

PN-ABM-357

MALARIA AND DEVELOPMENT IN AFRICA

A Cross-Sectoral Approach

American Association for the Advancement of Science

Malaria and Development in Africa

A Cross-Sectoral Approach

**American Association for the Advancement of Science
Sub-Saharan Africa Program**

**Under Cooperative Agreement with
U.S. Agency for International Development
Africa Bureau
No. AFR-0481-A-00-0037-00**

September 1991

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Foreword

The American Association for the Advancement of Science (AAAS) is the leading general scientific society in the US, with over 130,000 individual members. AAAS is also a federation of some 300 affiliated societies and academies, encompassing the physical, biomedical, and social sciences as well as engineering. For more than forty years a major goal of the AAAS has been "to improve the effectiveness of science in the promotion of human welfare." Programs have accordingly reflected this deep concern about the interactions between science and society. In the international arena AAAS has capitalized on its relations with scientific and engineering institutions here and abroad to carry out collaborative activities that address this goal.

Since the early 1970s AAAS has devoted significant resources and attention to enhancing the contributions that science and technology can make to the economic growth of developing countries. Common to a broad array of AAAS initiatives related to the developing world has been the forming of working partnerships involving foreign scientific groups, AAAS, its affiliated societies, and funding organizations.

For nearly a decade now the AAAS Sub-Saharan Africa Program has addressed selected problems related to science, technology, and development in Africa, always in close collaboration with African scientific and academic organizations. The AAAS study of Malaria and Development in Sub-Saharan Africa conducted during 1990 and 1991, which is the subject of this report, has been among the most challenging of these endeavors. It has required our mobilizing and guiding a team of scientists and practitioners from Africa and abroad, with a broad range of specialized technical expertise and with solid on-the-ground experience, in order to attack a very serious, and extremely obstinate, health problem in the region.

During 1990 AAAS and the Agency for International Development (A.I.D) entered into a Cooperative Agreement under which AAAS would harness scientific and area-specific knowledge in order to examine the relationships between malaria and development in Africa and thereby develop innovative, practical strategies for preventing and controlling the disease. In particular, AAAS has been committed to taking a broad-gauged approach to malaria in Africa, one that gives serious weight to sociocultural, behavioral, and environmental issues, especially their manifestation at the local level, as described below, in the introduction. The outcome of fifteen months of concentrated study, and collective deliberations, is crystallized in this report. It contains recommendations for action, and is intended to provide general policy guidance to A.I.D, and to other organizations explicitly concerned with malaria in Africa.

AAAS adopted a several-stage workplan in carrying out this study of malaria and development in Africa, relying on a sequential model that has proved effective in the past as well. Initially a small US steering group was selected, with its members drawn from key disciplines, including those in the natural and social sciences and engineering, all distinguished by having spent much of their professional lives working in Africa and other parts

of the developing world. The major task of this group was to conceptualize and map out the overall scope of work, thus establishing the basis for the next agenda-setting phase of the project, which included experts from sub-Saharan Africa. (A list of Steering Committee Members and of the other participants in this project is found in the Appendix.) Since September 1990, when it first met as a working group, this larger Steering Committee has assisted staff in all aspects of the project.

The cornerstone of our multidisciplinary study was the intensive workshop held in Mombasa, Kenya, from May 27 through 30, 1991. Some two dozen participants set aside their customary responsibilities in order to prepare background papers for circulation, to travel to Mombasa, and then to engage in several days, and nights, of intensive discussion of vital subject areas, during plenary sessions and especially within three informal working groups. Their involvement did not end when they left Mombasa, however, and participants were extremely helpful, and diligent, in reviewing and emending drafts of this report and of the appendix material. Indeed the report could not have been completed at this time, and in this form, without the contributions of all the workshop participants, which are hereby acknowledged, with gratitude.

The report, to the extent possible, is a distillation of the collective wisdom of workshop participants. It has also benefitted from input provided by countless other specialists consulted over the past fifteen months. The interpretations and conclusions found in the report, however, are those of its contributors — members of the Steering Committee and other participants in the workshop — and of staff of the AAAS Sub-Saharan Africa Program. It is staff members who bear ultimate responsibility for their presentation here. The edited papers included in the Appendix are attributable solely to their authors. This report and background papers do not purport to represent the views of the American Association for the Advancement of Science nor of the Agency for International Development, which undertook this work jointly, under a Cooperative Agreement.

The overarching aim of this study, namely, the formulation of strategies for coping effectively with malaria in the context of African development, does not end with the issuing of this report. AAAS intends to continue to work with African scientists and their institutions, and other organizations committed to combatting malaria in the region, disseminating the findings from this work, so as to ensure their reaching the attention of decisionmakers; encouraging the application of this approach, and its specific methods, to future malaria control endeavors in Africa; and continuing to foster capacity-building within Africa, particularly that needed to engage in effective, long-term cross-sectoral collaboration. Ultimately, of course, it is African scientists and practitioners, and their communities, who will continue to deal with the scourge of malaria, as they have in the past.

Appreciation for assistance with this study must be extended to a large number of people. First, we extend our gratitude to the scientists who contributed directly to this report, over a period of many months. Special thanks go to William Sawyer, Chairman of the Steering Committee, and to the other Committee members. Especially supportive and encouraging have been staff members of A.I.D., particularly William Lyerly, Gary Merriitt, and James Shepperd of the Africa Bureau. We also owe a debt to numerous other individuals with

whom we consulted: staff at the World Health Organization, including Robert Bos, Brian Doberstyn, Jose Najera; Patricia Rosenfield of the Carnegie Corporation of New York; Joel Breman, Malaria Branch, U.S. Centers for Disease Control; and Andy Arata of the Vector Biology Control project. In the course of the project, hundreds of other experts were contacted, and generously provided useful advice and information of various types.

The workshop in Mombasa could not have occurred, especially not with such efficiency and graciousness, without the assistance on site of Caroline Law, and English/French interpreting by Barbara Duncan and Ndeze Nyirarukundo. Credit should also go to Afsaneh Askari for the cover photograph and the artwork in the report.

At AAAS, staff members Brad Michaels, Carole Mitnick, and Monique Ntawiha were untiring in the multiple efforts they put forth on behalf of this project, from day one through today, which resulted in the successful and timely completion of our study, and the publication of this report.

Amy Auerbacher Wilson
Director
AAAS Sub-Saharan Africa Program

Executive Summary

The findings and recommendations contained in this report reflect the deliberations of our panel of experts. These conclusions are further illuminated and substantiated by examples from case studies prepared by these specialists and found in the Appendix.

In presenting recommendations, we have specified contributions best made by African governments, donors, and NGOs. A prescription is given for the health sector to take the lead within each of these groups and in their joint efforts. The role of community participation in control strategies is also discussed.

Problem Statement 1

Malaria is a complex problem for which there is no "magic bullet," no quick or easy solution, particularly in Africa, where approximately 80 to 85 percent of cases and 90 percent of deaths in the world due to malaria occur. Patterns of transmission and environmental and cultural factors all vary so greatly throughout the continent that differences in prevalence and incidence occur even between neighboring villages. The virulence of both parasite and vector has thwarted control efforts, and emerging "multi-drug resistant" parasite strains appear to be inducing an *increasing* human toll, with a resulting impact on already overburdened health services, and on productivity.

Approach

In response, the development of *locally sustainable* approaches is critical. These approaches must be tailored as specifically as possible to the myriad physical and social environments across the continent. To achieve this goal, the following strategies are recommended:

- Perhaps the most important investment to be made for malaria control is in human capital: to build local capacity in Africa to develop solutions specific to the affected local environment and population. Several options are proposed for developing the expertise *in Africa* to enable the design of strategies appropriate to identified ecological and human environments: research, reference, and training centers; as well as networks of African scientists and their institutions; and, finally, enhanced and innovative training and exchanges, including mentorships and short courses offered by scientific societies.
- Participation by communities throughout the project cycle is critical to program success and sustainability. It is important to recognize that "communities are already actively undertaking malaria control strategies of their own," (Mwabu) with members actively seeking treatment from health providers and carrying out preventive measures, such as clearing homesteads of mosquito breeding sites, or purchasing drugs, nets, and sprays. Malaria programs must be designed to be culturally sensitive: Program objectives must conform with the beneficiaries' needs and preferences in order to achieve success (Etikin).

- Urban and peri-urban populations, as well as groups with high mobility (seasonal laborers, nomads), require special attention as do the traditionally recognized high-risk groups, pregnant women and children under age five.
- The inhabitants of urban and peri-urban areas are often more accessible than dispersed rural dwellers. However, urban populations are growing rapidly, and are presently facing some of the most acute environmental problems. Many of these city dwellers are migrants and, as such, may lack immunity to the local parasites.
- Furthermore, the deterioration of the urban environment is enhancing the proliferation of vectors in urban areas (Thitai).
- Population changes related to employment, resettlement, and other events can significantly affect malaria transmission (Etkin). Migratory groups represent a large proportion of Africa's population, and require special strategies because their frequent movement exposes them to high risk of morbidity and mortality from malaria (Warsame).
- Opportunities should be seized for initiating innovative approaches. For example, the increasing decentralization of governmental decisionmaking in Africa offers a unique opportunity for establishing effective cross-sectoral initiatives and launching pilot projects for integrated approaches to malaria control.
- In Kenya, for example, the District Development Committee "is the obvious meeting point of the representatives of all the relevant sectors to ensure environmentally sound planning and implementation of water [and other development] projects." (Thitai)
- With African governments increasingly looking to cost recovery methods for health services, government incentives and penalties for practices that influence transmission of malaria should be established. "In practice, the pattern of financial incentives and disincentives in the area of health behavior is sometimes the exact opposite of what it should be. Products with positive externalities in fact are taxed, and products with negative externalities are subsidized. In these circumstances, useful anti-malaria work might be done by removing the distortion." (Barlow)

Problem Statement 2

Overall development *can* have an impact on transmission of malaria. Agricultural development, water resource management, industrial and infrastructural project sites, and household and community environments can create habitats favorable for mosquito breeding. (Gwadz) The potentially adverse impact of overall development on malaria can be reduced by:

- Strengthening "cross-sectoral" approaches for planning and implementing development initiatives. Furthermore, this study reveals that *cross-sectoral approaches do already exist in Africa*. Support should be provided for: (1) strengthening these efforts based on an inventory of their needs and priorities; and (2) researching how and where best to replicate and improve upon these models.

- Strengthening the health components of Environmental Impact Statements and/or establishing “Malaria Impact Statements.” Currently, Environmental Impact Statements, where implemented, do not have the authority necessary to monitor and take corrective measures to prevent or reduce the impact on malaria of a development initiative.

To strengthen the implementation of these recommendations — and of on-going malaria control efforts — the priority of malaria control must be raised (for governments, donors, NGOs, and affected communities), together with the recognition that malaria is not an intractable problem across the continent. The current increased interest in malaria must be taken advantage of, and national as well as global commitments strengthened. The Report to the President (March, 1991), prepared by Dr. Louis Sullivan, U.S. Secretary for Health and Human Services, and Dr. Ronald Roskens, Director, U.S. Agency for International Development, placed highest priority on investing in malaria control. The October 1991 WHO meeting on malaria control in Africa also signals increased attention toward malaria in general, and in Africa specifically. The present opportunity must not be lost: This is a pivotal moment for asserting as an urgent priority the long-term sustainable malaria control strategy embodied by adopting a cross-sectoral approach and by building the capacity of Africans themselves.

Introduction

Malaria and Development in Africa:

A Cross-Sectoral Approach

Purpose and Scope of Study

The purpose of this fifteen-month study, and its report, is to provide recommendations for the prevention and control of malaria in sub-Saharan Africa. These recommendations should assist the setting of policies and of priorities for investments in malaria control in the region by the Agency for International Development (A.I.D.) and other international development agencies, as well as ministries and scientific institutions in Africa, and others concerned with African development.

In requesting this study, A.I.D. urged AAAS to take a broad, multidisciplinary approach in order to devise innovative policy strategies, and provided the following guidance:

- Examine the contributions made to the spread of malaria in Africa by sectoral development programs, particularly in agriculture and water resource management, and by social and behavioral factors, such as migration and other changes in human habitat — and devise recommendations accordingly for malaria control programs.
- Propose creative, novel methods that will strengthen current malaria prevention and control activities.
- Consider ways to raise awareness regarding the toll of malaria in Africa. Decision-makers and individuals responsible for supporting development activities may not be fully cognizant of the potentially adverse impact of these operations on malaria, or of practicable ways to avoid these negative consequences.
- Develop an approach that will channel all available resources into a concerted attack against malaria in Africa. According to A.I.D., the resources allocated to most development sectors far exceed those designated for the health sector.

AAAS Method for Developing Recommendations

In response to the above guidelines proposed by A.I.D., AAAS established as its principal objective the development of recommendations that address the environmental, social, and behavioral aspects of malaria control in sub-Saharan Africa, emphasizing the potential impact on malaria of socioeconomic development.

A multidisciplinary team of specialists, with a broad range of scientific expertise and African experience, was identified, and then brought together to devise recommendations.

Several criteria were used in selecting experts to participate in this study effort. First, the team would include specialists from the key sectors identified as falling within the purview of this study, particularly agriculture and water management, and other development areas where the impact on malaria was significant. Individuals who could address the social, cultural, and behavioral components of malaria control were also included. Second, as noted in the Foreword, experience administering programs or conducting research in Africa was also deemed essential. Third, the composition of the expert group should cover different country and regional experiences within Africa. Finally, specialists were included who have been active participants themselves in cross-sectoral initiatives. A list of participants is included in the Appendix.

This group of 27 included experts from 15 different countries in Africa (20 specialists), Europe (2 specialists), and the US (5 specialists). Professional specialties represented were: agriculture, anthropology, biology, botany, community development, demography, ecology, economics, environment, epidemiology, health education, immunology, medical entomology, microbiology, parasitology, urban planning, and water and sanitation.

AAAS relied primarily upon African experts, for the following reasons:

- to tap Africans' own experience regarding program needs, constraints, and likely successes; and
- to build the capacity of African experts and their institutions.

Initially, a small Steering Committee was formed, and convened twice, in order to discern the most important strategies and design considerations for malaria control for further deliberation later by the full group.

Listed below, without any order of priority, are the principal points of agreement reached by the Steering Committee:

- Design considerations necessary to apply when developing malaria control approaches for Africa:
 - Diverse environmental and ecological systems, where patterns of malaria transmission may differ even between neighboring villages.
 - Local variations in human behavior, social organization, and culture reflected in varying definitions of priority problems and different understandings about disease transmission.
 - Lack of epidemiological and entomological data on actual patterns of malaria and habits of the mosquito vector, critical to determining means to control malaria.
- Potential approaches identified for further deliberation by full team of experts:
 - *Cross-sectoral planning and organization*: cooperation among different specialties within the health sector, e.g., clinicians, epidemiologists, health educators, as well as between representatives of health and development sectors such as agriculture, water and sanitation, and economics.

- *Community participation*: determination by communities of their own priorities, as well as of design and implementation of activities required to attain their own objectives.
- *Capacity building*: incorporation of training and support measures aimed at strengthening African institutions and individuals, thereby ensuring local sustainability.
- *Health Impact Assessment*: measurement of the potential adverse impact of development activities on health, specifically malaria, and recommendations to alleviate those effects.
- *High-risk groups*: studying the particular needs of individuals and communities at greatest risk of morbidity and mortality related to malaria, and designing control and prevention programs accordingly.
- *Appropriate roles for institutions at subnational, national, regional, and international levels*: specification of how various individuals and organizations, including international development agencies, can most effectively contribute to malaria control.

On the basis of the procedures and directives established by the Steering Committee, and summarized above, AAAS convened a workshop in Mombasa, Kenya, that brought together the full team of experts needed to specify a cross-sectoral approach to malaria in Africa. Particular attention was given to examining ways to ensure sectoral cooperation for the control of malaria associated with development efforts, with an emphasis on agriculture and water resource management. Priority was also given to human habitats, migration, settlement, and land use, and their relationships to malaria prevention and control in Africa.

Participants prepared background papers providing, in most instances, case examples of actual experience in or design considerations for developing and implementing effective malaria control programs. These papers are included in the Appendix. These papers were the focus of "brainstorming" at the Mombasa workshop, and were discussed and evaluated by all participants on the basis of sustainability, suitability for replication or adaptation in other settings, economic viability, and other criteria.

The report that follows is the result of the efforts described here. The recommendations are based on those derived in the course of our expert meetings. Examples have been added from participant papers to amplify and substantiate recommendations made during those several working sessions.

Background

Malaria in Sub-Saharan Africa

Malaria in sub-Saharan Africa is a problem of dimensions unlike those seen anywhere else in the world today. Malaria, which can be fatal, is transmitted to humans by mosquito vectors of the *Anopheles* species. The magnitude of malaria in Africa is affected by a variety of factors, none of which addressed alone is likely to effect a resolution. It is further compounded by the generally poor social and economic conditions in sub-Saharan Africa. Approximately 80 percent of malaria cases and 90 to 95 percent of malaria-related deaths in the world are estimated to be in Africa. In some areas of sub-Saharan Africa people receive 200 to 300 infective bites per year (Beier, Perkins, & Onyango, 1990; Molineaux & Gramiccia, 1980). At least 300 to 500 million malaria episodes are treated annually in sub-Saharan Africa. Moreover, many communities engage in preventive and treatment practices outside what is provided by "official programs" (Mwabu, 1991; Deming, Gayibor, Murphy, Jones, & Karsa, 1989). The disease afflicts pregnant women, young children, and migratory populations particularly severely because of their low or non-existent immunity to the disease: Each year between 675,000 and 1,000,000 deaths among children in sub-Saharan Africa are attributed to malaria.

Problems of Control in Africa

Vector

The vector population in sub-Saharan Africa is uniquely effective, with the six species of the *Anopheles gambiae* complex being the most efficient vectors of human malaria in the region, and often considered the most important in the world. *An. funestes* is also capable of producing very high inoculation rates in a wide range of geographic, seasonal, and ecological conditions (Coluzzi, 1984). These vectors have proven effective in transmitting the malaria parasite to humans across the region, in rural and urban areas alike. *An. pharoensis* is also widely distributed in Africa, geographically and ecologically, and can maintain active transmission of malaria even in the absence of the main malaria vectors (Janssens & Wery, 1987, p. 489). Moreover, these vectors have shown resistance to numerous insecticides, including DDT, various organo-phosphates, and some carbamates. Finally, there is a considerable lack of information regarding vector habits, such as where *Anopheles* rest during the day, information that is critical for control efforts.

Parasite

Another contributing factor in sub-Saharan Africa is the diversity of the parasite that infects humans. Although *Plasmodium falciparum* accounts for the most severe cases of malaria and "for over 90 percent of infections in most areas of tropical Africa where malaria is endemic," (Beausoleil, 1986) it is by no means the sole perpetrator. *P. vivax*, *malariae*, and *ovale* contribute significantly to the pool in sub-Saharan Africa. Resistance of *P. falciparum*

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to chloroquine is on the increase across the continent, having first been reported in East Africa in the 1970s. This resistance has since spread rapidly; for example, in Kenya chloroquine-resistant *P. falciparum* was first discovered in an infant in 1982. Since then the reported level of chloroquine-resistant *P. falciparum* cases has reached 20 percent in west Kenya and 50 percent on the coast. There have also been reports of increasing multiple-drug resistance to drugs other than chloroquine, such as amodiaquine, mefloquine, and Fansidar, rendering treatment of malaria even more problematic.

Other Factors

Human and financial resources devoted to malaria control are grossly inadequate. Most African countries have faced declining GNP/GDP, and often this has resulted in a decrease in health and other social services. Since the "malaria eradication" era of the 1950s and 1960s, there has been a paucity of trained malaria researchers and control program managers. Inabilities to acquire up-to-date information and equipment, as well as inadequate salaries, have caused many able and promising scientists and technicians to be trained and employed outside of Africa.

Moreover, significant cultural, social, and environmental variations among communities require that strategy design include an evaluation of the characteristics of the target communities. Community leaders need to be identified and consulted. Control programs must be structured to conform to a community's expectations and priorities. Concerns such as sleeping, working, and recreational hours and locations; religious practices; proximity of homes to breeding areas; understanding of disease etiology; and acceptance and use of various prevention and control measures (e.g., coils, sprays, chemoprophylaxis, etc.) have an impact on malaria transmission, and hence must be considered when devising control and health education strategies. Level of economic development has also been shown to affect malaria prevalence rates and propensity to use control measures: "...during the initial stages of economic development, increases in income and high rates of malaria prevalence are likely to coexist. However, at a certain threshold level of income, there occurs a reversal in the positive relationship between incomes and malaria prevalence..." (Mwabu).

Emerging Patterns

The severity of malaria and its relationship to other diseases have heightened the urgency of controlling the problem in African countries. Cerebral malaria is now estimated to be responsible for a fatality rate of more than 20 percent of malaria cases, even in urban areas (Warrell, Molyneux, & Beales, 1990). Mortality and morbidity rates due to malaria, as monitored in specific countries, appear to be increasing. For example, reported deaths due to malaria increased from 2.1 percent of cases in 1984 to 4.8 percent in 1986, to 5.8 percent in 1988 in Zaïre. Malaria deaths as a percent of mortality in Zaïre increased from 29.5 percent in 1983, to 45.6 percent in 1985, and to 56.4 percent of all mortality in 1986 (Paluku, presentation at AAAS workshop, May 1991). Pediatric anemia, in 1987, had increased to three times its 1984 prevalence among malaria patients (Greenberg, Nguyen-Dinh, & Mann, 1988). Moreover, in some cases HIV infection from blood transfusions is becoming a major concern.

