Technical training should include not only information on guinea worm disease and personal prevention, but also community participation in the interventions, whether these be health education and filter distribution only, or whether they also involve chemical treatment or water supply improvement. Materials include pre-cut filter cloth and the cost of sewing it into filters and the cost of printing or reproducing educational materials. It is also assumed that personnel to mount the health education/filter distribution effort will generally be available and will not have to be newly recruited and trained.

Improved Water Supplies

Improved water supplies, properly maintained, offer the most straightforward, long-term solution to guinea worm disease control. In addition, improved water supply offers a variety of other health and economic benefits to the community and is generally well-received and valued by the recipients. The major drawbacks are its high cost and capital-intensiveness and the need for extensive community participation and planning, both in the design and implementation stage as well as for long-term operation, financing, and maintenance. In addition, the allocation of tube well systems is often highly political due to their high cost and being fraught with political overtones which are beyond the control of planners. (For a spreadsheet analysis of improved water supplies in the control of guinea worm, see Section 3 of Appendix Tables 1, 2, and 3.)

It is assumed that improved drinking water systems will comprise a very low proportion (10 percent) of the interventions for guinea worm control in NWFP and Punjab and will not be introduced at all in Sind. This reflects the short-term, rapid results perspective of the program which does not permit the design and implementation of new drinking water systems.

Costs for improved water supplies included both new well construction and well rehabilitation and are assumed absorbed under the budgets of the outside implementing agency. It is further assumed that hydrogeologic surveys will already be complete and that capped springs and gravity systems are not feasible for these areas. A small number of handpump systems are included, reflecting current UNICEF interests. Their feasibility may be limited in many of the guinea worm endemic areas.

Finally, a key assumption in the costing of the community water supply alternatives in the original concept paper is that only 40 percent of the costs should be attributed or "charged" to the guinea worm control program. This assumption acknowledges the other health and economic benefits of improved water supplies. In contrast, all costs for the other modules (epidemiologic surveillance, health education/filter distribution, and chemical treatment) are charged to the guinea worm program since these modules would focus solely on the disease and have fewer peripheral benefits. In the case of the Pakistan program, however, none of the construction costs are being charged to the guinea worm program. Instead a substantially smaller amount is costed for operation and maintenance support of existing systems that have fallen into disrepair.

ABATE for Chemical Control of the Cyclops Vector

Use of ABATE to control the cyclops intermediate vector has been emphasized from the beginning of the guinea worm program in Pakistan. Drinking water supplies have been treated with the chemical in both of the pilot areas, and a great deal has been learned regarding its appropriateness and acceptability as an intervention. However, without a program to collect and count cyclops themselves, the actual effectiveness of the intervention is not known. Given the very different types of water supplies being treated (covered cisterns in NWFP, open ponds in Punjab, open, relatively shallow and seasonal tarais in Sind), the effectiveness of ABATE would obviously vary. However, the same form of ABATE (50% EC) at the same concentration (1 ppm) and with the same treatment intervals (four to six weeks) is currently planned for all areas. (For the computer spreadsheet analysis of chemical treatment of water, see Section 4 of Appendix Tables 1, 2, and 3.)

In the NWFP pilot village, treatment of numerous family compound cisterns has proven logistically very difficult and has met with a high refusal rate for second and third treatments. Complaints regarding odor and taste have been common. Higher incidence of guinea worm disease could occur next year if currently treated water supplies are shunned and more people use untreated and possibly contaminated water supplies. Chemical treatment of water in other endemic villages in NWFP and Punjab is not practical. Data from guinea worm Special Search on usual sources of drinking water indicate that approximately 12 percent of the water sources in NWFP and 22 percent in Punjab are appropriate for ABATE.

In Sind the seasonal drinking water ponds (tarais) are relatively few in number (one to three per village) and present fewer logistic problems for treatment once the remote areas are reached. In addition, acceptance by the population appears less of a problem due to the ponds being open, offering the ABATE 50% EC petroleum a chance to evaporate. The actual effectiveness of ABATE under these conditions is still not known because the drought has resulted in few tarais to be treated. Anecdotes from West Africa suggest that the 50% EC may not be effective in open ponds, and in stepwells in India the sand granule formulation is at least as appropriate. Ongoing operations research would certainly be desirable. The special search in Sind did not include data on usual sources of drinking water. However, for the purposes of the planning model it was assumed that chemical treatment with ABATE would be feasible in 80 percent of the endemic villages.

The cost items for chemical treatment with ABATE have the same components for all areas: (1) baseline surveys and initial chemical application, including forms, materials, equipment, training, and transportation; (2) purchase of the chemical, including transportation; (3) storage, repackaging, and local transportation in-country; and (4) ongoing follow-up and support, including subsequent applications. It is assumed that personnel for chemical application will generally come from professionals of the malaria eradication, agricultural extension, or other appropriate government programs. Salary, per diem, and other costs, however, are to be covered by the guinea worm program.

2.5 Cost-Benefit Analysis

The microcomputer model links the implementation planning and cost spreadsheets (as described above and presented in the appendix) with a spreadsheet projecting cost and benefit flows over time.

Cost-benefit models applicable to each strategy (cistern-based, pond-based, and tarai-based) were developed, with potential production gains in the agriculture sector as the only quantified benefit. This restriction results in a very conservative estimate of benefits and, more precisely, constitutes a cost-benefit analysis of guinea worm control as it relates to the agricultural sector, rather than being a cost-benefit analysis for the society as a whole. Other benefits that could be considered include avoidable health care costs for guinea worm disease (under the assumption that health care is available), reduced absences from school among children owing to lowered disease prevalence, and reduced mortality due to secondary infections.

A variety of sources were used to estimate model parameters for the cost-benefit model. Specific to the guinea worm program were data from the special and general search (used for population estimates and for determining the appropriateness of chemical control interventions) and data from the prevalence survey (used to estimate disease prevalence in the three areas). Other sources included Department of Census data, Department of Labor Statistics data (to estimate the percent of the population working in agriculture), and Department of Agriculture data on agricultural production and prevailing prices in the guinea worm endemic areas. Expert opinion on various aspects was obtained from guinea worm program officials and other Pakistan government and bi- and multi-lateral agency representatives.

2.5.1 Benefits (Agricultural Productivity)

Key assumptions with regard to benefits are:

1. The agricultural sector is the only economic sector affected by guinea worm disease;
2. Persons affected by guinea worm are totally disabled with regard to agricultural productivity;
3. There is no surplus labor to substitute for the guinea worm-disabled person; and
4. All agricultural productivity occurs during the season when guinea worm disease symptoms are occurring.

The first assumption results in a downward bias in the estimate of total benefits which would accrue to guinea worm control. The other three assumptions would tend to bias the estimates upward. Overall, however, restricting the estimate of total benefits to increased agricultural productivity alone should result in conservative estimates of benefit-cost ratios.

