WORLD HEALTH ORGANIZATION

ORGANISATION MONDIALE DE LA SANTÉ

EM ADVISORY COMMITTEE ON MEDICAL RESEARCH
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Agenda item 7.

REVIEW OF RESEARCH ACTIVITIES IN THE BLUE NILE HEALTH PROJECT, SUDAN

TABLE OF CONTENTS

I INTRODUCTION AND BACKGROUND INFORMATION

The Committee would recall that at its Fifth Meeting in 1979, it had reviewed the proposed research component of the Blue Nile Health Project, which had been established early on in that year Since that time, considerable progress has been made, including implementation of several research studies Hence, it was felt that the Committee may wish to review the project and its research activities again at this stage.

The overall objective of this project is to control and prevent the major water-associated diseases, primarily malaria, schistosomiasis and diarrhoeal diseases, in the area, by means of a comprehensive programme of disease prevention and control, and to assess health and socio-economic impacts

The project has the following specific objectives

(a) To prevent schistosomiasis transmission from developing in the Rahad irrigation system, emphasizing permanent and long-term vector control measures,

(b) To assess and reorganize immediately the ongoing water-associated disease control programme in the Gezira/Managil scheme and develop and implement an interim comprehensive strategy, based on improving currently used methods and materials and strengthening the existing infrastructures,

(c) To develop and assess in study zone a long-term comprehensive strategy which will considerably reduce water-associated disease transmission and which will maintain the results achieved at low cost, and with minimal environmental hazards, also to apply the strategy in the project area,

(d) To seek innovative control measures which are considerably more cost-effective than the present techniques, emphasizing environmental management, biological control, community participation and health education and reducing foreign exchange requirements,

(e) To maximize socio-economic benefits of diseases control by improving basic health services, water supply and sanitation and integration of project activities into local basic health services,

(f) To establish the costs and benefits of water-associated disease control in tropical agriculture systems, including measurements of community productivity

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for the planning of new water resource developments,

(g) To train decision-makers, planners, designers and operators of the water resources' projects and health staff in the Sudan and elsewhere on the approaches and methods for the prevention and control of water-associated diseases in water resources projects,

(h) To promote and establish close coordination amongst the different national departments and institutions involved and with the international agencies concerned.

For operational purposes the project area is divided into three zones (Figure 1 The details of the zones are given below

Zones	No. of population	No. of villages	Area in hectar
Rahad	80,000	46	126,000
Gezira-Managil	1,800,000	2 101	870,000
Study Zone	50,000	31	18,400

An agreement was signed by the Government of Sudan and the World Health Organization for the implementation of this project within the decade 1979-1989 The total cost for the implementation of this project over these 10 years is estimated to be US $ 155 Million Out of this total, the Government is providing US $ 89.5 million The remaining US $ 65.5 million should be provided from other sources. In order to secure funds, a donors' meeting was held in February 1980 in Khartoum Several countries and international agencies pledged to provide financial assistance to this project. So far, the financial aspects of the project are encouraging

II. PROJECT DESIGN AND STRATEGY

As may be noted from the objectives set, attempts are being made to prevent and control water-associated diseases through an integrated approach The most prevalent water-associated diseases in the project area are malaria, schistosomiasis and diarrhoeal diseases The first two diseases are transmitted through the mosquito vector and the snail intermediate host both of which require water for breeding and habitat

The integrated control measures planned to be implemented for prevention and control of these diseases are

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(a) extensive community education

(b) chemotherapy for schistosomiasis

(c) treatment of diarrhoeal diseases with ORS therapy

(d) malaria treatment based on laboratory diagnosis only

(e) suppression of snails and mosquitoes by chemical, biological and environmental methods

(f) extensive improvements in domestic water supply to reduce man/water contact

(g) construction of pit latrines

(h) community action on drainage and sanitation

As may be understood from the above, measures being implemented for the control of water-associated diseases are aimed either against the vector or the intermediate host of the disease or treatment of the patient for elimination of reservoir of the disease. The control measures are based on an integrated approach, this results in considerable saving in staff, equipment, supplies, management services and facilities, and consequently in total project cost Moreover, some of the control methods used against the vector of one disease are also effective against the vector or intermediate host of the other disease. In fact, the control measures thus adopted are being developed and will be implemented, combining efforts in one programme within the framework of existing and planned health services and the development of Primary Health Care The project is therefore multidisciplinary, utilizing expertise in medicine, biology, engineering, agronomy, sociology, economics and public education

The important feature of this integrated approach is intersectoral cooperation for the implementation of all the control measures adopted For example, in order to clean and clear irrigation canals, the Ministry of Irrigation is the executive agency, therefore, funding and technical services will be provided through this agency The same applies in the case of improvement of water supplies in villages The agency responsible for this activity is the Rural

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Water Supply Authorities. All the national ministries and agencies involved in this project have formed a National Coordination Board to meet once a year to discuss the direction and policy of the Blue Nile Health Project The National Coordination Board has met twice since the initiation of the project. For details of the Blue Nile Health Project's organization see Figure 2 attached.