Population, political, and economic pressures have been forcing groups to leave non-endemic areas throughout the region (e.g., in Ethiopia, Somalia, and the Sudan) and to enter endemic areas without natural immunity. Long-term migrants, as well as seasonal laborers and nomadic populations, suffer some of the gravest consequences because of their transient status. Also, recent urbanization trends in Africa have caused increases in both the human and vector pools. These population movements as well as various climatic factors have introduced malaria into areas that had previously been malaria-free. This trend has been observed in major cities, which in recent years have lost their malaria-free status, as well as in areas of higher altitude, for example in parts of Zaïre (Paluku, personal communication, November 1990), Madagascar, and Kenya, among others. Urbanization also decreases the salt marshes and rain forests that have traditionally been ecologically unfriendly to *An. gambiae*. Moreover, new urban construction is usually accompanied by pools of water that serve as effective breeding sites, particularly for *An. gambiae*, and compounds the problems of generally deteriorating urban environments.

Agricultural development projects have also very seriously affected transmission; through deforestation, desalinization, and irrigation, the environment has been altered drastically. Furthermore, development projects in hydroelectricity, mining, industry, and agriculture have created ecological changes, increasing mosquito contact with humans, many of whom had no prior exposure to malarious mosquitoes, and hence no natural immunity. In Rwanda, for example, populations accustomed to inhabiting higher altitudes have been forced, because of intense population density and growth reaching 3.7 percent annually, to move into the swampy areas more favorable to anopheline breeding. However, limited success has been reported as a few development projects have begun to incorporate disease prevention and sanitation measures in the planning and implementation phases. For example, the Société pour l'Expansion et la Modernization de la Riziculture de Yagua (SEMRY) in Mayo-Danai, Cameroon, managed to fill a 35,000 ha lake, build irrigation canals, and resettle migrant populations for a rice development project without increasing the incidence of malaria or schistosomiasis in the project area. Their success was attributed to the controls implemented, including: regular drain and canal cleaning, provision of drinking water in villages (tube wells or bore-holes with hand pumps), and careful design of canals so they would not be conducive to mosquito breeding (Audibert, Josserane, Josse, & Adjidji, 1990). (Several other examples may be found among the case studies in the Appendix.)

This combination of devastating factors and influences has resulted in an inability to control malaria across this vast continent. Yet, as this report will demonstrate, with renewed attention, resources, and strategies targeted to discrete environments, there is hope for success in malaria control in sub-Saharan Africa.

Report Recommendations

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Report Recommendations

I. Broaden Attack on Malaria by Strengthening Cross-Sectoral Cooperation for Malaria Control

Background

Humankind's long history with malaria has provided ample opportunity for the trial and failure of many approaches. Earlier this century, "malariologists" alone were expected to be able to control malaria. It is now increasingly recognized that a much broader, coordinated approach, range of skills, and resource base are required in Africa. In addition to epidemiologists and parasitologists, for example, entomologists are necessary to study the occurrence and habits of the vectors; anthropologists are needed to ascertain the local beliefs and practices regarding the perceived cause of malaria, and local methods of prevention and treatment; community development specialists must provide the link to working effectively with communities to conduct the above assessments and to plan appropriate programs that respond to the problems and priorities identified by the communities. Economists, as well as specialists from development sectors that may have an adverse impact on malaria, must also be consulted.

Nevertheless, the health sector in developing countries and in donor agencies, such as A.I.D., is well placed to take the lead strengthening a cross-sectoral approach to malaria control. Such an approach will serve to:

- *broaden the expertise available.* Because of the complexity and scope of this scientific, operational, and *human* problem in Africa, specialists need to be drawn from a variety of relevant disciplines.
- *expand the resource base available for efforts to control malaria.* Resources allocated to many development sectors are greater than those invested in the health sector.
- *establish planning for malaria control in development efforts falling outside of the health sector.* Malaria associated with development efforts can be contained by ensuring that prevention and control measures are built into project planning and implementation requirements.

Actions for National Governments

To enhance malaria prevention and control, the cross-sectoral integration of ministries involved in specific development efforts must be established or, in the case where such cooperation already does exist, strengthened. In particular, the Ministry of Health (MOH) must play a leading role in planning, implementing, and monitoring development efforts that may have an adverse impact on malaria.

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The MOH should therefore take the initiative in developing a national group to coordinate anti-malaria activities, effectively involving other relevant ministries, NGOs, women's groups, schools, etc. This MOH-directed group would be responsible for:

- increasing awareness of malaria as a problem among ministries other than health: Ministries of education, agriculture, water resources, town and country planning, and housing, for example, should all consider malaria as being directly relevant to their respective missions.
- encouraging cross-sectoral cooperation at the regional, district, and community levels, for example:
 - fostering collaboration between a village health worker and an agricultural extension worker for community outreach, education, and training programs, and for regulation of insecticide use. In the Blue Nile Health Project in Sudan, the Health Education and Community Participation Unit utilizes extension officers who promote health education messages by linking up with farmers. (For further information, see paper by A.A. El Gaddal in the Appendix)
 - strengthening community-level collaboration in the maintenance of local water resources and small irrigation projects;
 - promoting research on community structures and behaviors to facilitate development of appropriate education messages and control strategies;
 - supporting cooperation among development workers from health and other sectors to convey malaria and other critical health- and development-related messages to the community, emphasizing the relationship between development and health.

Other priority functions of such a coordinating group include:

- conducting multi-sectoral prevention campaigns;
- improving the quality and quantity of treatment centers;
- promoting collaboration among the private sector, NGOs, international bodies, etc.;
- facilitating and supporting malaria research; and
- training medical personnel, managers, and extension workers.

(See paper in the Appendix by B.I. Mululebwe for more information.)

Two of several interesting African examples are the cross-sectoral bodies in Ghana and the Sudan. The Blue Nile Health Project (BNHP) in the Sudan has established a participatory management structure, which includes a National Coordination Committee, Management Board, Scientific Advisory Group, and Health Education and Community Participation component. The National Coordination Committee, "with wide national membership, has become an important component of the management structure. As the objectives of the project are shared by many governmental and non-governmental departments and agencies, coordination among them and the project administration has become a significant feature of

the management system. Notably, the BNHP and the Health Committee on Water Resources in Ghana (described in greater detail later in this report) are both led by the respective country's Minister of Health. (For further information, see papers by A.A. El Gaddal and E. Laing in the Appendix.)

Actions for Donors

Cooperation is required among the sectoral departments of single donor organizations, and among independent donor agencies. Structuring donors in a cross-sectoral manner will assist donors in encouraging cross-sectoral implementation, and in creating a program mechanism for funding cross-sectoral initiatives.

Health sector specialists in donor agencies must therefore establish coordinating bodies within and among donor agencies. These entities would increase awareness of malaria as a problem in sectors other than health, and ensure cross-sectoral planning, implementing, and monitoring of development efforts that may have an adverse impact on malaria.

A.I.D. can also take the lead in working with other international development agencies to establish a model and protocol for cooperation between sectors to establish safeguards against increased malaria transmission. They will also undertake joint evaluations of the program impact on malaria and other health priorities. Lessons may be learned from the World Bank's large-scale efforts to reorganize and reorient staff and to strengthen the Bank's commitment toward safeguarding the environment from development's adverse effects.

Support Existing Cross-Sectoral Cooperation in Sub-Saharan Africa

Existing examples of cross-sectoral cooperation require financial support as well as evaluation to determine how they can best be strengthened, and with regard for potential replication in other settings in Africa. It is also clear that to be sustainable and effective, cross-sectoral bodies must have their own funding and clear authority. A few examples of networks specific to environmental and development-related health issues follow:

1. Ghana: The Ghana Health Committee on Water Resource Development (HCWRD) was inaugurated in 1979 with the objective of examining health implications of proposed water development projects to: encourage, promote, and stimulate research by appropriate agencies on health effects of water development; disseminate information on such effects; and determine resources necessary for improvement of adversely affected groups, etc. The Committee is composed of representatives from health, irrigation, finance, environmental protection, water resource development, and the Council for Scientific and Industrial Research. These individuals represent ministries and related research institutions. The HCWRD evaluates already-existing water development projects and reviews plans for new ones. Recommendations have been offered to groups responsible for implementation and monitoring of such projects, as well as to the Director of Medical Services. The HCWRD has suffered from a lack of funding for these collaborative efforts, resulting in a cessation of meetings for several years. Based on this experience, several recommendations were made: The collaborative body

itself must be funded in order to be sustainable; high-level officials should be involved in the collaboration in order to lend credibility and authority to the effort; individuals likely to be involved in such efforts should gain exposure to interdisciplinary approaches through training courses. (See paper by E. Laing in the Appendix.)

2. *Ethiopia:* A diverse group of specialists, including members of the Ministries of Health and Community Development and the National Institute of Medical Research, organized themselves to apply a cross-sectoral approach to controlling malaria and other tropical diseases. Of particular concern to the Ethiopian group have been changing concentrations of human habitation because of both planned and unplanned migration and settlement.

3. *Regional:* The Environmental Education and Training Network of the African Ministerial Conference on the Environment is concerned primarily with environmental education at the university level. The members of this network, Centres for Environmental Studies at several African universities, have been active in running short courses in environmental management and have expressed interest in developing activities in vector research as well as other health impacts of development projects.

These cooperative efforts can play a pivotal role in developing cross-sectoral approaches to malaria control and other diseases associated with development.

II. Utilize Cross-Sectoral Approach and Resources to Combat Malaria Associated with Development Efforts

Potential Impact of Resource Development Projects on Malaria

Development projects have the capacity to influence the transmission of malaria. It can be expected that if not anticipated and corrected for in the initial plan, most development projects will result in an increase in malaria transmission because of one or more of the following factors:

- irrigation
- water provision
- building sites
- road construction
- deforestation
- population shifts (resulting from economic, seasonal or permanent migration, refugee situations)

For example, water resource development projects such as multi-purpose reservoirs, irrigation canal systems, and urban drainage projects have been shown in many cases to increase the incidence of vector-borne disease in Africa, especially malaria. These macro-scale projects are generally characterized by the following: their location in semi-arid lands (where irrigation projects are directed), the diversion and manipulation of large quantities of surface water, their requirement for significant donor funding, and a total implementation period that normally spans 10-15 years.

Furthermore, many water resource projects for irrigated semi-arid lands are implemented without any significant assessment of potential health impact. The fact that most semi-arid regions of Africa are presently low endemic areas for malaria means the potential is great to create high endemic and epidemic conditions in close proximity to the project. (For further background see papers by E. Laing and W. Thitai in the Appendix.)

Example: Irrigation Development and Malaria Incidence in Zanzibar

Irrigation development in Zanzibar was initiated with the objective of increasing rice production in the isles and consequently reducing the import bill for rice. Initially, no consideration was given to the potential for irrigation schemes to increase transmission of malaria and other vector-borne diseases. It was only later in the project phase when the Malaria Control Project of Zanzibar cautioned the project planners on the excessive use of insecticides, which were also suitable for mosquito control, that a concern for malaria was reported.

A fact-finding mission was subsequently organized to collect more information on the presence of vector mosquito larvae and snail intermediate hosts in the paddy fields. The preliminary survey indicated that the presence and, to some extent, the density of mosquito larvae of the genus *Anopheles* were directly related to the irrigation regime:

It was very unfortunate that during the planning phase for such endemic areas of malaria no attention was drawn to the need and the possibilities for systematic action and to indicate where research, collaboration and assistance could be most effective. (Khatibu)

In addition, the resources of development sectors other than health, frequently often the private authority responsible for the development project, must be tapped and coordinated to bring to bear the broadest approach and resource base for tackling malaria control.

Opportunities for Control of Malaria Associated with Development Efforts

Planning for and monitoring of malaria control associated with development efforts

It is recommended that all development projects take into account the potential for an adverse impact on malaria. Project plans must thus include provisions for reducing the potential for transmission. Development of such plans and mechanisms for monitoring impact can best be achieved by cross-sectoral teams.

Standard pre-project planning requires input from such teams with representation from various sectors. Controlling malaria associated with these development efforts would be strengthened by changing the requirements for project planning and implementation to mandate that these experts should operate as a team throughout the project life to monitor project impact, recommend revisions to the project as required, and evaluate actual compliance with and effectiveness of revised malaria control efforts.

Prevention of malaria associated with development can best be established at the pre-planning stage. Early prevention of malaria is generally simpler and cheaper than instituting corrective measures later. (See paper by E. Laing in the Appendix.)

Specific recommended components, to be carried out by the team members, must be included in the planning and implementation phases, respectively, to prevent an adverse impact on malaria. It is critical that the implementation phase must continue and reinforce the interventions initiated in the planning phase. These efforts should include:

- in the planning phase:
 - Epidemiologic assessment for malaria. Projects must include a baseline epidemiologic characterization of the region selected for development. This characterization will include the current malaria situation, the biology of the malaria parasite and its various vector control strategies, and the roles of the health system, the community, and the other sectors in any existing malaria program.

- A commitment to and plan for community involvement, to be developed in conjunction with the affected community. The *input, consultation, and education* of the affected human population, the community, are imperative.
- Design and establishment of safeguards. Preventive and corrective policies and practices must be instituted to control malaria associated with development efforts.
- Opportunity for later modifications to the development plan. The planning phase must also include a consideration of changes that the development projects may generate and, most importantly, allow for modifications to the plan to reduce the transmission of malaria in the future.
- in the implementation phase:
 - regular and ongoing monitoring (at least yearly) of malaria epidemiology.
 - continual involvement of the community in program implementation.
 - monitoring and enforcement of safeguards.

Establish a requirement for a strengthened Environmental Impact Assessment

Current environmental impact requirements are neither strong nor specific enough to prevent or reduce malaria associated with planned development efforts. For example, A.M.A. Imevbore points out that although "the National Health Policy established since 1986 explicitly requires intersectoral collaboration among ministries of health planning, agriculture and finance, several irrigation projects have nevertheless been built without implementing this policy for intersectoral collaboration at the planning stage." (See paper by A.M.A. Imevbore in Appendix.) Also, in the A.I.D. checklist for environmental impact, public health and disease vector questions receive less attention than do endangered species, pest plants, and animals, or tourism and recreation. Given the importance of malaria as a public health problem, and the potential that development schemes have to influence the intensity of malaria transmission, a requirement for malaria-specific impact statements should be justifiable in Africa. The emphasis should be placed on reviewing current requirements for Environmental Impact Assessment in A.I.D.-funded development projects, and incorporating safeguards for malaria control throughout a project cycle.

Therefore, it is also recommended that:

- A full disclosure, cross-sectoral Environmental Impact Assessment (EIA), with a strengthened, integrated health impact component, must be prepared for all development efforts that may have a negative impact on malaria, for example: water resources, industrial development, urban development, integrated agriculture, hydro-electricity, flood control, resettlement, drainage, and wastewater treatment.
- In addition, a Malaria Impact Statement, as part of the EIA process, should be a prerequisite for all development projects. This Malaria Impact Statement may be prepared either completely by or with the assistance of a regional malaria research and training center, network, or institute (See Section II.)

- The Health or Malaria Impact Assessment component should be fully integrated into the EIA process with the health impact considered the most significant feature of the EIA. The health impacts should be summarized to show the net health changes due to the project's construction and implementation. The Health Impact Assessment component should consider in its analysis both on-site and off-site project impacts that are commonly associated with development projects. Such an assessment should include the following questions: Does the project:
 - Change the ability of groups of individuals to fight disease?
 - Change the exposure of individuals to disease and injury?
 - Change the virulence of disease-causing pathogens?
 - Change the accessibility of health care services?
 - Change the ability to pay for health care services?
 - Change the local ability to provide (manufacture) health promotion and disease-treating products?
- This EIA process should be prepared early enough in the planning process to ensure that pre-implementation baseline health data can be collected and that beneficial design changes can be incorporated into the final design. The process for both scoping and preparing the EIA should include representatives from all the involved ministries and a team of environmental/health assessors.
- Those ministry representatives will also specify the informational requirements and review the specific conclusions of the EIA.
- It is recommended that post-project monitoring for health impacts be implemented in a cross-sectoral manner by all concerned ministries.
- Critical research topics in the areas of vector biology, epidemiology, mitigation effectiveness, monitoring techniques, and design factors can and should be identified through this Health Impact Assessment process.

Recommendations for Donors

There is evidence that the impact of small development efforts, generally uncontrolled by national governments, may be greater than that of large-scale projects. In response, donors should establish a broad, agency-wide policy for malaria and health impact, so that safeguards are established on a national or regional basis. Therefore, a comprehensive approach to controlling malaria associated with all development is recommended, incorporating such safeguards.

- Bilateral and multilateral donors either should develop EIAs along these guidelines or should review any existing process and incorporate into their EIAs an integrated health impact component that meets these criteria.

- Bilateral and multilateral donors should convene meetings to discuss ways to initiate or improve techniques and methodologies to assess health impacts. This step will also serve as an important donor education activity concerning health impact.
- Donors should discuss ways, among themselves and with local communities, to coordinate techniques and methodologies to assess health impacts. Standards and/or prototypes could be developed that would be accepted by a group of affiliated donors.

Establish a requirement for cross-sectoral assessment of selection, design, and construction of development sites

- In addition to the recommendations provided above for general development efforts, special opportunities exist for targeting malaria control interventions to urban, industrial, and infrastructural development.
 - Encourage dispersed geographic distribution of industrial development to avoid over-concentration and over-population of urban areas, factors that frequently lead to increased disease transmission.
 - Development sites and construction methods should be reviewed by a cross-sectoral body concerned with malaria (including entomologists and sanitation engineers, community development specialists, and community representatives) to avoid situating the accompanying human populations near existing mosquito breeding sites and to prevent proliferation of new mosquito breeding sites.

III. Strengthen Local Capacity, Including Developing Cross-Sectoral Approaches

In order to ensure achievement of the long-term goal of locally sustainable malaria control efforts in Africa, highest priority must be placed on investing in Africans themselves, principally by a broadened, more intensive approach toward building the capacity of African specialists and institutions.

It is thus necessary to support training and capacity building, within local universities and institutions, as well as through less formal structures, for malaria specialists at the doctoral and post-doctoral levels (see papers by R. Gwadz and W. Kilama in the Appendix), and also for multi-skilled workers, at lower levels.

Training

There is a shrinking number of trained malaria specialists in Africa. This lack is apparent at all levels, from the very specialized medical entomologists to the more general mid-level technicians to the community health worker as well. It is critical that the corps of expertise in Africa be strengthened, and in some disciplines entirely rebuilt.

- Program managers should be trained cross-sectorally—through work in, for example, agriculture, health, education, water, and economics—to prepare for cross-sectoral collaboration.
- Training should: expose students to other perspectives, encourage exploratory ideas, and provide experience working in a cross-sectoral team in order to prepare students for cross-sectoral work.
- Training in health sciences should include a special emphasis on malaria, because of the magnitude of the disease as a health problem in Africa.
- It is also critical for health workers at all levels to receive continuing education through seminars and conferences, in order to stay informed of the latest concerns and developments with respect to malaria, such as drug or insecticide resistance or possible side effects.
- Management training must be included in technical training curricula.
 - Entomologists and malariologists need to be trained not only in research, but also in the design, management, and implementation of malaria prevention and control programs. Presently, the successful implementation of technically sound programs may be compromised because of a lack of management training for technical staff.
- In order to effect multi-level, cross-sectoral cooperation, trained manpower is needed at the ministry level in: anthropology, community medicine, economics, epidemiology, health planning, information sciences, medical entomology, public health engineering, and sociology.

- There is a need to engage in other means of training/capacity building. It is recommended that such programs could be effectively implemented by NGOs, and should be a funding priority of donors, including:
 - North/South and South/South exchanges that would facilitate appropriate technology transfer among individuals and institutions;
 - mentorships that encourage interactive relationships between junior and senior scientists; and
 - training programs, or short courses, sponsored by professional societies, networks, or other "unofficial" bodies.

Case study: Training in Tanzania

In Tanzania and in many other African countries, since the 1960s, malaria assistants, malariologists, entomologists, and engineers have not been trained in large enough numbers to deal effectively with the growing problem. In response to this need, one participant's paper describes training programs recently developed in Tanzania to redress the shortages of health personnel and to update and enrich the curricula of the actual training programs for malaria prevention and control:

- *Diploma of Vector Control* is intended for experienced health officers. It aims to improve their technical skills in vector control and enable them to plan, implement, monitor, and evaluate vector control programs at the district level or in large urban areas. The curriculum includes both theoretical and practical training.
- *MSc in Tropical Disease Control* aims to prepare individuals for work in ministries or institutes. Candidates are trained to: identify community health problems for purposes of research and control; investigate particular aspects of endemic diseases; design, implement, and evaluate disease control programs; and mobilize communities for participation in prevention/control. The two-year comprehensive curriculum includes courses in behavioral sciences, community health, epidemiology, biostatistics, microbiology, and immunology.

Candidates have university degrees in medicine, social sciences, engineering; admission is open to African nationals.

Also offered in Tanzania are diplomas in public health engineering, and in public health, as well as a Master's in community health. Training at Muhimbili Medical Centre is carried out by staff there, as well as by representatives from the National Institute of Medical Research. (See paper by W. Kilama in the Appendix for more information.)

Capacity Building

In designing strategies for malaria control tailored to specific communities, a need was identified in Africa to establish a mechanism to utilize and build capacity (i.e., to strengthen the skills and knowledge of beneficiaries so that they can take responsibility for managing projects themselves).

Three different proposals were offered by participants to meet these needs:

- *Option 1: Regional Resource Centers*
- *Option 2: Networks of Specialists*
- *Option 3: Malaria Institute*

Since each proposal has relative advantages, each is individually summarized below. Following these descriptions, recommendations are provided regarding options for funding these regional structures.

Option 1: Regional resource centers

Structure for resource centers

Four regional centers are proposed, of which two would be in Francophone Africa (one in the arid/Sahel region and one in the equatorial/forest region), and two in Anglophone Africa (one in East Africa and one in West Africa).