Table 3 gives the 1986 district-level production of major crops in the guinea worm-endemic districts as obtained from the Pakistan Ministry of Agriculture. The crop value is derived by multiplying the government fixed price, or the prevailing market price, by the quantity produced. Total crop values for endemic districts were totaled and divided by the total population in agriculture to give per capita agricultural productivity. This figure, when coupled with the estimate of days lost due to guinea worm disease, provides the basis for estimating the value of production lost or potential production gains. As mentioned above, limiting the scope of benefits to this amount alone results in an underestimate of total benefits and conservative estimates of cost-benefit ratios. The advantage of such a restriction, however, is that it presents benefits based on published, quantifiable data, and is easy to understand. If favorable investment criteria (benefit-cost ratios greater then one) are forthcoming even under such conservative restrictions, then how much more favorable would they be if the analyst could put reliable monetary value on other phenomena such as lessened human suffering, improved school attendance, lowered mortality due to secondary infections, etc.?

2.5.2 Cost-Benefit Results

<u>Model Assumptions and Starting Values</u>

Table 4 presents the model assumptions and starting values for the cost-benefit analysis, broken out by the provinces representing the three separate strategies. The list of model parameters is adapted from the more comprehensive list of parameters developed in WASH Technical Report No. 38.

Table 3

District Level Agricultural Output Calculations
(Guinea Worm Endemic Areas)

Province		NWFP				Punjab		Sind			
District		D.I. Khan		Bannu		D.G. Khan		Tharparkar		Sanghar	
Crop (000 tonnes)	Price /40kg.	Quantity Produced	Crop Value	Quantity Produced	Crop Value	Quantity Produced	Crop Value	Quantity Produced	Crop Value	Quantity Produced	Crop Value
Wheat, unirrig.	82.5	19.8	37,125,000	37	69,375,000	7.9	14,812,500	0	0	0	0
Rice, unirrig.	175	0.2	795,455	0.9	3,579,545	5.4	21,477,273	1.5	5,965,909	0.6	2,386,364
Maize	100	2.4	5,454,545	29.1	66,136,364	1.2	2,727,273	3.8	8,636,364	1.9	4,318,182
Bajra	150	2.4	8,181,818	0.1	340,909	2.1	7,159,091	83.8	285,681,818	2	6,818,182
Jowar	135	5.7	17,488,636	0.5	1,534,091	11.6	35,590,909	1.9	5,829,545	3.5	10,738,636
Barley	85	1.2	2,318,182	1.7	3,284,091	0.9	1,738,636	0	0	0	0
Sugarcane	11.52	72.1	18,877,091	55.5	14,530,909	26.2	6,859,636	560.8	146,827,636	297.8	77,969,455
Cotton (000 bales)	173 (per bale)	2.5	432,500	0.3	51,900	69.3	11,988,900	237	41,001,000	345.8	59,823,400
Tobacco (tonnes)	489.5	0	0	16	178,000	46	511,750	0	0	0	0
Total			90,673,227		159,010,809		102,865,968		493,942,273		162,054,218

Total by Province	Total Agri. Output (000 Rupees)	Total Population in Agriculture	Per Cap. Agri. Productivity (GW areas)
NWFP	249,684	98,530	2,534
Punjab	102,866	36,187	2,843
Sind	655,996	94,699	6,927

Note: These crops are only the major crops. There are a number of minor crops produced but not noted. The totals, therefore, are understated and conservative regarding the agricultural output. Additionally, economic output other than agricultural crops are not considered.

Source: "Agricultural Statistics of Pakistan 1986--Volume II" (Planning Unit, Food and Agricultural Division).

Table 4

Cost-Benefit Worksheets -- Model Assumptions and Starting Values

Parameter	Province NWFP	Punjab	Sind	
Population at risk	147,610	54,229	153,359	Estimates from GW Special/General Search (Spring, 87)
Percent of popul. working in agri.	66.75	66.73	61.75	1985-86 Dept. of Labor Statistics, Govt. of Pakistan
Total population in agriculture	98,530	36,187	94,699	
Disease prevalence	1.46	4.14	3.20	Percent. Estimates from prevalence survey (Fall, 87)
Working days lost/year	23,976	24,969	50,506	1 day for ea. 6% of prod. popul. affect. (Ward, 1984)
Agri. prod/person/year	2,534	2,843	6,927	Rupees
Total agri. output (000 rupees)	249,684	102,866	655,996	From agricultural statistics and local prices.
Adjusted agri. prod/person/year	2,572	2,965	7,156	Rupees (adj. for guinea worm-related work absences)
No. of days in agricultural season	120	120	120	
Adjusted agri. prod/person/day	21	25	60	Rupees; assuming all loss occurs in agri. season
Total production loss/agri. season	513,805	617,024	3,011,919	Rupees
Intervention effectiveness	0.90	0.90	0.90	Overall expected effectiv. in reducing guinea worm
Year 1 implementation factor	0	0	0	All interventions
Year 2 implementation factor	0.90	0.90	0.90	"
Discount rate	0.075	0.075	0.075	

This list reflects some of the simplifying assumptions that were necessary in applying the model under actual country conditions, such as using agricultural production as a proxy for gross domestic product (GDP) and eliminating considerations of health care costs.

The number of villages to be served and the population at risk were derived from data obtained in the special and general search. Information from the follow-up case counting (prevalence) survey indicates that these may be high estimates. The sensitivity analysis presented below investigates the effect of this potential bias. Disease prevalence in the total population was estimated from the prevalence survey, which not only indicated the there may be fewer endemic villages than previously suspected but also that the incidence of the disease within villages may be lower than suspected. Working days lost per year were estimated according to the calculations developed by Ward (1984), as described in Chapter 1. Agricultural production was calculated as described above.

In addition to an economic discount rate to allow calculation of net present values of future investments, two additional "technical" parameters were included: estimated effectiveness of the interventions in preventing guinea worm disease and implementation factors to adjust for phase-in of the interventions. Values for these two parameters are relatively arbitrary. However, they offer a point of departure for conducting sensitivity analyses.

The effect on economic productivity of health care for guinea worm disease, costs of health care for the disease and estimates of availability of health care were not estimated or included in the model. (WASH Technical Report No. 38 provides details of how such estimates can be used.)

Cost-Benefit Analysis Summary Spreadsheets

Tables 5 through 7 present summaries of the cost-benefit analyses for the NWFP, Punjab, and Sind intervention programs described above.

Section 1 of Table 5 gives the cost flows over a ten-year time frame. Section 1 is derived from the planning spreadsheets described earlier and presented in the appendix. Note that after three years health education and vector control activities with respect to guinea worm disease are assumed to be finished, as are maintenance activities for community water supplies. Epidemiologic surveillance is projected through year six. The last column in section 1 gives total costs of the different intervention modules and a net present value (NPV) is calculated over ten years at the assumed discount rate of 7.5 percent.

Section 2 of each spreadsheet projects agricultural production benefits for the control of guinea worm disease due to the intervention alone. This results in a conservative and somewhat narrow estimate of benefits which would accrue to guinea worm control; however, it provides an easily quantified and understandable figure. Earlier calculations attempted to link benefits of the intervention with available health care, assuming a program of health care for 50 percent of the population affected by guinea worm disease is available, with estimates of the marginal benefits of the proposed guinea worm intervention strategy. However, these attempts were not realistic or useful for the Pakistan situation due to the basic lack of such services and was dropped from use in the cost-benefit model as a simplifying step.