Coordination of work and cooperation for implementation of the project is also functioning at international levels in addition to WHO, FAO, UNEP and WFP, the World Bank, JICA and USAID are contributing to the projects. The representative of donor agencies participate in the Scientific Advisory Group (SAG) meeting held periodically to review and discuss technical aspects of the project and make recommendations for future plans In the SAG meeting, in addition to the representatives of the above agencies and the donor's governments, prominent scientists and experts in the field of water-associated diseases and vector control are invited to attend and contribute in discussions and recommendations. So far two SAG meetings have been held.

The project is being carried out in two timed phases, each of five years' duration, in all the three zones mentioned above

Phase I. (1979 - 1983)

(i) Improvement and gradual reorientation of ongoing anti-malaria and anti-schistosomiasis operations in line with an interim comprehensive strategy using available and proven methods of disease prevention and control

(ii) Detailed review of health services infrastructure, staff and functions and a gradual strengthening and incorporation into the existing infrastructure of progressively more intensive case detection and treatment for malaria, schistosomiasis and diarrhoeal diseases

(iii) Detailed review of the existing rural water supply system and sanitation, strengthening of the maintenance operations and quality control study and development of designs for improvement of the present systems and for the construction of new ones.

(iv) Strengthening of the ongoing programme of health education and community

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participation, so as to achieve increasing participation of populations in the comprehensive programme.

(v) Development, field testing and assessment of all available and up to date, permanent and economical methods of prevention and control of malaria, schistosomiasis and diarrhoeal diseases and their adaptation and incorporation into a feasible and cost/effective strategy for assessment. This will include a detailed review and analysis of the irrigation systems and agriculture practices.

(vi) Continuous evaluation of the activities project-wide and revision and reorientation of plans and activities as required.

(vii) Comprehensive training of all staff concerned from Sudan and elsewhere.

Phase II. (1984 - 1988)

The second 5-year phase will be the expansion phase whereby

(i) Gradual incorporation of the developed and tested strategy into the on-going operations and its expansion stage-wide to cover the entire project area by the end of the 10th year.

(ii) Continuation of operational research and training programme.

At that time, i.e. by the end of the decade, it is expected that the comprehensive strategy will have:

(a) reduced both diseases to levels no longer representing public health problems, and

(b) become able to maintain the results at costs well within the financial resources of the Government, thus

(c) plans will be developed for expansion of the programme to other irrigation schemes

The attached Figure 3 "Charts of Events", illustrates the events for each phase of the Blue Nile Health Project, covering the period 1979 - 1990

III. SUMMARY OF ACCOMPLISHMENT UP TO THE END OF 1981

After the Project Headquarters were established in Wad Medani and most staff positions were filled early in 1981, the year was characterized by success in securing significant additional financial support and by expansion of field

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activities and training into all three operational zones The most noteworthy accomplishment of the year was the continued suppression of schistosomiasis in the newly constructed Rahad Irrigation Scheme, one of the first objectives of the project

The expanded activities also included efforts against malaria and diarrhoea in the Rahad Zone, epidemiological surveys with continued control of malaria in the Gezira-Mangil Zone and initiation of pre-control surveys and research in the Study Zone.

3 1 Field activities

3.1.1 Suppression of schistosomiasis transmission in the Rahad Zone

The successful prevention of schistosomiasis transmission in the Rahad Zone was the major field achievement of the Blue Nile Health Project. Utilizing an interim strategy combining chemotherapy and mollusciciding, locally acquired infections were prevented and the prevalence of infections imported from other endemic areas was reduced by one half. No evidence of locally acquired infections was found in the 3,000 school children, nor in the random sample of households from 8 monitor villages resurveyed in 1981 Additional supportive evidence was found upon re-examination of residents of village 18, who had been treated in 1980 with oxamniquine Of the 107 people treated only 4 were passing schistosome eggs after one year, indicating very effective chemotherapy and no re-infection For comparison, similar studies in the endemic Gezira-Managil Zone showed prevalence of 30% to 90% one year after treatment Also in snail surveys prior to application of molluscicides in the Rahad canals not a single infected snail was found during 1981.