These centers, in general, need not be created *de novo*; they can be created from existing research/training centers. They are intended to increase affiliations, networks, and connections with experts in country, in the region, and internationally. These centers will be staffed by representatives of many disciplines, including: agronomists, anthropologists, clinicians, ecologists, economists, engineers (civil, public health, etc.), epidemiologists, health service administrators, medical entomologists, parasitologists, and sociologists. The centers will specialize in malaria control specific to different ecological regions, and will have satellite units accessible to and familiar with ecologically diverse situations within individual countries and across the region. However, no center will be directly responsible for a country's national malaria control program.

Multidisciplinary team

Multidisciplinary teams prepared to collaborate with development planners, nationally and internationally, can be trained in and available through these resource centers. The teams will provide expertise to meet the requirements of a cross-sectoral approach (enumerated in Section I) needed to prevent an adverse impact on malaria from development efforts, including:

- performing baseline and longitudinal epidemiologic assessments for malaria;
- involving communities in the planning and implementing of the center activities;

- designing and establishing safeguards; and
- modifying development plans, as necessary, to alleviate adverse effects.

Other center functions

- *Service:* Center staff will conduct or participate in the preparation of Environmental Impact Assessments and/or Malaria Impact Statements in response to preliminary project proposals and upon request of donor agencies (see Section IIC). Center staff will also provide input into initial development plans to ensure planning to prevent potential adverse impacts on the transmission of malaria. Staff will also be expected to make recommendations for modifications to project plans as required to ensure a reduction in transmission. Moreover, they will monitor the implementation and long-term operation phases of development projects and ensure adherence to control strategies.
- *Research:* Each regional center will be responsible for an ongoing research program, specific to the expertise housed in the center and/or to the problems unique to the sub-region, for example:
 - evaluation of existing malaria control technologies for use in specific locales;
 - evolution of new control strategies;
 - follow-up evaluation and modification of older (sometimes prematurely discarded) technologies;
 - research in malaria-related topics, for example: epidemiology, immunology, chemotherapy, rapid diagnosis; and
 - research in the social, cultural, and epidemiological issues particular to affected communities, relevant to selection (and success) of appropriate control strategies.
- *Training:* Each regional center will provide training functions on several levels: postdoctoral, predoctoral, and mid-level (e.g., technicians, vector control specialists). The centers will provide managerial as well as technical training on all levels. Continuing education will also be provided by the centers, or their satellite units.
- *Education of and interaction with the community:* The centers will have longstanding, interactive ties with their neighboring communities. Their mandate will include the application of research on cultural factors that affect a community's perception of social and health problems, including disease and appropriate treatments (for example, identification of and cooperation with social and religious leaders as well as churches, schools, active women's and men's groups, and agricultural extension workers).

The centers will also disseminate health education messages. The messages disseminated and the methods used will be determined (respectively) by what is appropriate to the target population, given a community's needs and structure, and by the community's access to high-technology media: Radio and television can be used, where feasible, to reach a large portion of a population. However, centers will also be prepared to disseminate such

information using “lower technology” where more effective, such as posters and booklets for non-literates.

Expected outcomes

The expected outcomes of establishing such centers will be a general reduction of malaria transmission associated with development, through the creation in Africa of integrated control strategies appropriate to the various regions and ecological zones of malaria transmission. The centers will support the application, by these resident specialists, of the latest advances in an African context. The centers will also foster the training of a cadre of African experts, who will be linked in an Africa-wide network of malaria research and training centers, with close ties to leading malaria centers worldwide. An important aim of the centers is to reduce “brain drain” by providing an environment within Africa that is stimulating for African scientists.

Option 2: Network of specialists

This approach will allow intersectoral, intra-African, and inter-continental cooperation to be implemented without the delays and the burdens of substantial inputs that institution-building may entail. The network will also permit the most direct manner of collaboration among overseas and African scientists.

The network will comprise:

- a designated center that will operate as the coordinating unit, and which may be an existing research institution or university; and
- other existing centers in Africa that will work to complement each other to conduct pre-project planning and regular monitoring and evaluation to ensure that the linkages between malaria and development are understood, anticipated, and controlled for.

The technical coordinating unit of the network will:

- identify African scientists who will participate in the network and promote communications among them;
- facilitate and coordinate research among network participants;
- work with African scientists in the network to
 - plan and carry out Malaria Impact Statements
 - plan, implement, and monitor safeguards proposed to reduce malaria transmission
 - prepare guidelines for malaria reduction during project development
 - organize and carry out short training programs at various locations; and
- seek and channel funds to strengthen the participating centers as may be necessary to enable scientists to function within the network.

Option 3: Malaria institute

Structure and function

This institute will maintain a database of relevant scientific literature on malaria, including the less widely available journals — especially those published in developing nations in Africa and elsewhere. The malaria literature will therefore be available in a central location in Africa for all scientists and others on the continent interested in problems of malaria. Electronic transfer of requested information will provide academic and governmental agencies ready access to the world's records of malaria-related research findings.

The center will collect not only written data, but specimens of malaria vectors, maintained in an up-to-date insectary for studies on vector biology, insecticide resistance, etc. It is proposed that rather than being a broad-based, high technology center focused on vector biology, the institute concentrate on applied problems related to malaria vector control strategies specific to Africa and be a resource for other research laboratories throughout Africa and elsewhere in the world. Museum-type collections of vectors will be maintained for teaching purposes. Regarding the vectors, malaria parasites could also be collected throughout Africa and, although some strains might be maintained in culture, a comprehensive collection, stored in liquid N₂, could provide materials upon request to research institutions worldwide. Thus, the institute will not only provide malaria parasite strains for research purposes but could conduct limited investigations on drug resistance and other practical issues related to control and treatment of malaria. These activities could include studies on bed nets, insect repellents, and new insecticides.

In addition to acquiring literature related to malaria and collecting malaria vectors and parasites, the institute could actively accumulate data on malaria epidemiology, monitoring changes and the spread of parasite drug resistance and insecticide resistance throughout the region. These data will reflect changes in malaria endemicity — especially those related to development projects, urbanization, demographics, etc.

Dissemination of information on malaria will be one of the principal tasks of the institute. Since the focus of the institute will be malaria control, workshops on malaria control techniques will be held on a regular schedule. These will be aimed at training individuals and national teams interested in malaria control. These workshops will outline the organizational infrastructures necessary for malaria control programs as well as the management training required to ensure results. In addition to providing “in-house” training, the institute will maintain teams of extension agents that will offer technical advice and evaluation of local programs and problems related to malaria control. Demonstration sites located near the institute could be used for teaching proper use of developed technologies. The center will also produce and disseminate videos and written instructional media related to malaria control.

The institute will become a valuable resource to assist international agencies interested in development projects to conduct appropriate environmental and Health Impact Assessments related to malaria. Post-project monitoring of changes in malaria endemicity would provide useful experience to direct future development efforts.

The center will maintain a permanent staff with guidance from an international board of directors selected from African member states and international development agencies.

A single institute is recommended, the focus of which is principally the reduction of morbidity and mortality of malaria through the appropriate application of the best available technologies and methods. Its mission is chiefly one of training and service, with research activities limited to the evaluation of malaria control related activities and issues related to drug resistance, insecticide use and resistance, management of development schemes, education and media campaigns, etc. Its mission should not be competitive with existing institutions, the principal aims of which are basic research related to malaria. The proposed institute will be bilingual and viewed as resource center dedicated to problems of malaria control in Africa.

Funding Alternatives

There are several possible means for funding any of the above recommended options. Because development itself has the capacity to influence malaria, control should be the responsibility of those most directly responsible for supporting the development scheme—the appropriate national agency and donors. It therefore would be reasonable to expect the donor agencies to play a role in supporting the infrastructure necessary to address the linkage between malaria and development.

This support could come from an annual assessment levied on all development schemes scheduled for Africa. Funds would be provided by the donor at the start of the fiscal year and be based on the total development budget. A flat rate of one percent might be recommended. Or the percentage to be contributed might be determined based on the potential adverse impact of each project being reviewed by objective center/institute staff. Moreover, some mechanism for enforcing payment of a tax must be established, e.g., access to center/institute/network resources will be contingent on payment of fee.

- Additional revenue could be provided by international development agencies and NGOs interested in development in Africa.
- Donations might come from African member states independent of the required percentage of all development projects where EIAs suggest potential or real impacts on malaria endemicity.
- Fees from workshops and other services provided for users would also help to offset the cost of operation of the institute/centers/network.

These funds would:

- support the regional centers/network/institute and their research training functions;
- support the preliminary malaria impact studies;

- support the monitoring programs of the implementation and operational phase of the development schemes; and
- place centers/network/institute in a position to provide advice and pilot experience to development schemes and national malaria control programs.

IV. Sustainable Malaria Control Requires a Community-Based Approach

Recognizing the Social and Environmental Factors That Influence Behavior

Malaria is a behavioral as well as a medical problem. Social, cultural, and economic factors must be understood and incorporated into the design and implementation of malaria control programs. A top-down approach alone will not work. Rather, a community-based strategy must be employed recognizing that individuals are already making decisions for themselves and their families regarding malaria prevention and control, and only programs that are consistent with their interests will ultimately be sustainable.

It is also apparent that social and economic factors influence people's decisions regarding where they live and where they will situate their dwellings; such decisions in turn affect exposure to malaria. The economic benefit derived from locating homes near swamps (for fish and pasture land) that are known to be malarious, for example, may outweigh the perceived loss from contracting malaria. It appears that in cases where agricultural workers contract malaria, short-term productivity is not lost perhaps because of substitution by other community members to complete the required task (Mwabu). Malaria is likely, however, to have a *long-term impact* on household and community productivity:

Malaria morbidity reduces a household's ability to accumulate human and health capital because it interferes with schooling of children... Thus, although the short-run agricultural production of a household may not be affected by malaria because of the phenomenon of intrahousehold reallocation of labor in the event of a malaria attack, long-run labor productivity is in all probability impaired. It is this impairment of future labor productivity that could detain a malaria-endemic community in the initial stages of growth where increases in incomes have a negligible or no effect on malaria prevalence. (Mwabu)

Therefore, in developing a community-based approach, it is important first to determine local priorities and understandings of disease causation. "The majority of a community may not see health, as medically understood, as a priority. One should therefore not assume that people are ready and waiting to participate in malaria control activities." (Kaseje) Much of the population of Africa is more concerned with assuring the day-to-day necessities for survival such as collection of water, food, and fuel for cooking. In addition, malaria in some areas "is so common as to be perceived as being the 'norm' and not a condition that warrants expenditure of limited resources" (Etkin). Finally, regarding disease causation, "while mosquitoes are generally considered to be a nuisance, their relation to disease may not be appreciated" by affected individuals (Etkin).

Practices and perceptions can be assumed to be neither known, nor uniform across the continent. It is recommended, therefore, that participant observation be conducted for affected communities in order to incorporate local understandings of health into project

design. This end can be achieved quickly and at low cost by employing rapid assessment techniques that can be carried out, for example, by local health workers or students (Etkin).

Essential components for establishing a community-based approach include (Kaseje):

- Identifying, developing, and supporting current and potential leadership at all levels (community, district, national, and international).
- Providing existing health workers and those in related sectors with orientation to malaria control.
- Establishing a collaborative network of interested government sectors, NGOs, and districts to enable sharing of approaches.
- Developing appropriate organizational mechanisms for collaboration and for fostering political commitment and will.

In brief, the following conclusions and recommendations can be stated:

1. Community characteristics (demography, social and political structures, epidemiology, habitat, priorities) all affect the role any community might play, and must be assessed before any control program can be designed and implemented. The specifics will vary across communities and even within communities; they cannot be assumed to be homogeneous.
2. A community must play an active role in formulating, implementing, and evaluating strategies for control.
3. Where feasible, all critical variables relating to a specific community must be factored into the development of any control strategies.
4. Communities must determine their own priorities, needs, and capabilities. Any project should capitalize on those priorities and capabilities.
5. Local resources should be used, developed, and refined where possible in order to ensure local sustainability in any control project.
6. Functioning community structures, e.g., women's groups, schools, religious groups, traditional healers, should be used for the coordination of control activities.
 - Since women are frequently the primary health providers in the home, they should be utilized accordingly in control programs.
 - Traditional healers, as respected community members who are consulted for health matters, should be used in developing prevention and control strategies.
7. Communities also need to be informed about the effects of development on malaria. Often, small development projects, such as a series of small irrigation schemes, can have a pronounced adverse effect on malaria transmission within a

community. That community must also be prepared to prevent or mitigate any adverse effects.

8. Community participation can be enhanced by income-generating activities. In some cases, a community needs to perceive an economic (or some other tangible) benefit to carry out a project.

9. A community's perception of a project *as its own* is also critical for success.

- Community members must see themselves as the principal beneficiaries of and actors in programs (Mululebwe).
- For example, the community participates both financially and physically in the Gezira scheme (Blue Nile Health Project) in the Sudan regarding activities in water supply, construction of latrines, garbage collection (El Gaddal).

10. Education may be a particularly important component at this level, where Environmental Impact Assessments may be less feasible for small-scale, community-level projects.

- Health education messages should specifically target high-risk groups, such as pregnant women, children, and migrant workers.
- Weaknesses or shortcomings (in areas where improvements seem essential for successful malaria control) may be remedied through education and communication, particularly through community leaders and existing structures such as schools.

11. Intersectoral cooperation needs to be encouraged at the community level as well. Groups should cooperate to convey health messages to the community regarding health and development.

12. Coordination with the national or district government may also be necessary in order to obtain the support critical to the success of a project.

In sum:

The public particularly has a contribution to make in the management or proper use of amenities for housing, water supply, and sanitation. Further, sustained good management by the community requires some commitment on its part and comes when members are involved in decision making and implementation in the provision of the desired facilities. Local knowledge, values, and practices may determine acceptability of facilities meant to help the community. Continued interaction and communication with the beneficiaries of social projects are thus important. (Laing)

V. Raise Global Awareness of the Magnitude of the Malaria Problem in Sub-Saharan Africa

The importance of malaria in terms of morbidity, mortality, economic costs, needs to be recognized in order to stimulate action by the international community — donors, NGOs, and governmental bodies alike. Regional organizations not typically involved in malaria control, e.g., the African Development Bank, Organization of African Unity, African Academy of Sciences, should also be encouraged to play a major role in malaria control by:

Increasing Attention to and Resources for Malaria

- Help to raise awareness among other governments, communities, and NGOs regarding the seriousness of the disease and its relationship to development, the environment, and health.
- Place more resources at the disposal of malaria control, perhaps through the establishment of an endowment fund to support malaria control and the malaria resource centers for long-term malaria support (see paper by E. Laing in the Appendix for more information). A.I.D and other donors should allocate funds specifically for malaria control; the many recommendations contained in this and other reports provide ample funding opportunities.
- Facilitate training to build local capacity. There is a recognized need for technical and management training at all levels for Africans involved in malaria control. Donors should perceive such activities as a funding priority.
- Ensure that capabilities are in place for sustaining the implementation of measures for the mitigation of adverse health impacts of development projects.
- Illustrate how malaria relates to development efforts. For example, the potential loss of long-term productivity resulting from uncontrolled development and increased malaria transmission could be highlighted. (See paper by Mwabu in Appendix).
- Demonstrate that malaria is not an intractable problem throughout the region. Use case studies where success in malaria control has been achieved through proper planning and implementation.

Formulating and Implementing a Market Strategy

- For donors, including the World Bank, devote a major document, such as their annual report, to the theme of malaria and development, demonstrating its relation to economic well-being in Africa, as a strategy for drawing attention to the relationship between health and development and to the uniqueness of the African situation.
- Focus attention on malaria for “a malaria decade,” with realistic goals of control for achievement within a specified period of time. Take advantage of the experiences of other issue decades or years, such as the decade for water, and the current decade for

disaster prevention. Capitalize on the current resurgence of interest in malaria as demonstrated by the "Report to the President" on the Roskens and Sullivan trip to Africa, (1991) and by the series of WHO meetings on malaria beginning in October 1991 in Africa.

- Develop a coordinated initiative, similar to the African Capacity Building Initiative (ACBI), a multi-donor capacity-building enterprise led by the World Bank, to encourage an integrated, cooperative approach by donors, governments, and NGOs to malaria control, particularly in the context of development, in Africa. Like the ACBI, a long-term evolving process would be required, as would flexibility in approaches used across the continent.

VI. Encourage Innovative Approaches to Malaria Prevention and Control

Because of the unique nature of the malaria situation, and the virulence of mosquitoes and parasites in Africa, innovative approaches to the problem are necessary. Doctors, governments, and NGOs should initiate new solutions appropriate for individual situations. No single approach to malaria control will be successful across the continent; therefore multiple strategies, appropriate to culturally and ecologically unique settings, must be implemented.

Focus on Priority Populations in Addition to Pregnant Women and Children under Five Years of Age

It is widely recognized that pregnant women and children under the age of five are at particularly high risk of malaria morbidity and mortality. (See paper by D. Gbetoglo in the Appendix.) Program interventions and research are required for other vulnerable groups as well.

Certain groups, for example, forced to migrate for political, economic, or cultural reasons, may become exposed to a higher risk of malaria morbidity and mortality. Carriers of malaria parasites who move into non-endemic areas serve as reservoirs for transmission of the disease among non-immune populations. Furthermore, non-immune populations may choose or be forced to move into endemic regions. These movements may occur as water becomes scarce during droughts, when populations often move closer to water sources and breeding areas, thereby increasing the risk of malaria morbidity and mortality. All these at-risk groups are ideal targets for health education and control programs tailored to their social, cultural, and geographical settings and needs.

1. Urban and peri-urban populations require special interventions

In *planned* urban areas, and other arranged settlements, planners must allow for an integrated approach to community design that considers features such as settlement site selection, minimum housing standards, chemoprophylaxis, environmental modification, larviciding, and residual spraying. (Nega and Meskal) After the community is established, malaria control should be under local purview: diagnosis, treatment, intervention, water management, housing, etc. Industrial development sites should be dispersed to avoid over-concentrations of population. Planners at any level must consult the populations for which the settlement is being developed. Health education, geared toward prevention in the new setting, should be implemented in the very early stages of the relocation of populations, in cooperation with leaders of these communities. They should be encouraged to maintain, with the assistance of NGOs, their own systems for diagnosis, treatment, and intervention, as part of a community-level integrated approach.

Case studies: Lessons learned

Pawie Settlement, Ethiopia: In a planned settlement scheme in Pawie, Ethiopia, the Ethiopian government anticipated malaria problems when a largely non-immune population entered a malaria-endemic area. Prevention and control measures were instituted including: weekly chemoprophylaxis; diagnostic and treatment centers; training of community health workers; organization of health committees with representation from agriculture, construction, health, education as well as from community leadership; source reduction and environmental control activities; spraying, etc. In spite of these efforts, the Pawie settlement experienced a drastic increase in malaria prevalence from 1985 to 1988.

Although attempts were made to control the problem, certain critical features were neglected. The increase in prevalence was attributable to ineffectiveness of spraying because tukul (home) walls were not plastered; also, tukuls were frequently within 100 meters of breeding sites; human-vector contact was high because of outdoor sleeping patterns; and chloroquine resistance emerged. Steps taken since 1988 include: plastering of walls, surveillance of chloroquine-resistant *P. falciparum*, and drainage of major breeding sites. (Nega and Meskal)

Arba Minch, Ethiopia: In a planned urban area, Arba Minch, where malaria had been endemic but controlled, the introduction of development projects, and subsequent influx of non-immune populations, resulted in a resurgence of malaria between 1985 and 1989. Training institutes, a textile factory, and cotton plantations were opened during the time period, all bringing in laborers, many from non-malaria endemic regions. However, measures to mitigate these effects were not taken, and malaria prevalence and incidence rates consequently nearly doubled between 1986 and 1988. (Nega and Meskal)

In *unplanned* urban areas (i.e., urban fringes densely populated mostly inhabited by individuals who seek economic opportunities, but who remain on the city outskirts, usually in unsafe, unsanitary surroundings), no single plan is appropriate because of the heterogeneity of these peri-urban areas. Attempts to organize the disparate community members may be hindered by the transient nature of such a community. Efforts should be made to extend services available within the cities to the peri-urban fringe:

- The primary focus should be on general sanitation, e.g., safe water supply, latrines, drainage, waste disposal, etc. Control programs could be built into general sanitation as the latter develops and becomes sustainable.
- NGO activity should be encouraged in these unplanned areas because frequently there are few supporting, traditional infrastructures on which to base control programs. NGOs could play a critical part in developing and implementing malaria control programs, including a role in identifying "natural" community leaders (religious, social, and educational) and developing local health committees.

2. Migratory populations, comprising a significant high risk population in Africa, may enter areas where malaria is more prevalent or where there are parasites to which they have developed no immunity.

Nomadic populations: Social and anthropological research is still required to determine how best to address malaria in this kind of population. Moreover, there exists very little epidemiological data on the patterns of prevalence of malaria among nomadic populations. However, we do know that some migratory patterns (in Somalia, for example, see paper by M. Warsame in the Appendix for more information) bring non-immune populations into endemic areas, often when a population has moved in search of water, more fertile land, pastures for cattle, sheep, etc. Such movements may have been shown to raise the incidence of malaria to epidemic proportions and, in the case of Somalia (among others), to increase chloroquine resistance.

Seasonal laborers: The problems of groups of seasonal laborers who migrate once, twice, or several times annually also need to be explored. The unique problems that they face, leaving and or entering malaria-endemic areas, losing any natural immunity that they may have had, need to be assessed. Moreover, in cases where workers who previously inhabited endemic areas arrive in non-endemic areas, frequently as labor for development projects, these carriers serve as a parasite reservoir, permitting malaria transmission among the native, non-immune populations.