Table 5
Cost-Benefit Summary Spreadsheets -- NWFP Cistern-based Strategy

Section 1. Program Costs Province: NWFP

Year Following Project Start	Epidemiolog. Surveillance	Commun. Health Education	Commun. Water Supply	Chemical Control	Field Costs Alone	Non-Field Related Costs	Total Cost
Factor:	1.00	1.00	1.00	1.00	1.00	0.42	(Rupees)
Year 1 (1988)	469,640	1,182,776	29,670	45,610	1,727,696	1,041,339	2,769,035
Year 2 (1989)	469,640	709,666	17,802	27,366	1,224,474	948,939	2,173,412
Year 3 (1990)	281,784	354,833	8,901	13,683	659,201	474,469	1,133,670
Year 4 (1991)	93,928	0	0	0	93,928	94,894	188,822
Year 5 (1992)	93,928	0	0	0	93,928	47,447	141,375
Year 6	0	0	0	0	0	47,447	47,447
Year 7	0	0	0	0	0	0	0
Year 8	0	0	0	0	0	0	0
Year 9	0	0	0	0	0	0	0
Year 10	0	0	0	0	0	0	0
Net Present Value (NPV)							5,639,741

Section 2. Production Benefits Province: NWFP

Year 1 (1988)	0
Year 2 (1989)	416,182
Year 3 (1990)	462,425
Year 4 (1991)	462,425
Year 5 (1992)	462,425
Year 6	462,425
Year 7	462,425
Year 8	462,425
Year 9	462,425
Year 10	462,425
Net Present Value (NPV)	2,703,943

Section 3. Outcome Parameters Province: NWFP

Benefit-Cost Ratio	0.48	Discount Rate: 0.075
Internal Rate of Return	-10 %	No. of Years: 10
Years to Payback	>8	

Table 6

Cost-Benefit Summary Spreadsheets -- Punjab Pond-based Strategy

Section 1. Program Costs Province: Punjab

Year Following Project Start	Epidemiolog. Surveillance	Commun. Health Education	Commun. Water Supply	Chemical Control	Field Costs Alone	Non-Field Related Costs	Total Cost
Factor:	1.00	1.00	1.00	1.00	1.00	0.15	(Rupees)
Year 1 (1988)	324,500	783,297	26,700	67,415	1,201,912	371,907	1,573,819
Year 2 (1989)	324,500	469,978	16,020	40,449	850,947	338,907	1,189,854
Year 3 (1990)	19,4700	234,989	8,010	20,225	457,924	169,453	627,377
Year 4 (1991)	64,900	0	0	0	64,900	33,891	98,791
Year 5 (1992)	64,900	0	0	0	64,900	16,945	81,845
Year 6	0	0	0	0	0	0	0
Year 7	0	0	0	0	0	0	0
Year 8	0	0	0	0	0	0	0
Year 9	0	0	0	0	0	0	0
Year 10	0	0	0	0	0	0	0
Net Present Value (NPV)							3,129,635

Section 2. Production Benefits Province: Punjab

Year 1 (1988)	0
Year 2 (1989)	499,790
Year 3 (1990)	555,322
Year 4 (1991)	555,322
Year 5 (1992)	555,322
Year 6	555,322
Year 7	555,322
Year 8	555,322
Year 9	555,322
Year 10	555,322
Net Present Value (NPV)	3,247,142

Section 3. Outcome Parameters Province: Punjab

Benefit-Cost Ratio	1.04	Discount Rate:	0.075
Internal Rate of Return	9 %	No. of Years:	10
Years to Payback	8		

Table 7

Cost-Benefit Summary Spreadsheets -- Sind Tarai-based Strategy

Section 1. Program Costs Province: NWFP

Year Following Project Start	Epidemiolog. Surveillance	Commun. Health Education	Commun. Water Supply	Chemical Control	Field Costs Alone	Non-Field Related Costs	Total Cost
Factor:	1.00	1.00	1.00	1.00	1.00	0.44	(Rupees)
Year 1 (1988)	826,380	2,576,075	0	911,322	4,313,777	1,066,133	5,379,910
Year 2 (1989)	826,380	1,545,645	0	546,793	2,918,818	971,533	3,890,351
Year 3 (1990)	495,828	772,823	0	273,397	1,542,047	485,766	2,027,813
Year 4 (1991)	165,276	0	0	0	165,276	97,153	262,429
Year 5 (1992)	165,276	0	0	0	165,276	48,577	213,853
Year 6	0	0	0	0	0	0	0
Year 7	0	0	0	0	0	0	0
Year 8	0	0	0	0	0	0	0
Year 9	0	0	0	0	0	0	0
Year 10	0	0	0	0	0	0	0
Net Present Value (NPV)							10,348,793

Section 2. Production Benefits Province: Sind

Year 1 (1988)	0
Year 2 (1989)	2,439,655
Year 3 (1990)	2,710,727
Year 4 (1991)	2,710,727
Year 5 (1992)	2,710,727
Year 6	2,710,727
Year 7	2,710,727
Year 8	2,710,727
Year 9	2,710,727
Year 10	2,710,727
Net Present Value (NPV)	15,850,477

Section 3. Outcome Parameters Province: Sind

Benefit-Cost Ratio	1.53	Discount Rate:	0.075
Internal Rate of Return	21 %	No. of Years:	10
Years to Payback	7		

Section 3 of each worksheet presents the resultant benefit-cost ratios (BCRs) and internal rates of return (IRRs), as discussed below.

Resulting Benefit-Cost Ratios

BCRs calculated on a ten-year time frame at an assumed discount rate of 7.5 percent for the intervention strategies alone are greater than one (i.e., favorable) for the analyses relating to Punjab and Sind, although only marginally so for Sind. The BCR for NWFP, calculated similarly, is substantially less than one, largely because the disease prevalence rate in NWFP is very low, between 45 and 65 percent lower than for the other two provinces.

When taken together, the overall ten-year BCR (at 7.5 percent) for the programs nationwide is a favorable 1.14, as shown in Table 8. In other words, the discounted value of the total production benefits over a ten-year period that would be realized through guinea worm eradication is estimated to be 14 percent higher than the discounted costs of the field eradication program for the nationwide effort over the projected six-year period. When the time frame is increased to 15 years, the ratio improves and the program becomes even more attractive from an economic investment standpoint.

It should be reiterated, however, that only costs related to field implementation and the concurrent support of that effort are considered. The substantial administrative support from both the Pakistan National Institute of Health and Global 2000 is not included, nor are the costs already incurred in such critical activities as the national search, the pilot programs, and the follow-up prevalence study.

Finally, earlier calculations incorporating estimates of potentially avoidable health care costs increased the BCRs. By excluding this factor the results of this analysis are conservative and the true beneficial effects are being understated.