3.1.2 Continued control of malaria in all three zones

Malaria transmission was maintained at a low level in the three zones by the interim strategy of spraying houses with residual insecticides, larvicide application in settled areas and presumptive treatment with chloroquine Prevalence of the parasite in children was found to be 0.5% in the Rahad Zone, 1 4% in the Gezira-Managil Zone and 0 4% in the Study Zone. Due to the widespread

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resistance to malathion of the mosquito Anopheles arabiensis, the new insecticide fenitrothion 40% wdp. was used effectively in the Gezira-Managil Zone in 1981

3 1 3 Initiation of continuous monitoring of disease transmission in all three zones

Annual epidemiological surveys were initiated in all three project zones during 1981. Surveys on schistosomiasis, diarrhoea and malaria were completed in 12 monitor villages in the Rahad Zone and 21 monitor villages in the Study Zone, while in the larger Gezira-Managil Zone 28 monitor villages were selected and surveyed for schistosomiasis and malaria, in addition to the established malaria survey in 27 villages. From the results it was clear that diarrhoeal disease was a major problem causing annual death rates in children of about 50 per 1000, and Schistosoma mansoni was widespread in the Gezira-Managil Zone, with a prevalence over 50%. Malaria was under control

In the Study Zone each technical unit initiated an intensive monitoring of pre-control conditions by June 1981 in order to establish data for one complete agricultural year before intervention begins. The data being collected cover snail populations, schistosome infections in snails, distribution of aquatic vegetation, densities of mosquito adults and larvae, general aquatic fauna, sociological aspects, human contact with water, community water supplies, irrigation and agricultural practices, in addition to epidemiological surveys on the three diseases.

3 1.4 Field research activities outside the Study Zone

Research continued on schistosomiasis control by focal application of molluscicides and by chemotherapy. It was supplemented by new studies on snail vector using biological agents, including fish, local competitor snails and the ampullarid snail Marisa cornuarietis which was imported from Puerto Rico. For malaria control, studies were conducted on control of mosquitoes using chemicals and fish. Weeding machines and fish were being evaluated for their direct effect on aquatic vegetation and for their value in control of snails and mosquitoes

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The project benefitted from active cooperation of the Medical Research Council and the Universities of Khartoum and Gezira.

3 2 Study Zone

According to the project design, the period 1979-1983 is Phase I In this phase all innovated vector control methods will be field-tested; those found more cost effective, will be selected and the new strategy for integrated vector control component of the project will be developed and the study zone selected for detailed evaluation of the comprehensive strategy The study zone is at present a part of the Gezira-Managil Irrigation Scheme, including two out of the 107 of agriculture blocks These two blocks, 26 and 27, are along the Blue Nile, midway between Khartoum and Wad Medani. The study zone includes 31 village areas with a total population of 50,000. The village areas are the basic social, agricultural and epidemiological units

The following activities have been carried out in the study zone since its initiation in 1979

3.2 1 Collection of geographical reconnaissance data

Complete geographical reconnaissance of all villages, including precise mapping of 15 villages and sketch mapping for the remainder. The whole zone has been stratified for epidemiological purposes, based on proximity to the irrigated fields. The 31 village areas are divided into 3 strata 7 in road stratum, 15 in core stratum and 9 in fringe stratum. 21 monitor village areas have been selected for annual monitoring. Out of 21 village areas, 3 are for intensive study and the rest for routine monitoring. These 21 village areas will be monitored during Phase I (5 years) for evaluation of the comprehensive strategy.

3 2 2 Collection of baseline data

In 1981 the first epidemiological surveys were completed for all three diseases in the Study Zone to provide pre-control measurements of disease transmission At least one full agricultural cycle will be monitored before initiation of the Trial Comprehensive Strategy, scheduled to begin June 1982 This data from the year prior to intervention will serve as one reference for evaluating the impact of the control effort. Another reference will be the 28

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monitor villages in the Gezira-Managil Zone which are covered only by the Interim Strategy

All households were sampled in the 3 intensive study villages of the Core Stratum 11 other village areas in this stratum were selected as monitor village areas, excluding only Angado which had been used for drug trials in 1980.

3 2 3 Biological data

Baseline data including parasitological and entomological data were collected with regard to the malaria vector A. arabiensis and the snail hosts of schistosomiasis Bulinus truncatus and Biomphalaria pfeifferi

3.2.3.1 Entomological surveys started in the study zone in 1981 in order to monitor adult and larval mosquito population 6 representative villages were selected for this purpose. In addition to A. arabiensis, A. pharoensis was also recorded in this area The entomological survey included indoor resting density, larval density, man-vector contact, collection and study of natural mosquito predators

3.2 3 2 Studies on snails included geographical distribution of snails, seasonal variation of their density, infectivity rate of snails, aquatic vegetation present in canals and their relationship, if any, with snails.