Currently there are few data and little experience upon which to base an effective approach to malaria among these inherently transient groups. More research is required on structures available that could support malaria control efforts. Strategies must be developed that are suitable for a population that moves frequently, and may sleep outside, often near water. Emphasis needs to be placed on protecting non-immune populations from exposure to parasites brought in by the migrant-labor carriers. Successful health education programs must be tailored to this way of life. Social, political, and cultural leaders must be identified and their leadership solicited for health education efforts.

Traditional rural communities: Community health workers, like district-level specialists, require continuing education and training. The village health worker, in addition to providing simple treatments, should mobilize the community through other existing diverse groups and their leaders, e.g., women's groups, schools, agricultural workers. In many cases community members do practice their own control measures, and village health workers should coordinate and promote members' efforts.

Again, because of geographical, ecological, and cultural differences, these communities' practices, priorities, and existing control programs need to be assessed before strategies and health education efforts can be implemented, e.g., if a community has a long history of sleeping outdoors, neither bed nets nor window screening would be appropriate measures.

Take Advantage of the Recent Movement toward Decentralization of Governments

The current trend toward decentralization of government planning and management in Africa (Ghana and Kenya, for example), providing increased responsibility to the district or equivalent level, offers a unique opportunity for malaria control.

- In general, there is probably a greater chance for success in establishing cross-sectoral cooperation at the district level where typically there is less conflict between the sectors than at ministry levels.
- For developing malaria control plans specifically suited to the local environment, the increasing responsibility of district level officers provides an ideal setting for implementing control programs uniquely tailored to individual districts. This decentralization enables further specialization of control policies, allowing for ecological and cultural diversity. The district level also provides a more manageable area for monitoring and surveillance programs, and for carrying out pilot projects.

In Ghana, for example: By Local Government Law, 1988... a District Assembly exercises political and administrative authority in the district ... This includes, among other things, preparing and submitting to the government the development plan and budget for the district, ensuring effective use of the resources of the district, social development, development of basic infrastructure (which should include water and health amenities), and management of human settlements and the environment (Section 6). The role the district assembly plays in the area of mitigation of adverse impacts of water resource development is thus clear. The Planning Committee is to guide and coordinate local communities and all other agencies (Section 15, Development, Planning and Budgeting Unit of Assembly). The assembly is empowered to seek technical advice from professionals in the district. With the necessary collaboration of all concerned, then, the Planning Committee should be able to incorporate adequate public health and other preventive measures in developmental projects and in other activities of the community. (Laing)

In Kenya, the District Development Committees (DDCs) are responsible for intersectoral environmental planning and implementation of district-level water projects. In addition, they have supervisory roles in the development of national-level projects, within the involved districts. The DDCs, through their recently established District Water Boards, also supervise and advise the community-level projects. NGOs are now required to submit proposals for water resource management in communities to DDCs for approval in order to avoid conflict and duplication of effort (Thitai).

Establish Pilot Initiatives to Serve as Models for an Integrated, Cross-Sectoral Approach to Malaria Control

Complete pilot projects should be designed for and implemented in small sections of a problem area, e.g., in one community in a peri-urban area, to be replicated elsewhere if successful. This approach may be preferable to testing only parts of an integrated approach in different communities, which would result in never seeing the viability of a complete, integrated program. The potential for replicability will depend on geographical, ecological, cultural, social, political, and economic factors.

NGOs are typically better suited than bilateral or multilateral donors (e.g., A.I.D., World Bank, WHO) to support pilot projects that might be high risk. Moreover, NGOs may be least rigid and sector-bound, therefore best suited to effect cross-sectoral programs.

Establish Incentives and Penalties for Individual Behaviors and Commercial Practices That Affect Malaria Transmission

Governments and donors can develop and enforce incentives and/or penalties to encourage implementation of malaria control projects as part of development activities, in order to ensure that these activities engender no adverse impacts:

- Subsidizing expensive forms of vector control or drug treatment; or materials needed for source-reduction activities, "positive externalities." (See paper by R. Barlow in Appendix.)
- Fining individuals for engaging in practices detrimental to malaria control, practices that generate negative externalities. (Barlow)
- Encouraging local development and production of control materials, e.g., bed nets, screens, insecticides, etc.

Promote Strategies to Prevent Human-Vector Contact

As part of a multifaceted environmental, social, and behavioral approach to malaria control, and given the particular virulence of the mosquito and parasite in Africa, recommendations also underscored the importance of reducing human-vector contact in order to reduce transmission of malaria:

- Facilitate the widespread use by the population of impregnated bed nets, as part of an integrated approach. Especially important are government actions to bring down the cost of bed netting such as cost subsidization, elimination of customs duties on bed net importation, and promotion of competition in the manufacturing and importation of bed netting. It is understood that efficacy of bed nets is currently undergoing testing, and that this intervention is suitable primarily for individuals resting indoors during periods when malaria-carrying mosquitoes feed. It is also understood that this process must include education; if bed nets are found to be effective, efforts must go into education on how to use them correctly.

- Disseminate extensive health education messages targeted to populations at risk, i.e., young children and pregnant women. The messages should stress the importance of sleeping inside under bed nets, of draining/removing standing water accumulations near the home, and of taking prompt action to stop any leaks in water supply systems.
- Undertake efforts to increase the use of window screening in the home where appropriate and affordable. Emphasis should be placed on education and developing innovative methods for coupling screening into the design/re-design of housing and for increasing competition among potential suppliers of materials and manufacturing facilities used in the construction of screening.
- Support increased research on improved mosquito repellents (including those derived from natural products), and on the proper use of household insecticides. Consideration should be given to a possible international agreement restricting the use of chemicals known to be effective household insecticides for public health purposes only.
- Ensure that projects, such as water resource projects built in semi-arid and arid regions of low endemicity, are designed to minimize contact between the mosquito vector and the human population, and to prevent these regions from becoming highly endemic. Such projects will inevitably attract human resettlement into the newly developed area, and should therefore make use, to the extent appropriate and feasible, of such measures as low elevation reservoirs, efficient drainage systems, and well-maintained canals.

In sum, "Success of malaria control programs depends on the extent to which both the design and the implementation of malaria control programs are informed by interactions between economic development and malaria." (Mwabu)

Conclusion

Lessons Learned

The results of this study offer promise for a social, behavioral, and environmental approach to malaria control:

- Malaria control and other development efforts in which communities are participating fully hold the greatest potential for being sustained. Participation by communities throughout the project cycle is essential. Also critical are an understanding of social, economic, and cultural factors influencing communities and incorporation of these factors into development programs.
- African expertise already exists throughout the continent and across disciplines. African institutions and other entities conducting malaria and development-related work present a compelling case for targeted capacity-building.
- Cross-sectoral approaches are being used in Africa. These initiatives should be further studied to determine how they can best be strengthened and in what situations they can most appropriately be replicated. A cross-sectoral approach will successfully coordinate the:
 - integration of “bottom-up” and “top-down” approaches
 - cooperation among the participants in international development, working together to achieve the goal of reducing the impact of development efforts on malaria
 - utilization of maximum resources available from all relevant sectors to reduce their impact on malaria transmission.

To provide the undergirding for this approach:

- Malaria control must be a high priority, along with a commitment to implementation, for all active participants in international development. At the same time there are specific activities most appropriate for implementation by communities, local or national governments, donors, or NGOs.
- Strategies can and must be tailored to the social and physical environment in which they are to be executed. A long-term mechanism for developing strategies appropriate to the environmentally, culturally, and socially similar regions, districts, or smaller divisions exists in the creation and maintenance of training and resource centers within Africa.

This report discusses several existing and proposed cross-sectoral, capacity-building, and other innovative initiatives targeted to different levels as appropriate. A foundation has thus been established for future efforts through an evaluation of these and other promising approaches in terms of their capacity for reducing the impact of development on malaria. Such an assessment should identify program achievements and constraints to success. In this evaluation it is essential to examine African enterprises in order to determine their potential for improvement and for replication in order to enhance the effectiveness of malaria control in Africa.

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The Behavioral Dimensions of Malaria Control: Guidelines for Culturally Sensitive and Microecologically Germane Policies

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Lutte Antipaludique au Togo

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Dr. M. Warsame Yusuf, Lecturer, Faculty of Medicine, Somali National University, Somalia

Creating Incentives for Anti-Malarial Behavior

Robin Barlow
Department of Economics, University of Michigan
Ann Arbor, Michigan, USA

Summary

One approach towards controlling malaria in Africa is to change patterns of consumption and other behavior among the population. This is usually attempted by means of education programs.

But another method would use financial incentives and disincentives. These can be created through imaginative applications of the taxing and subsidizing powers of the public authorities.

This paper first considers examples of individual behavior relevant for malaria transmission. Second, some examples are given of financial incentives and disincentives that could encourage anti-malarial behavior. Third, cases of financial incentives and disincentives are noted.

Individual Behavior Relevant for Malaria Transmission

Avoidance of Vectors

It is desirable to encourage behavior that separates humans from vectors. An important example in many circumstances may be the purchase and use of bednets. Another may be the purchase and use of insect repellents in such forms as skin lotions and smoke coils. Window screens are another beneficial product.

Reduction of Vector Population

Several activities at the household level can contribute to reducing the vector population. An example would be the removal of accumulations of stagnant water. Another would be insecticidal spraying within dwellings. Research underway indicates that the use of bednets impregnated with insecticides is an alternative that could both keep humans away from vectors and reduce the number of vectors.

Appropriate Use of Drugs

Individuals can reduce malaria transmission in the short run by taking drugs in either the prophylactic or the therapeutic mode. As is well known in the malaria case, however, higher

drug consumption today can lead to higher disease prevalence tomorrow as a result of stimulating parasite resistance. Correct anti-malarial behavior from a social point of view therefore involves using some drugs but not others, depending on the parasite resistance outlook in the particular ecological setting involved.

As argued by Schapira (1989), the socially appropriate use of anti-malarial drugs can be promoted through greater use of microscopic blood examinations, as a result of which the drugs can be restricted to genuine cases of malaria instead of being indiscriminately prescribed for all fevers. The wider the use of the anti-malarial drugs in the human population, the greater the opportunities for the development of parasite resistance.

Financial Incentives and Disincentives

In the technical language of economics, one person's behavior that promotes malaria transmission generates "negative externalities," in the sense that the well-being of other persons is adversely affected. Such behavior should be taxed or otherwise discouraged in the interests of social well-being. Behavior tending to reduce malaria transmission generates "positive externalities," and should be subsidized or otherwise encouraged. What financial incentives and disincentives might be attempted in this context, bearing in mind political, administrative, and budgetary realities?

Subsidization

Anti-malarial products generating positive externalities are good candidates for government subsidy, even up to a rate of 100 percent. Consumers who for their own reasons have a positive demand for those products ought to have easy access to them at a low or even zero price. From the discussion above of anti-malarial behavior, examples may include bednets (impregnated or otherwise), certain repellents, certain insecticides (those unlikely to cause vector resistance), and certain drugs (those unlikely to cause parasite resistance). Following Schapira's suggestion, substantial subsidization of microscopes and associated supplies may also be a good idea, in order that both public and private providers of health care may be stimulated to improve the quality of diagnosis.

It should be noted that the subsidization of these and other socially beneficial products is justified even if those consuming them have other motivations besides the avoidance of malaria. For example, a person using a bednet may do so in order to escape the nuisance of biting insects, and may not care about malaria. But this does not alter the fact that his behavior tends to reduce malaria transmission and hence should be subsidized.

Taxation

Symmetrically, products favoring malaria transmission are good candidates for taxation. In some circumstances, this principle may even call for the taxation of certain anti-malarial drugs. If in a given region Drug A appears to be creating parasite resistance to a serious degree, whereas Drug B does not have this problem, it might be appropriate to tax A in order

to encourage a switch in consumption from A to B. The same reasoning could justify in some circumstances the taxation of specific insecticides causing vector resistance.

In some cases, the taxation of these offending products will be facilitated by the fact that they can only be obtained through importing. In this event, it is relatively easy to apply a tax. Whether the product is imported or domestically produced, it is to be expected that taxing it will stimulate parallel market operations in the form of smuggling or clandestine production. However, the net result of the government's intervention will be some increase in the price paid by consumers, even if they resort to the parallel market, so there will still be some deterrent effect on consumption as desired.

The use of taxes to affect behavior relevant for health is well established, particularly in the area of tobacco products and alcoholic beverages. (Obviously the rationale for such taxes includes the desire to obtain revenue as well as to improve health.) An extensive empirical literature exists on tobacco and alcoholic beverage taxes, and shows that they usually reduce consumption by a significant though not overwhelming amount.

Rewards

Authorities might consider staging the payment of rewards to individuals and communities with exceptional anti-malarial achievements. The payment should be accompanied by substantial publicity. Examples of such anti-malarial "champions" might include residents of malarial zones testing negative for parasites x or more years in a row, family compounds where inspection reveals less than y square centimeters of stagnant water, and persons turning in z or more old tires (or other notorious breeding receptacles) at public collection points.

In most countries the practice of giving public recognition to individuals and communities with remarkable achievements is well established. There is no reason why anti-malarial behavior should not also receive such recognition. Examples already exist of this approach. It is reported that the malaria control program in Ethiopia has considered promoting inter-village competitions along these lines. (Personal communication, May 1991)

Fines

Finally, in some social settings it may be appropriate to use the stick rather than the carrot, and impose fines on certain activities. In many cases, the political and administrative costs of this approach will be prohibitive. But, in general, the authorities should be encouraged to examine the potentials of both financial incentives and financial disincentives as instruments for changing health behavior.

Correcting Financial Distortions

In practice, the pattern of financial incentives and disincentives in the area of health behavior is sometimes the exact opposite of what it should be. Products with positive externalities in fact are taxed, and products with negative externalities are subsidized. In these circumstances, useful anti-malarial work might be done by removing the distortions.

An example is provided by the fiscal treatment of imported bednets in Tanzania, which instead of being subsidized are heavily taxed. The cost per bednet unloaded at Dar es Salaam is currently US\$3-4. Customs duties and sales taxes are then imposed, and these, along with margins applied by distributors, lead to a retail price of about \$20. This price places the bednet beyond the reach of the mass of the population. Tax exemption is clearly in order. Probably another useful contribution by the government in this instance would be to promote competition in the distributive sector, in order to bring margins down.

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The Experience of the Blue Nile Health Project in the Control of Malaria and Other Water-Associated Diseases

A. A. El Gaddal
Manager, Blue Nile Health Project
Medani, Sudan

Introduction

Economic development in the Sudan has been intimately linked to irrigated agriculture. Irrigation projects, such as the Gezira, Kenana, and Rahad, have increased agricultural production in the country and have contributed significantly to the nation's annual GNP and to its export earnings. As a matter of fact, the agricultural sector contributes 95 percent of all exports, 40 percent of GDP, and provides a livelihood to 80 percent of the population.

It is this predominance of agriculture and the intensive use of irrigation that give rise to a number of water-associated diseases such as malaria and bilharzia. Control efforts against these diseases have been going on for the last thirty years, but the magnitude of the problem has been increasing with serious consequences for the farmers, their families, and the national economy.

The strategy adopted by the Blue Nile Health Project (BNHP) is considered an acceptable solution to the hazards of those water-associated diseases.

Background Information

BNHP started as a joint venture between the World Health Organization (WHO) and the government of the Sudan in 1980. The project life was supposed to be 10 years; the first five years were devoted to research aiming at reaching a strategy that could be applied to the rest of the Gezira Project. The strategy was expected to be applicable, practical, and within the resources of the country. Environmental measures as well as biological control methods were to be tried.

The aim of the project is to control malaria, schistosomiasis, and diarrheal diseases; to reduce the prevalence of malaria to below 2 percent and schistosomiasis from above 50 percent to below 10 percent; and to reduce mortality and consequently morbidity due to diarrheal diseases and maintain those rates at a lower level.

Objectives

The overall objective of this project is to control and prevent the major water-associated diseases in the area through a comprehensive program of disease prevention and control and to assess its health and socioeconomic impact.

Methods

The methods used for the application of the approved comprehensive strategy include:

- provision of an abundant safe water supply (deep bore wells, shallow wells with hand pumps, and Horizontal Flow Roughening Slow Sand Filters, H.F.R./S.S.F.)
- health education with the aim of community participation and formation of village health committees
- use of pesticides and drugs:
 - residual insecticides for malaria control
 - larvicides
 - molluscicides for snail control
 - anti-malarial as well as anti-bilharzial drugs
- use of biological methods of control: Gambusia for mosquitoes, Marisa snail for schistosomiasis intermediate hosts
- environmental control methods:
 - draining of rain water collection
 - elimination of breeding places of mosquitoes by volunteers
- provision of Oral Rehydration Salts (ORS) or teaching mothers how to prepare them locally
- provision of trained personnel to work in the established diagnostic laboratories for malaria and schistosomiasis
- training of water caretakers (volunteers) from the villages to look after and maintain the water systems
- persuasion of the people to construct their own pit latrines and provision of enforced concrete slabs for latrines at a nominal price
- the use of carts pulled by donkeys for the collection of garbage and ultimately its incineration

Malaria in the Sudan

Geographical Distribution

Malaria is the main endemic parasitic disease in the country. The endemicity of the disease ranges from holoendemic in the south to hypoendemic in the north. The endemicity of the disease follows more or less the natural distribution of geographical zones.

Malaria is holoendemic in the equatorial and rich savannah belt, hyperendemic in the savannah zone, mesoendemic in the poor savannah and semi-desert zone in central Sudan, and hypoendemic along the main Nile in the northern part of the country and along the Red Sea Hills. Accordingly, transmission ranges from perennial in the south to seasonal in the other parts of the country (see Figure 1).

In the irrigated areas in central Sudan, transmission ranges from seasonal to perennial, and the endemicity is changing from meso to hyperendemic.

Vector Species

Three vector species are identified. These are: *A. gambiae* which is geographically restricted to the southern part of the country; *A. arabiensis* which extends from the south and reaches up to the northern limit near the Egyptian border and is considered to be the principal vector in the country; and *A. funestus* which is found in the southern part of the country.

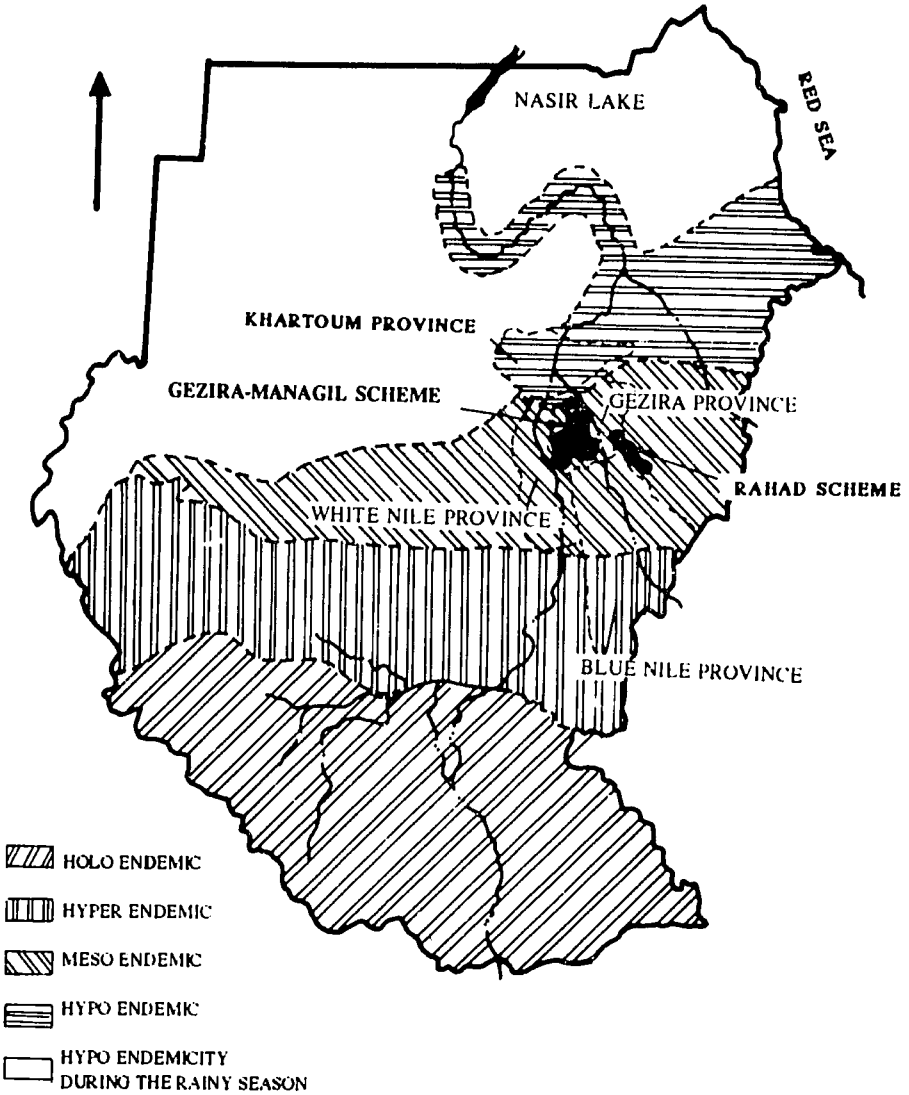
Parasite Species

The predominant parasite species is *P. falciparum* which is responsible for about 90 percent of human infection. However, *P. vivax* is widespread in the eastern part of the country and may reach up to 20 percent close to the Ethiopian borders. *P. malaria* is reported mainly in southern Sudan. *P. ovale* is reported in a sporadic manner.

Sudan shares its boundaries with eight countries and is subject to population influx from neighboring countries and hence to the introduction of various parasite strains.