2.5.3 Sensitivity Analysis

Table 9 presents an analysis of the sensitivity of outcomes to changes in: (1) the assumed annual per capita GDP; (2) time frame over which benefit-cost ratios are calculated; and (3) number of endemic villages. From the calculations, the higher the agricultural productivity, the greater the benefit of controlling guinea worm morbidity interfering with this productivity. Moreover, the case counting data, in addition to revealing substantially lower prevalence than previously suspected, also indicated fewer endemic villages; the fewer the villages, the lower the costs and the higher the resultant benefit-cost ratios. Finally, since ongoing costs are not an issue in a program that aims at eradication, the longer the time frame over which benefits are counted (without incurring any further costs), the more favorable the benefit-cost ratios will be. Other key model parameters include: (1) the number of days in the agricultural season; (2) the percent of population working; and (3) the discount rate. The sensitivity of benefit-cost outcomes with regard to these parameters was tested in the draft field

Table 8

Merged Cost Spreadsheets/Joint Cost-Benefit Analysis

Section 1.
NWFP, Punjab, and Sind Intervention Programs
Total (Joint) Program Costs (Rupees)

Year	Epidemi. Surveillance	Commun. Health Education	Commun. Water Supply	Chemical Control	Field Costs Alone	Non-Field Related Costs	Total Costs (Rupees)
Year 1 (1988)	1,620,520	4,542,148	56,370	1,024,347	7,243,385	2,479,378	9,722,763
Year 2 (1989)	1,620,520	2,725,289	33,822	614,608	4,994,239	2,259,378	7,253,617
Year 3 (1990)	972,312	1,362,644	16,911	307,304	2,659,172	1,129,689	3,788,861
Year 4 (1991)	324,104	0	0	0	324,104	225,938	550,042
Year 5 (1992)	324,104	0	0	0	324,104	112,969	437,073
Year 6	0	0	0	0	0	47,447	47,447
Year 7	0	0	0	0	0	0	0
Year 8	0	0	0	0	0	0	0
Year 9	0	0	0	0	0	0	0
Year 10	0	0	0	0	0	0	0
Net Present Value (NPV)							19,118,168

Section 2.
Joint

Production Benefits	Rupees
Year 1 (1988)	0
Year 2 (1989)	3,355,626
Year 3 (1990)	3,728,474
Year 4 (1991)	3,728,474
Year 5 (1992)	3,728,474
Year 6	3,728,474
Year 7	3,728,474
Year 8	3,728,474
Year 9	3,728,474
Year 10	3,728,474
Net Present Value (NPV)	21,801,562

Section 3.

Joint Outcome Parameters	10 Year Time Frame	15 Year Time Frame	
Benefit-Cost Ratio	1.14	1.52	Discount Rate: 0.075
Internal Rate of Return	11 %	17 %	
Years to Payback	9	9	

Table 9

Sensitivity Analysis
Pakistan Guinea Worm Control Programme

I. Number of villages determined from national search data

Province	Assumed GW preval. in Population	No. of Vill.	Assumed annual adj. agri. prod. (Rp.)	10-year time frame BCR	10-year time frame IRR	15-year time frame BCR
NWFP	1.46%	79	2543 *	0.48	-10%	0.64
			3543	0.67	- 3%	0.90
			5300	1.00	8%	1.34
Punjab	4.14%	70	2843 *	1.04	9%	1.39
			3843	1.40	18%	1.87
Sind	3.20%	252	4510	1.00	7%	1.33
			5927	1.31	16%	1.76
			6927 *	1.53	22%	2.05

Joint (overall) 10-year BCR using *'d values = 1.14. IRR 11 %.

II. Decreasing number of villages to be treated by 25% (following case-counting implications)

Province	Assumed GW preval. in Population	No. of Vill.	Assumed annual per cap. GDP (Rup.)	10-year time frame BCR	10-year time frame IRR	15-year time frame BCR
NWFP	1.46%	60	2543	0.53	- 8%	0.70
			3543	0.73	- 1%	0.98
Punjab	4.14%	53	2843	1.18	13%	1.58
			3843	1.60	23%	2.14
Sind	3.20%	190	5927	1.58	23%	2.11
			6927	1.84	29%	2.46

Notes: Benefit-cost ratios estimated using a 7.5 percent discount rate.

Guinea worm prevalence figures are from the case-counting study, Sept.-Oct. 1987.

For reference, the annual GDP per capita in Pakistan, agricultural sector (1983): 4828 rupees (World Bank, World Development Report)

report for Pakistan and in the WASH Technical Report for the generic model. Changes in the magnitude of 25 percent seemed to represent the lower limit for BCRs to remain greater than one.

2.5.4 Other Factors Affecting Cost-Benefit Analysis

Certain factors affecting BCRs were not taken into consideration in this analysis. The analysis did not include (1) assumptions regarding surplus labor, which, if it exists, would lower the resultant BCRs; (2) health care costs averted, assuming health care is available for care of guinea worm disease symptoms; (3) "quality of life" factors such as pain, inconvenience and grief, which, if quantified and lessened by lower disease incidence, would increase the BCRs for the program; (4) the benefits of reduced school absenteeism as disease prevalence is lowered, which would also improve the BCRs; or (5) lost productivity due to mortality from secondary infections. Refer to WASH Technical Report No. 38 for a more complete discussion of these and other factors which could affect the outcome of a cost-benefit analysis.

2.5.5 Next Steps

This preliminary cost-benefit analysis of a program to eliminate guinea worm in Pakistan could serve as a starting point for an ongoing economic analysis of the benefits (and costs) of the effort currently under way. Assumptions and data sources behind the assumptions need to be refined as the program evolves and develops. The planning model in the appendix will need periodic updating and elaboration. Finally, some of the model assumptions themselves need to be examined in the Pakistan context to determine the dynamics of variable interactions, such as the effect of health care availability on the population afflicted on the flow of costs and benefits.

An appropriate next step may also be training in planning, budgeting, and analysis using microcomputers for in-country program professionals. This could be done either individually or in workshops.

Chapter 3

SUMMARY AND CONCLUSIONS

The implementation planning and cost-benefit model based on earlier work in WASH Technical Report No. 38 was field tested in Pakistan. The work was intended to assist the Pakistan National Institute of Health in the planning of a nationwide eradication effort for the upcoming guinea worm transmission season. The implementation model focusing on the four intervention-related activities (epidemiologic surveillance, health education/personal prevention, community water supply, chemical control) appeared flexible enough for consideration in Pakistan. For this analysis benefits were limited to the effects of guinea worm eradication on per capita agricultural productivity. Overall estimates of benefits are conservative because other benefits were not included such as potentially lowered health care costs, positive effects on education, and benefits due to reduced mortality from secondary infections.

Cost-benefit ratios were found to be substantially more favorable (by a factor of one-third) when benefits were considered over 15 years rather than ten years as proposed in the original model. Selection of the time frame is not important from a methodological standpoint; it is of concern only to policy makers. In the case of disease eradication, however, a sufficiently long time frame guarantees a positive CBR since the flow of costs is by definition time limited while the flow of benefits will continue indefinitely.

3.1 Lessons Learned

Even under the most ideal conditions there will not be comprehensive sources of data available to estimate costs and benefits. Substantial ingenuity is necessary to come up with data and to devise proxy measures when direct measures are not available. In Pakistan, it was necessary to "brainstorm" with program officials to devise a proxy measure used for lost productivity.

Implementation of the model is completely dependent upon use of a microcomputer. This has implications not only for hardware and software, but also for the training, orientation, and interests of the program manager and associated professionals.

3.2 Further Activities

Subsequent activities could include:

- Further elaboration of the planning model. Refinement of design, assumptions, and cost estimates as the program evolves could be useful in monitoring program implementation. Development of subsequent generations of the cost-benefit analysis are also possible, as well as elaboration of the economic analysis of the program.