3.2.4 Environmental management baseline data

Starting July 1981, complete records on water supply of study zones in 24 villages were collected. These data included source of water, source of power for pumping, fuel consumption, volume of water provided daily and distribution systems This information will be used for preparing a plan to improve the existing water supply system.

An initial design and the cost estimate for mass production of latrine slabs were developed in collaboration with the Irrigation Public Works Corporation These slabs will be installed in individual houses with community participation

Data in respect of irrigation systems were also collected, in order to prepare a plan for the improvement of the system, especially those factors which

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have an impact on vector habitats and their survival within the system The surveys cover the number and types of canals in the study zone, the rate of flow of water, rate of silting and its removal, overflow and breakage of the canals, rainfall record is also covered

3.2.5 Community studies

Since transmission of vector-borne diseases partly depends on human behaviour and man's contact with vectors and intermediate hosts, an intensive study has been carried out to understand transmission dynamics, with a view to recommending control measures

A detailed plan has been prepared to stimulate community participation in all phases of the project: The World Food Programme (WFP) donation to the proje which consists mainly of food items, will be utilized for this purpose.

3 2.6 Comprehensive strategy for trial in the Study Zone

The first step in developing the Comprehensive Strategy for control of the three diseases in the Study Zone was initiated early 1981, when the senior staff of the project with assistance of WHO consultants developed a malaria transmission model for the Gezira and outlining a strategy for malaria control The staff then developed similar proposals for strategies to control diarrhoea and schistosomiasis

In August the Second Scientific Advisory Group met in Wad Medani to review and refine the three proposed strategies With the help of the advisers, the project staff then integrated the separate elements into one Comprehensive Strategy

From this Comprehensive Strategy a detailed Plan of Activities for the Study Zone was developed and in December 1981 it was presented in Khartoum to the second annual meeting of the National Coordination Committee. The Committee endorsed the Plan of Activities and took steps to implement the action required in the various agencies The Plan of Activities went into effect in 1982

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IV. RESEARCH AND TRAINING

4.1 Research

As a major objective of the Blue Nile Health Project, is the development of innovative control measures and new strategies, therefore, research has an important role in this project. However, as would be evident from the preceding summary of activities, research is very much an integral part of the project activities and is being carried out to meet the need of field operations. Most of the activities in the Study Zone, which aim at developing and testing control measures, can be classified as research.

Although there is an administrative unit in the project organization dealing with research and training, there is no separate staff for research. It is carried out by the project staff itself and in some cases by postgraduate students.

Currently 14 research projects are underway. They are listed in Table 1.

In order to facilitate the development of an effective research programme, there is a close coordination between various national and international agencies As would be seen from Table 1, there are a number of agencies collaborating and supporting research activities in this project, e g the National Council of Research and the Medical Research Council of Sudan, University of Khartoum, Department of Fisheries, Ministry of Agriculture, Ministry of Health, WHO/TDR, USAID and the Edna McConnel Clark Foundation

The Scientific Advisory Group of the project, on which most of these agencies are represented, has been closely reviewing the research activities of this project, at its annual meetings

Research proposals submitted to the Blue Nile Health Project itself, for financing, are reviewed by the senior staff and if found technically satisfactory and feasible, are approved.

4 2 Training

With the expansion of activities of the project, the need for training project personnel was recognized During 1981, 9 senior staff members went on study tours

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and attended seminars related to their specialized fields in different countries

Courses were organized for public health officers and field workers in control of snails, mosquitoes and mosquito larvae Microscopists were trained in diagnosis of malaria and schistosomiasis

Several public health workers from within the country and also from abroad, visited the project and/or studied the different aspects of control of water-associated diseases, under the supervision of the project staff.

6 postgraduate students used the project facilities for conducting research under the combined supervision of university and project staff. It is expected that when the M.Sc. course on Vector Biology starts at the University of Khartoum, the Blue Nile Health Project will provide facilities for field training for the students attending the course

In order to orient and train project staff in the social and economic aspects of schistosomiasis and malaria, a Course on Health Services Research and Tropical Diseases was held in March 1982. Financial support for this Course was provided by WHO The Course was also attended by scientists from various collaborating institutes and agencies in Khartoum and from Gezira During the Course 3 research projects were formulated by the participants. These dealt with the impact of schistosomiasis and malaria on agricultural productivity, factors effecting utilization of health services by selected sedentary and migrant groups in Gezira and the effect of health education and community participation in decreasing dependence on molluscicides and insecticides in the control of schistosomiasis and malaria.

