COST-EFFECTIVENESS ANALYSIS OF INSECTICIDE-IMPREGNATED MOSQUITO NETS (BEDNETS) USED AS A MALARIA CONTROL MEASURE: A STUDY FROM THE GAMBIA

by

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ABSTRACT

Insecticide-impregnated bednets are currently being promoted as one of the promising malaria control methods in endemic regions of most developing countries. Although, much is known about the entomological and epidemiological aspects of treated bednets, little is known about the efficiency of malaria control programmes in general, and bednets in particular. This cost-effectiveness analysis forms part of the evaluation of the Gambian National Insecticide-impregnated Bednet Programme (NIBP).

The research was conducted in the rural Gambia where malaria is endemic. An integrated approach to data collection approach (qualitative and quantitative) provided information for the four objectives of the study, namely;

1. to calculate the total NIBP implementation costs (ie direct and indirect costs);

2. to estimate the number of child (under 10 years) deaths averted in the intervention area;

3. to calculate the resources saved by averting a child death to the health sector and households both direct (ie saved treatment costs, saved preventive expenditures, postponed funeral expenses) and indirect (ie time costs saved by carers and relatives that can be spent on productive activities) and subtract these from the programme costs, to produce net cost-effectiveness ratios and

4. to investigate the effect of impregnated bednets on primary school attendance in terms of days and reasons for absenteeism.

The study covered 64 government and non-governmental organization personnel, 179 village dippers, 306 women in groups of 5 - 8 in focus group discussions, 25 in-depth interviews of men, 134 carers of children, 50 women in random spot observations and 2182 pupils in school attendance study.

The main findings of the study were;

1. The annual implementation cost of NIBP was D757,874.72.

2. The implementation and the net cost-effectiveness ratios per child death averted were D4,946.63 and D1,332.31 respectively and,

3. Impregnated bednets were observed to reduce absenteeism due to ill-health.

NIBP was an efficient malaria control method in rural Gambia and saved resources.

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DEDICATION

To my wife (Brenda) and son (Ekow) for their continuous love, support and dedication and my parents for their love and support at all times.

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ABBREVIATIONS

AATG	-	Action Aid of The Gambia
ARI	-	Acute respiratory tract infection
AWA	-	Gambian Women's Development Journal
BCG	-	Bacillus Calmette Guerin
CBA	-	Cost-benefit analysis
CCF	-	Christian Children Fund
CCP	-	Cost per case prevented
CEA	-	Cost-effectiveness analysis
CDA	-	Cost per death averted
CHN	-	Community health nurse
CI(s)	-	Confidence intervals
CIF	-	Cost, insurance & freight
CMA	-	Cost-minimization analysis
CUA	-	Cost-utility analysis
CUSO	-	Canadian Universities Services Overseas
D	-	Dalasis (Gambia currency)
DALY	-	Disability adjusted life year
DDT	-	Dichloro-diphenyl-trichloroethane
DIS	-	Double intervention study
DLYG	-	Discounted life-year gained
DPT	-	Diphtheria, pertussis & tetanus
EC	-	Emulsified concentration
EPI	-	Expanded Programme on Immunization
FGD	-	Focus group discussion
FIC	-	Fully immunized children
GNP	-	Gross National Product
GPTC	-	Gambia Public Transport Corporation
GRUDA	-	Gambian Rural Development Agency
HCH	-	Hexachlorohexan
IDI	-	In-depth interview
MCH/FP	-	Maternal & Child Health/Family Planning

MFCC	-	Matched fatal case-control study
mg	-	Milligrams
MID	-	MacCarthy Island Division
mls	-	Millilitres
MoH	-	Ministry of Health & Social Welfare
MRC	-	Medical Research Council (The Gambia)
NADC	-	National Agricultural Documentation Centre
NGO	-	Non-governmental agency
NIBP	-	National Impregnated Bednet Programme
OPD	-	Out-patient department
ORT	-	Oral rehydration therapy
PHC	-	Primary Health Care
PW	-	Paediatric ward
QALY	-	Quality-Adjusted Life Year
R1,..R6	-	Respondents of focus group discussions
Res	-	Respondent of in-depth interviews
RHT(s)	-	Regional health teams
RSO	-	Random spot observation
RVH	-	Royal Victoria Hospital
SA	-	Sensitization & Awareness campaign
SCF(US)	-	Save the Children Federation (United States of America)
SPHN	-	Senior Public Health Nurse
SPHO	-	Senior Public Health Officer
TB	-	Tuberculosis
TBA	-	Traditional birth attendance
ULYG	-	Undiscounted life-year gained
UNICEF	-	United Nations Children's Fund
URD	-	Upper River Division
VDC	-	Village Development Committee
VHW	-	Village health worker
vs	-	versus

NON-ENGLISH TERMS USED IN THE TEXT

Aada	-	Custom
Alhaji	-	Title for a Muslim who has visited Mecca, Saudi Arabia
Allah	-	Almighty God
Alikalo	-	Village head
Bantaba	-	Shady platform for resting and sitting
Benachi	-	Local rice meal
Buroo	-	Tablets
Charity	-	Burial, funeral & mourning ceremonies
Churai	-	Local fragrant made from resin and wood kernel
Fure loola	-	Corpse washer
Hoja	-	Co-wife
Jallango	-	Idols
Koran	-	Muslim holy book
Lasiloo	-	Lineage
Lumo	-	Locally held weekly market
Marabou(s)	-	Local religious healer(s)
Musu kebba	-	Grandmother/mother in-law
Nebe dai	-	Type of local medicine made from herbs
Sankewo	-	Bednets
Tantango kosoo	-	Locally improvised drum made by placing a calabash upside down in a bowl of water
Tubab	-	White person

CHAPTER 1: INTRODUCTION

1.1 Statement of the problem

Malaria remains one of the world's most serious public health problems and in tropical Africa it is one of the common infections in virtually all the countries (Haworth, 1988). Conservative estimates worldwide in 1986, shows about 439 million clinical cases, of which 62% were from Africa alone (Sturchler, 1989). Overall, 234 million of the cases was due to the malaria parasite *Plasmodium falciparum*, out of which at least 2.3 million were fatal (Sturchler, 1989). In tropical Africa alone, it is estimated that 10% of annual deaths of infants and children below the age of 14 years were from malaria with the greatest toll in the age group 6 months to 4 years (Haworth, 1988).

The malaria situation in The Gambia is no different. The disease causes widespread morbidity and mortality particularly in infants and children. For instance, in the rural areas of The Gambia, one child in 20 under the age of five dies from malaria (Greenwood et al., 1987). Little is known, about how malaria affects the development of children who survive.

Most African countries are poor and malaria is just one of a growing list of problems. The recent economic recession that almost all developing countries find themselves in, coupled with demographic changes and the reluctance of some donors to continue financing health care programmes, significantly affects the ability of countries to develop their health care services to their full capacity, especially PHC systems (UNICEF, 1988). Moreover, the increasing economic crises of the African countries since the mid-1970s has resulted in a reduction of the standard of living of their populations and of their ability to import the appropriate technology to combat diseases (World Bank, 1988). Again, The Gambia is no exception. The standard means of malaria control and treatment in The Gambia relies heavily on the few health facilities and its extensive primary health care (PHC) programme which became functional in 1981 (Cham et al., 1987).

In view of this, to curtail the prevalence of the disease, malaria control at the individual and community levels, has assumed greater national priority. Malaria control in The Gambia is based mainly on treatment of presumptive attacks with chloroquine and the use of bednets as a protective barrier particularly in the rural areas. However, reduction in malaria morbidity (or mortality) through chloroquine treatment cannot be relied upon due to non-compliance, overdose, indiscriminate use of the drug, among others (Menon et al., 1988). Further studies have demonstrated that chemoprophylaxis is difficult to sustain or implement widely and it may also increase the spread of drug resistant parasites (Greenwood et al., 1988).

The epidemiological results of one recent study in The Gambia, the Double Intervention Study (DIS) which combined chemoprophylaxis and insecticide-impregnated bednets strategies, showed that overall mortality and malaria-specific mortality in children 1-4 years were reduced by 63% and 70% respectively in the intervention villages (Alonso et al., 1991). Among the children who slept under treated nets the addition of chemoprophylaxis gave no additional benefit in preventing deaths. Moreover, the trial was cost-effective compared with other intervention programmes in developing countries (Picard et al., 1993). Thus, for the first time, a malaria control strategy in Africa was shown to be competitive with other interventions that prevent child deaths. These results cannot be easily ignored by public health authorities. Ironically, there had been no instituted national programme to control the malaria vector until recently.

These encouraging results prompted the Gambian government, in conjunction with the Medical Research Council (MRC), The Gambia and the World Health Organization (WHO), to implement an insecticide-impregnated bednet programme nationwide using the existing PHC scheme. This culminated in the establishment of a National Insecticide Impregnated Bednet Programme (NIBP). The fundamental question to be answered was; would similar results of Alonso, Picard and their colleagues be obtained by a national control programme?

The research of this thesis was stimulated by the interest in using insecticide-impregnated bednets to control malaria, due to the failure of earlier attempts in the 1950s to eradicate malaria worldwide using residual insecticides such as dichloro-diphenyl-trichloroethane (DDT) and hexachlorohexan (HCH). The WHO is in the forefront of this noble effort to bring malaria under control. Drawing on the experiences of various studies throughout developing countries, WHO has sponsored trials of insecticide-impregnated bednets in malarious areas in Africa, with The Gambia being one of the countries. Although these trials vary from country to country, The Gambian insecticide-impregnated bednet trial is the only national programme sponsored by WHO and it covers several the research areas including epidemiology, entomology and economic studies. This thesis covers one aspect of the research in economics of the programme - the cost-effectiveness analysis of NIBP.

1.2 Organization of the Thesis

This thesis consist of 9 chapters. Chapter 1 provides the introduction to the thesis in terms of stating the problem to be addressed and the organization of the thesis.

Chapter 2 reviews the relevant literature for this study and is organized in three parts; the first section deals with methods of malaria control primarily in developing countries showing malaria vectors control methods - past and present. The second section covers economic evaluation of health intervention programmes, including theoretical and empirical studies of economic evaluation techniques used with special emphasis on tropical diseases in developing countries such as malaria. The third section reviews indirect cost studies in relation to adults and children especially time cost to women in terms of child and ill-health care and also the effect of childhood morbidity on education. The final section of this chapter summaries the whole review drawing on lessons and gaps in knowledge some of which this study hopes to address. This chapter aims at providing information for the development of the research methodology, analysis and interpretation of the study results.

Chapter 3 describes the setting of the study in terms of the country where the study took place, its malaria situation and the instituted control programmes to date and also a description of the National Insecticide-impregnated Bednet Programme (NIBP) in relation to this study.

Chapter 4 presents the study objectives vis-a-vis NIBP objectives and describes the various methods used for data collection. A schedule of activities for the study is also included.

Chapters 5, 6 and 7 describes the results of the study in the following order; the implementation cost and effects of NIBP intervention, resource use consequences of NIBP intervention and the cost-effectiveness ratios of NIBP intervention.

Chapter 8 discusses the main findings of the thesis in relationship to its objectives. Comparative assessment of the study results is also made at the national and international levels.

Finally, the conclusion of this thesis is in Chapter 9 which gives the policy options of cost-effectiveness analysis studies with respect to the major findings of this research. The future research needs in terms of methodological approach and other effects of an intervention programme are also highlighted.

Additional information emanating from the study ie questionnaires, forms, field notes, coding manuals, samples of transcribed interviews and tables are provided in the appendices section.

CHAPTER 2: A REVIEW OF MALARIA CONTROL METHODS, ECONOMIC EVALUATION OF HEALTH INTERVENTION PROGRAMMES AND TIME ALLOCATION STUDIES IN DEVELOPING COUNTRIES

2.1 Introduction

This review is organized in three parts; the first section deals with methods of malaria control primarily in developing countries showing malaria vectors control methods - past and present. The second section covers economic evaluation of health intervention programmes, including theoretical and empirical studies of economic evaluation techniques used to evaluate other diseases as well as malaria studies. The third section reviews indirect cost studies in relation to adults and children. The final section of this chapter summaries the whole review drawing on lessons and gaps in knowledge some of which this study hopes to address.

The defined sphere of interest in this review was organised to show the various control measures used, economic evaluation methods available, evaluation of some tropical diseases interventions and the resource consequences of this interventions especially to families, an area which has received relatively little attention in most studies as this review would show.

The literature of interest reviewed consists largely of original papers published in health and economics journals, health economics books, methods of malaria control studies particularly the ones on mosquito nets (bednets), economic studies on other disease and malaria intervention programmes carried out in developing countries and unpublished articles and papers on bednets and malaria control. Most of references can be found in public health, health, medical and social sciences journals and various WHO publications. The literature search was made from libraries and computer facilities such as Medline and CD roms. The majority of the literature falls within the period of 1980 and 1994, with just a few older references before this period. The unpublished documents were obtained from personal contacts of colleagues, lecturers and officials of relevant institutions. Finally, only English literature was searched.

2.2 Methods of Malaria control

The principal vectors of malaria in the world and especially tropical Africa are *Anopheles arabiensis*, *A. funestus* and *A. gambiae* (Haworth, 1988 and Toure, 1989). Well known anti-malaria measures are chemotherapy, vector control and vaccine. The implicit objective of most anti-malaria strategies is to reduce morbidity and mortality (Beausoleil, 1984). Yet, malaria control activities in various parts of the world depends on; the prevailing epidemiology of the disease, the efficacy of technological methods, the structure of health service, the logistic and financial capability of each country and last but not least, national commitment (Lancet, 1983). For example a review by Bruce-Chwatt et al. (1984) in Africa during the malaria eradication era reveals in that the first period (1950 and 1964) residual insecticides such as DDT and HCH might decrease the amount of malaria transmission, yet interruption of transmission could not be achieved. The second period (1965-74) also disclosed that the difficulties of malaria eradication and control in Africa were due to the development of resistance of *A. gambiae* to DDT, HCH and dieldrin, as well as administrative, logistic and financial problems. Thus it became clear that the prospects for malaria control were related to the availability of a network of basic health services. Following this, programmes were setup in order to develop better methods of malaria control and to improve the rural health infrastructure. Other activities were chemotherapy of malaria trials. The results showed the value of collective or selective administration of antimalarial drugs was fully recognised, although its effect on malaria transmission in Africa was minimal (Bruce-Chwatt et al., 1984).

Recently, the WHO Expert Committee on Malaria recommended among others that; 1) countries should review their antimalarial activities in the light of the policy of health for all and the principles of primary health care and their state of development; 2) malaria control should be based on an epidemiological approach, recognizing local variability in the distribution and evolution of problems and 3) plans to control malaria or to modify existing malaria control programmes should be based on the best available information and experience (WHO, 1986).

Support of the WHO Expert Committee's recommendations is by observations made by Habluetzel (1989) and Toure (1989) that experience over the years suggest that PHC activities integrated with malaria epidemiology of the locality and controls such as individual measures (home spraying, impregnated bednets and eave curtains usage) appears to be the most feasible strategies for endemic countries. More importantly, vector control must be adapted to local situations to make them efficient and feasible.

Conventionally, vector control methods can be divided into biological, environmental management and chemical approaches. The proceeding discussion will be grouped under these 3 sub-headings.

2.2.1 Biological control of malaria

Some success had been achieved with existing types of biological control methods. This approach may entail introducing larvivorous fish into mosquito breeding sites to feed on their larvae. However, as Knell (1991) noted, this is effective in water tanks and other enclosed water bodies.

Another method is using bacteria which produce toxins and kill mosquito larvae. Other mosquito pathogens and predators such as viruses, protozoa, fungi, nematode worms and frogs have been tried (Knell, 1991). Sterilized (by chemical and X-ray) males mosquitoes can also be released into the wild to reduce mosquito population through non-reproductive fertilization.

Proponents of biological approach (Sharma, 1987 and Fletcher et al., 1993) especially Sharma, argues that first the essence of the vector control is to make it an integral part of community development activities for the continuity of the project. Secondly, the philosophy of malaria control (or eradication) using residual insecticides and chemotherapy was to tackle 2 components of the malaria triangle (ie vector and parasite) without involving the third component - man. This was based on 2 assumptions; a) to kill vectors or reduce their life-expectancy below that which will allow the on-going transmission and b) using drugs to eliminate the parasite from human reservoir. After 3 decades of trials, all the 2 components of the triangle have developed resistance which can only be tackled by using integrated biological and environmental control methods. Moreover, Sharma argues that biological control can bring about permanent ecological changes rather than affecting the longevity of the mosquito.

Sharma et al. (1991) used larvivorous fish to reduce vector species in the Kheda District of Gujarat, India. The project also reported other community benefits. However, the failure of biological control method was due to the perceived social and economic value of the biological agent used. For instance, Knell (1991) cited a biological control method in India where frogs were used. The frogs were apparently hunted for export to Europe due to their high commercial value leading to an upsurge of mosquitoes and malaria infection. It could be argued that agents for control in the two above examples were different which might have resulted in the two extreme outcomes. Notwithstanding these shortcomings, identification of indigenous larvivorous fishes in particular for future biological control are continuing. For example, Fletcher et al. (1993) have recent reported some work done in Ethiopia.

2.2.2 Environmental control of malaria

Environmental control of malaria largely involves engineering methods such as drainage and water management. The approach seeks to reduce the number of breeding sites for mosquitoes. This is by far the oldest method in use (Knell, 1991), but had been found to be more practicable in urban areas. In rural areas, on the other hand, small ponds are required to be filled in and the edges of streams and irrigation canals kept free of vegetation (Knell, 1991).

Both biological and environmental control methods are ecologically friendly, have long-term positive effects and less sensitive to short-term interruptions (Bos and Mills, 1987). Moreover, in economic terms, depending on the criteria for analysis, they are usually favoured. Yet, they require high initial capital outlay with low maintenance cost compared to chemical control approaches (Bos and Mills, 1987). Besides, MacCormack, (1984), has pointed out that biological and environmental control though promising, cannot in themselves control malaria alone, but in conjunction with other vector control measures their cumulative effect will be appreciable.

2.2.3 Chemical control of malaria

There are 2 main types of chemical control methods - chemotherapy and residual insecticides application. Chemotherapy is made up of 2 varieties namely, prophylaxis (usually given to pregnant women and children) and treatment of mild and severe cases of malaria. Chemotherapy usage in malaria control predates several centuries of the discovery of the aetiology and mode of transmission of the disease (Jeffrey, 1984). However, mass chemoprophylaxis is not feasible due primarily to recurrent cost and compliance, coupled with the spread of drug resistance in both parasites and man (Goriup, 1989). This calls for additional alternative measures to help combat malaria. Although research into developing a malaria vaccine is continuing, technological breakthroughs such as preventive vaccines are still elusive. For example, recent studies in Columbia by Valero et al. (1993) and Tanzania by Alonso et al. (1994) using synthesised SPf66 malaria vaccine has demonstrated a protective efficacy of 38.8% amd 31% respectively. These result are encouraging. Yet, experience over the years indicates that even where preventive or therapeutic strategies exist, delivering them to cover sufficient proportion of population is fraught with difficulties.

The other type of chemical control is residual insecticide. Residual insecticides can be applied in various ways, such as area spraying through larviciding and fogging against larvae and adult mosquitoes respectively. They are used indoor and outdoor through spraying and burning. Another revitalised method of using residual insecticide that is receiving the attention of most malariologist is impregnated bednets.

The most well known and used residual insecticide which initially appeared to be the panacea of malaria control was DDT. Gramiccia and Beales (1988) noted that DDT first discovered by Zeidler in 1874, has been used across almost all regions of the world where malaria is endemic. It use has been curtailed by problems of the spread of mosquito resistance to DDT and other associated social problems in the communities where they were used such as killing domestic animals, fish in water, destroying walls of rooms etc.

Recent studies in India (Cohn, 1973; Sharma and Sharma 1986) and in Nepal (Mills, 1989) have shown that DDT house spraying was effective in reducing the vector population and malaria transmission. The strategy of this malaria control measure was to interrupt the transmission by reducing man-vector contact through the introduction of residual insecticide. Other residual insecticide used for house and aerial sprayings were fenitrothion and malathion, but costly and again their social acceptability was low as well (Gandahusada et al., 1984; El Gaddal et al., 1985; Sharma and Sharma 1986).

Other mosquito repellents such as insecticidal bars (Chiang et al., 1990), burning of local repellents (*'churai'*) in The Gambia (Snow et al., 1987), applying oil, cream, burning coils and using electrical devices (Ansari et al., 1990) have all been shown to be less effective.

Failure to eradicate malaria from large parts of the world by DDT, coupled with the spread of chloroquine resistance across Africa and with attempts being made to develop a viable vaccine, Marsh (1993) noted that the options left were; 1) health education, which has poor track record in many areas; 2) development of new drug to replace chloroquine, a venture most pharmaceutical industries are reluctant to pursue due to low commercial returns and 3) vector avoidance, the most appropriate one being bednets which are poor barrier by themselves in most settings. One possible solution is to impregnate nets with residual insecticide. Currently, most hopes rest on impregnated bednets and other materials with pyrethroid compounds which had been shown to work in other areas of Africa for example Burkina Faso, Tanzania, The Gambia etc (Darriet et al., 1984; Lines et al., 1987; Lindsay et al., 1989).

The 1980s have seen the revival of an old technique of using insecticide to reduce man-vector contact through impregnated bednets (Lindsay and Gibson, 1988). Available pyrethroid have high insecticidal effect and low mammalian toxicity (Lin, 1991). Other studies have also shown that bednets have been used by communities for a long time as a protective barrier as well as for other purposes. It use might have arisen from the desire to have uninterrupted sleep (MacCormack, 1984; MacCormack and Snow, 1985; MacCormack and Snow, 1986; Lindsay and Gibson, 1988 and Aikins et al., 1993). Untreated bednets have been shown to reduce malaria morbidity when used properly (The Gambia, Bradley et al., 1986 and Lindsay et al., 1989; Papua New Guinea, Burkot et al., 1990). However, the protective effect of nets may be enhanced if they are treated with an insecticide (see Table 2.1). Other materials impregnated with insecticide are curtain eaves, wall cloth and anklelets which offers varying degrees of protection (Curtis and Lines, 1985; Procacci et al., 1991; Mutinga et al., 1992; Sexton et al., 1990). One study of treated-bednet (in combination with chemoprophylaxis) that has aroused the quest for more research work on bednets is that of Alonso et al. (1991). The results showed a reduction of 63% in the overall deaths of children (1-4 years) and a reduction of 70% in malaria associated deaths.

The reviewed studies summarised in Table 2.1 show the use of various insecticides for impregnation. Permethrin is recommended by the WHO Expert Committee on Vector Biology and Control (cited in Lin, 1991). The choice of permethrin might be due to its insecticidal and deterrent effects which makes it exerts both killing and repellent effects. This has been shown in most of the studies (Darreit et al., 1984; Hossain and Curtis, 1989; Lindsay et al., 1989; Miller et al., 1991 etc). But, less pronounced deterrency was reported by Lines et al. (1987).

Table 2.1 also shows that the indicators of the effect of impregnated bednets is the incidence of clinical malaria and vector population. All the entomological trials irrespective of the insecticide used, showed a reduction in vector population leading to substantial reduction in man-vector contact. Consequently, episodes of clinical malaria (health indicator) were reduced as reported in all the studies, particularly in children under 5-year-old (Graves et al., 1987; Sexton et al., 1987; Snow et al., 1988 etc). The only trial that measured malaria mortality showed that the protection was greater against malaria-related mortality than morbidity (Alonso et al., 1991). The use of child mortality as an indication of health impact is most promising (Bermejo and Veeken, 1992). Current studies are yet to substantiate the impact of impregnated bednets on child mortality.

Other studies that used impregnated materials such as curtains and wall cloth (Lines et al., 1987; Mutinga et al., 1992 and Sexton et al., 1990), showed that though they were effective, bednets were better, probably due to their larger surface area.

It is also worth mentioning that critics of studies from The Gambia who claim that the country has had its fair share of studies and that the results usually obtained are biased and characteristic of the country, though anecdotal, the review in Table 2.1, shows the contrary. Results obtained from The Gambia compare favourably with those from other parts of the world (eg Burkina Faso, China, India, Kenya, Papua New Guinea, Tanzania etc).

An increasing body of work in the use of insecticide-impregnated bednets in the control of malaria in recent times is geared towards ascertaining the cost-effectiveness of the approach. The current study - economic evaluation of impregnated bednet in The Gambia, is also in tune with current thinking and seeks to address an important, though a neglected area, in the evaluation of most intervention programme. The next section deals with the economic evaluation techniques used in health evaluation programmes.

2.3 Economic evaluation of health intervention programmes

The review in this section will focus primarily on disease control programmes in developing countries. This implies that a distinction is made between preventive programmes such as vector control and immunization which have the objective of reducing the incidence, prevalence or mortality of a disease. Curative programmes such as hospital based treatment which do not have the paramount objective of influencing the level of disease will be excluded from the study. Likewise, general primary or secondary care programmes which are not targeted to specific diseases will also be excluded. This review will thus set up the framework for the empirical work presented in the whole study.

The allocation of resources is the dominant theme in economics. This is true regardless of the stage of development of the country concerned, which implies that a choice has to be made on how to use scarce resources (Linnenberg, 1964; Stoddart and Drummond (1984); Drummond and Stoddart, 1985 etc). The distribution of the scarce resources between and within different sectors of the economy therefore calls partially for a systematic and scientific means of resource allocation (not forgetting the political pressures). One of the means available is economic evaluation, which has been used extensively in other sectors of the economy such as planning, education and defence (Linnenberg, 1964; Dunlop, 1975 and Klarman, 1982). Similarly, in the health sector, the growing interest in using economic evaluation techniques is to ensure that the scarce resources available are used efficiently (Mills and Thomas, 1984). Mills and Thomas (1984) identified 3 main factors that have led to the application of economic evaluation in the health sector. These are; 1) acute shortage of public funds for health; 2) both national and international concern about the ineffectiveness of past health investments to combat major health problems in developing countries and 3) the growing realization of the enormous resource implications of achieving widespread health improvements, even through the recommended approach of primary health care.

Moreover, with an average health budget of less than '$3 per capita' (Lennox, 1991) and the worsening of income growth in developing countries due to the world recession, governments are faced with chronic shortage of public funds which implicitly calls for the achievement of efficient investment planning in the whole of the public sector (Mills and Thomas, 1984).

2.3.1 Forms of economic evaluation

The techniques of economic evaluation make an important contribution to the methods of health service evaluation and are based on the economist's concern with "economic efficiency" and "opportunity costs" (Mills and Gilson, 1988). Two useful definitions of economic evaluation will be referred to in this review. Drummond et al. (1987) defined economic evaluation as;

> "the comparative analysis of alternative courses of action in terms of both their costs and consequences."

Mills and Gilson (1988) also defined it as;

> "the quantitative analysis of the relative desirability to the whole community of investing in alternative projects or programmes."

In the definitions, "desirability" or "alternative courses of action" are both assessed in terms of both costs and consequences. Furthermore, in Drummond et al. (1987) definition, "consequences" is used as the collective term for the beneficial results of a programme, which depend on the techniques of analysis employed (ie "effects", "benefits" or "utility"). The implication of these two definitions are the same ie to identify, measure, value and compare the costs and consequences of the alternatives being considered (Drummond et al., 1987). Schematically, Drummond et al. (1987), have classified the components of economic evaluation of health care programme as resources consumed in terms of cost (direct costs, indirect costs (production losses) and intangible costs) and health improvement in terms of effects (health effects in natural units), utilities (health effects in quality-adjusted life-years) and benefits (direct benefits, indirect benefits (production gains) and intangible benefits). Using the principle underlining these two definitions, several forms of economic evaluation emerge as shown in Figure 2.1.

Figure 2.1 Distinguishing characteristics of health care evaluations.

Are both costs (inputs) and consequences (output) of the alternatives examined?

		NO		YES
Is there comparison of two or more alternatives?	NO	Examines only consequences	Examines only costs	
		1 A PARTIAL EVALUATION Outcome description	1B Cost description	2 PARTIAL EVALUATION Cost-outcome description
	YES	3A PARTIAL EVALUATION Efficacy or effectiveness evaluation	3B Cost analysis	4 FULL ECONOMIC EVALUATION Cost-minimization analysis Cost-effectiveness analysis Cost-utility analysis Cost-benefit analysis

(Source: Drummond, Stoddart and Torrance, 1987)

However, only those forms which examine both costs and consequences for two or more alternatives fit the above definitions and can be described as full economic evaluation studies. From Figure 2.1, the full economic evaluation studies are: cost-minimization analysis, cost-effectiveness analysis, cost-utility analysis and cost-benefit analysis.

From the combined literature of Mills and Gilson, (1988); Drummond et al. (1987) and Mills and Thomas, (1984), the full economic evaluation analyses can be described as follows;

Cost-minimization analysis (CMA) is based on prior epidemiological (or programme) findings which show that the outcome measure is achieved to the same degree by two (or more) interventions. The efficiency evaluation of such a study is essentially to identify the least cost alternative (or intervention).

Cost-effectiveness analysis (CEA) on the other hand, examines the best way of achieving a single objective comparing programme (or intervention) effects and costs. The results are expressed either as costs per unit of output or as effects per monetary unit.

Cost-benefit analysis (CBA) entails valuing both costs and benefits in monetary terms and comparing them to assess whether the project is desirable through the use of decision criteria. Results of CBA are stated either in the form of a ratio of 'dollar costs to dollar benefits' or as a simple sum representing the net benefit of one programme over another (ie internal rate of return or net present value).

Finally, **cost-utility analysis (CUA)** the most recent method, is a special case of CEA but measures the project/programme effects in terms of utilities (ie the quality-adjusted health outcome caused or averted). Again like CEA, it can focus on either minimizing cost or maximising effects. CUA results are usually expressed in terms of costs per Quality-Adjusted Life Year (QALY).

2.3.2 Concept of cost

Cost can be defined in financial and economic terms. Whilst financial cost entails expenditure of goods and services, economic cost takes a broader view by considering cost as the opportunities lost in employing resources (ie opportunity cost). This gives cost a social dimension as well. There are instances where prices of goods and services are good indicators of this opportunity cost. However, in other situations, this is not the case. For example; a) gifts or donations; b) resources with false prices; c) certain activities with externalities and d) money prices are often distorted by transfer payments (eg taxation or subsidies do not in themselves constitute an opportunity cost) (Mills and Gilson, 1988). In such situations, 'shadow prices' are employed if market prices do not reflect the opportunity cost of resources (eg salaries, imported goods, unskilled labour work etc) (Phillips et al., 1993).

Economic costs usually adopts the direct/indirect costs approach (Stoddart and Drummond, 1984 and Drummond et al., 1987). Direct costs in health care programme refers to the costs of preventing and treating the disease. This embraces payment for all resources. Indirect costs on the other hand, is concern with the value of the entire loss of productivity associated with the disease, such as time costs of caring for the patient as well as losses from productive activity and psychic cost (Stoddart and Drummond, 1984; Drummond et al., 1987 and Hanson, 1992). A detailed review of costs are given in the relevant section below.

2.3.3 Indicator of consequences (or effects)

Another prerequisite for full economic evaluation, after obtaining the necessary cost data, is that the consequences (or effects) of an intervention need to be identified, measured and valued. These effects refer to the treatment results of the intervention. The effects of an intervention study requires the application of various epidemiology techniques. In addition, two important steps are necessary in the process of measuring effectiveness, namely;

a) choosing an appropriate indicator of effectiveness and
b) measuring the value of the indicator for each of the interventions (Phillips et al., 1993).

Moreover, there are three main indicators of effectiveness - outputs, outcomes and impacts influencing one another in that sequence. A simplified example of causal chain linking outputs through outcomes to impacts of a malaria control programme (eg insecticide impregnated bednet) is given in Figure 2.2.

Figure 2.2 Effects of Insecticide-impregnated bednet for the control of malaria vector.

		OUTCOMES	IMPACTS	
INTERVENTION	OUTPUTS	on vector and human behaviour	on disease	on socio-economic variables
Introduction of insecticide-impregnated bednets	Provision of insecticide-impregnated bednets	Decrease in mosquito life expectancy a) Decrease in mosquito abundance b) Decrease in mosquito infection rate c) Decrease in inoculation rate	Decrease in malaria morbidity & mortality	Increase in production & Decrease in treatment costs

Source: Adapted from Phillips et al. (1993).

Needless to say, like cost data, the availability of epidemiological information is crucial for the determination of consequences (or effects). The nature of the intervention partly predetermines the completeness of the epidemiological data used in economic evaluation. For instance, in many societies, to subject a group of people to experimental interventions repetitively is considered unethical. One therefore encounters problems when establishing effectiveness of an intervention over a period of time, say by denying the control group similar treatment when positive effects of the intervention are noticeable. To resolve this, most studies rely on the effectiveness data from intervention trials over a short period of time. Such data may reflect only the epidemiology of the disease at that particular time. Thus, any assumption that such measured effectiveness holds always or that intervention effectiveness remains constant over space and time may lead to erroneous conclusions. In the light of the above discussion, for a disease like malaria, establishing effectiveness is not easy on an *a priori* basis, because malaria epidemiology may vary with several factors: for instance, environmental changes might affect mosquito population leading to increase or decrease in malaria or an upsurge of disease due to immigration of people from an area of lower endemicity to another area of higher endemicity.

2.3.4 Type of costs and consequences (or effects) relevant to economic evaluation of health programmes

Stoddart and Drummond (1984), Drummond and Stoddart (1985) and Drummond et al. (1987) pointed out that it is impossible to measure and value all the relevant costs and consequences of the alternatives being compared, because some of the indirect costs and benefits are difficult to quantify at the present moment. However, they stated that their full identification was necessary. This will enable researchers to make the appropriate decision on whether to consider indirect costs or not, depending on its effect in the evaluation of the programme and to examine any bias in the analysis which favours the easily measurable items at the expense of others.

The type of costs and consequences likely to be encountered and relevant to economic evaluation of health services and programmes are presented in Figure 2.3.

Figure 2.3 Types of costs and consequences relevant to economic evaluation of health care services and programmes.

COSTS		CONSEQUENCES	
I Organizing and operating costs within the health care sector (eg health care professionals' time supplies, equipment, power and capital costs)	**Direct costs**	I Changes in physical, social or emotional functioning (**effects**)	
II Costs borne by patients and their families - Out-of-pocket expenses - Patient and family input into treatment	**Direct costs**	II Changes in resource use (**benefits**)	III Changes in the quality of life of patients and their families (**utility**)
		a. for organizing and operating services within the health sector - for the original condition - for unrelated conditions	**Direct benefits**
- Time lost from work	**Indirect costs**		
- Psychic costs			
III Costs borne externally to the health care sector, patients and their families		b. relating to activities of patients and their families	
		- savings in expenditure or leisure time	**Direct benefits**
		- savings in lost work time	**Indirect benefits**

(Source: Drummond, Stoddart & Torrance, 1987)

On the side of costs, Category I comprises the costs of organizing and operating the programme. Identifying these costs usually amounts to what Drummond et al. (1987) referred to as "**listing the ingredients of the programme**". Economists often refer to these costs as direct costs. Category II is made up of costs which are borne by the patients and their families. As shown in Figure 2.3, this also contains costs due to production losses (ie time lost from work by patients and/or family members while seeking treatment or participating in the health care programme). These are called indirect costs. The other aspect of costs are psychic costs often experienced by patients and their families, that is, the anxiety and pain associated with treatment as a whole. The final category of costs are those that are borne externally to the health care sector. As Drummond et al. (1987) noted, in principle these costs should be incorporated in economic evaluation, yet for many health care programmes they may be insignificant.

With respect to the consequences (or effects) part of the table, they consist of the therapeutic outcomes or effects of the alternatives in question (Stoddart and Drummond, 1984; Drummond and Stoddart, 1985 and Drummond et al., 1987). This gives rise to two other essential categories of consequences as shown in Figure 2.3. Category II of consequences indicates that the effects may lead to changes in resource use in the future. Where such effects result in savings in health care utilization attributable to the programme, economists refer to it as the direct benefits of the programme in question. On the other hand, if the therapeutic effects of the programme affect the resource use of patients and their families such as production gains from increased working time associated resulting from treatment, these are referred to as the indirect benefits (Drummond et al., 1987). It is this aspect of benefits (indirect) that has been a major source of controversy in economic evaluation because of the problem of valuing these health status improvements in monetary terms. Finally, the third category of consequences deals with changes in the quality of life of patients and their families. This component of therapeutic effects embraces the value that patients and their families attach to the effects (ie individual preference).

It is necessary to point out that Drummond et al. (1987) model was based on the health sector of developed countries as a whole focusing on personal health care as opposed to disease control programmes in developing countries (seeFigures 2.2and 2.3). Yet, the principles underlying the benefits aspect of the 2 models are the same and are therefore related (ie Phillips et al.'s model the outcome and impact and Drummond et al.'s consequences of the intervention).

As Drummond and his colleagues concluded, within the broad framework of costs and consequences, the inclusion and exclusion of items needs to be "**judged in the larger context of objectives for health services in a given country**". This implies that a country-situational approach is required in economic evaluation. Moreover, the choice of consequences of principal interest invariably determines the type of economic evaluation technique to be used in the study. Cost-benefit analysis and cost-effectiveness analysis, the techniques most frequently used in evaluating health sector programmes in developing countries will be discussed further below.

2.4 The use cost-benefit analysis and cost-effectiveness analysis in health care programmes

The application of economic evaluation techniques to decision making in the health sector is comparatively new (Mills and Thomas, 1984). The basic concepts and procedures underlying the analytical techniques arose from work in the 1930s in the United States to establish decision-making criteria for public investment activities (cited in Mills and Thomas, 1984). Thereafter, academic interest in the subject area grew, leading to numerous critical comments in journals throughout the 1950s and onwards (Mills and Thomas, 1984).

In the health sector, cost-benefit analysis became widely used to analyze health programmes in the late 1960s and it was used in one of three ways, first, to analyze disease-specific programmes or interventions; second, to analyze a set of alternative ways in which a given health or medical care service can be produced or distributed and third, to estimate the return to public investment in health-related programs such as health and medical research and health manpower training programmes (Dunlop, 1975). Regardless of their outcome measure, Dunlop (1975) observed that virtually all studies concluded that the benefits to health investments outweigh the cost.

Cost-benefit analysis (CBA) techniques developed from welfare economics and public finance which seeks to maximize the economic welfare of the community. In essence, CBA entails a comparison of costs and benefits for alternative or competing programmes for public funds (Klarman, 1967). Naturally, the cost consists of the programme expenditures. However, benefits comprises averted future losses with the success of the programme. Klarman identified three groups of benefits - savings in the use of health, gains in economic output and satisfactions from better health. The outcome of CBA is expressed as a monetary outcome. Monetary valuation of benefits creates problems in health status improvements. Two of the most well-known valuation methods suggested by economists are the "human capital" and the "willingness to pay" approaches. The human capital approach values the economic return (benefits) to society using the individuals expected earnings (annual income). This invariably, lowers the value of life where formal employment opportunities and wages are low as in developing countries (Creese and Henderson, 1980). The popular use of this approach lies in its feasibility, in terms of availability of data. But, its major drawback is that it tends to place lower value on lives of unproductive members (such as the unemployed and children) with respect to productive members of the society. The "willingness to pay" approach is based on a potential Pareto improvement (ie gainers of a programme could compensate losers and still be better off; this is used as a criterion for judging whether a programme is desirable) where a change can be said to be worthwhile (Cullis and West, 1979; Mills and Thomas, 1984 and Drummond et al. 1987).

As CBA is a technique for identifying potential Pareto improvement (Mills, 1989), evaluating the change requires measurement and valuation of the gains and losses of the programme in question (Mills and Thomas, 1984). However, the theoretical basis for measurement is controversial and has been criticized by several economists (Dunlop, 1975; Klarman, 1982; Gaspari, 1983; Gish, 1984 etc).

In practice, three methods are used to measure costs and benefits. They are direct question approach, individual revealed preferences and market observations. First, the direct question approach involves interviews. However, the interviewee may give false answers that bias the outcome of the proposed health project and like most health care systems in developing countries it is virtually free, so the issue of payment may mean little to people. The second method relies on the individuals revealed preference. The argument is that there are instances where individuals trade off time in health care, for example, the choice of means of transport to health centres. Such trade offs can be used as a guide to value the time savings in health care. The final approach is market observations. Here, market prices are used as proxies of benefits or costs of similar activities. For example, using wage rate to value lost working time (Cullis and West, 1979). However, in developing countries market prices may not reflect the correct prices of goods and services due to government monopoly of markets, taxes or subsidies and other forms of market distortions (Cullis and West, 1979). In such situations, shadow prices should be used.

Generally, the principle of considering all gains and losses of proposed public sector investments is well accepted however, problems arise when valuing them in practice and these problems are particularly acute in the health sector (Mills and Thomas, 1984). Although "willingness to pay" approach apparently gives a higher value to life saving and recognises the benefits of health services to individuals and their families, it is seldomly used compared to the former method due to difficulty in obtaining the appropriate data.

Where data are available they are likely to be subjective and apparently values life higher than that obtained from that of the human capital approach. Cost-effectiveness analysis does not allow the judgement of "losers and gainers" to be made since it does not concern itself with valuing benefits, but is based on Paretian principles in the sense that the prices used to value the resources used up by the programme are assumed to have welfare significance (Mills, 1989).

With CBA faced with the problems of valuing benefits, recent developments in the health sector show a general shift in programmes being evaluated to cost-effectiveness analysis techniques (Klarman, 1982; Gaspari, 1983). Klarman (1982) accordingly called CEA "**a truncated form of cost-benefit analysis that stops short of putting an economic value on the health status outcomes of programs**". Other researchers like Shepard and Thompson (1979) and Gaspari (1983) have supported the claim by Klarman that CEA is a more appropriate micro-economic tool in the health sector (particularly for preventive health programmes) compared to CBA. CEA as defined earlier is a technique for identifying the most effective use of limited resources. As Gaspari (1983) emphasized, the main assumption of CEA is that only projects/programmes with identical effects can be compared. This presupposes that CEA can only be used to compare projects/programmes with identical end-points. Shepard and Thompson (1979) mentioned an alternative use of CEA, which could also be deduced from Gaspari's work, that CEA is also used to determine which programme accomplishes a given objective at minimum cost. This dual purpose of CEA, Gaspari (1983) pointed out, is one of its major advantages. In an attempt to standardise and raise the quality of the application of CEA, Shepard and Thompson (1979), Drummond et al. (1987) and Mills and Gilson (1988) have outlined five major steps in undertaking CEA studies. These are;

1) defining precisely the programmes to be analyzed (ie developing alternative approaches to the problem and also ascertain who does what to whom, where, when and how often);
2) computing net costs;
3) computing net health effects;
4) applying decision rules and
5) performing sensitivity analysis.

These steps are likely to yield good results. Like all the other economic evaluation techniques, CEA is not without limitations. The main ones were identified by Shepard and Thompson (1979) and Gaspari (1983) as follows;

- comparisons of programmes (CEA indicates the best way to allocate resources among health programmes but cannot determine the most appropriate total investment for health);
- data limitations (complicates and reduces the precision of the analysis, however can be checked by the use of sensitivity analysis) and
- unquantifiable nature of human values (CEA interferes with humanistic values if society bases decisions on it, CEA thus must be viewed as general guideline for the provision of preventive and curative services)

The next section comprises of a critical review of some of the practical applications of these two economic evaluation techniques in developing countries and covers mainly preventive health services.

2.4.1 Review of some economic evaluation studies of other tropical diseases intervention programmes

The aim of this section is to present a summary of a number of studies on the economics of other tropical diseases in developing countries to allow a broader comparison of work done on malaria and other tropical diseases. Though economic evaluation is relatively new to health care programmes, much has been achieved in past 2 decades since its introduction. However, as the review will show few studies have been conducted in developing countries. The studies reviewed cover the following diseases - schistosomiasis, tuberculosis (TB), onchocerciasis, childhood immunizable diseases, diarrhoea, other diseases and health related services intervention programmes. These diseases, including malaria are prevalent in developing countries and of concern to public health authorities in general.

The studies reviewed are summarised in Table 2.2 and studies can be classified into 3 main regional groups of developing countries - Africa, Asia and Latin America. Of the 39 studies reviewed, 51% are from Africa, 31% from Asia, 10% from Latin America and 8% are a mixture of developing countries studies. Furthermore, all studies on schistosomiasis and onchocerciasis reported here were conducted in Africa. Fifty per cent of TB studies were from in Africa, 33% from Asia and 17% from work in some a mixture of developing countries in general. Other studies were conducted in primary health care (PHC) programme setting such as immunization and diarrhoeal control. Of these 44% were from Africa, 31% from Asia, 13% from Latin America and 13% from a mixture of developing countries. On other diseases and health related services studies, 45% from Asia, 36% were from Africa and 18% from Latin America. The studies span field trials to health centre and hospital based studies and are targeted on both children and adults.

An interesting aspect of this review is examining the type of cost data collected in the studies. Of the 39 studies, only 8% considered both direct and indirect costs in their studies. Another 8% did not specified what type of cost data was being used in the studies. The remaining studies 84% did not consider indirect cost at all. This seems to support the Drummond and his colleagues (1984, 1985 and 1987) assertion referred to earlier in this review about indirect costs. The issue of indirect costs seems to be ignored in most studies and always not deliberately, since at least some of the studies did mention that they were not considered (eg Ashworth and Feechem, 1985; Creese, 1986; Creese and Henderson, 1980; Houston et al., 1991; Lerman et al., 1985; Murray et al., 1991 and Sesso et al., 1990). As Creese and Henderson (1980) noted of "intangible benefits" in their evaluation work, similar treatment is given to indirect cost; in most studies they are described but not valued. The most plausible reasons for indirect costs not being given due attention in most studies are as follows; a) measurement and quantification difficulties and b) most studies seems to start off with the premise that indirect costs makes no impact on the total cost of programmes. Yet, it must be acknowledged that the magnitude and importance of indirect cost varies from society to society and from season to season, thus it requires attention where necessary. At the moment, proxies can be used in most cases to quantify indirect cost after it has been measured. Some of these include taking the average time loss in the society by age and sex, using the minimum wage rate of unskilled labour in the locality. The cost centres considered in these studies were capital and recurrent costs (56%), recurrent costs alone (33%), no specified cost centre (8%) and indirect cost alone (3%). A wide range of consequences were also considered by these studies from population covered, cases protected, cases prevented, attendance day, deaths averted, cure rate, survivors, information collected and for CBA both direct and indirect benefits.

These studies employed 2 main types of economic evaluation methods, namely, cost-effectiveness analysis (CEA), cost-benefit analysis (CBA) as well as cost analysis alone or in addition with CEA or CBA. The majority of the studies were evaluated with CEA alone (64%), 21% underwent cost analysis only, 8% with CBA alone, 3% each with CEA and cost analysis and CEA cum CBA and the other 3% underwent all the 3 evaluations. The popularity of CEA might plausibly be due to availability of data, relative ease of computation and its popularity amongst health economists these days.

Several studies did not perform sensitivity analysis to assess the sensitivity of their conclusions to variations in key assumptions used. Only 26% of the studies reviewed performed sensitivity analysis. Of this, the majority (80%) of them were with CEA studies as suggested in the economic evaluation theory. Various parameters were used in the few sensitivity analysis performed, such as costs (mostly when average estimates were used), discount rates, disease prevalence rates, compliance rates and effects (like survival rate). Contrary to the usual practice, Kamolratanakul et al. (Unpublished), in their study of chemotherapy control of TB in Thailand used median costs instead of the average costs in their sensitivity analysis. This is a novelty in cost analysis where distribution of an aspect of cost data are available. Moreover, average costs does not always give an approximation of the required costs. Finally, Joesoef et al. (1989), in their study of epidemiological modelling of TB in Indonesia after considering sensitivity analysis, carried out threshold analysis of treatment cost to affirm their choice of figures (estimates) in their overall computation.

The review presented here gives a broad range of economics of diseases in developing countries which will enable some comparison to be made with malaria studies to be discussed.

2.4.2 The economic studies of malaria

The purpose of this sub-section is to review studies done of the economics of malaria, with the view of examining their methodological approaches in terms of their strengths and weaknesses, type of analysis used, limitation of studies and results. This will enable the present work to address some of the weaknesses of the past studies and/or to appraise their strengths by filling in the gaps in knowledge or improving on weak methodologies where appropriate. Moreover, the review will act as a framework for the research by allowing comparison of methods, analysis and outcome measure. The studies to be discussed are classified into three main groups; cost-effectiveness studies, cost-benefit studies and other economics of malaria studies most of which are presented in Tables 2.5, 2.6 and 2.7. Considering the available literature, cost-effectiveness studies and especially cost-benefit studies are in the minority, perhaps indicating the paucity of data and neglect in that area of economics of malaria control programmes. By and large, these studies have several differences which makes comparison between studies difficult. The other economics of malaria studies category in Table 2.5 comprises studies dealing with cost analysis only or concentrating mainly on consequences (effects).

2.4.2.1 Cost-effectiveness studies of malaria control programmes

Studies dealing with the cost-effectiveness of malaria control strategies are shown in Table 2.3. The CEA ratios[1] in Table 2.3 were made comparable in terms of currency and year. These studies show variation in the range of nature of study, costs and cost-effectiveness ratio considered. The costs considered in the studies differ from project to project and also from

[1]All cost-effectiveness ratios were adjusted by the rise in consumer prices using the year of the study as a base to US dollar ($) 1992 to reflect the time interval between the studies.

intervention to intervention. They range from direct to indirect costs. Within the direct costs some studies considered recurrent (operational) cost alone depending on the nature of the study.

Four types of cost-effectiveness ratios were identified, namely cost per person protected, cost per case prevented, cost per death averted and the others category. The majority (64%) of the studies were based on direct vector control programmes, yet studies using the same cost-effectiveness ratio, for example cost per death averted are not easily comparable due to differences in epidemiological data and the control strategy used (see Mills, 1989 and Molineaux and Gramiccia, 1980). Whilst Mills (1989) presented her ratios by type of intervention, Molineaux and Gramiccia (1980) produced one ratio. It is not clear whether this ratio represents the combined effects of the interventions or otherwise. The large variations in the cost-effectiveness ratios reported are expected, since the studies were conducted at different time periods and with different consequences. For instance, even with the comprehensive work of Mills (1989), the results are subject to a wide margins - cost per death averted ranges from $133 to $21,745, depending on the type of intervention used. The wide range of CEA values in Table 2.3 are plausibly due to the lack of sensitivity analysis in most of the studies to test their conclusions. For example, only 23% of the studies applied any sensitivity analysis. Those which did used discount rate, compliance rate, value of a day if work lost, cost of private treatment, government inpatient cost, side effect rates etc. Two of the studies (Mills, (1989) and Sudre et al. (1992), conducted thorough sensitivity analyses and Sudre et al. (1992), moved a step further by carrying out threshold analysis. With most of the studies, lacking sensitivity analysis, it is difficult to know the important influencing parameters in the CEA ratios and how helpful they would be to future research needs. The only conclusion that could be drawn from these studies are the very considerable variation between programmes and countries circumstances.

Some of the studies were thorough in producing cost-effectiveness ratios for two of the 4 groups given in Table 2.3. The studies of Gandahusada et al. (1984), Hedman et al. (1979) and Sudre et al. (1992) provided ratios for cost per person protected and cost per case prevented. Walsh and Warren (1979) also had ratios for cost per person protected and cost per death averted. But they all considered direct costs only. The most comprehensive study to date is that of Mills (1989) which provided ratios by intervention types and for all the 4 groups of ratios. The range of CEA ratios makes it a more flexible technique compared with the other economic evaluation techniques. Each of the 4 groups of cost-effectiveness ratios also gives an indication of how to prioritise the services.

2.4.2.2. Cost-benefit studies of malaria

Fewer studies have been attempted in this area. In Table 2.4, the majority of the studies were adopted from the review made by Barlow and Grobar (1986). Most of the studies date back to the late 1960s and mid-1970s. This perhaps reflects the general shift from the use of CBA to CEA as observed by Klarman (1982). In their review, Barlow and Grobar (1986) noted that there were several indications in the literature that malaria control has a clearly favourable impact on output, however what was not clear was

> **"...how large that impact really is in relation to costs. There is also the strong possibility, in view of the powerful demographic effects of malaria control, that the output increase will be swamped by a population increase, and that an economic crisis will be produced".** (pp17).

In contrast, some research findings have indicated that malaria control methods might not necessarily result in an increase in output: Malenbaum (1973) found that malaria deaths did not affect production.

The studies vary widely in the CBA estimates, because, they were under taken at different time periods, used different discount rates and production levels; varying assumptions about the effect of disease control on mortality, absenteeism and debility and life spans of projects. This makes comparisons difficult. In the light of this, Barlow and Grobar (1986) again noted that these studies

> "**...obtained their estimates of economic effects by making numerous medical and other assumptions (often based on little or no evidence) in the context of an economic simulation model either explicit or implicit.**" (pp16).

Thus these studies often ignored the important externality of malaria control programmes that is the possibility of population increase which results in reductions in per capita income. As was shown in Barlows' (1968) study there was a reduction in per capita income despite the very high cost-benefit ratio due to an increase in population and high dependency ratio. It is worth noting that even though malaria is classified as the disease of the rural poor (typical of most developing countries), most of the studies were mainly concerned with analysing the effect of malaria on small localised communities engaged in non-agricultural activities quite contrary to the economic base of most rural areas. Barlow and Grobar (1986) concluded their review excellently, by observing that "**..the justification for malaria control is more likely to be found in its health effects than in its effects on per capita income**".

It is important to note that 63% of the summary presented in Table 2.4 were embraced from Barlow and Grobar (1986) review. These are all comparatively old studies published in the 1960s and 1970s. The latest CBA study in this review is the study undertaken in Sudan (1975). This shows how seldom CBA is used nowadays. Health effects shown in Table 2.4 were all valued with the marginal product of labour. For example, Griffith et al. (1971) used the volume of production as a cue to compute the "average extraction rate by one man per month". The difference in estimated output with and without prophylaxis was regarded as benefit gained and was valued. Ortiz (1968) applied output per man-day and Kamolratanakul et al. (Unpublished) used the shadow price of labour in the locality. Again, the use of different method of valuation makes it difficult to compare results.

2.4.2.3 Other economics of malaria studies

This group of studies is mostly summarised in Table 2.5 and deals with an aspect of the economics of malaria - particularly the costs of or the effects of malaria control. Researchers have implicitly assumed that effectiveness is implied. Classification of these studies into a single heading is difficult, since a few are cost of illness studies and others have elements of CEA or CBA or are preliminary reports of projects (Audibert, 1986; Kere and Kere, 1992; Shepard et al., 1991; Yap, 1986).

Recently, a number of studies have considered the socio-economic determinants of malaria infection. Notable amongst them are Banguero (1984), Castro and Mokate (1988) and Fernandez and Sawyer (1988). Models were used in these studies in an attempt to show the relationship between malaria infection and individual, household and community characteristics. Findings suggest that occupation, work site and other socio-economic characteristics such as age, sex, education and migration are the main risk factors, albeit with varying levels of significance. Fernandez and Sawyer (1988), for instance, pointed out that malaria prevalence is associated with the socio-economic characteristics of individuals or groups and the environmental characteristics of the places in which they work and live. However, variables like age and sex might have confounded the occupation and the other socio-economic variables, since these variables are highly associated with the occupation variable. A counter study by Vosti (1990) found no relationship between the risk of malaria infection and socio-economic and environmental factors, rather the major determinant was the area variable. This implies that a high risk area affected all individuals equally irrespective of the differences in their socio-economic status.

Malaria infection leads to disability, debility, and death. Disability in this context, refers to physical handicap resulting in change in nature of work whilst debility deals with weakness leading to low productivity or reduction in hours at work. This distinction is not always clear cut. This area has been addressed by some of the studies summarised in Table 2.6. In the case of disability, most studies have assumed rather than measured them. Such assumptions result in over-estimating the actual days lost, thus biasing the results. On the other hand, the authors problem might be how to measure them rather than assuming them. Studies have shown that in rural areas particularly household and family oriented work, there is a possibility of replacements for those ill which reduces the importance of determining the disability days (Castro and Mokate, 1988; Mills, 1989; Nur and Mahran, 1988). Such replacement will affect some other production or leisure time of family members (Coreil, 1983; Ho, 1979; Leslie, 1989 and Mueller, 1984).