- The use of program management software to assist in the planning and development of various intervention activities. As the program becomes increasingly ambitious and spread out in its efforts, management is going to be vastly more complicated, and informal, small-group management may be less feasible. This type of software is particularly appropriate for programs with well-defined goals, objectives, and activities and could be linked with the implementation planning/CBA spreadsheet models.

3.3 Limitations

The field test revealed several limitations to the applicability of the methodology developed in WASH Technical Report No. 38.

- The methodology is computer-dependent. Specific computer hardware and software (as well as specific skills) are required to implement the methodology and carry out the cost-benefit analyses. Although this was not a problem in Pakistan, it could be a limitation elsewhere. At the present time the software (available as spreadsheets in either Lotus 1-2-3 or SuperCalc 4 format) is not self-explanatory enough or free enough of idiosyncrasies for the inexperienced user. The model often requires minor adjustments to make it function. These adjustments require moderate confidence in the use of microcomputers and spreadsheet software.

- The methodology requires skills and/or familiarity and knowledge in several different areas. For the implementation planning (costs) component, it is necessary to understand basic program planning and budgeting and to be able to break up activities into component parts. For the cost-benefit component, it is necessary to understand the concepts of discounting and present values even though understanding the actual mechanics may not be necessary. Interpreting and applying the results are facilitated if the individual can manipulate the model in "what-if" sensitivity-type analyses.

3.4 Conclusion

The implementation planning models and cost-benefit analysis produced useful information in the context of an actual country program. This successful shift from a simulation of a hypothetical country and program to a real country and program was encouraging; however, the follow-up of the planning/modeling approach over time for Pakistan or other country programs is equally important and will only be revealed through subsequent application of the methodology by in-country professionals.

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APPENDIX TABLES

Table 1. Implementation Planning Spreadsheets for Cistern-based Interventions (NWFP)

Section 1. Cost Items: Epidemiologic Surveillance (100 percent of intervention villages; sample others)

Province: NWFP Population: 147610 Villages: 79

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	No. of Units	Cost (Rupees)	Comments
A. Ongoing monitoring, intervention areas	all interven. villages	villages		79		
1. Labor	salaries, TA/DA					
a. Village monitors		person-month	100	1896	189600	# of monit. per vill. * # of vill. * 12 mo.
b. Technical personnel --supervision and review	GW program staff					
1) Senior professional		person-days	600	25	15000	10 % , 1 yrs. (.1 *21 days/mo *12)
2. Training						
a. Village monitors	2 day annual sessions	person-days	100	316	31600	
b. Technical personnel --to conduct training	GW program staff	person-days				
1) Senior professional			600	10	6000	
2) Junior professional			300	20	6000	
3. Transportation						
a. Supervision and review						
1) Drivers	GW prog. vehicle	person-days	240	25	6000	
2) Fuel, oil, repairs	GW prog. vehicle	per day	100	25	2500	
b. Training						
1) Village monitors		per session	200	158	31600	
4. Materials						
a. Monitoring materials	per village monitor	persons	200	158	31600	
b. Training material	per monitor	persons	100	158	15800	printing and duplic. costs
5. Total, ongoing monitoring		villages			335700	
B. Monitoring of Surrounding Areas (screening surveys)	sample of villages	villages		16		sample of surrounding villages (20% of interven. villages)
1. Labor	salaries, TA/DA					
a. Technical personnel						
1) Senior professional	GW program staff	person-days	600	25	15000	10% of time
3) Field teams	3 person team	team-days	1200	24	28440	1 senior and 2 junior prof.
2. Training for field teams	annual sessions	team-days	1200	2	2400	2 day sessions
a. Technical personnel --to conduct training	senior professional	person-days	600	2	1200	

Section 1. (continued) NWFP

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	No. of Units	Cost (Rupees)	Comments
3. Transportation						Operating and leasing costs; assumes 4 WD vehicle
a. Driver	for GW prog. vehicle	person-days	240	20	4800	
b. Fuel, oil, repairs	for GW prog. vehicle	per day	100	20	2000	
c. Vehicles/Drivers	2nd and subseq. teams	per veh./day	600	0	0	
4. Materials						
a. Training material	per field team trainee	persons	500	32	15800	
b. Survey material	per team	persons	500	16	7900	development, printing, and duplic. costs
5. Total, screening surveys					77540	
C. Liaison with health workers						
and other public officials	(at district and provincial level)					to promote the use of improved reporting
1. Technical personnel	salaries, TA/DA					
a. Senior professional	GW program staff	person-days	600	10	6000	
2. Training/Public relations						For health workers and other personnel
--district personnel	salaries, TA/DA	person-days	300	40	12000	assume 10 persons, 2 districts, 2 days
a. Planning costs		per session	5000	2	10000	district level training meeting (2 districts)
b. Transportation costs	GW prog vehicle	per day	340	10	3400	
3. Forms and materials		per year	10000	1	10000	Design and produce hierarchy of reporting forms
--production, duplication						
4. Total					41400	
D. Data analysis and reporting						
1. Technical labor	salaries, no travel					
a. Senior professional	GW program staff		200	25	5000	10% time
2. Reports and materials	per year		10000	1	10000	preparation, duplication, and distribution
3. Total					15000	
				Total	469640	

Table 1. Implementation Planning Spreadsheets for Cistern-based Interventions (NWFP) -- continued
Section 2. Cost Items: Community Health Education (100 percent of villages)
Province: NWFP Population: 147610 Villages: 79

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	Number of Units	Cost (Rupees)	Comments
A. Technical labor	salaries, TA/DA					
1. Senior professional	GW program staff	person-days	600	50	30000	20 % , planning, supervision, and review
2. Field teams	3 person teams	team-days	1200	237	284400	1 sr. and 2 jr. prof.
--number of teams necessary:	6					
B. Training for field teams	prior to field imple.	team days	1200	18	21600	3 day training session
--filter distribution						As appropriate for selected strategies. Includes salary and perdiem.
--health education/ personal prevention						
--community participation						
--chemical treatment						
--water system maintanence						
1. Technical personnel --to conduct training	senior professional	person-days	600	10	6000	includes planning time for training in Punjab and Sind
C. Transportation						
1. Training programs	ave trans costs	per partic.	300	18	5400	transportation per person for training
2. Field work						
a. Driver	for GW prog. vehicle	person-days	250	40	10000	
b. Fuel, oil, repairs	for GW prog. vehicle	per day	75	40	3000	
c. Vehicles	2nd and subseq. teams	per veh./day	600	200	120000	
3. Total					138400	
D. Materials and Support						
1. Training						
a. Planning costs		per session	5000	1	5000	
b. Tech. training materials	equip. and supplies	per session	5000	1	5000	
2. Health educ materials --posters, flip charts, etc.	per village	per year	1000	79	79000	development cost of health educ materials not included
3. Filters (precut polyester)	monofil. sieve material	per filter	12	32802	409372	US $6.50 per sq meter; approx 9 pieces sieve material per meter
a. Other material		per filter	2	32802	65604	assume 1 filter/hsehld. (ave. # of fam. members = 4.5)
4. Medical treatment kits --bandgages, simple meds.		per village	400	158	63200	per team per visit
5. Total					627176	
				Total	1182776	

Table 1. Implementation Planning Spreadsheets for Cistern-based Interventions (NWFP) -- continued
Section 3. Cost Items: Community Water Supply Module (assumed for 10% of the villages)
Province: NWFP Population 14761 Villages: 8