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V CONCLUSION

The vast expansion of water development schemes for irrigation, production of energy and satisfaction of water demand of fast-growing urban areas had added a new dimension to existing problems in prevention and control of vector-borne diseases, such as malaria and schistosomiasis These diseases have caused mortality and severe morbidity among the inhabitants concerned. This has resulted in decreased agricultural productivity in the area, plus the financial burden involved in the treatment of patients Therefore, the need for effective prevention and control of these diseases in water resource development is obvious. The Blue Nile Health Project is providing the opportunity to develop a comprehensive strategy for prevention and control of vector-borne diseases in the water resource development scheme.

Many of the control methods used against one water-associated disease are also effective against the others, e g. provision of safe drinking water, which is mainly directed towards prevention of water-borne diseases, can also prevent schistosomiasis by reducing human contact with infective water In the Blue Nile Health Project, the multiple benefits of control measures are being utilized to the fullest extent to increase cost effectiveness

In the Blue Nile Health Project, efforts are being exerted to replace chemical control with other alternative vector control measures, such as environmental and biological control of mosquitoes and snails, improvement in basic health services, permanent modification in agriculture and domestic water use and, possibly, changes in human behaviour which are long-lasting, economical and safer to the environment By replacing or decreasing the use of chemical insecticides and drugs which are mainly imported from outside, with alternative prevention and control measures, significant saving will occur in hard currency which is a rare commodity in developing countries Development of these alternative control measures require extensive research activities in the project Therefore, research components of the Blue Nile Health Project are diverse and very much emphasized

So far, preventing transmission of schistosomiasis in Rahad Zone by the

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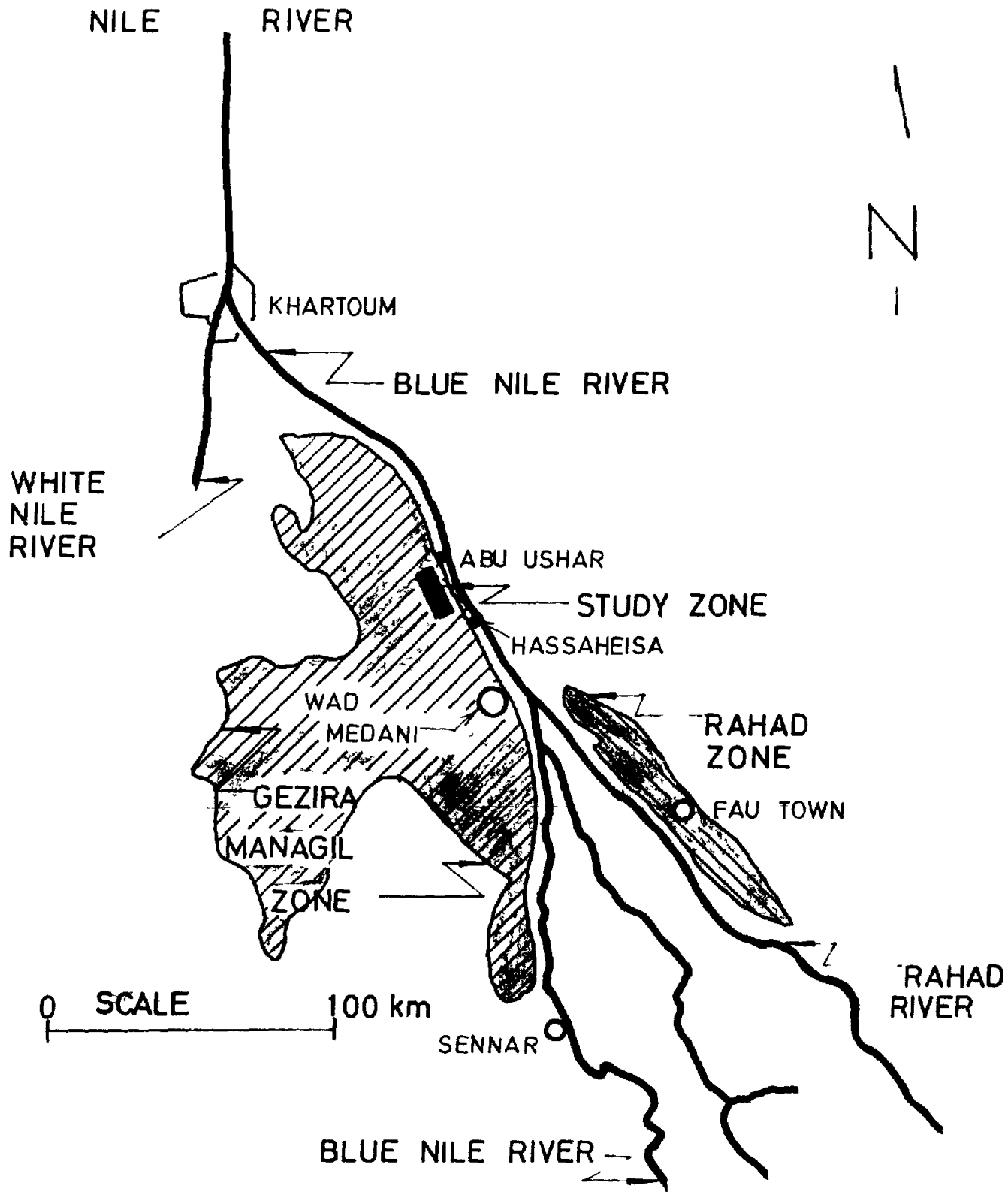
application of integrated control measures is a significant breakthrough which could be applied in other newly-established irrigation schemes where effort as well as financial inputs are justified Equally, the results of research and field trials carried out by the Blue Nile Health Project, can be utilized in other vector-borne disease control projects