Measuring debility was attempted by Brohult et al. (1981) and they found no difference in the physical performance between adult Liberian farmers and miners with and without malaria. Another study by Pehrson et al. (1984) in the same locality again found no difference between industrial worker who received malaria prophylaxis and those who did not in terms of labour output. However, these studies were based on bicycle ergometery, which may not be an appropriate method to determine that malaria does not affect actual labour output by measuring particular muscle activities, since farm labour is not limited to physical capacity.

Other studies measured the impact of malaria on agricultural production to ascertain the magnitude of debility and disability. For example, Conly (1975) looked at the impact of malaria on peasant producers in Paraguay. Accordingly, she classified 69 families into 3 groups depending on the level of malaria infection. The 'much malaria' group families experienced a marked decrease in their production levels. Kuhner (1971) also examined the effect of malaria on agricultural population by valuing the man-years of work lost in agriculture expressed in GDP per agricultural worker. Finally, Audibert (1986) fitted a similar production function and analyzed the elasticities of the inputs concerned. The malaria variable in this particular study was the malaria prevalence rate in the community. The limitation of this study is the assumption that prevalence rates are proxy measures for disability and debility. One major problem with production is valuing the product lost (indirect costs) especially in developing countries contest where markets are not competitive and in situations like household activities where produces are not marketable, placing a value on products produced for home consumption remains a problem. Thus few studies have attempted to estimate them or shown how to value them (Mills 1991 and Goldschmidt-Clermont, 1987).

Authors have attempted in their various studies to show the impact of malaria (in terms of costs and days lost from work) on people. One difficulty encountered by authors is using national aggregate data in their valuation (Kaewsonthi and Harding, 1989); Kuhner, 1971; Ettling and Shepard, 1991 etc). Other studies were mainly cost of illness studies (Ettling and Shepard, 1991; Fungladda and Sornmani, 1986; Sauerborn et al. 1991 and Shepard et al., 1991) which again applied either average or aggregate costs data and other secondary data for analysis. Two other studies (Audibert, 1986 and Conly, 1975) examined the effect of malaria without any intervention. They both reported various impact of the disease such as output losses and emigration, cropped land decreased etc by Conly, however, they did not quantify these reported outcomes. This makes comparison quite impossible.

The final comment of this review is that of the cost considered for the studies. Overall, out of the 51 studies on economics of malaria reviewed, 55% of them considered only direct costs, 8% only indirect costs, 23% both direct and indirect costs and 14% were with costs that were either not specified or not applicable. This again reveals the extent to which indirect costs had been ignored in most economic evaluation studies.

This section of the review sets a broad framework for assessing the current study. Lessons drawn from these studies in terms of their methodological and analytical approaches will be utilized. The next review is on indirect cost studies on malaria.

2.4.2.5 Indirect cost studies with emphasis on malaria

The review in this section will cover 2 broad areas - studies on adults and that on children. The studies on adults will cover productivity loss and time cost. Whilst the review on children will focus on child and ill-health care and education. As shown in the previous section, a few studies (eg Fernandez and Sawyer, 1988 and Castro and Mokate, 1988) have highlighted the role played by socio-economic factors in the incidence of infectious diseases in developing countries; other studies have focused on household production (i.e. unpaid labour) in relation to time allocation and looked into issues like work in the household, income inequality, food preparation, children's economic value, womens' and children's time use and fertility in developing countries (Nag, 1972; Gillespie, 1979 and Mueller, 1985). Using a similar approach to study the relationship between women's time and fertility in general, Mueller (1982) found that time use does two major things - provides estimates of hours worked within a reference period and gives an adequate estimate of time spent on unpaid family work, which frequently is either underreported or omitted altogether in conventional labour force studies (Goldschmidt-Clermont, 1987). Moreover, though children are indeed time-consuming as the economic theory of fertility postulates, "child rearing need not interfere with market work". The reasons being that mothers in developing countries are more likely "to obtain help from relatives, servants and other children who have time than in modern industrial countries", and the traditional jobs that women are engaged in are compatible with child care or often they find time to care for them by cutting down on leisure and housework. This does not mean that time has no cost to these women but there is flexibility in leisure and household time.

As the literature reviewed in this section will show, time allocation analyses, though sparsely used in costing time, have found its application in numerous socio-economic studies on time allocation to production activities in the household, social determinants of health care and consequences of diseases on household members. Therefore, the review in this section will be grouped under 2 areas namely, 1) analytical approaches to time allocation, child and ill-health care cost in households and 2) the effect of malaria on children education. These sub-divisions do not imply that the groupings are mutually exclusive but rather help streamline the discussion of the available literature.

2.4.2.5.1 Time allocation, child and health care cost in households

Agriculture in smallholdings still remains the mainstay of the economies of most developing countries. However, their efforts are thwarted by infectious and parasitic diseases, which hamper their already noted low productivity (Kamuzora, (1980). As mentioned in the previous sections, scarcity of data in this area, makes it difficult to estimate the real impact of these diseases on communities and families living in endemic areas. The few studies available have however, focused mainly on women and development issues paying little attention to the severe time constraint they face in balancing their time between household activities, reproductive roles and health.

Most studies of time use or time allocation were conducted in rural agricultural communities yet, little work has been published on time expenditure, their impact of diseases on production and health status (Bleiberg et al., 1980; Kamuzora, 1980 etc). For instance, the work of Audibert (1986) on agricultural non-wage production and health status, shows that the condition of farmers has not been studied and it must be studied for 2 reasons - firstly agriculture in developing countries is in the hands of peasant farmers and secondly, the relationship between health status and labour productivity will be incomplete without the input from peasant farmers. One important finding from Audibert's work was that rice growing is a labour intensive activity which can be strongly affected by ill health especially during transplanting time. But, farmers are unfamiliar with the linkage between planting time and quantity of harvest, so are unlikely to compensate for the fall in productivity due to illness by working for longer hours or taking on more hands on their farms.

Other studies have argued that women's status is related to their economic base (MacCormack, 1988). One such study is that of Acharya and Bennett (1983) in Nepal. Using the "inside-outside" dichotomy model, which uses the perspective of the rural household and time allocation data, they provide a practical means of analysing the subsistence sector and its interaction with market sector in traditional and developing economies. Thus they proposed that the village economy should be conceived as operating in 4 concentric spheres or sectors namely;

1) the household's domestic work;
2) its agricultural production activities;
3) village labour market and
4) migration for employment.

Their analysis revealed that women and children are confined to the first two (ie 1 and 2) inner sectors. Activities in these two areas are usually excluded from the category of economic activities simply "**because in traditional subsistence economies they are performed by family members without pay**". However, as they commented, economic value could be assigned to these sectors if detailed time data is collected. This model describes in broad terms, the economic setting of most rural communities, with The Gambia not being an exception.

Child care and its compatibility with other activities have also been examined by DeVanzo and Lee (1983) in Malaysia. It was observed that agricultural activities appeared less compatible with child care than that of sales and production occupations. Moreover, child care seems to consume most of the mother's time when she works outside the home, which appears that mothers' primarily reduce their leisure time rather than the time spent for child care or home production. Time cost may be more crucial during this season when marginal value of labour is highest (Ayalew, 1985; Ho, 1979; McCauley et al., 1992; Whitehead et al., 1978 etc).

A recent review by Leslie (1989) on women's time as a factor in the use of child survival technologies throws enough light on the multiple responsibilities of women and the hours they spend daily in fulfilling these responsibilities. As Leslie quotes;

> **"The average number of hours spent working ranged from 6 to 15 hours a day, with a median of 10.0 work hours per day in Africa and 10.8 work hours in Asia".**

This shows that most women have little if any free time or leisure left.

Two of the most relevant activities amongst the multiple responsibilities of women in developing countries are time spent on agricultural work vis-a-vis child and ill-health care (Leslie, 1989). However, as the author pointed out, the difficulty with these time allocation studies in estimating time on child care was twofold; some of the studies included both women with and without children hence lowering the average amount of time spent in child care, and child care was not (in most cases) recorded as a separate activity but joined with other activities therefore no firm conclusion could be drawn. The problem of including the wrong women in the denominator of estimating time cost of child care and the joint activity nature of child care mentioned by Leslie, could be partly overcome in the absence any sound methodological approach, by the use of both quantitative and qualitative (eg various types of observation methods) approaches used by some of the studies in Table 2.6. Qualitative approaches usually allow the researcher to have some understanding of the household dynamics and relationships which can not be captured by quantitative methods. The issue of joint activities, can roughly be estimated by sharing the time allocated for the activities equally between the activities, with the assumption that they all have equal importance to the person, since the person could not forgo one at that point in time.

Results in Table 2.7 shows that half (57%) of the studies have not measured child care, apparently because it was not the main concern of the studies or since the nature of child care in most societies is a joint activity with other household duties, its identification and subsequent apportionment of time is difficult (Goldschmidt-Clermont, 1987; Mueller, 1982; Ho, 1972 etc). Thirty-five per cent of the studies summarised in Table 2.6 have sample sizes below 100 and another 21% did not specify their sample sizes, thus the estimated time allocated to morbidity and mortality are likely to be unrepresentative. In all, 57% of the summarised studies used only quantitative methods of data collection, 14% only qualitative methods and 29% used both quantitative and qualitative approaches. This shows how seldom both approaches are used in time allocation studies. Therefore, the generalization of the results of time allocation studies are difficult.

A similar review by Mills (1991) on the available data of the economics of malaria also show the impact of malaria on productive activities in various communities. The review reveals that time lost due to malaria (ie disability and debility (days/episode)) estimated in most of the studies ranges from 2.4 days in areas like El Salvador to 44 days in

Paraguay. Other studies were conducted on male subjects (Miller, 1958; in West African men: 4.2 days/episode). However, most of these estimated that days lost were not valued by any method. The summarised review in Table 2.7 also shows that majority (63%) of the studies were undertaken in Africa from different study populations - patients, households, families and national aggregate statistics. The source of data also varies from qualitative to quantitative methods as well as computer search and official records and statistics. The estimated days lost due to malaria ranges from 3.1 days in Thailand to 12 days in combined African countries.

Most of them used national aggregates due to paucity of data particularly in Africa. Estimates from national aggregate data are usually unreliable in the sense that seasonal and geographical variation in the incidence of malaria is compromised. Appropriate data for estimation of the impact of malaria cannot be obtained from national data set except approximated ones and socioeconomic indices. Thus the time (days) lost due to malaria needs further study, since the few studies which exist, most show that such estimates are country specific and dependent on the endemicity of malaria.

2.4.2.5.2 Effects of malaria on children education studies

The majority of available literature focuses attention on the detrimental effect of malaria morbidity and mortality in children generally without relating it to any specific activities like in adults (eg work days loss, productivity loss etc). One general neglect in economic analysis is the effect of malaria on education (Wernsdorfer and Wernsdorfer, 1988 and Halloran et al., 1989). Halloran et al. (1989) gave two main plausible reasons for this neglect - the definition of a case of malaria in semi-immunes has been too unspecific, and the difficulty of studying the direct effects of infection on school performance. Yet, Wernsdorfer and Wernsdorfer (1988) argue that in areas of unstable malaria, high school absenteeism usually runs parallel to the seasonal incidence of malaria. Moreover, with a substantial part of Africa's resources presently devoted to education, a large extent of this is lost on account of illness among a major segment if not a majority of the school children. This issue must therefore be given some attention.

The scope of the few studies on school children available are in areas like knowledge and control of tropical disease and their health status. For example, investigating some of the social and behaviour factors contributing to the transmission of some tropical diseases among school children in Nigeria, Ekeh and Adeniyi (1986) observed that apart from malaria and guineaworm that pupils had the correct notions of causes, treatment and prevention (ie 36% and 43% respectively), there was a generally low knowledge on schistosomiasis and onchocerciasis prevalent in the study area. In another study by N'gandu et al. (1991) in Central Zambia on the health status of rural primary school children, they used screening procedures to provide information to direct health education and other disease control measures in school health programmes. Their results show a high prevalence of hookworm (33%) and malaria (43%) infections amongst the children. These two studies shows the need for the inclusion of health education on the school curriculum.

In these circumstances malaria control will keep the disease down not to disrupt the schooling of the pupils. One earlier malaria control study conducted on 7-year-old school children in Accra by Colbourne (1955) showed an improvement in the school attendances of the treated group compared with control group. Antimalarial drugs were used for the intervention. The results indicate that, annually, children in Accra suffer an average, 5-6 days sickness from malaria capable of causing absence from school. The work of Mills (1989) also showed an average of 9.6 days of school lost in all the survey districts in Nepal. Colbourne (1955), also made a brave attempt at looking at the improvement in their performance in class. There was no difference between the treated and control groups, apparently due to the 'crude' test before and after the intervention used to judge performance in class. A recent study by Trape et al. (1987) also revealed that in Linzolo, Congo, one of the main causes of school absenteeism was malaria. Of the medical causes (19%) of absenteeism, 42% were likely due to malaria cases (confirmed and possible clinical cases). Both their weekly and daily surveys confirmed the high rate of malaria related absenteeism. However, they found no difference in attacks of clinical malaria among children who claimed to be users and non-users of bednets. On the contrary, Nevill et al. (1988) found that both bednets and proguanil provides effective protection from malaria under their well supervised study among boarding school children in Kenya.

These few studies have shown the importance of investigating the effect of malaria on school absenteeism. The current study hopes to investigate the effect of insecticide-impregnated bednets on school absenteeism especially malaria related ones.

2.5 Summary

The literature reviewed in this chapter clearly shows that the most popular method of malaria control at the moment is by chemical means. Of which, residual insecticide application is regarded as the most feasible method. Insecticide-impregnated bednets have been shown in most studies reviewed to be an effective protective barrier against mosquito bites. The commonly used insecticide were permethrin and deltamethrin. Field trials of insecticide-impregnated bednets worldwide were supported by WHO. Recent malaria vaccine trials have also shown some promising results, however, until a proven and cheap vaccine is discovered, the emphasis will be on protective barriers (eg bednets). Ironically, only a few of these malaria control programmes of any sort have been economically evaluated.

There have been a reasonable number of economic evaluation studies on various tropical diseases, however, since the studies vary in the type of costs and consequences considered for the evaluation of the programmes, comparison of results are difficult. More importantly, most of the studies did not conduct sensitivity analysis to test their conclusions. The most commonly used form of economic evaluation technique was cost-effectiveness analysis.

The review of economic evaluation studies on malaria control programmes also indicated that both cost-effectiveness analysis and cost-benefit analysis approaches have been used. But most of the cost-benefit analysis studies were old and there was a general shift from the use of cost-benefit analysis to cost effectiveness analysis in most intervention programmes in developing countries for various reasons given in this review. There were 4 classified cost-effectiveness ratios considered by these studies, yet after standardization, the values vary widely due to country circumstances, nature of programme and methodological approaches. Most of the studies also considered direct cost only, however, in the case of indirect costs only few studies considered them. Of those which did, most were faced with the difficulties of measuring and valuing them.

The review on the time allocation studies, also showed how important indirect costs were to both adults (particularly women) and children. Invariably, the time cost of adults were related to productive activities whilst that of children were not. Very few studies have addressed the effect of malaria (or other diseases) on the education of children. This needs to be addressed with both qualitative and quantitative studies as indicated in the review.

Finally, only few studies conducted any sensitivity analysis to test their study conclusions to highlight the most important influencing parameter(s) in their analyses. This might have resulted in the wide range of cost-effectiveness ratios and also affects the reliability of the study conclusions.

The review in this chapter was employed in the objective and design of this study on the cost-effectiveness of insecticide impregnated bednets as a malaria control measure. Lessons gathered from the review has led this study to undertake an extensive cost analysis of NIBP (ie direct and indirect costs) and sensitivity analyses to test the study conclusions.

Table 2.1 Summary of insecticide-impregnated mosquito nets (bednets) studies.

Source	Nature of study	Insecticide used	Results
Alonso et al. (1991)	Double Intervention study of the effect of impregnated bednets & chemoprophylaxis on children mortality, The Gambia	Permethrin	Reduces mortality; childhood mortality by 63% & malaria mortality by 70%
Curtis & Lines (1985)	Review of impregnated fabrics worldwide	Permethrin, deltamethrin & Diethyl toluamide	Acceptable and effective & Permethrin has favourable mosquito to mammalian toxicity ratio
Darriet et al. (1984)	Experimental study of locally styled & designed Mossi and Bobo huts, Burkina Faso, 1983	Permethrin	Reduces substantially man/vector contact even with damaged nets
Graves et al. (1987)	Study the effect of impregnated bednet on incidence and prevalence of malaria in under 5 year-old children in 4 villages near Madang, Papua New Guinea	Permethrin	Reduces the prevalence of *P.falciparum* in 1-4 year olds
Hossain & Curtis (1991)	Studying the effect of impregnated bednet on mosquito behaviour in laboratory studies, 1975.	Permethrin	Deters and kills mosquitoes
Jambulingam et al. (1989)	Trail in Orissa state, India	Permethrin	Effective in killing mosquitoes (*A. culicifacies*)
Lindsay et al. (1989)	Study of 4 villages, The Gambia	Permethrin	90% reduction in biting on man by *A. gambiae s.l.*
Lines et al. (1987)	Trial of insecticide-impregnated nets & curtains in huts & houses in Magugu, Arusha region & Maheza, Tanga region of Tanzania	Permethrin	More effective protection than untreated nets. Nylon nets better than cotton & nets better than curtains
Lin (1991)	Overview of pyrethroid treated nets as anti-malarial strategy in China	Permethrin & Deltamethrin	Deltamethrin much more effective than permethrin nets. Both have killing & excito-repellent effects

Table 2.1 (continued)

Source	Nature of study	Insecticide used	Results
Magesa et al., (1991)	Trial of pyrethroid impregnated nets & house spraying in 5 villages in Tanzania	Permethrin, Lambdacyhalothrin & DDT	Reduction in Anopheles mosquito population density & no evidence of diversion to outdoor resting or animal biting
Miller et al., (1991)	Experimental hut trials of impregnated bednets for mosquito control, The Gambia, 1988.	Cypermethrin, Deltamethrin, Lambdacyhalothrin , Permethrin & Pirimiphosmethyl	All insecticides effective in reducing vector population. Washing reduces deterrency of insecticides to varying degrees
Njunwa et al., (1991)	Trial of pyrethroid impregnated nets & house spraying in 5 villages in Tanzania	Permethrin, Lambdacyhalothrin & DDT	Acceptable. Lambdacyhalothrin has unpleasant side-effects & nets expensive relative to income
Rozendaal & Curtis (1989)	Review of studies on impregnated nets worldwide - Africa, the Pacific & South America	Deltamethrin & permethrin	Effective in reducing malaria problems. Insecticide activity reduced by washing. Optimal dosage of impregnation varies by netting material and vector type
Schreck & Self (1985)	Documentary	Permethrin	Reduces insect-borne diseases. Kills mosquitoes & other pest. Comfortable sleep & Provide more protection to vulnerable groups
Sexton et al., (1990)	Evaluation of treated bednets & curtains as malaria control measures in Uriri, Kenya, 1988	Permethrin	Reduces malaria infections. Kills mosquitoes
Snow et al., (1987)	Study of 389 children in The Gambia	Permethrin	Acceptable. No side-effects & reduces episodes of clinical malaria
Snow et al., (1988)	Trial of impregnated net in 16 Fula villages (of 491 children aged 1-9 years) in The Gambia	Permethrin	Acceptable. Reduces episodes of clinical malaria by 63%

Table 2.2 Summary of Economic Evaluation of other tropical diseases intervention programmes

a) Schistosomiasis Control Programmes

Source	Nature of study	Cost considered	Consequences considered	Type of economic evaluation
Brinkmann et al. (1988)	300 Malian villages with a population of 180000. Four different types of intervention schedules introduced	Capital & recurrent costs. Indirect cost excluded	Number of people protected	a) Cost analysis b) CEA. No sensitivity analysis performed
Korte et al. (1986)	Mali & Peoples Republic of the Congo. 2 different settings of intervention	Recurrent cost.Indirect cost excluded	Number of persons cured	CEA. No sensitivity analysis performed
Polderman (1984)	3 mining villages in Zaire intervened with 3 different schedules of treatment	Recurrent cost. Indirect cost excluded	Number of people protected	CEA. No sensitivity analysis performed
Rohde (1989)	Mali & Madagascar, 1988. Four different types of intervention schedules used. Est. population 100000	Capital & recurrent costs. Indirect cost excluded	Not applicable	Cost analysis. No sensitivity analysis performed

b) Tuberculosis (TB) Control Programmes

Source	Nature of study	Cost considered	Consequences considered	Type of economic evaluation
Barnum (1986)	Botswana, 1982. Compliance to 2 TB treatment regimens	Capital & recurrent costs.	Number of persons treated & persons effectively treated	CEA. Sensitivity analysis performed
Grzybowski (1987)	Situational review in developed & developing countries	Recurrent cost. Indirect cost excluded	Number of cases & number of persons protected	Cost analysis & CEA. No sensitivity analysis performed
Houston et al. (1991)	Zimbabwe. Situational review in terms of therapy and cost	Recurrent cost. Indirect cost excluded	Not applicable	Cost analysis. No sensitivity analysis performed

Table 2.2 (continued)

Tuberculosis (TB) Control Programmes

Source	Nature of study	Cost considered	Consequences considered	Type of economic evaluation
Joesoef et al. (1989)	Indonesia. TB epidemiological model of total population	Recurrent cost. Indirect cost excluded	Number of cases prevented	CEA. Sensitivity analysis performed
Kamolratanakul et al. (Unpublished)	5 zonal TB centres, Thailand, 1987-88. 383 patients randomly interviewed	Recurrent cost & indirect cost	Number of persons cured	CEA. Sensitivity analysis performed
Murray et al. (1991)	Malawi, Mozambique & Tanzania. Cost & impact of chemoprophylaxis in National Tuberculosis programmes	Capital & recurrent costs. Indirect cost excluded	Number of cases cured, death averted & year of life saved	CEA. No sensitivity analysis performed

c) Onchocerciasis Control Programmes

Source	Nature of study	Cost considered	Consequences considered	Type of economic evaluation
Evans & Murray (1987)	Bougouriba area, Upper Volta, 1975. Economics of blindness prevention	Total programme expenditure. Type of cost not specified	Number of cases prevented	CEA. Sensitivity analysis performed
Prescott et al. (1984) & Prost & Prescott (1984)	Bougouriba area, Upper Volta, 1975. Economics of blindness prevention.	Total programme expenditure. Type of cost not specified	Number of cases prevented	CEA. No sensitivity analysis performed

Table 2.2 (continued)

d) Other PHC programmes - Expanded Programme Immunization (EPI), Diarrhoea etc.

Source	Nature of study	Cost considered	Consequences considered	Type of economic evaluation
Ashworth & Feachem (1985)	Data review in Ghana, Haiti, Indonesia, Morocco, Philippines & Burkina Faso	Capital & recurrent costs except in Burkina Faso which included indirect cost	Death averted, number of participating children	CEA. No sensitivity analysis performed
Barnum et al. (1980)	Assessment of cost & effectiveness of proposed EPI in children & pregnant women. Indonesia, 1979-80	Capital & recurrent costs. Indirect cost excluded	Death averted	CEA. Sensitivity analysis performed
Creese (1984)	Comparison of alternative immunization strategies in Northern & Northeast Brazil	Capital & recurrent costs. Indirect cost excluded	Number of cases & deaths averted	CEA. No sensitivity analysis performed
Creese (1986)	Cost assessment of infant immunization in Ivory Coast, Kenya, The Gambia, Cameroon, Ghana, Indonesia, Philippines, Thailand, Brazil	Capital & recurrent costs. Indirect cost excluded	Number of cases & deaths averted	CEA. Sensitivity analysis performed
Daga & Daga (1985)	Assessment of cost & effectiveness of special care unit of babies. JJ Group of hospitals, Bombay, India, 1978-80	Capital & recurrent costs. Indirect cost excluded	Number of survivors	CEA. No sensitivity analysis performed
Diarrhoeal Disease Control Programme (1990)	Cost effectiveness analysis of ORT in diarrhoeal control. Maseru, Lesotho, 1986	Capital & recurrent costs. Indirect cost excluded	Number of children treated	CEA. No sensitivity analysis performed

Table 2.2 (continued)

Other PHC programmes - Expanded Programme Immunization (EPI), Diarrhoea etc.

Source	Nature of study	Cost considered	Consequences considered	Type of economic evaluation
Foreit et al. (1991)	Examines reduction in expenditure of curative child health care through preventive intervention & prescription practices. Private mining company, Peru 1986-87	Capital & recurrent cost. Indirect cost excluded	Number of children covered	CEA. No sensitivity analysis performed
Kielman et al. (1985)	Testing various modules of ORT delivery mechanisms among pre-school children. Dakahlala Governorate, Egypt, 1980	Recurrent cost. Indirect cost excluded	Deaths averted	CEA. No sensitivity analysis performed
Lerman et al. (1985)	Cost analysis of diarrhoeal treatment in children. 4 subdistrict in Indonesia, 1984	Capital & recurrent costs. Indirect cost excluded	Not applicable	Cost analysis. No sensitivity analysis performed
Ponnighaus (1980)	Cost-benefit analysis of measles immunization amongst children. Southern Zambia, 1978	Capital & recurrent costs. Indirect cost excluded	Life saved	CBA. No sensitivity analysis performed
Robertson et al. (1985)	Estimation of cost of preventing childhood mortality & morbidity through immunization. The Gambia, 1979	Capital & recurrent costs. Indirect cost excluded	Number of cases prevented & deaths averted	CEA. No sensitivity analysis performed
Robertson et al. (1992)	Cost & CEA of EPI. The Gambia, 1988	Capital & recurrent costs. Indirect cost excluded	Number of fully immunised children	CEA. No sensitivity analysis performed
Shepard et al. (1986)	Assessment of cost & effectiveness of measles component in 3 demonstration & training zones. Ivory Coast, 1981	Capital & recurrent costs. Indirect cost excluded	Number of cases & deaths averted	Cost analysis, CEA & CBA. Sensitivity analysis performed

Table 2.2 (continued)

d) Other PHC programmes - Expanded Programme Immunization (EPI), Diarrhoea etc.

Source	Nature of study	Cost considered	Consequences considered	Type of economic evaluation
Srivastava et al. (1985)	Comparison of oral & intravenous rehydration in diarrhoeal control. New Delhi, India, 1982	Capital & recurrent costs. Indirect cost excluded	Number of patients	CEA. No sensitivity analysis performed
Whittaker et al. (1985)	Assessment of Nutrition Day centre on malnutrition in Cape Town, South Africa, 1982-83	Recurrent cost. Indirect cost excluded	Number of child attendance days	CEA. No sensitivity analysis performed
Zeng-sui et al. (1989)	Comparison of incidence of enteric infectious disease in villages with surface & tap water. Qidong county, China, 1983	Capital & recurrent costs	Direct & indirect benefits	CBA. Sensitivity analysis performed

e) Other Diseases and health related services intervention programmes

Source	Nature of study	Cost considered	Consequences considered	Type of economic evaluation
Berman (1989)	Comparison of simple model of average cost curves for health centres & sub-health centres. Central Java Province, Indonesia, 1981-83	Capital & recurrent costs. Indirect costs excluded.	Not applicable	Cost analysis. No sensitivity analysis performed
Bloch et al. (1987)	Evaluation of itraconazole for treatment of acute vaginal candidiasis. Cape Town, South Africa	Not specified	Cure rate	Mention of CEA. No sensitivity analysis performed
Cavalcante et al. (1991)	Review procedures of hospital financial control using surveillance for major nosocomial infection. Hospital das Forcas Armadas, Brasilia, Brazil, 1986-89	Recurrent cost. Indirect costs excluded.	Not applicable	Costs analysis. No sensitivity analysis performed
Chongsuvivatwong & Nitimanop (1991)	Cost effectiveness of report forms for compilation of health statistics. District hospitals & health centres, Thailand, 1988	Indirect cost	Number of health information collection	CEA. No sensitivity analysis performed
Gillis et al. (1990)	Evaluate cost effectiveness of home visiting programme. Valkenberg Hospital, Cape Town, South Africa, 1987	Recurrent cost. Indirect costs excluded.	Number of home visits	CEA. No sensitivity analysis performed
Kang & Lim (1991)	Modelling involving transitions between possible states of duodenal ulcer, National University Hospital, Singapore, 1990	Recurrent cost. Indirect costs excluded.	Not applicable	Cost analysis. Sensitivity analysis performed

Table 2.2 (continued)

e) **Other Diseases and health related services intervention programmes**

Source	Nature of study	Cost considered	Consequences considered	Type of economic evaluation
Mayombana et al. (1990)	Cost comparison of training for 2 groups of VHWs. Morogoro Region, Tanzania, 1987	Recurrent cost. Indirect costs excluded.	Not applicable	Cost analysis. No sensitivity analysis performed
Mengistu et al. (1991)	Assessment of suboptimal clinical setting for diabetics. Ethiopia, 1985-89	Recurrent cost. Indirect costs excluded.	Number of patient visits	CEA. No sensitivity analysis performed
Phaosavasdi et al. (1987)	Cost-benefit analysis of diagnosis & treatment of syphilis in pregnant women. Chulalongkorn University, Thailand, 1984-85	Capital & recurrent costs. Indirect costs included	Direct & indirect benefits	CBA. No sensitivity analysis performed
Saxena & Kaushik (1991)	Estimation of liver transplantation. India	Capital & recurrent costs. Indirect costs excluded.	Not applicable	Cost analysis. No sensitivity analysis performed
Sesso et al. (1990)	Cost effectiveness analysis of 4 treatments of end-stage renal disease. University Hospital, Escola Panlista de Medicina, Brazil, 1983-85	Capital & recurrent costs Indirect costs excluded.	Life year of survival	CEA. Sensitivity analysis performed

Table 2.3 Summary of cost-effectiveness studies of malaria intervention programmes expressed in US$ 1992[a] .

Source	Nature of study	CEA ratio			
		Cost per person protected	Cost per case prevented	Cost per death averted	Other
Balaraman & Hoti (1987)	Laboratory studies of mosquito control with larvicidal bacilli & insecticides. Considered direct (capital & recurrent) costs only. No sensitivity analysis performed.	-	-	-	Cost of larval control per hectare: 61.44-74.20
Barlow (1968)[*]	Sri Lanka: actual data 1947-66; projected data 1967-77. Insecticides control programme. Considered direct (recurrent) cost only. No sensitivity analysis performed.	-	-	119.05	-
Bruce-Chwatt (1981)[*]	Population exposed to malaria, 1978. Proposed chemoprophylaxis control programme. Considered direct (recurrent) cost only. No sensitivity analysis performed.	0.067[a]	-	-	-
Cohn (1973)	India, 1950-71. Insecticides control programme. Considered direct (capital & recurrent) costs only. Sensitivity analysis performed.	-	3.02	-	-
Gandahusada et al. (1984)	Regency Banjarnegara, Central Java, Indonesia 1980-82. Insecticide spraying control programme. Considered direct (recurrent) cost only. No sensitivity analysis performed.	2.27-7.10	107.64-132.48	-	-

Table 2.3 (continued)

Source	Nature of study	CEA ratio			
		Cost per person protected	Cost per case prevented	Cost per death averted	Other
Hedman et al. (1979)	Mining district, Liberia, 1976-77. DDT spraying, antilarval measures & chemotherapy with amodiaquine. Considered direct (capital & recurrent) costs only. No sensitivity analysis performed.	11.20[b]	20.74[b]	-	-
Helitzer-Allen et al. (1993)	4 Lilongwe district, Malawi. Assessment of health education message & antimalarial drug. Considered direct (recurrent) cost only. No sensitivity analysis performed.	-	-	-	Cost per compliant women
Heymann et al. (1990)	Antenatal clinics at 4 sites in Malawi. Pregnant women using chloroquine prophylaxis in 1988. Considered direct (recurrent) cost only. Sensitivity analysis performed.	-	17.25	-	-
Jeffrey (1984)	Population exposed to malaria, 1984. Proposed chemotherapy (chloroquine) control programme. Considered direct (recurrent) cost only. No sensitivity analysis performed.	0.075[a]	-	-	-
Kaewasonthi & Harding (1984)	Thailand 1980-81. Two zones with populations of 1.3m & 0.5m. Vector control & chemotherapy programme. Considered direct (capital & recurrent) cost and indirect cost as well. No sensitivity analysis performed.	15.30-21.24	-	-	-

Table 2.3 (continued)

Source	Nature of study	CEA ratio			
		Cost per person protected	Cost per case prevented	Cost per death averted	Other
Kaewasonthi & Harding (1989)	Assessment of different strategies for malaria control programmes in Thailand, 1980. Considered direct (capital & recurrent) cost and indirect cost as well. No sensitivity analysis performed.	-	-	-	a) Cost per patient: 9.57; b) Cost per positive case: 29.89
MacCormack <u>et al</u>. (1989)	Assessment of insecticide-impregnated bednets, The Gambia, 1987. Considered direct (individual) costs only. No sensitivity analysis performed.	Treated bednet only: 2.98; Treated bednet & drug: 4.02	-	-	-
Mills (1989)	Cost-effectiveness analysis of malaria control (drugs & spraying) in Nepals, 1984. Considered direct (capital & recurrent) cost and indirect cost as well. Sensitivity analysis performed.	Drugs: 0.34-1.08; Vector control: 1.10-3.45; Both: 0.67-1.08	Drugs: 3.34 -123.78; Drugs & Vector control: 2.71-279.11	a) Drugs: 215.03-21,571.97; b) Drugs & Vector control:13 3.72-21,745.44	Cost/day of healthy life gained; Cost/ discounted day of healthy life gained; Net savings in government curative & preventive cost; Total net savings; Net savings/ case prevented; Net savings
Mills (1992)	National Malaria Eradication Organization districts, Nepal. Examining a mix of spraying & surveillance malaria control strategy. Considered direct (capital & recurrent) cost and indirect cost as well. No sensitivity analysis performed.	DDT: 1.10-1.21; Malathion: 1.72	-	-	Cost per case: a) Active case detection: 92.43-238.99; b) Passive case detection by volunteers: 43.02-182.90; c) Passive case detection by malaria clinics: 18.77

Table 2.3 (continued)

Source	Nature of study	CEA ratio			
		Cost per person protected	Cost per case prevented	Cost per death averted	Other
Molineaux & Gramiccia (1980)*	Four areas in Garki district, Kano State, Nigeria, 1969-76 Indoor spraying, mass drug administration & larviciding programme. Considered direct (capital & recurrent) cost only. No sensitivity analysis performed.	-	263.23	-	-
Nevill et al. (1988)	Assessment of the effectiveness of bednet usage & proguanil treatment in a Kenya school. Considered direct (capital & recurrent) cost only. No sensitivity analysis performed.	-	-	-	Annual cost per patient: a) bednet: 3.67; b) proguanil: 21.85
Ortiz (1968)	Estimating the cost of malaria eradication programme in Paraquay, 1965-72. Direct (grants, loans etc) costs only. No sensitivity analysis performed.	-	115.07	-	-
Picard et al. (1993)	Cost-effectiveness of impregnated bednet & chemoprophylaxis, The Gambia. Considered direct (capital & recurrent) cost only. Sensitivity analysis performed.	-	a) Treated bednet: 33.68 b)Treated bednet & drugs: 23.08	a) Treated bednet: 222.97 b)Treated bednet & drugs: 305.73	Cost/healthy year of life saved: 9.50 & 13.04
San Pedro (1967/68)*	Philippines. Eradication programme (10 years). Cost not specified. No sensitivity analysis performed.	-	-	-	5.40
Sharma et al. (1990)	Kheda district of Gujarat, India, 1988. Estimation & comparison of the impact of bioenvironmental control strategy on economic loss. Consider direct (capital & recurrent) costs as well as indirect costs. No sensitivity analysis performed.	-	-	-	a) Day lost by patients (8 days); b) Loss of wages 2.75; c) Total expenditure: 7.37
Sudre et al. (1992)	Cost effectiveness model for the treatment of paediatric malaria in sub-Saharan Africa. Modelling of chemoprophylaxis treatment. Considered (recurrent) cost only. Sensitivity analysis performed.	-	0.04-0.5[a]	1.31-2.58[a]	-
Walsh & Warren (1979)	Using PHCs in developing countries as mosquito control programme strategy. Considered direct (capital & recurrent) costs only. No sensitivity analysis performed.	2.97[a]	-	892.20[a]	-

@ All cost were adjusted by the rise in the consumer prices using the year of the study as a base to US$ 1992 to reflect the time interval between the studies [Source: International Monetary Fund (1994).
* Source: Adapted from Barlow & Grobar (1986), Tables in Section XIII.
a Unadjusted figure due to non-specificity of study area.
b Consumer prices were only available up to 1989 plausibly due to the raging civil war.

Table 2.4 Summary of cost-benefit studies of malaria intervention programmes.

Source	Nature of study	Cost & Health effects considered	Economic effects	CBA ratio
Barlow (1968)*	Sri Lanka 1947-77. Insecticides control programme	Direct costs only. 1005000 deaths averted, reduction in mortality & rise in fertility.	By 1977, GDP increased by 9%; lowered per capita income by 14%	146.3
Griffith et al. (1971)	Tungsten mining area, Western Thailand, 1969. Chemoprophylaxis control programme	Direct (drug) costs only. Recruitment of new workers possible with reduction in threat of disease.	Mining profit observed	6.5
Kamolratanakul et al. (Unpublished)	Economic analysis of permethrin-treated nets in migrant workers, Bothong district, Thailand. Impregnated nets control programme	Direct & indirect costs Amount of time lost for work through malarial illness.	Net savings using treated nets	Malaria Division & Migrant worker
Khan (1966)*	West Pakistan (15 years projection). Eradication programme	Not specified but total cost given. Average case among 2.5m. workers: 10 workdays lost due to disability and 10 workdays lost due to debility.	Annual gains due to reductions in: disability, debility & treatment cost	4.9
Niazi (1969)*	Iraq 1958-68. Eradication programme	Not specified but total cost given. Without programme, 917 malaria deaths annually; 7 workdays lost due disability.	10 years gains due to reduction in: mortality, disability & treatment cost.	6.0
Ortiz (1968)	Estimating the cost of malaria eradication programme in Paraquay, 1965-72.	Direct (grants, loans etc) costs only. Average case of disability: 44 workdays.	Output gains due to reduction in disability.	3.6
San Pedro (1967/68)*	Philippines. Eradication programme.	Not specified but total cost given. Average case: disability 7 workdays & debility 7 workdays	10 years gains due to reduction in: mortality, disability & treatment costs.	2.4
Sudan (1975)*	Gezira Irrigated area, Sudan (1976/77-1983/84). Control programme.	Not specified but total cost given. Output reduction due to disability.	Output gains due to reduction in disability.	4.6

* Source: Adapted from Barlow & Grobar (1986), Table 5 and Tables in Section XIII.

Table 2.5 Summary of various other studies on economics of malaria.

Source	Nature of study	Reported results
Audibert (1986)	Mayo Danai, Cameroon 1977-81. Effect of malaria on output of rice farming community.	Rice output affected by malaria especially delay in transplanting
Brohult et al. (1981)	LAMCO, Yekepa Liberia. Physical performance was compared in adult Liberian males (138) residing in holo- & meso-endemic areas using ergometer. Direct (drug) cost only.	No significant difference in physical performance either by area of residence or by positive and negative malaria blood smear
Cohn (1973)	India's National Malaria Control Programme & National Malaria Eradication Programme reviewed in terms of costs & benefits. Direct (capital & operational) costs only.	a) Control programme less expensive in the long-run; b) Positive social consequences in terms of reduction in demographic variables
Conly (1975)	Paraguay 1968-70. Comparison of families with classified malaria ('much' & 'moderate') to measure effect on disability, land usage, labour utilization, output & population movement.	a) 5.4 disability days per malaria case; b) Effect on population: labour demand & usage increased, caused some emigration, land clearance slowed, cropped land decreased & output losses
El Gaddal et al. (1985)	Gezira-Managil Irrigation Scheme, Central Sudan. House spraying by larvicidal control & aerial spraying Direct cost (insecticide & operational) costs only.	Annual cost per capita for malathion & fenitrothion
Ettling & Shepard (1991)	Using national aggregate statistics on epidemiology and economic values to determine the economic cost of malaria in Rwanda. Direct & indirect costs.	a) Total cost of malaria per capita of which in indirect cost (1989) - 3.5 days of individual production. Impact greater in the rural sector
Fungladda & Sornmani (1986)	Sanjok district & Kanchanaburi, West Thailand. Clinic-based case-control study of social & behavioural factors associated with malaria (1984). Direct (treatment & transport) costs only.	Average cost of medical treatment of malaria patient
Ghana Health Assessment Project Team (1981)	Data from Ghana vital statistics & other sources. Assessment quantitatively the relative importance of different diseases in the country. Indirect costs only	32567 days of healthy life lost per 1000 due to malaria
Guyer & Candy (1979)	South Central Province, Cameroon. Examined the usage of antimalarial drugs (injectables & orals). Direct (drugs) costs only	a) Orals less expensive & lesser risks of complicating infection; b) Injectables more expensive & fever usage
Kaewsonthi & Harding (1989)	Thailand. Examining different strategies for malaria control programmes. Direct & indirect costs	Aggregate cost for malaria control
Kere & Kere (1992)	Florida Islands, Solomon Islands. Comparison of cost analysis of DDT house spraying & permethrin-impregnated bednets, 1989/90. Direct (insecticide, transport, equipment & operational) costs only.	Cost per capita: a) DDT house spraying & b) Permethrin-impregnated bednet

Table 2.5 (continued)

Source	Nature of study	Reported results
Kuhner (1971)	Thailand 1952-66. Impact of malaria eradication on agricultural labour. Indirect costs only.	15 working days lost due to disability by malaria. Loss of agricultural GDP fall
Neng et al. (1991)	China. Laboratory studies to evaluated insecticide-impregnated nets & DDT house spraying. Cost not specified.	Cost of impregnating with permethrin is 1.3 times the cost of DDT residual spraying
Pehrson et al. (1984)	Yekepa, Liberia. Effect of biweekly chloroquine prophylaxis case-control study of 32 men on working performance. Direct (drug) costs only.	Treatment group experienced no gain in physical working capacity
Phillips & Mills (1991)	National Malaria Eradication Organization, Nepal. Cost analysis relating to spraying, transport & safety in 1985-86. Direct (operational) costs only.	Cost of spraying with Ficam, Malathion & DDT
Picard & Mills (1992)	Dhanusa & Nawal Parasi districts, Nepal. Case-control study of effect of malaria on work time. Indirect costs only.	Number of days disabled by malaria: a) Wholly: 5.31 days b) Partially: 1.21 days
Sauerborn et al. (1991)	Estimating the economic costs of malaria in Solenzo, a rural district of Burkina Faso, 1985. Direct & indirect costs.	a) Loss of lifetime production from premature death (at net present value) b) Indirect costs make up 77% of the cost of malaria for 1985
Sharma & Sharma (1986)	Cost analysis of malaria control by insecticide & bioenvironmental methods in Kheda district, India, 1985-86. Direct (insecticide & operational) costs only.	Direct cost: a) Bio-environmental; b) Insecticide DDT.
Shepard et al. (1991)	Assessment of the economic impact of malaria using 4 case studies in Africa - Mayo-Kebbi district, Chad (1987); Brazzaville, Congo (1984); Rwanda (1989) & Burkina Faso (1985). Direct & indirect costs.	Cost per capita of malaria based on the 4 studies in sub-Saharan Africa and expected to rise in 1995
Vosti (1990)	Four gold mining communities, Southern Para, Brazil. Estimates of determinants & cost of malaria made from 338 miners. Indirect costs only.	Group cost lost for 9.8 inactive days on average
Yap (1986)	Penang Island, Malaysia. Use of soap formulation (DEET & permethrin) as a vector control strategy. Direct (soap) costs only.	Bar of soap formulation cost

Table 2.6 Summary of studies showing time allocated to child care.

Source	Group/areas of study	Sample size	Data collection methods	Child care time estimated
Acharya & Bennett (1982)	Rural, Nepal	167 households	In-depth & questionnaire interviews	0.9 hours/day
Ayalew (1985)	Girarm, Ethiopia	Not specified	Questionnaire interviews & direct observation	Not measured
Bleiberg et al. (1980)	Mossi plateau, Upper Volta	15 women	Observation	0.15 hours/day
Caldwell et al. (1980)	Manikganj & Dacca, Bangladesh	23 rural households	Continuous observation	a) 0.1 hours/day in rural areas; b) 0.09 hours/day in urban areas
Coreil (1983)	Carrefour Sanon, Haiti	230 episodes of infants & child illness	Questionnaire interviews	0.04 hours/day
Doan & Popkin (1993)	Cebu, Philippines	3080 women	Questionnaire interviews	Not measured
Devanzo & Lee (1983)	Malaysia Family Life Survey	Not specified	Questionnaire interviews	Not measured
Ho (1979)	Laguna, Philippines	211 households	Questionnaire interviews	1.6 hours/day
Kamuzora (1980)	Bukoba District, Tanzania, 1976	105 male headed households	Questionnaire interviews	1 hour/day
Mannan (1988)	Rural, Bangladesh	Not specified	Rural Studies Project survey	Not measured
McCauley et al. (1992)	Gogo, Tanzania	37 households	Questionnaire interviews & participant observations	Not measured
McSweeney (1979)	Zimtenga, Upper Volta	30 women	Questionnaire interviews & direct observations	0.3 hours/day
Mehretu & Mutambirwa (1992)	Chiduku communal area, Zimbabwe, 1984-85	331 households	Questionnaire interviews	Not measured
Whitehead (1978)	Keneba, The Gambia	81 children were observed	Measurements & Observations	Not measured

Table 2.7 Summary of studies estimating days lost due to malaria.

Source	Group/areas of study	Sample size	Source of data	Estimated days lost due to malaria
Ayalew (1985)	Girarm, Ethiopia	Not specified	Questionnaire interviews & direct observation	7 days lost due to family death
Brinkmann & Brinkmann (1991)	Review of 426 articles	Varies	Computer search	3.5 days
Ettling et al. (1991)	Maesot district, Thailand 1985-86	3299 patients	Questionnaire interviews	3.1 days
Ettling & Shepard (1991)	Rwanda	National aggregate statistics	MoH records & statistics	3.5 days
Mills (1989)	6 District, Nepal	3253 cases in 6 districts & 867 case-control pairs in 2 areas	PhD survey	9.4 days/worker; 7 days partly disabled
Nur & Mahran (1988)	Geriza, Sudan	250 families	Questionnaire interviews	6 days
Sauerborn et al. (1991)	Solenzo district, Burkina Faso	626 households	Questionnaire interviews & records of Ministry of Agriculture	Not estimated
Shepard et al. (1991)	Rwanda, Burkina Faso, Chad & Congo	Varies	Epidemiological data, documents & records (World Bank)	12 days

CHAPTER 3: THE SETTING OF THE STUDY

3.1 Introduction

This chapter is divided into 4 main sections, the first section gives an overview of the country of study, The Gambia. This is followed by the malaria situation in the country. Thirdly, the establishment of the National Insecticide Impregnated Bednet Programme (NIBP) is described and finally the evaluation of NIBP is explained.

3.2 The country of study: The Gambia

The Gambia is situated on the most westerly part of the West African coast, lying between latitude 13^0,13'N and 13^0,49'N and between longitude 16^0,48'W and 13^0,47'W. The country is surrounded by the Republic of Senegal except on the west where it is bordered by the Atlantic Ocean (Figure 3.1). The main feature of the country is the River Gambia, after which the country takes its name. The country stretches inland from west to east along the length of the river for approximately 480 km. The average width of the country is about 24 km, with the widest extent of 48 km being near the mouth of the river. The river is saline to a distance of approximately 150 km from the coast. The Gambia has a total land area of 11,295 km^2.

The climate is typically Sahelian (Sudano-Sahel) with a long dry season which lasts from October to June/July, and a shorter rainy season covering the remaining months (with most rain falling in July and August). Rainfall statistics for The Gambia shows a gradual decline of annual rainfall over the past three decades characterised by wide fluctuations from year to year. The average annual rainfall in recent years has been about 600 mm (Greenwood and Pickering, 1993). Temperature variation from one season to another are generally slight, from about 24^0C in January to 29^0C in June (Crowther, 1989) but may be more marked away from the coast. The soil is of sandstone plateau type with scattered ferruginous and laterite outcrops. Most of the country is flat, except about 400 km inland where it rises to the highest point of about 90 metres above sea level. The vegetation is mainly of the savanna woodland type with mangrove swamps bordering the river. The flooded plains on the sides of the river are cultivated with rice during the rainy season.

The country is very dependent upon on its meagre rainfall as most of its agricultural activity is rain fed. Thus, much of the agricultural activity is subject to seasonal fluctuations, and output is vulnerable to variations in annual rainfall levels. The economy is based on a single commodity - groundnuts, which takes up about 60% of cropland and also accounts for 75% of domestic exports. Agriculture is the mainstay of the economy, with over 70% of the population engaged in subsistence farming, livestock rearing and groundnuts (Statistical Yearbook Gambia Agriculture, 1991). In recent times, tourism has become an important foreign exchange earner for the country. The population is poor, with a GNP per capita of about US$ 260 (World Development Report, 1992).

The Gambia is a former British enclave within French speaking Senegal. It achieved full independence in 1965, after two centuries of colonial rule and became a sovereign republic 5 years later. Until recently it had a unicameral parliament and an executive president with elections held every 5 years by universal suffrage. The ousted president, Sir Alhaji Dawda Jawara and his Peoples' Progressive Party have won all elections since independence. The country now has a military government (the Army Forces Ruling Council) which came to power through a coup detat in July, 1994. The current president is Captain Yahya Jammeh. The country is a member of a host of international organisations. Amongst them are the United Nations Organisation (UN), the Commonwealth, the Organisation of African Unity (OAU), the Islamic League and the Economic Commission of West African States (ECOWAS). It formed the Senegambia Confederation with Senegal in 1981 but this confederation was dissolved in 1989.

Results of the 1993 Population Census indicate that the population in the country is now just over 1 million with an annual growth rate of around 3.2% (Central Statistics Department, 1993). This was about 50% higher than the previous census figure of 687,817 in 1983. The increase in population is partly due to a high birth rate but also to the in-migration of foreigners (mainly from the sub-region and Oceanic countries). The population of the country is made up of a number of ethnic groups with the Mandinka ethnic group forming the majority. The other main ethnic groups are the Wolof, Fula and Jola. Over 90% of the people practice Islam, with other religions (eg. Christianity) being in a minority. The majority of the population are religious, thus *marabou* (traditional religious healer) consultation is widespread and cherished for spiritual and physical support. The Gambia is culturally a male dominated and a pro-natalist society, hence women have little decision making power. Traditional beliefs, norms and customs are strongly adhered to, particularly in rural areas.

Like most African countries, the government is the main provider of health care, However, its efforts are supplemented by several Non-Governmental Organisations (NGOs) which have external financial support. The government runs two hospitals in Banjul and Bansang, an upcountry provincial town, and a number of health centres. The country is a signatory to the Alma-Ata Declaration of 1978. The aim of the government is to provide adequate health care for all through its primary health care (PHC) programme. Consequently, in 1980, the government initiated a PHC programme which now covers all villages with a population of 400 or more. Each of these villages has a trained village health worker (VHW) and a trained traditional birth attendant (TBA) who were selected by their village and who are supported by their communities. The VHW runs the village PHC post, giving basic medication, mainly first-aid for a small fee and provides a source for information on health matters.

3.3 Malaria in The Gambia

3.3.1 Malaria epidemiology in The Gambia

Malaria is one of the most researched tropical diseases in The Gambia. It is mesoendemic and it affects mainly children.

A recent review of the epidemiology of malaria in The Gambia by Greenwood and Pickering (1993) reports that the documentation of malaria started in the 15th century with the arrival and settlement of European explorers, missionaries and traders in west Africa. Mortality among permanent settlers of Bathurst (now Banjul) was high and most of the deaths were attributed to malaria or yellow fever.

The review also shows that the first malaria survey in The Gambia was conducted by Dutton (1903) at the beginning of the century among children aged 0-15 years. Eighty percent of blood films were positive for malaria parasites, but the parasitaemia was lower in children over 10 years. Information available on malaria during the period of 1901-1950 provided an insight into malaria mortality. Malaria accounted for approximately a tenth of out-patient attendances and hospital admission at the Royal Victoria Hospital (RVH), Banjul. The hospital noted a substantial increase in malaria deaths in the 1940s ranging from about 10-50 each year; the reason for this was thought to be in-migration from rural areas. The peak of admissions was always in the rainy season (Greenwood and Pickering, 1993).

Research activities in The Gambia increased with the establishment of the Medical Research Council (MRC) in 1948. The Keneba field station was instituted to examine the effect of parasites on health and nutrition in a rural community. Studies by McGregor and Smith, (1952), Gilles and McGregor, (1959), Billewicz and McGregor, (1981), McGregor and Williams, (1978) and Lamb et al., (1984) established the basis epidemiology of malaria in The Gambia and showed that the burden of malaria morbidity and mortality fell on children under 5 years.

In 1982, the MRC initiated a new series of epidemiological studies in Farafenni on the north bank of the River Gambia, with the aim of determining the importance of malaria as a cause of mortality and morbidity prior to an intervention programme. Malaria mortality rates were determined using a village-based mortality surveillance system. The estimated mortality rates were 6.3 per 1000 in children under the age of one year and 10.7 per 1000 in children aged 1-4 years with malaria accounting for 25% of all deaths in this age group (Greenwood et al., 1987a). Malaria deaths were also noted to occur most frequently during and shortly after the rainy season. Subsequent studies for example those by Marsh et al., (1989) and Snow et al., (1989) showed a similar pattern of peak malaria incidence at the end of the rainy season.

Urban and peri-urban malaria in The Gambia has also been studied. It is less severe than in rural communities, as shown by Haverson et al., (1968) and Lindsay et al., (1990). This can be explained in part by the lower density of the malaria vector *Anopheles gambiae sensu stricto* in urban than in rural area. Increased access to antimalarials in urban areas may also play a part.

The conclusion drawn from the two child mortality studies in the Upper River Division by De Francisco et al., (1993) and O'Dempsey et al., (1993) suggest that about 1000 Gambian children under 5 years die from malaria annually. A hospital based study in Royal Victoria Hospital (RVH) over a period of 3 years by Brewster and Greenwood (1993) has also stressed the continuing importance of malaria as a cause of childhood death in The Gambia. There is clear evidence that throughout The Gambia, malaria is still today one of the leading causes of death among young children (Greenwood and Pickering, 1993).

3.3.2 Malaria vectors in The Gambia

An enormous number of studies have been undertaken to identify malaria vectors (mosquitoes) in rural Gambia since the first investigations were undertaken in 1901; Dutton (1903); Bertram et al., (1958); Bryan (1979 and 1983); Bryan et al., (1982 and 1987); Snow et al., (1983); Lindsay et al., (1991b) and Thomson et al., (In press). The results of these studies have shown that the *An. gambiae sensu stricto* (freshwater breed) and *An. melas* (brackish water breed) are the main malaria vectors. *An. arabiensis* is also found, particularly during the dry season. *An. melas* was found to be more zoophilic and exophilic than *An. gambiae s. s.* (Greenwood and Pickering, 1993). Studies of the peri-urban areas have revealed lower numbers of anopheline mosquitoes than in rural areas (Lindsay et al., (1990) and Adiamah et al., (1993). This implies that comparatively malaria is likely to be more prevalent in rural areas than peri-urban areas.

A recent study by Thomson et al., (In press) has observed higher malaria transmission rate in the eastern part of the Gambia compared to the western half and this was associated with a high sporozoite rate but not mosquito abundance. Moreover, bednet usage correlates strongly with mosquito density. Thus, there is heterogeneity in bednet usage and malaria transmission throughout the Gambia.