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	Number of Units	Cost (Rupees)	Comments
A. Hydrogeologic surveys	Assumed available from other sources			8		
B. Tube well constr. and repair						
1. New construction	at 10 sites	per well	800000	4	3160000	Per well 8 lakh rupees (NWFP PHED). Cost per well approx. $46377
2. Well rehabilitation	at 2 sites	per well	320000	2	505600	Estimated 40% of the cost of new well construction.
C. Borehole/Hand Pump Systems	at 3 sites	per well	31500	2	49770	UNICEF estimates (new program). Cost per well aprox. US$ 1800.
D. Maintanence requirements	all systems	per system		8		
1. Labor						
--village-level	volunteer labor	2 pers./vill	0	16	0	assume elected/appointed by village
2. Training	2 day annual sessions	person-days	100	32	3160	training costs as for village monitors
--transportation	average cost	per person	200	16	3160	aver. transportation costs to training sites, both years
--trainers	senior professsionals	person-days	600	6	3600	
3. Equipment and materials	per year	per village	2500	8	19750	
4. Total, maintanence					29670	
				Total	3745040	
	Less construction costs assumed to other programs				3715370	tube wells and hand pump systems by others (PHED and UNICEF)
				Net to GW progr.	29670	

Table 1. Implementation Planning Spreadsheets for Cistern-based Interventions (NWFP) -- continued
Section 4. Cost Items: Chemical Treatment with Abate (assumed for 13% of the villages)
Province: NWFP Population 18451 Villages: 10

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	Number of Units	Cost (Rupees)	Comments
A. Baseline surveys and initial application		villages		10		feasibility for chem treat determined through village surveys
1. Technical labor	salaries, TA/DA					
a. Technicians	1 day/village	person-days	300	0	0	at same time as health educ visit
--malaria/health workers						
2. Training for technicians		person-days	300	0	0	incorporated as part of health education team training
3. Transportation						included as part of health education team field work
4. Equipment and materials	per technician	person	2000	1	2000	
--chemical storage containers						
--measuring rods, tapes						
--sprayers, funnels, flags/paint						
--forms, tables, log books						
5. Total, survey and first application					2000	
B. Purchase of Abate	*50 EC liquid formulation*					*assume 1500 cu. meter total water supply to be treated per village*
1. 50 EC liquid formulation	500 gr/l active ingred	liter	390	90	35100	2 ml per cu. meter for 1 ppm conc., 3 treatments/yr.
2. Transportation to POE	5.49 kg/l	kg.	40	0	0	assume delivery
3. Total, chemical purchase	purchase and transp.				35100	
C. Storage and transportation						
1. Warehousing costs	10% purchase cost	per year			3510	for secure storage; liquid formulation
--National level						
--Regional/district level						
2. Transportation	vehicle availability					to deliver chemical treatment supplies
a. Drivers		person-days	600	0	0	
3. Total, storage and trans.					3510	
E. Follow up and support (2nd and 3rd applications)						
1. Technical labor	salaries, TA/DA					
a. Malaria/health workers	1 vill/day	person-days	300	0	0	2 follow up visits per year for chem applic; w/ hlth. ed. visits
b. Technical supervisors		person-days	600	0	0	
2. Transportation						incl. as part of health ed. team field work (as for 1st applic.)
3. Materials	for tech labor	per year	500	10	5000	forms, replacement supplies for chem applic.
4. Total, follow up and support					5000	
				Total	45610	

Table 2. Implementation Planning Spreadsheets for Pond-based Interventions (Punjab)

Section 1. Cost Items: Epidemiologic Surveillance (100 percent of intervention villages; sample others)

Province: Punjab - Population: 54229 Villages: 70

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	No. of Units	Cost (Rupees)	Comments
A. Ongoing monitoring, intervention areas	all interven. villages	villages		70		
1. Labor	salaries, TA/DA					
a. Village monitors		person-month	100	840	84000	# of monit. per vill. * # of vill. * 12 mo.
b. Technical personnel --supervision and review	GW program staff					
1) Senior professional		person-days	600	25	15000	10 % , 1 yrs. (.1 *21 days/mo *12)
2. Training						
a. Village monitors	2 day annual sessions	person-days	100	140	14000	
b. Technical personnel --to conduct training	GW program staff	person-days				
1) Senior professional			600	10	6000	
2) Junior professional			300	20	6000	
3. Transportation						
a. Supervision and review						
1) Drivers	GW prog. vehicle	person-days	240	25	6000	
2) Fuel, oil, repairs	GW prog. vehicle	per day	100	25	2500	
b. Training						
1) Village monitors		per session	200	140	28000	
4. Materials						
a. Monitoring materials	per village monitor	persons	200	140	28000	
b. Training material	per monitor	persons	100	70	7000	printing and duplic. costs
5. Total, ongoing monitoring		villages			196500	
B. Monitoring of Surrounding Areas (screening surveys)	sample of villages	villages		14		sample of surrounding villages (20% of interven. villages)
1. Labor	salaries, TA/DA					
a. Technical personnel						
1) Senior professional	GW program staff	person-days	600	25	15000	10% of time
3) Field teams	3 person team	team-days	1200	21	25200	1 senior and 2 junior prof.
2. Training for field teams	annual sessions	team-days	1200	2	2400	
a. Technical personnel --to conduct training	senior professional	person-days	600	2	1200	

Section 1. (continued) Punjab

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	No. of Units	Cost (Rupees)	Comments
3. Transportation						Operating and leasing costs; assumes 4 WD vehicle
a. Driver	for GW prog. vehicle	person-days	240	20	4800	
b. Fuel, oil, repairs	for GW prog. vehicle	per day	100	20	2000	
c. Vehicles/Drivers	2nd and subseq. teams	per veh./day	600	0	0	
4. Materials						
a. Training material	per field team trainee	persons	500	28	14000	
b. Survey material	per team	persons	500	14	7000	development, printing, and duplic. costs
5. Total, screening surveys					71600	
C. Liaison with health workers and other public officials	(at district and provincial level)					to promote the use of improved reporting
1. Technical personnel	salaries, TA/DA					
a. Senior professional	GW program staff	person-days	600	10	6000	
2. Training/Public relations						For health workers and other personnel
--district personnel	salaries, TA/DA	person-days	300	40	12000	assume 10 persons, 2 districts, 2 days
a. Planning costs		per session	5000	2	10000	district level training meeting (2 districts)
b. Transportation costs	GW prog vehicle	per day	340	10	3400	
3. Forms and materials --production, duplication		per year	10000	1	10000	Design and produce hierarchy of reporting forms
4. Total					41400	
D. Data analysis and reporting						
1. Technical labor	salaries, no travel					
a. Senior professional	GW program staff		200	25	5000	10% time
2. Reports and materials	per year		10000	1	10000	preparation, duplication, and distribution
3. Total					15000	
				Total	324500	

Table 2. Implementation Planning Spreadsheets for Pond-based Interventions (Punjab) -- continued

Section 2. Cost Items: Community Health Education (100 percent of villages)