During the last few years, due to the unstable situation in most of the neighboring countries, a great number of refugees have crossed the borders to seek shelter and peace in the Sudan. Many of these people are considered as carriers of different strains of the malaria parasite. This migration has given rise to a change in the epidemiology of the disease. The most important change is the introduction of resistant strains of *Plasmodium falciparum* to the Sudan.

ENDEMICITY OF MALARIA IN THE SUDAN



Control Measures in the Sudan

There are no proper control measures in the Sudan except in the Gezira irrigated area (BNHP) and New Halfa Scheme:

- Residual insecticides are applied in some of the big towns. In some cases, this is supplemented by chemical larviciding and draining of water collection points, especially during the rainy season.
- Microscopical diagnosis is available in towns and villages with hospitals or health centers. Even in these health posts, the Geimsa stain is not used. I am glad to report that the Minister of Health has recently directed the National Health Laboratory authorities to use Geisma stain in all diagnostic laboratories for the diagnosis of malaria; previously field stain had been used.
- Treatment of malaria is available all over the Sudan. Some of the inhabitants prefer the use of injections to tablets. Chloroquine was the drug of choice until recently when resistance appeared in some cases of *P. falciparum* malaria. In such resistant cases, quinine injections are used as people prefer them to tablets. Fansidar (Sulfadoxine 500 mgs., Pyrimethamine 25 mgs, per tablet) is only available through the malaria department in Khartoum. Some of the Sudanese working abroad, especially those in the Persian Gulf and Saudi Arabia, used to send Fansidar to their relatives in the Sudan.

Resistance of *falciparum* malaria to chloroquine

A few years ago cases of *falciparum* malaria resistant to chloroquine appeared in Khartoum. Currently the resistant cases are spreading and covering many parts of the Sudan. These cases are mostly concentrated in the eastern part of the Sudan bordering Ethiopia and the southern parts bordering Uganda and Kenya. This shift is mainly due to the influx of refugees from Ethiopia, Uganda, Kenya, and other countries. The spread of the chloroquine-resistant malaria is due to population movement, particularly the introduction of labor forces from different parts of the country as well as from neighboring countries.

In vivo and *in vitro* tests to determine resistance to chloroquine have been performed in Khartoum, the eastern region as well as the central region. The tests were carried out by the following collaborating bodies:

- Faculty of Medicine, University of Khartoum
- Blue Nile Health Project and Gezira University
- National Malaria Service, Khartoum

In the eastern and central regions, the percentage of the resistant cases ranges from 10 to 20 percent of all cases. We still consider chloroquine to be the drug of choice. For resistant cases, quinine injections are used, also Fansidar if available.

Participatory Management

Finally it must be pointed out that participation in management, i.e., a well-defined strategy and proper financing, has played an important role in the success of the project. The project design has fortunately provided for this important aspect of management, which has been an effective procedure for consultation and decision-making on crucial issues.

At the top management level, active involvement and participation by all those concerned with the project activities have been achieved through the development of a number of participatory structures. Interagency cooperation and cross-sectoral collaboration have been maintained and strengthened by the creation of the following entities:

National Coordination Committee

This committee, with wide national membership, has become an important component of the management structure. As the objectives of the project are shared by many governmental and non-governmental departments and agencies, coordination among them and the project administration has become a significant feature of the management system. The Minister of Health is the chairman of this committee.

The National Coordination Committee, in its annual meetings, has continued to play an extremely vital role not only in advancing and promoting coordination, but also in initiating and developing a working method and a common understanding.

Management Board

This body has been established as a top policy-making organ. It is headed by the Regional Governor with the Project Manager as Secretary General of the Board. Members include Project Unit Directors in addition to professionals and outstanding individuals. The main responsibility of the Board is to consider the project budget, to endorse its plans, to review its program and performance, and to seek solutions to problems.

Scientific Advisory Group

This body meets once every one or two years. Its members include top advisors and consultants from WHO and other countries of the world. They advise on the scientific and technical components of the project and also review the annual plan of action, the budget, work progress, and research activities.

Internally, the group has also successfully established two other tools of participatory management: the monthly staff meeting and the annual reporting system. The monthly staff meeting in particular has become an integral part of the management process and has noticeably increased the efficiency of the administration. It allows the staff to contribute to the decision-making process, ensures that programs and activities are well understood, provides opportunities for review and evaluation of policies, and contributes to staff cooperation and morale.

Health Education and Community Participation

This is the most important department in the BNHP. Without the cooperation and participation of the community, the comprehensive strategy of the BNHP will never succeed. Thus there is a well-developed Health Education and Community Participation Unit with the BNHP, which is staffed by social workers seconded from the Ministry of Education. The Health Education and Community Participation Unit also utilizes extension officers, employed by the Gezira Board, who capitalize on their close links with the farmers to help promote our health education messages.

Changing human behavior is a long-term occupation demanding the confidence of the people, which takes time to develop. Village Health Committees are formed in most of the villages. Despite the short life of the project to date, the success of the Village Health Committees has been satisfying. Villages are cleaner, and the response to the offer of chemotherapy for schistosomiasis has been almost 100 percent. Use of ORS has increased, and recently the response to the immunization program through the village committees has been high. Volunteers who maintain and look after the water points or eliminate breeding places of mosquitoes are proud of their work.

We believe that the success of the committee system has been based on the careful planning by the project teams and the coordination between operational units so that once the health committee was formed, the project immediately moved to offer benefits that the villagers could appreciate.

In some parts of the Gezira, we depend on the volunteers from the villages to spray their own villages with mosquito residual insecticides during the annual spraying campaign.

The community participates in the provision of water supply and environmental sanitation of the villages as follows:

- Villagers share in the cost of the construction of shallow wells fitted with hand pumps. They pay about one-third the cost of the well.
- Unregistered small villages are supplied with a small-scale filtration unit, H.F.R./S.S.F. Here the villagers participate by providing labor during the construction of the filter. One or two villagers (volunteers) are trained by project personnel to look after and maintain the filter or shallow well.
- The project is focusing on construction of pit latrines by individual households. Again the participation of the community is of paramount importance, and only through the efforts of the health education teams can these objectives be achieved. The project offers to provide a subsidized concrete latrine slab to any household that digs a pit and constructs the superstructure for the latrine.
- The cleaning up of the garbage around the villages is achieved by providing a cart for the village, used by a villager appointed by the council as a sweeper. He must keep the village clean, and burn the excess garbage daily, and in return he can use the cart

for private business during his free time to generate an income for himself. This system works excellently.

It is worth mentioning that both the Ministry of Health and the Eastern Mediterranean Regional Office in Alexandria have agreed to the continuation of the BNHP beyond 1991. Both parties have recommended the application of the approved strategy of the BNHP to all the irrigation agricultural projects in the Sudan.

The BNHP (Gezira irrigated area) will be used as a field training area for all the staff concerned who are to implement the strategy in the different irrigation agricultural schemes. The BNHP staff will be the technical body that will supervise and help in the implementation.

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The Behavioral Dimensions of Malaria Control

Guidelines for Culturally Sensitive and Microecologically Germane Policies

Nina L. Etkin

Department of Anthropology, University of Hawaii at Manoa
Honolulu, Hawaii, USA

Introduction

The failure of many malaria control programs can be traced to inattention to relevant bio-behavioral interactions, such as could be elucidated through a theoretical perspective in disease ecology that focuses on interrelations among agent, vector, and host within a particular ecosystem. Empiricist, epidemiologic models need to be elaborated to address as well the economic, social, and political antecedents and outcomes of disease. Through macro- and micro-social perspectives we learn how individual manifestations of culturally prescribed behaviors contribute to risk or protection from infectious disease (Turshen, 1984; Inhorn & Brown, 1990).

A problem is that these observations seem so obvious, so patently rational, that one becomes impatient when they are repeated yet again. Why do social scientists feel the need to promote their theoretical frameworks and methodologies in the context of malaria control? I propose that we do so, and with growing frustration, precisely because failure to deal even relatively superficially with the behavioral dimension squanders the technical sophistication and competence of mosquito control technology and the prophylaxis and chemotherapy of plasmodial infections. To the extent that contemporary malaria control programs deviate little from their early design, and that too many studies still conclude that "sociocultural variables should have been taken into account at the program's onset," the redundancy in recommendations for program design is apparently necessary.

Overview of Basic Concerns

To date, malaria control programs in Africa have foundered on a set of misconceptions, fallacies that plague international public health efforts in general (Polgar, 1963). These are summarized as:

- *The fallacy of the empty vessel*: "target" populations have no established customs centering on issues of health and environment, but are in that regard voids, needing only to be filled with whatever technology and information are being advocated.

- *The fallacy of interchangeable faces:* all proposed recipients of "development" programs will respond to change in the same way. In this regard populations of Africa especially have suffered because of tendencies among international health personnel to conceptualize issues continent-wide, despite great diversity in physical, environmental, and cultural circumstances.
- *The fallacy of the discrete capsule:* health beliefs and practices constitute a corpus of behavior and cognition separate from other aspects of society and culture, i.e., neither linked to nor overlapped with religion, occupation, kinship, etc., so that proposed changes in one sector have no bearing on any other.
- *The fallacy of the single pyramid:* societies are organized in such a way that information and materials offered at the top of the political hierarchies trickle down, in their original form, and are in that configuration comprehended and implemented at the local level.

The specific implications of these problems for malaria control, and suggestions for practical means to circumvent them, are the objectives of this paper, with most attention paid to the first two dimensions of this problematic, aspects 3 and 4 falling more appropriately under the purview of other addenda to this report.

There Are No Empty Vessels

In fact all societies have established criteria by which they judge health and in correspondence with which they develop means of preventing and treating illness. This reality is often lost on westerners who cannot understand why other people do not accept as conventional wisdom the purported superiority of pharmaceuticals, immunizations, and other bio(western) medicines. The paradigms that underlie a group's understanding of physiology and illness may correspond closely, or not at all, with those that inform biomedicine. That is not the point, nor is the intent to judge the "rationality" of those other medical systems. The personnel of malaria control programs need to become informed about the broad outlines of local health beliefs in order to understand how those influence disease prevention and treatment. This can be accomplished by entertaining such questions as the following.

What are the local priorities? Is malaria, or any of its symptoms, recognized, and, if so, how important is it relative to other illnesses? Some malaria control programs have failed because the intended recipients were more concerned with epidemic measles and infant diarrheas, to which they ascribed the greatest mortality. In some hyperendemic areas malaria is so common as to be perceived as being the "norm" and not a condition that warrants expenditure of limited resources. On the other hand, in nonwestern medical paradigms there is probably greater discernment of malaria from other fevers than what medical planners generally anticipate, because of the periodicity of those fevers, the likelihood that they will be season-bound, and the attendant high rates of morbidity and mortality.

What are local understandings of disease causation? Because ethnoetiologies are culturally constructed, they offer insights into the acceptability of different modes of prevention and therapy (Etkin, 1988; Rubel & Hass 1990; Good 1987). Are biomedical prophylaxis and

therapy for malaria consistent with local expectations of how medicines should be administered and which outcomes are expected, i.e., are mode of delivery (injection, capsule, etc.) and its scheduling and dose appropriate? Should therapy only relieve symptoms, or generate other signs of healing as well? What is the local prognosis for malaria, and who should engage in its therapy? What is the source of infection and what of contagion? Gender, age, ethnicity, and moral turpitude have all been implicated in differential susceptibility to malaria. Moreover, those categories may shift over time or along other axes. While mosquitoes are generally considered to be a nuisance, their relation to disease may not be appreciated, and, other concerns looming larger in the collective conscience, efforts to control breeding and biting behavior would then be deemed frivolous. The point, again, is not to assess the veracity of indigenous models, but to determine how those local views can best be used to design the varied aspects of cross-sectoral malaria control.

In the end, one wants to know how malaria control programs can design culturally sensitive approaches and explain their objectives to conform with local expectations and priorities. Where indigenous paradigms stand in marked contrast to the biomedical, how can a control program present information in such a way that the programmatic objectives can be achieved without compromising local relations and future interactions with that community?

People Are Not All Alike

The vicissitudes of local cultures mediate between people and their material and sociocultural environments in such ways that differences accrue *both between and within* societies regarding perceptions of health and illness. But, to date, medical and technical strategies have overwhelmed concern for social dynamics and politico-cultural processes; and people have received less attention from health planners than have parasites and vectors, the presence and specific actions of which are as much an artifact of human behavior as they are the consequence of the "natural" environment. Although the importance of culture is implied at some early state of most projects, most behaviors have generally been considered in a static context, and people have been treated as passive recipients of technology, unsuited to education or to active roles in the organization of community health efforts (Ault, 1983). A better comprehension of those behaviors, including attention to intracultural heterogeneity, can be used to advantage in redesigning malaria control programs. The geographer Jacques May was among the earliest to conceptualize how covariance among these aspects of the physical and social environments affects the presence and expression of disease (May, 1958). The outline that follows illustrates how this approach to disease ecology can be adapted easily to malaria control programs.

Housetype: material, fenestration, light, elevation, location of cooking fire and other sources of smoke. How does any one of these factors impact on whatever anophelines are present? While smoke repels mosquitoes, it is at the same time a mucosal irritant and promotes pulmono-respiratory disorders. How do health personnel assess relative health risks under such circumstances, i.e., are traditional practices then to be encouraged or discouraged? Should they be modified and, specifically, how? Repellent coils are a relatively easy adaptation from traditional fumigants, but the intention of mosquito deterrence must be clear, since people use fumigants for all variety of reasons, including chasing spirits, generating odors (good and bad), divining, and so on (Etkin, 1988). Other local modes of repelling

insects through variable use of plants, including several for which western phytochemists have “corroborated” insect-repellent, larvicidal, and insectidal actions (e.g., *Eucalyptus globulus* Labill., *Lycopersicon esculentum* Mill., *Melia azedarach* L., and *Momordica charantia* L.) remain to be explored (Duke, 1985).

Sleeping Patterns: time and locus are the more salient features, although number per sleeping unit factors into considerations of bite density. The presence or absence of netting signifies only when it has been established how that netting is used and for what duration. Peoples throughout Africa have traditionally used cloth and grass mats above and around their beds, and while this practice may intend to shield against mosquitoes, nets are used too for storage of clothing, to protect against scorpions and rodents, and as decoration. Moreover, within the same ecology and economy, netting is used differently by age groups, gender, social class, and ethnicity (MacCormack, 1987).

Domestic Animals: proximity, type, number. Whereas the presence of certain animals might discourage the anthropophily of anophelines — drawing them to cows or pigs, for instance (Gorup & van der Kaay, 1984) — the risk of certain zoonoses logically increases. How will a malaria control program judge relative health risk in that case?

Daily Activity Patterns in the Context of Occupational and Recreational Activities: diurnal, seasonal, and temporal proximity to water and other mosquito hatching sites, and human density during activity. Especially in agricultural communities, patterns of land tenure help to define relative risk based in differential proximity to sites of mosquito hatching (Ault, 1983; Ross, 1987), and variables such as age, gender, health status, and the like are important determinants of exposure. But does differential risk of infected bite translate into dissimilarities in the occurrence and severity of malaria, e.g., is someone who receives four bites at greater risk than someone who receives two?

Technology: infrastructure — relations of production and economy, communication and links to regional economies, schools and outreach/community education programs, inventory of material artifacts, and indigenous classification of relevant resources. All these help to define the kind of control program possible and give shape to the logistics of organizational efforts.

Mobility: migration, circulation, relocation. These movements are inspired by a myriad of circumstances, including religious pilgrimage, employment, resettlement, kin obligations, transhumance, life cycle events, etc. Depending on duration, scale, and microecologic constraints, all can profoundly affect the transmission of malaria infection (Prothero, 1965; Curtin, 1989).

Understandings of Health and Illness: refer to There Are No Empty Vessels, above.

Social Organization: mechanisms that ensure the integrity of group relationships (roles, statuses, institutions) vary among human societies and can impact decision-making at all levels of malaria control.

Because aspects of microecology and culture vary from one local biotope to another, all these circumstances need to be observed *in situ* and to be coordinated with epidemiologic data to generate hypotheses about relative risk and appropriate control measures. Even the most likely of predictors needs to be examined for risk potential, as illustrated by the paradoxically higher rates of malaria among a woodland savanna population compared to neighboring rice paddy cultivators in Burkina Faso (Gorup & van der Kaay, 1984), which may be explained by the presence in these two biotopes of different anopheline sibling species, although other explanations have not been ruled out. In another case, while greater incidence of malaria among males in a Sri Lankan population may be accounted for by differential risk patterns defined by occupation, sleeping, and clothing, it is possible too that malaria is underreported among women because they refuse examination by the predominantly male cadre of health personnel involved in case detection (Silva, 1988).

Health and Medicine Are Part of a Broader Biosocial Reality

Paradigms of health and illness are embedded in a larger whole that includes the biological and social environments. Models of disease and therapeutics are frameworks onto which are projected and which in turn reflect understandings of how the universe functions, the causes of misfortune and ways to assure good health, the social organization of healing, etc. "Holistic" and comprehensive ecologic approaches provide the necessary conceptual tools to address these complexities in order to design appropriate malaria control strategies.

Top Down, Hierarchic Approaches to Development Do Not Work

It is necessary to understand how hierarchies of authority, decisionmaking, and information dissemination vary across region and community and among smaller subgroups such as occupational and religious associations, families, ethnic alliances, and gender-discrete groups. Simple and unidirectional chains of command ordinarily do not exist; and without adequate rural health infrastructures, it is not possible to sustain even modest programs. At a minimum, malaria control programs must first set the requirements and standards for capacity building and then upgrade infrastructures and train staff of all kinds to incorporate anti-malarial measures into primary health care.

Future Directions and Practical Applications

In order for malaria control programs to be successful, it is imperative that local understandings of health no longer be perceived as deterrents. The adversary models of international health that juxtapose western technology and biomedicine against the backdrop of whatever culture is a proposed recipient only simplify and mislead. There is ample evidence from social science research that medical innovation is feasible under certain general circumstances (Bloom & Reid, 1984; Foster, 1978), which include perceptions on the part of local populations that: 1) there exist social, economic, psychological, health, or other advantages in doing so; 2) change is a realistic and sustainable possibility for them; 3) economic costs, including sustainability of the program, fall within their capabilities; 4) advantages are not outweighed by social costs, such as compromised kin and other relationships that occur as part of the restructuring of local disease prevention and treatment

strategies. Among these considerations, failure to contain economic costs and to sustain the project constitute the more significant barriers. Elaborate cosmologies notwithstanding, people worldwide share a pragmatism and desire to improve quality of life. These observations have been codified in WHO-UNICEF primary health care strategies that emphasize cross-sectoral approaches, community involvement, equitable distribution, prevention, and appropriate technology (WHO, 1978).

Malaria control should be or become identified as a community priority and can be contextualized within or linked to other development initiatives — immunization programs, water improvement schemes, maternal and child health, etc. Information dissemination that works within existing structures — primary education, for example — has been effective in translating biomedical understandings of malaria to local populations (Ekeh & Adeniyi, 1986). Programs that foster autonomous organization are especially likely to be acceptable (Mills, 1983). Precedent has already been established that voluntary collaborators, including community associations of various types, can assist malaria programs to diagnose, deliver drugs, assist in early recognition of epidemics, and mount community efforts for vector control (Gorup & van der Kaay, 1984; Morgan, 1983; Stevens, 1984). Increasingly, women are becoming recognized as resources for community health programs (Gender & Cantlay, 1983; Justice, 1986; McLain, 1989). Mothers have participated successfully in a malaria control program to administer chloroquine in a rural area of Gambia that had no existing home-based tradition of malaria therapy (Menon, Joof, Rowan, & Greenwood, 1988). Herbalists and other indigenous medical specialists are another obvious resource of inclusion in various aspects of malaria control program, especially in therapeutic modalities (Dunn & Jancs, 1986; Oppong, 1989; Green, 1988). So too are specialists who find parallels in other aspects of control programs, e.g., fishermen and irrigation farmers are understood to know more about aquatic environments, local builders can participate as well in construction of drainage systems, etc. Because the circumstances of such collaborations are politically and socially charged (Last, 1990; Last & Chavunduka, 1986; Green, 1988), knowledge about the roles and specialties peculiar to a society is necessary to design programs in a culturally appropriate manner (Nations, 1986; MacCormack, 1983). Identification and incorporation of key individuals should occur early in the planning stages with a view toward making them the principal actors in programs of continuing education regarding the rationale and expectations of malaria control programs (Jeffrey, 1984).

A first, or at least early, task in program design is to discern and incorporate local understandings of health and the broad outlines of relevant sociopolitical processes (Nations, 1986; Janzen & Prins, 1981). Participant observation can be employed successfully to that end, i.e., observing a community as people go about their customary activities, in order to understand the complex behavioral antecedents of illness and acceptable modes of prevention and therapeutics. This need *not* entail the substantial time commitment and embellishment of ethnographic detail that characterize much of anthropological field research. In fact the rudiments can be rather quickly discerned, and local sources (nationals) of various categories — students, health care workers, etc. — can provide much of the salient information. Links between biomedical and local categories will not be drawn by conspicuous parallels but will instead rely on abstraction and metaphor to translate between the local culture and biomedicine. Beyond the influence of local models of illness, interest and participation in malaria control programs are mediated as well by a social dynamic that

distinguishes salient demographic variables such as family composition, age, and gender. The views and input of key local residents should be paramount in assessing the feasibility of, and eventually implementing, a particular program that will be judged both by its constituent parts and overall.

For example, programs that hope to include residual spraying of insecticides must bring that objective into conformity with local sensitivities. Populations have objected to spraying because it is ritually polluting (e.g., among Moslems and Tamils); others regard the smell offensive and discoloration of sprayed surfaces unattractive (Ault, 1983; Gruenbaum, 1983; May, 1958). How can those attitudes be transformed? Efforts should be directed at illustrating the links between mosquitoes and malaria in a way that promotes development of individual and collective modes of self-protection for the future. Who in the community is best situated and suited to translate those particular intentions of the control program to the rest of the group?