3.3.3 Malaria control in The Gambia - therapy and chemoprophylaxis

Until recently the Gambia's malaria control strategy relied upon the treatment of clinical attacks of malaria with quinine or chloroquine (Greenwood and Pickering, 1993). However, studies by Greenwood et al., (1988) and Menon et al., (1990b) detected no reduction in overall child mortality or malaria-associated mortality following the introduction of a village-based malaria treatment programme through PHCs. The likely reasons for this unexpected finding were the sudden nature of severe malaria attacks and the absence of the non-salaried VHW when most needed (Greenwood and Pickering, 1993). Though chloroquine resistance is now being detected in The Gambia (Menon et al., 1987; Menon et al., 1990a), chloroquine remains an effective treatment for uncomplicated malaria in most cases, with quinine being used for cases of cerebral malaria (Greenwood and Pickering, 1993).

Chloroquine has also been used as a chemoprophylactic drug. Early studies showed that weekly chloroquine chemoprophylaxis offered effective protection against malaria in children, and that it also increased their haemoglobin level and weight (McGregor et al., 1956; McGregor et al., 1961). Greenwood and Pickering, (1993) observed that the results of the above studies were not translated into a public health malaria control measure primarily due to the concern that chloroquine prophylaxis might affect the development of natural immunity, drug resistance and because of problems with sustained drug administration. With the advent of the PHC system, VHWs were used to overcome the drug administration problem and a high level of drug administration was achieved in children under 5 years (Allen et al., 1990b). Maloprim prophylaxis taken fortnightly throughout the rainy season reduced overall child mortality and morbidity from malaria substantially (Greenwood et al., 1988; Menon et al., 1990b and Greenwood et al., 1991). Although these studies have shown that chemoprophylactic drugs are an effective control measure, its public health use are thwarted by the reasons given above.

3.3.4 Malaria vector control

The control of mosquito breeding sites was initiated in the capital, Banjul in 1903 based on Dutton's recommendations. The programme has been seriously affected by supply problems (eg insecticide, spraying equipments) (Greenwood and Pickering, 1993). In rural communities, measures to control the malaria vector through attacks on breeding sites have not been attempted (Greenwood and Pickering, 1993).

Nevertheless, some measures of protection against mosquito have been adopted by the populace. Bed nets have been used both by expatriate and the local population for over a century (Greenwood and Pickering, 1993; Aikins et al., 1993). This high level of bed net usage in The Gambia is unique in the West African sub-region. Bed nets are used for privacy as well as to curb mosquito nuisance (MacCormack and Snow, 1986; MacCormack et al., 1989; Aikins et al., 1993).

The effectiveness of bed nets as a malaria control measure was explored earlier by Bradley et al., (1986) and Campbell et al., (1987). They observed that the prevalence of both parasitaemia and splenomegaly was lower in net users compared with non-users, indicating that ordinary nets offered some protection to users. The differences were partly explained by ethnic and geographical variation in net usage (MacCormack and Snow, 1986). Subsequently, a series of intervention trials using treated and untreated nets were carried out by Snow and his colleagues in the Farafenni area (Table 3.1).

Table 3.1 Summary of the results of three small-scale intervention trials of bed nets in the Farafenni area of The Gambia

	Study 1	Study 2	Study 3
Reference	Snow et al., (1988b)	Snow et al., (1987)	Snow et al., (1988)
Type of net	Untreated	Treated	Treated
Study group	Whole village	10% of village	Whole village
Comparison (no. of villages in parenthesis)	Untreated (7) vs. no nets (9)	Untreated vs. treated nets	Untreated (9) vs. treated nets (7)
Outcome			
Fever plus			
Any parasitaemia	-18%	**-43%***	**-72%***
High parasitaemia[a]	-37%	**-50%***	**-63%***
Spleen rate[b]	-38%	+10%	**-66%***
Parasitaemia			
Any	-3%	-17%	-32%
High[b]	+19%	-52%	-54%
Packed cell volume	+0.8%	+0.6%	+2.7%

* Asterisks indicates that differences between intervention and comparison groups were statistically significant at the 5% level; -indicates reduction, +indicates increase.
[a] Parasitaemia greater than 5000 per microlitre.
[b] Enlargement of the spleen during the course of the malaria transmission season.
(**From Greenwood and Pickering, 1993**).

The first trial with untreated nets carried out in Fula hamlets, showed an 18% reduction in episodes of fever with parasitaemia and a 37% reduction in fever episodes with high levels of parasitaemia among net users but theses differences were not statistically significant. There was no reduction in the prevalence of malaria parasitaemia or splenomegaly among net users (Snow et al., 1988a). To improve the effectiveness of nets, permethrin-treated nets were used in the second trial, which were randomly assigned to children (1-9 years). About 10% of the nets in the village were treated. Similar results were obtained. The incidence of fever episode with parasitaemia was reduced by 43% and a 50% reduction in febrile episodes with a high level of parasitaemia was also observed in children using nets. Again there was no reduction in the prevalence of parasitaemia or splenomegaly among treated net users (Snow et al., 1987). Finally, treated nets were made available to everybody in 7 villages and compared with 9 villages with untreated nets. Fever episodes with parasitaemia were reduced by 72% and fever episodes with high level of parasitaemia was reduced by 63%. There was a reduction in the prevalence of splenomegaly among children using treated nets but no reduction in the prevalence of parasitaemia (Snow et al., 1988b).

Lindsay et al., (1989a) showed that ordinary nets reduce man-vector contact, resulting in a reduction of about 90% in infective bites. Further studies with several pyrethroid insecticide have shown that they are effective at preventing mosquitoes from feeding on humans (Lindsay et al., 1991a; Miller et al., 1991). Permethrin was found to have both a killing and a repellency effect.

A recent intervention trial of impregnated nets and malaria chemoprophylaxis (Double Intervention Study [DIS]) in another part of the country gave striking results. The study showed a 63% overall reduction in mortality among children aged 1-4 years who slept under treated nets. Chemoprophylaxis with Maloprim combined with treated nets reduced the prevalence of splenomegaly by 63% and parasitaemia by 83% (Alonso et al., 1993). In the study area 86% of the people were net users (Aikins et al., 1993). However, although impregnated bed nets were found to be an effective barrier against mosquitoes, there was little reduction in the population density of mosquitoes in villages with impregnated nets indicating that there had been no mass killing effect (Lindsay et al., 1993).

Economic evaluation of the DIS by Picard et al., (1993) showed that the programme was cost-effective. The estimated costs per death averted and per clinical episode of malaria averted were US$188 and US$28 for bed net impregnation, and $257 and $19 for impregnation combined with chemoprophylaxis.

The results of the DIS, prompted the Gambian government, with the collaboration of MRC and WHO, to institute a systematic malaria vector control programme in the rural areas using impregnated bed nets. This resulted in the formation of a national programme - the National Insecticide Impregnated Bednet Programme (NIBP).

3.4 National Insecticide Impregnated Bednet Programme (NIBP)

The NIBP covers two broad activities - implementation and evaluation (Figure 3.4). The initial aim of the programme was to introduce impregnated bednets into all PHC villages in The Gambia within 2 years. The Implementation aspect of NIBP, headed by a Project Manager was made up of the following programme areas; Sensitization and Awareness (SA) campaign, Training, Supply Management, Impregnation Exercise (Bednet dipping) and Assessment of dipping.

a) **Sensitization & Awareness campaign**. Education at all levels in the community on the NIBP started in March 1992 and involved government officials, NGOs and private institutions at all levels of the health care delivery system. Working links were established with counterparts (ie. health and development workers) in the relevant organisations. An abridged version of the NIBP project document was made available to them. Meetings and discussions were held with top government officials and counterparts[2] to delineate roles and responsibilities.

The Sensitization and Awareness campaign focused on malaria as a health problem and on measures used to control it. The objectives and activities of the NIBP were also highlighted and the roles of the collaborating institutions were discussed. Different mass media means were employed to promote NIBP activities. These ranged from the use of printed media (ie. posters and T-shirts), radio programmes (ie. spots, interviews and discussions), film production (video) to interpersonal communication.

Radio Gambia and the Film Production Unit under the Ministry of Information & Tourism also played an important role in this area. Radio Gambia, as part of its Rural Broadcasting and Adult Education programme, developed 17 radio spots of 2-3 minutes durations in the 5 main languages (Mandinka, Wolof, Jola, Fula and Sarahuli) and English. Broadcasting of these radio spots throughout the country started on 1st May and ended on 30th June, 1992. These NIBP spots were integrated into 8 existing radio programmes and spot slots namely, Health Programme in Mandinka and Wolof, *'Mefahamundeh'* in Sarahuli (Creating or developing understanding among us), *'Yewterefulbah'* in Fula (Discussion of topical issues),

[2]Government officials and counterparts were the Honourable Minister for Health (MoH), the Permanent Secretary, Director of Medical Services, counterparts of Health Education Unit, In-service Training Unit, Epidemiology & Statistics Unit (eg Malaria control coordinators) all of MoH, Divisional Commissioners, officials of the Regional Health Teams (RHT), Bansang Hospital, Womens' Bureau, Womens' Council, Radio Gambia and the Film Production Unit of the Ministry of Information & Tourism, the Ministries of Education and Local Government & Lands. The NGOs collaborators were Action Aid of The Gambia (AATG), WHO, UNICEF, Save The Children Federation-USA (SCF(US)), Gambian Rural Development Agency (GRUDA), Christian Children Fund (CCF) and Canadian Universities Services Overseas (CUSO).

'Kameka Jola' in Jola (Discussion of topical issues), *'Muso taa'* in Mandinka (Women's programme), *'Jotaiyi Gigainyi'* in Wolof (Women's programme), *'Tesito'* in Mandinka and Wolof (Self-reliance programme), and *'Bantaba'* in Mandinka and Wolof (Agricultural related programme). The spot slots followed News and Announcements in the mornings and evenings and under-ran programmes slots. Furthermore, the relevant spots were recorded and made available to the radio sub-station in the Upper River Division for onward broadcasting in areas which Radio Gambia does not cover. Radio interviews were held with the management team of the programme in local languages. Radio quiz programmes at the district and village levels were also organised. Audio-visual aids (audio and video recordings) were produced by the Film Production Unit, mainly demonstrating the bednet dipping process at the village level in the six languages mentioned above. These were used in the campaign when appropriate by the RHTs. The theme of these radio discussions, interviews and spots was mainly malaria control in general and the NIBP in particular, the use of impregnated nets and how they should be dipped.

Other communication methods used were posters and T-shirts. Existing posters depicting the use of treated bed nets to control malaria were re-produced and distributed to relevant individuals, organizations and PHC villages (see Figure 3.2). T-shirts illustrating bed net dipping were produced and distributed among the key players of the programme; fieldworkers, CHNs, VHWs, TBAs, NIBP workers and some participating institutions, to strengthen the message of NIBP. Letter heads and complimentary slips were also produced for the use of NIBP officials.

b) **Training of NIBP field staff**

Three groups of field staff worked under the NIBP Project manager. These were; i) field workers (MRC employed), ii) the

Ministry of Health (MoH) Malaria coordinating officer and iii) Community Health Nurses (CHNs) and Senior Public Health Nurses/Officers (SPHNs/SPHOs). For the majority of these field staff, bednet impregnation was not a new exercise, since they had been engaged in the previous MoH pilot programme in their localities.

Training was started at all levels of the health care delivery system before the scheduled dipping process. The initial stage of the training exercise was a review of past dipping experience and was organised for the Regional Health Teams (RHTs) and the staff of participating NGOs (Action Aid of The Gambia (AATG), Save the Children Federation-USA (SCF-US)) involved in the NIBP. The objectives and nature of the NIBP was spelt out and the responsibilities of each party were made known.

Field workers obtained two days in-service training at the NIBP office. Their training entailed detailed description of the NIBP dipping posters, measurement and dilution of insecticide with water, practical demonstration of dipping (dipping process), drying and hanging of impregnated bed nets. They were also trained on how, when and where to mark treated nets with both indelible and washable markers, instructed on the purpose of marking nets and finally, taught ways of appealing to bednet owners to refrain from washing their impregnated nets during the rainy season. The whole dipping process was demonstrated using visual aids. Dipping Manuals (guidelines for bednet dipping) were used during the training sessions.

In-service training was held for the staff of the health centres, dispensaries and key villages in the context of their existing in-service training sessions.

At the village level, training of village health workers (VHWs), traditional birth attendants (TBAs), volunteers from women's groups, village development committee (VDCs) helpers and other villages volunteers as programme dippers was determined by whether or not such persons had participated in previous bednet impregnation programmes. NIBP field workers were responsible for training and/or re-training of these dippers when appropriate. The training sessions were accompanied by demonstrations and lasted for an hour on average.

c) **Supply management**

Another important exercise carried out along side the training activities was the management of logistics for dipping (ie insecticide, measuring cups, hand gloves, funnels, containers and markers). This entailed the ordering, reception and distribution of dipping implements and insecticide to meet the deadline for the dipping exercise. The main logistics centred on the distribution of insecticide (20% EC[3] permethrin), measuring and distribution of implements. The insecticide was provided by UNICEF, AATG and NIBP, but distribution was coordinated by the project manager. The distribution of items was based on the results of the bed net census taken prior to the dipping exercise.

d) **Bednet impregnation (dipping) exercise**

The first dipping of bednets commenced in most selected villages on 16th June, 1992 and ended mid-July, 1992. Fifty per cent (221) of the NIBP villages were covered. The dipping exercise was delayed for a week due the Muslim festival of '*Yawmu Ashora* (*Tam haret*)' which fell on 12-13th June. On this occasion, many people travel to various parts of the country for family reunions and the offering of group Islamic prayers.

[3]20% EC=20% emulsified concentrate of permethrin.

Dipping arrangements were discerned by the VHWs and TBAs with '*Alikalos*' (village heads), women groups leaders and arrangements made for dipping to be done on a convenient day within the stipulated period. A compound-to-compound approach to dipping was adopted for maximum coverage. The TBAs and the leaders of the women '*kafoos*'(organised groups) mobilised women in compounds to impregnate their bednets. On the day of dipping, women in the compound arranged to have all 'washed' bednets deposited outside sleeping rooms. All bed sheets were also removed from beds since dipped nets were dried on mattresses. The dipping entailed mixing 40 mls of permethrin (20% EC) with 2 litres of water for one bednet (Figure 3.3).

In compounds with large number of bednets, dippers were instructed to mix the insecticide solution for 5 bednets at a time with the lighter nets being dipped first, to minimise wastage and also enable thicker and bigger nets be dipped with no extra addition of insecticide. The measurement of insecticide and water were the responsibility of the VHW with the NIBP field staff helping and supervising. After dipping, excess insecticide solution was wrung out of the nets and bednets were spread on mattresses to dry. Dried nets were then hung on beds. The NIBP field staff visited compounds later to mark the treated nets with both indelible and washable markers. Owners of treated nets were instructed to refrain from washing them until the end of the rainy season. The dipping exercise was carried on successive days until all the bed nets in a village were treated.

e) **Assessment of dipping**

A national survey of dipped bednets was undertaken at the end of the dipping exercise, firstly to validate the level of coverage achieved during the dipping process; secondly, to ascertain initial reactions to the dipping process and thirdly, to find out the effectiveness of the preceding sensitization exercise. Results and lessons learnt from the whole implementation process were fed into the second-year implementation programme of NIBP. The results of the survey are given in Tables 3.2, whilst that of Table 3.3 shows that for the NIBP study areas for the evaluation of the programme (Figure 3.4).

Table 3.2 Impregnated Bednet coverage by regions, The Gambia

Region	Bednet count	No. of Impregnated bednets	Coverage (%)
Western	15,659	12,692	81.05
Central	34,219	29,500	86.21
Eastern	34,064	29,121	85.49
Total:	83,942	71,313	84.96

(From NIBP, The Gambia, 1992)

Table 3.3 Impregnated Bednet coverage by NIBP study areas (zones), The Gambia

NIBP Study areas	Bednet count	No. of Impregnated bednets	Coverage (%)
1	2,247	2,282	101.56
2	3,442	3,414	99.19
3	5,737	5,930	103.36
4	3,314	3,081	92.97
5	4,377	4,172	95.32
Total:	19,117	18,879	98.76

(From NIBP, The Gambia, 1992)

3.5 Evaluation of NIBP

Based on the previous studies already reviewed at the beginning of this chapter, three main areas were identified as requiring evaluation by the Director of MRC in conjunction with the MoH officials; epidemiology, entomology and economic and other socio-cultural factors (See Figure 3.1). The main objective of epidemiological evaluation was to determine the impact of the NIBP on mortality and morbidity in children under 10 years. Entomology addressed the impact of large scale use of insecticide-impregnated bed nets on mosquito density, behaviour and sensitivity to pyrethoids. Finally, an economic evaluation of NIBP was undertaken to determine its cost-effectiveness and to explore the effects of economic factors in determining bed net purchases and their effect on the willingness and ability of individuals and communities to pay for insecticide. Other socio-cultural factors affecting net usage were also be addressed to give a clearer understanding of the use and non-use of bednets. The evaluation of NIBP is described in Section 3.5.1.

3.5.1 NIBP: The setting and study areas

The implementation of NIBP in the first year covered 221 PHC villages. However, the evaluation of the programme was based on selected areas of the country due to logistical reasons. This entailed the establishment of study areas for evaluating the impact of the programme. Thus, in 1991, the NIBP epidemiology team identified and established five study areas for NIBP evaluation on the basis of their geographical representativeness. Another criteria was that the areas were not exposed to any other major medical interventions during the period of the trial (D'Alessandro, personal communication). In all, 104 villages were identified and randomly matched by population size in 2 groups with one group receiving impregnated bed nets and the other group acting as a control in each zone. The groupings were as follows;

Study area 1: 7 treated villages & 7 untreated villages;

Study area 2: 9 treated villages & 9 untreated villages;

Study area 3: 10 treated villages & 11 untreated villages;

Study area 4: 12 treated villages & 11 untreated villages;

Study area 5: 15 treated villages & 13 untreated villages; (Figure 3.4)

The difference in number of villages amongst the groups was to balance the overall population in the 2 groups of each study area. Meetings were held with *'Alikalos'* and elders of these villages and they were briefed about NIBP activities. Their consent to participate in the study was sought. A village-based surveillance system of recording vital statistics (eg births and deaths) was established in each NIBP study villages. Village reporters were recruited, briefed and provided with ledgers to report all births and deaths in their villages. To verify and cross-check these vital events, Imams in the villages willing and able to participate were also recruited into the reporting system (D'Alessandro, personal communication).

Epidemiology field workers were stationed in some study villages to communicate regularly with reporters, to supervise their work and to relay their information to the MRC field stations in Farafenni or Basse on a regular basis. Mortality surveillance commenced in May, 1991. Morbidity surveillance was undertaken during a cross-sectional survey undertaken in sampled villages throughout the country annually. Data entry clerks computerised the data. Cleaning and cross-checking of the data was completed by the data manager of the computer centre.

Before the commencement of the NIBP, baseline information on bednet ownership and the population distribution of the villages in the study areas were collected. A bed net ownership survey was undertaken in September 1991 to obtain baseline data on bed net distribution in the country. Results showed that approximately 60% of Gambians owned nets (D'Alessandro et al., 1994). A full population census was conducted in the study areas between March and May, 1992. The total population of the NIBP study villages was 115,895, with 18,803 children aged 1-4 years. The main ethnic groups in the study areas are Mandinka (41.1%), Sarahuli (24.5%), Fula (11.8%), Wolof (11.5%) and Jola (8.8%). The majority of the people are subsistence farmers, and Islam was the predominant religion.

The objective of the study described in this PhD is to undertake an economic evaluation of the NIBP implementation and to estimate of the cost-effectiveness of NIBP (excluding all the research components - epidemiology, entomology and economic and socio-economic of NIBP). Hence, costing of the NIBP is concentrated on the implementation activities described above. Part of the effectiveness data (health effects) will be obtained from the epidemiology component of NIBP (ie deaths averted). The other effectiveness data will be the overall effect of impregnation on primary school attendance.

The cost-effectiveness study (CES), part of the economic evaluation of NIBP, was carried out parallel to the other NIBP evaluations (ie epidemiology and entomology). The same study areas were used. Five field workers were recruited for the economic evaluation and they were resident in one village of each of the 5 zones. The economic evaluation team worked closely with the other teams especially the epidemiology and implementation teams, since their work complemented each other.

The NIBP evaluation team was based in MRC Farafenni while the office of the NIBP Implementation was located in MRC head station in Fajara. A Bednet Working Group was formed comprising all the MRC researchers engaged in NIBP activities. The director of MRC, The Gambia was the chairperson. Monthly meetings were held to assess the working positions of all segments of the programme.

The next chapter describes the objectives of the study and the methods used to gather the necessary data for evaluation.

Figure 3.1 Structure of NIBP

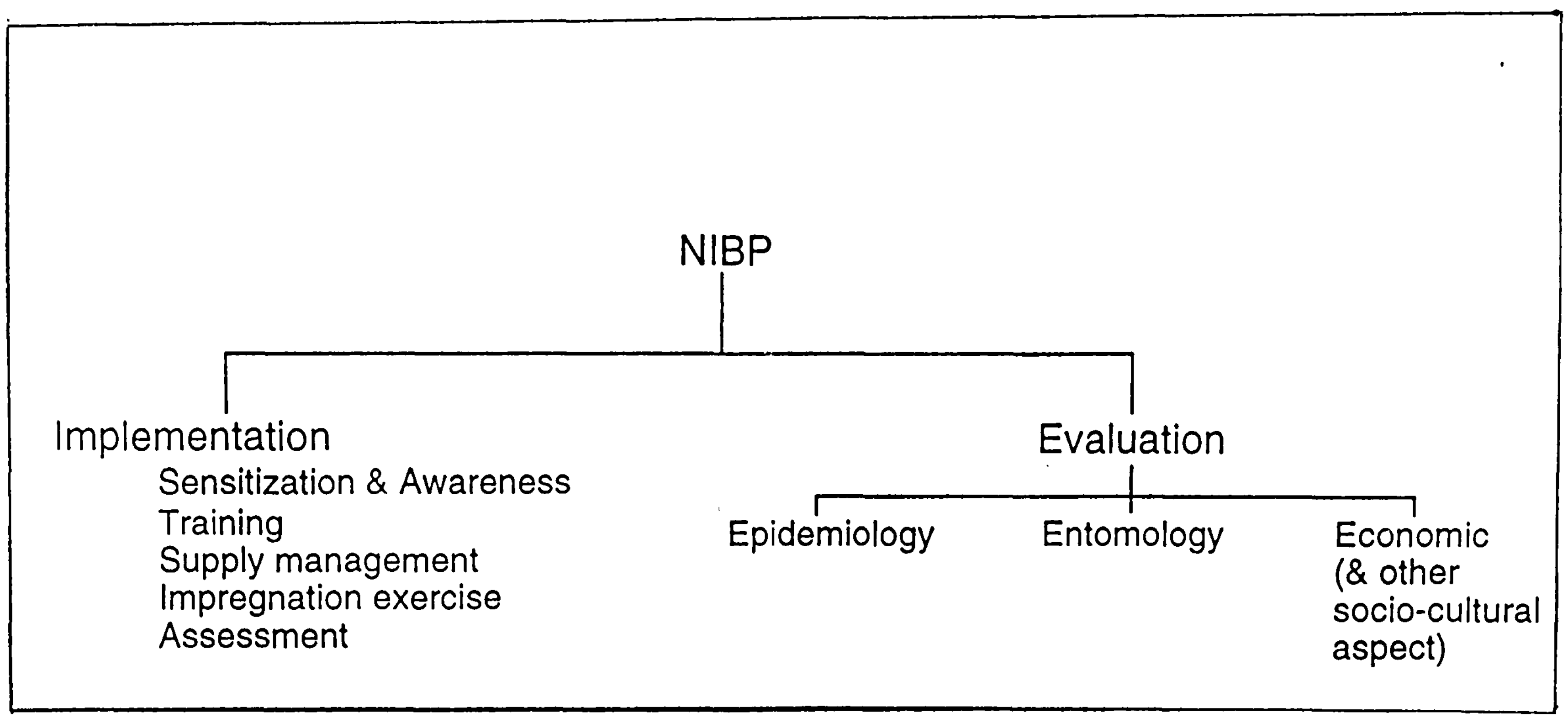
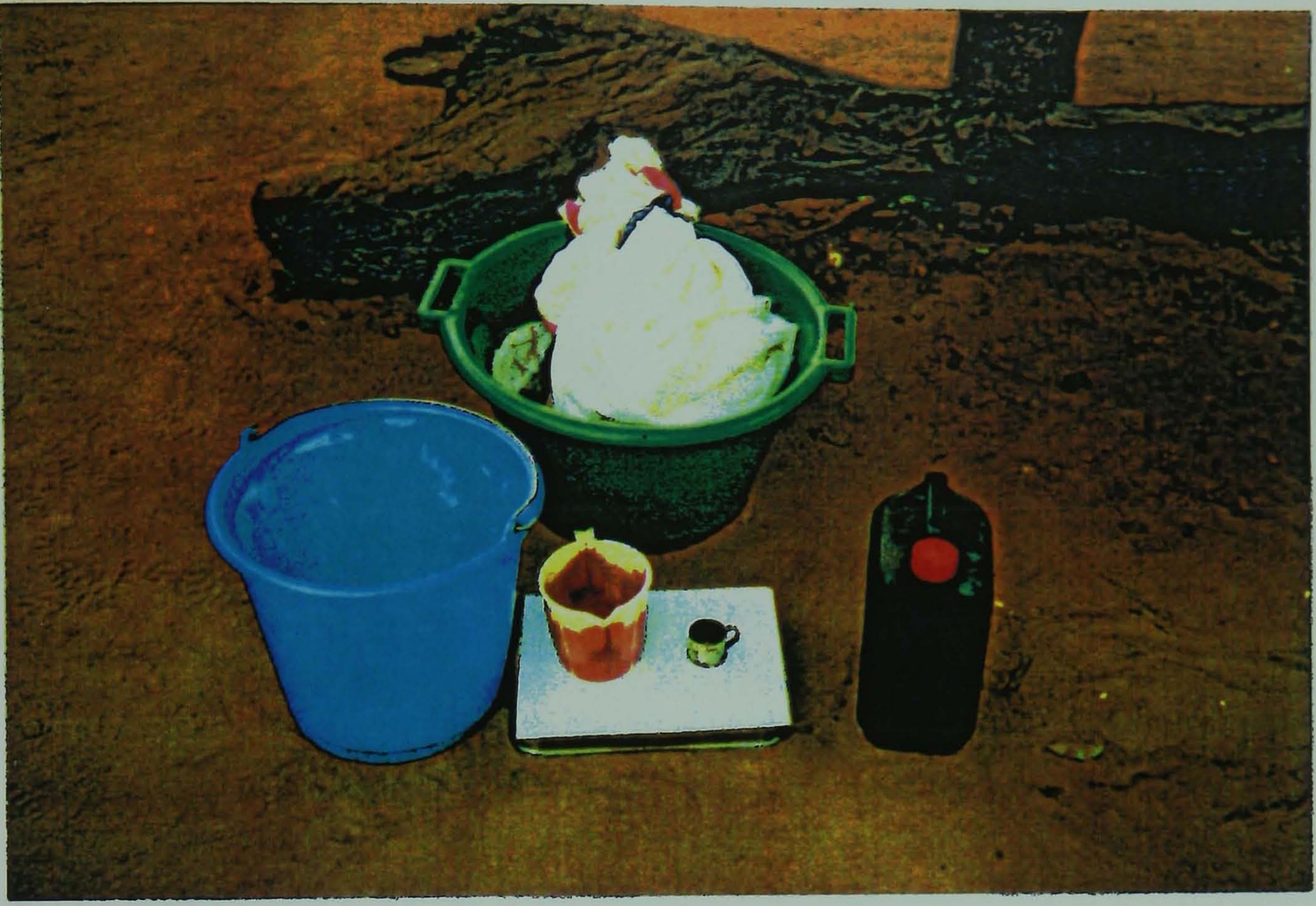
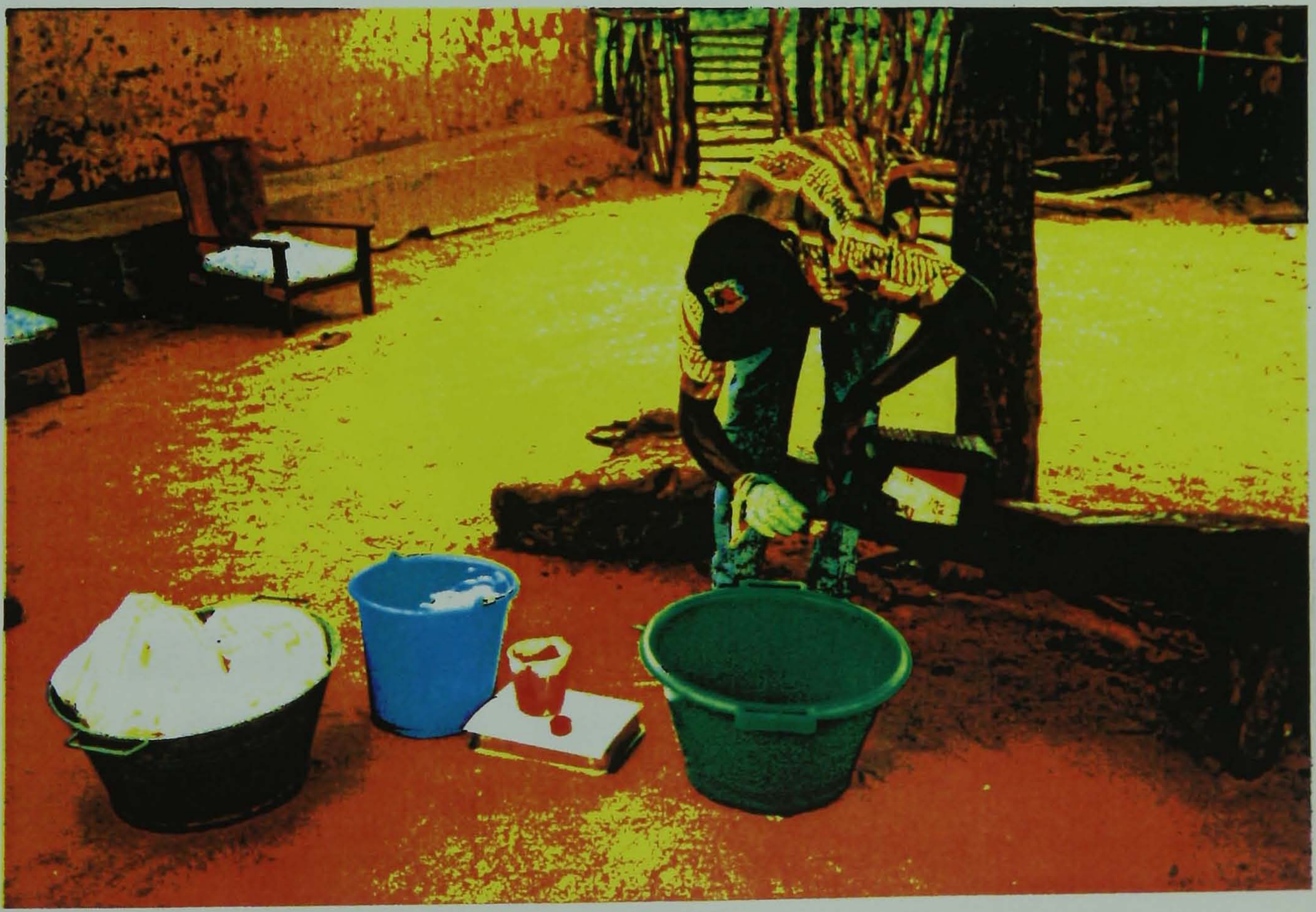


Figure 3.3 Dipping implements and VHW measuring insecticide

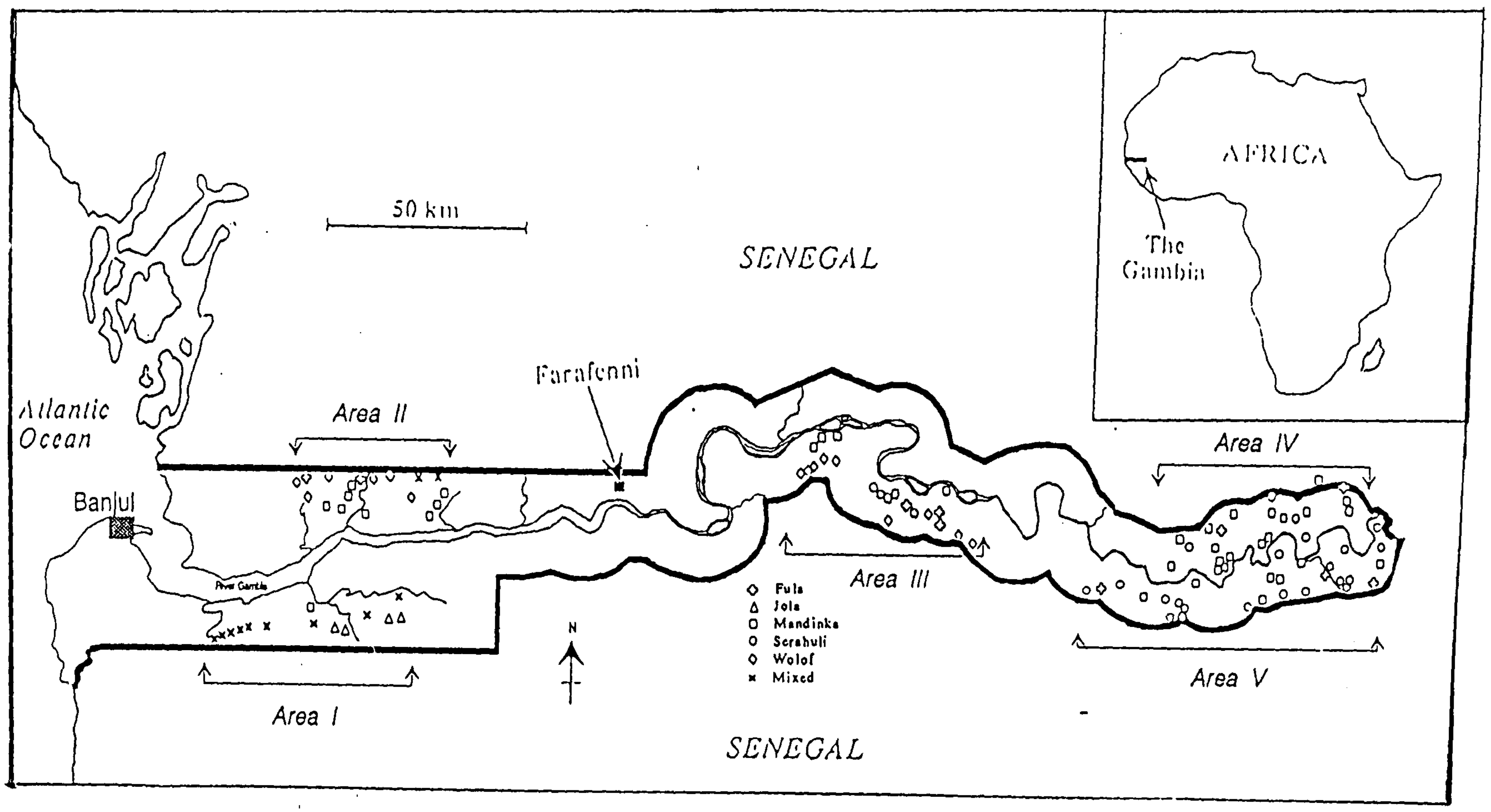




(Photographs taken by Dr Alice Greenwood, MRC, The Gambia.)

Figure 3.2 Posters used for Sensitization & Awareness campaign

Figure 3.4 Map of The Gambia showing the 5 NIBP study zones



CHAPTER 4: RESEARCH OBJECTIVES AND METHODOLOGY

4.1 Introduction

This research is a subset of the economic evaluation component of the National Impregnated Bednet Programme (NIBP) in The Gambia. It must be reiterated that the NIBP as an intervention programme, encompasses various projects (ie implementation and evaluation - epidemiology, entomology and economic) with each charged with the responsibility of addressing a specialised aspect of the programme (see Figure 3.1).

The aim of this chapter is first to show the relationship between this study's objectives vis-a-vis NIBP's objectives, the conceptual framework of the study and methods used to achieve the objectives. The chapter then proceeds to elaborate the organisation of the fieldwork, problems encountered in the field and finally, data processing and management.

4.2 NIBP's objectives

The general objective of the NIBP was to implement and evaluate a national programme of malaria control in The Gambia using insecticide-impregnated bednets within the existing primary health care (PHC) setting.

The specific objectives were;

1. to introduce impregnated bednets into all PHC villages in The Gambia within 2 years;

2. to evaluate the impact of the NIBP on mortality and morbidity in children under the age of 10 years;

3. to evaluate the impact of the NIBP on the outcome of pregnancy in primigravidae, in particular its influence on birth weight;

4. to monitor the effects of the large scale use of insecticide-impregnated bednets on mosquito behaviour and sensitivity to pyrethroid;

5. to investigate the ways in which impregnated bednets achieve their protective effect;

6. to develop a strategy which might be adopted to delay the onset of insecticide resistance;

7. to evaluate the cost-effectiveness of the NIBP and

8. to evaluate ways in which financing of the NIBP might be sustained.

From the above NIBP objectives, it is clear that objectives 7 and 8 form the economic component of the programme[4] with objective 7 being the main crux of this thesis.

4.3 Objectives of the economic evaluation component of NIBP

The economic component of the NIBP aims at identifying the relative cost-effectiveness and affordability of this intervention as a means of preventing child deaths and to explore other possible economic consequences that follow from the intervention. The specific objectives were;

1. to calculate the cost-effectiveness of the NIBP;

2. to calculate the resources saved by averting a child death to households (both direct and indirect) and

[4] Government of The Gambia (1991). Gambian National Impregnated Bednet Programme submitted to WHO/TDR for funding.

subtract these from the programme costs, to produce net cost-effectiveness ratios;

3. to investigate the effect of impregnated bednets on primary school attendance and;

4. to explore the importance of economic factors in determining bednet purchases and assess the willingness and ability of the household and village to pay for the insecticide required for impregnation.

These were the stated objectives in the project document[5]. This PhD research study is concerned with objectives 1, 2 and 3 of the economic component of NIBP.

4.4 Aim and objectives of the study

The aim of this research study is to calculate the cost-effectiveness of NIBP in terms of total programme cost per child (under 10 years) death averted.

To achieve this aim, this study has set itself the following specific objectives;

1. to calculate the total NIBP implementation costs (ie direct and indirect costs);

2. to estimate the number of child (under 10 years) deaths averted in the intervention area;

3. to calculate the resources saved by averting a child death to the health sector and households both

[5] Republic of The Gambia (1991). Gambian National Impregnated Bednet Programme.

direct (ie saved treatment costs, saved preventive expenditures, postponed funeral expenses) and indirect (ie time costs saved by carers and relatives that can be spent on productive activities) and subtract these from the programme costs, to produce net cost-effectiveness ratios and

4. to investigate the effect of impregnated bednets on primary school attendance in terms of days and reasons for absenteeism.

To achieve these objectives, the appropriate method for the assessment of cost and effectiveness analyses needs to be selected. The selection of methods also requires a conceptual framework for the analysis of the study.

4.5 Conceptual framework of the study

The economic evaluation tool for this study is cost-effectiveness analysis (CEA) and the analytic framework is based on the Drummond, Stoddart and Torrance (1987) model as shown in Table 4.1 below.

The model sets out the costs and consequences relevant to a cost-effectiveness study of NIBP. The costs of NIBP are made up of two main categories: costs falling on the government and those falling on the patient, their family and the community.

Table 4.1 Framework for the cost-effectiveness study of NIBP

Costs

I. Organizing and operating costs within the health sector (ie costs of implementing NIBP).

II. Costs borne by patients,families and the community.
- out-of-pocket expenses (ie transport, food costs and purchase of nets for impregnation)
- patient and family input into treatment & other (ie treatment, preventive, funeral, burial and mourning costs)
- time lost from work (ie dippers, carers', travel, treatment, funeral, burial and mourning times).

Consequences

I. Changes in physical, social and emotional functioning (ie Health & other effects - 1) child deaths averted and 2) reduction in school absenteeism due to malaria control (NIBP)).

II. Changes in resource use (ie benefits)

a) for organizing and operating services of the intervention (ie savings in government resources that in the absence of NIBP would be spent on treatment of cases).
b) relating to activities of patients and their families (ie (1) savings in household expenditure on transport, treatment, food, preventive, funeral, burial and mourning (2) savings in lost work time namely, carers, travel, treatment, funeral, burial and mourning).

(Source: Adapted from Drummond, Stoddart and Torrance (1987))

Arguably, financial prices of investment and recurrent expenditures do not always reflect their true opportunity costs particularly in developing countries. However, anecdotal evidence (Walsh[6], personal communication, 1991) suggests that the Gambian economy is relatively stable (ie less distortion in prices of goods and services), and that market prices reflect the opportunity costs of goods and services. Hence, no shadow prices (ie difference in official foreign exchange rate and that of the parallel market) was used in the NIBP cost analysis. The discount rate selected for this study was based on the difference between the government treasury bill rate and inflation rate. A similar approach for discounting goods and services was used a previous study by Picard et al., (1993). Accordingly, the social approach of costing was used in the study (ie opportunity cost).

[6] Dr Walsh, Economic consultant working in the Ministry of Finance and Economic Affairs.

Consequences are of two main types. The first is the immediate health effect of the intervention (ie child deaths and illnesses averted and reduction in school absenteeism due to malaria control). Child deaths and illnesses averted were chosen in accordance with the overall aim of NIBP, since earlier studies in The Gambia have shown that malaria adversely affects children most (Greenwood et al., 1987) and malaria control programme was also beneficial to children (Alonso et al., 1991). The second is any savings in resource use to the government and to the families as a result of NIBP. The other type of savings is in lost work time (ie carers, travel, treatment, funeral and mourning times). These indirect costs and savings are potentially of crucial importance to the study, because the target population (children under 10 years old) requires extra carers time during ill health. For instance, this carers time could have been channelled to productive economic activity during the malaria season which coincides with the rainy and farming seasons in The Gambia. However, in The Gambia, obtaining a value for lost work time is methodologically difficult. Yet, an attempt was made in three of the studies to be described later in this chapter to identify, measure and value the magnitude of lost work time resulting from NIBP implementation to child illness and death and its implications for the families and the community.

The third categories of Drummond, Stoddart and Torrance (1987) model of both costs (ie costs borne externally to the health sector, patients and their families) and consequences (ie changes in the quality of life of patients and their families (utility)) have been omitted from this study model. The reasons are first, for this type of costs, methods for identifying, measuring and valuing them remains underdeveloped and difficult due to other intervening variables (ie social, cultural, political and economic). Secondly, as Drummond, Stoddart and Torrance (1987) noted "for many health care programmes they may be insignificant". The third category of consequences (though a special case of CEA) falls outside the scope of the main concern of this study.

An important aspect of CEA is the comparison of alternative ways of achieving an objective. In the case of malaria control, as Mills (1989) observed, it is particularly complicated for two main reasons. Firstly, malaria control is usually conducted through a mix of strategies some of which are primarily preventive (vector control), some curative (various treatment regimes) and some both preventive and curative (case detection and treatment). The health consequences are thus heterogeneous: both cases prevented and cases cured. Secondly, because of the process of malaria transmission, one case cured or prevented may also prevent further cases. Hence, a dynamic view should ideally be taken of health consequences (Mills, 1989).

CEA investigates alternative ways of achieving an objective, and objectives and choices can be specified at different levels. In the case of malaria control, Mills (1992) identified 4 different levels involving objectives and choices of increasing specificity:

1) the objective of improving health (choice of malaria control versus other means of health improvement);

2) the objective of malaria control (choice of vector control versus case detection and treatment and various mixes of both);

3) the objectives of (i) vector control and (ii) case detection and treatment (choice of strategies for each);

4) the objective of delivering a pre-determined strategy (choice of means of blood slide examination, choices of different mixes of staff for various activities, choice of organizational pattern etc).

Mills (1992) observed that these levels are significant conceptually, practically and relevant to policy. If decision-makers want to choose between investing a given sum of money in malaria control rather than another health programme, then the objective is at the first level, that of improving health, and the measure of health consequence used must be one that is common to many different health programmes, for instance increasing years of healthy life.

The second level of objectives are more concerned with how to maintain malaria control and the measure of health consequence used must be relevant to comparisons between, for example case detection and treatment on the one hand and vector control on the other (Mills, 1989). At the third level, the objectives are stated separately, not requiring choice between them. For instance, if the objective is that of detecting and treating cases, the measure of health consequence used would be cases detected and treated. At the fourth level, the desirability of malaria control and of existing control strategies is taken for granted, and emphasis placed on discovering the least cost way of delivering the components of a control strategy, for instance introduction of impregnated bednets.

Assessing cost-effectiveness in terms of health impact is, however, extremely important. For instance, there is little point in minimizing the cost of an ineffective control strategy. Because at all the 4 levels of objective, misleading information and non-competitive alternatives will be presented for policy decision, thus, for this CEA, an attempt is made to produce information relevant to all four levels of objective. The choices to be evaluated are therefore:

Level 1: choice of malaria control versus other health programme;

Level 2: **choice of vector control versus case-detection and treatment as means of malaria control;**

Level 3: **choice of means of case-detection and treatment, (including case detection by active and passive methods and use of anti-malarial drugs);**
: choice of means of vector control, including different insecticides target doses;

Level 4: **choice of ways of organizing an activity, for instance at regional versus community levels, integrated versus unintegrated patterns of organization.**

Relevant information on all the 4 levels of objective will give a broad base of alternatives from which to make a choice. Although these choices are specified as alternatives to one another, a mixture of strategies are an important consideration (Mills, 1989). For instance, making a choice 'at the margin' (Mills, 1989) ie given an existing mix of strategies, where should additional resources be put and at which stage should it be introduced. This study will provide information for levels 1, 2 and 4, and also the second part of level 3 as the overall design of NIBP excluded the first part of level 3.

With the cost-effectiveness framework for this study discussed, the next step is to obtain cost-effectiveness ratios. This requires the collection of relevant data such as the cost of resources used in the implementation of NIBP (both government and community) and the appropriate effectiveness data (child deaths under 10 years averted) and the overall effect of impregnated-bednets on primary absenteeism. The methods used for data collection are described below.

4.6 Methods of data collection

This study used both qualitative and quantitative methods to collect the necessary data for the full accomplishment of the proposed objectives. The summary of the conceptual framework, research objectives and studies undertaken are given in Table 4.1.

An integrated research approach of using both qualitative and quantitative methods was adopted in this study for various reasons. As numerous proponents of social research (ie Jick, 1983; Stone and Campbell, 1984; Glik et al., 1987; Heggenhongen and Clements, 1987; Basch, 1989) have argued, integrating research methods for data collection in a single project has the advantage of strengthening any inherent weakness in any one technique when used on its own. It also enables the sharpening, verification, clarification and wider interpretation of the data which may result in a more complete understanding of the phenomenon under study. The qualitative approaches will allow for deeper understanding and knowledge of the socio-cultural life of the people being studied (Pearlin, 1992) and the quantitative studies will provide alternative quantified information on work, activities, pattern and time allocation to these activities, thus enabling wider interpretations, generalizations and conclusions to be drawn from the research findings.

The details of the methods used for data collection are discussed below.

4.6.1 Cost studies

Most of the cost data were collected between June to December, 1992 during the first year field work and in the second year, from July to December, 1993 (See Table 4.2). The NIBP implementation cost data collected for this study excludes all the cost of the NIBP evaluation projects (ie epidemiology, entomology and economic).

4.6.1.1 Study 1: NIBP resource inputs study

The reference period for data collection was 1991/92 financial year in NIBP implementation year. Information on costs incurred in the implementation of NIBP were obtained from several sources such as official records and reports. The sources included the office of the NIBP, administrative office of MRC The Gambia, UNICEF Gambia office, Ministry of Health & Social Welfare (Accounts Section, Community Health Unit, Directorate of Planning & Information, Regional Medical & Health Teams and Transport Unit), Ministry of Finance & Economic Affairs (Project Evaluation & Monitoring Unit), Gambia Public Transport Corporation, Radio Gambia, Film Production Unit and NGOs such as Action Aid of The Gambia (AATG), Save the Children Federation (SCF(US)). Others were the Department of Labour, Central Statistics Department (National Accounts Section), Central Bank of The Gambia and the Ministry of Agriculture (Department of Planning). There was no systematic and completely organised financial information system at any of these sources, thus information was collected from receipts, ledgers, pay vouchers, travel claim returns, log sheets, fuel ledgers (of both government and NGOs engaged in the programme), filed records, reports and from interviews and discussions held with officers in-charge of projects/programmes and units. Advice was sought from accountants and officers in-charge of financial units and NIBP related projects in situations where activities were joint in nature and the cost to NIBP was apportioned accordingly. For example field staff's time allocated to the various activities of NIBP.

Detailed descriptions of data collected for various recurrent and capital items were as follows:-

1) Recurrent costs of NIBP

a) Personnel

Two broad classes of health personnel were engaged in NIBP activities. These were non-governmental organizations (NGOs)-MRC, AATG and SCF(US) and the government health department, Ministry of Health & Social Welfare. The MRC staff were employed on a full-time basis for NIBP. The other staff worked on a part-time basis. These personnel include the NIBP Project manager and staff (Administrative assistant, secretary, fieldworkers and driver), project managers, supervisors and planners at the ministries and the NGOs offices. Others at the regional, district and village levels of MoH were hospital administrators, public health officers, community health nurses, transport officers and drivers.

All the personnel involved in NIBP activities were interviewed (n=64) to ascertain the time they allocated to the programme. The interviews were conducted with a structured questionnaire and covered only personnel from the various institutions mentioned-above primarily involved in NIBP Implementation activities. The questions covered a brief description of the officer's duties and responsibilities, personal involvement in NIBP activities, number of days and time allocated to each NIBP activity, post or grade, personal emolument and pattern of movement within working area when working on NIBP activities (see Study 1 questionnaire in Appendix 1). The value of their time was taken as a portion of the sum of their gross salary, allowances and employers' national insurance contribution and allocated to the NIBP activities accordingly. Transport and subsistence allowances paid where appropriate were also taken into account, for example, ferry charges paid for crossing River Gambia and overnight allowances.

b) Transportation

Vehicles used for NIBP implementation were cars, a truck and motorbikes. Where appropriate, distances covered by these vehicles were obtained from log sheets and ledger books. Otherwise, the pattern of movement for any of the NIBP activity was ascertained through interviewing the personnel concerned. Then, the distances (or paths) were then re-traced by the researcher and his team using a landrover and 5 motorbikes. The re-traced distances were recorded for each of the personnel concerned. Information on fuel consumption for the various vehicles were obtained from transport officers and verified with private vehicle workshops and garages. The total fuel consumption of each vehicle were estimated from the distances covered. Advice was sought on vehicle maintenance from MRC transport officer and mechanics, MoH Transport foreman, private mechanics and workshop owners in bigger towns where some of these government vehicles turn up for occasional maintenance.

The Director of Finance of Gambia Public Transport Corporation (GPTC) was also consulted on costing of transport in the public sector (ie how transport rates were estimated for their fleet of vehicles) and in the private sector from the MRC transport officer (ie how transport rates were also estimated for project vehicles).

c) Other cost data collected

Local weekly markets (*'lumos'*) in or around the 5 study areas were also visited and the market prices of items like bednets, plastic wares and washing soaps were obtained. This was to verify the cost of locally purchased items for the project.

2) Capital costs of NIBP

i) Vehicles

There were 4 main vehicles used for the implementation of NIBP. They were Landrover (Defender 110), Toyota (Hilux twin-cab) pick-ups, Renault (Commando G17) truck and Honda 110 motorbikes. With the exception of the Toyota pick-up, the Medical Research Council (MRC) Transport officer provided the landed costs (comprising of cost, insurance and freight (CIF) and 10% spare parts costs) of most of these items and were re-confirmed by the MRC Accountant. The cost of the Toyota pick-ups were obtained from the Ministry of Health & Social Welfare's Transport officer and the UNICEF officer in-charge of purchases. UNICEF donated the Honda 110 motorbikes to the ministry. In all cases, proof of purchases were provided by showing receipts or other documentary evidence of purchase. The UNICEF and the Ministry of Health & Social Welfare (MoH) officers provided the landed costs of their vehicles, whilst the MRC Transport officer and Accountant produced the receipts of the actual costs of the vehicles, insurance cover, registration and sales tax paid. This information was collected by the researcher. This method of double checking cost information was adopted to clarify and verify information obtained from the different sources.

The annualized cost was calculated in the local Gambian currency (Dalasis). Cost apportionment to NIBP (ie NIBP cost) was carried out on the basis of individual personnel's usage of the vehicle; in terms of period of usage or distance covered by the vehicle for any NIBP activity. This information was obtained from vehicle log sheets and books and by interviewing the various personnel involved in the programme. The 64 interviewees were made up of the Project manager, his Administrative assistant and secretary, MoH Malaria control officer, Senior Public Health Nurses/Officers (SPHNs/SPHOs), Health coordinator, Community Health Nurses (CHNs), Health

Inspectors, Community Development Officers and drivers. They were asked about their involvement in NIBP by activities, vehicle used, number of days used per activity, other non-NIBP activities undertaken (if any during working for NIBP, how regular log sheets and books were used). The interviews were carried out by the researcher mainly in English (official language in The Gambia).

ii) Buildings

Various types of office accommodation were used for NIBP activities throughout the country. The Medical Research Council provided 2 offices and a storeroom for the NIBP Project manager and his staff on the MRC Fajara premise. Other office space occupied by SPHNs/SPHOs for their daily activities were identified. Consultation and advice was obtained from the MRC Buildings officer for the shared cost of NIBP offices out of the block of offices. In the case of MoH and other staff office accommodation, the rental value of similar offices in the same locality was used due to the difficulty of obtaining any information on such building costs. However, since SPHNs/SPHOs spent the majority of their time in the office organising activities for the CHNs which had no direct bearing on NIBP per se, 5% of the rental value of the offices was therefore attributed to NIBP on the advice of the MRC Buildings officer and consultation with the SPHNs/SPHOs.

iii) Office equipment and furniture

The cost of office equipment and furniture where obtained from the MRC Administration, Fajara - Administrative officer, Purchasing officer, Head of the Computer section, Transport officer (also in charge of ordering general equipments from overseas) and the Accountant. Available receipts of purchased items and records of orders were examined. For items ordered from abroad, it was ascertained whether they were delivered by air or sea, since the government charges for these 2 routes differ. Other government charges such as handling and returnable buffer were all considered in the costing exercise.

The Hewlett-Packard Laserjet III postscript used by the NIBP Project manager was shared with the MRC Director, thus 50% of the cost was allocated to the NIBP office and apportioned according to NIBP activities.

The other items in this section were bought locally (or produced by the MRC Buildings and Maintenance unit) by the purchasing officer. The cost provided excludes transportation costs which is quite difficult to determine since transport allocated by MRC transport office for shopping or purchasing engages in numerous purchasing activities per trip. As such, transport cost solely attributable to NIBP purchases will be small and unreliable, and thus have not been considered. Again double checking of cost information was used for the same reasons given above.

iv) Other supplies

The following items further facilitated the operations of the NIBP Implementation field activities and storage of insecticide. The items were field bags, raincoats, map of The Gambia (Scale 1:125,000) and 2 door locks for the storeroom. They were procured locally. Receipts where available were inspected for prices from the MRC Administration and Accounts office, otherwise, the prices obtained were cross-checked on the local market.

v) Other cost data

a) Sensitization & Awareness campaign

Blank video and audio cassettes were procured by the Office of the NIBP to record programmes to facilitate the above-named campaign. For example a demonstration of the impregnation (dipping) process was video recorded for presentation to various sections of the community as appropriate. The cost of these items were obtained from receipts kept in the MRC Administration and Accounts office.

b) Impregnation (dipping) implements

The costs of the other minor implements used for the dipping of bednets by way of distributing the insecticide and measuring the appropriate quantities of insecticide per bednets were also obtained. The items were plastic wares (containers, bowls and cups), funnels, measuring cups and rubber gloves. With the exception of the rubber gloves, all the other items were purchased from the local market.