Province: Punjab Population: 54229 Villages: 70

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	Number of Units	Cost (Rupees)	Comments
A. Technical labor	salaries, TA/DA					
1. Senior professional	GW program staff	person-days	600	50	30000	20 % , planning, supervision, and review
2. Field teams	3 person teams	team days	1200	210	252000	1 sr. and 2 jr. prof.
--number of teams necessary:		5				
B. Training for field teams	prior to field imple.	team days	1200	15	18000	3 day training session
--filter distribution						As appropriate for selected strategies. Includes salary and perdiem.
--health education/ personal prevention						
--community participation						
--chemical treatment						
--water system maintanence						
1. Technical personnel	senior professional	person-days	600	3	1800	planning time included from time for NWFP
--to conduct training						
C. Transportation						
1. Training programs	ave trans costs	per partic.	300	15	4500	transportation per person for training
2. Field work						
a. Driver	for GW prog. vehicle	person-days	250	40	10000	
b. Fuel, oil, repairs	for GW prog. vehicle	per day	75	40	3000	
c. Vehicles	2nd and subseq. teams	per veh./day	600	160	96000	
3. Total					113500	
D. Materials and Support						
1. Training						
a. Planning costs		per session	5000	1	5000	
b. Tech. training materials	equip. and supplies	per session	5000	1	5000	
2. Health educ materials	per village	per year	1000	70	70000	development cost of health educ materials not included
--posters, flip charts, etc.						
3. Filters (precut polyester)	monofil. sieve material	per filter	12	12051	150395	US $6.50 per sq meter; approx 9 pieces sieve material per meter
a. Other material		per filter	2	12051	24102	assume 1 filter/hsehld. (ave. # of fam. members = 4.5)
4. Medical treatment kits		per village	400	140	56000	per team per visit
--bandgages, simple meds.						
5. Total					310497	
				Total	783297	

Table 2. Implementation Planning Spreadsheets for Pond-based Interventions (Punjab) -- continued

Section 3. Cost Items: Community Water Supply Module (assumed for 10% of the villages)

Province: Punjab Population 5423 Villages: 7

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	Number of Units	Cost (Rupees)	Comments
A. Hydrogeologic surveys	Assumed available from other sources			7		
B. Tube well constr. and repair						
1. New construction	at 10 sites	per well	800000	4	2800000	Per well 8 lakh rupees (NWFP PHED). Cost per well approx. $46377
2. Well rehabilitation	at 2 sites	per well	320000	1	448000	Estimated 40% of the cost of new well construction.
C. Borehole/Hand Pump Systems	at 3 sites	per well	31500	1	44100	UNICEF estimates (new program). Cost per well aprox. US$ 1800.
D. Maintanence requirements	all systems	per system		7		
1. Labor						
--village-level	volunteer labor	2 pers./vill	0	14	0	assume elected/appointed by village
2. Training	2 day annual sessions	person-days	100	28	2800	training costs as for village monitors
--transportation	average cost	per person	200	14	2800	aver. transportation costs to training sites, both years
--trainers	senior professsionals	person-days	600	6	3600	
3. Equipment and materials	per year	per village	2500	7	17500	
4. Total, maintanence					26700	
				Total	3318800	
	Less construction costs assumed to other programs				3292100	tube wells and hand pump systems by others (PHED and UNICEF)
			Net to GW progr.		26700	

Table 2. Implementation Planning Spreadsheets for Pond-based Interventions (Punjab) -- continued
Section 4. Cost Items: Chemical Treatment with Abate (assumed for 22% of the villages)
Province: Punjab Population 11930 Villages: 15

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	Number of Units	Cost (Rupees)	Comments
A. Baseline surveys and initial application		villages		15		feasibility for chem treat determined through village surveys
1. Technical labor	salaries, TA/DA					
a. Technicians	1 day/village	person-days	300	0	0	at same time as health educ visit
--malaria/health workers						
2. Training for technicians		person-days	300	0	0	incorporated as part of health education team training
3. Transportation						included as part of health education team field work
4. Equipment and materials	per technician	person	2000	1	2000	
--chemical storage containers						
--measuring rods, tapes						
--sprayers, funnels, flags/paint						
--forms, tables, log books						
5. Total, survey and first application					2000	
B. Purchase of Abate	50 EC liquid formulation					assume 1500 cu. meter total water supply to be treated per village
1. 50 EC liquid formulation	500 gr/l active ingred	liter	390	135	52650	2 ml per cu. meter for 1 ppm conc., 3 treatments/yr.
2. Transportation to POE	5.49 kg/l	kg.	40	0	0	assume delivery
3. Total, chemical purchase	purchase and transp.				52650	
C. Storage and transportation						
1. Warehousing costs	10% purchase cost	per year			5265	for secure storage; liquid formulation
--National level						
--Regional/district level						
2. Transportation	vehicle availability					to deliver chemical treatment supplies
a. Drivers		person-days	600	0	0	
3. Total, storage and trans.					5265	
E. Follow up and support (2nd and 3rd applications)						
1. Technical labor	salaries, TA/DA					
a. Malaria/health workers	1 vill/day	person-days	300	0	0	2 follow up visits per year for chem applic; w/ hlth. ed. visits
b. Technical supervisors		person-days	600	0	0	
2. Transportation						incl. as part of health ed. team field work (as for 1st applic.)
3. Materials	for tech labor	per year	500	15	7500	forms, replacement supplies for chem applic.
4. Total, follow up and support					7500	
				Total	67415	

Table 3. Implementation Planning Spreadsheets for Tarai-based Interventions (Sind)

Section 1. Cost Items: Epidemiologic Surveillance (100 percent of intervention villages; sample others)

Province: Sind   Population: 153359 Villages: 252

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	No. of Units	Cost (Rupees)	Comments
A. Ongoing monitoring, intervention areas	all interven. villages	villages		252		
1. Labor	salaries, TA/DA					
a. Village monitors		person-month	100	3024	302400	# of monit. per vill. * # of vill. * 12 mo.
b. Technical personnel --supervision and review	GW program staff					
1) Senior professional		person-days	600	25	15000	10 % , 1 yrs. (.1 *21 days/mo *12)
2. Training						
a. Village monitors	2 day annual sessions	person-days	100	504	50400	
b. Technical personnel --to conduct training	GW program staff	person-days				
1) Senior professional			600	10	6000	
2) Junior professional			300	20	6000	
3. Transportation						
a. Supervision and review						
1) Drivers	GW prog. vehicle	person-days	240	25	6000	
2) Fuel, oil, repairs	GW prog. vehicle	per day	100	25	2500	
b. Training						
1) Village monitors		per session	200	504	100800	
4. Materials						
a. Monitoring materials	per village monitor	persons	200	504	100800	
b. Training material	per monitor	persons	100	252	25200	printing and duplic. costs
5. Total, ongoing monitoring		villages			615100	
B. Monitoring of Surrounding Areas (screening surveys)	sample of villages	villages		50		sample of surr. villages (non-endemic; 20% of interven. vill.)
1. Labor	salaries, TA/DA					
a. Technical personnel						
1) Senior professional	GW program staff	person-days	600	25	15000	10% of time
3) Field teams	3 person team	team-days	1200	76	90720	1 senior and 2 junior prof.
2. Training for field teams	annual sessions	team-days	1200	8	9600	2 day sessions
a. Technical personnel --to conduct training	senior professional	person-days	600	2	1200	