Similarly, for implementation of drug programs, it is imperative that programs accommodate different perceptions of biomedicine in general and pharmaceuticals in particular (van der Geest & Whyte, 1988; Etkin, Ross, & Muazzanu, 1990). It should be clarified whether the proffered medicine is intended for prevention or therapy (MacCormack & Lwihula, 1983). Furthermore, drugs must be delivered in appropriate dose and combination and used in a way and for a duration consistent with their design (Menon, Joof, Rowan, & Greenwood, 1988). Outcome, in addition to symptom resolution, should be clarified as well. While some common adverse reactions to certain anti-malarial drugs have little effect on their acceptability and utilization (e.g., gastrointestinal distress, fatigue) or develop over such a long term that the cause and effect are not linked (e.g., ocular and oto-toxicity, dyskinesia), chloroquine-associated pruritus is important in its rejection, and has been determined in some studies to effect default rates of chloroquine use as high as 91 percent (Mnyika & Kihamia, 1991). Other reactions are apparently interpreted differently: e.g., vomiting may mark disease egress and headache, and fatigue may simply overlap malaria symptoms. Because chloroquine itching is not accompanied by urticaria (which also might signal disease egress), and for other nongeneralizable reasons, itching is an unacceptable "side effect." Especially because the antihistamine treatment proffered by biomedicine has little effect among Africans who experience a more severe itching reaction (Salako, 1984), chloroquine is rejected. These and other sequelae of pharmaceutical use must be viewed through local perspectives. How do local populations understand that in some instances the use of potentiating combinations of anti-malarials is the treatment of choice (e.g., pyrimethamine and sulfadoxine [Fansidar], or pyrimethamine and dapsone [Maloprim])? This combination may be interpreted as the standard mode of (biomedical) treatment, or people might consider that it should be reserved for especially severe or refractory symptoms, or something else. But this must be ascertained *in situ*, on a case by case basis.

Beyond the aspects of cultural suitability, there is much evidence that mass chemoprophylaxis programs failed largely because of the practical shortcomings of resource insufficiencies that prohibited a sustained program of regular and dose-supervised drug distribution (Laing, 1984). Past experience with malaria control further prejudices acceptability. Cats and other domestic animals have been poisoned by insecticides, and spraying has had the effect of increasing populations of other pests (cockroaches and bedbugs)

resistant to DDT (Beausoleil, 1984; Dhillon & Kar, 1963). Assurances need to be offered not only that program personnel respect the concerns of local populations and have made efforts to assure that the mistakes will not recur, but also that other contingencies have been considered and steps taken to avoid those as well. Further, previous experience with development efforts may be generalized to malaria control programs, with — from the perspective of program personnel — both positive and negative outcomes.

Other disincentives to community participation include uneven support of competing local and national politics, some of which reflect vested interests embedded in discontinuities and complex social asymmetries that western observers are unlikely to understand. Even the smallest village community may be subject to internal rivalries and exploitations through which aspects of malaria control programs become the resources deployed in political struggle (Heggenhougen, 1984; Heggenhougen & Shore, 1986; MacCormack, 1983). Still other obstacles are defined by gender, age, ethnic, and class discrepancies among such program personnel as drug dispensers, clinical examiners, and insecticide sprayers working inside of homes (Ault, 1983). Programs must be designed or redesigned to take these social issues into account.

Finally, all malaria control programs should have evaluatory procedures built in for ongoing assessment of efficacy and progress. Especially when community participation or other aspects of a program fail, it is imperative that the circumstances be analyzed immediately in order to characterize obstacles and modify program design accordingly. This last point underscores the need for flexibility not only in the initial design of a program but also in its continuation.

Conclusion

The conclusion is simply that there is no “quick fix,” no generic checklist or similar survey instrument that can be quickly dispensed with in order that the “real” work of malaria control begin. This reality has yet to be incorporated into policy. The international health community has made a commitment to understanding the behavioral dimension of malaria control. Without an explicitly formulated behavioral perspective that can be practically translated into policy, “community participation” and “bottom-up planning” will simply continue to be used as rhetoric of international health.

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Lutte Antipaludique au Togo

Dr. A. Gayibor
Médecin Chef, Service National du Paludisme
Lomé, Togo.

Introduction

Il n'est plus à démontrer que le paludisme constitue la première cause de consultation et d'hospitalisation dans les formations sanitaires au Togo (cf. figures 1 & 2). Cette maladie endémique, connue depuis la haute antiquité, sévit de façon permanente durant toute l'année, avec une augmentation des cas pendant les périodes de saisons pluvieuses durant lesquelles la transmission est forte.

Les pays du monde entier touchés par cette maladie, ne sont pas restés inactifs. Bien au contraire, ils ont mené et mènent encore une lutte acharnée contre ce fléau qui ne cesse de s'adapter, à son tour, aux nouvelles conditions de vie.

La difficulté essentielle liée aujourd'hui à la lutte antipaludique est l'émergence de la chimiorésistance du *P. falciparum* aux antipaludiques en général, et en particulier aux amino-4-quinoléines chloroquine et amodiaquine qui sont très connues de nos populations, mais mal utilisées par elles.

En effet, à la suite des tests de sensibilité *in vivo* réalisés au cours de 1988, l'émergence de la chimiorésistance du *P. falciparum* aux amino-4-quinoléines est devenue une réalité au Togo, qui donc désormais fait partie de la zone ouest-africaine de chloroquino-résistance.

Morbidité

On note ces dernières années une nette agmentation des cas, due probablement à:

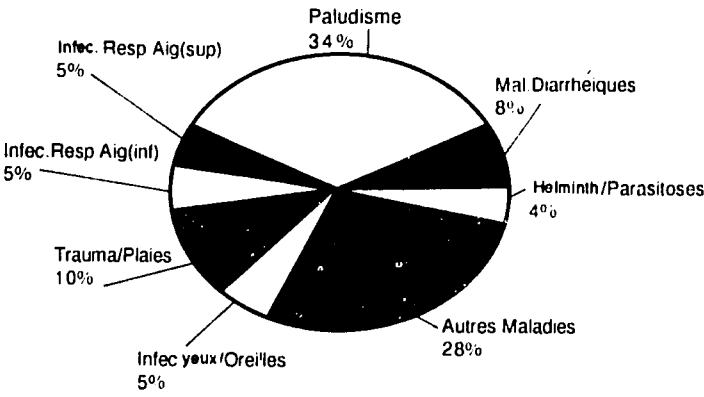
- l'abandon de la lutte antivectorielle sur le plan national
- l'abandon de la chimioprophylaxie de masse
- l'amélioration du système de recueil des données
- l'apparition de la chimiorésistance du *P. falciparum* aux antipaludiques (cfr.figure 3).

Mortalité

Grâce aux efforts du Service National des Statistiques Sanitaires, la mortalité due au paludisme est mieux connue dans les centres hospitaliers du Togo. Au CHU de Lomé, la létalité se situe entre 4 et 8% en 1989 (cfr. figure 4).

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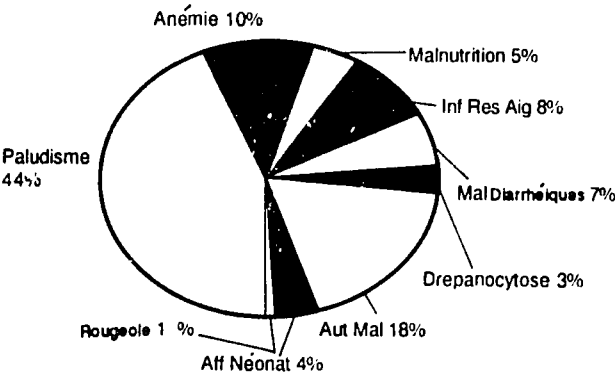
Figure 1 MALADES CONSULTANTS PAR MALADIE
Ensemble du Togo, 1989
Soins Externes



Source: SNSS

Total: 2.161.491

Figure 2 PRINCIPALES CAUSES D'HOSPITALISATION
Services de Pédiatrie
Ensemble du Togo, 1989



Objectifs

Objectifs Généraux:

- Renforcer la lutte antipaludique dans le cadre des soins de santé primaires;
- Réduire le nombre de cas sévères, les complications et la mortalité liés au paludisme, en particulier chez les enfants de 0-5 ans;
- Réduire la morbidité et la mortalité liées au paludisme chez la femme enceinte et les risques péri et néonataux;
- Renforcer la surveillance épidémiologique et celle de la chimiosensibilité du *P. falciparum* aux antipaludiques.

Objectifs Spécifiques:

- Traiter tous les cas fébriles à la dose correcte de chloroquine: 25mg en 3 jours;
- Améliorer la capacité de diagnostic parasitologique des centres d'orientation-recours;
- Prévenir le paludisme chez la femme enceinte par la prise régulière de chloroquine: 5mg/kg/semaine.
- Renforcer l'accessibilité au diagnostic et au traitement appropriés à la population;
- Continuer la surveillance de la chimiosensibilité du *P. falciparum* aux antipaludiques par les tests *in vivo* et *in vitro*.

Les Activités

Traitement des Cas Fébriles

Le Séminaire Atelier National tenu à Kpalimé en mars 1988 a défini les grandes lignes de la politique nationale et à adopté un arbre de décision dans le traitement des cas fébriles (cf. annexes I & II).

Les nouvelles molécules inscrites sur la liste des médicaments essentiels, halofantrine et la triple association sulfadoxine pyriméthamine méfloquine, sont réservées uniquement au traitement des cas résistants. La chloroquine reste le médicament de première intention dans le traitement des accès palustres simples. La voie orale est recommandée dans tous les cas où le malade peut avaler.

Prévention du Paludisme

La prévention du paludisme est devenue plus complexe aujourd'hui avec l'émergence de la chimiorésistance du *P. falciparum* aux antipaludiques. Néanmoins, la lutte antivectorielle et l'assainissement de l'environnement restent le seul espoir car la chimioprophylaxie de

CAS DE PALUDISME RAPPORTES PAR AN SOINS EXTERNES, Togo, 1980-89

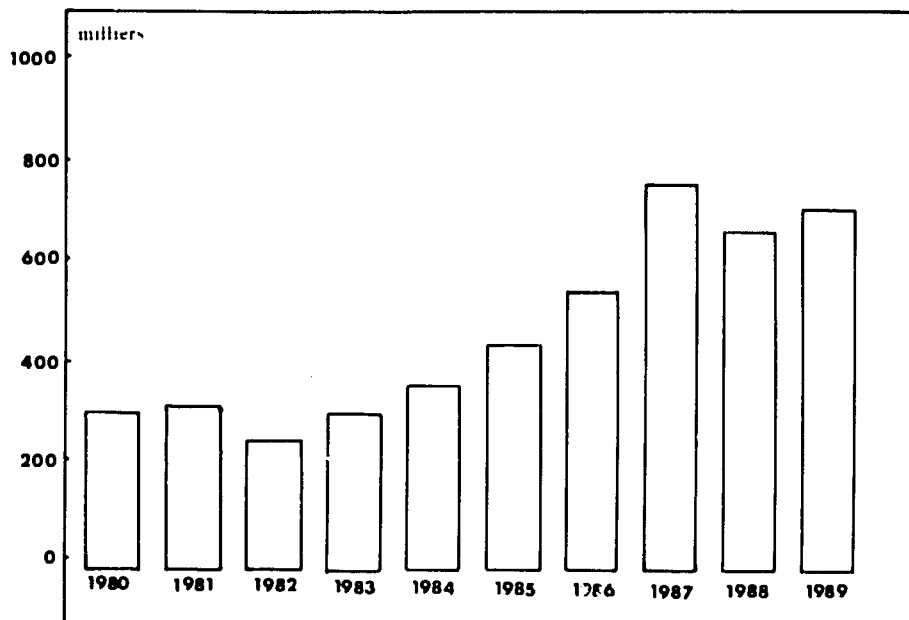
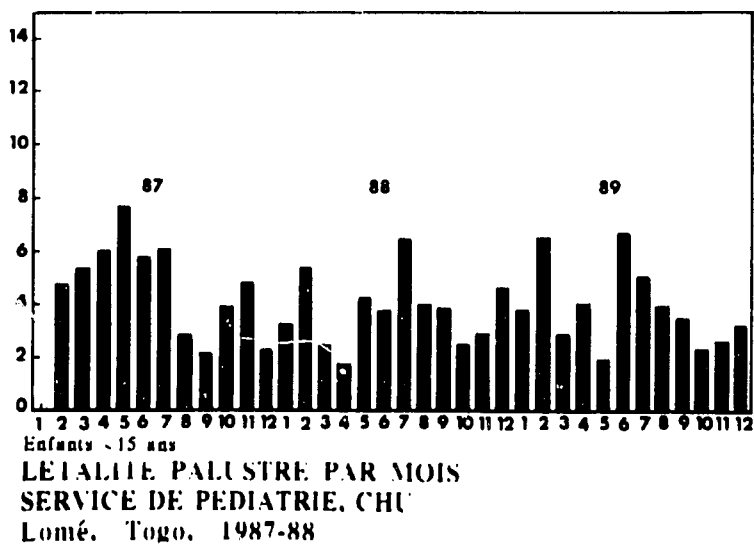


Figure 3 Source : Statistiques Sanitaires

Figure 4



masse, tant prônée à l'époque par l'Organisation Mondiale de la Santé, n'est plus recommandée aujourd'hui que pour le groupe des femmes enceintes, et celles allaitantes jusqu'à deux mois après l'accouchement. La chloroquine est recommandée à la dose de 5mg/kg/semaine.

Education pour la Santé

Après les tests de 1988 dans 4 régions du Togo, l'information du personnel de santé au sujet des résultats de ces travaux est l'une de nos préoccupations actuelles. C'est pourquoi plusieurs réunions et conférences ont été organisées aussi bien à Lomé qu'à l'intérieur du pays pour informer le personnel de Santé et lui faire les recommandations suivantes:

- utilisation rationnelle des antipaludéens
 - le choix de l'antipaludéen suivant le cas à traiter
 - la dose
 - le rythme d'administration
 - la durée du traitement
- information de la population sur:
 - le rôle du moustique dans la transmission du paludisme
 - la dose correcte de Chloroquine à utiliser
 - l'élimination des gîtes larvaires
 - les méthodes de protection individuelle.

A cet effet, des affiches ont été élaborées et envoyées dans toutes les formations sanitaires, de même qu'une brochure de sensibilisation Mieux Etre - "Comment vaincre le Paludisme"?

Surveillance de la Chimiosensibilité du *P. falciparum* aux Antipaludiques

La surveillance la plus simple à faire au niveau de la périphérie est l'observation des malades: les cas de fièvre, traités à la chloroquine qui persistent, sont à signaler dans le rapport mensuel, ainsi que le nombre de cas de fièvre parmi les femmes enceintes sous chimioprophylaxie régulière.

Au niveau du chef-lieu de la subdivision le médecin suit la parasitémie de certains malades J0, J2, J7.

L'équipe nationale se charge des Tests de Sensibilité en bonne et due forme. C'est ainsi qu'au début d'octobre, l'équipe nationale s'est rendue à Sokodé.

La Recherche Opérationnelle

Plusieurs sujets de recherche sont envisagés à long terme.

Au cours de 1990, l'Equipe du Service National du Paludisme a réalisé une enquête dans les pharmacies de Lomé pour étudier le comportement du pharmacien vis-à-vis du malade qui se présente sans ordonnance.

Une autre enquête est également en cours. Elle porte sur l'étude des possibilités de mise en pratique des moustiquaires imprégnées par la communauté.

Les statistiques de 1989 ont montré l'augmentation des cas de paludisme et d'anémie ainsi que les cas de décès dus au paludisme et à l'anémie (cf. figures 5 & 6). Il serait fort intéressant de rechercher dans les années à venir les relations existantes entre le paludisme et l'anémie.

Conclusion

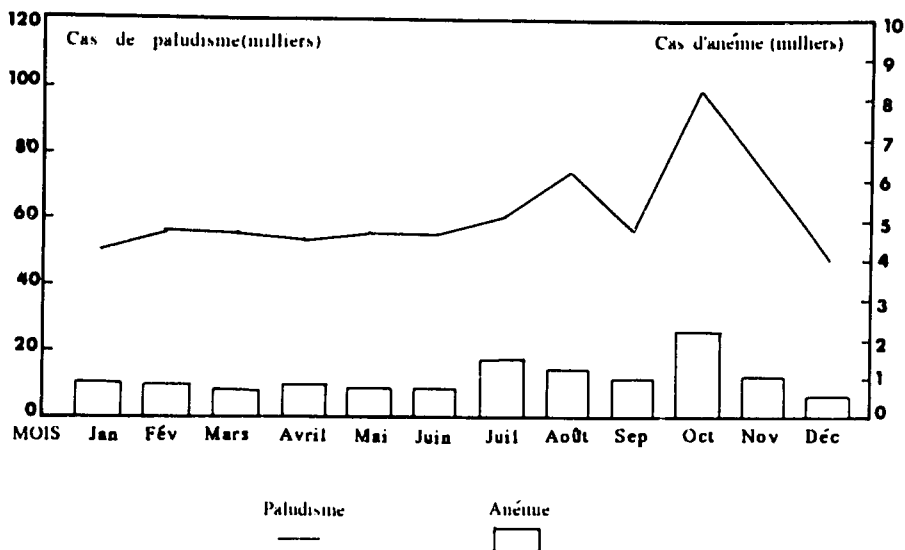
En attendant l'inscription du paludisme sur la liste des maladies cibles du PEV, nos efforts doivent être concentrés essentiellement sur l'utilisation rationnelle des antipaludiques à tous les niveaux.

Notre point faible reste encore la surveillance passive de la chimiosensibilité du *P. falciparum* aux antipaludiques. Un accent particulier devra être mis sur ce volet dans toutes les formations sanitaires au cours des années à venir.

Il serait également souhaitable, compte tenu du nouveau contexte de l'évolution de la lutte antipaludique, d'explorer à présent les domaines jusque là laissés pour compte, il s'agit de la lutte antivectorielle, qui malheureusement nécessite des ressources financières importantes.

CAS DE PALUDISME ET D'ANEMIE RAPPORTES PAR MOIS, SOINS EXTERNES, Togo, 1989

Figure 5



DECES DUS AU PALUDISME ET A L'ANEMIE SERVICE DE PEDIATRIE, CHU Lomé, Togo, 1984-89

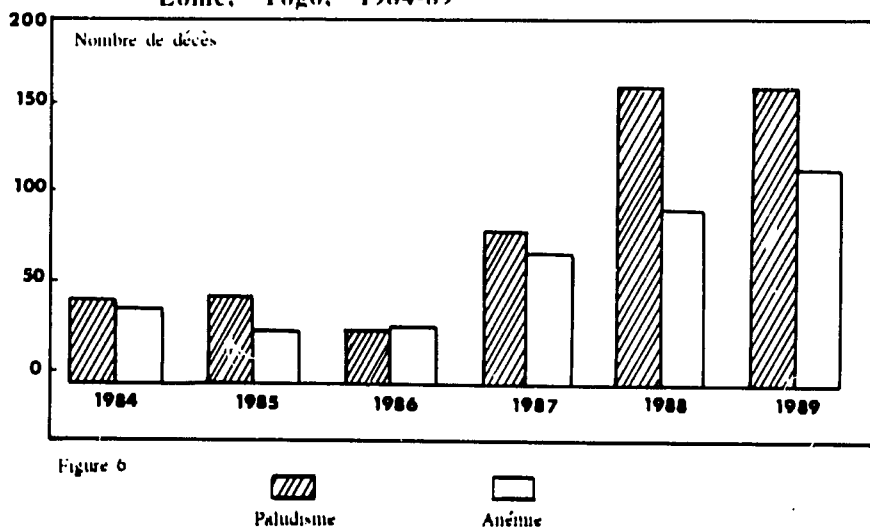
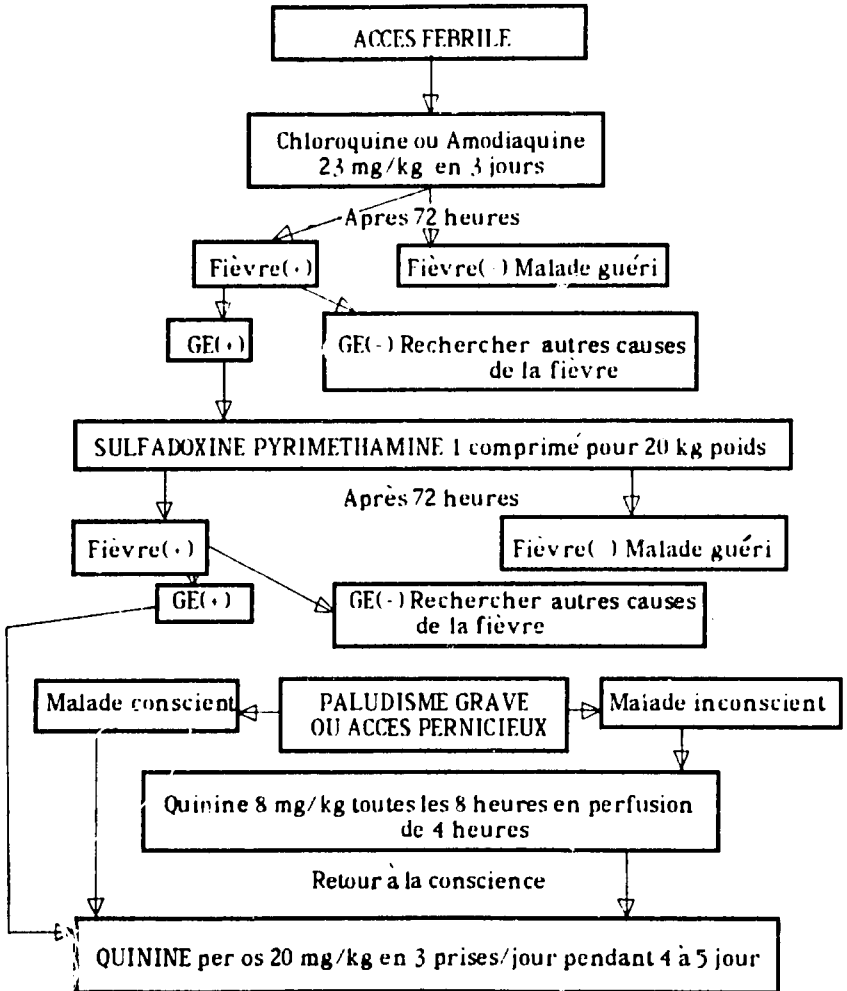