All capital costs such as vehicles, buildings, office equipment and furniture, other supplies and other capital items for NIBP activities were annualized and apportioned accordingly.

3) Community capital and recurrent costs

Compounds in the villages, provided their own 25 litre plastic bowls for preparing the insecticide dipping solution. The cost of these bowls were obtained from the '*lumos*'. It was observed that dippers after a day's impregnation wash the implements with soap and water. Quantities of water were also provided by compounds for dipping their nets. The amount of water used was very difficult to ascertain. A conservative estimate was made from discussions with dippers and women on washing of nets, estimates of the amount of water and soap used per household laundry, estimation of the number of items usually washed etc. The total amount of water used was estimated from the number of bednets dipped at the end of the Impregnation exercise. Water wastage rate of 13.88% was added on to allowed for washing up and rinsing bowls and hands, the same wastage rate estimated for the insecticide by NIBP Project manager.

Prior to dipping nets, all bednet owners were authorised to wash them, However, the amount of soap and water used for washing was impossible to ascertain, since most household laundry is done in bulk usually on Wednesdays (when the women do not go to their farms) and a bednet washed alone was likely to be an isolated case. Generally, observations have revealed that, washing of bednets were rather frequent. The amount of soap and water used for these washing were also estimated from the discussions held with dippers and women. The local authority water rate charge was obtained from the head office of the Management Services Gambia Limited.

4.6.1.2 Study 2: Dippers study

Trained dippers (see Chapter 3) from the study areas were interviewed to evaluate the average time per dipper for dipping bednets. All 179 dippers in the 53 study villages covered by the first year of NIBP were interviewed with a structured questionnaire (see Study 2 questionnaire in Appendix 1). The questionnaire was developed based on the Impregnation procedure and process, since the time taken for dipping was directly related to these activities. Questions covered their name, age, sex, village of dipping, wet season occupation, time taken on each day of participation in dipping, time taken off to do other things during dipping (if any) and dipping implements and items used.

The results of the interview was used to quantify the time of the dippers. The interviews were conducted immediately after the dipping has ended in the village to minimise recall lapse time. The dippers were made up of Traditional birth attendances (TBAs), Village health workers (VHWs), volunteers (men, women and students on holidays) in the various villages.

4.6.1.3 Study 3: Focus group discussions and in-depth interviews on socio-economic activities and childcare responsibilities in the household

The qualitative methods used were Focus Group Discussion and In-depth Interview of key informants. Focus group discussion is a group interviewing technique employed to obtain information on participants' beliefs and perceptions on a defined area of interest. The defined area of interest of this study was the social and domestic behaviour of women and health care behaviour in rural Gambia. In the rural Gambia, anecdotal evidence suggests that the health of children is strongly dependent on maternal care behaviour, since they are the primary child care providers. Hence, maternal or female perception of child care and ill health care practices are an important consideration for the study.

Focus group discussion was selected from other group interviewing techniques like mapping and modelling (ie use of local materials to represent view points and interests), seasonal calenders (ie construction of say seasonal patterns of illness) and time lines (ie recall local events and community history with dates) due to its suitability to the study which aims at understanding the social and domestic activities of women and ill-health care for children. Moreover, focus group discussion is a useful tool for gathering information on community knowledge, beliefs, attitudes, understanding and perception about health and health resources available and used. And more importantly to this study, who to address the question of family expenditure such as treatment, burial, funeral and mourning ceremonies and home management strategies of sick children (ill-health care). Focus group discussion also allows a thorough discussion of the subject of interest, which leads to open and spontaneous expression of views. It is less time consuming and economical (Khan and Manderson, 1992) and helps to establish working rapport among the study fieldworkers and the women (carers) and the society at large. Finally, it also enables the study to develop the vocabulary of local terms which was used to design the structured interview (eg matched fatal case-control (MFCC) questionnaires).

Nonetheless, focus group discussion research approach has its disadvantages, namely, 1) analysis of the transcribed discussions are time consuming and expensive; 2) the moderators skills usually determines the quality and quantity of data obtained and 3) the variations in data analysis, in other words, there is no standard approach for data analysis, but depends primarily on the researcher's interest (Khan and Manderson, 1992).

In-depth interview is another qualitative method which entails using direct conversation to obtain detailed information on cultural beliefs and practices from the perspective of the informant. A key informant is a person identified to be knowledgeable about a subject area of interest by the researcher's definition (eg funeral ceremonies in this case). In-depth interview of key informants became necessary when an aspect of the information (ie funeral ceremonies) being sought from the community was gender related. In the Gambian Muslim culture, bereavement and interment is the domain of men. The majority of women in the focus group discussions advised the research team to seek assistance on the subject from the elderly men. However, detailed knowledge of funeral ceremonies and their meanings, was limited among even men. Focus group discussion could not be used in this case because of the limited in-depth knowledge of the subject among most men due plausibly to changing societal norms and the introduction of formal education. Finally, it will be time consuming and expensive to assemble few and scattered key informants from the various villages in groups for the discussion.

Five fieldworkers of the study were trained on how to carry out focus group discussion and in-depth interview by briefing them on the nature of these two studies, the differences in approach and the roles they play in social research. The 2 senior fieldworkers in the team of the 5, were selected as moderators for the focus group discussion based on their field experience, fluency in the local languages, good listening and interviewing skills and finally, their long standing rapport with the study population. The moderators in particular were trained on how to manage group dynamics and interactions, how to control and manage aggressive and timid participants (eg by breaking eye contact, using names of participants during discussion, minimising gestures), directing discussion to always focus on subject and maintaining conformity within the group. All the fieldworkers were trained on taking notes of responses, observing and documenting any non-verbal messages and recording procedures (tape recording). The main subjects discussed were socio-cultural setting, domestic activities and child care practices, carer preference, home management strategies of sick children (ie treatment behaviours, carers and payment of treatment costs). The themes and questions under each of these subject were also discussed with emphasis placed on how to use probing questions to generate further discussion (see Study 3 questionnaire in Appendix 1).

The focus group discussion and in-depth interview research instruments were piloted for 4 days in the Farafenni township and 2 other surrounding study villages (ie Kerewan and Kerr Pateh) which had not been selected for this study. There were 5-6 women in each of the 4 discussion groups and 6 men were interviewed for the in-depth interview. Results obtained and other field observations (eg structure of questions, flow of questions, interviewing setting) were used to restructure and re-organised the main study in terms of identifying the right respondents for the various parts of the questionnaire, local terminology and the range and scope of questions.

Focus group discussion with women: Two groups of 5-8 women each were selected randomly from randomly selected 25 NIBP study villages[7]. The groups were;

Group 1: women between the ages of 21-49 years (ie women in the child bearing age) and

Group 2: women aged 50 years and over (ie elderly women).

This provided a total sample of 306 women (Group 1: n=155 and Group 2: n=151). These 2 groups were purposely selected because of their respective roles in women's activities in rural Gambia and their socio-cultural perceptions and attitudes towards domestic activities, child care practices and health behaviour. Women in the first group were more likely to be practically involved in child care and, in Group 2 were the alternative source of child care and more likely to be knowledgeable about health care practices in the villages. Prior to the discussion, participants were given general information about what was likely to be discussed, the estimated duration of the discussion and the confidentiality and use of the information collected. Participants were also informed about other members of their group and their consent were sought about participation and membership in the group. This was to improve cordiality within the group and enhance open and free discussion. Finally, group members selected the local language for the discussion, which then enabled the

[7] Randomly selected focus group study villages were Sibanor, Batabout Kantora, Bessi, Bwiam, Kamfenda, Marong Kunda, Darurilwan, Salikenni, Njawara, Bali Mandinka, Taifa, Sare Ngai, Galleh Manda, Kudang, Mamud Fana, Sutukonding, Yorobawol, Limbambulu Bambo, Limbambulu Yamado, Kerewane, Dingiri, Diabugu Alpha, Demba Kunda Kuta, Numuyel and Demba Kunda Koto.

researcher and the fieldworkers to schedule the discussions and select the appropriate moderator for each group.

The discussions were conducted by 2 teams of 2 and 3 fieldworkers each who could all speak fluently the 2 widely spoken languages in The Gambia (Mandinka and Wolof). Two of them could speak fluent Jola and Sarahuli. They all spoke and understood passable Fula. Discussions mostly took place in the compounds of either the Traditional Birth Attendant (TBA) *'Alikalo'* (traditional leader) or the MRC reporter, at the women's convenience since most of them were busy with farm work around the time of the study. The discussions with the 2 groups of women were held simultaneously and were recorded and transcribed after each section. Recorded interviews were re-played to the satisfaction of some of the women and also to further clarify and discuss overlooked points and issues. About a third of the recorded audio interviews were randomly selected for independent transcription for comparison with that of the fieldworkers. Similar interpretations were obtained. A sample of the transcribed focus group discussion is provided in Appendix 1.

In-depth interview of key informants: In-depth interview of key informants was used to collect in-depth and comprehensive knowledge on family structure, "evolution of bereavement", child bereavement, interment and decision making on expenditure in the compound. These were some of the main focus of the research. The study focused on men (ie elderly men 55 years and over). The interviews were conducted in the 5 NIBP study areas. In each of these areas, 5 study villages were selected at random, thus 25 villages[8] in all were involved the

[8] Randomly selected In-depth interview study villages were Somita, Bessi, Bajana, Ndemban, Bulock, Mandori, Darurilwan, Salikenni, Bali Hali Hawa, Bali Mandinka, Pacharr, Sarengai, Tabanani, Mamud Fana, Bati, Taba Wuli, Jah Kunda, Bantunding,

study. Key informants were identified in each village with the help and consent of the *'Alikalo'* and the Imam of the village. The criteria used for the selection of key informants were 1) the person should be knowledgeable about the history of the village, their cultural practices and norms; 2) the person should be willing to discuss freely the issues about bereavement, rites performed, its cultural significance and social implications and 3) the person should describe in-depth bereavement practices, funeral rites performed and its relationship with the teachings of Islam. There were a total of 25 male key informants.

Interviews took place on the compounds of key informants and at their convenience since most of them were busy on their farms during the study period. Interviews were recorded and later transcribed. Recorded interviews were re-played to the satisfaction of key informants and also to further clarify and discuss points and issues overlooked. Where appropriate and with the consent of the informant, a few of the interviews (n=5) were re-played for the *'Alikalos'* and the *'Imams'* (Islamic religious leader) to check on the information collected, clarify thorny issues and also to solicit their views and further information. A sample of a transcribed in-depth interview is provided in Appendix 1.

Results obtained from these qualitative studies were utilized in the quantitative studies particularly in designing the questionnaire for the MFCC and time-allocation studies. Consequently, this complementarity of methods offers a synergistic exchange, with each approach taking advantage of each other. In sum, focus group discussion and in-depth interview were used to gather information which could not be

Guntur Kuta, Kerewane, Dingiri, Perai, Kulari, Badari and Gillangel.

easily studied by quantitative methods. The two qualitative approaches were also used as a preliminary step in the development of the quantitative study.

4.6.1.4 Study 4: Matched fatal case-control (MFCC) study

The MFCC study was aimed at obtaining; 1) information on the direct costs (eg treatment costs) and the indirect costs (eg work time lost in seeking treatment and due to interment) borne by households and 2) direct and indirect cost savings to households (see section 4.5). In this study, the fatal cases and the controls provide estimates for the costs borne and saved by the households on treatment, preventive, funeral, burial and mourning activities.

This type of study design was chosen to minimise the confounding influences of extraneous variables such as selection bias, difference in mortality, time use variation etc in the observed differences in data, since the control group allows the measurement of the size of 1) the observed direct and indirect costs incurred by the fatal case and 2) direct and indirect costs saving (ie benefits) due to the intervention. The main disadvantage of this study design is the selection of the appropriate control in an 'unplanned[9]' community.

The design of the study was partly determined by the mortality surveillance system of the NIBP Epidemiology team (ie it provided the fatal cases - child deaths in the study areas). Reported deaths of children under 10 years were obtained from all the 5 study areas. A fatal case's control child, was a child matched by age and sex, randomly selected in the same village using the modified EPI sampling scheme (Bennet et al.,

[9]Compounds (houses) are randomly located and they vary in size.

1991). Controls were selected by the 'pen-spinning' approach. The fieldworker stood at the entrance of the compound of the fatal case and spun the pen. In the compound of the direction of the head of the pen, a control child was selected of the same sex and about the same age of the fatal case (ie 6 months younger or older). However, if the pens' head pointed to no compound, the process was repeated. But if the selected compound had no child of the required specification, the fieldworker walked out of that compound and turned to the next compound on his left in that order until a control was found. This approach helped to achieve random or near random selection of controls. It is also easy, clear and unambiguous (Bennet et al., 1991). More importantly the 'pen-spinning' approach is appropriate to the rural conditions with sporadic buildings of compounds and thus do not offer the fieldworker the opportunity to be subjective in choosing controls. The interviews were conducted 10 days or more after the death of the child, at which time all funeral rites for the child would have been performed (usually 7 days after death in children). This time frame also enables parents, carers and family members give a better account (recall) of the events prior to and after a child's death. The whole study was time sensitive due to the information being sought (ie as the number of days after death increases, the less likely events after death are recalled especially disbursement of family resources eg money). Hence, deaths were followed as they occurred and were reported by the NIBP epidemiology team rather than taking a sample of the dead children some time after all the mortality data have been collection.

Structured questionnaires were used for data collection. The questionnaires for the study was partly adapted from a previous study (Picard et al., 1993) and first developed at the London School of Hygiene and Tropical Medicine. There were 2 questionnaires - one for the fatal case and another for the controls. The fatal case questionnaire of Picard and his colleagues was made up of 5 main sections - Characteristics of the child, Characteristics of parent, Carers time, Treatment sought and Funeral ceremonies. The control questionnaire had 4 sections of the same questions but without a section on Funeral ceremonies since the controls were living children. These questionnaires could not be used directly without any modifications, because 1) it was not detailed enough (eg funeral costs) and 2) it was designed to be administered to the deceased carer alone, who might not necessary be the right person to provide the information required by the study.

The original modified study questionnaire for the fatal case comprised of 8 sections, namely, 1) Characteristics of the child - identification number, name, age, sex, total number of children under 5 years in the compound and bednet usage; 2) Characteristics of the dead child's mother or carer - name, age, main occupation, occupation in the wet season, if farmer, crops planted, level of education; 3) Illness behaviour - when the child's illness started, duration of illness, cost of special food prepared for the sick child (if any), time taken to prepare special food (if any), cost of traditional treatment (if any) and time taken to prepare and administer the medicine (if any); 4) Treatment sought - various treatment sources sought prior to the child's death, their costs and time taken; 5) Carers time - carer's time taken due to the child's ill health; 6) Funeral cost - the cost of the child's burial and funeral ceremonies performed, the work time lost by adults family members due to the child's death, other household cash income lost due to child's death, the families cash income and the compounds last year's farm produce, 7) Housing conditions - the state of the child's sleeping room, types and condition of the windows and doors and 8) Other malaria control measures used - cost of mosquito coils etc. The questionnaire was 18 pages of standard A4 paper. The control's questionnaire was also made up of 7 sections with the same questions as that of the fatal case, with the exception of the section on Funeral costs, since the controls were living children. This was also 15 pages of standard A4 paper. The respondents of the questionnaires were the mothers or carers of the deceased or control child with the exception of the funeral cost in the fatal case questionnaire. This part was administered to father or a male family member for information on child's funeral ceremonies expenses and other expenditure incurred by the families, since family cash income, major expenditure and compound produces are managed by men in rural Gambia. The choice of different respondents for different parts of the questionnaire was determined by the outcome of the focus group discussions and in-depth interviews undertaken earlier on as part of this research. The questionnaire was therefore sectioned to give clarity to the respondents, the different information being sought and the fieldworker as well.

Fieldworkers received 2 days discussion and training on the questionnaires. This entailed how to ask the questions (ie the flow of questions), recording of responses and cross-checking some of the information obtained where appropriate (eg using Child Health cards to verify age of children, inspecting receipts of farm produce sales to government cooperatives) and selecting of controls. The questionnaires was piloted in all the 5 NIBP study areas by the researcher and the fieldworkers.

The piloting was aimed at testing the questionnaire's ability to elicit information in terms of the easy of wording, comprehension, length of the questionnaire and structure of the questionnaire. Deaths in June and July, 1992 were used to pilot the questionnaires. Given the time constraint and low child mortality generally in the months of June and July, 15 cases (3 per study area) were purposely selected to test the questionnaires and give the fieldworkers a feel of the questionnaire and the demands of fieldwork. Fifteen questionnaires were piloted. However, there were 3 refusals mid-way through the interviews who complained about the length of the questionnaire and one respondent refused to participant in the study. The results of the piloted indicated that the questionnaire was lengthy. It was also awkward and inconvenient to both the interviewee and the fieldworker to have questions for 2 different respondents in the same questionnaire.

The result of the piloting was that the questionnaire was divided into 2 sub-questionnaires - Part 1 and Part 2 for the fatal case. The questionnaire was further revised to take account of the emerging issues gathered from the pilot (eg too many filtering and cross-checking questions, repetitions etc). Thus, important questions that have direct bearing on the subject of interest were considered. For example, the section on Carers time was eliminated, since mothers/carers found such recalls of events (eg what exactly the child was doing and who the carer was on these days) complicated and difficult. Thus, another qualitative method (ie random spot observation (RSO) discussed in section 4.6.1.6) was used to obtain this information. The section on housing was also removed since it did not provide any information which met any of the objectives of the study. Similar revisions were effected in the questionnaire for the controls.

The final fatal case questionnaire was made up of Parts 1 and 2 to cater for the 2 different respondents. Thus, Part 1 of the fatal case questionnaire had 4 sections, namely, 1) Characteristics of the child; 2) Characteristics of the dead child's mother or carer; 3) Illness behaviour and 4) Treatment sought. Part 2 comprised of 4 sections - 1) Characteristics of the child (obtained from Part 1); 2) Funeral ceremonies and 3)

Other malaria control measures (see Study 4 Fatal case questionnaires Part 1 and 2 in Appendix 1). There was a single questionnaire for the controls made up 5 sections - 1) Characteristics of the child; 2) Characteristics of the control child's mother or carer; 3) Illness behaviour; 4) Treatment sought and 5) Other malaria control measures (see Study 4 Control questionnaire in Appendix 1). The fieldworkers were provided with a brief field notes to guide them in the selection of control children (see Appendix 1).

The MFCC study commenced on 1st September, 1992 to mid-January, 1993, however, only deaths up to 31st December, 1992 were considered, because the malaria season falls within these months. The questionnaires were administered by the 5 study fieldworkers fluent in English and Wolof and Mandinka, the 3 most widely spoken languages in The Gambia.

4.6.1.5 Study 5: Hospital treatment cost study (1 & 2)

The aim of this study was to calculate the government resource consequences of the NIBP intervention. The cost data collection covered both capital and recurrent items pertaining to the study aim in order to estimate the resource cost and savings in hospital malaria treatment in children. The government treatment cost and savings with and without the NIBP intervention were estimated from this study. The study was undertaken in the only hospital (Bansang hospital) in the study area, since some of the study children received treatment from this hospital. The duration of the study was 2 weeks in November, 1992 and 1 week in November, 1993.

The procedure for treatment was ascertained from a senior nurse in-charge of the out-patient department (OPD). Children receiving treatment especially those suspected of have contracting malaria, were pointed out to the researcher by the nursing officer on duty at the OPD. These children were followed by the researcher or a fieldworker until they had received the final treatment or were referred to the in-patient (paediatrics) ward. Referrals could not be followed beyond the point of referral due to the hospital's bureaucratic procedure (ie visitors required permits for visiting in-patient wards out of visiting hours and permits were generally difficult to obtain). Observations were made for 5 continuous days in the OPD, X-ray room, laboratory and dispensary to ascertain the pattern of work and personnel time allocation by activities. The times spent on each patient by health personnel at each unit were noted.

Furthermore, officers in-charge (n=18) of each activity in the various departments of the hospital were interviewed about their time apportionment per patient, inputs used, post, grade, salary and allowances received and other related activities performed. These were the hospital administrator, doctors of the out-patient and paediatrics departments, pharmacist, dispensary assistants, hospital clerks, nurses, laboratory technician, X-ray technician, chief cook, laundry assistants, security personnel (ie police) etc. Visits were paid by the researcher and a fieldworker to each of the hospital departments - the administration office, paediatric ward, records office, laboratory, X-ray unit, dispensary, out-patient unit, kitchen and laundry area to obtain a rough picture of the hospital lay out and/or the number rooms and space used by the departments for costing.

Financial information on buildings, various hospital items, equipment, personal emoluments etc were obtained from pay vouchers, records, receipts and reports of the hospital, the Ministry of Health & Social Welfare (Accounts Section and Directorate of Planning & Information) and the Ministry of Finance & Economic Affairs (Project Evaluation & Monitoring Unit).

During the second year of this study, the revamped Records Office of Bansang Hospital were visited in October 1993 for statistics on out-patient and in-patient attendance. An unpublished bi-annual report on the hospital activities was obtained from the officer in-charge but without out-patient statistics. Out-patient statistics for 1992 were still not properly organised by the Records office due pressure of other work and priority given to in-patient department. Thus an approximate estimate of out-patient attendance was obtained by counting out-patient prescription slips. The available prescription slips (for medication) in the dispensary from August to October, 1993 were counted by the researcher and a fieldworker. Twenty-one days per month were selected randomly and the prescription slips of the selected days in the month were counted. The study covered 8 working days.

4.6.1.6 Study 6: Household time allocation study

The time-allocation study was used to investigate the use of time by a specific group of women in the rural Gambia. These were women with children under 10 years of age. The rationale for studying the use of time by these women were twofold: economically, time is an important productive input of limited quantity (Paolisso et al., 1991) especially when the time of the study coincides with the productive and malaria seasons in the rural Gambia. Secondly, time also dictates the socio-cultural behaviour of the people and vice versa. These various patterns of time allocation form comparable quantitative profiles of activity (Paolisso et al., 1991).

The method of data collection chosen for this time use study was random spot observation (RSO) as opposed to other popular anthropological approaches such as recall and continuous observation methods. Recall and continuous observation methods are time consuming and difficult to sustain for a long period of time (Khan and Manderson, 1992) and it also requires skilled personnel as well. Moreover, personal field experience in The Gambia has shown that recall by respondents of specific daily activities is difficult and the responses obtained have questionable reliability. For instance, for carers to recall child care which culturally, by and large, is a joint activity and goes unnoticed will provide highly unreliable information. Anecdotal evidence also suggest that continuous observation in this case can be both disruptive of normal household behaviour and also considered socially inappropriate after a period of time by some members of the study population (eg husbands). RSO is easy to implement, more flexible, reduces the intrusive effect of the observer to a minimum, powerful and scientifically objective (Johnson, 1975; Gross, 1984 and Paolisso et al., 1991). It also generates a large number of observations that can provide a quantitative (statistical) profile of the lifestyle of the study population from which health relevant behaviour can be detected.

RSO entails scheduling of observation periods randomly, thus obtaining data of higher representativeness. More importantly, the duration of observation is short. In RSO, the fieldworker makes an 'on the spot' observation of behaviour and records that behaviour as the activity being performed. Once the activity has been noted, the observation period ends, and the fieldworker proceeds to the next observation location. No attempt is made to record the duration of activity at the data collection stage. Thus, large number of observations are made liable to both statistical and ethnographic interpretation (Paolisso et al., 1991). The time spent per activity is an estimate of the proportional frequency of the activity expressed in some time unit. The activity can be converted to a time estimate by multiplying this proportion by the length of sampling day, for example, if the observation times are 06.00 hours to 19.00 hours in a day, then the length of the sampling day is 14 hours. The general relation for estimating the amount of time spent (T) in an activity is;

T = Length of day x (Observation of specific activity/Total observations)

The disadvantages of RSO are that; 1) on a large scale and for longer periods, it is expensive to run due to the large logistical support it requires for continuous operation and 2) in principle, reported activity of an absent subject later, is not a proper observation since the recollected activity might be inaccurate.

The RSO approach to study time use by rural Gambian women was targeted to the research needs of the study. The rationale of the study was to determine the time use of carers vis-a-vis domestic chores and other responsibilities. The target individuals were women and their children under 10 years of age. The study was biased in favour of these 2 groups because children under 10 years invariably require more care and are prone to childhood diseases, especially during the malaria transmission period when intensive farming is also undertaken in the rural Gambia.

Five villages (Bwiam, Njawara, Jahally, Sutukonding and Sanunding), one in each study area of the NIBP, were purposely selected for the survey. Six compounds in each of the villages were randomly selected from the study area census. Women with children under 5 years of age from these selected compounds were recruited, at least one from each compound. Fifty women were obtained, 10 from each village. The observations were conducted for four months from 1st August to 30th November, 1993. The selection of the number of villages, compounds and study subjects were all restricted by the logistical support, the duration of the study and the workload of the fieldworkers. The observation (visit) day and time were both randomly selected using EPI INFO computer programme. Visits were made on all the 7 days of the week and the time ranges from 05.00 to 20.00 hours. One visit per woman on a selected day was made. Visits were unannounced, consequently minimising any discrepancy in normal behaviour in response to an anticipated visit by the fieldworker (Paolisso et al., 1991). In other to make efficient use of fieldworkers' time, variation in weather conditions and unpredictable factors such as the occasional breakdown of motorbikes, 3 of the selected villages were the resident villages of 3 of the fieldworkers and 2 were the nearest study villages from the other 2 fieldworkers' residents. No fixed pattern for visiting compounds were established, but visits were rotated among the subjects during observations.

A semi-structured form for recording the activities of each woman was used (see Study 6 questionnaire in Appendix 1). The form was partly completed before the observation day and time with routine information such as study area, village, compound number, visit number, mother's name, child(ren) name(s) and observation date. During the observation, the fieldworker filled in the other vital information of time and description of (observed or reported) activity. The observed behaviour/activities were coded (daily) later using standard codes (see Random Spot Observation codes in Appendix 1) after the end of all the daily observations. The standard codes were compiled from the results of the focus group discussion with women on household chores and working activities and other field observations made by researcher.

The coding manual for RSO was made up of 2 broad categories: mother and children. The mother's activities were divided in 3 parts. The first category indicates whether the activity was observed or reported by a member of the compound in the absence of the women under study. The second category were the women's general activities established by the researcher through other studies, focus group discussion and field experience. Finally, the last category dealt with the specific activity code for each general activity identified. The specific activity code were constantly updated as new activities were observed and confirmed by the researcher's field visits. The children category was used to check whether the woman under observation's child(ren) stays in the same compound and also the type of carers and who normally undertakes child care.

The researcher visited the 5 fieldworkers fortnightly and on such visits accompanied them on their RSO visits.

4.6.2 Consequence studies

4.6.2.1 Health effects - Estimation of child deaths averted by NIBP intervention

The required study to provide the parameters (ie age-specific mortality rates and population) for the estimation of the deaths averted falls outside the scope of the economic evaluation component of NIBP. It was undertaken by the NIBP Epidemiology team in their mortality surveillance study (see Chapter 3, section 3.5.1). They provided the estimated age-specific mortality rates and their respective population sizes for 1992 (the intervention year) to the researcher.

4.6.2.2 Study 1: Other effects - Primary school attendance study

Two study areas were purposely selected from the 5 NIBP study areas due to logistical support for the study (with the help of the epidemiology team of the NIBP). The study areas were areas 2 and 3. The selection of the 2 study areas were based on the assessment of the NIBP Epidemiology team to be 2 contrasting areas in malaria transmission. Secondly, in terms of accessibility, they were closer to the MRC Farafenni field station, the base of the NIBP evaluation team and therefore allowed easy cross-checking of data between the schools and the research team. A complete enumeration of all primary schools (ie pupils' vital statistics, classes etc) and place of residence were collected at the end of the 1990/91 academic year (June, 1991). Eight schools were selected out of the 29 primary schools in the 2 study areas based on the highest proportion of the pupils residing in the villages of the school, logistical support and the workload of fieldworkers. Two resident-school villages in each study area were earmarked for impregnation of bednets during the first year of NIBP. Thus, 1071 pupils were recruited from 4 schools in Study Area 2 and 1111 from 4 schools in Study Area 3. The total number of pupils for the study was 2182.

Three questionnaires were designed for routine data collection based on information acquired through discussions with some primary school head teachers and teachers in the Farafenni township. The questionnaires were; a) Class Register form used to extract the relevant information from the school's main daily register; b) List of Absentees form for recording daily absenteeism in the week by classes, absent days and their reasons for being absent and c) Weekly Dispensary record form for extracting information from the school dispensary books where they are available on pupils complaints, day(s) reported sick and dispenser's remarks given for treatment. This helped to ascertain the type of illness an absent pupil might have reported at the school to receive free medical care at the nearest health centre (see School Attendance and Dispensary Record forms in Appendix 1). These forms complemented one another and helped to cross-check and validate absenteeism and reasons for absenteeism. All the questionnaires were completed by the class teacher daily and collected the following week by fieldworkers.

One academic year's data was collected prior to the impregnation in all the selected schools. With the impregnation of half of the resident-school villages, a follow-up survey was carried out in the first term of the 1992/93 academic year, which incidentally coincided with the malaria season in The Gambia. The survey continued as in the previous year. This time, however, 2 schools in each of the 2 study areas, were in villages where impregnation had taken place. The study continued to the end of the first term (December, 1992).

4.6.2.3 Other related studies

There are 2 studies already described in this chapter which will also provide the necessary information required to estimate the resource savings due to NIBP intervention. First, the Hospital treatment cost study (Section 4.6.1.5) will provide part of the information needed to calculate the government resources saved in the treatment of cases. Second the MFCC study (Section 4.6.1.4) will be used to calculate the resource savings by the patients and their families.

4.7 Organisation of study fieldwork and supervision

The field work for the study was conducted in two phases, pre-determined by the malaria season in The Gambia. The first year field work was from June to December, 1992 and the second year one from July to December, 1993. The total field work period was 13 months as shown in Table 4.3.

The first year's work comprised of development and piloting of research tools, training of the fieldworkers and the collection of majority of the research data. The second phase of field work in 1993, was mainly supplementary studies to the first year studies.

Five fieldworkers were recruited for the study by the MRC Administration. They were initially briefed about the study and trained for a week in MRC field station in Farafenni by the researcher. They were then assigned each to one of the 5 NIBP study areas depending on their fluency in the local language spoken in the area. They took residence in one of the study villages in the NIBP study areas during the study period. The fieldworkers were provided with a motorbike to enable them visit the other study villages at all times.

The fieldworkers worked seven days in a week depending on the work load and at the convenience of the subjects. They received instructions from the researcher on what was required of the study in question. The researcher visited each fieldworker weekly in the field at each point of the data collection to ensure that instructions were understood and followed by editing and checking some of the already completed questionnaire. Some of the field problems (eg broken down motorbike, shortage of questionnaires and fuel, dry cell for torches, payment of night allowances and ferry-crossing fares etc) were addressed during the visit.

Data verification was done by the researcher and an interpreter (ie the project driver, who is as educated and fluent in some of the local language as the fieldworkers) by re-interviewing about 5% of the completed questionnaire (ie dippers, MFCC study, RSO and bednet usage study[10]). Other methods used for cross-checking on the information on completed questionnaires and forms were causal conversations and unstructured interviews with respondents and key

[10] NIBP project study.

informants. This form of checking proved useful because each fieldworker was forced to be as accurate as possible since they had no way of knowing which of their questionnaires would be checked.

The researcher made further personal recall checks on reported refusals and unsuccessful contacts. For instance, in the MFCC study, the researcher visited all reported refusals (ie 4) and expressed the MRC's, as well as personal, condolence to the bereaved families with the view of convincing families to agree on re-interviews. This opportunity was also used to check the interviewing approach of the fieldworker and whether they had actually called on the person for the interview.

4.8 Field problems encountered

About 2 weeks after the commencement of the MFCC study, the MRC Bednet Working Group member changed the target population of the study from under 5 years old to under 10 years. This was based on some members opinion on the effect of malaria in this broad age group. This inevitably increased the work load for the research team in terms of following more deaths and restructuring and producing new questionnaires to cater for this age group.

The fieldworkers of the NIBP Epidemiology team in study areas 4 and 5 (ie Upper River Division of The Gambia) failed to report a substantial number of deaths among children under 10 years (22%). This was due to slack supervision on the part of one of the field supervisors. The field supervisor failed to inspect and cross-check the vital statistics reported by the NIBP epidemiology fieldworkers with that of the Village reporters and the bereaved families. This resulted in late reporting of child deaths by the NIBP Epidemiology team for interviewing. This affected the MFCC study, resulting in 68% (134) coverage of the MFCC study during the study period. This under-reporting of deaths was only detected during the re-enumeration in the 5 NIBP study areas in March, 1993 when the MFCC had long ended. As one is aware, the MFCC study was time sensitive, thus household cost information to be obtained from parents, carers and family members 2-5 months after the death of the child was likely to be inaccurate, since the objective of the MFCC study was to carry out interviews, 10 days after a child's death with upper limit being 3 weeks after death. The other reason was that it would have been unethical after such an elapse period to refer families to an event they want to quickly forget about. No information was obtained from such late reported deaths. Information was also lost on bereaved families that moved away from the study area (ie 3%) and 5% of the cases where, the carers were continuously absent (or on holidays) any time the fieldworker called for the interview during the study period.

There were few refusals (n=4) during the MFCC study. Reasons for refusing the interviews were twofold; refusal of respondents to participate in the study. The other was that the fieldworkers in some cases were mistaken for Local Government officers (ie tax officers) enquiring about family expenditure (ie transport, treatment, funeral and mourning, family produces etc) for the family's onward taxation. In all cases, attempts were made by the researcher to re-assure the subjects about the importance and confidentiality of the study to MRC in order to offset any 'snow ball' effect that such interviewee behaviour and people's perception of the fieldworkers might have on the whole NIBP evaluation studies.

4.9 Data processing and management

Data obtained from the NIBP resource inputs study and the cost of hospital treatment study were recorded in separate note books as the required information was obtained from administrative, accounts records, financial reports and files and interviews with various individuals involved in NIBP activities were being undertaken. Forms were used where appropriate, however, the information obtained were later transferred into their respective data note books.

The focus group discussions and in-depth interviews were audio recorded. The audio recordings were transcribed at the earliest opportunity after the interviews. The transcription was done with the help of interviewing notes by the two moderators (ie the senior fieldworkers). Interviews were transcribed on forms according to the questionnaire format that were used for the interviews. Independent transcription was also obtained from a local language instructor on randomly selected interviews for comparison. Approximately 30% (17) of the interviews were transcribed again to verify the translations obtained from the fieldworkers. Similar interpretations were obtained. The thematic approach was used to analyze the qualitative data. This entails noting down interested emerging themes under each subject interest discussed, how frequently they were expressed in all the sessions and how participants tended to agree or disagree about the themes and reasons given. However, this does not imply quantification of the discussion but rather the extent of knowledge and views about the subject matter. A clear understanding of some of the local terms relating to health, illness, child care practices and the impact of child death on families (ie funeral and mourning ceremonies) was obtained.

The data collection of the dippers study, MFCC study and time-allocation study were undertaken by 5 fieldworkers based in the 5 NIBP study areas. Completed questionnaires were collected weekly during the researcher's visit. The researcher manually checked each questionnaire as when submitted. Consistency errors as well as completeness of the questionnaires were checked. Corrections that could be handled by the researcher were made (eg age and sex). Coding of open-ended questions were also completed at this stage of editing.

Data from of the primary school attendance study was collected by the class teachers. The forms were collected and edited by the researcher and Data entry clerk weekly during the school academic session. Long absenteeism were followed up by the 2 senior fieldworkers to ascertain their reason for being absent. These fieldworkers resided in the study areas of the schools.

Edited questionnaires were computerised. All the questionnaires were double entered at the MRC field station in Farafenni by two independent people - a data entry clerk and the researcher using the Epi Info Version 5 programme (a public domain software programme developed by WHO Geneva and Centres for Disease Control, Atlanta, Georgia). The double entry helped in checking data entry errors. The data was cleaned by the researcher with the help of the computer centre manager using the computer editing specifications for consistency and range errors in preparation for analysis.

4.10 Analysis of data

Initial statistical analyses used Epi Info Version 5.01 (Public Domain Software for Epidemiology & Disease Surveillance, Center for Disease Control, Atlanta, Georgia, USA) programme to produce descriptive statistics (ie frequency distribution, percentages, proportions, means, standard deviation, cross-tabulations etc) of the variable being investigated. Cost analysis was undertaken using the standard cost analysis procedures of Drummond et al., (1987). Annualization of capital cost was based on the estimated useful life of the capital items and a discount rate of 6% per annum. Cost tables of NIBP items were obtained by using the Quattro Pro Version 4.0 spreadsheet and Wordperfect 5.1

computer packages. Further statistical analyses were performed where appropriate using the Epi Info package. The confidence limit selected for all the estimates was at 95% level. The other computer software packages used were Textbase Alpha (Institute of Psychology, University of Aarhus, DK) for qualitative analyses and Harvard Graphics 3 for drawing graphs.

The findings of the study are presented in the next chapter.

Table 4.2 Relationship between conceptual framework, study objectives and studies undertaken

Costs	**Study objectives**	**Studies undertaken**	**Information obtained**
Category I: (ie NIBP implementation costs)	Objective 1	NIBP resource inputs study	Capital & recurrent costs on NIBP implementation
Category II: (ie Costs borne by households)	Objectives 1 & 3	a) Dippers study	Work time of dippers
		b) Focus group discussion & In-depth interview	a) 'Evolution' of bereavement in children; b) Identifying respondents for various sections of questionnaires; c) Wording & designing of fatal case-control questionnaire and d) Substantive socio-cultural information
		b) MFCC study	Household costs: - **Direct costs** (ie transport, treatment, food, preventive, funeral, burial & mourning) - **Indirect costs** (ie work times lost due to travelling to seek treatment, food preparation, funeral, burial & mourning activities)
		d) Hospital treatment cost study	Hospital treatment costs: - **Direct costs** (ie treatment)
		e) Household time allocation study using random spot observation	Carer's time (**Indirect cost**)

Table 4.2 (continued)

Consequences	Study objectives	Studies undertaken	Information obtained
Category I:			
Health effects (ie child deaths averted)	Objective 2	a) Mortality surveillance study undertaken by the Epidemiology team of NIBP[1]	Age specific mortality rates & population size
Other effects	Objective 4	b) Primary school attendance study	School absenteeism due to; i) ill-health & ii) Other reasons
Category II (a):			
(ie Resources saved by treatment)	Objective 3	a) MFCC study	Savings in household treatment & preventive expenditure (**Direct costs**)
		b) Hospital treatment cost study	Savings in hospital treatment costs (**Direct costs**)
Category II (b):			
(ie Work time saved by households)	Objective 3	a) MFCC study	Work time saved by households in seeking treatment for sick children (**Indirect costs**)
		c) Household time allocation study using random spot observation	Carer's time saved (**indirect cost**)

1 Study not undertaken by this PhD research but by the NIBP Epidemiology team.

Table 4.3 Schedule of field work activities

Activity	First year field work (1992)							1993	
	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.
Researcher visits NIBP study areas	xxx								
Assignment of fieldworkers to the NIBP study areas	x								
Training of fieldworkers at MRC field station Farafenni	x								
Dippers study	xx	xx							
NIBP resource inputs study		x	x	x	x				
Piloting of Focus group discussion and In-depth interview questions and sessions	x								
Focus group discussions and In-depth interviews	x	xxxx							
Piloting of MFCC questionnaire			x						
Field visit by second Supervisor		x	x						
Re-designing of MFCC questionnaire			xx						
Piloting of re-designed MFCC questionnaire			x						
MFCC study				xxx	xxxx	xxxx	xxxx	xxxx	
Field visit by main Supervisor					xx				
Hospital treatment cost study (Part 1)						xx			
Data entry and cleaning		xxxx		x	xxxx	xxxx	xxxx	xxxx	xxxx

Key to table: (X) represents time of activity

Table 4.2 (continued)

Activity	Second year field work (1993)						1994
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.
Selection of study villages for Time-allocation study of women using random spot observation	xx						
Piloting of random spot observation forms	x						
Random spot observation study		xxxx	xxxx	xxxx	xxxx		
Field visit by main Supervisor				xx			
Data entry and cleaning		xx	xxxx	xxxx	xxxx	xx	
Bednet usage study[1]			xxxx	xxxx	xxxx		
Hospital treatment cost study (Part 2)					x	x	
NIBP resource inputs study					x		x
Tidying of field activities					xxxx	xxxx	xx

1 NIBP project study.

Key to table: (X) represents time of activity

Chapter 5: THE IMPLEMENTATION COSTS AND EFFECTS OF NIBP INTERVENTION

5.1 Introduction

The results of this study have been divided into three chapters (5-7) for purposes of clarity and subject areas. Chapter 5 looks at the cost of the control programme (ie NIBP implementation cost) to both the providers[11] and community, as well as its consequences (health effects) in terms of cases and deaths averted and other effects. Chapter 6 addresses the issue of the resource use consequences of the control programme (NIBP) as they relate to government resources, in terms of treatment cost and savings made with and without the programme. Furthermore, the programme's effect on household expenditure (ie treatment costs and savings, burial, funeral and mourning (*'charity'*) cost and work time lost and saved) are also covered in this chapter. The last chapter, Chapter 7, pulls all the information together and provides various cost-effectiveness estimates for the NIBP (ie implementation cost-effectiveness and net cost-effectiveness ratios) as well as the net savings in both government and household resources. Finally, Chapter 7 covers the sensitivity analysis of key assumptions made in the production of the cost-effectiveness ratios.

Chapter 5 is divided into 2 sections. The first section describes the NIBP implementation cost (direct and indirect) to the providers and the community. The second section describes the effectiveness of NIBP and the estimation of NIBP health effects.

5.2 NIBP Implementation cost

The implementation costs considered in this analysis were financial costs to the NIBP (ie organising and operating costs

[11]Gambia Government and other NGOs.

within the programme). The main activities costed were the Sensitization and Awareness campaign and the Impregnation exercise. Data analyzed were obtained from 2 studies discussed in Chapter 4, namely, the NIBP resource inputs study and the Dippers study. Summarised tables and graphs of the results are provided and commented on where appropriate.

5.2.1 NIBP Implementation cost borne by providers

The annual general providers recurrent cost of NIBP was comprised of personnel from non-governmental organization (NGOs) - the Medical Research Council (MRC), Action Aid of The Gambia (AATG) and Save the Children Federation (SCF-US) and the government, Ministry of Health and Social Welfare (MoH), other office supplies and services, insecticide (permethrin), impregnation supplies and services and transport running cost. The total personnel cost to the 2 NIBP activities and of goods and services were calculated by apportionment using the relevant personnel's time allocation to these activities. The summary of results are presented in Table 5a in Appendix 2.

Table 5a (Appendix 2) shows the summary of the annual providers recurrent cost of NIBP personnel and other supplies and services cost. This personnel cost separation was due to the differential in salaries between the 2 groups of personnel (ie MoH and NGOs). The NGO personnel cost constituted 61% of the general providers recurrent cost followed by the MoH personnel, 25% and other office supplies and services cost was 13%. Of the other office supplies and services cost, telephone services alone accounted for half the cost. The remaining cost was made up of letter heads (2%), utilities (2%), general office supplies and services (1%) and the other items were less than 1% of the cost.

There were additional recurrent costs incurred by NIBP solely for the bednet impregnation exercise. These costs are presented in Table 5b and grouped into supplies and services and transportation. The Impregnation supplies and services accounted for 91% of the cost, of which insecticide cost alone was almost 90%. The amount of insecticide used in the programme was calculated from the impregnated bednet coverage plus an wastage rate of 13.88% (estimated by the project manager). The cost of the insecticide was obtained by averaging the landed costs per drum (20 litres) from the 4 sources of purchase (MRC, MoH, AATG and UNICEF). Transportation cost for the bednet survey and impregnation exercise also took 6% of the cost and transportation cost of insecticide distribution 2%.

The total annual providers recurrent cost was D602,064.40 (presented in Table 5.1). Insecticide accounted for 74% of the providers recurrent cost, followed by personnel (15%), running transport (7%) and other supplies and services (4%).

Table 5c (see Appendix 2) gives the annual general providers capital cost of NIBP, 1992 which has been broken down into vehicles, buildings, office equipment and furniture and other supplies. The table shows that vehicles took up majority of the cost, about 81%, followed by office equipment and furniture in the NIBP secretariat (14%), buildings (5%) and other supplies less than 1%. Table 5d (see Appendix 2) shows the annual providers operational cost of the Sensitization and Awareness campaign (SA). This covered the training and dipping demonstration and transportation costs. The cost profile shows that the organization of the training programme of SA accounts for nearly 60% of the cost whilst transportation took the remainder (40%). The total operational cost was D64,133. This was treated as a capital item, since the SA campaign lasted for more than 1 year. The lifetime of such investment in SA campaign for example the dipping training of field workers, other health personnel and dippers reflected recent staff turnover rates (Picard et al., 1993). Thus Table 5e shows the summarised annualized providers capital cost of SA campaign, partly obtained by annualizing SA operational cost in Table 5d. Table 5e shows that the SA operational cost accounted for virtually the whole capital cost of SA (99%). Table 5f shows the annual providers capital cost for Impregnation exercise alone. The majority of the cost was taken up by rubber gloves used by dippers (46%) which were imported, followed by measuring cup and vehicle (16% each), metal funnel 13% and the rest of the items were less than 10% of the cost. Tables 5c - 5f are the providers capital cost contribution to the NIBP capital cost presented in Table 5.2. The total annual providers capital cost was D100,161.80.

5.2.2 NIBP Implementation cost borne by the community

The community recurrent costs were made up of supplies (water and detergent) and the cost of dippers time as shown in Table 5g. Estimates of both water and detergent used for washing and dipping bednets and dipping implements were based on NIBP impregnated bednet statistics and the same wastage rate calculated for insecticide was used for water. Personal observation in rural Gambia revealed that portable water is not always readily available in all villages. For instance, in Dingiri (in NIBP study area 5) of the URD, there is a daily queue of containers at the standing pipes, which upon enquiry the research team was informed that the pipes flow usually at late night or early mornings when most people would be in bed. This suggest that water is available for a short period of time. The same explanation might hold for other villages in the country with similar water problems. Thus, portable water is a cost to the community in such water related programmes.

The total number of dippers and dipping time were estimated based on the sample of dippers (178) in the NIBP study area. The average number of dippers per village was 4.25 (95% CI: 3.81, 4.75) giving a total of 942 dippers in the 221 villages covered by NIBP, 1992. The average dipping time per dipper was 8.00 hours (95% CI: 7.21, 8.87) giving a total of 7,531.68 dipping hours per year. Dippers time was valued using calculated hired farm labour rate in the community, since 80% (143) of the dippers claimed they would be undertaking farm work (ie weeding and preparing plots for planting) if they were not engaged in the dipping exercise. The average hired farm labour charge was obtained from 8 local farming clubs (all males) interviewed in the 5 NIBP study areas. Their charges were based on work done (ie clearing a piece of land at a fee) rather than working on hourly rates. The estimated charge (including food, kola nuts, cigarette and black mint sweet) per hour per worker was D2.19. Thus, the cost of dippers time was valued at this rate and presented in Table 5g (Appendix 2).

The community capital cost contribution to NIBP were mainly bednets bought specifically for impregnation, plastic bowls and buckets. These capital items were annualized using the same discount rate of 6%. The cost profile in Table 5h shows that bednets accounted for 87% of the cost followed by plastic buckets (12%) and plastic bowls (1%). The total annual community capital cost was D4,228.59.

The overall annual community cost (recurrent and capital) of NIBP, 1992 was D55,648.52 (from Tables 5g and 5h in Appendix 2). Of which, the community recurrent cost constitutes about 92% of the total community cost.

5.2.3 Total NIBP Implementation cost

Table 5.1 provides the annual recurrent cost profile of NIBP obtained from Tables 5a, 5b and 5g (Appendix 2). Table 5.1 was sub-divided into general recurrent cost (for both SA and Impregnation exercise) and costs related solely to the Impregnation exercise incurred by the providers and the community. The annual recurrent cost of NIBP was D653,484.33 (US$79,210.22).

The structure of the recurrent cost profile shows that insecticide accounted for the largest proportion of the cost (69%), followed by personnel 14%. The remaining items were all less than 10%. The relatively high recurrent cost of Impregnation exercise alone (84%) was due to the expense of importing insecticide by the providers (Table 5.1). The share of recurrent cost borne by the providers (D601,989.38) was again high, 92% compared to 8% by the community (D51,494.38).

Table 5.1 Annual recurrent cost profile of NIBP to both providers & community, 1992

Item	Total annual cost (D)	Cost profile (%)
i) **General providers recurrent cost**		
Personnel		
i) MRC & other NGOs	63,357.80	9.70
ii) MoH	26,066.35	3.99
Other supplies & services	13,785.00	2.10
Sub-total	103,209.15	15.79
ii) **Impregnation exercise alone:**		
a) **Providers cost**		
i) Insecticide	448,176.17	68.58
ii) Other supplies & services	8,125.00	1.24
iii) Transport running cost	42,554.08	6.51
b) **Community cost**		
i) Supplies	34,925.55	5.34
ii) Dippers cost;	16,494.38	2.52
Sub-total: (All Impregnation)	550,275.18	84.21
Total NIBP recurrent cost:	653,484.33	99.98

Table 5.2 gives the annual capital cost profile of NIBP obtained from Tables 5c - 5f and 5h in Appendix 2. Table 5.2

is divided into general capital cost (for both SA and Impregnation exercise) and costs earmarked solely for SA and Impregnation exercise activities alone obtained from Tables 5f and 5h. The total annualized capital cost of NIBP was D104,390.39 (US$12,653.38[12]). The cost of the general capital cost accounted for 57% of the cost and SA and Impregnation exercise specific costs the remainder, 43%.

Table 5.2 Annual capital cost profile of NIBP to both providers & community, 1992

Item	Total annualized cost (D)	Cost Profile (%)
i) **General capital cost**		
Vehicles	48,208.13	47.18
Buildings	3,092.18	2.96
Office equipments & furniture	8,026.96	7.69
Other supplies	225.46	0.22
Sub-total:	59,552.73	57.05
ii) **Sensitization & awareness (SA) campaign alone**	35,203.74	33.72
iii) **Impregnation exercise alone**	9,633.92	9.23
Sub-total:	44,837.66	42.95
Total NIBP capital cost:	104,390.39	100.00

The capital cost profile indicates that 47% of the cost was attributable to vehicle cost due to the high use of vehicles on NIBP activities. The Sensitization and Awareness (SA) campaign alone also took about 34% of the cost. The relatively high SA campaign cost was due to the varying activities and its associated transport cost. The remaining capital costs were all less than 10%; Impregnation exercise alone 9%, office equipment and furniture 8%, building 3% and the remainder to other miscellaneous supplies (Table 5.2). The capital costs incurred by the providers (D100,161.80) and the community (D4,228.59), indicates that the providers virtually financed the whole (96%) of the capital cost and the community only 4% (see Tables 5c - 5b and 5h).

[12]Exchange rate (June, 1992): D8.25 = US$1.00 and D15.70 = £1.00.

Table 5.3 Annual NIBP Implementation cost profile, 1992

Item	Total annual cost (D)	Cost profile (%)
a) **Capital costs**		
Vehicles	48,208.13	6.36
Buildings	3,092.18	0.41
Office equipments & furniture	8,026.96	1.06
Other supplies	225.46	0.03
SA campaign	35,203.74	4.65
Impregnation exercise	9,633.92	1.27
Sub-total:	104,390.39	13.77
b) **Recurrent costs**		
Personnel	89,424.15	11.80
Other supplies & services	13,785.00	1.82
Impregnation transport running cost	42,554.08	5.61
Impregnation exercise	507,721.10	66.99
Sub-total:	653,484.33	86.23
Grand total:	757,874.72	100.01

Combining the annual capital and recurrent costs produced an annual NIBP Implementation cost of D757,874.72 (US$91,863.60). The total NIBP Implementation cost profile was presented in Table 5.3. Figures 5.1 and 5.2 also shows the percentage share of recurrent and capital items of NIBP Implementation cost. The total NIBP Implementation cost profile in Table 5.3 shows that recurrent cost was about 86% and capital cost 14%. Again the high cost of insecticide played a significant role.

Thus, the cost of implementing a national malaria control programme using insecticide-impregnated bednets in rural Gambia was largely determined by the cost of the insecticide (permethrin) which constitutes 59% of the NIBP implementation cost.

5.2.4 Cost apportionment to NIBP study areas

The NIBP implementation cost of D757,874.72 (Table 5.3) represents the cost of implementing the insecticide-impregnated bednet programme in 221 primary health care (PHC) villages across rural Gambia in 1992. To the evaluate NIBP (ie epidemiological, entomological and economic evaluations), the 5 NIBP study areas were set up, of which 53 PHC villages of the study area were among the 221 PHC villages covered. The share of the NIBP implementation cost apportioned to the study areas was based on impregnated bednet coverage. This method of cost apportionment reflects the cost of NIBP activities in the study areas rather than using other means such as the proportion of study area villages to the total NIBP villages covered.

Therefore, the share of NIBP implementation cost apportioned to the study areas was the total number of impregnated bednets in the NIBP study areas (18,879) divided by the overall total number of impregnated bednet by NIBP (71,313) multiplied by the total NIBP implementation cost (D757,874.72);

[0.2647 (18,879/71,313) x D757,874.72] = D200,635.46 (US$24,319.45).

5.3 Effectiveness of NIBP

5.3.1 Health effects of NIBP

The effectiveness of NIBP was evaluated in terms of childhood mortality. The continuous mortality surveillance system of the NIBP epidemiology team was used to gather information on child deaths (under 10 years) prior to the intervention, during the intervention year and the post-intervention year. The mortality rates of the pre-intervention and intervention years are presented in Figures 5.3 and 5.4 respectively. Figures 5.3 and 5.4 shows the mortality rates in the NIBP study areas before the intervention and the intervention years. The mortality rates in the 2 groups of villages (Group 1, treated in 1992 and Group 2 remained untreated in 1992) were different. In study areas 1, 2 and 3 the mortality rates in Group 2 villages were higher than Group 1 villages and in study areas 4 and 5 the mortality rates were higher in Group

1 villages than in Group 2 villages (Figure 5.3). However, after the intervention , the mortality rates fell in all the Group 1 villages with the exception of study area 5, where the mortality rates in the treated villages (Group 1) remained higher than that of the untreated villages (Group 2). During the intervention year, a 25% reduction in overall mortality in children under 10 years old was detected (p=0.04) in bednet-impregnated villages (D'Alessandro et al., In press).

To further assess the effectiveness of NIBP in terms of its affordability and coverage, other measures of unit cost were estimated and presented in Chapter 7. These were cost per child-year protected, cost per life-year gained, cost per person protected (per capita), cost per impregnated bednet and cost per person sleeping under impregnated bednet. The indicators of NIBP effectiveness used for the estimation of the above unit costs, were obtained from the NIBP epidemiology team and Implementation office. The other effects of NIBP intervention investigated by this study was the overall effect of impregnated (treated) bednets in villages on school absenteeism. This is presented in the preceding section.

5.3.2 Other effects of NIBP: Effect of impregnated bednet usage on primary school absenteeism due to ill-health

A total of 2182 pupils from 8 primary schools were recruited to the study (4 primary schools each in study areas 2 and 3 of the NIBP study areas) for baseline information. This was during the first term of the 1991/1992 academic year. The average ages of the pupils ranged from 6 to 14 years in classes 1 and 6 respectively. The official age for children to be enroled for primary education in The Gambia is 7 years. Of the 2182 pupils, 32% were girls and 68% were boys. The proportion of girls in all the 6 classes in the schools progressively reduces from class 1 to class 6. For example, 35.4% of the pupils in class 1 were girls and there were only

25.5% in class 6. Most families prefer boys compared to girls to enrol into modern formal schooling.