Section 1. (continued) Sind

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	No. of Units	Cost (Rupees)	Comments
3. Transportation						Operating and leasing costs; assumes 4 WD vehicle
a. Driver	for GW prog. vehicle	person-days	240	20	4800	
b. Fuel, oil, repairs	for GW prog. vehicle	per day	100	20	2000	
c. Vehicles/Drivers	3nd and subseq. teams	per veh./day	600	40	24000	
4. Materials						
a. Training material	per field team trainee	persons	500	11	5670	
b. Survey material	per team	persons	500	4	1890	development, printing, and duplic. costs
5. Total, screening surveys					154880	
C. Liaison with health workers						
and other public officials	(at district and provincial level)					to promote the use of improved reporting
1. Technical personnel	salaries, TA/DA					
a. Senior professional	GW program staff	person-days	600	10	6000	
2. Training/Public relations						For health workers and other personnel
--district personnel	salaries, TA/DA	person-days	300	40	12000	assume 10 persons, 2 districts, 2 days
a. Planning costs		per session	5000	2	10000	district level training meeting (2 districts)
b. Transportation costs	GW prog vehicle	per day	340	10	3400	
3. Forms and materials		per year	10000	1	10000	Design and produce hierarchy of reporting forms
--production, duplication						
4. Total					41400	
D. Data analysis and reporting						
1. Technical labor	salaries, no travel					
a. Senior professional	GW program staff		200	25	5000	10% time
2. Reports and materials	per year		10000	1	10000	preparation, duplication, and distribution
3. Total					15000	
				Total	826380	

Table 3. Implementation Planning Spreadsheets for Tarai-based Interventions (Sind) -- continued
Section 2. Cost Items: Community Health Education (100 percent of villages)
Province: Sind   Population: 153359 Villages: 252

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	Number of Units	Cost (Rupees)	Comments
A. Technical labor	salaries, TA/DA					
1. Senior professional	GW program staff	person-days	600	50	30000	20 % , planning, supervision, and review
2. Field teams	3 person teams	team-days	1200	756	907200	1 sr. and 2 jr. prof.
--number of teams necessary:	19					
B. Training for field teams	prior to field imple.	team days	1200	4	4800	4 day training session
--filter distribution						As appropriate for selected strategies. Includes salary and perdiem.
--health education/ personal prevention						
--community participation						
--chemical treatment						
--water system maintanence						
1. Technical personnel	senior professional	person-days	600	4	2400	planning time included from training for NWFP
--to conduct training						
C. Transportation						
1. Training programs	ave trans costs	per partic.	300	57	17100	transportation per person for training
2. Field work						
a. Driver	for GW prog. vehicle	person-days	250	40	10000	
b. Fuel, oil, repairs	for GW prog. vehicle	per day	75	40	3000	
c. Vehicles	3rd and subseq. teams	per veh./day	600	680	408000	
3. Total					438100	
D. Materials and Support						
1. Training						
a. Planning costs		per session	5000	1	5000	
b. Tech. training materials	equip. and supplies	per session	5000	1	5000	
2. Health educ materials	per village	per year	1000	252	252000	development cost of health educ materials not included
--posters, flip charts, etc.						
3. Filters (precut polyester)	monofil. sieve material	per filter	12	34080	425316	US $6.50 per sq meter; approx 9 pieces sieve material per meter
a. Other material		per filter	2	34080	68160	assume 1 filter/hsehld. (ave. # of fam. members = 4.5)
4. Medical treatment kits		per village	400	504	201600	per team per visit
--bandgages, simple meds.						
5. Total					957075	
				Total	2576075	Cost per village per year approximately Rupees

Table 3. Implementation Planning Spreadsheets for Tarai-based Interventions (Sind) -- continued
Section 3. Cost Items: Community Water Supply Module (assumed for 0% of the villages)
Province: Sind Population 0 Villages: 0

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	Number of Units	Cost (Rupees)	Comments
A. Hydrogeologic surveys	Assumed available from other sources			0		
B. Tube well constr. and repair						
1. New construction	at 10 sites	per well	800000	0	0	Per well 8 lakh rupees (NWFP PHED). Cost per well approx. $46377
2. Well rehabilitation	at 2 sites	per well	320000	0	0	Estimated 40% of the cost of new well construction.
C. Borehole/Hand Pump Systems	at 3 sites	per well	31500	0	0	UNICEF estimates (new program). Cost per well aprox. US$ 1800.
D. Maintanence requirements	all systems	per system		0		
1. Labor						
--village-level	volunteer labor	2 pers./vill	0	0	0	assume elected/appointed by village
2. Training	2 day annual sessions	person-days	100	0	0	training costs as for village monitors
--transportation	average cost	per person	200	0	0	aver. transportation costs to training sites, both years
--trainers	senior professsionals	person-days	600	0	0	
3. Equipment and materials	per year	per village	2500	0	0	
4. Total, maintanence					0	
				Total	0	
	Less construction costs assumed to other programs				0	tube wells and hand pump systems by others (PHED and UNICEF)
				Net to GW progr.	0	

Table 3. Implementation Planning Spreadsheets for Tarai-based Interventions (Sind) -- continued
Section 4. Cost Items: Chemical Treatment (assumed for 80% of the villages)
Province: Sind Population 122687 Villages: 202

Activities/Items	Assumptions	Units	Unit Cost (Rupees)	Number of Units	Cost (Rupees)	Comments
A. Baseline surveys and initial application		villages		202		feasibility for chem treat determined through village surveys
1. Technical labor	salaries, TA/DA					
a. Technicians	1 day/village	person-days	300	0	0	at same time as health educ visit
--malaria/health workers						
2. Training for technicians		person-days	300	0	0	incorporated as part of health education team training
3. Transportation						included as part of health education team field work
4. Equipment and materials	per technician	person	2000	15	30400	
--chemical storage containers						
--measuring rods, tapes						
--sprayers, funnels, flags/paint						
--forms, tables, log books						
5. Total, survey and first application					30400	
B. Purchase of Abate	50 EC liquid formulation					assume 1500 cu. meter total water supply to be treated per village
1. 50 EC liquid formulation	500 gr/l active ingred	liter	390	1818	709020	2 ml per cu. meter for 1 ppm conc., 3 treatments/yr.
2. Transportation to POE	5.49 kg/l	kg.	40	0	0	assume delivery
3. Total, chemical purchase	purchase and transp.				709020	
C. Storage and transportation						
1. Warehousing costs	10% purchase cost	per year			70902	for secure storage; liquid formulation
--National level						
--Regional/district level						
2. Transportation	vehicle availability	per day				to deliver chemical treatment supplies
a. Drivers		person-days	600	0	0	
3. Total, storage and trans.					70902	
E. Follow up and support (2nd and 3rd applications)						
1. Technical labor	salaries, TA/DA					
a. Malaria/health workers	1 vill/day	person-days	300	0	0	2 follow up visits per year for chem applic; w/ hlth. ed. visits
b. Technical supervisors		person-days	600	0	0	
2. Transportation						incl. as part of health ed. team field work (as for 1st applic.)
3. Materials	for tech labor	per year	500	202	101000	forms, replacement supplies for chem applic.
4. Total, follow up and support					101000	
				Total	911322	Cost per village per year approximately Rupees