The Blue Nile Health Project is an integrated disease control project in operation, and provides a suitable training facility for interested candidates in the control of water-associated diseases

BLUE NILE HEALTH PROJECT
RESEARCH PROJECT ON VECTOR BIOLOGY
AND CONTROL

No	Subject of Research Project	Starting Date	Period of trial (years)	Principal investigators	Source of Funds
1	The prevalence of aquatic vegetation in Gezira, canals. The relationship between vegetation and snails and the effect of vegetation control on snail population	Sept. 81	4	Dr Asim Daffalla Dr Lutfi Mr Abdul Moneim	BNHP/USAID
2	Study on malacophagous fish and snail competitors (local and exotic) as possible biological control agents for Biomphalaria pfeifferi and Bulinus truncatus	November 81	4	Dr Asim Daffalla Mr Elias	BNHP/USAID
3	Assessment of low-cost, small-scale, clean water supply system in Gezira, Sudan, with particular reference to reduction of water contact and schistosomiasis transmission	March 82	2	Dr Asim Dafalla Dr Alan Fenwick	Edna McConnel Clark Foundation through Sudan MRC
4	Schistosomiasis transmission dynamic study for planning an integrated control of snail intermediate hosts of the disease	June 1980	3	Prof. Mutamed A.Amin et al	TDR Schistosomiasis Applied Field Resea (through University of Kha
5	Comparative cost effectiveness studies on larvivorous fish Tilapia nilotica and Tilapia zilli for mosquito control	June 1981	2	Mr Salah Hassan El Safi Dr A.M. Haridi	BNHP/National Counc of Research
6	Impact of pesticides on aquatic animals in irrigation canals in Gezira	January 1982	2	Dr A M. Haridi Miss Afaf MSC student	University of Khart BNHP
7	**Study on the relation between weeds and snails for development of environmental control of snails**	**May 1981**	**2**	**Dr M.A. Haridi Mr Omer Saeed**	**BNHP/USAID**

No.	Subject of Research Project	Starting Date	Period of tiral (years)	Principal investigator	Source of Funds
8	Study on the impact of mechanical weeding of canals on snail population in Managil minor canals	October 1981	18 months	Dr A.M. Haridi Mr Khidir Mr Pol Kolock	BNHP
9	Field evaluation of Tilapia and Carp for mosquito and snail control	October 1982	3	Dr A.M. Haridi Mr T.T. George	TDR/BNHP/Dept. of Fisheries
10	Phase III Clinical trials of oltipraz against S. mansoni infections in school children in Gezira, Sudan	December 1981	8 months	Dr M.A. Kardman et al	Rhone Poulanc, NIH., USA through Michigan State University
11	Phase III Clinical trials of oltipraz against S. mansoni infections in school children in Gezira, Sudan	June 1982	12 months	Dr M.A. Kardman Dr A. Fenwick	PDP, WHO, through Medical Research Council, Sudan
12	Phase III Clinical trials of parasiquantel against double infection caused by S. mansoni and S hematobium in Gezira, Sudan	December 1981	12 months	Dr M.A Kardman Dr A. Fenwick	PDP, WHO, through Medical Research Council, Sudan
13	Serological measurement of malaria incidence in the Gezira	October 1982	6 years	Dr Mustafa Abdalla Mr Faysal Tayeb	Ministry of Health, Sudan, BNHP
14	Impact of schistosomiasis and malaria on agricultural productivity	June 1983	18 months	Dr A.M. Haridi Mr Ahmed El Badawi Mr Faysal Osman	TDR, BNHP, Sudan Gezira Board