In two villages in each of the study areas where the schools were situated, insecticide-impregnated bednets were introduced in June, 1992. Thus, the 8 schools were classified into 2 groups - group 1 were schools (n=4) situated in villages where insecticide-impregnated bednets were introduced and group 2 schools (n=4) were in villages without the intervention. The follow-up year (Intervention year) reflected the same pattern of sex ratios in the classes. Of the 2376 pupils followed during the 1992/93 first term of the academic year, 32.7% were girls and 67.3% were boys. Girls form 37.8% of class 1 and only 28.2% of class 6.

This study was concerned with absenteeism due to ill-health, hence, the analysis was based only on reported absenteeism due to ill-health rather than other reasons which are more likely to be gender determined.

5.3.2.1 Daily absenteeism due to ill-health among pupils

There was no statistically significant difference in primary school absenteeism attributable to reported ill-health between the 2 groups of schools in the 2 NIBP study areas, prior to the intervention (Yates corrected Chi square = 0.01; p=0.938). This indicates that the 2 groups did not differ in general reported ill-health. Ill-health due to fever also showed no difference between the two group of schools (Yates corrected Chi square = 1.24; p=0.265).

During the intervention year (1992), there was no significant difference in general reported ill-health between the 2 groups of schools (Yates corrected Chi square = 1.03; p=0.31). However, absenteeism due to fever was significantly different between the 2 groups of schools (Yates corrected Chi square =

5.16; p=0.02). The reported fever rates were higher in Group 2 schools. Overall, the rate of absenteeism of both reported ill-health and fever were reduced in the intervention year (1992) in the 2 group of schools (see Figure 5.5 and 5.6). There was a slight reduction in absenteeism attributable to ill-health Group 1 schools compared to Group 2 schools in the intervention year (1992). The reduction in absenteeism due to fever was noticeable in both group of schools and were relatively lower than that of the pre-intervention year.

5.4 Estimation of deaths and illnesses averted by NIBP

The consequences of NIBP in terms of illnesses and deaths averted were estimated as shown in the following sections. The estimation of life years gained (undiscounted and discounted) is considered in Chapter 7. The data used for the estimation of deaths averted by NIBP were obtained from the mortality rates in the 5 NIBP study areas. The mortality rates were obtained from the continuous mortality surveillance of the NIBP epidemiology team during the intervention year. However, there was no similar morbidity surveillance system partly because it required a substantial amount of resources in terms of logistics and manpower which could not be met by NIBP. Hence, cross-sectional morbidity surveys were undertaken annually to provide an indication of the prevalence of malaria amongst the target population. Therefore, the morbidity rates amongst the non-fatal cases (controls) of the matched fatal case-control (MFCC) study were used for the estimation of illnesses (cases) prevented.

5.4.1 Estimation of deaths averted by NIBP

The estimation of deaths averted was based on mortality rates obtained from the NIBP Epidemiology team's continuous mortality surveillance system. The number of deaths averted by bednet impregnation was calculated by multiplying the mortality rates in the treated[13] and untreated villages to the target population (1-9 years) in that age group of the treated village to obtain the actual and expected deaths. The difference between the expected and actual deaths gave the deaths averted. The sum of the deaths averted in the 5 NIBP study areas gave the total deaths averted by the intervention. Confidence intervals (95% CI)[14] were estimated for the deaths averted to show the range and reliability of the figures. The summary of the calculation are shown in Table 5.4. Figure 5.7 also shows the expected deaths, actual deaths and deaths averted by NIBP.

The estimated total number of child deaths averted by the intervention in the target population in the 5 NIBP study areas in 1992 was 40.56 deaths. Results in Table 5.4 shows that the impact of the intervention was more pronounced in NIBP study area 3, even though the CI were relatively wide. In areas 1, 2, 4 and 5, the estimates are to be treated with caution because the CIs includes zero and negative values. Moreover, in area 5, there were more deaths in treated villages than untreated villages which was unexpected. Differences in mortality rates between the 2 groups of villages in the study areas may have contributed largely to the weak deaths averted estimates obtained. Even though the reliability of the estimated deaths averted in 4 of the study

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[13]Implies bednets were impregnated with insecticide (permethrin)

[14]Confidence intervals were calculated using the formula

$$1.96\ x\ \sqrt{Var(No.\ of\ cases\ averted)}$$

where the no. of cases are either illnesses or deaths averted and the variance was obtained from the formula

$$N_t^2 x [VAR(r_u) + VAR(r_t)]$$

N^2_t = total population of children in treated villages; r_u = morbidity or mortality rates in untreated villages and r_t = morbidity or mortality rates in treated villages.

areas were weak as shown by their respective CIs, the overall deaths averted having wide range of CI is more reliable compared with the estimate of illnesses averted.

Table 5.4 Estimated number of child (1 -9 years) deaths averted by NIBP

NIBP study area	Population[1]	Mortality rate (000) in the villages		Expected deaths	Actual deaths	Deaths averted
		Treated	Untreated			
1	2,261	2.212	5.456	12.34	5	7.34 (-0.88, 15.56)[2]
2	3,051	6.228	10.480	31.97	19	12.97 (-1.10, 27.04)
3	3,988	6.018	12.292	49.02	24	25.02 (7.73, 42.31)
4	4,069	9.585	10.144	41.28	39	2.28 (-15.71, 20.27)
5	6,544	11.614	10.473	68.54	76	-7.46 (-28.73, 13.81)
Total	19,912	8.186	10.223	203.56	163	40.56 (4.54, 76.58)

1 Refers to the child-years lived
2 Figures in parenthesis are 95% confidence intervals

5.4.2 Estimation of illnesses (cases) averted by NIBP

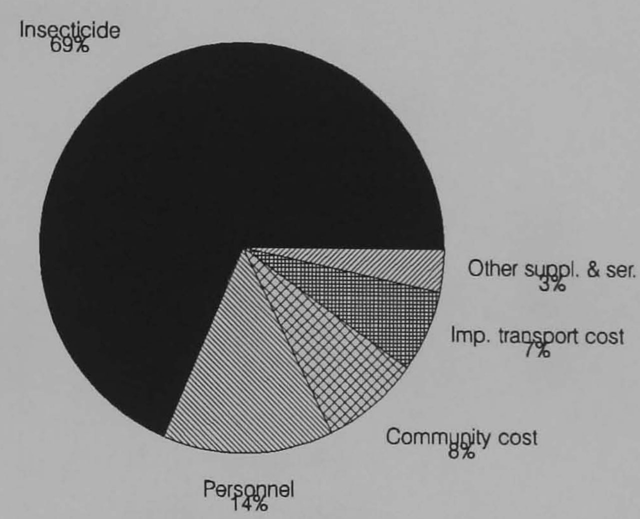
The reported morbidity rates in the treated and untreated villages were obtained from the non-fatal cases of the MFCC study. The estimated reported morbidity rates in the treated and untreated villages were 0.406 and 0.440 respectively. The number of illness episodes averted by bednet impregnation was calculated by applying the morbidity rates in the treated and untreated villages of the relevant age group to the target population (1-9 years) to obtain the actual and expected illnesses (cases). The difference between the expected and actual illnesses gave the illness averted by the intervention. The total number of illnesses averted by the intervention in the target population was 707.81 (95% CI: -2360.46, 4343.20). However, the wide ranges of CI including zero and negative values indicate that the estimation is weak. This is likely to be due to the small sample size (134) used in the estimation of the morbidity rates in both the treated and untreated areas. The estimated illnesses averted must therefore be treated with caution. The illnesses averted were used for subsequent calculations of the resource use consequences for both government and households with the institution of the intervention reported in the next chapter.

5.5 Summary

The cost profile of NIBP shows that of the total implementation cost of D757,875 (US$91,864), recurrent cost comprised 86% and capital cost accounted for 14%. The bulk of the capital cost was incurred by the providers (96%), of which 47% constituted vehicle cost. In the case of recurrent cost, 92% of it was borne by the providers, of which, 69% was due to the expense of importing insecticide. Epidemiologically, impregnated-bednets usage have been shown to reduce child mortality. The estimated health effects were 41 deaths averted and 708 illnesses prevented respectively in the study areas. Moreover, primary school absenteeism due to reported ill-health and fever among pupils were reduced in both groups, but was relatively more pronounced in the intervention area.

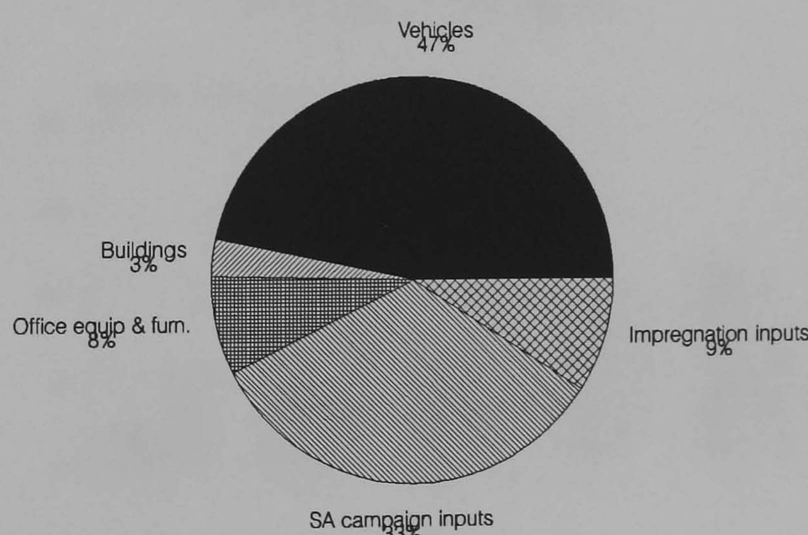
The NIBP implementation cost and estimates of the illnesses and deaths averted were used to estimate the main cost-effectiveness ratio of NIBP, life year gained and other resource use consequences of NIBP to both the government and the community which are covered in details in the next chapter.

Figure 5.1 Annual recurrent cost profile of NIBP, 1992



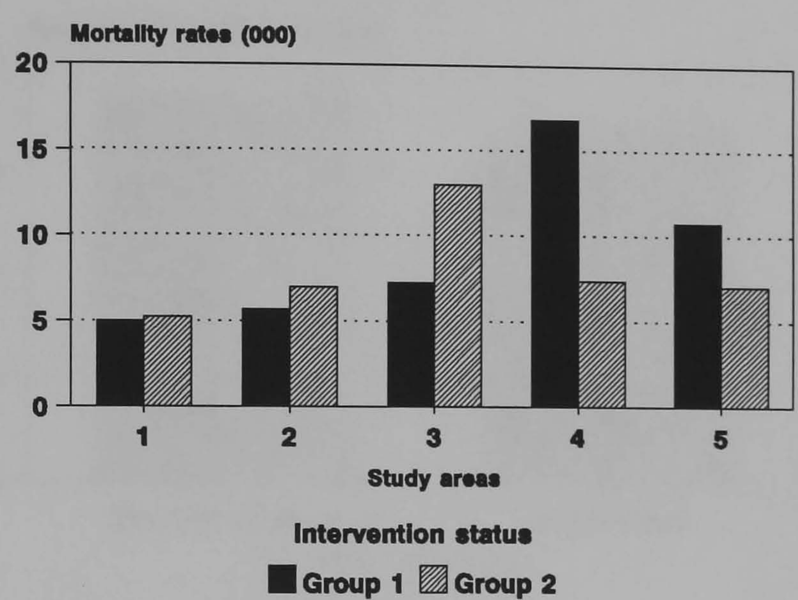
Total recurrent cost: D653,484.33

Figure 5.2 Annual capital cost profile of NIBP, 1992



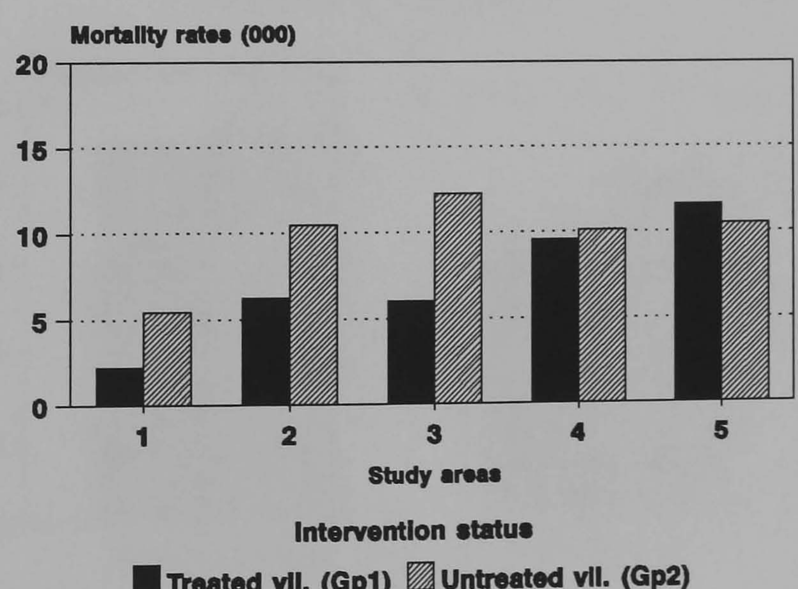
Total capital cost: D104,390.39

Figure 5.3 Est. mortality rates of children (1-9 yrs), NIBP study area (Pre-intervention year, 1991)



Source: (D'Alessandro etal. Unpublished)

Figure 5.4 Est. mortality rates of children (1-9 yrs), NIBP study area (Intervention year, 1992)



Source: (D'Alessandro etal. Unpublished)

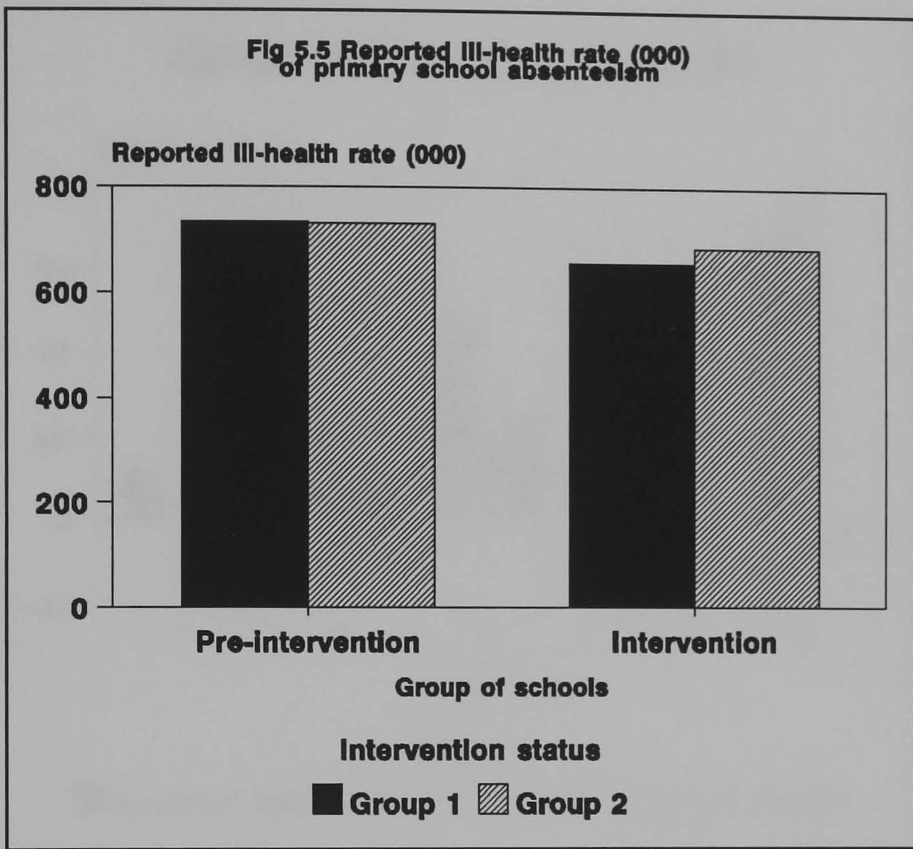


Fig 5.5 Reported ill-health rate (000) of primary school absenteeism
Reported ill-health rate (000)
800
600
400
200
0
Pre-intervention
Intervention
Group of schools
Intervention status
Group 1
Group 2

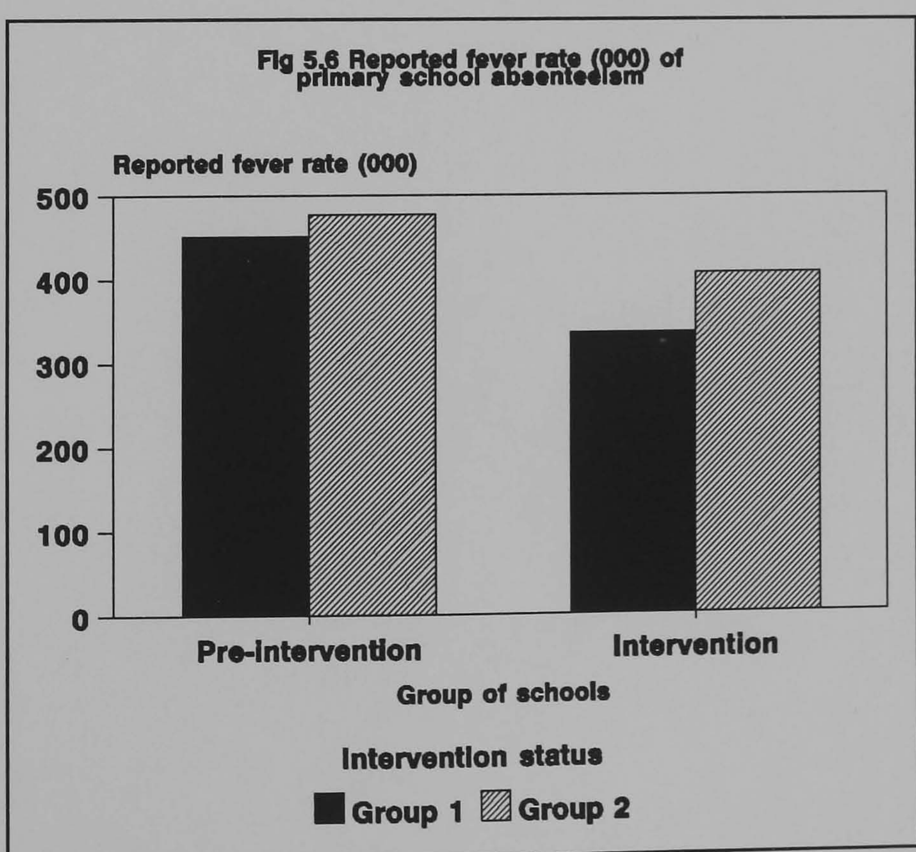
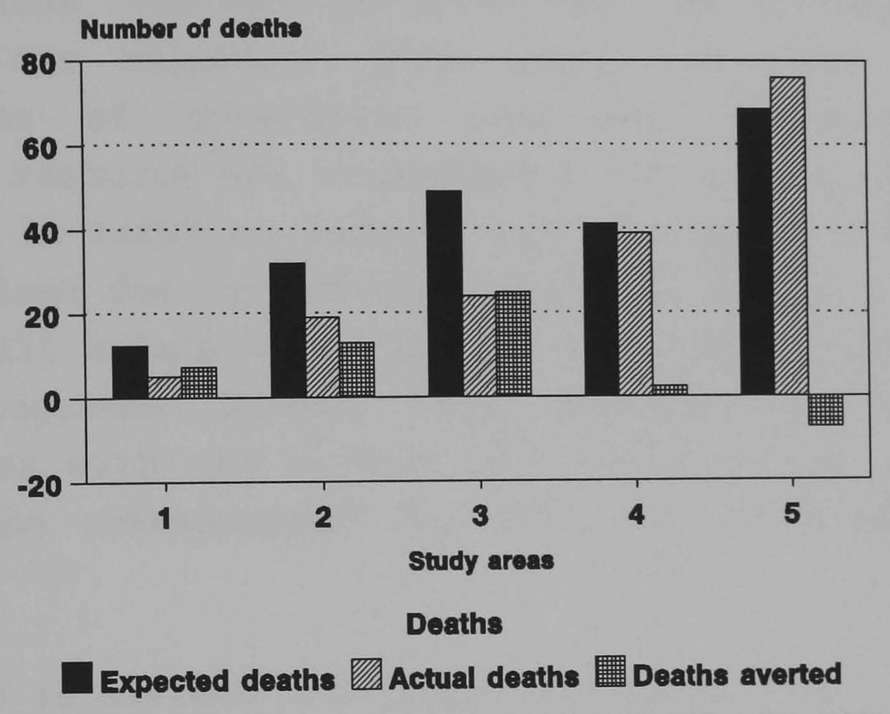


Fig 5.6 Reported fever rate (000) of primary school absenteeism
Reported fever rate (000)
500
400
300
200
100
0
Pre-intervention
Intervention
Group of schools
Intervention status
Group 1
Group 2

Figure 5.7 Estimated number of child (1-9 yrs) expected, actual & averted deaths by NIBP, 1992



CHAPTER 6: RESOURCE USE CONSEQUENCES OF NIBP INTERVENTION

6.1 Introduction

With the introduction of the NIBP control programme, if the programme was effective a smaller number of patients are likely to seek treatment at government health facilities (eg treatment for malaria). This would therefore have some consequences of government resources (treatment cost). Similarly, resource use consequences would be experienced by households in terms of reduced expenditure on treatment and work time lost due to seeking treatment. Whilst the previous chapter dealt solely with the cost and health effects of the control programme (NIBP), this chapter will address the consequences with and without the intervention in terms of resource use consequences for both the government and the household.

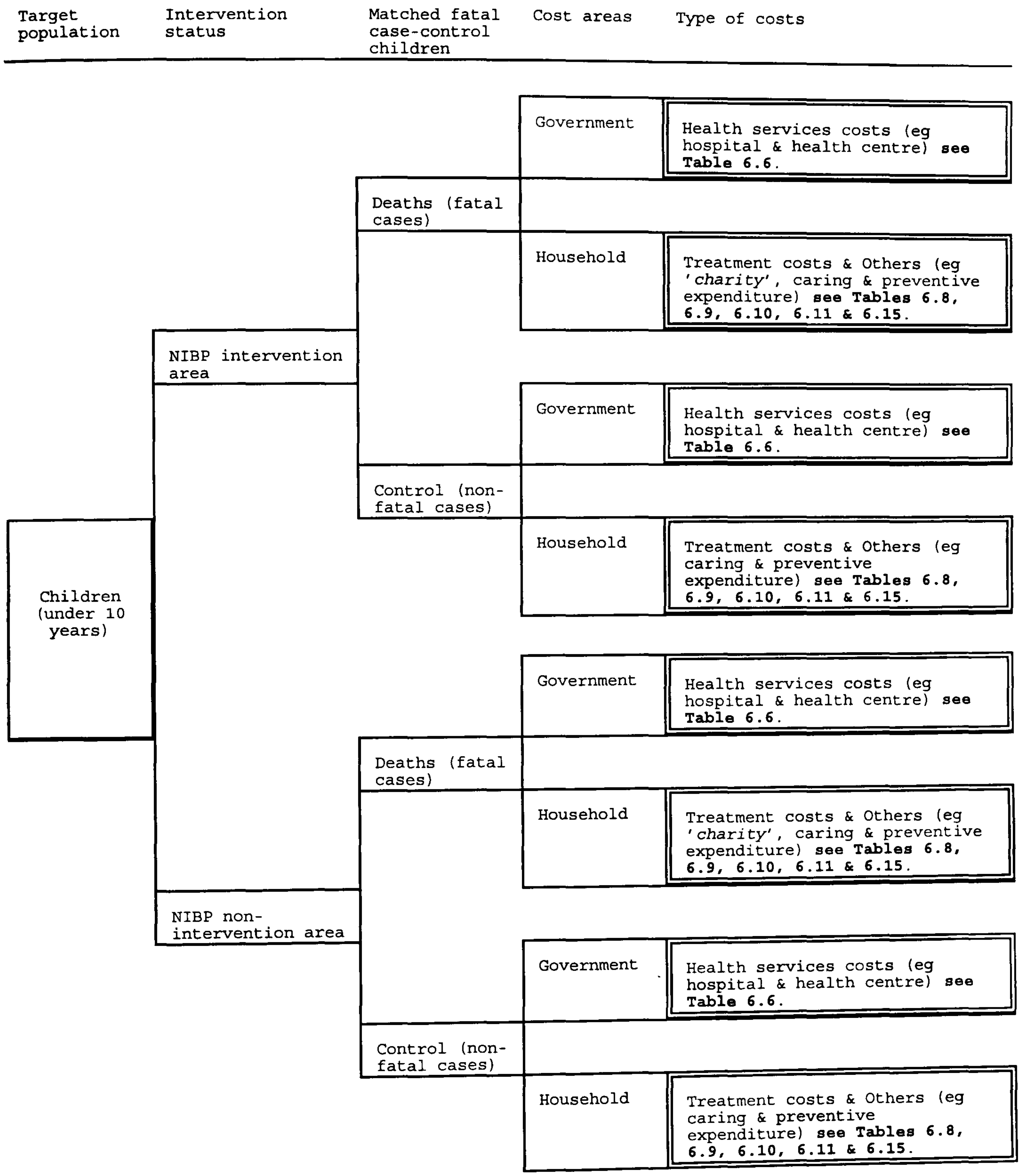
The chapter is divided into 3 main sections. The first section deals with the resource use consequences for the government in terms of health services treatment costs in children. The second section is the largest section and it deals the resource use consequences in terms of household expenditure. This section covers the direct cost associated with child health care responsibilities within the household, treatment sources used and the number of sick days per illness episode. The cost of treatment, burial, funeral and mourning ('*charity*') activities incurred by the household with and without the intervention as well as the household cash income lost due to deaths are also described. The indirect costs, which include work time lost by the household and other members associated with treatment, ill-health care and '*charity*' activities are also covered in this section. This is followed by estimation of the net savings in resource use made by both the government and the household as the result of the NIBP. Finally the cost and savings on other preventive measures undertaken by households are estimated. The type of costs considered are illustrated in Figure 6.1 with and without NIBP intervention. The difference between without and with the NIBP intervention costs was the net savings on the type of cost considered.

The analysis undertaken in this chapter, integrates data from both quantitative and qualitative studies. The estimation of the total treatment cost to both the government and the household requires data on the proportion of patients seeking treatment and the mean treatment cost per case. The MFCC study was used to provide estimates of the mean household expenditure on treatment, '*charity*' activities (both direct and indirect) and other preventive measures. Health service costs (ie hospital and health centre treatment costs) were obtained from hospital and health centre cost information.

6.2 Cost and saving in government resources

Before the cost and saving in government resources for treatment could be estimated, the mean health services cost (ie hospital and health centre treatment costs) and the number of patients that are likely to seek treatment had to be ascertained. These estimates were obtained from the hospital treatment cost analysis, health centre treatment cost, population of children under 10 years, illnesses (cases) and deaths described in Chapter 5 and from NIBP epidemiological data. This section commences with the estimation of the mean hospital treatment cost.

Figure 6.1 Government and household costs with and without NIBP intervention



The hospital cost analysis was undertaken for both the out-patient department (OPD) and paediatric ward (PW) to estimate the treatment costs in the departments. Recurrent and capital cost information was obtained from the hospital administrator and the departments. Capital items were annualized using a discount rate of 6% and their appropriate useful lives. Cost apportionment was based on personnel time allocation and the cost of item(s) used. Drugs were costed as part of the overall dispensary cost. OPD and PW treatment cost were computed based on routine hospital procedures ascertained from health personnel in the hospital. In the case of health centre treatment cost, the information was obtained from a secondary source of a recent work done in The Gambia by Fabricant and Newbrander (1994).

6.2.1 Estimation of hospital treatment cost in children

The purpose of this hospital cost analysis was to calculate the mean hospital treatment cost. Bansang hospital was selected because 39% (n=39) of the carers of all fatal cases (ie in MFCC study) sought first treatment for their children there. Secondly, the hospital was situated in the centre of the NIBP study area and was a hospital serving principally the people of the rural communities in that part of the country. Finally, it was also accessible to a majority of the study population.

A complete line item presentation of recurrent and annualized capital cost was prepared and a summary is presented in Table 6a in Appendix 3. The hospital departments were classified into 2 broad cost centres - non-treatment and treatment departments (Table 6a). The non-treatment departments were Administration, Laundry and Catering. These were departments which rendered essential services to the other departments for the overall operation of the hospital services. The treatment departments were Out-patient clinic (OPD), Maternal & Child

Health (MCH) clinic, Dental clinic, Dispensary, Radiology (X-ray), Acupuncture, Laboratory, Operating theatre, Female ward, Male ward, Isolation ward, Maternity & labour ward, Paediatric (children) ward and Corpse room. Table 6a gives a summary of the hospital's departmental cost for 1992. Table 6a shows that Administration accounted for the highest total cost and the lowest was Laundry.

6.2.2 Step down cost analysis of hospital overhead cost

The cost of the 3 non-treatment departments (administration, laundry and catering) identified as the overhead costs were stepped down to the treatment departments as shown in Table 6b of Appendix 3. The order of the step down calculation of the overhead cost was Administration, Catering and Laundry. This was determined on the basis of their broad functional nature in the hospital. The criteria used to step down non-treatment department costs was based on the accessibility and availability of data and the extent to which they might measure the interrelationships between departments (Raymond et al., 1987). The criteria used for each non-treatment department was;

1) Administration: staff ratios in the departments;
2) Catering: average of staff ratios and beds by patient ward and;
3) Laundry: beds by patient ward.

The step down procedure was necessary because the non-treatment departments render services to all other treatment departments and the cost incurred needs to be shared accordingly. Table 6.1 shows the summary of Bansang hospital's costs by departments after the allocation of overhead costs. The results will be used to help compute the mean treatment cost per patient.

Distribution of the non-treatment department costs to the treatment departments presented in Table 6.1 indicates that dispensary cost constituted the largest component of the total cost and the smallest was laboratory.

Table 6.1 Distribution of annual non-treatment costs to treatment departments after step down calculations, Bansang hospital, 1992

Treatment department	Type of cost (D)				Total cost (D)
	Non-treatment[a]	Personnel	Supplies/ services	Capital	
Dispensary	86,386.76	40,090.00	541,640.40[b]	@	668,117.16
Laboratory	103,676.91	36,504.00	50,000.00	6,414.05	196,594.96
Radiology	35,671.56	54,403.20	75,000.00	45,258.48	210,333.24
OPD	138,257.21	155,511.40	**	@	293,768.61
Paediatric ward[c]	208,051.13	80,526.00	5,000.00	179,818.48	473,395.61
Total	572,043.57	367,034.60	671,640.40	231,491.01	1,842,209.58

a Obtained from Table 6b.
b Estimated from the expenditure on drug & other medical supplies for the first half of 1991/92 financial year (ie D318,612.00) [15% of the cost was allocated to MCH & Dental clinics by Pharmacist estimation because they keep their medications in their clinic].
c Allowance was made for the other wards in terms of the Administrative cost (Table 6b in Appendix 3)
@ Annualized capital cost was less than D500.00.
** OPD supplies/services (eg stationary etc) were considered under Administration.

6.2.3 Mean hospital treatment cost at OPD

Information on out-patient statistics was obtained by counting available prescription forms. The share of dispensary cost to the various treatment departments of the hospital was based on the pharmacist daily estimated time allocation[15] for the management and administration of drugs and supplies to these units; OPD 50%, all wards 40% and laboratory, radiology, theatre etc 10%.

Four different cost components constitute the overall treatment cost namely, dispensary[16], laboratory, radiology and OPD operating costs. The costs components were considered separately and summed to provide the overall treatment cost. A summary of the analysis is presented in Table 6.2. Table 6.2

[15]Excluding MCH and dental clinics which keep most of their drugs and supplies.

[16]Made up of dispensary operating, drug and other medical supplies.

shows that dispensary cost accounts for the majority of the total OPD cost due to the costs of operating, drugs and other medical supplies.

Table 6.2 Hospital OPD treatment cost per patient

Items	Cost & hospital data
a) Proportion (50%) of dispensary cost[1] (D668,117.16) for the interval[2] (August-November; 33%)	D110,239.33
b) Proportion (80%) of OPD cost[3] (D293,768.61) to out-patient for the interval (August-November; 33%)	D77,554.91
c) Proportion (6%) of laboratory cost[4] (D196,594.96) to out-patient for the interval (August-November; 33%)	D3,892.58
d) Proportion (1%) of radiology cost[5] (D210,333.24) to out-patient for the interval (August-November; 33%)	D694.10
e) Total OPD cost ([a]+[b]+[c]+[d])	D192,380.92
f) Number of patients (August - November)	19,815
g) Mean OPD cost per patient[6] ([e]/[f])	D9.71

1 Made up of dispensary operating, drug and other medical supplies.
2 Refers to the time for reviewed cases from prescription forms.
3 Time allocation by the Senior Staff Enroled Nurse at OPD.
4 Based on time allocation of laboratory technician to reading of blood slides (30%) and the proportion of children blood slides for OPD (20%) during the interval (August - November).
5 Based on the number of children x-rayed in November due to scarcity of data.
6 For all diseases.

6.2.4 Mean hospital treatment cost in the paediatric

The in-patient treatment cost consists of 5 different costs - paediatric ward (PW), dispensary, laboratory, radiology and part of OPD operating costs.

Table 6.3 Paediatric ward treatment cost per patient

Items	Cost & hospital data
a) Proportion of paediatric cost (D473,395.61) for the interval (August-November; 33%)	D156,220.55
b) Proportion (40%[1]) of dispensary cost[2] (D668,117.16) to all wards for the interval (August-November) = D88,191.47; and a share of wards dispensary cost (D88,191.47) allocated to paediatric ward (ie 20%[3])	D17,638.29
c) Proportion (20%) of OPD cost[4] (D293,768.61) to in-patient for the interval (August-November; 33%)	D19,388.73
d) Proportion (18%) of laboratory cost[5] (D196,594.96) to in-patient for the interval (August-November; 33%)	D11,677.74
e) Proportion (8%) of radiology cost[6] (D210,333.24) to in-patient for the interval (August-November; 33%)	D5,552.80
f) Total paediatric ward cost ([a]+[b]+[c]+[d]+[e])	D210,478.11
g) Admission in paediatric ward during the interval (August-November)	909
h) Mean paediatric ward cost per patient[7] ([f]x[g])	D231.55

1 Time allocation of pharmacist to wards.
2 Made up of dispensary operating, drug and other medical supplies.
3 Share of paediatric ward dispensary cost amongst the 5 wards in the hospital.
4 PW admissions are made through OPD.
5 Based on time allocation of laboratory technician to reading of blood slides (30%) and the proportion of blood slides for paediatric ward (60%) during the interval (August - November).
6 Based on the number of children x-rayed in November due to scarcity of data.
7 For all diseases.

The summary of the costing procedure is presented in Table 6.3. Table 6.3 indicates that paediatric cost took a large share of the total in-patient cost due especially to the cost of capital items (eg beds, cabinets).

6.2.5 Health centre treatment cost

A recent health facilities cost study undertaken by Fabricant and Newbrander (1994) in The Gambia provides estimates for the unit cost per in-patient admission and that of OPD (ie minor and major health centres). These estimates were based on total government expenditure consisting of the following cost components; drug/medical supplies, transportation, patient food, generators (operation and maintenance), maintenance of equipment and other expenses in 1992-93. A summary of the unit costs are provided in Table 6.4 below. Weighted averages for in-patient and out-patient costs were taken due to the cost variation between major and minor health centres. The health centre costs were about half that of the hospital. The OPD and in-patient treatment cost difference between the two health facilities were plausibly due to the relatively higher number of qualified personnel at the hospital and also because the hospital cost incorporates cost of capital items.

Table 6.4 Unit cost (D) of treatment at health centres, The Gambia

Health centres	Average unit cost (D) (using total government expenditure)	
	In-patient admissions	Out-patient clinics
Major health centres	122.70	6.50
Minor health centres	106.60	5.80
Weighted average[1]	113.23	6.09

1 Accounts for the cost variations in health centre treatment (Total of 17 health centres; 7 major & 10 minor ones). [**Source: Fabricant and Newbrander, 1994**].

6.2.6 Consequences for governmental resources

6.2.6.1 Annual health service treatment costs borne by the government

The number of patients in the community was likely to be affected by the NIBP intervention which would be in favour of reducing cases in areas with the intervention. Estimating the total treatment cost required assumptions about the proportion of patients that would seek treatment from both areas with and without the intervention. It was assumed that the mean household treatment expenditure per case would remain at the same level for both fatal and non-fatal cases.

With reference to Figure 6.1 the estimation of hospital treatment cost at OPD and PW with and without the intervention is summarised in Tables 6.5 and 6.6.

Table 6.5 Information on children (under 10 years) in the NIBP study areas

Items	Intervention status	
	With NIBP	Without NIBP
1) Study population (under 10 years)		
a) Population[1]	19,912	19,912[2]
b) Number of deaths[3]	163	203[2]
c) Exposed population[4] ([a]-[b])	19,749	19,709
d) Morbidity rates[5]	0.406	0.440
e) Number of cases ([c]x[d])	8,018	8,672
2) Deaths (fatal cases)		
f) Proportion of fatal cases who received treatment at hospitals[5]	0.32	0.32
g) Proportion of fatal cases who received treatment at health centres[5]	0.39	0.39
h) Number of fatal cases treated at hospitals ([f]x[b])	52	65
i) Number of fatal cases treated at health centres ([g]x[b])	64	79
3) Non-fatal cases		
j) Proportion of non-fatal cases who received treatment at hospitals[5]	0.13	0.13
k) Proportion of non-fatal cases who received treatment at health centres[5]	0.26	0.26
l) Number of non-fatal cases treated at hospitals ([e]x[j])	1,042	1,127
m) Number of non-fatal cases treated at health centres ([e]x[k])	2,085	2,255
4) Total annual cases		
n) Hospital cases ([h]+[l])	1,094	1,192
o) Health centre cases ([i]+[m])	2,149	2,334

1 Refers to child-years lived.
2 Original figure (22,792) was adjusted by 13%.
3 From NIBP epidemiological mortality data.
4 Excludes the deceased children.
5 Obtained from the MFCC study (see Table 6.7).

In Table 6.5, the population of the non-intervention area (ie without NIBP) was adjusted to allow for the difference in population between the 2 groups which will influence both the estimation of cases and the final costs in the 2 groups. The estimated population, deaths and cases were used to calculate the resource use consequences for the government and the household.

Table 6.6 Annual health services cost (D) to government, 1992

Items	Intervention status	
	With NIBP	Without NIBP
1) **Estimation of cases**		
a) Number of hospital cases[1]	1,094	1,192
b) Number of health centre cases[1]	2,149	2,334
c) Proportion of cases treated at hospital OPD[2]	0.4	0.4
d) Proportion of cases treated at hospital PW[2]	0.6	0.6
e) Proportion of cases treated at health centre PW[3]	0.15	0.15
f) Cases treated at hospital OPD ([a]x[c])	438	447
g) Cases treated at hospital PW ([a]x[d])	656	715
h) Cases treated at health centre OPD ([b]x[c])	860	934
i) Cases treated at health centre PW ([b]x[e])	322	350
2) **Hospital treatment cost (D)**		
j) OPD treatment cost[4] (D9.71 x [f])	4,252.98	4,631.67
k) PW treatment cost[5] (D231.55 x [g])	151,896.80	165,558.25
Total hospital treatment cost ([j]+[k])	156,149.78	170,189.92
3) **Health centre treatment cost (D)**		
l) OPD treatment cost[6] (D6.09 x [h])	5,237.40	5,668.06
m) PW treatment cost[6] (D113.23 x [i])	36,460.06	39,630.50
Total health centre treatment cost ([l]+[m])	41,697.46	45,298.56
Total health services treatment cost ([2]+[3])	197,847.24	215,488.48

1 Obtained from Table 6.5.
2 Obtained from MFCC study (the same proportion used for hospital and health centre irrespective of Intervention status).
3 Expert opinion from Drs Umberto D'Alessandro and Ben Olaleye.
4 Obtained from Table 6.2.
5 Obtained from Table 6.3.
6 Obtained from Table 6.4.

From Table 6.6, hospital treatment cost accounted for the largest share of the health service cost particularly PW treatment cost. This was due to the high hospital in-patient cost and the large proportion of cases at the hospital being hospitalized. The net annual savings to government in health services cost was the difference between the health services treatment cost without the intervention (D215,488.48) and the health services treatment cost with the intervention (D197,847.24). Thus, the net savings was D17,641.24.

6.3 Cost and saving in household expenditure

The MFCC study served to provide estimates for costs (direct and indirect) saved and borne by households with and without the intervention. Impregnated bednet interventions are observed to lead to an improvement in health (reduced morbidity and mortality) in the intervention areas (Alonso et al., 1991; D'Alessandro et al., In press). The 3 different costs borne by households were the treatment cost, cost of burial, funeral and mourning (*'charity'*) and the cash income lost by households due to child deaths. There were indirect costs associated with some of these direct costs borne by the households as well.

6.3.1 Child health care within the household

One crucial point that requires some description which was closely related to the cost borne, and savings made, within the household was health care responsibilities within the household. This determines who normally pays for household health bills, the type of treatment usually sought and who seeks or accompanies the patient for treatment. The situation in rural Gambia is discussed below.

6.3.1.1 Child health care responsibilities within the household

Findings from the qualitative studies (focus group discussions and in-depth interviews) revealed that men usually provide money for the treatment cost of their household members. This is apparently due to the fact that in most households they are the decision makers and overseer of compound resources. However, culturally, women are responsible for childcare. Women attested to this fact in their discussions. A typical example of one group response to this was;

> "Mod: What role does your husband and other men play when your child is sick?
> R1: They give us the money to pay for treatment.

R2: Sometimes they take the sick child to the village health post whilst we do the housework.
R3: They consult their '*marabou*' for medication.
R4: Some buy tablets from the village health post and dispensary for the sick child.
Mod: What happens if your husband is not around?
R1: You go to the compound head.
R2: I see my husband's brothers.
R3: Sometimes we go to our mother-in-laws or mothers.
R4: We pay for the treatment ourselves.
R5: If you are lucky you get your money back.
R(most women): Laughter.
R6: This is true (laughing)."

Thus, men act as providers of money and sometimes provide medication. In their absence, this role was invariably taken up by another male member of the extended family - the compound head or their brothers. This point was further strengthened by similar responses given by men;

"FW: Who provides the money for treatment and who normally takes the child for treatment?
Res: The father of the child provides money for the mother to take the child for treatment if need be. For example, in my compound and like most compounds I know of in this village, when one is sick, we first give him/her 'locally prepared medicine for instance, if a child has 'hot-body' (fever), we prepare a decoction of tomato leaves and '*nebe dai*' (local herb) to wash the child, then apply shea butter or cow oil all over the body and allow the child to rest. If the child's condition does not improve, then the mother takes the child to the health centre."

Most people also rely on local medicine (ie herbs) for the treatment of some childhood disease as indicated in the preceding example. These home-made medicines are usually prepared by old women (eg grandmothers) with esoteric knowledge.

It could be inferred from the previous illustration that women bear the greatest responsibility of the indirect cost of child treatment and ill-health care (ie treatment and caring times), whilst men take up the direct cost. The pronouncement made in both the focus group discussions and the in-depth interviews was well supported by the results of the MFCC study. It was reported by mothers/carers in both fatal and non-fatal cases that fathers normally pay for their children's treatment costs, and mothers were saddled with the responsibility of taking the sick child to the agreed treatment centre. Eighty seven percent of mothers (n=117) of all fatal cases mentioned that their husbands normally pay for the treatment of their children likewise 96% of mothers (n=128) of all non-fatal cases said the same thing. Moreover, mothers and carers of both fatal and non-fatal cases attested to the fact that it was their duty to take their sick child for treatment when the need arose. Of which mothers form 91% (n=122) in all fatal cases and 96% (n=128) in all non-fatal cases.

6.3.1.2 Various treatment centres used by the household

The sources of treatment available in rural Gambia are village health posts (staffed by a village health worker (VHW)), community health nurses (CHNs), health centres, dispensaries/shops/pharmacies, '*marabous*' (traditional religious healers) and a hospital (eg Bansang hospital). The pattern of attendance (visit) to these treatment sources by both fatal and non-fatal cases is presented in Table 6.7.

In all, a maximum of 5 visits were made by some fatal cases and non-fatal cases. The most visited treatment source on different occasions for treatment were the hospital, the health centres and the '*marabous*' by fatal cases. Whilst non-fatal cases utilized the village health post, the health centre and the dispensary/shop/pharmacy. Of the 99 fatal cases that sought first treatment at the 6 various treatment sources available, 31% (n=31) made second visits to 5 of the 6 treatment centres in the community, 14% (n=14) made third visits to the 5 treatment sources, 9% (n=9) made fourth visits to 4 treatment sources and 3% (n=3) made fifth visits to 3 treatment sources prior to death. Similarly, for non-fatal cases, of the 56 cases who sought first treatment at the 6 treatment sources, 50% (n=28) made second visits again to 6 treatment sources and 11% (n=6) made third visits to 3 treatment sources. However, as expected in both fatal and non-fatal cases the number of patients decreased with visits as shown in Table 6.7. The pattern of visits amongst the study children was not clear and depended much on the households' treatment experiences and resources available at the time of illness. This suggests that some visits to the treatment centres have not resulted in cure and repeated visits might be attributable to referrals, continuous observation, 'shopping around' and/or authorised call backs.

Table 6.7 Treatment sources used by households of sick children

Study children (1-9 years)	Treatment source	Treatment visits made to treatment source (%)					
		First	Second	Third	Fourth	Fifth	All visits
Fatal cases	VHW	17.2	12.9	-	-	-	13.5
	CHN	5.1	6.5	7.1	-	-	5.1
	Health centre	33.3	45.2	50.0	66.7	33.3	39.1
	Dispensary/shop / pharmacy	2.0	-	14.3	11.1	-	3.2
	'Marabou'	3.0	16.1	7.1	11.1	33.3	7.1
	Hospital	39.4	19.4	21.4	11.1	33.3	32.1
	Total cases (n)	99	31	14	9	3	156
Non-fatal cases[a]	VHW	39.3	25.0	16.7	-	-	34.1
	CHN	17.9	25.0	-	-	-	19.3
	Health centre	17.9	32.1	66.7	-	-	26.1
	Dispensary/shop / pharmacy	1.8	3.6	16.7	-	-	3.4
	'Marabou'	1.8	10.7	-	-	-	4.5
	Hospital	21.4	3.6	-	-	-	12.5
	Total cases (n)	56	28	6	-	-	90

a Obtained from the control cases of the MFCC study.

As reported above, there was overwhelming evidence from the focus group discussion and in-depth interviews that mothers usually take their sick children for treatment. This was supported by the results from the MFCC study indicating that carers who normally accompany the patients for treatments were mostly mothers. Others are grandmothers, elder sisters and fathers in that order. For fatal cases, 83% (n=82) of the mothers went with their children to seek treatment on first visits, 71% (n=22) on second visits, 64% (n=9) on third visits, 89% (n=8) on fourth visits and all mothers went with their wards on the fifth visits. The same trend was observed in non-fatal cases; 98% (n=55) of mothers went with their sick children on first visits, 83% (n=23) on second visits and all third visits was undertaken by the mothers.

6.3.1.3 Mean number of sick days per illness episode

Results from the MFCC study indicate that the mean number of sick days per episode for fatal cases was 1.13 days (95% CI: 0.04, 2.22) and that of non-fatal cases was 3.99 (95% CI: 2.81, 5.16). Fatal cases have a comparatively shorter duration of an illness episode than the non-fatal cases. This was plausibly due to the fact that fatal episodes have an end-point - death, whereas in non-fatal episodes there was the likelihood that the time of recuperation might have been taken into consideration by the carers. This was evident in the relatively wider confidence interval of the non-fatal cases estimate. There was no statistically significant difference in the mean number of days ill between fatal cases with and without NIBP intervention (Kruskal-Wallis $H=0.4$; $df=1$; $p=0.5$) and also between sick non-fatal cases with and without NIBP intervention (Kruskal-Wallis $H=1.14$; $df=1$; $p=0.3$).

6.3.2 Consequences for the household expenditure

6.3.2.1 Annual treatment cost borne by the household

The treatment cost was made up of cost of traditional and modern medicines as well as special food. Table 6c in Appendix 3 gives the mean[17] treatment costs incurred by households at the health facilities. Estimation of the resource use consequences for household expenditure in terms of treatment cost with and without the intervention required assumptions on the proportion of patients seeking treatment and the mean treatment cost per case. It was assumed that the mean treatment cost per case would remain the same irrespective of the intervention. There is no statistically significant difference in mean treatment cost within cases with and without NIBP intervention for household OPD expenditure (Kruskal-Wallis $H=0.8$; $df=1$; $p=0.4$) likewise that of household PW expenditure (Kruskal-Wallis $H=0.08$; $df=1$; $p=0.8$). Thus the overall adjusted mean treatment costs for OPD and PW were used in the calculations (see Table 6c).

A summary of the estimation of the resource use consequence for household expenditure is presented in Table 6.8. Table 6.8 shows that household expenditures for both hospital and health centre PW were higher compared with OPD treatment costs. This was due to PW cost. For household OPD treatment cost, the health centre cost was higher compared to that of the hospital due to more cases visiting the health centre OPDs. Hence, the net savings in household expenditure on treatment was the difference between the total household treatment cost without (D18,916.44) and with (D13,402.68) the NIBP intervention. Therefore, the net annual saving made in household expenditure on treatment was D5,513.76.

[17] Log transformation due to skewness of data

Table 6.8 Annual household treatment cost (D) borne

Items	Intervention status	
	With NIBP	Without NIBP
a) Cases at hospital OPD[1]	438	477
b) Cases at hospital PW[1]	656	715
c) Cases at health centre OPD[1]	860	934
d) Cases at health centre PW[1]	322	350
e) Fatal cases at hospital PW[2]	52	65
f) Fatal cases at health centre PW[2]	64	79
g) Adjusted mean household treatment cost (D) for fatal cases at hospital PW[3]	9.78	9.78
h) Adjusted mean household treatment cost (D) for fatal cases at health centre PW[3]	8.50	8.50
i) Adjusted mean household treatment cost (D) for non-fatal cases at hospital OPD[3]	3.27	3.27
j) Adjusted mean household treatment cost (D) for non-fatal cases at hospital PW[3]	8.33	8.33
k) Adjusted mean household treatment cost (D) for non-fatal cases at health centre OPD[3]	3.05	3.05
l) Adjusted mean household treatment cost (D) for non-fatal cases at health centre PW[3]	8.79	8.79
m) Household treatment cost at hospital PW ([b]x[j])+([e]x[g])	5,973.04	6,591.65
n) Household treatment cost at health centre PW ([d]x[l])+([f]x[h])	3,374.38	3,748.00
o) Household treatment cost at hospital OPD ([a]x[i])	1,432.26	1,559.79
p) Household treatment cost at health centre OPD ([c]x[k])	2,623.00	3,269.00
Total household treatment cost (D) ([m]+[n]+[o]+[p])	13,402.68	18,916.44

1 Obtained from Table 6.6.
2 Obtained from Table 6.5 (deaths occurring at OPDs were negligible).
3 Obtained from Table 6c in Appendix 3.

6.3.2.2 Annual preventive expenditure borne by households

Expenditure on anti-mosquito preventive measures took the form of burning repellents such as mosquito coils and '*churai*[18]'. In the intervention areas, 27% (16) of the carers of fatal cases and 33% (19) of non-fatal cases claimed they do use mosquito coils in the year. Whilst in the non-intervention areas it was 24% (18) and 34% (25) of the cases respectively. In the case of '*churai*' the proportion of usage was higher; in the intervention area 90% (53) of fatal cases and 91% (54) of

[18] Locally perfumed resin and wood kernel, Aikins et al., (1993)

non-fatal cases used *'churai'* in the year. Whereas in the non-intervention areas, 89% (67) of fatal cases and 91% (68) of non-fatal cases used *'churai'*. There was no statistically significant difference in annual expenditure on mosquito coils in intervention and non-intervention areas between fatal cases (Kruskal-Wallis H=0.06; df=1; p=0.8) and for non-fatal cases (Kruskal-Wallis H=2.13; df=1; p=0.15). The mean annual expenditure on mosquito coils for fatal cases was D49.09 (95% CI: 47.77, 50.41) and for non-fatal cases D46.56 (95% CI: 45.28, 47.84). There was also no statistically significant difference in annual expenditure on *'churai'* in intervention and non-intervention areas for fatal cases (Kruskal-Wallis H=1.18; df=1; p=0.3) and for non-fatal cases (Kruskal-Wallis H=0.2; df=1; p=0.6). The mean annual expenditure on *'churai'* for fatal cases was D40.74 (95% CI: 39.55, 41.93) and non-fatal cases D46.60 (95% CI: 45.44, 47.76). A summary of the estimation of the household expenditure on these preventive measures are presented in Table 6.9.

The net annual household expenditure on mosquito coils saved was the difference between areas without (D314,403.97) and with (D305,591.48) the intervention, which was D8,812.49. Similarly, the net annual household expenditure on *'churai'* saved was the difference between areas without (D843,144.94) and with (D843,483.98) the intervention. The expenditure on *'churai'* as expected was higher because it was used extensively in rural Gambia (Aikins et al., 1993) and also readily available at the *'lumos'* (local weekly markets). The net annual *'churai'* cost saved -D350.26. The negative values of the expenditure on *'churai'* suggest that the expenditure on *'churai'* was higher in the intervention than the non-intervention areas. However, the net annual household expenditure on preventive measures saved was D8,473.51.

Table 6.9 Annual household preventive expenditure (D) on mosquito coils and *'churai'*

Items	Intervention status	
	With NIBP	Without NIBP
1) **Mosquito coils annual expenditure (D)**		
a) No. of deaths[1]	163	203
b) Exposed population[1]	19,749	19,709
c) Proportion of fatal cases who used mosquito coils[2]	0.27	0.24
d) Proportion of non-fatal cases who used mosquito coils[2]	0.33	0.34
e) No. of fatal cases who used mosquito coils ([a]x[c])	44	49
f) No. of non-fatal cases who used mosquito coils ([b]x[d])	6,517	6,701
g) Mean annual expenditure on mosquito coils by fatal cases who spent something[3]	49.09	49.09
h) Mean annual expenditure on mosquito coils by non-fatal cases who spent something[3]	46.56	46.56
i) Total annual expenditure on mosquito coils by fatal cases ([e]x[g])	2,159.96	2,405.41
j) Total annual expenditure on mosquito coils by non-fatal cases ([f]x[h])	303,431.52	311,998.56
Total annual household expenditure on mosquito coils ([i]+[j])	305,591.48	314,403.97
2) ***'Churai'* annual expenditure (D)**		
k) Proportion of fatal cases who used *'churai'*[2]	0.90	0.89
l) Proportion of non-fatal cases who used *'churai'*[2]	0.91	0.91
m) No. of fatal cases who used *'churai'* ([a]x[k])	147	181
n) No. of non-fatal cases who used *'churai'* ([b]x[l])	17,972	17,935
o) Mean annual expenditure on *'churai'* by fatal cases who spent something[3]	40.74	40.74
p) Mean annual expenditure on *'churai'* by non-fatal cases who spent something[3]	46.60	46.60
q) Total annual expenditure on *'churai'* by fatal cases ([m]x[o])	5,988.78	7,373.94
r) Total annual expenditure on *'churai'* by non-fatal cases ([n]x[p])	837,495.20	835,771.00
Total annual household expenditure on *'churai'* ([q]+[r])	843,483.98	843,144.94
Total annual household expenditure on preventive measures ([1]+[2])	1,149,075.46	1,157,548.91

1 Obtained from Table 6.5.
2 Obtained from MFCC study.
3 Obtained from Table 6d in Appendix 3.

6.3.2.3 Annual burial, funeral and mourning (*'charity'*) cost of fatal cases borne by the household

In-depth interviews of male key informants showed that burial, funeral and mourning ceremonies are widely known as *'charities'* in The Gambia. This was well supported in this study, where 47% of occurrence of the total different words in the transcripts of the interviews were charities (referring to burial, funeral and mourning ceremonies). Respondents identified 4 types of *'charities'*, namely first day *'charity'*, third day *'charity'*, seventh day *'charity'* and fortieth day *'charity'*. These *'charities'* have socio-cultural connotations, moreover, not all the 4 *'charities'* were performed for every dead person, especially children. One comment of a key informant epitomizes all others;

> "FW: Now, lets talk about our *'charities'*. Why do we have different *'charities'*?
> Res: They all have different cultural implications.
> FW: What are the different *'charities'*?
> Res: They are the first day *'charity'*, the third day *'charity'*, the seventh day *'charity'* and the fortieth day *'charity'*.
> FW: How long does a *'charity'* take? I mean in terms of days, weeks or months?
> Res: Oh, *'charities'* takes only a day each.
> FW: Are the same *'charities'* observed for children and adults?
> Res: No, in adults the 4 *'charities'* are performed. But in children, we usually do the first 3 *'charities'* or the first day *'charity'* only, depending on the age of the dead child and the family finances.
> FW: Why do we perform these 4 *'charities'*?
> Res: The first day *'charity'* is to bury the body and mourn with the bereaved family. The third day *'charity'* is the day the dead loses spiritual contact with the living being. The seventh day *'charity'* is when the body starts decaying completely and the fortieth day *'charity'* is the final funeral rites which marks when the dead person joins its ancestors".