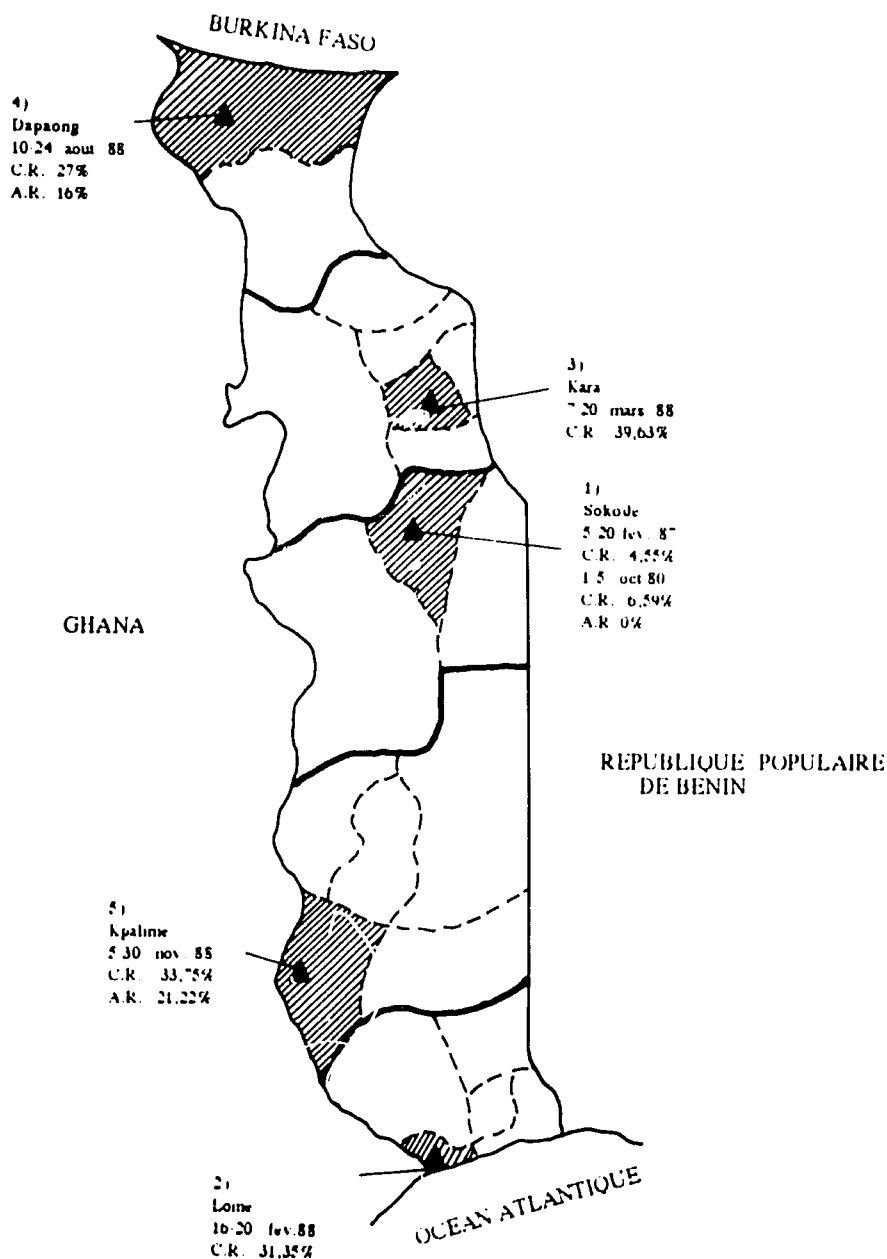
Figure 6

ANNEXE 1

TRAITEMENT DU PALUDISME
(ARBRE DE DECISION)

Annexe II

CARTE DE LA CHIMIO RESISTANCE IN VIVO DU P. FALCIPARUM AUX ANTIPALUDIQUES TOGO



LEGENDE

PROJECT: DR. GAYIBOR

— C.R. - CHLOROQUINO RESISTANCE
 - - A.R. - ANIDOLACINO RESISTANCE

Notes Synthétiques sur l'Évolution du Paludisme au Togo

K.D. Gbetoglo
Economiste-Démographe
Unité de Recherche Démographique, Université du Bénin
Lomé, Togo.

Résumé

Le paludisme est une maladie parasitaire qui pose des problèmes de santé publique dans les pays en voie de développement. Il est, de loin, considéré comme la maladie qui entraîne dans le monde entier la plus grande morbidité et la plus grande mortalité annuelle. L'Organisation Mondiale de la Santé (O.M.S) estime que plus de 250 millions de personnes sont atteints annuellement et plus de 100 millions de personnes sont touchées par la forme aiguë de la maladie (KASEJE, 1989).

En Afrique au Sud du Sahara, environ 88% de la population vit dans des régions impaludées, et environ 26% dans des zones où le paludisme est endémique (Ewbank, 1988); le tribut humain payé chaque année pour la maladie est très lourd; plus d'un million d'enfants en meurent.

Des études menées dans plusieurs pays et les statistiques sanitaires ont montré que la mortalité et la morbidité résultant du paludisme en font un des plus graves problèmes de santé du continent africain.

Au Togo, les données disponibles dans les Statistiques Sanitaires placent le paludisme en tête des principales causes de consultation. Cette maladie constitue ainsi un problème indéniable de santé pour le pays. Au cours de ces dernières années, au moins un consultant sur trois (34%) est parti dans un centre de soin pour cause de paludisme. La situation des enfants est encore plus préoccupante. D'après les Statistiques Sanitaires, parmi les malades de moins de 15 ans se présentant dans les formations sanitaires, les 3/5 sont atteints de paludisme.

L'Enquête Démographique et de Santé au Togo (EDST) organisée en 1988 a essayé d'approcher la prévalence du paludisme dans la population des enfants de moins de 5 ans en collectant des informations sur la fièvre. Ces informations, bien que surestimant l'impact véritable du paludisme, ont montré que les 2/5 de ces enfants ont souffert de fièvre pendant les deux dernières semaines précédant le passage de l'enquêtrice.

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L'Evolution du Paludisme au Togo

Situation Générale

Par manque d'état civil fiable, il existe peu de données sur les taux de mortalité spécifique au Togo. Mais en ce qui concerne les enfants, les données disponibles dans les statistiques sanitaires, dans les travaux de recherche d'organismes travaillant dans le domaine de la santé entre autres, placent le paludisme, les maladies diarrhéiques, les infections respiratoires aiguës et la rougeole en tête des causes de décès.

La lutte contre le paludisme vient en tête des activités de soins de santé maternelle et infantile (SMI) et de soins de santé primaire (SSP) intégrées.

Un des problèmes que pose la connaissance exacte de l'ampleur de la maladie est lié au fait qu'elle ne peut être véritablement dépistée que dans un milieu hospitalier doté de matériels et d'appareils permettant certains examens spéciaux (Goutte épaisse, Flottis de sang, etc.); or, les centres de soins ne couvrent pas tout le territoire et la majorité de ceux qui existent ne disposent pas de moyens nécessaires pour réaliser ces examens de dépistage. Il est donc important de rappeler le caractère "trompeur" des statistiques officielles ou plus précisément leur sous-estimation lorsqu'elles sont basées sur des documents hospitaliers de centres de soins.

Néanmoins, les cas observés à partir de la population consultante méritent une grande attention. Comme on peut le voir dans le tableau 1, selon les statistiques sanitaires, depuis plus d'un quart de siècle, le paludisme demeure la principale cause de consultation; son importance dans la masse des consultations la place en tête de toutes les maladies. La proportion des consultants pour cause de paludisme varie de 17,50 % en 1965 à plus d'un tiers (34%) en 1989.

Tout en reconnaissant qu'il s'agit des statistiques de malades consultants, on observe bien que le paludisme constitue un problème indéniable de santé au Togo. Il se taille souvent la part du lion de la pathologie due au groupe des maladies infectieuses et parasitaires (de 1987 à 1989, le paludisme a constitué respectivement 67,1%, 66,7% et 70,7% de ce groupe). De 1965 à 1983, l'effectif des consultants n'a pas beaucoup évolué (17,5% à 20,6%), comparativement à l'évolution de la population nationale. En 1987, on observe un doublement de l'effectif des consultants de 1983. Cette situation est-elle due aux données statistiques (fiabilité des collectes), à un phénomène naturel ou une crise, ou à une prise de conscience de la population des problèmes de santé, etc.? Les informations actuellement en notre possession ne nous permettent que de faire des tentatives de réponses.

Alors que plusieurs cas de maladie n'ont certainement pas été présentés dans un centre de soins, au cours des années 1987 à 1989, au moins un consultant sur trois entre dans un centre de soins pour cause de paludisme (tableau1). Si le triplement du nombre de consultants entre 1965 et 1989 peut être perçu comme un regain probable de la prévalence de cette maladie dans le pays, il est probable qu'il représente aussi le signe d'une évolution de la mentalité vis-à-vis de la santé au sein de la population. Cette évolution que nous pouvons attribuer en

Tableau 1: Fréquences absolues et relatives des malades consultants dans tous les centres de soins pour le paludisme, de 1965 à 1989 au Togo

Années	Effectif Consultant Paludisme	Pourcentage par rapport à l'ensemble
1965	231.455	17,5
1967	222.555	14,2
1968	256.865	13,9
1969	247.862	14,1
1970	260.925	13,4
1971	240.015	13,5
1972	244.274	13,3
1973	247.825	14,2
1974	236.881	14,1
1977	292.191	28,0
1978	342.886	17,1
1979	315.553	19,5
1980	321.339	18,4
1983	318.707	20,6
1987	778.724	34,8
1988	673.474	34,7
1989	730.168	33,9

partie à un changement de comportement, se situe d'une part dans la perception de la maladie en général et du paludisme en particulier, et, d'autre part dans la confiance que les populations ont acquis avec le temps dans les services de soins modernes. Le "rapprochement" des centres de soins des populations et l'extension de la scolarisation dans le pays y ont probablement contribué de façon considérable.

Si la véritable raison de cette évolution reste sans doute difficile à élucider du fait de la qualité des données, on peut cependant retenir que cette évolution a pu être, en dépit de l'imperfection des données, provoquée par plusieurs causes, entre autres, les effets conjugués de la croissance démographique, de l'augmentation de la propension de la population à consulter pour des maladies, des différentes sensibilisations concernant les prises des produits antipaludéens, et peut-être aussi de l'accroissement de la prévalence de la pathologie.

Situation des Enfants de Moins de 5 Ans et de Moins de 15 Ans

Les enfants de moins de 5 ans appartenant à une classe d'âge particulièrement vulnérable à de multiples risques, la situation sanitaire de cette tranche d'âge est et demeure un problème préoccupant pour tous les pays. D'ailleurs le taux de mortalité infantile (TMI) et le taux de mortalité des enfants de moins de 5 ans (qui demeurent toujours très élevés dans les pays africains) constituent des indicateurs utilisés pour appréhender l'état de santé d'une population.

Au Togo le nombre d'enfants de moins de 5 ans consultant pour le paludisme est relativement important comme le montre le tableau 2. D'après les statistiques sanitaires, environ un tiers de la population consultante se situe dans cette tranche d'âge, et on n'observe pas une grande différence selon le sexe. En considérant les moins de 15 ans, on dénombre les 3/5 de la population les deux sexes réunis.

Tableau 2 : Fréquences annuelles relatives des malades de moins de 5 ans et de moins de 15 ans consultant pour le paludisme

Années	POURCENTAGES						Effectif malades consultant pour palu- disme
	Moins de 5 ans			Moins de 15 ans			
	Masc	Fém	Ens	Masc	Fém	Ens	
1965	32,7	38,7	35,5	57,7	62,6	60,0	231.455
1967	40,3	39,4	39,8	65,4	61,9	63,7	222.555
1968	37,3	36,0	36,7	61,2	60,3	62,3	256.865
1969	36,5	35,1	35,8	63,1	59,9	61,5	247.862
1970	36,3	34,0	35,2	64,3	59,0	61,6	260.925
1971	37,8	36,2	37,0	66,4	61,7	64,1	240.015
1972	37,1	35,2	36,2	64,2	61,7	63,1	244.274
1973	33,5	30,6	32,0	64,1	61,1	62,6	247.825
1974	31,0	30,6	30,8	61,6	59,6	60,6	236.881
1977	29,1	27,8	28,4	57,6	55,7	56,7	291.191
1978	29,7	27,1	28,9	57,5	54,0	55,8	342.886
1979	28,7	27,4	28,1	56,2	52,9	54,6	315.553
1980	29,4	28,6	29,0	55,2	53,7	54,4	321.339
1983	28,1	26,5	27,3	53,2	50,8	52,0	318.707
1987	29,8	29,8	29,8	53,1	52,3	52,7	778.724
1988	30,9	29,8	30,3	54,3	52,2	53,3	673.474
1989	31,2	30,6	30,9	53,4	51,9	52,7	730.168

Le Programme de Lutte contre le Paludisme au Togo

Comme signalé ci-dessus, la lutte contre le paludisme a préoccupé très tôt les autorités togolaises mais les multiples problèmes que pose la maladie et les difficultés socio-économiques de la population ne permettent pas d'apprécier la valeur réelle des efforts fournis. Le programme ci-dessous décrit a été évalué en décembre 1989 en vue de prendre les mesures nécessaires pour accélérer son exécution.

Après l'échec du programme d'éradication du paludisme par le traitement des épisodes fébriles, la chimioprophylaxie de masse, et la pulvérisation intradomiciliaire d'insecticides, de nouvelles stratégies ont été adoptées en vue du contrôle de la maladie par la réduction de la morbidité et de la mortalité.

A partir de 1983 la stratégie a consisté en une chimiothérapie des cas fébriles par la chloroquine à raison de 10 mg/kg en prise unique et en une chimioprophylaxie pour les femmes enceintes et allaitantes, à raison de 5 mg/kg par semaine en prise unique pendant toute la durée de la grossesse et jusqu'à deux mois après l'accouchement.

En 1988, suite à la constatation d'une baisse de la sensibilité du *Plasmodium falciparum* à la chloroquine et vu l'extension du problème de la chimiorésistance dans les pays voisins, les responsables sanitaires ont décidé de réaliser des activités de surveillance active de la chimiosensibilité pour 4 régions au moins par les tests de sensibilité *in vivo* du *P. falciparum* aux antipaludéens.

Dès les premiers résultats des tests de sensibilité qui ont montré l'émergence de la résistance, une note circulaire a été adressée à tous les médecins chefs du pays pour maintenir la chloroquine comme antipaludéen de premier choix et porter la dose unique de 10mg/kg à 25mg/kg répartis en trois jours. Le Fansidar est le médicament de second choix et en cas d'accès graves, il est recommandé d'utiliser les sels de quinine.

A l'heure actuelle, les perspectives du programme sont les suivantes :

- sensibilisation et information du personnel de sante sur l'utilisation rationnelle des antipaludéens existants
- sensibilisation de la population sur le respect des doses d'antipaludéens à utiliser
- promotion des mesures de protection individuelle
- recherche opérationnelle concernant surtout la surveillance épidémiologique de la chimiosensibilité du *P. falciparum* aux antipaludéens.

Prévalence de la Fièvre à Travers l'Enquête Démographique et de Santé au Togo.

L'Enquête Démographique et de Santé au Togo (EDST) organisée en 1988 sur l'ensemble du territoire togolais s'est préoccupée, à côté des variables démographiques, de collecter certaines données sur la santé. Elle a rassemblé des informations sur la prévalence de certaines maladies des enfants comme la diarrhée, les maladies respiratoires, la rougeole, la fièvre et la malnutrition. Il faut noter qu'à part la rougeole et la malnutrition, il s'agit plus de cas de symptômes que de pathologies effectives. Par ailleurs, le fait que les données aient été collectées par des non-spécialistes en santé a contribué probablement à réduire la précision des informations en même temps qu'il a donné une idée plus "commune" de ces "maladies" au sein de la population.

Les indicateurs obtenus à partir des informations tirées de ces symptômes ont un caractère plus informatif que prospectif. Mais ils présentent l'avantage de produire des informations sur un domaine qui a, jusqu'à présent, été la "chasse gardée" des professionnels de la santé. Cette ouverture oblige les différents spécialistes à une collaboration dans le sens d'une vision plus globalisante des problèmes de santé.

C'est l'une des rares fois qu'une enquête par sondage à portée nationale a interrogé les femmes sur la prévalence de ces maladies, sur différents comportements liés à la santé de la mère et de l'enfant.

En collectant des informations sur la fièvre, l'EDST avait pour objectif d'approcher la prévalence du paludisme dans la population des enfants de moins de cinq ans. Toutefois, il faut reconnaître que les informations sur la fièvre peuvent surestimer l'impact véritable du paludisme sur la santé des enfants dans la mesure où la fièvre est un syndrome lié à d'autres maladies que le seul paludisme.

Il ressort des résultats de cette enquête (selon les déclarations des femmes interviewées) que, parmi les enfants de moins de cinq ans, plus des 2/5 (43,2 %) ont souffert de fièvre pendant les deux dernières semaines précédant le passage de l'enquêtrice (EDST, 1989).

"Il ne se dégage pas de différence importante dans la prévalence de la fièvre selon le sexe des enfants. En effet, la proportion d'enfants ayant eu une fièvre est de 42,8% chez les filles contre 43,6% chez les garçons. Il existe par contre un écart non négligeable entre le milieu urbain et le milieu rural. La prévalence de la fièvre est relativement plus élevée en milieu rural (44,9 %) qu'en ville (38,6 %). Si l'on suppose que le paludisme est à la base de la majorité des cas de fièvre, on peut dire que la prévention en vigueur contre cette maladie en milieu urbain pourrait expliquer cette différence entre les villes et le milieu rural. De plus, comme on peut le voir dans le tableau 3, les femmes de niveau scolaire secondaire ont moins d'enfants atteints de fièvre au cours de la période. Comme en général les femmes les plus instruites se trouvent également en milieu urbain, le niveau relativement faible de la prévalence de la fièvre dans ce milieu peut être surtout dû au niveau scolaire plus élevé des femmes et tous ses corollaires.

Tableau 3: POURCENTAGE DES ENFANTS DE MOINS DE 5 ANS QUI ONT EU DE LA FIEVRE DANS LES 2 DERNIERES SEMAINES ET QUI ONT RECU DIFFERENTS TRAITEMENTS SELON CERTAINES CARACTERISTIQUES SOCIO-DEMOGRAPHIQUES, EDST, 1988

Caractéristiques socio-démographiques	Enfant avec fièvre	Formation médicale	Niva-quine	Aspirine	Autre comprimée	Injection	Plantes médicinales	Gélule du marché	Autre	Rien	Enfant moins de 5
AGE											
Moins de 6 mois	43,0	30,8	64,2	43,3	18,3	5,0	11,7	3,3	10,0	7,5	279
6-11 mois	57,1	33,5	52,6	36,4	21,4	9,2	15,0	5,8	12,1	6,4	303
12-17 mois	49,7	28,7	67,3	54,7	20,0	9,3	16,0	4,0	10,0	3,3	302
18-23 mois	52,6	35,5	61,0	49,6	19,9	21,3	19,1	5,7	7,1	5,0	268
24-59 mois	37,9	29,4	52,5	41,7	25,5	11,1	19,4	5,4	10,3	7,2	1616
SEXE											
Masculin	43,6	30,7	56,9	44,4	21,8	11,6	18,2	4,8	9,2	5,1	1398
Féminin	42,8	30,9	56,1	42,8	23,9	10,8	16,9	5,5	11,1	7,7	1370
MILIEU											
Urbain	38,6	41,8	56,0	51,8	30,5	19,5	12,4	2,5	17,4	3,9	731
Rural	44,9	27,4	56,7	41,1	20,5	8,6	19,1	5,9	7,9	7,1	2037
REGION											
Maritime	39,2	29,5	49,6	38,7	31,0	14,0	18,6	4,4	11,4	4,8	1054
Des Plateaux	45,5	22,1	64,2	47,0	17,5	7,0	21,1	4,9	13,0	3,5	627
Centrale	47,0	34,5	59,5	50,7	11,5	12,2	8,1	11,5	4,7	11,5	315
De la Kara	48,1	44,3	69,3	56,3	12,5	15,3	17,0	3,4	8,0	6,8	366
Des Savanes	42,9	31,0	44,8	31,0	32,2	6,3	17,8	3,4	9,2	9,8	406
INSTRUCTION											
Aucune instruction	43,4	26,7	55,1	37,9	22,4	7,9	19,1	6,1	8,5	8,4	1842
Primaire	45,1	36,6	59,9	55,7	21,7	16,6	15,9	3,8	10,2	2,9	697
Secondaire et plus	35,8	47,6	57,3	53,7	31,7	23,2	8,5	0,0	25,6	0,0	229
TOTAL	43,2	30,8	56,5	43,6	22,8	11,2	17,6	5,1	10,1	6,4	2768

Note : Le total des pourcentages des types de traitement et des enfants non traités est supérieur à 100 pour cent en raison des réponses multiples.