BLUE NILE HEALTH PROJECT IN SUDAN

FIGURE 1

BLUE NILE HEALTH PROJECT ORGANIZATION CHART

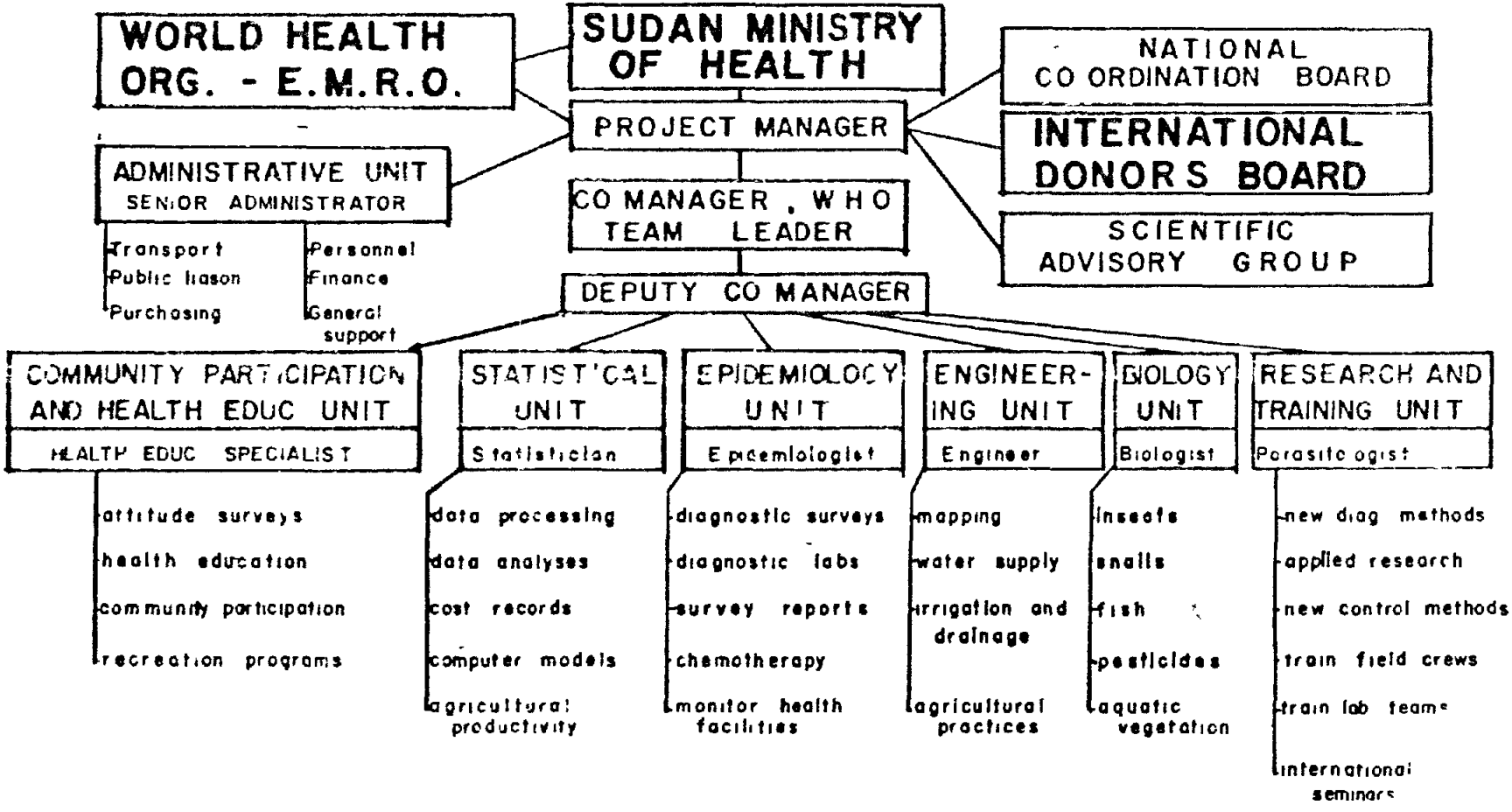


FIGURE 2

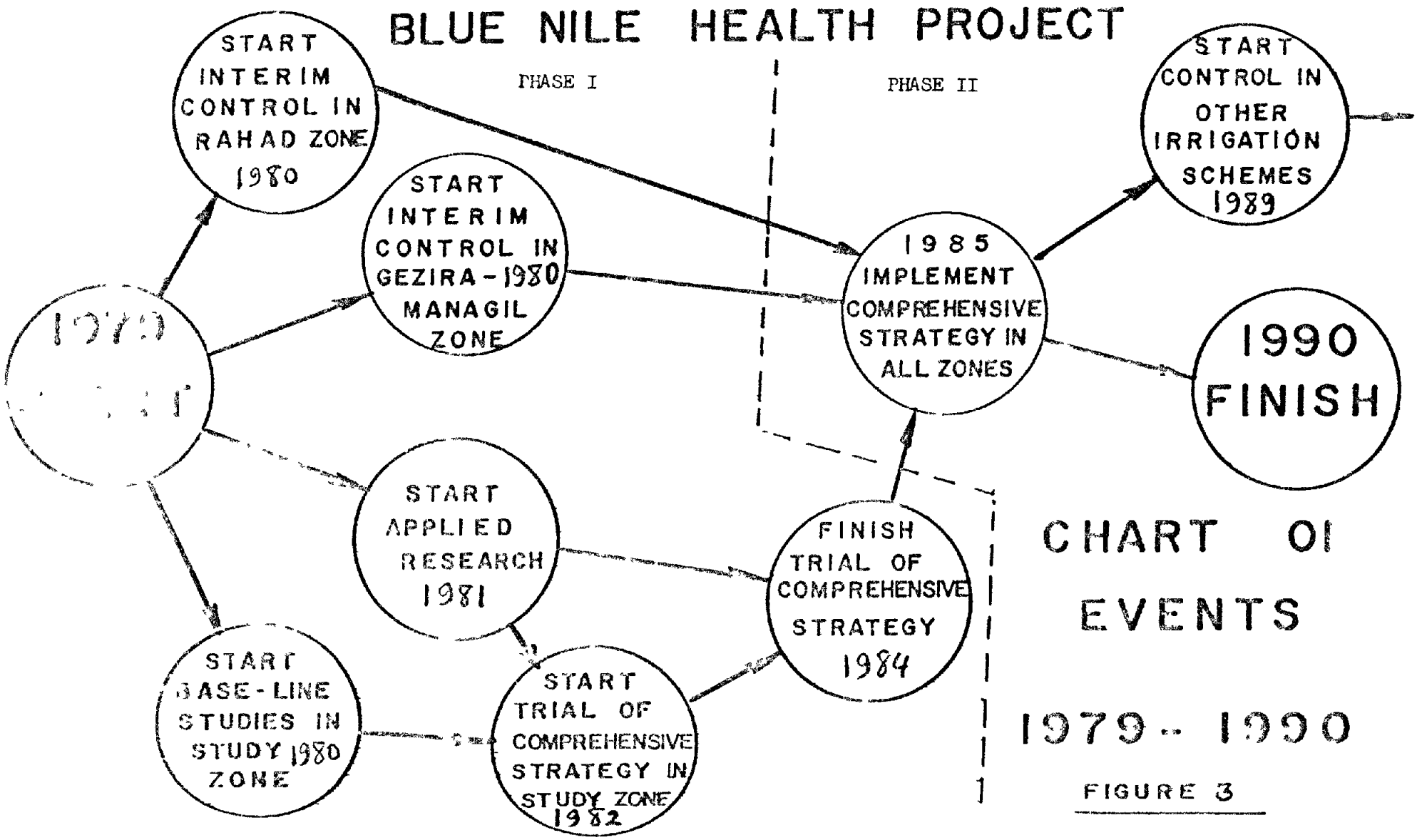

BLUE NILE HEALTH PROJECT
PHASE I
PHASE II
START INTERIM CONTROL IN RAHAD ZONE 1980
START INTERIM CONTROL IN GEZIRA - 1980 MANAGIL ZONE
1979
START APPLIED RESEARCH 1981
START BASE-LINE STUDIES IN STUDY 1980 ZONE
START TRIAL OF COMPREHENSIVE STRATEGY IN STUDY ZONE 1982
FINISH TRIAL OF COMPREHENSIVE STRATEGY 1984
1985 IMPLEMENT COMPREHENSIVE STRATEGY IN ALL ZONES
START CONTROL IN OTHER IRRIGATION SCHEMES 1989
1990 FINISH
CHART OI EVENTS
1979 - 1990

FIGURE 3