All Muslim burials take place within 24 hours of death. The *'fure loola'* (corpse washers) bathes and prepares the body. The corpse is then wrapped in white cloth and laid on a mat in-front of the mourners and sympathizers. Islamic prayers are said and rites performed for the dead person. This is followed immediately by the burial. After the burial, kola-nuts and rice cakes are usually distributed to mourners and sympathizers, amidst tributes being paid to the deceased.

Mourners and sympathizers are required to wait for the *'charity'* food (usually the most favoured food of the deceased). The last Islamic prayers are said after the *'charity'* meal to end the first day *'charity'*. Mourners and sympathizers express their condolence to and offer donations to the bereaved family and depart. The next *'charities'* are on the third, seventh and fortieth day after death. During all *'charities'*, meals are provided to the mourners.

Results of the MFCC study supported the fact that there were 4 charities performed for the dead in rural Gambia. However, not all these *'charities'* are performed for children. About 89% of the fatal cases households performed at least the first day *'charity'*. Thirty five percent (34.8%) cases had both first and third day *'charities'*, 40.9% had first, third and seventh day *'charities'* organised for them and only 1.7% received all the 4 *'charities'* and they were all boys.

The calculated mean net *'charity'* cost (difference between burial, funeral and mourning costs and donations given by sympathizers and mourners) was D38.99 (95% CI: 37.69, 40.29). There was no statistically significant difference between intervention and non-intervention areas (Kruskal-Wallis H=0.3; df=1; p=0.61).

However, deaths and the corresponding *'charity'* costs are not prevented but delayed for the future with the intervention. Thus childhood deaths are postponed to adult deaths. Moreover, when an adult dies, all the 4 *'charities'* are performed. The data obtained for the MFCC study suggest that the net *'charity'* of an adult was on average about twice that of a child. Therefore, the mean net *'charities'* cost for an adult death in the intervention area was D311.93. Using the approach of Picard et al., (1993) the net present value of the total *'charities'* cost was calculated as follows. Given that on average, most fatal cases lived for 2.5 years of their life expectancy of 43 years[19], with the intervention they would have a further 40.5 years to live. Using the discount rate 6%, the present value of the net *'charities'* cost per adult in the intervention area would be D30.32. The total *'charity'* cost borne by households with and without the intervention were calculated as follows. The number of deaths averted by NIBP was 40.56. The *'charity'* cost borne by households without the intervention was the number of deaths averted (40.56) multiplied by the mean net *'charity'* cost per child death (D38.99), which gave D1,581.43. Since in the intervention area childhood deaths would be delayed and would occur in adulthood, the *'charity'* cost borne by the households was the number of deaths averted multiplied by the present value of the net *'charities'* cost per adult (D30.32), which gave D1,229.78. The net savings in household expenditure on *'charity'* was the difference between the without (D1,581.43) and with (D1,229.78) the intervention. The net savings made in household expenditure on *'charity'* was D351.65.

6.3.2.4 Annual household cash income lost due to child deaths

Some bereaved households incurred further expenses in the form of household cash income lost due to the death of their children. Thirty-four percent (n=46) of fatal cases household members lost some household cash income. These are the cost of goods and services that household members lost. For example, some household members had to forgo trading, gathering and selling of firewood etc during the *'charity'* period. Others had to pay for farm labour to work on their farms. The mean household cash income lost was D42.66 (95% CI: 41.38, 43.94). There was no statistically significant difference in the household cash income lost between intervention and non-

[19]Obtained for Population & Housing census 1993, Preliminary report.

intervention areas (Kruskal-Wallis H=1.76; df=1; p=0.2). The estimation of the total household cash income lost with and without the intervention is shown in Table 6.10.

Table 6.10 Annual household cash income lost due to child death

Items	Intervention status	
	With NIBP	Without NIBP
a) No. of deaths[1]	163	203
b) Proportion of fatal cases who lost some household cash income[2]	0.34	0.34
c) No. of deaths who lost cash income ([a]x[b])	55	69
d) Mean household cash income lost (D)	42.66	42.66
Total household cash income lost (D) ([c]+[d])	2,346.30	2,943.54

1 Obtained from Table 6.5.
2 Obtained from MFCC study and was the same irrespective of the intervention.

The net saving in annual household cash income due to child death was the difference between the household cash income without (D2,943.54) and with (D2,346.30) the intervention. The net saving in household cash income was D597.24.

6.3.3 Consequences for lost work time by the household

Besides direct costs, the households also incurred indirect costs associated with treatment and '*charities*'. The different indirect costs are described and estimated below.

6.3.3.1 Annual work time lost by carers due to seeking treatment

During visits to treatment centres, the most frequent work left undone by carers in seeking treatment for children were agriculture, domestic chores, food processing and trading, with agriculture increasing consistently with the visits made by both fatal and non-fatal cases. For fatal cases, agricultural work left unattended ranged from 51% (n=50) on first visits to 100% (n=3) on fifth visits. Similarly, in non-fatal cases it ranged from 71% (n=40) on first visit to 100% (n=6) on the third and final visit. Household members usually undertook the work of the carers when they went seeking treatment for their ward, however, this depended on the nature of work, relationship between the carer and other household members, past experiences and the climatic season of the year. Carers who reported that they did not have any replacement for their work increased from first to the final visits to the treatment centres by work activities. For agricultural activities, non-replacements in fatal cases increased from 26% (n=13) on first visit to 100% (n=1) on fifth visit whilst in non-fatal cases, there were no replacements for agricultural work on all the visits made by carers. However, replacements for domestic, food processing and trading activities were easy to come by. In both fatal and non-fatal cases, carers who left these activities to seek treatment for their wards were replaced by either the co-wives, elder daughters, sisters and grandmothers in that order. Replacement for agricultural activities were mainly undertaken by farming partners, co-wives, daughters, grandmothers, mother-in-laws in that order and in one instance a husband. This work substitution apparently reflects the task, location of activities, leisure time and whether the helper can take on extra work. Since most female farms (mainly rice farms in swamps) are located on the outskirts of the villages (which requires some travelling and carrying of farming implements) and most people were farming around the same time, farm labour substitution was always in short supply. However, domestic chores, food processing and trading activities are mainly carried out in the village (ie in or around the compound) and done on a roster basis, are therefore relatively easy to find helpers within the compounds of the village.

Work time lost due to seeking treatment has an opportunity cost to the mothers, because they could have spent that time on productive ventures. There was no statistically significant difference between fatal and non-fatal cases in work time lost for hospital OPD visits (Kruskal-Wallis H=0.02; df=1; p=0.9) as well as health centre visits (Kruskal-Wallis H=0.01; df=1;

p=0.9). It was difficult for carers to estimate their treatment seeking time for in-patient cases, because they could not fully describe their activities at the health facilities. Moreover, personal observation suggest that there is household 'labour substitution' in such situations. Therefore the analysis was restricted to out-patient cases only. The overall mean work time lost by carers of fatal and non-fatal cases was used in the calculation (see Table 6c in Appendix 3). A summary of the estimated work time lost by carers due to seeking treatment is presented in Table 6.11.

Table 6.11 Estimated work time lost by carers due to seeking treatment

Items	Intervention status	
	With NIBP	Without NIBP
a) No. of cases at hospital OPD[1]	438	477
b) No. of cases at health centre OPD[1]	656	715
c) No. of fatal cases at hospital OPD[2]	52	65
d) No. of fatal cases at health centre OPD[2]	64	79
e) Proportion of fatal cases treated at OPD[3]	0.4	0.4
f) No. of fatal cases at hospital OPD ([c]x[e])	21	26
g) No. of fatal cases at hospital OPD ([d]x[e])	26	31
h) Mean work time (hours) lost by carers of sick fatal cases seeking treatment at hospital OPD[4]	2.50	2.50
i) Mean work time (hours) lost by carers of sick fatal cases seeking treatment at health centre OPD[4]	2.17	2.17
j) Mean work time (hours) lost by carers of sick non-fatal cases seeking treatment at hospital OPD[4]	5.87	5.87
k) Mean work time (hours) lost by carers of sick non-fatal cases seeking treatment at health centre OPD[4]	4.82	4.82
l) Work time (hours) lost by carers of sick fatal cases ([f]x[h])+([g]x[i])	108.92	132.27
m) Work time (hours) lost by carers of sick non-fatal cases ([a]x[j])+([b]x[k])	5,732.98	6,246.29
Total work time (hours) lost by carers ([m]+[n])	5,841.90	6,378.56

1 Obtained from Table 6.8.
2 Obtained from Table 6.5.
3 Obtained from Table 6.6.
4 Obtained from Table 6c in Appendix 3.

Table 6.11 shows the main influencing factor in work time lost was the number of cases seeking treatment at the health centre OPD. The net savings in work time (hours) was obtained as the difference between without (6,378.56) and with (5,841.90) the intervention work times lost. Hence the net work time saved by carers from seeking treatment was 536.66 hours.

6.3.3.2 Annual work time lost by carers due to ill-health care

The analysis of the random spot observation (RSO) study provided the time cost of childcare which was corroborated by results of the focus group discussion with women. Descriptive analysis of the random spot observation is presented in Appendix 3.

Analyses of the domestic activities category (by specific domestic activity performed) showed that a third (33%) of all domestic activities such as food processing (pounding grains such as rice and millet), fetching and gathering of firewood and washing utensils is done jointly with childcare - "carrying the child on the back". Observations show that children carried on the back are invariably those under 2 years' old and likely to be still breastfeeding. However, older children who are sick are frequently carried on the back by carers to treatment centres[20] and also to enable the child to relax and sleep, and the carer to perform her work. Thus "carrying the child on the back" by carers is one of the popular childcare activity in rural Gambia. This observation has also been shown in AWA[21]. It shows a diagrammatical representation of a woman's daily work in rural Gambia. Women are alleged to spend about 1.5 hours/day in exclusive childcare activities such as bathing and feeding the child. The joint activity nature of childcare (ie "carrying the child on the back") has also been depicted in 3 of their daily activities, namely, going to the farm, fetching firewood and

[20] Village health posts, health centres, dispensaries, clinics, hospital and traditional healers centres.

[21] AWA (the Gambian Women's Development Journal), Special Edition, February, 1990.

grains processing which were also mentioned in the focus group discussion with women.

The mean time that women spend on average in the 14 hour wake-period in a day (6.00am to 8.00pm in this study) on these daily activities in rural Gambia were estimated by multiplying the proportion of spot observations per activity with the length of the wake-period of the observations (14 hours). Thus, the time spent on each activity per day were as follows; domestic activities 5.68 hours/day, other miscellaneous activities 4.51 hours/day, productive activities 1.92 hours/day, childcare alone 1.02 hours and social activities 0.87 hours/day in that order.

Childcare was also observed to be done jointly with other household maintenance activity, which is difficult to apportion accurately. In this study, joint activity was apportioned equally since they are performed together. Therefore, the total childcare time in a day was taken as the sum of the 50 % share of childcare activity of domestic activities (ie 0.5 of a third of domestic activities time; 0.5 x 0.33 x 5.68) plus the time of observed childcare done exclusively (1.02). Thus, the total childcare time in the 14 hour wake-period was 1.96 hours.

The specific childcare activities identified were carrying the child (on the back)/holding/sitting with carer, dressing/clothing, bathing/washing/defecating, feeding/breastfeeding, comforting the child, ill-health care, playing with the child and other miscellaneous activities. Ill-health care (ie carrying the sick child, preparing/taking the child for treatment, putting the sick child to sleep, administering medicine and food and comforting/encouraging the sick child) of carers with sick child took up an additional 17.9% of their time. Therefore, carers of sick children spent approximately ([14-1.96] x 0.179) 2.16 hours/day/child on ill-health care (during the wake-period). This estimate only corresponds to time spent on the specific ill-health care activities mentioned above. However, some health care aspects were embedded in general childcare when the child was sick. For example, feeding, bathing, comforting and putting the sick child to sleep. This was difficult to ascertain and single out, partly because most child caretaking activities were routine activities irrespective of the health status of the child.

Further information gathered from focus group discussion with women alluded to the fact that in cases where a mother attended to a sick child and depending on the perceived state of the ailment, household chores were done alongside child and ill-health care or by older daughters, however, sometimes co-wives took up these activities. In other cases, farming work was delayed or taken up by co-wives or working partners and sometimes by husbands, depending on the ownership of the farm or the tenure of the farm land. The additional carers time taken up by sick children (ie 2.16 hours/day/child) was more likely to be time forgone in productive and/or domestic activities. Furthermore, ill-health care is usually offered at home and requires the presence of the carer at most times.

The total work time lost (ie ill-health care time) by carers of sick children with and without the intervention is summarised in Table 6.12 below. It was assumed that ill-health care pattern and time was unaffected by the intervention. Table 6.12 indicates that the important factor affecting work time lost due to ill-health care was the sick non-fatal cases.

Table 6.12 Estimated work time lost by carers due to ill-health care

Items	Intervention status	
	With NIBP	Without NIBP
a) No. of sick fatal cases[1]	163	203
b) No. of sick non-fatal cases[1]	8,018	8,672
c) Mean no. of days ill by fatal cases[2]	1.13	1.13
d) Mean no. of days ill by non-fatal cases[2]	3.99	3.99
e) Ill-health care time (hours)	2.16	2.16
f) Work time (hours) lost due to care of sick fatal cases ([a]x[c]x[e])	397.85	495.48
g) Work time (hours) lost due to care of sick non-fatal cases ([b]x[d]x[e])	69,102.33	74,738.77
Total work time (hours) lost due to ill-health care ([f]+[g])	69,500.18	75,234.25

1 Obtained from Table 6.5.
2 Obtained from section 6.3.1.3 in Chapter 6.

The net savings in work time (hours) as a result of the impact of the intervention on ill-health care was the difference between the without (75,234.25) and with (69,500.18) the intervention ill-health times lost. The net work time saved by carers on ill-health care was 5,734.07 hours.

6.3.3.3 Annual work time lost by compound members due to burial, funeral and mourning (*'charity'*) activities

The time cost associated with *'charity'* activities varied with the gender of adult household members, partly due to different roles played by genders in *'charity'* activities. Secondly, because of division of labour by gender in the society. The main occupation in rural Gambia is subsistence farming, although, they all work on grains, women grow rice and vegetables, whilst groundnuts and millet (*'coos'*) are the men's preserve. Traditional ethos requires deceased families to temporarily stop all productive activities during the *'charity'* periods. These periods are denoted for "showing last respect to the dead person" by all family members, sympathizers and mourners. In all, 610 adult[22] men in deceased

[22]Persons aged 15 years and over were considered by the community as adults

compounds stopped work, of which, 85% (n=519) were household members and 15% (n=91) were other residing members in the compound. Moreover, 723 adult women also stopped work, of which, 83% (n=598) were household members and the remainder (17%) were other compound members. The most frequent work that was left undone due to the *'charity'* activities by these deceased compound members was agricultural activities; 97.4% (n=594) men and 94.9% (n=686) women. Table 6e in Appendix 3 shows the mean number of adults and work time lost by compound members due to *'charity'* activities. Table 6.13 shows the estimation of the work time lost by adults due to *'charity'* activities. The net work time (hours) saved from *'charity'* activities was the difference between without (3,291.27) and with (169.88) the intervention work times lost. The net work time saved by compound members from *'charity'* activities was 3,121.39 hours.

Table 6.13 Estimated work time lost by adults due to *'charity'* activities

Items	Intervention status	
	With NIBP	Without NIBP
a) No. of deaths averted[1]	40.56	40.56
b) Mean no. of men who stopped work due to *'charity'* activities[2]	2.68	3.73
c) Mean no. of work hours lost by men work due to *'charity'* activities[2]	7.96	11.61
d) Mean no. of women who stopped work due to *'charity'* activities[2]	3.13	3.85
e) Mean no. of work hours lost by women work due to *'charity'* activities[2]	6.93	9.86
f) No. of men who stopped work due to *'charity'* activities ([a]x[b])	109	151
g) No. of women who stopped work due to *'charity'* activities ([a]x[d])	127	156
h) Total work hours lost by men ([c]x[f])	84.33[3]	1,753.11
i) Total work hours lost by women ([e]x[g])	85.55[3]	1,538.16
Total adult work hours lost ([h]+[i])	169.88	3,291.27

1 Obtained from Table 6.5.
2 Obtained from Table 6e in Appendix 3 and was assumed that the same number of compound members would stop work and the work time lost would be the same for each charity in adults.
3 Present value of work time lost by gender (Original values were discounted at 6% and 40.5 years of useful life).

6.3.3.4 Valuation of work time lost and saved by the household

The approach of valuing indirect costs used by Picard et al., (1993) in a similar programme was adopted. However, the rates for the marginal value of working on groundnuts (D1.58/hour) and traditional rice (D0.68/hour) were adjusted from their 1990 values by the rise in the published agricultural producer prices (NADC, 1992) of groundnut (0%) and rice (50%) to reflect the time interval between the 2 studies. These adjusted rates were D1.58/hour for groundnut and D1.02/hour for rice. Since the work time lost to households in relation to gender are known, they were valued accordingly with these adjusted rates for working on groundnuts (men) and rice (women) as shown in Table 6.14. The study by Picard et al., (1993) also showed that cultivation of these crops were gender specific. Moreover, the agricultural activities undertaken by the majority of adults at the time of the study, reflects their work time on these two main crops. Thus, work time lost and saved by households was assumed to be on agricultural activities since it was the farming season in rural Gambia.

Table 6.14 shows that the work time lost without the intervention was higher than that with the intervention for health seeing and care, resulting in net gains to the household with the implementation of the control programme. The work time saved by households was more pronounced in ill-health care than in treatment seeking.

However, the value of the work time gained was higher in the non-intervention area compared with the intervention area. The net total household work time saved was valued at D24,647.10.

Table 6.14 Summary of the value of work time lost and saved by households[1]

Type of work time	Gender	Work time lost		Net savings in work time[2]
		Without NIBP	With NIBP	
1) Work time (hours)				
Treatment seeking	Women	6,378.56	5,841.42	537.14
Ill-health care	Women	75,234.25	69,500.18	5,734.07
'Charity'	Women	1,538.16	85.55	1,452.61
	Men	1,753.11	84.33	1,668.78
Total	All	84,904.08	75,551.48	9,392.60
2) Value of work time (D)				
Treatment seeking	Women	6,506.13	5,958.25	547.88
Ill-health care	Women	76,738.94	70,890.18	5,848.76
'Charity'	Women	1,568.92	87.26	1,481.66
	Men	2,769.91	133.24	2,636.67
Total (D)	All	87,583.90	77,068.93	10,514.97

1 Values obtained from Tables 6.12, 6.13 and 6.14.
2 Total work time lost without the NIBP minus total work time lost with NIBP.

6.4 Summary

The resource use consequences of NIBP intervention showed gains to both government and household in terms of treatment costs. The government health services treatment cost saved was estimated at D17,641.24. On the other hand, the net household expenditure saved on treatment was D11,909.91 (for both direct and indirect costs). The indirect cost to households of importance is ill-health care of sick children, which took an additional 18% of carers time aside from the usual childcare time. There were savings on annual preventive expenditure on mosquito coils and *'churai'* of D8,473.51. In addition, households who experienced childhood deaths, also saved D4,469.98 on *'charity'* expenses (for both direct and indirect costs) and a further D597.24 on household cash income attributable to the deaths.

Having calculated the necessary costs and effects of the NIBP intervention in chapters 5 and 6, the next chapter pools them together in the estimation of various cost-effectiveness ratios. In addition, the assumptions underlying the calculations of the costs and effects are tested with sensitivity analysis.

CHAPTER 7: COST-EFFECTIVENESS RATIOS OF NIBP INTERVENTION

7.1 Introduction

This final results chapter of the study deals with the various cost-effectiveness ratios of NIBP and sensitivity analysis of the costs and health effects. Since cost-effectiveness analysis is a comparative technique, NIBP is compared with the existing practice of malaria control measures used in rural Gambia. This is mainly the use of ordinary bednets as have been shown by earlier studies (Bradley et al., 1986; MacCormack & Snow, 1986; Campbell et al., 1987; MacCormack et al., 1989; Aikins et al., 1993). Other control measures used are the burning of mosquito coils and *'churai'* (Snow et al., 1987 and Aikins et al., 1993), however, observation have shown that they are not popularly used as much as bednets in rural Gambia. It is worthwhile noting that, NIBP only provided insecticide for impregnation (ie treatment) of existing bednets and did not provide bednets. Studies have shown that ordinary bednets offered some protection to users (Bradley et al., 1986 and Campbell et al., 1987).

The chapter is divided into 2 sections. The first section provides the unit costs in terms of cost-effectiveness ratios and a comparison of NIBP to the existing practice (without NIBP). The second and last section covers the sensitivity analysis of the costs and health effects of NIBP intervention. In sum, this chapter pulls together the costs and effects estimates on NIBP which illustrates the resources required for example to prevent cases and deaths. However, the relative value of these ratios requires some comparison with similar ratios of other health programmes (Mills, 1993) in order to relate it into a broader context.

7.2 Cost-effectiveness ratios of NIBP

The effectiveness indicators of NIBP used in the calculation of the implementation cost-effectiveness ratios were deaths averted, illness (case) averted, child-year gained, population in treated villages, number of treated bednets and number of people sleeping under treated bednets. The estimates of NIBP study area implementation cost and the various indicators of effectiveness were then combined to yield the NIBP implementation cost-effectiveness ratios reported in Table 7.1

The calculated cost-effectiveness ratios are shown in Table 7.1 using the study area's share of NIBP implementation cost (section 5.2.4 in Chapter 5) and its effectiveness indicators. Estimates were also made of NIBP implementation cost plus the cost of bednets as shown in the last column of Table 7.1. Table 7.1 shows that all the cost-effectiveness ratios increase by 2.5 times with the inclusion of bednet cost to the NIBP implementation cost. The estimated implementation cost per death averted and case prevented were D4,947 (US$600) and D283 (US$34) respectively. The cost per child-year protected was D10 (US$1). The cost per discounted life year gained (DLYG) by children (1-9 years) due to NIBP intervention was D328 (US$40), about 3 times that of the undiscounted value. The implementation cost per capita was D3 (US$0.4) whilst the cost per impregnated bednet was D11 (US$1) and the cost per person sleeping under impregnated bednet was D6 (US$0.7). Thus, Table 7.1 provides a wide range of NIBP implementation cost-effectiveness ratios.

Table 7.1 Implementation cost, effectiveness and cost-effectiveness of NIBP, 1992

Cost (D)		NIBP	NIBP (plus bednet cost[a])
Total NIBP implementation cost (D)		757,874.72	1,906,727.10
Study area's share (26.47%) of NIBP implementation cost		200,635.46	504,710.66
Items	Effectiveness indicators	Cost-effectiveness ratios	
		NIBP	NIBP (plus bednet cost)
Cost[b]/death averted:			
Deaths averted	40.56		
Cost/death averted		4,946.63	12,443.56
Cost/illnesses (cases) averted:			
Illnesses (cases) averted	707.81		
Cost/illness prevented		283.46	713.06
Cost/child-year protected:			
No. of child-year protected[c]	19,912		
Cost/child-year protected		10.08	25.35
Cost/life year gained:			
Life expectancy at death (years)[d]	43		
Mean age at death (years)	2.5		
Difference (years)	40.5		
DLYG[e]/death averted	15.09		
Cost/ULYG[f]		122.14	307.25
Cost/DLYG		327.81	824.62
Cost/capita:			
No. of persons protected[c]	62,550		
Cost/capita		3.21	8.07
Cost/impregnated bednet:			
No. of impregnated bednet[g]	18,879		
Cost/impregnated bednet		10.63	26.73
Cost/person sleeping under impregnated bednet:			
No. of persons sleeping under impregnated bednet[h]	33,793		
Cost/person sleeping under impregnated bednet		5.94	14.93

a Annualized cost of bednet at 6% discount rate and a useful life of 6 years (Aikins et al., 1993).
b Refers to study area's share of NIBP implementation cost (D). (Exchange rate in June 1992; £1.00 = D15.70 & US$1.00 = D8.25).
c Obtained from NIBP census data.
d Obtained from Population & Housing census 1993, Preliminary results.
e Discounted life year gained [discounted at 6%] = cost per death averted divided by 15.09.
f Undiscounted life year gained = cost per death averted divided by 40.56.
g Obtained from NIBP Implementation office.
h Mean number of persons sleeping under bednet (1.79), Bednet usage study (Aikins et al., unpublished).

The comparison of NIBP with the existing practice of using ordinary bednets (referred to as "without NIBP") is presented in Table 7.2. Table 7.2 is a summary of the NIBP implementation cost and resource use consequences of NIBP results presented in Chapters 5 and 6 respectively. The share of the Implementation cost to the NIBP study areas was obtained from section 5.2.4 in Chapter 5. The net savings in government health services treatment cost with and without NIBP in the study areas was also obtained from section 6.2.6 in Chapter 6. Finally, the net household savings in expenditure on treatment, *'charity'*, cash income lost due to child death and preventive measures were obtained from sections 6.3.2.1, 6.3.2.2, 6.3.2.3, 6.3.2.4 and 6.3.3.4 (ie value of work time lost in treatment seeking and ill-health care), all in Chapter 6. Table 7.2 shows the net savings in both the control programme, government health services and household related expenditures. With the introduction of the NIBP, there was a saving of 34% on control cost, government health services cost was reduced by 8% and household saved 75% in *'charity'* expenditure, 20% on household cash income lost due to child death, 12% on treatment cost and 1% on other anti-mosquito preventive measures. The total net savings on resources used was 8%. The savings profile shows that the highest cost saved was on control programme (71%) followed by government health services (12%), household expenditures on treatment (8%), other anti-mosquito preventive measures (6%), *'charity'* (3%) and on cash income lost due to child death (0.4%). The overall result suggest that the net resource savings was about 73% the cost of NIBP in the study area. Thus, considering only the resources used in the NIBP and the resources that the programme saved, the NIBP could be justified.

Table 7.3 was generated from Table 7.2 showing the net cost-effectiveness ratios. The net cost per illness prevented

(D76.35) and death averted (D1,334.316) were positive showing that the net resource savings was less than the cost of the intervention. The final 2 cost-effectiveness ratios calculated the incremental cost per illness and death prevented as -D146.23 and -D2,551.90 respectively. The negative values suggest that NIBP implementation cost was less than the cost of the existing practice (ie using ordinary bednets).

Table 7.2 Cost[a] comparison with and without NIBP

Items	Cost (D)		Net savings[c] (D)	Savings profile[d] (%)
	Existing practice[b]	With NIBP		
Cost of control programme	304,140.69[e]	200,635.46[f]	103,505.23 (34%)[g]	70.61
Other household preventive measures[h]	1,157,548.91	1,149,075.46	8,473.51 (1%)	5.78
Government health services treatment cost[i]	215,488.48	197,847.24	17,641.24 (8%)	12.03
Household treatment expenditure (direct & indirect)[j]	102,161.51	90,251.60	11,909.91 (12%)	8.12
Household *'charity'* expenditure (direct & indirect)[k]	5,920.26	1,450.28	4,469.98 (75%)	3.05
Household cash income lost[l]	2,943.54	2,346.30	597.24 (20%)	0.41
Total net resource savings	1,788,203.39	1,641,606.34	146,597.11 (8%)	100.00

a All cost refers to NIBP study areas.
b Without NIBP intervention
c Cost of Existing practice (without NIBP) minus cost with NIBP.
d Net savings (c) divided by total net resources savings (D146,597.11).
e Annualized cost (D) of bednets in the study areas (18,879) prior to NIBP costed as the cost of the community control programme.
f Share of NIBP implementation cost to the study areas (see section 5.2.4 in Chapter 5).
g Percent savings equals Net savings divided by Existing practice cost.
h Obtained from Table 6.9 in Chapter 6.
i Obtained from Table 6.6 in Chapter 6.
j Obtained from Tables 6.8 and 6.15 in Chapter 6.
k Obtained from Tables 6.10 and 6.15 in Chapter 6.
l Obtained from Table 6.11.

In the estimation of the cost-effectiveness ratios, some uncertainties were encountered in some aspects of the data used and in other cases assumptions or proxies had to be used. To check the overall effects of such uncertainties and assumptions on the conclusions of the research, a simple and multi-way sensitivity analyses were carried out. However, for comparability of this research with other studies which do not address the issue of resource use consequences of the control programme, the focus of the sensitivity analysis was more biased towards the NIBP implementation cost and effects. The parameters tested and results are described in the next section.

Table 7.3 Net cost-effectiveness ratios

Items	Cost/effectiveness ratio
Net cost per illness prevented[a] (D)	76.35
Net cost per death averted[b] (D)	1,332.31
Incremental cost per illness prevented[c] (D)	-146.23
Incremental cost per death averted[d] (D)	-2,551.90

a NIBP implementation cost (D200,635.46) minus total resource savings (D146,597.11), divided by illness cases prevented (707.81).
b NIBP implementation cost (D200,635.46) minus total resource savings (D146,597.11), divided by deaths averted (40.56).
c NIBP implementation cost (D200,635.46) minus Existing practice cost (without NIBP) (D304,140.69), divided by illness cases prevented (707.81).
d NIBP implementation cost (D200,635.46) minus Existing practice cost (without NIBP) (D304,140.69), divided by deaths averted (40.56).

7.3 Sensitivity analysis of the costs and health effects

Both simple and multi-way sensitivity analyses were selected amongst the 4 options proposed by Briggs et al., (1994) because first the study data lent itself to such analysis. Secondly, it is straightforward and will allow the results of this study to be compared with other studies. Finally, it also handles all the 4 inherent uncertainties (data variability, generalization, extrapolation and analytical method) three of which were considered in this study. A summary of parameters considered in the simple sensitivity analysis are shown in the Table 7.4.

Table 7.4 Parameters considered for sensitivity analysis of costs and effects of NIBP

Areas of uncertainty	Parameters considered	Justification
1) Variability in sample data	Cost:	
	Insecticide	The cost of insecticide (permethrin) takes up a high proportion (69%) of the recurrent cost of NIBP implementation cost. Different insecticides have different dosages for net impregnation. NIBP used 250mg/m^2 dosage of permethrin, one of the minimum recommended dosages by WHO. Cost of the insecticide are related to the dosage. Thus other insecticides at similar dosages were used in the sensitivity analysis.
	Transportation	Transport operating cost for 2 years relating to the Sensitization & Awareness campaign was 41% of capital cost. The rate used for costing NIBP was that of an NGO (ie MRC) regarded in The Gambia to be running a efficient service (Langfield, personal communication). This rate is on the high side. However, there are no government or public rates for similar vehicles in The Gambia. Since in successive years the whole programme will be handed over to the government, an arbitrary figures of 50% and 150% of the MRC rates was applied in the sensitivity analysis.
	Personnel	Personnel cost constituted 16% of recurrent cost. There were 2 groups of personnel involved in NIBP implementation - government and NGOs. Government salaries were used for all NIBP personnel in the sensitivity analysis, again, since the programme was being handed over to the government for its continuation and sustainability.
	Capital items	Annualization of capital items was based on a discount rate of 6%. Other discount rates of 3% and 10% (Recommendation of Drummond et al., 1987) were used to ascertain their effect on the total NIBP implementation cost.
	Value of work time lost	Halving and doubling the value of work time lost due to treatment seeking and ill-health care, to ascertain the effect of a reduction or an increase in the selected variables on net savings and cost-effectiveness ratios.

Table 7.4 (continued)

Areas of uncertainty	Parameters considered	Justification
	Treatment costs	Halving and doubling the household expenditure on treatment and government health services treatment cost (with and without capital cost), number of cases seeking treatment, to observe the effect of a reduction or an increase in the selected variables on net savings and cost-effectiveness ratios.
	Effects:	
	Deaths averted	Variability of the estimate was shown by the confidence interval (CI). The CI values were used - the lower CI and the upper CIs respectively .
2) Generalization	Cost	
	NIBP Implementation cost	The cost of bednets was added to the NIBP Implementation cost to enable future comparison with other WHO/TDR sponsored trials (ie Burkina Faso, Ghana and Kenya) where nets formed part of the implementation cost.
3) Analytical method	Cost:	
	Total cost	Valuation of indirect costs remains a thorny issue in evaluation. Thus indirect costs and community costs were purposefully excluded from the total cost to ascertain its effect and to make this study comparable to previous study by Picard et al., (1993) in The Gambia.

Indirect cost (dippers time) was not considered in the sensitivity analysis because its total contribution to NIBP Implementation cost was negligible (about 3% of the recurrent cost in Chapter 5).

7.3.1 Using different insecticides

Recurrent cost accounts for over 80% of NIBP implementation cost (see Tables 5.3 in Chapter 5), of which 69% was due to the cost of insecticide. Although NIBP obtained its insecticide (permethrin) supplies from 4 main sources, namely, MRC, MoH, AATG and UNICEF, The Gambia, the price variations were very small. All the permethrin was imported and expensive. The NIBP target dose per net was one of the minimum WHO recommended dosages. Cost is directly related to the dosage of the insecticide. In view of this, the sensitivity analysis undertaken examined variations in target doses of other competing insecticides available to see their effect on the NIBP implementation cost and the implementation cost/effectiveness ratios. Some of these insecticides were being used in some African countries (eg Tanzania) and the Far Eastern countries (eg China) (Lines et al., 1987 and Lin, 1991) in similar projects. The cost of these insecticides were based on minimum target doses as well, but at 1994 prices. Attempts to obtain 1992 prices have proved difficult. It is assumed that since the insecticides were imported from developed countries, price variation due to inflation over the 2 year period was small and negligible. The insecticide used in the sensitivity analysis were K-othrine moustiquaire (deltamethrin), Imperator 25% EC (the content is permethrin) and ICON 10 CS (the content is lamdacyhalothrin).

The analysis shows a reduction in implementation cost and its related cost/effectiveness ratios ranging from 23 - 34%; deltamethrin 23%, ICON 33% and Imperator 34% (Table 7.5). The main plausible reasons for the use of permethrin in the Gambian programme (NIBP) may be due to its continuous use for nearly a decade, communities approval and no known side-effects to date. Thus, substituting NIBP permethrin with other insecticides would require trials to ascertain their effects on the Gambian vector species and also social acceptability.

Table 7.5 Sensitivity analysis using other insecticide apart from permethrin

Cost (D)	Selected insecticides			
	Permethrin (NIBP ie base case)	Deltamethrin	Imperator (permethrin)	ICON
Capital	104,390.39	104,390.39	104,390.39	104,390.39
Recurrent				
i) Insecticide	448,176.17	275,110.04	191.008.85	196,739.11
ii) Other	205,308.16	205,308.16	205,308.16	205,308.16
Total	757,874.72	584,808.59	500,707.40	506,437.66
Cost difference from base case (%)	na[a]	- 22.84	- 33.93	- 33.18
Cost/death averted[b]	4,946.63	3,816.54	3,267.68	3,306.08
Cost/case prevented[b]	202.38	156.15	133.69	135.22

a Not applicable
b Refers to NIBP study areas cost-effectiveness ratios.

7.3.2 Variation in transport running charges

Changing the transport running charges per kilometre by 50% and 150% led to a reduction and an increase of only 3% each in the overall implementation cost and its related cost/effectiveness ratios. This was negligible considering the fact that transport running cost constitutes about 7% of the NIBP implementation cost. Thus ratios were not sensitive to transport running charges used in the base case which were appropriate for the study (Table 7.6).

Table 7.6 Sensitivity analysis using different transport running cost of MRC

Cost (D)	Different transport running rates		
	50% MRC rate	Base case (NIBP)	150% MRC rate
Capital	98,204.77	104,390.39	110,600.23
Recurrent			
i) Insecticide	448,176.17	448,176.17	448,176.17
ii) Other	186,999.81	205,308.16	221,189.30
Total	733,380.75	757,874.72	779,965.70
Cost difference from base case (%)	- 3.23	na[a]	- 5.55
Cost/death averted[b]	4,786.14	4,946.63	5,090.16
Cost/case prevented[b]	195.81	202.38	208.25

a Not applicable
b Refers to NIBP study areas cost-effectiveness ratios.

Table 7.7 Sensitivity analysis using Gambian government salary rates for all NIBP personnel

Cost (D)	Different salary rate	
	All Government rates	Base case (NIBP)
Capital	104,390.39	104,390.39
Recurrent		
i) Insecticide	448,176.17	448,176.17
ii) Other	182,523.16	205,308.16
Total	745,089.72	757,874.72
Cost difference from base case (%)	- 1.69	na[a]
Cost/death averted[b]	4,862.56	4,946.63
Cost/case prevented[b]	198.94	202.38

a Not applicable
b Refers to NIBP study areas cost-effectiveness ratios.

7.3.3 Using government salary rates for NIBP personnel

Applying government salary rates to all the NIBP personnel, resulted in a reduction of 2% in the overall NIBP implementation cost and its related cost-effectiveness ratios. Again, this reduction does not alter the estimated costs and cost-effectiveness indicators much and was therefore negligible (Table 7.7).

7.3.4 Using different estimates of deaths averted

The sensitivity analysis of using the confidence interval of the estimated deaths averted from NIBP epidemiology data, enables the study to set upper and lower limits some of its cost/effectiveness indicators. The NIBP implementation cost per death averted was shown to range between D2,619.95 to D44,192.83. Further analysis shows that, if NIBP were to have the same deaths averted (ie 57.13) as in the previous controlled pilot study by Picard et al., (1993), the cost per death averted would have been reduced by 29% (ie D3,511.91). Similar reductions would have been obtained if the other insecticides (see Table 7.5) were used in the NIBP instead of permethrin (Table 7.8).

Table 7.8 Sensitivity analysis using different estimates of deaths averted and different insecticides

Cost (D)	Selected insecticides			
	Permethrin (NIBP)	Deltamethrin	Imperator (permethrin)	ICON
Capital	104,390.39	104,390.39	104,390.39	104,390.39
Recurrent				
i) Insecticide	448,176.17	275,110.04	191.008.85	196,739.11
ii) Other	205,308.16	205,308.16	205,308.16	205,308.16
Total	757,874.72	584,808.59	500,707.40	506,437.66
Cost/death averted[a] (NIBP)	4,946.63	3,816.54	3,267.68	3,306.08
Cost/death averted[a] (Lower CI)	44,192.83	34,096.66	29,193.23	29,527.32
Cost/death averted[a] (Upper CI)	2,619.95	2,021.40	1,730.70	1,750.51
Cost/death averted[b] (Picard et al., (1993)	3,511.91	2,709.59	2,319.92	2,346.47

a Refers to NIBP study areas cost-effectiveness ratios.
b Refers to NIBP study areas share of the NIBP implementation cost.

7.3.5 Using different discount rates

One of the key variables of the cost analysis was the discount rate used to annualize capital items. Drummond et al., (1987) recommended discount rates (3% and 10%) were used. Using a lower discount rate of 3% and a higher rate of 10% compared to the base value of 6% (ie NIBP), led to a reduction of about 1% and an increase of about 1% respectively in the NIBP implementation cost and its related cost/effectiveness indicators. However, changes in the discount rate had its big effect on cost per discounted life year gained; at 3%, there was a reduction of 36% and at 10%, an increase of 56%. Although capital cost accounts for about 14% of NIBP implementation cost, it was not very sensitive to different discount rates (Table 7.9).

Table 7.9 Sensitivity analysis using different discount rates for annualizing capital items

Cost (D)	Different discount rates		
	3%	Base case (NIBP)-6%	10%
Capital	97,551.90	104,390.39	114,034.48
Recurrent			
i) Insecticide	448,176.17	448,176.17	448,176.17
ii) Other	205,308.16	205,308.16	205,308.16
Total	751,036.23	757,874.72	767,518.81
Cost/death averted [a]	4,901.36	4,946.63	5,008.93
Cost/discounted healthy life year gained[a]	210.72	327.81	511.64
Cost/case prevented[a]	200.53	202.38	204.93

a Refers to NIBP study areas cost-effectiveness ratios.

7.3.6 Varying both the government and the household resources on treatment

The effect of varying both the government and households resources spent on treatment on the net cost-effectiveness ratios are shown in Tables 7.10 and 7.11. Table 7.10 shows the changes in treatment costs whilst Table 7.11 depicts the changes in number of cases seeking treatment. In Table 7.10, 4 different scenarios were taken; Scenario 1 shows the effect of arbitrary halving government health services treatment cost; Scenario 2 shows the effect of arbitrary halving all household expenditures; Scenario 3 shows the effect when both government health services treatment cost and household expenditures were halved and finally, Scenario 4 shows the effect of arbitrary doubling the health effects of NIBP. In all the scenarios, the net cost effectiveness ratios remained positive, but much bigger effect was observed when both the government health services and the household expenditures were halved (ie 63% increase in the ratios).

Table 7.10 Summary of sensitivity analysis of resource use consequences of NIBP[a]

Items	Net savings (D)				
	Base case[b]	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Total control measures cost[c]	111,978.74	111,978.74	111,978.74	111,978.74	111,978.74
Government health services treatment cost	17,641.24	8,820.62[d]	17,641.24	8,820.62[f]	17,641.24
Other household expenditures[g]	16,977.13	16,977.13	8,488.57[e]	8,488.57[f]	16,977.13
Total net savings (D)	146,597.11	137,776.49	138,108.55	129,287.93	146,597.11
Net cost per illness prevented[h]	76.35	88.81	88.34	100.80	38.17[j]
Net cost per death averted[i]	1,332.31	1,549.78	1,541.59	1,759.06	666.16[j]

a All costs and health effects were based on NIBP study areas.
b Refers to Net saving in Table 7.2.
c Sum of the cost of control programme and other household preventive measures.
d Halved government treatment cost.
e Halved household expenditures.
f Halved both government treatment cost and household expenditures.
g Sum of household expenditures on treatment, '*charity*' & cash income lost due to child death.
h NIBP implementation cost (D200,635.46) minus total net savings, divided by illnesses prevented.
i NIBP implementation cost (D200,635.46) minus total net savings, divided by deaths averted.
j Doubling health effects (illnesses prevented [1,415.62] and death averted [81.12]).

Further analysis showing the variation in the number of cases seeking treatment is presented in Table 7.11. Table 7.11 shows the comparison of 4 different scenarios of cases seeking treatment and treatment cost of both government and household. The scenarios were; 1) using 75% of illness cases of base case; 2) using 50% of illness cases of base case; 3) using 25% of illness cases of base case and 4) using direct costs of household expenditures. There was a gradual reduction in total net resources saved ranging from 5% in Scenario 1 to 15% in Scenario 3. All the net cost effectiveness ratios remained at their positive values. There was a 7% reduction in the net resources saved between the base case and Scenario 4 (without indirect household costs), resulting in a 19% increase in their corresponding ratios yet the ratios in Scenario 4 still remained positive. The variation shown in the ratios confirms its sensitivity to the number of cases seeking treatment.

Table 7.11 Summary of sensitivity analysis of resource use consequences of NIBP with variation in cases seeking treatment and treatment cost[a]

Items	Net savings (D)				
	Base case[b]	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Total control measures cost[c]	111,978.74	111,978.74	111,978.74	111,978.74	111,978.74
Government health services treatment cost	17,641.24	13,230.93[d]	8,820.62[e]	4,410.31[f]	17,641.24
Household treatment expenditure[h]	16,977.13	13,999.65[d]	11,022.18[e]	8,044.70[f]	6,462.65[g]
Total net savings (D)	146,597.11	139,209.32	131,821.54	124,433.75	136,082.63
Net cost per illness prevented[i]	76.35	86.78	97.22	107.66	91.20
Net cost per death averted[j]	1,332.31	1,514.45	1,696.60	1,878.74	1,591.54

a All costs and health effects were based on NIBP study areas.
b Refers to Net savings in Table 7.2.
c Sum of the cost of control programme and other household preventive measures.
d Cost based on 75% of illness cases in base case.
e Cost based on 50% of illness cases in base case.
f Cost based on 25% of illness cases in base case.
g Direct household costs only.
h Sum of household expenditures on treatment, *'charity'* & cash income lost due to child death.
i NIBP implementation cost (D200,635.46) minus total net savings, divided by illnesses prevented.
j NIBP implementation cost (D200,635.46) minus total net savings, divided by deaths averted.

7.3.7 Varying the analytical method

To make this study comparable with the previous study in The Gambia (Picard et al., 1993), the community implementation costs were excluded from the implementation cost. This led to a 7% reduction in the NIBP implementation cost and its related cost/effectiveness ratios as shown in Table 7.12.

Table 7.12 Sensitivity analysis with and without community cost

Cost (D)	NIBP Implementation cost	
	With community cost	Without community cost
Capital	104,390.39	100,161.80
Recurrent		
i) Insecticide	448,176.17	448,176.17
ii) Other	205,308.16	153,888.23
Total	757,874.72	702,226.20
Cost/death averted[a]	4946.63	4,582.82
Cost/case prevented[a]	283.46	262.61

a Refers to NIBP study areas cost effectiveness ratios.

7.3.8 Standardising NIBP implementation cost

The NIBP implementation cost excludes the cost of bednets because the programme did not provide bednets. In the rural Gambian community, most adults own bednets (Aikins et al., 1993 and D'Alessandro et al., 1994). For future comparison of this study with other WHO/TDR sponsored insecticide-impregnated bednet programmes in Africa (Burkina Faso, Ghana and Kenya), the cost of bednets were included in the analysis (Tables 7.13, column 3) because bednets form part of the implementation cost in these trials. With the inclusion of the annualized cost of bednets, the NIBP implementation cost and its related cost/effectiveness ratios rose dramatically by about 2.5 times (Table 7.13, column [3]).

7.3.9 Comparing NIBP to a hypothetical programme

In the following analysis, a plausible hypothetical programme was compared with the base case (NIBP) with and without the annualized cost of bednets. The hypothetical programme referred to as NIBP2 was based on the insecticide Imperator 25% EC, which is permethrin and relatively cheaper. The personnel cost was also based on government salary rates, although it was insignificant in the simple sensitivity analysis. Nonetheless, it was important in this scenario because the NIBP management and sustainability in subsequent years would be the responsibility of the government (MoH). The summary of the analysis is presented in Table 7.13.

The implementation cost of the NIBP2 (column [2]) was 37% less than NIBP implementation cost (column [1]). However, NIBP2 implementation cost with bednet cost (column [4]) was only 15% less than NIBP implementation cost with bednet cost (column [3]). Similar reductions where observed in their respective cost/effectiveness indicators.

Table 7.13 Comparing NIBP to a hypothetical programme

Cost (D)	NIBP Implementation cost			
	[1] NIBP (base case)	[2] NIBP2	[3] NIBP (with bednet cost)	[4] NIBP2 (with bednet cost)
Capital	104,390.39	104,390.39	1,253,242.77	1,253,242.77
Recurrent				
i) Insecticide	448,176.17[a]	191,008.85[b]	448,176.17[a]	191,008.85[b]
ii) Other	205,308.16	182,523.16	205,308.16	182,523.16
Total	757,874.72	477,922.40	1,906,727.10	1,626,774.78
Cost difference from base case (%)	na[c]	- 36.94	na	- 14.68
Cost/death averted[d]	4,946.63	3,118.99	12,443.56	10,616.55

a Cost of NIBP insecticide (permethrin).
b Cost of Imperator (permethrin).
c Not applicable.
d Refers to NIBP study areas cost effectiveness ratios.

The results of the sensitivity analysis by varying the sample data and analytical method shows that the study conclusions are only slightly affected by changes in transport running charges, discount rate, value of work time lost, community and personnel costs. However, the cost of bednets (if considered as implementation cost), type of insecticide used, treatment costs, number of cases seeking treatment and estimated effectiveness indicators (ie illnesses and deaths averted) have a considerable effect on the study conclusions drawn.

7.4 Summary

In sum, the NIBP implementation cost-effectiveness ratios were D4,946.63 and D283.46 cost per death averted and illness prevented respectively. The cost per discounted life-year gained was D327.81. The Implementation cost of the NIBP was 34% (D103,505.23) less costly than the existing community control of ordinary bednets. The net resource saved (D146,597.11) with the introduction on NIBP was 73% the implementation cost (D200,635.46) in the study areas. The net cost-effectiveness ratios for death averted and illness prevented were also D1,332.31 and D76.35 respectively. Sensitivity analysis of the costs and health effects of NIBP indicates that the cost of bednets, insecticide, treatment costs, number of cases seeking treatment and health effects do have significant effect on the study conclusions.

CHAPTER 8: Discussion

8.1 Introduction

The study findings presented in the previous three chapters are discussed in this chapter. The chapter is divided into three parts. The first part discusses the major findings of the study in relation to its objectives and the overall effectiveness and efficiency of NIBP. In the second section, a comparative assessment of the study results is made at the national and international levels. The final section is a critique of the study methods.

8.2 Is the introduction of NIBP in rural Gambia efficient?

The study's major findings are summarised in Table 8.1. One important aspect of NIBP worth emphasising was that, the programme only provided insecticide for impregnation of existing bednets in the community. Thus, bednets were not costed as part of NIBP implementation cost as in other malaria control programmes currently being evaluated elsewhere in Africa. The NIBP was a rural-based programme with the majority of programme activities centred at the village level. The total annual NIBP implementation cost was D757,874.72 (see Table 8.1) for implementing the malaria control programme in 221 PHC villages throughout the country. This included 2 main programme operational areas, namely Sensitization and Awareness campaign and Impregnation exercise covering all selected PHC villages. The cost of NIBP was mainly determined by the insecticide, organization of the programme at the national level and the programme activities run by a secretariat.

The paramount concern of health planners and policy makers is whether NIBP was an efficient control programme. Although economists use various definitions of efficiency, as Green (1990) noted, the underpinning concept is the relationship between inputs and outputs, the idea being to assess how a given objective could be achieved with least cost or maximising the output with a given level of resources. Using cost-effectiveness analysis, the efficiency of NIBP was assessed by the estimation of various cost-effectiveness ratios.

Table 8.1 Summary of major findings

Objective of study	Study undertaken or NIBP study used	Major finding(s)
1) **Calculate the total NIBP implementation cost**	NIBP resource input study & Dippers study.	**D757,874.72**[a]
2) **Estimate the child (1-9 years) deaths averted**[b]	NIBP epidemiology mortality surveillance data.	40.56
3) **Cost-effectiveness ratios**[b]		
i) **NIBP implementation cost-effectiveness ratio**	NIBP resource input study, Dippers study & NIBP epidemiology mortality surveillance data.	Cost/death averted: **D4,946.63**[a] Cost/case prevented: **D283.46**[a]
ii) **Net NIBP cost-effectiveness ratio**	NIBP resource input study, Dippers study, Focus group discussions, In-depth interviews, Matched fatal case-control study, Household time allocation study, Hospital treatment cost study & NIBP epidemiology census data.	Net cost/death averted: **D1,332.31**[a] Net cost/case prevented: **D76.35**[a]
4) **Investigate the effect of impregnated bednet on primary school attendance**	Primary school attendance study	**Reduction in absenteeism due to reported ill-health as well as reduction in reported fevers**

a All costs are in Gambia currency (D = Dalasis).
b Refers to NIBP study areas.

The NIBP achieved a high level of impregnated bednet coverage of 85% nationwide, with an estimated cost per capita of D3.21, cost per impregnated bednet of D10.63 and cost per person sleeping under impregnated bednet of D5.94. These ratios shows a high coverage of the programme at low cost. Further, epidemiological evidence indicated that there was a 25% reduction in overall deaths in children under 10 years in bednet treated villages due to NIBP (D'Alessandro et al., In press). The estimated health effects in the NIBP study areas were deaths averted 40.56 and cases prevented 707.81. However, these estimates have wide confidence intervals indicating their weakness especially that of the cases prevented. The weakness of the estimated cases prevented was largely due to the small sample (134) from which the morbidity rates were obtained. The NIBP's concern was mortality reduction and not morbidity. Thus, annual cross-sectional morbidity surveys were undertaken in few randomly selected villages to give an indication of some malaria indices (eg parasite rates, spleen rate and mean packed cell volume) and information on chloroquine consumption. (D'Alessandro et al., In press). However, if morbidity reduction were one of NIBP's objectives, the programme would require enormous resources for such a nationwide surveillance. But, a pilot study could have been instituted in some of the study villages to provide estimates of the morbidity rates given its importance in the estimation of resource use consequences of malaria control. The implementation cost-effectiveness and the net cost-effectiveness ratios of averting childhood death were D5,000 and D1300 respectively (see Table 8.1).

The resource use consequences of NIBP indicates that savings were made by the government on health services treatment cost (8%) and the household on treatment (12%), other preventive measures (1%), *'charity'* (75%) and cash income lost expenditures (20%) with the implementation of NIBP (see Table 7.2). The net resource saved featured prominently in the net cost-effectiveness ratios, thus making the net ratios about 4 times less than that of their corresponding implementation ratios. However, sensitivity analysis shows that the net ratios were sensitive to changes in the treatment costs and the number of cases seeking treatment (Tables 7.10 and 7.11). The health services treatment cost were obtained from 2 different sources namely the hospital cost analysis study and the health centre treatment cost study by Fabricant and Newbrander (1994). Information collected for the hospital treatment cost analysis were mainly obtained from the hospital administrator and the Ministries of Health and Social Welfare and of Finance and Economic Affairs (Project Evaluation and Monitoring Unit) which were the appropriate sources.

Additional information was obtained from the hospital departments and the paediatric ward through interviews, reviewing of available records and personal observations. Most of this hospital data were cross-checked within the 2 weeks study period. Thus the estimated hospital treatment cost is reliable. The health centre treatment cost was obtained from a secondary source which is a recent study reflects the current costs in health centres in The Gambia.

The household treatment cost on the other hand was obtained from the matched fatal case-control study (MFCC). Although, this study was undertaken in the NIBP study area, the sample size was small (particularly sick non-fatal cases) due to some field problems. The reason for the small sample size are discussed in section 8.4.2 further down in this chapter. The proportion of cases seeking treatment at hospital and health centres were obtained from the MFCC study as well. Additional information on household treatment behaviour was obtained from the qualitative studies undertaken. The qualitative studies were used to complement the quantitative studies and they provided useful information on household indirect costs. For example, the random spot observation (RSO) provided the estimate on ill-health care time. The time cost of joint childcare and other household work were shared equally since they were done together. The household indirect costs in this study were mainly incurred by women and were valued with the marginal rate of working on two main crops by gender. This reflected their work time by gender at the time of the study (Picard et al., 1993). However, without valuing the indirect costs, the work time lost by households due to child health activities was substantial showing its importance to the programme.

Given the results of NIBP and coupled with the fact that The Gambia has a relatively high bednet usage compared with similar areas in the West Africa sub-region (Aikins et al., 1994), impregnated bednets would be one of the efficient malaria control programmes in rural Gambia.

Reviewing the total annual NIBP implementation cost profile revealed that insecticide was the most influential cost. Insecticide (permethrin) accounted for 59% of the total NIBP implementation cost. It is likely that insecticide played such a significant role in the total cost of the programme because it was imported and expensive. For example, the sensitivity analysis showed that using a relatively cheap permethrin (eg Imperator 25% EC) reduced the implementation cost by 34% (see Table 7.5). However, since such programmes are usually under donor funding, importation of the insecticide might be assigned to a 'recognised' suppliers and about which recipient governments have little or no choice. Recent developments and interest in impregnated-bednets has triggered the production of various insecticides by different manufactures worldwide (eg ICON, Cyfluthrin and Vectron). However, the majority of these products are still at the experimental stages (Prof. C. Curtis, personal communication). Yet, they stand to compete favourably with other insecticides on the market as future malaria control insecticides. Nonetheless, the cost of insecticide in malaria vector control programme will still be significant, since in most programmes, the insecticide cost is over 50% the total cost of the programme (Picard et al., 1993 and NIBP). Thus, programme managers could do little about reducing programme cost significantly, if the insecticide prices continued to be imported at high prices.

One important aspect of NIBP that needs to be brought to light is that it was largely externally funded. This raises a major question of funding in future; Will the Gambian government be able to fund NIBP without external funds? It is unlikely that the government will be able to fund the programme with little or no external assistance, considering at least the insecticide cost (ie 59% of the total NIBP implementation cost). The NIBP secretariat have attempted to employ cost recovery means to recover part of the cost of the insecticide. However, this is proving difficult. Presently, the organization of NIBP with respect to the programme activities is partially run by MoH. Bednet owners are charged D5.00[23] (50% subsidised rate) for the insecticide for impregnating one bednet. However, preliminary analysis of impregnated bednet coverage in villages where payment were instituted showed a far lower coverage (14%). This low coverage was plausibly due to 3 main reasons - the cost of the insecticide, the number of bednets per household and the availability of money during impregnation time. Earlier exploratory study by Mills et al., (1994) relating to the various financing mechanisms in rural Gambia and the payment of insecticide-impregnation, showed that people were first willing to pay for the insecticide impregnation and respondents mainly opinion leaders cited paying D1 - 5.00 per bednet impregnated. However, most of the households have more than one bednet. But when NIBP secretariat instituted the payment of D5.00 per bednet, no room was made for adjusting the cost of the insecticide with growing number of bednets per household. In most compounds, the head of the household was supposed to pay for the impregnation and not necessarily the bednet users. Another contributing factor was the availability of money during the time of impregnation. Personal observation suggest that during the impregnation period, most people would not find it easy to pay D5.00 for impregnation due to other socio-economic competing needs (eg feeding the family, buying farming implements). Subsistence farming is the main occupation in rural Gambia and money becomes readily available during the trading season (December - February), but not in the non-

[23]Determined by the Bednet Working Group of NIBP and was made independent of the Mills et al., (1994) study

trading season (March - June) which coincides with the time of impregnation. Social marketing approaches are currently being used to address some the issues of paying for the insecticide by households through more Sensitization and Awareness campaigns and making the insecticide available at most retail outlets (shops) at the village level.

In an attempt to make the insecticide available throughout the year so that consumers could buy it at all time (eg when money becomes available) and reserve it for use at the appropriate time, another insecticide although more expensive was introduced (ie Peripel). Sachets of 'Peripel' were sold at D7 - 7.50 per sachet for impregnating one bednet. The Peripel was on trial and was sold at selected village shops and health posts but distributed free to mothers at MCH/FP clinics. They are easy to distribute and offset some of the distribution problems associated with liquid permethrin such as measuring, spillage and pilferage. However, personal observation indicates that the uptake of the Peripel was slow and people complained about the cost, although they were perceived to be more powerful than liquid permethrin.

As the resource use consequences of the NIBP indicated, the government made 8% savings on treatment cost, which was equivalent to only 4% of the insecticide cost used in the study areas. Although this savings is small compared to the insecticide cost, if saved treatment cost are really saved, then this savings could be used to fund at least part of the operations of the programme. Moreover, considering the direct household savings on treatment cost (29%) which was equivalent to D8 saved per case in the study areas, it is justified that the insecticide is sold to the people for impregnation.

All the indications for the future are that MoH will take over the running of the NIBP and the for some time, the programme will require continuous external funds at least to purchase the insecticide. However, a mixture of free and paid for insecticide services targeting different groups of people in the community (aimed partly to recover some of the insecticide cost), would auger well for the programme. For example currently, the NIBP programme distributed free insecticide to mothers at MCH/FP clinics and all others pay for it. This idea was aimed at targeting mothers (carers) who are more likely to share their bednets with their children (Aikins et al., unpublished). This programme should be expanded and continued.

Health planners' decisions based on the implementation cost-effectiveness ratios may not be most appropriate. Nonetheless, the cost-effectiveness ratios of programmes may be crucial in shaping the final decision. For example, as Picard et al., (1993) alluded, if two control programmes of similar cost-effectiveness ratios have varying treatment costs,

> "...then the health budget is more efficiently spent on the control of the more expensively treated disease, so saving treatment costs".

Thus, the comparison of their net cost-effectiveness ratios become necessary for health planners to ascertain whether the difference in treatment costs alter their ranking (Picard et al., 1993). Unfortunately, most cost-effectiveness studies do not go beyond the estimation of the implementation cost-effectiveness ratios thus limiting the options available to health planners for thorough comparison and decision making. Evidence from NIBP economic evaluation presented here, suggest the need for future researchers to consider the resource use consequences of programmes in estimating their net cost-effectiveness ratios as well, since the implementation cost-effectiveness ratios excludes the effect of the resource used. Presentation of the two cost-effectiveness ratios is important for health planners in their decision-making process. Therefore, this study suggest that the net cost-effectiveness ratio is the most appropriate ratio to consider in decision making.

The other effects of NIBP in terms of school absenteeism further suggests that villages with impregnated bednets experienced reduction in absenteeism due to ill-health and fever. This broad generalization of the mass-protective effect of impregnated bednet through the mass-killing effect of mosquitoes is yet to be proven in The Gambia, however, treated bednets were found to offer individual protection (Lindsay et al., 1993, Quinones, personal communication). This momentary protection might be due to the repellency effect of the insecticide. If the mass-protective effect of the insecticide is proven, then this suggest that insecticide is a public good (ie non-excludable) with both users and non-users of impregnated bednet sharing a room benefiting from its protective effect. This then implies that the market price of the insecticide will not reflect its true value since some people will not buy it but rely on buyers to share the benefit. The study results indicates that the study design was appropriated and differences in absenteeism due to reported ill-health could be detected. Furthermore, schools with daily attendance records supported by dispensary records makes cross-checking and confirmation of attendance data easy. Teachers used for the study were appropriate, resulting in little or no interruption of classes, little training and their record keeping experience can be counted on with little increase in workload. In comparison with the few studies on malaria and school attendance on issues of main causes of school absenteeism (Trape et al., 1987) and protection offered by bednet (Nevill et al., 1988), the study shed some light on the possibility of impregnated bednet reducing absenteeism due to ill-health and fevers. However, in terms of mean school days lost (eg Colbourne, 1955 and Mills, 1989), it was very difficult to assess that from this study due to the questionnaire design.

In conclusion, the NIBP results presented here (ie implementation, epidemiological and economic evaluations), suggests that it achieved very good coverage and was effective and efficient in reducing child deaths (under 10 years). There is also a possibility of impregnated bednets reducing school absenteeism due to ill-health. The economic evaluation of NIBP also demonstrates both the potential and difficulties of a national malaria control programme. This study finally suggests that NIBP is justified and a worthy programme to support financially, especially if the policy objective is to provide most people with impregnated bednets at a relatively low cost, save resources for both the government and the household and to reduce child deaths.

8.3 Comparative assessment

The cost-effectiveness ratios have to be placed in the broader contest by comparing them with those of other interventions. However, scarcity of comparable data usually hinders this process (Picard et al., 1993). Moreover, such comparisons must be "interpreted with great caution given the very considerable variation between programmes and countries in cost-effectiveness of any particular intervention" (Mills, 1993). Notwithstanding this, such comparison gives the relative value or indication of the programme in question. In the subsequent section, a comparison is made first with a previous study (Picard et al., 1993) which also used impregnated bednets. Secondly, an international comparison is made from the available literature on malaria and other diseases. Then finally, a national comparison is undertaken with other health programmes for children in The Gambia.

8.3.1 Comparison of the two impregnated-bednet studies in The Gambia

The two studies are Picard et al., (1993) on the Double Intervention study (DIS) and the NIBP. The cost-effectiveness ratios of the 2 studies although undertaken in the same country within the space of approximately 3 years were different. The cost-effectiveness ratios for deaths averted of Picard et al., (1993) and NIBP studies were US$220 and US$600 respectively. The NIBP's cost-effectiveness ratio was about 3 times that of Picard et al., (1993). The reasons underlying this difference must be highlighted to show the differences and whether they were genuine considering the two programme activities which were associated with their respective implementation costs. A summary of the 2 studies showing their differences are presented in Table 8.2.

Table 8.2 Summary of studies on insecticide-impregnated bednets in The Gambia

Items	Studies	
	DIS (Picard et al., 1993)	NIBP
Nature of study	A pilot covering about 21,000 people in 17 PHC[1] and 56 non-PHC[2] villages, 1989-90	A national programme covering about 240,000 people in 221 PHC villages, 1992
Cost/death averted (US$)	222.97[3]	599.59
Study comparison for epidemiological evaluation	PHC users of treated bednets against non-PHC non-users of bednets	PHC villages with treated bednets against PHC villages without treated bednets
Target population	Children under 5 years	Children under 10 years
Bednet usage	86% of people in the study area	58% of people in rural Gambia
Insecticide (permethrin) dosage (mg/m^3)	About 500	About 200-250
Deaths averted per 1000 population	30[4]	2[5]
Annual implementation cost (US$)	12,739.24[3]	91,863.60
Percentage (%) share of insecticide cost to total programme cost	80	59
Percentage (%) share of community cost to total programme cost	0.01[6]	7

1 Gambian villages with a population of 400 or more.
2 Gambian villages with a population less than 400.
3 1992 equivalent figure.
4 Children under 5 years.
5 Children under 10 years.
6 Made up of only Dippers time.

Three main factors may have contributed to the threefold difference in the implementation cost-effectiveness ratios of these programmes, namely, the nature of the programmes, bednet usage and the epidemiological evaluation methods used.

It is important to note that the NIBP was a national programme run by a secretariat in an urban area whilst the DIS was run by a field supervisor in a small field station situated in one of the study villages. Therefore, compared with the DIS, the NIBP was a completely 'new' programme with regards to organization, programme activities and scope. The NIBP being a national programme had difficulties controlling all its field activities. For example, Pickering (Unpublished) reported that the Sensitization and Awareness campaign programme was less effective in the Upper River Division of the country and had started later than the other areas. Furthermore, the Regional Health Team of MoH have wide range of responsibilities and have not given NIBP sufficient attention. Thus, the division of duties between the implementation (MoH) and the monitoring (MRC) teams led to certain amount of confusion over responsibility, particularly as the NIBP team had easier access to resources, such as transport than did the implementation team (MoH). Finally, insecticide leaked in some areas. It was observed that the NIBP insecticide was being sold at '*lumos*' (weekly local markets) at the same price offered in the NIBP villages. Customers were mainly from non-PHC villages (who were not part of NIBP) and the neighbouring Senegal. This would have contributed to the higher implementation cost of NIBP.

Coincidentally, a recent study by D'Alessandro et al., (1994) has also revealed that the DIS study areas have the highest bednet usage in The Gambia (86%) whilst the national average was 58%. Although the impregnation coverages were similar in the two programmes (ie DIS 88% and NIBP 85%), impregnated bednet usage amongst the target populations varied. In the DIS, 92% of the target population slept regularly under an impregnated-bednet (Alonso et al., 1993). However, bednet usage amongst the children in the NIBP was difficult to ascertain due to its national nature. But, the study by D'Alessandro et al., (1994) prior to NIBP intervention indicated that 72% of children (under 5 years) were reported to sleep under bednets. Since impregnated-bednets offer individual protection (Lindsay et al., 1993) and the insecticide dosage was higher in DIS, the DIS target population were more protected.

The epidemiological evaluation of the two programmes, in a sense were different. The two programmes were all evaluating the effect of impregnated bednet on child mortality. However, the DIS's comparison of mortality was based on children sleeping under impregnated-bednet in PHC villages and those sleeping under ordinary bednets in non-PHC villages (ie controls). Furthermore, it was a controlled trial[24]. Whilst in the NIBP, due to its national nature and resource constraints based its evaluation on villages with and without impregnated bednets. This suggest that in the evaluation of NIBP, non-users of bednets and users of ordinary bednets residing in impregnated-bednet villages were considered as users of impregnated-bednet. Hence, the impregnated bednets were supposed to have offered protection to the target population residing in impregnated villages. However, impregnated-bednets offers individual protection to users (Lindsay et al., 1993), thus in reality NIBP only protected children who used impregnated bednet and not all children residing in the impregnated-bednet villages as was assumed in the epidemiological evaluation. This would have contributed to

[24]Children recruited for the study were monitored periodically by fieldworkers

the lower deaths averted by NIBP compared with the DIS thus resulting in its higher cost-effectiveness ratio.

The NIBP sensitive analyses was relatively elaborate covering insecticide cost, personnel salary, community cost, transport cost, discount rates, effectiveness indicators, treatment cost and number of cases seeking treatment. Whilst that of the DIS covered insecticide cost, health effects and discount rate. In both cases, the ratios were found to be sensitive to insecticide cost and health effects. Apart from the 3 main cost-effectiveness ratios (ie cost per death averted, cost per case prevented and cost per discounted health life year gained), the NIBP provided 4 additional ratios namely, cost per child-year protected, cost per capita, cost per impregnated bednet and cost per person sleeping under impregnated bednet. Thus, the NIBP was extensively evaluated compared with the DIS. The costs of both programmes reflected their programme activities. These were the main explanations that accounted for the threefold difference in the cost-effectiveness ratios between the two programmes.

Further comparison of NIBP is made with other malaria intervention programmes in developing countries to assess the merits of allocating resources to impregnated bednets as opposed to other malaria control programmes such as case detection and treatment, chemoprophylaxis and spraying.

8.3.2 Comparing NIBP with some malaria interventions in developing countries

Tables 8.3 and 8.4 are rankings of cost per death averted and cost per case prevented of malaria control programmes in developing countries. As Table 8.3 shows, studies of cost per death averted are fewer than those of cost per case prevented (Table 8.4). However, some studies have estimated both cost per death averted and cost per case prevented (Mills, 1989; Sudre et al., 1992; Picard et al., 1993 and NIBP).

Table 8.3 Rankings of cost per death averted (CDA) of some malaria control programmes in developing countries expressed in US$ 1992*

Rank by CDA	Sources	Group/area studied	Nature of study	Cost/death averted
1	Sudre et al., (1992)	Sub-saharan Africa	Modelling of chemoprophylaxis treatment	1.31 - 2.58[a]
2	Barlow (1968)	Sri Lanka	Vector control programme using insecticide	119.05
3	Picard et al., (1993)	The Gambia	Vector & malaria control using insecticide-impregnated bednets & chemoprophylaxis	a) Treated bednet; 222.97 b) Treated bednet & drugs; 305.73
4	Walsh & Warren (1979)	Developing countries	Vector control strategies (PHCs)	1,132.20
5	NIBP	The Gambia	Vector control using insecticide-impregnated bednets	317.57 - 5,356.71
6	Mills (1989)	Nepal	Malaria & vector control (drugs & spraying)	a) Drugs; 215.03 - 21,571.97 b) Drugs & spraying; 133.72 - 21,745.44

* All cost were adjusted by the rise in the consumer prices using the year of the study as a base to US$ 1992 to reflect the time interval between the studies [Source: International Monetary Fund (1994)].
a Unadjusted figure because the year of the study was not stated.

In Table 8.3 the cost per death averted studies ranges broadly from PHCs in developing countries, modelling of chemoprophylaxis treatment in sub-Saharan Africa to individual country malaria and vector control programmes; The Gambia, Nepal and Sri Lanka. From the rankings, the most cost-effective malaria programme was the modelling of chemoprophylaxis treatment in sub-Saharan Africa and the least cost-effective was the combined method (drugs and spraying) in Nepal. One of the impregnated bednet programmes (ie Picard et al., 1993) takes the middle range of the rankings giving it an impressive position. It must be reiterated that interpretation drawn from such rankings must be treated with caution because as Mills (1991) pointed out, "The dearth of reliable data and the difference circumstances in which studies have been conducted makes it difficult to conclude that one malaria control strategy (or a particular mix) is unquestionably superior to another". Another shortcoming is that, cost-effectiveness studies of malaria, are limited in number, thus narrowing the scope for broad range comparison. Yet, comparison of the two Gambian programmes shows that Picard et al., (1993) was more cost-effective (about 3 times) for reasons already discussed above. Similar rankings were obtained for cost per case prevented and presented in Table 8.4.

Table 8.4 Rankings of cost per case prevented (CCP) of some malaria control programmes in developing countries expressed in US$ 1992*

Rank by CCP	Sources	Group/area studied	Nature of study	Cost/case prevented
1	Sudre et al., (1992)	Sub-saharan Africa	Modelling of chemoprophylaxis treatment	0.04 - 0.50[a]
2	Cohn (1973)	India	Vector control using insecticide	3.02
3	Heymann et al., (1990)	Malawi	Prophylaxis amongst pregnant women	17.25
4	Hedman et al., (1979)	Liberia	Vector control using insecticide	20.74[b]
5	Picard et al., (1993)	The Gambia	Vector & malaria control using insecticide-impregnated bednets & chemoprophylaxis	a) Treated bednet; 33.68 b) Treated bednet & drugs; 23.08
6	NIBP	The Gambia	Vector control using insecticide-impregnated bednets	34.36
7	Gandahusada et al., (1984)	Indonesia	Vector control using insecticide	107.64 - 132.48
8	Ortiz (1968)	Paraguay	Malaria eradication programme	115.07
9	Molineaux & Gramiccia (1980)	Nigeria	Vector control using insecticide & drugs (Garki)	263.23
10	Mills (1989)	Nepal	Malaria & vector control (drugs & spraying)	a) Drugs; 3.34 - 123.78 b) Drugs & spraying; 2.71 - 279.11

* All cost were adjusted by the rise in the consumer prices using the year of the study as a base to US$ 1992 to reflect the time interval between the studies [Source: International Monetary Fund (1994)].
a Unadjusted figure because the year of the study was not stated.
b Consumer prices only available up to 1989 plausibly due to the raging civil war.

The study areas in Table 8.4 comprised of regional (sub-Saharan Africa) to individual country programmes and have the same control strategy mix as the cost per death averted. The cost per case prevented ranges from as low as US$0.04 to US$280, with the lowest still being in sub-Saharan Africa with modelling of chemoprophylaxis treatment and the highest in Nepal with the combined strategy of drugs and spraying. Furthermore, the two impregnated bednet programmes still occupied the middle range of the cost per case prevented rankings as well. As Mills (1991) mentioned the cost per case prevented ratio is difficult to interpret due to many influencing factors. Yet it "shed light on the choice of strategy". The ranking shows chemoprophylaxis and prophylaxis on top followed by impregnated bednet and the lower down the ranking was the combined strategy of drugs and spraying. Thus arriving at the same conclusion drawn by Mills (1991) that spraying was far more expensive than the other strategies.

Finally, the World Development Report (1993) has suggested that malaria can be substantially controlled with a cost-effective intervention of cost per disability life year (DALY) saved less than US$100. The DALY is a measure similar to the discounted healthy life year (DHLY) gained in the case of malaria (Mills, 1993). Only 3 studies in Tables 8.3 and 8.4 have estimated the DHLY. Using the discount rate of 3% to be consistent with the other 2 studies (eg Mills, 1989 and Picard et al., 1993), the DHLY (US$ 1992) of these programmes were; Picard et al., (1993) ranges between US$9.30 - 12.89, NIBP was US$25.30 and Mills (1989) ranges between US$4.06 - 758.24. By the report's standard, both impregnated bednet programmes were more cost-effective. However, at the minimum level, the Nepal programme was very competitive and cost-effective. It must be reiterated that the comparison was based on only 3 programmes.

A recent WHO Ministerial Conference on Malaria (1992) recommended for the improvement of malaria control programmes in sub-Sahara Africa, the use of impregnated bednets and curtains and for pregnant women the use of chemoprophylaxis unless precluded by drug resistance. The NIBP have provided some economic evaluation indicators to support the WHO recommendations. In the next section, NIBP is compared with other health interventions in The Gambia.

8.3.3 Comparing NIBP with other health interventions in The Gambia

Table 8.5 gives a summary of economic evaluations of health intervention programmes in the country. There are 6 studies all together; 2 in EPI, 3 in malaria and 1 in maternal health. The economic evaluation of the malaria studies have provided more comprehensive indices compared with the EPI possibly due to the scope of the effectiveness data available to the two groups of studies. Moreover, all the EPI studies were national programmes, whilst, NIBP was the only one among the 3 malaria studies which was a national programme; Picard's study was a pilot study and MacCormack's study was described by Mills (1991) as aiming at the individual by providing partial cost and effectiveness information. The discussion therefore focuses more on the 2 EPI studies and NIBP. The most costly programme was the EPI (1979) and NIBP ranks lowest in cost; about 8 times less in cost and the second EPI (1988) was about 5 times the cost of NIBP. Thus, the implementation of a national malaria control programme is far cheaper than that of EPI.

The cost of averting a child death by EPI (1979) ranges from US$81 to 22,000 and NIBP from US$320 to 5,400. However, most of the deaths averted by EPI were children under 1 year whilst that of the malaria programmes were over 1 year. Moreover, the cost per capita for FIC in EPI (1988) ranges from US$8 to 9 and that of the treated bednet in NIBP was US$1 and even less when considering the number of people sleeping under treated bednets (US$0.72). This cost of programme coverage, shows again that malaria programmes are less costly and more efficient. The difference in cost does not only reflect the scope and variability in programmes but the cost of resources inputs as well. However, depending on the plans and budget constraints of the health ministry, a combination of the 2 programmes might provide a cost-effective means of averting infant and child deaths in The Gambia.

Table 8.5 Programme cost and Cost-effectiveness ratios expressed in US$ 1992*

Source	Nature of study	Programme implementation cost	Cost-effectiveness ratios	
			Cost/death averted	Other
Robertson et al. (1985)	EPI, The Gambia, 1979	749,153.24	81.62 - 22,254.87	na[1]
Robertson et al. (1992)	EPI, The Gambia, 1988	501,834.25	na	Cost/FIC; 7.70 - 8.77
MacCormack et al. (1989)	Malaria control using insecticide-impregnated bednets, The Gambia, 1987	na	na	a) Treated & bednet cost; 2.98 b) Treated bednet & drugs; 4.02
Picard et al., (1993)	Vector & malaria control using insecticide-impregnated bednets & chemoprophylaxis, The Gambia, 1990	a) Impregnation; 12,739.24 b) Impregnation & chemoprophylaxis; 16,892.13	a) Treated bednet; 222.97 b) Treated bednet & drugs; 305.73	Cost/case prevented; a) Treated bednet; 33.68 b) Treated bednet & drugs; 23.08
NIBP	Vector control using insecticide-impregnated bednets, The Gambia, 1992	91,873.60	317.57 - 5,356.71	a) Treated bednet; 1.29 b) Treated & bednet cost; 2.26 c) Cost/person sleeping under treated bednet; 0.72 d) Cost/case prevented; 34.36
Fox-Rushby (Forthcoming)	Adding mobile maternal services to the MCH services in health centres, The Gambia.	3,639.90 - 7,861.08 per health centre	506.28 - 2,354.68	a) Cost/life year gained; 14.45 - 76.44

* All cost were adjusted by the rise in the consumer prices using the year of the study as a base to US$ 1992 to reflect the time interval between the studies.
1 Not applicable.

Barring the limitations of this comparative assessment of the studies discussed, the tentative conclusion drawn about impregnated bednets is that, they seem to be a relatively cheap, effective and efficient form of improving health in rural Gambia. However, more cost-effectiveness studies of impregnated bednets in different parts of Africa and other malaria endemic areas are required for firm conclusion to be drawn since bednet usage in The Gambia is relatively high compared with other countries in the sub-region (Aikins et al., 1993). Nevertheless, the NIBP is justified in The Gambia.

8.4 Methodological assessment of the study

8.4.1 Integration of research methodologies

The ultimate purpose of the findings of this study is to contribute to the development of knowledge on malaria and its vector control, especially, cost-effectiveness of impregnated bednets. In the quest to broaden the scope of literature on cost-effectiveness analysis and given that economic evaluation of impregnated bednets is a relatively new area of study both quantitative and qualitative methods were used for cost data collection as complementary methods. Integration of data collection methodologies as discussed in Chapter 4 (section 4.6) provided a broader understanding of both the context and the range of costs particularly borne by households in their socio-cultural setting.

The integrated research approach allowed for questionnaire design and further coverage of cost areas borne by the household. Respondents interviewed through structured interviews in the various studies were; 134 carers in the MFCC study, 64 NIBP related personnel and 179 dippers. The qualitative studies also covered 306 women in groups of 5 - 8 in the focus group discussions, 25 men in the in-depth interviews, 3050 random spot observations of 50 women and 2182 pupils in school attendance study. Personal observations of any phenomena of interest to the study were also made parallel to the other method. Through the scope of quantitative methods, it was possible to gather information on cost such as salary scales, time allocation, various treatment sources, treatment costs, *'charity'* cost and other anti-mosquito preventive measures used.

Qualitative methods first and foremost, helped this study to gather local terminologies for the design of the quantitative study (ie MFCC study). For example, in rural Gambia, burial, funeral and mourning ceremonies are referred to collectively as *'charity'*. Secondly, the correct respondents were able to be identified for the various sections of the MFCC study, since they relate to the division of household responsibilities - child and ill-health care were done by women and men paid the health bills. Thus, the health seeking behaviour of children with regards to choice, payment of treatment and the seeker of treatment for the sick child would not have been clearly understood if only quantitative methods were used, thus compromising on the cost incurred. Thirdly, ill-health care information was obtained through qualitative means (ie random spot observation) when it was difficult to use quantitative approach. Finally, qualitative studies indirectly helped to establish rapport between the research team and the community under study, thus, paving the way for the quantitative studies. It was also possible through observation to identify other community cost such as water used for impregnation and to verify the process of impregnation as well. However, it is necessary to point out that while no undue disadvantages of using these qualitative methods were encountered, there were a few problems that were experienced in the organization of sections and analysis of the data, especially with the transcription of discussion and interviews for content analysis. Recent development in computer software has facilitated the task of content analysis which hitherto was a time consuming exercise. The Textbased Alpha computer programme was used for the analysis of the qualitative data of this study.

The integrated research approach enabled the study to examine considerable sources of variation in both the cost and effectiveness data (direct and indirect) of NIBP. Drawing largely on the communities contributions to NIBP no matter how small they were. This was in tune with Berman's (1982) comment that the cost-effectiveness ratio was affected by factors like the nature of the delivery system, service mix and utilization. The implication was that a wider approach to cost and effectiveness data must be taken by researchers considering these factors. Moreover, other 'secondary' unit costs were estimated (see Table 7.1 in Chapter 7) aside for the cost per death and case averted figures, to present policy-makers with a spectrum of 'complementary' indicators. Furthermore, the integrated research approach allows for clarification, understanding and wider interpretation of the data. Thus the NIBP results relates more to the community.

8.4.2 Limitations of the study

The main limitation of the study like most cost-effectiveness studies was related to the epidemiological data. Reported child deaths formed the sample for the MFCC study. The MFCC study was sensitive to time, since the cost data required from both the fatal and control (non-fatal) cases was restricted to a maximum of one month after the occurrence of the fatal event. Because it was assumed that after this time period, carers and household members would have difficulty in recalling their expenditure on treatment and '*charities*' and more importantly the indirect costs associated with these events. Delays in reporting children deaths occurring in the 5 NIBP study areas seriously affected the sample size of the MFCC study thus affecting the reliability of the estimates of the family expenditure on treatment and '*charity*'. The initial plan of the MFCC study was to follow all reported deaths during the period of the study. However, most of the deaths of the target children were reported after the MFCC study period and it was too late to be considered. Consequently, the family expenditure on treatment and '*charity*' and its associated indirect costs might be unrepresentative of the community due to the small sample used in the estimation. However, the study design was appropriate and can be replicated in other areas with the improvement of mortality surveillance and prompt reporting of deaths.

Secondly, the recurrent community cost of water and detergent was based on number of impregnated bednets, personal observations and informal discussions after the impregnation exercise. This was because it was not anticipated but it became apparent through personal observation and visits carried out in the field. If water had been initially considered as part of the community costs, appropriate measures in terms of sample surveys would have been carried out to obtain a more representative estimates particularly on the average amount used for washing the bednet prior to impregnation. However, under such circumstances these were the most reliable source of obtaining some information on water usage.

The third problem, though a minor issue and beyond the control of the research team, was the climatic conditions. The MFCC study was carried out at the peak of the rainy season which made some of the village feeder roads unmotorable. This caused some delays in the interviews outside the fieldworkers resident villages and thus affected the overall time schedule of the study in terms of interviews, data verification and data entry. This problem was partly resolved by working around the clock most of the time since additional fieldworkers could not be recruited at this stage of the study. One fieldworker also contracted malaria during the study period and in one study area (5) there were delays and late reporting of deaths by the NIBP epidemiology fieldworkers which prolonged the study period for over a month. Generally, no major discrepancies emanated from the findings obtained from the integrated research methods.

8.4.3 Contribution of research to knowledge and implications

The major contributions of this research to knowledge are, first, offering additional literature on cost-effectiveness studies, methodological approach to cost data collection and the use of confidence intervals in the estimation of health effects. Most authors of cost-effectiveness already referred to in this study (Robertson et al., 1985; Barlow, 1986; Sheppard et al., 1986; Mills, 1993; Picard et al., 1993) have all commented on the scarcity of literature on cost-effectiveness studies which makes relative comparison of studies difficult. From the comparative assessment discussion presented in section 8.3 of this chapter, one realises that to date there are only two cost-effectiveness studies on impregnated bednets, of which this study is one of the pioneers.

Secondly, in the quest to obtain primary data on cost, an unorthodox method in costing was applied for indirect cost of ill-health care; random spot observation. The review of time allocation literature by Leslie (1989) shows that most of the indirect costs were obtained by direct and personal observation, questionnaire interviews, computer search, epidemiological data, documents, records and statistics (Chapter 2 , Tables 2.6 and 2.7). This at least shows the attempt being made by various authors to quantify indirect cost. The current research offers another approach to this problem of measuring indirect cost using random spot observations which entails recording of observed activities over a period of time (see Chapter 4, section 4.6.1.6).

Thirdly, the MFCC approach used by Picard et al., (1993) was adopted in this study with a few changes and it proved to be useful in estimating household expenditure especially on treatment, funeral, burial and mourning and other anti-mosquito preventive measures with and without the intervention. It is simple and straightforward and only requires strict and right selection of control (non-fatal cases). Thus, the MFCC approach provided the bulk of the information for the estimation of the resource use consequence for households and subsequently the net cost-effectiveness ratios.

Finally, the literature reviewed for this study revealed that most of the studies have not shown the reliability of the estimated health effects of their studies by providing some statistical evidence (eg Cohn, 1973; Hedman et al., 1979; Gandahusada et al., 1984; Jeffery 1984; Kaewasonthi & Harding 1984; Mills 1989; Mills 1992 and Picard et al., 1993). However, most health economists have commented on the accuracy of health effects estimates from epidemiological data in economic evaluation (Robertson et al., 1985; Picard et al., 1993; Freemantle and Maynard, 1994). Thus this study use confidence intervals in the estimation of the health effects which is novel in studies of the cost-effectiveness of health care programmes.

The implications of the issues discussed above are addressed in the concluding chapter.

Chapter 9: CONCLUSION

9.1 Cost-effectiveness analysis (CEA) of malaria control programme

This thesis has elaborated in detail the numerous epidemiological and entomological studies undertaken on malaria in The Gambia since the beginning of the century with the expedition of Dr J. E. Dutton (Greenwood and Pickering, 1993). However, it was not until recently in the beginning of the 1990s that any full economic evaluation of malaria control programmes were embarked upon. Coincidentally, both the evaluations were on insecticide-impregnated bednets. The current interest in economic evaluation of health programmes might plausibly be due to dwindling resources and the large external debts of developing countries (Ebrahim, 1992) coupled with the fact that since the 1980s most developing countries national health budgets are donor dependent (Walt and Gilson, 1994). This thus calls for further efficient use of the scarce resources available and one of the means is by CEA.

In this study, the implementation cost-effectiveness ratio of NIBP has been shown to be competitive with other health intervention programmes in The Gambia and ranks well with other malaria control programmes in developing countries. The question posed at the beginning of the thesis regarding the replication of Alonso, Picard and colleagues (1993) results were partly answered. In the sense that, although the reductions in mortality and the cost-effectiveness ratios were different, the two interventions (ie DIS and NIBP) all reduced child mortality to different degrees and were cost-effective in comparison with other child health intervention programmes. This confirms the fact that for the time being, insecticide-impregnated bednets would be an efficient means of malaria control in The Gambia.

Although the majority of the implementation cost of NIBP was borne by providers (with the government being one of them) the government made resource savings on health services treatment cost which shows that the providers support of NIBP was a worthwhile investment in the health sector. The community also incurred some cost and households gained from NIBP implementation in terms of household expenditure on treatment and child deaths. On average, households spent D4 on treatment of a child and gained D8 with the introduction of NIBP. This suggest that spending D5 on the purchase of insecticide for impregnating a bednet was a good investment. However, such household monetary allocation are usually influenced by other social factors and for impregnation in particular, the number of bednets in the household. In view of the encouraging results of NIBP, its policy implications for malaria control in The Gambia need to be highlighted.

9.2 Policy implications of NIBP

As stated earlier in Chapter 4 of this thesis, an important aspect of CEA is the comparison of alternative ways of achieving an objective. In the case of malaria control, Mills (1992) identified 4 different levels involving objectives and choices in which this study aimed to shed some light:

Level 1: choice of malaria control versus other health programme;

Insecticide-impregnated bednets have been shown to be relatively cheap and efficient in reducing childhood deaths compared with other health intervention programmes in The Gambia.

Level 2: choice of vector control versus case-detection and treatment as means of malaria control;

Comparison cannot be made at this level because there was only one programme - vector control (NIBP). However, the cost and cost-effectiveness ratios of NIBP are now known for future use. In addition, the government made 8% savings on health services treatment cost which was equivalent to only 4% of the insecticide cost in the study area. Although this savings was comparatively small, it could be used to finance other activities in the programme.

Level 3: choice of means of vector control, including different insecticides target doses;

Both interventions of insecticide-impregnated bednet in The Gambia used different insecticide dosages; in Picard et al., (1993) study it was 500mg/m^2 and in the NIBP it was 250mg/m^2. These control programmes have been shown to be relatively cheap and cost-effective. This study recommends the dosage of 250mg/m^2 to enable large scale coverage and to cut down cost.

Level 4: choice of ways of organizing an activity, for instance at regional versus community levels, integrated versus unintegrated patterns of organization;

NIBP was community based and with the full community participation in the programme eg dippers. For high programme coverage, its sustainability and to cut down the programme cost, this study recommends the continuous use of the NIBP dipping process of the dipping team moving from compound to compound rather than the individual household dipping approach. The former approach ensures proper dipping and high coverage. Social marketing techniques of advertising impregnated bednets and the dipping process by illustrative leaflets (for customers) and posters (for shops and health posts) should also be continued. However, since most people do not read and write in English, messages in the local languages at the village level should be sent out clearly by health workers on where insecticide could be purchased, the type of insecticide available (ie liquid permethrin and Peripel), the price and the appropriate time for dipping bednets.

Although this study covered the costs (direct and indirect) of NIBP activities extensively , there are still some areas that require re-visiting to confirm some of the research methods used for data collection and whether the results hold outside The Gambia.

9.3 Implications for further research

Future research on the economic evaluation of impregnated-bednet programmes must aim at using both qualitative and quantitative approaches to identify, measure and value all the costs of the programme. Epidemiological data for the estimation of the health effects, must also be closely and regularly monitored.

Three main areas from the results of this thesis requires further research. First, ill-health care in the household. This study looked at ill-health care within a short period of time and the observations were obtained for a small sample of 50 women. The results were promising and it formed a substantial part of the household indirect costs. Thus, further research on ill-health care could cover all identified carers in the household over a longer period of time (both in the dry and wet seasons), to ascertain different roles played by carers, the type of childhood sickness that requires different carers and takes more carers time. Moreover, it will be interesting to know if, random spot observation approach could be used to explore the possibility of differentiating child and ill-health care practices from household activities.

Secondly, the estimation of resources saved by NIBP intervention showed clearly the importance of morbidity surveillance (at least a pilot study) in malaria control research. Future malaria control researches must establish a well monitored morbidity surveillance system to provide researchers with representative morbidity rates. Further information on morbidity and mortality could be obtained from a matched case-control study. For example, information on type of treatment sources used, treatment costs (direct and indirect), number of visits to treatment sources, who pays for treatment, who accompanies sick children for treatment etc.

Finally, from the results of primary school attendance study, the NIBP has shown that health intervention could also have other effects apart from the recognised health effects of the programme. Further researches should therefore attempt to look at the other related effects of the intervention programme, which might initially look trivial, but might turn out to be an important and a new area for the programmes attention.

This thesis concludes that until a viable vaccine is found which is cheaper, readily available and easy to dispense in developing countries, our best alternative at the moment is the insecticide-impregnated bednet which has proved effective and efficient in reducing morbidity and mortality in children.

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APPENDICES

QUESTIONNAIRES, FORMS, FIELD NOTES, CODING MANUALS, SAMPLES OF TRANSCRIBED INTERVIEWS AND TABLES

Appendix 1

Study 1 questionnaire

MRC FARAFENNI
COST-EFFECTIVENESS STUDY
PERSONNEL QUESTIONNAIRE

STUDY AREA: |__|

DISTRICT:....................................

1) Type of staff: 1) MRC; 2) MoH; 3) Other NGO (spec.) |__|

2) Name:.......................... 3) Sex (M/F) |__|

4) Age |__|__| 5) Duty Station:...................

6) Post and grade :.....................................

7) Villages covered by work:

....

....

8) Brief description of work:

....

....

9) When did you start working on the National Impregnated Bednet programme(NIBP)? **(PLEASE GIVE THE DATE)** |_|_/_|_/_|_|

10) How many days were you trained for the NIBP activities (eg Sensitization and Awareness, Bednet dipping demonstration etc)? |__|__|

11) What proportion of your working time did the training take (eg 15%; 20%; 50% etc)? |__|__|

12) How many days in all did you take for the Sensitization and Awareness campaign of the NIBP in the villages you work in? |__|__|

13) What proportion of your working time did the Sensitization and Awareness campaign take (eg 15%; 20%; 50% etc)? |__|__|

14) What type of vehicle did you use for the work in Q.12?

....

15) Did you use a log sheet or book? Y/N |__|
(IF YES, GO TO Q.17)

16) If No in Q.15, please provide the pattern of movement within working area when you were working on the NIBP activity in Q.10 (ie from the duty station to 1st village, 2nd village in that order)

Day 1:	Day 6:
Day 2:	Day 7:
Day 3:	Day 8:
Day 4:	Day 9:
Day 5:	Day 10:

17) Were you involved in the bednet census exercise? Y/N |__|
(IF NO, GO TO Q.20)

18) If YES, how many days in all did you spend on it? |__|__|

19) What proportion of your working time did the bednet census exercise take (eg 15%; 20%; 50% etc)? |__|__|

20) What type of vehicle did you use for the work in Q.17?

....

21) Did you use a log sheet or book? Y/N |__|
(IF YES, GO TO Q.23)

22) If No in Q.21, please provide the pattern of movement within working area when you were working on the NIBP activity in Q.17 (ie from the duty station to 1st village, 2nd village in that order)

Day 1:	Day 6:
Day 2:	Day 7:
Day 3:	Day 8:
Day 4:	Day 9:
Day 5:	Day 10:

23) Were you involved in the bednet dipping exercise? Y/N |__|

24) If YES, how many days did you spend on it? |__|__|

25) What proportion of your working time did the bednet dipping exercise take (eg 15%; 20%; 50% etc)? |__|__|

26) What type of vehicle did you use for the work in Q.23?

....

27) Did you use a log sheet or book? Y/N |__|
(IF YES, GO TO Q.29)

28) If No in Q.27, please provide the pattern of movement within working area when you were working on the NIBP activity in Q.23 (ie from the duty station to 1st village, 2nd village in that order)

Day 1:	Day 6:
Day 2:	Day 7:
Day 3:	Day 8:
Day 4:	Day 9:
Day 5:	Day 10:

29) Please what is your present salary scale if you don't mind to tell or know it? |__|__|

FWCODE:|__|__| DOC:|__|__/__|__/__|__|

<u>TO BE COMPLETED AFTER INTERVIEW:</u>

Personal emolument:

1) Salary (gross monthly) D..........................

2) Allowances:

	Type	Amount (D)
	a) Housing	D................
	b) Transport	D................
	c) Soc. security	D...............
	d) Other (spec.)	D................
	....	

Study 2 questionnaire

MRC FARAFENNI
COST-EFFECTIVENESS STUDY
DIPPERS QUESTIONNAIRE

Village : ....

Village Code |__|__|

Date of the start of impregnation of bednets |_|_/_|_/_|_|

a) CHARACTERISTICS OF DIPPER:

1) Dipper's name: ....

2) Dipper's occupation: |__|

1) VHW; 2) TBA; 3) OTH.(specify) ....

3. Age |__|__|

4. Sex (M/F) |__|

5. Ethnic group: |__|

1. Mandinka; 2. Wolof; 3. Fula; 4. Sarahuli;
5. Jola; 6. Other (specify)...............

b) DIPPING TIME:

6. How many of you were dipping the bednets? |__|__|

7. Time and days of dipping bed nets:

Time	Days						
	1	2	3	4	5	6	7
Start							
Finish							
Hours							

8. Total number of dipping days: |__|__|

9. Total number of hours & minutes spent: |__|__|__|.|__|__|

10. Did you do anything else between starting and finishing? |__|

Y/N (IF NO, GO TO Q.12)

11. If Yes, how long were you doing something else? (in minutes) |__|__|__|

12. If you were not involved in dipping bednets, what else would you have been doing? |__|__|

(CODE BY ACTIVITY)
(IF 'AGRICULTURE', ASK Q.13 AND CONTINUE, OTHERWISE GO TO Q.14)

13. What crops would you plant this year in Q.12? |__|

1. Groundnuts; 2. Coos; 3. Rice;
4. Others(specify).................

14. What actual work would you have been doing on your farm or your work place in Q.12? |__|

....

....

c) IMPLEMENTS FOR DIPPING BED NETS:

15. What dipping implement(s) did you use;

a) Hand gloves	Y/N	|__|
b) 1 litre cup(s)	Y/N	|__|
c) 40ml measuring cup(s)	Y/N	|__|
d) Metal funnel	Y/N	|__|
e) 5lt container	Y/N	|__|

FIELDWORKER'S CODE: |__|__| **DOC:** |__|__/__|__/__|__|

(CODE BY ACTIVITY)

Activity	Code
Animal husbandry	01
Agriculture	02
Hunting & gathering	03
Domestic work (ie sweeping, cleaning, fetching fuel & water, laundry etc)	04
Manufacturing (eg soap, salt, pottery)	05
Food processing/cooking	06
Construction (eg fencing, thatching roof etc);	07
Child care	08
Trading	09
Work for wages/salary	10
Education (Arabic or Western)	11
Resting/relaxing	12
Sleeping	13
Other (spec.)................	14

Study 3 questionnaire

FOCUS GROUP DISCUSSION

DATE: |__|__/__|__/__|__|

TIME: Start...........

End.............

Duration.............

Study area |__|__|

Village :..........................

Village code |__|__|

Meeting place :...................................

Characteristics of participants

Number of women |__|__|

Name	Marital status	Age
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Focus group discussions - Interviewing schedule

General Introduction:
Greeting and brief introduction of participants and topic for discussion by the moderator.

1) Favourite social activities in the village.

PROBES The time and its seasonality.

Is it for both men, women and children.

2) Childcare practice(s).

PROBES Activities involved.

How it is done and by whom (men or/and women or/and children)?

How, where and from whom it is learnt?

What is taught?

Alternative sources of childcare helpers (eg husband, co-wife, grandmother/mother-in-law, elder child etc).

Childcare and work (eg domestic activities and farm work).

3) Treatment seeking behaviour.

PROBES Child and ill-health care, treatment seeking and work.

Role of men (especially the husband) in child and ill-health care.

Decision on treatment.

Choice between local and modern treatments.

Who normally pays for treatments.

Who normally takes the child for treatments.

Express your gratitude to the group.

IN-DEPTH INTERVIEW

DATE: |__|__/__|__/__|__|

TIME: Start...........

End.............

Duration............

Study area |__|__|

Village :...........................

Village code |__|__|

Interviewing place :.............................

Characteristics of key informant

Name :...............................

Age |__|__|

Marital status ....

Duration stay in the village |__|__|

In-depth interview - Interviewing schedule

General Introduction:
Greeting and brief introduction of the topic by fieldworker.

1) Description of family structure.

PROBES Type of inheritance and lineage ('*lasiloo*') systems.

2) Linkages between different households in the compounds.

PROBES Relationship between heads of households and the head of the compound.

Decision on compound resources distribution amongst households.

3) Sources and types of treatment available in or around the village

PROBES Who decides on the type of treatment for children in the household.

Who provides the money for treatment.

Who normally takes the child for treatment?

Role of men in child and ill-health care (eg feeding, bathing, putting the child to sleep, administering medication, treatment seeking etc).

4) Burial, funeral and mourning ('charity') ceremonies.

PROBES Type of ceremonies.

Description of rites performed for children and adults.

Reasons for observing 'charities'.

Cost of 'charities'.

Role of family members and other compound members.

Express your gratitude to the key informant.

A sample of a transcribed focus group discussion with 6 women (aged between 21-50 years) in one of the study villages of the National Impregnated Bednet Programme, The Gambia.

Moderator:	(After the Islamic and traditional greetings, the women were seated on the '*bantaba*' (a shady platform) in the compound of the village Traditional Birth Attendant (TBA)). My colleagues and I are working for MRC in Farafenni, we don't want to take much of your precious time this morning, since you are all busy. However, we will like to learn from you as mothers and care takers of children, how you manage your daily activities. (The session was disrupted by the TBA's husband and visitors who traditionally went round greeting everybody and asking what the gathering was all about and latter left the scene). Now, tell us what your favourite social activities in this village are when you are not working? (Brief silence).
Speakers:	(Two women shouted simultaneously) Resting and sleeping, of course. (All of them started laughing).
Moderator:	No, I mean, things you do to make you happy as a group and enjoy the moment together.
Speaker 1:	I think, it is mainly drumming and dancing with our children.
Speaker 2:	We beat our '*tantango kosoo*' (calabash placed upside down in a bowl of water) and drums, we form a sort of circle with our children amidst singing and taking turns to dance in the circle.
Moderator:	Is this seasonal?
Speaker 1:	Yes, mostly during the dry season when we have a lot of marriage ceremonies and are much freer.
Speaker 2:	This both in the day and at night.
Moderator:	How useful do you find this drumming and dancing as women.
Speaker 1:	Our men like it too and enjoys seeing us happy (An uproar of laughter from the women).

Speaker 2: We get to know each other better and it keeps us together. Our children also learn our dancing and *'aada'* (culture).

Speaker 3: You see, I was a good dancer and that is what attracted my husband to marry me (An uproar of laughter from the women).

Moderator: Has any of your children taken after you, Fatou?

Speaker 3: They are still young so I can't tell but I hope one of the girls will.

Moderator: Now, let us talk about childcare, what does it involve?

Speaker 1: You people are asking a lot of questions today, I thought the MRC gives medicine to sick people (some of the women started laughing).

Speaker 2: As for you Oumie, no, no ...., anyway, childcare involves feeding, washing clothes, bathing, playing, carrying and generally making children happy and healthy.

Speaker 3: Taking proper care of your children, so that they don't fall sick so often.

Moderator: And how do you do normally do this, Oumie?

Speaker 1: Hmm ..., we stay close to our children, even when we have some domestic chores to perform, we keep close eyes on them by occasionally checking what they are doing.

Speaker 2: We pay particular attention to the junior ones (ie babies) who are yet to learn how to walk, talk and complain. As you know babies only cries for attention.

Most women: Yes, yes ....

Moderator: Where did you learn all this and how do you know that for example a baby needs attention?

Speaker 1: From our grandmothers, mothers and step-mothers (implying aunt). As mothers we have learned to understand and attach some meanings to our children's cries. And since we are always beside them we know when for example they need their next meal.

Speaker 2: When you have more children, these things become part of your life. Sometimes our mothers do tell us what to do or you see them doing it to your smaller brother or sister and you learn from that.

Most women: Yes, yes .... it is true, you know.

Speaker 3: Our mother-in-laws also teach us other childcare practices that we don't know. (Brief silence)

Moderator: What exactly did your grandmothers, mothers and mother-in-laws teach you about childcare?

Speaker 1: A lot. For example when babies (and children) are sick, they prepare medicine for them, they bath them during the first few days of birth and help you when you have a lot of work in the compound to do.

Speaker 2: Some of them are too old or busy to help. But if they leave with you in the compound, they always give advice when you need one.

Most women: That is true, yes, yes, yes .....

Speaker 3: They show their love to all the children in the compound, because they are happy to see and play with their grand children. They keep telling us to pray to '*Allah*' so that we can also see our grand children. Then we will understand and appreciate what grand motherhood is all about.

Speaker 4: They teach us to feed them, bath them, carry them on our back, put them to sleep and ...

Speaker 5: They also tell the children stories about their ancestors and give them presents.

Moderator: When you have a lot of work to do in the compound or have to go to the rice farms and you cannot look after your child(ren), who will you like to leave them with? Is it '*Hoja*' (husband's co-wife), grandmother /mother-in-law, elder child or their father?

Speaker 1: Oh, oh..., men can't look after children, they only shout on them and beat them. They don't know how to feed them at all.

Speaker 2: Some husbands try to help by only taking the child(ren) away when you are cooking and they are hungry(Uproar of laughter from the other women and fieldworkers)

Speaker 3: (Still laughing) You see, we believe (by oral tradition) that if a wife subdues the husband with domestic chores or woman's work, your children with that man will be cursed by '*Allah*'. They can be crazy later on in life. So we usually don't bother them with childcare.

Speaker 4: It is true (Most women nodding in support of this belief).

Speaker 5: I think most of us who have our grandmothers and mother-in-laws living with us in our compounds get a lot of help from them. They have a lot of experience in childcare, they are almost always at home and less busy.

Speaker 6: (With other women trying to contribute at the same time). Our elder daughters also help us by taking care of their smaller brothers and sisters as we did when we were at their age.

Speaker 7: Sometimes when there is no one in the compound to help, we take them to the field (ie farm), carry them on our backs or spread our cloth on the ground for them to sit and play around whilst we are working.

Most women: Yes, yes .....

Moderator: So how do you cope with your house household chores then?

Speaker 1: We do our work and childcare almost together most of the time.

Moderator: What happens when one of your children is sick and you have to look for treatment outside the compound or village, who takes over your work?

Speaker 1: '*Hoja*' (husband's other wife), elder daughters do help or take over, whilst you sought treatment for the child. Grandmothers also play an active part here if you are lucky to be living with one, for instance, they prepare medicine for the child when they are sick and advice.

Speaker 2:	If the rice farm belongs to you the wives, then the other wife/wives and/or husband will work on it whilst you are taking care of the sick child.
Speaker 3:	Or your working partner(s) takes over with the understanding that you will reciprocate in future.
Moderator:	Now, what role does your husband and other men of your family living with you play when your child(ren) is/are sick?
Speaker 1:	They usually tell us where to take the child for treatment. Occasionally, they go with us.
Speaker 2:	Our husbands also provide us with money if we have to seek treatment outside the village.
Moderator:	Oh so, most of the time your husbands pay for the child's treatment?
Most women:	Yes, yes .... of course, and we take the child for treatment.
Moderator:	What happens if your husband is not around?
Speaker 1:	You go and see the compound head or your husband's brother(s) also living in the compound or in the village, who might provide the help you need.
Speaker 2:	Otherwise, you use your own money, since it is your child as well.
Speaker 3:	If one is fortunate and your mother-in-law knows some local medicine (ie herbs), she will prepare some for the child to take first, whilst we wait for the father to come.
Moderator:	What will you do in situations where the sickness becomes serious? For example, your child shows signs of convulsion and becomes unconscious etc. Some of you know what I am talking about.
Speaker 1:	'*Musu Kebba*' (ie grandmother or mother-in-law) will prepare some medicine (ie herbal decoctions) for the child to drink and also they massage the child.
Speaker 2:	One can also use '*nebe dai*' to bath the child first.
Speaker 3:	When things does not improve the father or you might consult the '*marabou*' for help.

Moderator:	When do you decide to take the child for treatment? I mean to see the 'doctor' or the '*marabou*'.
Speaker 1:	It will all depend on the sickness and father's or his relatives decision.
Speaker 2:	Sometimes when our men folks are absent, we consult our mother-in-law by '*aada*' (custom), then we take the sick child to the place they recommend. (Brief silence)
Moderator:	So given the choice between the use of local medicine and '*tubab*' (ie a white person) medicine, which one will you prefer for yourself and your child(ren)?
Speaker 1:	We will take the child to the health centre, if we have the means to pay because the medicine is good. The health centre in this area is far, sometimes we don't have the money and means of transport to take the sick there, so we use local ones.
Speaker 2:	Otherwise, we obtain '*buroo*' (ie tablets) from the dispensary or pharmacy for the child.
Speaker 3:	Or we use the ones we have in the house or given by our neighbours.
Most women:	Yes, yes ....
Moderator:	But, how do you know that these '*buroo*' given to you by your neighbours is the right one to cure your child's illness?
Speaker 1:	They come to see the sick child and might have experienced the same illness in the family (Some of the women start whispering and laughing).
Speaker 2:	We live in the same village, and as we have already said, we try to help one another and eat the same food, so what caused the illness in one child can cause the same sickness in another child (Some of the women started laughing. A donkey also brayed nearby).
Moderator:	I think we have taken enough of your precious time. Thank you for this fruitful discussion and we wish you a good harvest this year.
Most of the Women:	'*Isha Allah*' (May God will this to come true, in Arabic). (One woman shouted: 'MRC we need medicine for our children and the sick').

A sample of a transcribed in-depth interview with a key informant in one of the study villages of the National Impregnated Bednet Programme, The Gambia.

Fieldworker: (After the Islamic and traditional greetings) I am working for MRC in Farafenni and I am here this morning to discuss with you some of our customs (*'aada'*), beliefs and social habits.

Over the years, MRC has been working throughout the country particularly giving medical treatment to children and their mothers. Currently, we are trying to protect people from mosquitoes by putting medicine on their bednets (*'sankewo'*). However, we know little about your culture and customs.

Please, Alhaji can you tell me about how the family is structured, the type of inheritance and lineage (*'lasiloo'*) systems existing in this village and how it differs from the other as a whole? I will like to record our discussion, will that border you in any way?

Alhaji: No, go ahead with your tape recorder. I am Alhaji Mustapha Touray, a younger brother of the *'alikalo'* of this village, Daruriliwan. I have lived here all my life and I believe I will die here (laughed). I think almost all of us in this village are Muslims. We are all patrilineal and this is how our lineage (*'lasiloo'*) is organised. The compound head is the head of the lineage, he takes the final decision usually in consultation with other elders in the compound. He sees to it that, the traditions of the family is maintained and also the arbitrator of disputes among lineage members. The compound head is usually the eldest male in the family and literally, members of the compound abides by his words and 'work' for him. If the compound head dies or is disabled by some disease or accident, the leadership of the family is passed on to the next of kin (ie his younger male sibling) who might be residing in the compound or the village. In the absence of a sibling, the eldest son is put in charge of the compound, but he is answerable to the elders of the extended family.

We do not believe in ancestral worship (ie calling on our forefathers in time of troubles or happiness by offering them libation), because our religion do not allow such practice. All we do is to name some of our children after them.

As you know, most of us are polygamous, but the children belong to the lineage as a whole. Marriages are contracted for the family, so that a widow can be married to one of the brother-in-laws, if the family deems it fit, thus there is continuity of the deceased's family and the lineage. Therefore, men in most compounds are biological and sociological fathers by our custom. The family is a unified corporate group, made up of a number of smaller units (ie households) normally bearing the same surname.

By tradition, men are responsible for providing shelter for their wives and children whilst women are charged with the responsibility of providing food and taking care of the children.

Fieldworker: Thank you Alhaji, now can you tell me how different households in the compounds are linked to each other and how decisions on the use of the compound resources are made?

Alhaji: In some compounds these days, a lot of things have changed. But most compounds are made up of one family with its members from a common parentage. The compound resources are mainly obtained from the compound's farm land and under the care of the head, who is responsible for the welfare of its members. Disbursement of the compound resources is at the discretion of the head. He usually discusses family issues with the elders of the family and household heads who help in taking the final decision. In some compounds, households are apportioned part of the compound resources for their own use.

Fieldworker: About medical treatments, what are the sources and types of treatment that are available in this village or around?

Alhaji: Most of us (elderly people) know about various plants in the bush and around the village that our forefathers used to cure diseases. And as you know there are some sicknesses that are effectively handle by our '*marabous*' such as spiritual disorders and insanity. So we have many sources of treatment namely, locally prepared medicine at home, '*marabous*' treatment, now we have the village health post and in some villages dispensaries and if you are lucky, one can have a health centre in or around the village. Our choice of treatment depends on what we know is wrong with the child. Can I also ask a favour from MRC people? Will you be kind enough to tell your authorities to send us some medicine for our village health worker (VHW). We need medicine but we do not have money to buy enough of it.

Fieldworker: I will tell my boss, but I can not promise anything because MRC do not offer medicine to villages.

Alhaji: Alright, lets carry on but do give your boss my message, who knows....(He calls a small girl sitting around to go into the compound and ask Jainaba to send him some bitter kola-nuts). Sorry, can you repeat your question again?

Fieldworker: We were talking about medical treatment, who decides that a child should, for instance, undergo a certain type of treatment, who provides the money for treatment and who normally takes the child for treatment?

Alhaji: I don't think we have one person in every compound who decides that the child needs treatment, but normally it is the fathers' responsibility. When the sickness is severe, the parents consult the elders in the compound who are normally ready to help in terms of advice, treatment, food and money.

In situations where the parents cannot meet the treatment cost, the compound head is approached, who provides it for reimbursement later or in turn solicits help from other members or neighbours. Like I said earlier on, in most villages we are one big family and the children are for all of us so we try to help one another. However, normally the father of the child provides money for the mother to take the child for treatment if need be.

For example, in my compound and like most compounds I know of in this village, when one is sick, we first give him/her 'locally prepared medicine. For instance, if a child have '*hot-body*' (fever), we prepare a decoction of tomato leaves and '*nebe dai*' (local herb) to wash the child, then apply shea butter or cow oil all over the body and allow the child to rest. If the child's condition does not improve, then a decision is taken on the next type of treatment to seek. Our religion does not permit us to take our children to '*jallangos*' (idols) and we do not have such a thing in this village.

Fieldworker: Now let us discuss children and their care, do men also take care of young children like women in terms of feeding, bathing, putting the child to sleep, things like that?

Alhaji: (Laughed). You want to turn us into women or what? I do not think this happens in your father's compound or you do that. Anyway, childcare and domestic work are a woman's job. We sometimes give them a helping hand by taking the little ones when they are very busy and there is no female around to help. I think you can talk with my wives in the compound about childcare and their daily activities if you wish.

Fieldworker: Finally, I want you to tell me more about burial, funeral and mourning ceremonies, are the same rites performed for children and adults?

Alhaji: You MRC people, you want to know everything in this country (laughter from on lookers). As Muslims, our burial, funeral and mourning ceremonies are known as 'charity'. There are 4 types of charities, namely first day charity (burial), third day charity, seventh day charity and fortieth day charity. These are mostly observed for adults. In children, usually only the first 3 are observed or the first day charity is performed for most children to mainly cut down on cost and also because of the shorter lives of deceased children they were not well known in the community and they are also not yet productive adults. These charities last for a day in each case.

Fieldworker: Why do we observe these 4 charities in our religion and for that matter by majority of Gambians?

Alhaji: The reasons for the 4 charities are;

a) first day charity is to mourn with the bereaved family and express our condolence;

b) third day charity marks the occasion when the dead loses spiritual contact with the living being;

c) seventh day charity is when the corpse is believed to loose 'sight' completely and the body starts decaying and;

d) fortieth day charity is the final rites and the corpse is spiritual laid finally to rest among its ancestors.

As you know, during this charity ceremonies, the most favoured meal of the deceased is prepared for the mourners. This is sometimes costly depending on the social status of the deceased.

All corpses must be buried within 24 hours of death as stated in the Koran. Thus, after the '*fure loola*' (corpse washers) have finished with their job, the body is prepared and wrapped in white cloth ready for prayers and then burial (ie first day charity). Prayers are said for the dead person and tributes paid, then the men carry the body to its grave for burial. Prayers are offered again at the burial site. Afterwards, kola-nuts and rice cakes are distributed to the mourners, whilst the women prepare the deceased's favourite meal for the mourners. After meals, the final prayer is said and mourners are then ready to leave for the next charity. But I have told my family, if I die, they should waste much money by killing cows for my charities (Smiled to himself).

Fieldworker: Good, so how much money do you want your family to use for your charities?

Alhaji: (Again laughed) Lets say nothing more than 1000 dalases and only one cow should be killed for '*benachi*' (a popular local rice meal). You are invited and don't forget to make a handsome donation to my family (Laughter erupted around).

Fieldworker: (Still laughing) Thank you Alhaji. You have been very helpful and I will remember your 'charity' invitation.

Alhaji: Thank you and Allah bless MRC for their continuous good work in The Gambia.

Field notes for Study 4: Matched fatal case-control (MFCC) Study

1. Introduction:

This brief notes is a guide to help you in the selection of control cases for each fatal case.

2. Background:

Malaria causes many deaths and much illness in The Gambia and elsewhere in the world especially in developing countries. Recent studies in The Gambia have shown that insecticide-treated bednets are effective in reducing general mortality and morbidity associated to malaria in children. However, all these intervention programmes cost money and the Government health budget is already over stretched by the constraints of other health measures. Thus limited amount of money is spent on malaria control each year. This study will help ministers, health administrators and their advisors make the right choice amongst malaria control methods, to ensure proper use of resources, save more lives and control malaria.

3. Aim:

The aim of the study is to work out the cost borne by household in terms of treatment, preventive measures (ie mosquito coils and '*churai*') and '*charity*'. In addition, time spent on seeking treatment, caring for sick children and attending '*charity*' ceremonies will also be estimated. Thus this study seeks to show the family expenditure and work time lost through disease and death.

4. Study subjects:

This study focuses on carers of 2 main cases namely, a) fatal cases (dead children under 10 years old during this rainy season in the NIBP study areas) and b) fatal cases' control (children (sick or healthy) of the same sex and around the age of the fatal case in question). All fatal cases (dead children) from the 1st September, 1992 to the end of the raining season (December, 1992) in the NIBP study area will be the sample of this study. **Interviews are to be conducted with their main carers 10 days or more after the death of the child**. When a death is reported, the appropriate control must be found, and the control questionnaire administered.

5. Selection of controls:

A control child will be selected for each fatal case randomly by the 'pen-spinning approach'. You stand at the entrance of the of the fatal case's (dead child's) compound and spin ('throw') your pen, the compound in the direction of the head of your pen, a child of the same sex and around the age of the fatal case is selected as the control. If the pen does not point to any compound, the spinning has to be repeated until a compound is selected. If the selected compound does not have a child of the same sex and around the age of the fatal case, you come out of that compound and turn to the next compound on your **left hand side** in that order until a control is found. **The control child can be a sick or a healthy child**.

The age range for selecting control children are;

Fatal case	Control
1yr (12mths)	6mths - 1.5yrs (18mths)
2yrs (24mths)	1.5yrs (18mths) - 2.5yrs (30mths)
3yrs (36mths)	2.5yrs (30mths) - 3.5yrs (42mths)
4yrs (48mths)	3.5yrs (42mths) - 4.5yrs (54mths)
5yrs (60mths)	4.5yrs (54mths) - 5.5yrs (66mths)
6yrs (72mths)	5.5yrs (66mths) - 6.5yrs (78mths)
7yrs (84mths)	6.5yrs (78mths) - 7.5yrs (90mths)
8yrs (96mths)	7.5yrs (90mths) - 8.5yrs (102mths)
9yrs (108mths)	8.5yrs (102mths) - 9.5yrs (114mths)
9.9yrs (119mths)	9.5yrs (114mths) - 10.5yrs (126mths)

For instance, the control for a fatal case of 1 year should be a child of the same sex and of age ranging from 6 months to 1.5 years (18mths). Again, the control for a fatal case of 2.2 years (26mths) should be a child of the same sex and of age ranging from 1.7 years (20mths) to 2.8 years (32mths). The selected age limit should always be 6 months below or above the age of the fatal case in question. **ALWAYS ASK THE CARERS FOR THE CHILD'S HEALTH CARD TO CHECK THEIR AGES**.

6. Summary of choosing a control case:

- Start from the gate/entrance of compound of the dead child;
- Spin your pen and follow the direction of the head of your pen, but remember the direction and order of selecting the compounds must be maintained throughout the study.
- The control must be of the same sex and around the age of the fatal case in question.

Study 4 Fatal case questionnaire - Part 1

Office use only
Serial No.

MRC FARAFENNI
COST-EFFECTIVENESS STUDY
FATAL CASES QUESTIONNAIRE

(THE RESPONDENT OF THIS QUESTIONNAIRE SHOULD BE THE MOTHER OR CARER OF THE DECEASED CHILD, HOWEVER, WHERE APPROPRIATE CHECK THE ANSWERS WITH THE FATHER)

A) CHARACTERISTICS OF THE CHILD:

Vilcode |_|_|

RESPONDENT: 1. Child's mother; |_|
2. Carer(spec.)..................

1. REFNO OF CHILD: |_|_|_|_|_|_|_|_|

2. Child's name :..................................

3. Date Of Birth (DOB): |_|_/_|_/_|_|

4. Date of Death (DOD): |_|_/_|_/_|_|

5. Age |_|_|

6. Sex of child M/F |_|

7. Ethnic group: |__|

1. Mandinka; 2. Wolof; 3. Fula; 4. Sarahuli;
5. Jola; 6. Other (spec.)...........

8. How many other children aged under 5 year are there in the compound? |_|_|

9. How many of these children were also ill during the time when the deceased child was also ill? |_|_|

10. Was the dead child sleeping under a bednet? |_|
1. Yes/ 2. NO (**IF NO, GO TO Q.13**)

11. Was the bednet impregnated? 1. Yes/ 2. No |_|
(IF NO, GO TO Q.12)

12. If NO in Q.11, why was the bednet not impregnated? |_|

1. ABSENT ON DAY OF IMPREGNATION;
2. NEW BEDNET;
3. DON'T LIKE IT;
4. OTHER(spec.).............

B) CHARACTERISTICS OF DEAD CHILD'S MOTHER OR CARER:

13. Dead child's mother/carer name:......................

14. Mother's age: |_|_|

15. Mother's/carer's main occupation; |_|
    1. Farmer;
    2. Trader;
    3. Not actively working
    4. Others (specify)..................

16. Mother's/carer's level of education; |_|
    1. Primary;
    2. Sec./Tech.;
    3. Koranic;
    4. No education

17. During this time of the year, do you normally work on the farm? |_|
    1.Yes/2.No (IF NO, GO TO Q.19)

18. If YES in Q.17, what crops do you plant? |_|
    1. RICE;
    2. GROUNDNUTS;
    3. BOTH 1 & 2
    4. OTHERS (spec.).........

19. If NO in Q.17, what is your main occupation this time of the year? |_|

(CODE BY ACTIVITY)

ACTIVITY	CODE
1. Animal husbandry:	01
2. Agriculture:	02
3. Hunting & gathering:	03
4. Domestic work (ie sweeping, cleaning, fetching fuel & water, laundry etc):	04
5. Manufacturing(eg soap & salt):	05
6. Food processing/cooking:	06
7. Construction(eg fencing, thatching roof etc):.	07
8. Childcare:	08
9. Trading:	09
10. Work for wages/salary:	10
11. Education (Arabic or Western):	11
12. Resting/relaxing:	12
13. Sleeping:	13
14. Other (spec.)	14

C) ILLNESS BEHAVIOUR:

20. When did the child's illness start? (DATE) |_|_/_|_|

21. When did the child's illness become severe (serious)? (DATE) |_|_/_|_|

22. How many days was the child ill? (DAYS) |_|_|

23. Did you or any one prepare <u>any special food</u> (different from the usual household meal) for the child on the day(s) he/she was ill? |_|
1.Yes/ 2.No **(IF NO, GO TO Q.26)**

24. How much did the ingredients cost (in cash and in kind round to nearest dalasis)?

a) Day 1 of illness: .... |_|_|_|

b) Day 2 of illness: .... |_|_|_|

c) Other illness day(s): .... |_|_|_|

Total(cash): |_|_|_|

25. How long did it take to prepare and administer the food?

a) Day 1 of illness:............... |_|_|_|

b) Day 2 of illness:............... |_|_|_|

c) Other illness day(s):........... |_|_|_|

Total(hours): |_|_|_|

26. Who normally pays for treatment when any of your children or your child falls ill? |_|
1. Child's mother;
2. Child's father;
3. Other (spec.)...................

27.Did you or someone else in the family prepare a traditional or any other treatment for the child? 1. Yes/ 2. No |_|
(IF NO, GO TO Q.30)

28. How much did the ingredients cost in total? (in cash and in kind: round to nearest dalasis) |_|_|_|
....

29. How long did it take to prepare

and administer (ie during the days when this was done)? (Mins)............ |_|_|_|

30. Was the child treated by anyone else?
1. Yes/ 2. NO |_|
(IF NO, GO TO Q.40)

ASK THE FOLLOWING QUESTIONS FOR EACH OF THE TREATMENTS RECEIVED FROM OUTSIDE THE FAMILY

D) TREATMENT SOUGHT:

QUESTIONS	1st visit	2nd visit	3rd visit	4th visit	5th visit
31. By whom was the child treated? 1.VHW; 2.CHN; 3.Health centre; 4.Dispensary; 5.Marabou; 6.Other (spec.)...................					
32. Was the child taken for treatment? 1. Yes/2. No **(IF NO, GO TO Q.38)**					
33. How long did it take to go there and come back? (mins) **(INCLUDING WAITING & TREATMENT TIME).**					
34. Who went with the child? 1. Child's mother; 2. Other (spec.)					
35. What would he/she have been doing if he/she was not taking the child for treatment? **(USE ACTIVITY CODES)**					
36. Did anyone take his/her place in this activity? 1. Yes/2. No **(IF NO, GO TO Q.38)**					

37. If YES, who? 1. Mother's sister; 2. Co-wife; 3. Husband; 4. Other.					
38. Did you spend any money to get the treatment? 1.Yes/2.No **(IF NO, GO TO Q.40)**					
39. Was the child admitted (if applicable) 1. Yes/2.No					
40. What was the cost? 1. Fee/present:	....	....	....	....	....
2. Med/lab test etc.:	....	....	....	....	....
3. Travel expenses:	....	....	....	....	....
4. Other:..........	....	....	....	....	....
5. TOTAL:	....	....	....	....	....

NOW GO BACK AND REPEAT Q's 31 - 40 FOR THE OTHER TREATMENTS. IF YOU HAVE ASKED QUESTIONS ON ALL TREATMENTS, THEN GO ON TO Q.41.

41. Because you people were spending time looking after the sick child, do you think your work/farming has suffered?
1. Yes/2. No **(IF NO, THAT'S THE END OF THE INTERVIEW)** |_|

42. If YES, what will be the effect?

....

....

FIELDWORKER'S CODE: |__|__| **DOC** :|__|__/__|__/__|__|

Study 4 Fatal case questionnaire - Part 2

Office use only
Serial No.

MRC FARAFENNI
COST-EFFECTIVENESS STUDY
FATAL CASES QUESTIONNAIRE

(THE RESPONDENT OF THIS QUESTIONNAIRE SHOULD BE THE FATHER OR THE FAMILY PERSON IN CHARGE OF THE DECEASED CHILD'S FUNERAL ARRANGEMENTS)

A) CHARACTERISTICS OF THE CHILD:

VILCODE |_|_|

RESPONDENT: 1. Child's father; |_|
2. Other(spec.)..................

1. REFNO. OF CHILD: |_|_|_|_|_|_|_|_|

2. Child's name: ....

3. Date Of Birth (DOB): |_|_/_|_/_|_|

4. Date of Death (DOD): |_|_/_|_/_|_|

Age (months) |_|_|

5. Sex of child M/F |_|

B) FUNERAL CEREMONIES etc.

6. After the child had died, what ceremonies did you hold?

1. First day charity; 1. Yes/2. No |_|
2. Third day charity; 1. Yes/2. No |_|
3. Seventh day charity; 1. Yes/2. No |_|

7. What did they cost? (in cash and including the estimated value of any payments made in kind; round to the nearest dalasis)

a) First day charity; D:......... |_|_|_|_|
b) First day charity donations: D:......... |_|_|_|_|

c) Third day charity; D:......... |_|_|_|_|

d) Third day charity donations: D:......... |_|_|_|_|

e) Seventh day charity; D:......... |_|_|_|_|

f) Seventh day charity donations: D:......... |_|_|_|_|

8. Did members of your compound stop doing their normal activities because of the child's death?
1.Yes/2. No **(IF NO GO TO Q.10)** |_|

9. If YES, who stopped what activities and for how long?

Type of compound member	No. of productive adults in the compound	Main Activities stopped (USE CODES)	No. of days stopped	Ave. number of hours lost per day	Total no. of hours lost
1. Family members					
2. Other					

10. Has the household lost any cash income because of the child's death (excluding expenditure on treatment and funeral ceremonies)? 1. Yes/2. No **(IF NO, GO TO Q.12)** |_|

11. If YES, why did the household lose income and what was its value? (in dalasis)

Activity	Reason	Value (in Dalasis)

12. What was family's (man and wife) cash income in;

a) Wet season (1991) D:..................

b) Dry season (1992) D:..................

13. How much of the following crops did your compound produce last harvest season (1991);

a) Groundnut (Donkeys)............ Amount :|_|_|_|_|

b) Coos (Specify unit)........... Amount :|_|_|_|_|

c) Rice (Specify unit)............ Amount :|_|_|_|_|

d) Other(Specify unit)............ Amount :|_|_|_|_|

C) OTHER MALARIA CONTROL MEASURES:

14. Do you use mosquito coils? 1. Yes/2. No |_|
(IF NO, GO TO Q.20)

15. If YES, how much do you spend on it in a month? (nearest dalasis per month) |_|_|

16. Do you spend this amount every month?
1. Yes/2. No |_|
(IF YES, GO TO Q.20)

17. If NO in Q.16, how many months do you spend this? |_|_|

18. If NO in Q.16, do you spend anything in the other month(s) |_|
1. Yes/2. No **(IF NO, GO TO Q.20)**

19. If YES in Q.18, how much per month? |_|_|_|

(CALCULATE TOTAL PER YEAR D:............) |_|_|_|

20. Do you burn 'churai'?
1. Yes/2. No **(IF NO, END OF INTERVIEW)** |_|

21. If YES, how much do you spend on 'churai' in a month? (nearest dalasis per month) |_|_|

22. Do you spend this amount every month?
1. Yes/2. No |_|
(IF YES, END OF INTERVIEW)

23. If NO in Q.22, how many months do you spend this? |_|_|

24. If NO in Q.22, do you spend anything in the other month(s)? |_|
1. Yes/2. No **(IF NO, END OF INTERVIEW)**

25. If YES in Q.24, how much per month? |_|_|_|

(CALCULATE TOTAL PER YEAR D:............) |_|_|_|

FIELDWORKER'S CODE: |__|__| **DOC** :|__|__/__|__/__|__|

Study 4 Control case questionnaire

Office use only
Serial No.

MRC FARAFENNI
COST-EFFECTIVENESS STUDY
FATAL CASE-CONTROL QUESTIONNAIRE

(THE RESPONDENT OF THIS QUESTIONNAIRE SHOULD BE THE MOTHER OR CARER OF THE CHILD)

A) CHARACTERISTICS OF THE CHILD:

Vilcode |_|_|

RESPONDENT: 1. Child's mother; |_|
2. Carer(spec.)..................

1. REFNO OF CHILD: |_|_|_|_|_|_|_|_|

2. Child's name :.....................................

3. Date Of Birth (DOB): |_|_/_|_/_|_|

4. Age |_|_|

5. Sex of child M/F |_|

6. Ethnic group: |__|

1. Mandinka; 2. Wolof; 3. Fula; 4. Sarahuli;
5. Jola; 6. Other (spec.)............

7. How many other children aged under 5 year are there in the compound? |_|_|

8. Is the control child sleeping under a bednet? 1. Yes/ 2. No |_|
(IF NO, GO TO Q.11)

9. Is the bednet impregnated? 1. Yes/ 2. No |_|
(IF YES, GO TO Q.11)

10. If NO in Q.9, why is the bednet not impregnated? |_|
1. ABSENT ON DAY OF IMPREGNATION;
2. NEW BEDNET;
3. DON'T LIKE IT;
4. OTHER(spec.)........

B) CHARACTERISTICS OF CONTROL CHILD'S MOTHER OR CARER:

11. Child's mother/carer name:..........................

12. Mother's Age |_|_|

13. Mother's/carer's main occupation; |_|
    1. Farmer;
    2. Trader;
    3. Not actively working
    4. Others (specify)....................

14. Mother's/carer's level of education; |_|
    1. Primary;
    2. Sec./Tech.;
    3. Koranic;
    4. No education

15. During this time of the year, do you normally work on the farm? |_|
    1.Yes/2.No (IF NO, GO TO Q.16)

16. If YES in Q.15, what crops do you plant? |_|
    1. RICE; 3. BOTH 1 & 2
    3. GROUNDNUTS; 4. OTHERS (spec.).........

17. If NO in Q.16, what is your main occupation this time of the year? |_|

(CODE BY ACTIVITY)

ACTIVITY	CODE
1. Animal husbandry:	01
2. Agriculture:	02
3. Hunting & gathering:	03
4. Domestic work (ie sweeping, cleaning, fetching fuel & water, laundry etc):	04
5. Manufacturing(eg soap & salt):	05
6. Food processing/cooking:	06
7. Construction(eg fencing, thatching roof etc):.	07
8. Childcare:	08
9. Trading:	09
10. Work for wages/salary:	10
11. Education (Arabic or Western):	11
12. Resting/relaxing:	12
13. Sleeping:	13
14. Other (spec.)	14

C) ILLNESS BEHAVIOUR:

18.Was your child well or sick in the week before .... died? (REFER TO FATAL CASE) |__|

1. WELL; 2. SICK;
(IF CHILD WAS WELL, GO TO Q.41)

19. When did the illness start? |_|_/_|_|

20. Is he/she now better? 1. Yes/ 2. No |_|

21. How long has he/she been ill with that illness? |_|_|

22. Did you or any one prepare <u>any</u> <u>special food</u> (different from the usual household meal) for the child on day(s) he/she was ill? 1. Yes/2. No |_|
(IF NO, GO TO Q.25)

23. How much did the ingredients cost (in cash and in kind, round to nearest dalasis)? |_|_|_|

24. How long did it take to prepare and administer the food? (Mins.)................ |_|_|_|

25. Who normally pays for treatment when any of your children or your child falls ill? |_|
    1. Child's mother;
    2. Child's father;
    3. Other (spec.)..................

26. Did you or someone else in the family prepare a traditional or any other treatment for the child? 1. Yes/ 2. No **(IF NO, GO TO Q.29)** |_|

27. How much did the ingredients cost in total? (in cash and in kind, round to nearest dalasis).............. |_|_|_|

28. How long did it take to prepare and administer (ie during the days when this was done)? (Mins)............ |_|_|_|

29. Was the child treated by anyone else? |_|
1. Yes/ 2. NO
(IF NO, GO TO Q.41)

ASK THE FOLLOWING QUESTIONS FOR EACH OF THE TREATMENTS RECEIVED FROM OUTSIDE THE FAMILY.

D) TREATMENT SOUGHT:

QUESTIONS	1st visit	2nd visit	3rd visit	4th visit	5th visit
30. By whom was the child treated? 1.VHW; 2.CHN; 3.Health centre; 4.Dispensary; 5.Marabou; 6. Other (spec.)...............					
31. Was the child taken for treatment? 1. Yes/2. No **(IF NO, GO TO Q.37)**					
32. How long did it take to go there and come back? (mins) **(INCLUDING WAITING & TREATMENT TIME).**					
33. Who went with the child? 1. Child's mother; 2. Other (spec.)					
34. What would he/she have been doing if he/she was not taking the child for treatment? **(USE ACTIVITY CODES)**					
35. Did anyone take his/her place in this activity? 1. Yes/2. No **(IF NO, GO TO Q.37)**					
36. If YES, who? 1. Mother's sister; 2. Co-wife; 3. Husband; 4. Other.					

37. Did you spend any money to get the treatment? 1.Yes/2.No **(IF NO, GO TO Q.39)**					
38. Was the child admitted (if applicable) 1. Yes/2.No					
39. What was the cost? 1. Fee/present: 2. Med/lab test etc.: 3. Travel expenses: 4. Other:.......... 5. TOTAL:	....	....	....	....	....

NOW GO BACK AND REPEAT Q's 30 - 39 FOR THE OTHER TREATMENTS. IF YOU HAVE ASKED QUESTIONS ON ALL TREATMENTS, THEN GO ON TO Q.40.

40. Because you people were spending time looking after the sick child, do you think your work/farming has suffered? 1. Yes/2. No
(IF NO, GO TO Q.42) |_|

41. If YES, what will be the effect?

....

....

RESPONDENT OF Qs 42 & 43 SHOULD PREFERABLY BE THE FATHER OF THE CHILD OR A MALE ADULT OF THE COMPOUND RESPONSIBLE FOR THE UPKEEP OF THE FAMILY

42. What was family's (man and wife) cash income in;

a) Wet season (1991) D:...................

b) Dry season (1992) D:...................

43. How much of the following crops did your compound produce last harvest season (1991);

a) Groundnut (Donkeys).......... Amount :|_|_|_|_|

b) Coos (Specify unit)......... Amount :|_|_|_|_|

c) Rice (Specify unit).......... Amount :|_|_|_|_|

d) Other(Specify unit).......... Amount :|_|_|_|_|

C) OTHER MALARIA CONTROL MEASURES:

44. Do you use mosquito coils? 1. Yes/2. No |_|
(IF NO, GO TO Q.50)

45. If YES, how much do you spend on it in a month? (nearest dalasis per month) |_|_|

46. Do you spend this amount every month?
1. Yes/2. No |_|
(IF YES, GO TO Q.50)

47. If NO in Q.46, how many months do you spend this? |_|_|

48. If NO in Q.46, do you spend anything in the other month(s) |_|
1. Yes/2. No **(IF NO, GO TO Q.50)**

49. If YES in Q.48 how much per month? |_|_|_|

(CALCULATE TOTAL PER YEAR D:............) |_|_|_|

50. Do you burn 'churai'?
1. Yes/2. No **(IF NO, END OF INTERVIEW)** |_|

51. If YES, how much do you spend on 'churai' in a month? (nearest dalasis per month) |_|_|

52. Do you spend this amount every month?
1. Yes/2. No |_|
(IF YES, END OF INTERVIEW)

53. If NO in Q.52, how many months do you spend this? |_|_|

54. If NO in Q.52, do you spend anything in the other month(s)? |_|
1. Yes/2. No **(IF NO, END OF INTERVIEW)**

55. If YES in Q.54, how much per month? |_|_|_|

(CALCULATE TOTAL PER YEAR D:............) |_|_|_|

FIELDWORKER'S CODE: |__|__| **DOC:** |__|__/__|__/__|__|

Study 6 questionnaire

MRC FARAFENNNI
RANDOM SPOT OBSERVATION STUDY FORM

STUDY AREA |__|

VILLAGE: ....

COMPOUND NUMBER: |__|__|__|

1) VISIT NUMBER: |__|__|

2) OBSERVATION DATE: |__|__/__|__|

3) MOTHER'S NAME :..................................

4) OBSERVATION TIME: |__|__|.|__|__|

5) ACTIVITY CODE: |__|__|__|__|__|

6) DESCRIPTION OF ACTIVITY:................................

....

....

FWCODE:|__|__|

RANDOM SPOT OBSERVATION ACTIVITY CODES

1) State of Activity entered on the form:

Observed activity = 1;

Reported activity = 2.

2) General category of activities:

General activities		CODE
Missed data	=	00
Eating/drinking	=	01
Food preparation	=	02
Child care	=	03
Domestic work	=	04
Agricultural work	=	05
Animal Husbandry	=	06
Inactive	=	07
Out of location	=	08
Social	=	09
Other	=	10
Trading	=	11

3) Specific level activity codes:

a) Eating/drinking:

Activity		CODE
Drinking 'attaya'	=	01
Drinking water/soft drinks etc	=	02
Eating alone	=	03
Eating with children	=	04
Eating with others	=	05
Other	=	06

b) Food preparation:

Activity		CODE
Washing utensils etc for cooking	=	01
Preparing firewood	=	02
Setting fire	=	03
Preparing ingredients for cooking	=	04
Cooking alone	=	05
Cooking with sibling	=	06
Helping in cooking	=	07
Milk preparation	=	08
Serving/sharing food	=	09
Fish/meat/vegetable preparation	=	10
Maize roasting	=	11
Other	=	12

c) Child care:

Activity		CODE
Carry on the back/Holding/patting	=	01
Dressing/combing/braiding hair/ haircut	=	02
Washing/Bathing	=	03
Breastfeeding/giving baby food	=	04
Feeding food	=	05
Treating wound or illness	=	06
Urinating/defecating	=	07
Singing	=	08
Comforting when crying	=	09
Physical punishing	=	10
Putting to bed	=	11
Preparing for Hospital/HC/ Dispensary/Clinic/PHC post	=	12
Taking to Hospital/HC/Dispensary/ clinic/PHC post	=	13
Playing with child(ren)	=	14
Drinking water	=	15
Other	=	16

d) Domestic work:

Activity		CODE
Sweeping compound/room etc	=	01
Fetching water	=	02
Laundry	=	03
Pounding rice, coos etc	=	04
Preparing pounded coos etc.	=	05
Washing utensils	=	06
Ironing	=	07
Firewood (splitting, gathering etc)	=	08
Other	=	09

e) Agricultural work:

Activity		CODE
Clearing	=	01
Digging	=	02
Planting	=	03
Weeding	=	04
Harvesting	=	05
Fertilizing soil	=	06
Dehusking/peeling groundnuts	=	07
Working on other farm produce (eg packing, bagging, removing leaves, dirt etc)	=	08
Other	=	09

f) Animal Husbandry:

Activity		CODE
Cleaning goats/sheep pen	=	01
Cleaning chicken/guinea fowl etc pen	=	02
Taking goats/sheep to feed	=	03
Other	=	04

g) Inactive:

Activity		CODE
Sleeping	=	01
Relaxing/ dozing	=	02
Resting	=	03
Other	=	04

h) Out of location:

Activity		CODE
Travelled/visiting in other village	=	01
Attending naming/marrying ceremony out of village	=	02
Attending funeral ceremony out of village	=	03
Gone to 'lumo'	=	04
Gone to health centre/hospital etc for treatment	=	05
Taking child to health centre/ hospital etc for treatment	=	06
Other	=	07

i) Social:

Activity		CODE
Chatting in compound	=	01
Chatting in other compound	=	02
Attending naming/marrying ceremony in the village	=	03
Attending funeral ceremony in the village	=	04
Celebrating a festival	=	05
Making social announcement	=	06
Attending women village meeting	=	07
Other	=	08

j) Other:

Activity		CODE
Quarrelling	=	01
Crying	=	02
Preparing to go out	=	03
Woman in labour	=	04
Praying	=	05
Sick sitting outside	=	06
Sick in bed	=	07
Bathing/urinating/defecating etc	=	08
At large	=	09
Sewing	=	10
Coming into compound	=	11
Hair plaiting/braiding	=	12
Packing things in room	=	13
Attending to money business (eg checking/counting/putting away)	=	14
Dressing up	=	15
Helping in repairing fence	=	16
Other	=	17

k) Trading

Activity		CODE
Selling goods	=	01
Buying goods	=	02
Other	=	03

School attendance form

LIST OF ABSENTEES PER WEEK

SCHOOL: ____________________

TEACHER: ____________________

CLASS: |__|__|

WEEK: |__|__|

DATE OF WEEK BEGINNING: |__|__/__|__/__|__|

DATE OF WEEK ENDING: |__|__/__|__/__|__|

DAY CODES:

MONDAY=**M**; TUESDAY=**T**; WEDNESDAY=**W**; THURSDAY=**H**; FRIDAY=**F**

DAY	CODE OF ABSENTEE	REASONS FOR BEING ABSENT				
		FEVER (Y/N)	VOMITING (Y/N)	BODY PAIN (Y/N)	OTHER ILLNESS	OTHER REASONS

TO BE COMPLETED BY FIELDWORKER:

FWCODE: |__|__|
DATE OF COLLECTION OF FORM: |__|__/__|__/__|__|

School dispensary form

WEEKLY SCHOOLS DISPENSARY RECORD

SCHOOL: ____________________

NAME OF HEALTH CENTRE: ____________________

DAY: ____________ **DATE:** |__|__/__|__/__|__|

No.	NAME	CLASS	CONPLAINTS	DISPENSER'S REMARKS
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

TO BE COMPLETED BY FIELDWORKER:

FWCODE: |__|__|

DATE OF COLLECTION OFFORM: |__|__/__|__/__|__|

Appendix 2

Table 5a Annual providers[1] recurrent cost of NIBP, 1992

Item	No.	NIBP cost (D[2])	Cost profile (%)
1) Personnel			
i) MRC & other NGO Personnel			
Project manager[3]	1	14,046.25	13.61
Administrative assistant	1	8,266.25	8.01
Secretary	1	2,443.11	2.37
Health coordinator4[3]	1	9,414.00	9.12
Community Development Officer[5]	2	749.17	0.73
Field staff	4	21,873.20	21.19
Driver	1	6,000.15	5.81
Cleaner	1	445.69	0.43
Watchman	1	119.98	0.12
Sub-total	13	63,357.80	61.39
ii) MoH personnel			
Malaria control officer	1	6,296.00	6.10
Senior Public Health Nurse/Senior Public Health Officer	7	4,179.62	4.05
Community health nurse (CHN)	37	9,919.54	9.61
Health inspector	2	1,325.15	1.28
Driver	6	4,346.04	4.21
Sub-total	53	26,066.35	25.26
Personnel cost (Sub-total)	66	89,424.15	86.64
2) Other office supplies & services			
Board bulletin	1	320.00	0.31
Letter heads	3,000	2,343.00	2.27
Complimentary slips	1,000	924.00	0.90
General office supplies & services[6]	Varies	1,412.35	1.37
Telephone services	-	6,950.71	6.73
Utilities[7]	-	1,834.94	1.78
Sub-total	-	13,785.00	13.37
Total recurrent cost	-	103,209.15	100.00

1 Comprises of government and NGOs.
2 D refers to Dalasis (Gambian currency).
3 Local salary rate was used instead of the actual expatriate rate earned.
4 Save the Children Federation (US) personnel.
5 Action Aid The Gambia personnel.
6 Stationary, pens, pencils, postage, other minor office equipments & supplies.
7 Electricity, water, printing & photocopying.

Table 5b Annual providers recurrent cost of NIBP Impregnation exercise alone, 1992

1) Impregnation supplies & services

Item	Amount	NIBP cost (D)	Cost profile (%)
Insecticide (Permethrin 20% EC)[1]	169	448,176.17	89.84
Markers:			
i) Indelible	150	3,750.00	0.75
ii) Washable	150	3,000.00	0.60
Ferry charges:			
i) Landrover	11	750.00	0.15
ii) Motorbike	81	405.00	0.08
Night allowance	8	220.00	0.04
Sub-total	-	456,301.17	91.47

2) Transport cost

a) Bednet survey & impregnation exercise

Type of transport	Distance covered (km)	Distance cost (D)[2]	Fuel cost (D)[3]	NIBP cost (D)[4]	Cost profile (%)
Landrover	3,497.0	9,651.72	2,268.00	11,919.72	2.39
Toyota (twin-cab)	460.0	1,269.60	268.10	1,537.70	0.31
Motorbike					
i) MRC	5,729.0	10,254.91	1,517.60	11,772.51	2.36
ii) MoH & other	2,916.3	5,220.18	772.10	5,992.28	1.20
Sub-total	12,602.3	26,396.41	4,825.80	31,222.21	6.26

b) Insecticide distribution

Type of transport	Distance covered (km)	Distance cost (D)[2]	Fuel cost (D)[3]	NIBP cost (D)[4]	Cost profile (%)
Landrover	338.8	935.09	219.50	1,154.59	0.23
Toyota (twin-cab)	1,638.8	4,523.09	683.00	5,206.09	1.04
Renault Commando G17 truck	1,276.7	3,523.69	1,447.50	4,971.19	1.00
Sub-total	3,254.3	8,981.87	2,350.00	11,331.87	2.27
Total impregntaion recurrent cost	-	-	-	498,855.25	99.99

1 Total amount of insecticide used includes 13.88% wastage.
2 Distance cost = [Distance covered (km)] x [MRC transport charge for the vehicle].
3 Fuel cost = [Distance covered (km)]/[Vehicle fuel consumption per litre] x [Fuel cost per litre].
4 NIBP cost = Distance cost + Fuel cost.
{MRC transport charge includes maintenance cost but excludes driver's salary and fuel cost}

Table 5c Annual general providers capital cost of NIBP, 1992 (at 6% discount rate)

Item	No.	Capital cost (D)	Useful life (yrs)	Annualized cost[1] (D)	NIBP cost (D)	Cost profile (%)
i) **Vehicles**						
Landrover (Defender 110)	1	219,800.00	5	52,617.67	18,635.42	31.29
Toyota (Hilux twin-cab)	6	228,000.00	5	54,564.30	10,340.00	17.36
Motorbikes (Honda 110)	45	17,270.00	3	6,526.94	19,232.71	32.30
Vehicle cost (sub-total)	52	464,270.00	13	113,708.91	48,208.13	80.95
ii) **Buildings**						
NIBP offices & store	3	50,000.00	20	18,718.47	2,187.72	3.67
MoH offices & stores	6	50,000.00	20	3,051.47	904.46	1.52
Building cost (Sub-total)	8	100,000.00	40	21,769.94	3,092.18	5.19
iii) **Other supplies**						
Door lock	2	155.00	3	57.99	41.08	0.07
Field bag	4	50.00	2	27.27	38.63	0.06
Raincoat	4	250.00	3	93.53	132.50	0.22
Map of The Gambia	1	100.00	3	37.41	13.25	0.02
Other supplies (Sub-total)	11	555.00	11	216.20	225.46	0.38
iv) **Office equip. & furniture**						
Computer (Amstrad Atomstyle)	1	22,922.00	4	6,615.10	2,342.85	3.93
Printer (HP laserjet 3 postscript)	1	7,564.26	4	2,182.98	386.57	0.65
IBM typewriter	1	12,056.97	3	4,510.65	1,597.52	2.68
Air conditioner (Panasoinc)	2	7,198.45	3	2,693.02	1,907.56	3.21
File cabinet	2	1,390.00	5	329.98	233.74	0.39
Office table	3	3,200.00	5	759.66	807.14	1.36
Computer table	1	1,500.00	5	365.09	126.12	0.21
Chair	6	948.00	5	225.05	478.26	0.80
File tray	3	300.00	5	71.22	75.67	0.13
Trash bin	2	300.00	4	101.01	71.55	0.12
Office equipment & furniture (Sub-total)	22	57,379.68	43	17,853.76	8,026.96	13.48
Total Cost	93	622,204.68	107	153548.81	59,552.73	99.99

1 Annualized cost per item.

Table 5d Annual providers operational costs of Sensitization & Awareness (SA) campaign alone of NIBP, 1992

i) **Training & dipping demonstration**

Item	No.	NIBP cost (D)	Cost profile (%)
NIBP T-shirt	300	9,000.00	14.03
Health education poster 1 & 2	4,000	11,088.00	17.29
Radio broadcast	17	6,295.00	9.82
NIBP video production	7	8,000.00	12.47
Ferry charges:			
i) Landrover	26	650.00	1.01
ii)Motorbike	234	1,170.00	1.82
Night allowance	50	1,330.00	2.07
Sub-total	-	37,533.00	58.52

ii) **Transport cost**

Type of transport	Distance covered (km)	Distance cost (D)¹	Fuel cost (D)²	NIBP cost (D)³	Cost profile (%)
Landrover	2,033.0	5,611.08	1,318.50	6,929.58	10.81
Toyota (twin-cab)	425.0	1,173.00	247.80	1,420.80	2.22
Motorbike (Honda 110)					
i) MRC	6,176.8	11,056.47	1,635.70	12,692.17	19.79
ii)MoH & other	2,704.4	4,840.88	716.10	5,556.98	8.66
Sub-total	11,339.2	22,681.43	3,918.10	26,599.53	41.48
Total cost	-	-	-	64,132.53	99.99

1 Distance cost = [Distance covered (km)] x [MRC transport charge for the vehicle]
2 Fuel cost = [Distance covered (km)]/[Vehicle fuel consumption per litre] x [Fuel cost per litre]
3 NIBP cost = Distance cost + Fuel cost
{MRC transport charge includes maintenance cost but excludes driver's salary and fuel cost}

Table 5e Annualized providers capital cost of SA campaign alone, 1992

Item	No.	Useful life (yrs)	Annualized cost² (D)	NIBP cost (D)	Cost profile (%)
SA operational cost¹	-	2	34,980.11	34,980.11	99.36
Video cassette	8	2	24.54	196.36	0.56
Audio cassette	5	2	5.45	27.27	0.08
Total SA cost:	13	6	35,010.10	35,203.74	100.00

1 Annualized total training & dipping demonstration and transport running costs in Table 5b.
2 Annualized cost per item.

Table 5f Annual providers capital cost of Impregnation exercise alone, 1992

Item	No.	Capital cost (D)	Useful life (yrs)	Annualized unit cost[1] (D)	NIBP cost (D)	Cost profile (%)
Renault Commando G17 truck	1	549,500.00	10	74,659.31	848.40	15.69
Plastic 1lt cup	150	5.00	3	0.53	79.50	1.47
Plastic 5lt container	150	8.00	3	2.99	448.93	8.31
Metal funnel	300	10.00	5	2.37	711.00	13.15
40ml measuring cup	300	12.00	5	2.85	855.00	15.82
Rubber glove	250	18.06	2	9.85	2,462.50	45.56
Total Impregnation exercise cost:	1,151	549,553.06	28	74,677.90	5,405.33	100.00

1 Annualized cost per item.

Table 5g Annual community recurrent cost of NIBP, 1992

Item	Amount	NIBP cost (D)	Cost profile (%)
1) **Supplies**			
Water[1]	1,588.68 cu. m	5,957.55	11.59
Detergent (ie 'donkey soap')[2]	14,484	28,968.00	56.34
Sub-total	-	34,925.55	67.92
2) **Cost of dippers time**[3]			
Sub-total	942	16,494.38[4]	32.08
Total recurrent cost	-	51,419.93	100.01

1 Estimated amount for washing bednets prior to dipping & used in dipping.
2 Estimated amount for washing bednets & bowls.
3 Estimated from the study areas and the 221 villages covered by NIBP, 1992.
4 Hired farm labour rate (D2.19 per hour) multiplied by 942.

Table 5h Annual community capital cost of Impregnation exercise alone, 1992

Item	No.	Capital cost (D)	Useful life (yrs)	Annualized cost[4] (D)	NIBP cost (D)	Cost profile (%)
Bednets purchased for impregnation[1]	228	80.00	6	16.11	3,673.78	86.88
Plastic bowl (25lt)[2]	450	35.00	3	13.09	58.94	1.39
Plastic bucket (15lt)[3]	6,630	25.00	3	7.48	495.87	11.73
Total:	7,308	140.00	12	36.68	4,228.59	100.00

1 Obtained from NIBP, 1992 impregnated coverage statistics.
2 Estimated number of bowls used by dippers in 221 villages covered.
3 Estimated number of buckets used in the compounds (ie about 30 compound/village) in the 221 villages coverd and 1% cost allocated to NIBP.
4 Annualized cost per item.

Appendix 3

Table 6a Annual departmental costs of Bansang hospital, 1992

Departments	Staff	Beds	Recurrent cost (D)		Total recurrent cost (D)	Annualized capital cost[1] (D)	Total cost (D)
			Personnel	Supplies/services			
Non-treatment							
Administration	41	-	230,886.00	708,785.00	939,671.00	151,592.94	1,091,263.94
Laundry	9	-	33,600.00	20,000.00	53,600.00	@	53,600.00
Catering	7	-	44,400.00	300,000.00	344,400.00	929.34	345,329.34
Sub-total	57	-	308,886.00	1,028,785.00	1,337,671.00	151,522.28	1,490,193.28
Treatment							
Dispensary	5	-	40,090.00	541,640.40	581,730.40	@	581,730.40
Laboratory	6	-	36,504.00	50,000.00	86,504.00	6,414.05	92,918.05
Radiology	2	-	54,403.20	75,000.00	129,403.00	45,258.48	174,661.68
OPD	8	-	155,511.40	**	155,511.40	@	155,511.40
Paediatric ward	6	30	80,526.00	5,000.00	85,526.00	179,818.48	265,344.48
Other wards & facilities[2]	29	95	na[3]	na	na	na	na
Sub-total	56	125	367,034.60	671,640.40	1,038,674.80	231,491.01	1,270,166.01
Total	113	125	675,920.60	1,700,425.40	2,376,345.80	384,013.29	2,760,359.29

1 Capital costs considered were annualized costs that were greater than D500.00 ie (1) Administration; building, vehicle, overhead water tank, generator, office equipment and refrigerator, (2) Catering; cooking utensils, (3) Laboratory; drying oven, microscopes and bench aids, (4) Radiology; X-ray machine, (5) Paediatric ward; building, beds, cupboards and other furniture.
2 MCH clinic, Dental clinic, Acupuncture unit, Operating theatre, Female & male wards, Isolation ward, Maternity & labour ward and mortuary were not considered for costing because they were not related to the treatment of children.
3 Not applicable.
@ Annualized capital cost was less than D500.00.
** OPD supplies/services (eg stationary etc) were considered under Administration.

Table 6b Step down procedure used to allocate non-treatment costs in Bansang hospital, 1992

Cost centre	Total cost (D)	Administration		Catering		Laundry		Final overhead allocation to cost centres
		Factor[a]	Amount	Factor[b]	Amount	Factor[c]	Amount	
Cost criteria		Staff ratios	(D)	Staff & beds	(D)	Beds	(D)	
Non-treatment department								
Administration[d]	1,091,263.94	1.0000	1,091,263.94					
Catering[e]	345,329.34	0.0972	106,070.85	1.0000	451,400.19			
Laundry[f]	53,600.00	0.1250	136,407.99	0.0425	19,184.51	1.0000	209,192.50	
Treatment department								
Dispensary		0.0694	75,733.72	0.0236	10,653.04	-	-	86,386.76
Laboratory		0.0833	90,902.28	0.0283	12,774.63	-	-	103,676.91
Radiology		0.0288	31,428.40	0.0094	4,243.16	-	-	35,671.56
OPD		0.1111	121,239.42	0.0377	17,017.79	-	-	138,257.21
Paediatric ward		0.0833	90,902.28	0.1483	66,942.65	0.2400	50,206.20	208,051.13

a Staffing in departments as a proportion to total hospital staff (see Table 6a).
b Average of staff ratios and proportion of beds in departments (see Table 6a).
c Proportion of beds in ward (see Table 6a).
d Administration costs to the other wards and departments not considered were accounted for in the allocation factor used.
e Catering costs to the other wards and departments not considered were accounted for in the allocation factor used.
f Laundry costs to the other wards and departments not considered were accounted for in the allocation factor used.

Table 6c Mean[1] household expenditure on treatment and indirect cost associated with treatment from MFCC study

Items		Mean[1] household treatment cost (D) per visit[2]	
		Fatal cases	Non-fatal cases
1) **Mean treatment costs[2] (D)**			
Hospital	OPD	4.79 (3.35, 6.25)[3]	4.27 (2.94, 5.60)
	PW	14.78 (12.39, 15.21)	13.33 (11.96, 14.70)
	Adjusted OPD[4]	3.79	3.27
	Adjusted PW[5]	9.78	8.33
Health centre	OPD	3.55 (3.14, 5.96)	4.05 (3.86, 5.04)
	PW	13.50 (13.13, 14.87)	13.79 (12.37, 15.19)
	Adjusted OPD[4]	2.55	3.05
	Adjusted PW[5]	8.50	8.79
2) **Treatment seeking time (hours) [ie work time lost]**			
Hospital	OPD	2.50 (2.47, 2.53)	5.87 (5.84, 5.90)
Health centre	PW	2.17 (2.14, 2.20)	4.82 (4.79, 4.85)

1 Means are logarithm transformations due to skewness of data.
2 Overall cost of traditional and modern medicines including cost of special food and transportation.
3 Figures in parenthesis are 95% confidence interval.
4 Minus D1.00 which account for the fees, medication etc paid by patients at OPD.
5 Minus D5.00 which account for the fees, medication etc paid by patients at PW.

Table 6d Mean[1] household expenditure on preventive measures from MFCC study

Items	Intervention status				Kruskal -Wallis H	p-value	All cases	
	n	With NIBP	n	Without NIBP			n	
3) **Annual preventive expenditure (D)**								
i) **Mosquito coils**								
Fatal cases	16	44.87 (43.28, 46.46)[2]	18	53.09 (51.70, 54.48)	0.06	0.81	34	49.09 (47.77, 50.41)
Non-fatal cases	19	53.21 (51.78, 54.64)	20	39.36 (37.95, 40.77)	2.13	0.15	39	46.56 (45.28, 47.84)
ii ***'Churai'***								
Fatal cases	53	37.76 (36.51, 39.01)	67	43.45 (42.16, 44.74)	1.18	0.28	120	40.74 (39.55, 41.93)
Non-fatal cases	54	43.65 (42.43, 44.87)	68	48.31 (47.08, 49.54)	0.23	0.63	122	46.60 (45.44, 47.76)

1 Means are logarithm transformations due to skewness of data.
2 Figures in parenthesis are 95% confidence interval.

Table 6e Mean number of adults and work time lost by compound members due to *'charity'* activities from MFCC study

Adults	Variable	Intervention status	Fatal cases	Means	Statistical test
Men	Mean number of men who stopped work per child death	With NIBP	59	2.68 (1.45, 3.91)[1]	KWH[2]=5.04; p=0.02
		Without NIBP	75	3.73 (2.51,4.95)	
		Total	134	3.23 (2.07, 4.39)	
	Mean number of work hours lost per child death[3]	With NIBP	59	7.96 (6.60, 9.32)	KWH=3.57; p=0.06
		Without NIBP	75	11.61 (10.31, 12.91)	
		Total	134	9.84 (8.61, 11.06)	
Women	Mean number of women who stopped work per child death	With NIBP	59	3.13 (1.90,4.36)	KWH=1.31; p=0.25
		Without NIBP	75	3.85 (2.60, 5.10)	
		Total	134	3.52 (2.35, 4.69)	
	Mean number of work hours lost per child death[3]	With NIBP	59	6.93 (5.62,8.24)	KWH=1.04; p=0.31
		Without NIBP	75	9.86 (8.54, 11.18)	
		Total	134	8.45 (7.25, 9.65)	

1 Figures in parenthesis are 95% confidence interval
2 KWH=Kruskal-Wallis H.
3 Excludes travel time, resting and eating times on the farm.

Descriptive analysis of Random Spot Observation study

The analysis was based on repeated observations of 50 women randomly selected with children under 5 years. Their average age was 28 years (range 16-42 years) and they had a total of 82 children under 5 years. They were under observation for 14 weeks during the wet season in The Gambia. The number of random spot observations recorded were 3050. However, only 3007 of the observations were used in the analysis as 43 instances were classified 'missed' as after 3 successive visits, the women were still absent. Of the 3007 spot observations, 71% were observed by the field workers and 29% were reported by either a household member on the day of the observation and/or the carer on a subsequent visit of the field worker. The 29% of cases were considered as part of the observations, because reported activities from both the household members and the subjects (absent at the time of the observations) tallied. Moreover, these reported activities were not different from the observed pattern of activities of the other women, at the time and month of the observation.

Twelve main observed activities were coded as well as their respective individual specific activities. The activities were further abridged into smaller and analyzable groups for comparability with other studies. The observed activities were classified into five main categories adapted from the Acharya and Bennett's (1982) descriptive model of the inside-outside dichotomy of a village economy. This model is suitable to the rural Gambia situation in that it depicts a subsistence economy with clear division of labour particularly by gender. The inside-outside formulation of Acharya and Bennett is made up of 4 spheres; household maintenance and family farm enterprise are spheres I and II referred to as the "inside" and usually undertaken by women, whilst the local market economy and migration for employment both within the village and beyond it (ie spheres III and IV) is the "outside" one. In rural Gambia, female labour in general, is concentrated in the "inside" - household domestic work and subsistence production which fits in this model. The 5 main categories used are productive activities, domestic activities, childcare activities, social activities and other activities.

The productive activities category is made up of all agricultural and animal husbandry activities. This is similar to Acharya and Bennett category of 'Family farm enterprise'. Domestic activities includes all activities related to food processing and preparation, cooking, laundry, cleaning, fetching water and firewood, washing utensils and some aspects of childcare (joint activity). However, childcare activities where possible have been separated from domestic activities were it was observed to be performed alone, since childcare is the main subject of interest. These two activities were classified as 'Household maintenance' by Acharya and Bennett. The additional classified activities of this study are the social and other activities groupings. Social activities encompass chatting, participating in naming, marriage and 'charity' ceremonies, attending village gatherings, festivals and other social events. The other activities category is a broad one embracing all other events not categorised in the 4 groupings discussed above, namely, sleeping, relaxing, resting, gone to the '*lumo*' (local market), out of location (travelled, not found in the compound etc), bathing etc.

The category of activities that took up most of the carers' time was domestic activities (40.6%), followed by the other activities (32.2%), productive activities (13.7%), childcare alone (7.3%) and social activities (6.2%). Further, analysis of the focus group discussion with women also suggests that there were 2 main roles played in childcare - 'care-charger' and 'care-provider'. In the absence of the mother, the 'care-chargers' were the grandmothers who take the overall responsibility of the children on the compound and 'care-providers' were young girls who render care to the children in terms of feeding, bathing, playing etc. Traditionally, old women (eg grandmothers and mother-in-laws) on the compounds are responsible for childcare and most mothers choose to leave their children with them because they are purported to have 'rich' experience in childcare, they are always available at home, less busy and invariably easily able to detect signs of ill-health in children.