Source : EDST, 1988, p.82

La tranche d'âge allant de 6 à 23 mois semble particulièrement plus touchée par la fièvre. Ici aussi, on pourrait mettre cette "sur-intensité" relative de la fièvre sur le compte de la vulnérabilité qui caractérise les enfants à la sortie de la période d'immunisation acquise de la mère. Par rapport à la scolarisation de la femme, seuls les enfants issus de mères ayant au moins un niveau de l'enseignement secondaire présentent une prévalence plus faible que dans les autres groupes" (EDST, 1989).

Les traitements contre la fièvre des enfants sont multiples comme l'indique le tableau ci-dessous. Un enfant sur trois a été présenté dans une formation médicale (30,8 %), et à plus de la moitié des enfants (56,5 %), on a administré de la nivaquine. Par ailleurs, à plus de deux enfants sur cinq (43,6 %), on a donné de l'aspirine et à près d'un enfant sur cinq (17,7 %), on a donné un traitement à base de plante médicinale. Enfin, à 5,1% des enfants, on a administré les "gélules" du marché; il s'agit de produits pharmaceutiques vendus au marché et qui sont utilisés en automédication pour traiter toute maladie. Il est évident que les mères togolaises prennent au sérieux la fièvre de leurs enfants puisque 3,6% des enfants seulement n'ont rien reçu comme traitement. Cependant, le problème de l'automédication constitue un point crucial dans le traitement efficace d'une maladie comme le paludisme et mérite une attention particulière.

Il y a des différences dans les types de soins selon les variables socio-démographiques. Plus les femmes sont instruites, plus elles recourent aux traitements modernes (en particulier les formations sanitaires) et efficaces. Par milieu de résidence, les femmes urbaines et celles des régions de la Kara, Centrale et des Savanes sont les plus nombreuses à avoir utilisé les services de santé (EDST, 1989).

Paludisme et Activités Socio-économiques

En termes démographiques, la population togolaise, à l'instar de la majorité des pays africains, est très jeune avec près de la moitié en dessous de 15 ans. Les femmes et les enfants de moins de 5 ans représentent respectivement 51% et 20% de la population estimée à près de 3.500.000 habitants en 1990. L'Homme constituant le point de départ et le point d'aboutissement de tout processus de développement, il importe que celui-ci jouisse de toutes ses capacités productives (physiques, intellectuelles ou morales), capacités conditionnées par l'acquisition et le maintien d'une bonne santé. La santé doit donc intégrer toutes les actions et toutes les ressources permettant de la maintenir, de la restaurer et de la promouvoir en vue d'offrir à chaque individu, la possibilité de mener une vie socialement et économiquement productive.

Bien qu'il soit relativement difficile d'évaluer les répercussions du paludisme sur la production économique, à travers l'état de santé de la population, de traduire en chiffres le bilan des campagnes anti-palustres, on peut noter que le paludisme empêche les adultes de travailler, entraîne de nombreuses absences à l'école et sur les lieux d'apprentissage; il est source de dépenses quelquefois lourdes pour les budgets familiaux. Des campagnes bien menées et couronnées de succès peuvent contribuer à procurer divers avantages relevant des domaines économiques et sociaux, en l'occurrence:

- la réduction du taux d'inactivité des parents due au temps passé à se soigner et/ou à soigner leurs enfants malades
- une réduction du taux d'absence dans les écoles et dans les centres de formation et d'apprentissage
- une réduction du niveau de la mortalité infanto-juvénile et de la mortalité générale
- une réduction des pertes financières et des manques à gagner occasionnés par ces inactivités, ces absences et les dépenses (médicaments, décès, etc.)

Si l'on considère le poids de la population féminine et le rôle de cette dernière dans le ménage et la production économique du pays, il y a lieu de mener une lutte serrée à tout ce qui peut entraver la santé de la famille en général et celle des femmes et des enfants en particulier. Le paludisme tue de nombreux enfants et empêche la croissance de beaucoup d'autres. Il ruine dangereusement la santé de la femme enceinte et menace surtout la vie de l'enfant qu'elle porte. Les médecins reconnaissent qu'un grand nombre d'avortements, d'accouchements prématurés, d'enfants morts-nés ou de faible poids peuvent être causés par le paludisme. Ce dernier entraîne souvent des anémies, particulièrement graves pour les femmes enceintes et les enfants. En outre, au Togo, la priorité des priorités en matière de santé, reste la santé maternelle et infantile par les soins de santé primaires.

Des programmes sont donc élaborés pour traiter les populations à risque que constituent les femmes et les enfants. Dans son programme quinquennal 1990-1994, l'UNICEF prévoit la poursuite des actions privilégiées dans le domaine des soins materno-infantiles: environ 50% des femmes enceintes recevront 300 milligrammes de chloroquine par semaine pendant toute leur grossesse et chez les enfants de moins de 5 ans, une bonne partie des accès paludéens seront traités.

Par ailleurs, en considérant que la santé doit être pensée en terme de mouvement social et qu'elle nécessite la contribution de chacun, la population est sensibilisée et éduquée à divers niveaux (écoles, centres de soins de santé, groupements et associations,...) par divers moyens (mass média, brochures, affiches, etc.) sur les moyens de prévention et de lutte contre le paludisme.

En Guise de Conclusion

Si le paludisme constitue encore un des grands fléaux sévissant dans les pays africains et que l'espoir d'un vaccin demeure toujours la solution miracle, mais que les spécialistes n'ont pas encore découvert, il importe que prioritairement, les actions de sensibilisation et d'éducation sur la prévention de la maladie soient plus intensifiées pour éviter des décès "bêtes". Un des problèmes est celui d'une population à majorité rurale et analphabète. Les mesures de prévention ne sont pas très bien respectées et les méthodes curatives et leur suivi paraissent difficiles d'application pour la population, en plus du jeu multifacettes de résistance que mène l'agent vecteur face aux différents produits de lutte. Cette situation est accentuée par le fait que l'identification même de la maladie constitue un problème au niveau de la

population; s'il est vrai que la fièvre est un symptôme du paludisme, toute fièvre est-elle un début de paludisme? Comment guérir efficacement la maladie pose de nouveau le problème de la médication et de structures de soins adéquates.

Il n'est pas inutile de rappeler que pour certaines maladies telles le paludisme, compte tenu du niveau social, des niveaux de vie et de scolarisation de nos populations, la médecine préventive doit largement l'emporter sur la médecine curative afin de sortir les pays africains du sous-développement sanitaire.

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Domaines d'Activités dans la Lutte contre le Paludisme

Dr. R.T. Guiguemde

Professeur de Parasitologie à l'Université de Ouagadougou, Chef de la Section
Parasitologie du Centre MURAZ/OCCGE, Organisation de Coordination et de
Coopération pour la Lutte contre les Grandes Endémies
Bobo-Dioulasso, Burkina Faso.

Introduction

Les domaines d'activités dans la lutte contre le paludisme s'intègrent dans le cadre des missions spécifiques de l'Organisation de Coordination et de Coopération pour la lutte contre les Grandes Endémies (OCCGE) et du Centre MURAZ, à savoir: la recherche, la formation et l'expertise, au profit des états-membres de l'organisation (le Bénin, le Burkina Faso, la Côte-d'Ivoire, le Mali, la Mauritanie, le Niger, le Sénégal et le Togo). Depuis sa création en 1939, le Centre MURAZ a toujours mené des activités dans le domaine des trois missions citées ci-dessus; telles sont aussi les activités dans la lutte contre le paludisme que nous menons dans ce même centre depuis 1981.

Activités de Recherche

Les publications et les travaux relatifs à ces activités de recherche sont répertoriés en annexe.

Etudes Epidémiologiques

- Etudes parasitologiques: incidence et prévalence parasitaire, variation de la densité parasitaire chez les porteurs asymptomatiques;
- Etudes sur la morbidité palustre: détermination d'un seuil de densité parasitaire pyrétogène, définition de critères de diagnostic de l'accès palustre.

Recherche sur les Stratégies de Lutte contre le Paludisme

- Etude comparative de la chimioprophylaxie et de la chimiothérapie systématique des accès fébriles: cette étude a montré les inconvénients et les difficultés de mise en œuvre de la chimioprophylaxie; la chimiothérapie des accès fébriles est au contraire une stratégie plus adaptée au contexte socio-économique de nos pays;
- Expérimentation d'un vaccin contre le paludisme: le vaccin antisporezoïte (NANP) 3-TT a été essayé chez des enfants de 3-5 mois dans la région de Bobo-Dioulasso. Il

est doué d'un pouvoir immunogène mais il doit être amélioré afin qu'il puisse conférer une protection efficace;

- Etudes des connaissances, attitudes et pratiques des populations et des agents de santé sur le paludisme et son traitement. Au niveau des communautés les perceptions du paludisme sont très diversifiées. Chez les agents de santé le diagnostic de la maladie est généralement porté sur des présomptions cliniques et les schémas thérapeutiques appliqués sont inadéquats.

Etudes sur la Chimiorésistance du Paludisme

- Réalisation de plusieurs enquêtes par des tests *in vivo* et des tests *in vitro* dans la région de Bobo-Dioulasso et dans la région de Ouagadougou pour la surveillance de la chimiosensibilité de *P. falciparum*;
- Transfert de la technologie des tests d'étude de la chimiorésistance aux équipes nationales des états de l'OCCGE;
- Mise en place d'un Centre de Référence de la Chimiorésistance du Paludisme pour la coordination des activités de surveillance de la résistance dans les états.

Activités de Formation en Paludologie

Un des freins dans la lutte antipaludique est l'absence de paludologues au niveau des pays. Pour combler cette lacune, le Centre MURAZ organise en collaboration avec la coopération française et l'Organisation Mondiale pour la Santé, un cours international de paludologie destiné à des médecins ou autres cadres supérieurs de la santé, futurs responsables nationaux pour la mise en place de plans nationaux de lutte. Ce cours qui se déroule depuis 1984 a une durée de 3 mois et a vu sa cinquième édition en 1990. Au total 66 paludologues ont déjà été formés. Nous sommes le coordonnateur de ce cours.

Nos Réflexions sur la Paludologie et sur la Lutte Antipaludique

Problèmes Rencontrés dans la Lutte Antipaludique

Lacunes dans nos connaissances de l'endémie

Ces lacunes persistent dans tous les domaines de la paludologie:

- Relations hôte-parasite
 - chronobiologie de *P. falciparum*
 - aspects physiopathologiques de la maladie
 - morbidité et mortalité palustres

- état immunitaire et marqueurs immunologiques
- mécanismes de la pharmacorésistance du parasite
- Vecteur
 - identification spécifique et biologie des vecteurs
 - capacité vectorielle des espèces
 - relations vecteur-parasite
 - mécanismes de la résistance aux insecticides
- Epidémiologie
 - études socio-anthropologiques, socio-économiques et socio-écologiques
 - standardisation des études épidémiologiques

Problèmes techniques

- résistance du parasite aux médicaments
- arsenal thérapeutique réduit
- peu de développement de nouveaux médicaments
- inexistence d'un vaccin opérationnel
- résistance des vecteurs aux insecticides

Carence des services de lutte antipaludique

- insuffisance de paludologues dans les pays
- absence de plans nationaux de lutte en exécution dans les états
- peu d'intégration de la lutte antipaludique dans les soins de santé primaires
- besoin de recyclage du personnel de santé aux méthodes de lutte contre le paludisme, notamment aux schémas thérapeutiques

Approches pour une Meilleure Efficacité de la Lutte

Meilleure orientation de la recherche contre le paludisme

Si la recherche fondamentale est nécessaire, la recherche appliquée doit être la plus privilégiée. En effet, celle-ci doit viser à apporter des solutions concrètes à des problèmes prioritaires concernant le paludisme. La définition et le choix de ces problèmes prioritaires sujets à la recherche doivent être faits à travers une concertation entre les chercheurs, les professionnels de la santé et la communauté.

Enseignement et formation du personnel de santé

Une réorganisation de l'enseignement en matière de paludologie et de lutte antipaludique doit être faite aux niveaux de toutes les structures de formation du personnel de santé; un recyclage de toutes les catégories du personnel déjà formés (infirmiers, médecins) doit être opéré dans tous les états.

Collaboration dans la lutte antipaludique

- collaboration multidisciplinaire dans l'élaboration des méthodes et stratégies de lutte; par exemple, une collaboration entre sociologues, anthropologues, économistes, épidémiologistes, etc. et paludologues s'avère nécessaire.
- collaboration intersectorielle dans l'élaboration et la mise en oeuvre des plans nationaux de lutte; par exemple entre les ministères de l'agriculture, de l'éducation, de l'information, avec le ministère de la santé.
- coopération inter-régionale et internationale: appuis techniques et financiers aux états dans la mise en oeuvre de leurs plans nationaux de lutte contre le paludisme.

Annexe

Travaux et Publications

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- Etude comparative de l'évolution du niveau de sensibilité de *Plasmodium falciparum* aux doses de 10 et 25 mg/kg dans 2 villages de la région de Bobo-Dioulasso. Thèse en cours.

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Malaria and Development in Africa

A New Strategy for Research, Training, and Control

Robert W. Gwadz
Head, Medical Entomology Unit, Malaria Section
Laboratory of Parasitic Diseases
National Institute of Allergy and Infectious Diseases
National Institutes of Health

Introduction

In January 1991 Dr. Louis Sullivan, Secretary of the Department of Health and Human Services, and Dr. Ronald Roskens, Administrator for the U.S. Agency for International Development (USAID), were asked by President George Bush to lead a U.S. Mission to Africa. Over a two-week period they visited eight countries, met with national health officials, and attempted to develop a list of African health priorities relating primarily to child survival. To the surprise of many in the U.S., although certainly not to those familiar with Africa, malaria appeared at the top of this list. Their final report to President Bush concluded that malaria, the forgotten killer, must be remembered. U.S. assistance should be intensified toward combating malaria in Africa, helping to develop more integrated approaches to applied and basic research and malaria control programs (pp. 24-25).

The precise U.S. response to this mandate is yet to be articulated. It certainly will not be in the form of Africa-wide malaria eradication or control programs similar to those previously sponsored by WHO and USAID. Therefore, this may be the ideal time to make suggestions to appropriate U.S. authorities regarding the composition of this response. The very agenda of our meeting was to prepare a document for USAID suggesting strategies for prevention and control of malaria in Africa. The AAAS has assembled an impressive roster of African scientists representing disciplines relevant to the reexamination of this problem. The role of these scientists will be to assist in the formulation of strategies for addressing the problems of malaria in Africa. An equally important aspect of the USAID charge to the AAAS was to relate the status and control of malaria to foreign donor-sponsored development projects, and to examine the effects of such projects on the epidemiology of malaria. What should emerge from this meeting is a series of mechanisms for addressing the problem of African malaria from an African perspective. Such an approach is both timely and long overdue.

Malaria in Africa

Before we go further, it may be useful to reconsider the picture of malaria in Africa, not as perceived from outside the continent, but as it really manifests itself. African malaria is an extraordinarily complex health problem with levels of morbidity and mortality unmatched

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on any other continent. It can be caused by any or all of three distinct protozoan parasites, *Plasmodium falciparum*, *P. ovale*, and *P. malariae* (*P. vivax* rarely occurs in sub-Saharan Africa) with *P. falciparum* the dominant and most lethal species. There are several mosquito species of the genus *Anopheles* involved in transmitting the infection, with *Anopheles gambiae* the most important. *An. gambiae* has been shown to be a complex of at least six morphologically identical species, each with its own behavioral characteristics. Now, with even more refined techniques, *An. gambiae* itself is further divided into forms with clearly definable ecological requirements and often varying capacities to carry parasites.

Malaria exists in an equally complicated range of African environments from coastal swamps through forests, various savannah habitats, desert fringes, and the ever expanding peri-urban communities developing around the continent's major cities. Perennial or seasonal transmission can depend on yearly patterns of rainfall or the regular availability of water. The ethnic diversity of the people of Africa also creates an incredible array of life styles, habits, housing types, and concepts of malaria prevention, treatment, and control.

Consequently, there can be no simple, all-inclusive characterization of African malaria. Moreover, there is no consensus as to what control strategies might be used in Africa today. Rather, it may be important to consider mechanisms whereby regional or local approaches to malaria can be developed. These local strategies could then become the basis for integrated attacks on malaria tailored to the needs of individual communities.

Malaria and Development

Most major development schemes can alter the environment in ways that may influence the intensity of malaria transmission. Some of these alterations are obvious; some are more subtle. Water management programs including dams, canals, and agricultural schemes requiring irrigation can create aquatic environments favorable to mosquito breeding. Similarly, wells and piped water in areas without adequate sewers can quickly produce larval habitats. Deforestation and cattle rearing can also increase mosquito breeding by creating sites particularly suitable for the rapid development of the primary vectors of human malaria. Construction sites, borrow pits, excavations, or the ruts left by heavy equipment all provide areas where rain water can collect and mosquitoes can proliferate. In very few cases have the consequences of these man-made changes on mosquito breeding or disease been considered. This neglect is particularly critical in light of the expectation that most development schemes will generate significant population increases in those areas under development.

The Malaria Impact Statement

What then should be the relationship between development and malaria? Every development scheme should take into account its possible effects on the future of malaria in the human population in the area under consideration. Indeed, every project should require that a Malaria Impact Statement be submitted concurrently with the development proposal to the donor agency. This impact statement would fully describe the epidemiology of malaria prior to the initiation of a project, the ramifications of the project on the human population, and

the predicted results on disease transmission. If the development project has the potential for increasing the disease burden on the human population, particularly while increasing the size of the human population at risk, then steps should be taken to reduce the threat as part of the project itself. The implementation and regular monitoring of appropriate control strategies must proceed with all phases of the project. Even those projects that might appear to be malaria-neutral should be able to include features that would help reduce the malaria threat to the beneficiaries of that project. Environmental Impact Statements are regular requirements for most major development projects in the United States. Given the importance of malaria as a public health problem, and the potential that development schemes have to influence the intensity of malaria transmission, a similar requirement for malaria-specific impact statements should be justifiable in Africa.

An African Approach to Linkage between Development and Malaria

The requirement for Malaria Impact Statements associated with development could create an exciting opportunity to develop an African-directed approach to malaria control in the region. To seize this opportunity, it would not be unreasonable to suggest the development of a program in Africa capable of responding to this challenge. Such an approach should include the establishment of a system of Malaria Research and Training Centers strategically located in Francophone West Africa and Anglophone East Africa. These centers would:

- have university affiliations and linkages with one or more malaria centers in the U.S. and/or Europe.
- be able to draw on a multidisciplinary staff with expertise relating to malaria. Among these should be epidemiologists, clinicians, parasitologists, medical entomologists, vector control specialists, health service administrators, engineers, sociologists, anthropologists, and others with appropriate interests. Most would have appointments in the university affiliated with the Center. Others with unique qualifications could be drawn from neighboring institutions on a regular basis or when needed.
- be regularly involved in the development and evaluation of malaria control strategies, and the implementation of technologies developed at other research institutions. An ongoing effort of the Center would be the consideration of community-based approaches to malaria control. Applied research would be a major responsibility of the Center with the goal of developing integrated malaria control strategies that could be applied to the development projects under observation, or utilized in national malaria control efforts. The opportunity to evaluate and apply appropriate multifaceted strategies in regional Centers should stimulate innovative approaches to what has been considered an almost unapproachable problem.
- take responsibility for training. They would serve as regional training centers for a range of malaria-related disciplines. Not all Centers would share the same strengths, and Center would be dependent on each other for mutual support. Training should be at postgraduate level and at the level of technicians involved in control operations.
- have responsibility for the preparation of Malaria Impact Statements for donor agencies. When a Malaria Impact Study is required by a donor agency planning a

development project in the region served by a Center, an appropriate multidisciplinary team would be assembled. The statement would be prepared and recommendations made for the inclusion of control strategies. The Center would then have responsibility for insuring compliance with the development plan as it relates to malaria.

Financial Support for the Center Concept

The development of a series of African Malaria Research and Training Centers would require an initial investment and a secure source of long-term financing. There are already in place research groups that could serve as nuclei for expansion into multidisciplinary Centers.

Support for these Centers could come from international agencies. More appropriately, however, support could be generated from the very development projects they seek to serve. In the U.S., mosquito control is financed by a tax assessment of the individuals served by the control program. In Africa, all development schemes could be assigned a flat fee assessment (2 percent to 3 percent of the total project budget or a similar amount direct from the donor). Funding would support the Center research and training activities, teams involved in preparation of impact statements, and teams involved in monitoring projects associated with malaria control activities.

Conclusion

The linkage between development and the transmission of malaria requires a dramatic approach to lessen the burden of disease on the very people development seeks to help. The requirement for Malaria Impact Statements and control schemes associated with these projects could do much to reduce this burden. The requirement that these impact statements be generated in Africa could also have a long-term effect on the evolution and maintenance of malaria control strategies appropriately tailored to the various habitats. Regional Malaria Research and Training Centers would serve as foci for developing strategies and training Africans to manage the problems caused by malaria. The net result of such a program could have far-reaching effects:

- There would be a general reduction of malaria transmission associated with development.
- There would be the development in Africa of integrated control strategies appropriate to the various regions and ecological zones of malaria transmission.
- There would be close and active ties between these centers and leading malaria centers in the U.S. and Europe, ensuring the application of the latest advances in an African context.
- A cadre of African experts would be established and linked in an Africa-wide network. This network could create a critical research mass capable of sustained productivity and advancement. The network would also provide the environment necessary to attract and keep the best and the brightest African scientists in Africa.

Malaria continues its reign as the scourge of Africa. There are no simple solutions to its control, and, with spreading chloroquine resistance, the situation will continue to deteriorate. Development alone, in the absence of an awareness of development's potential for reducing or increasing the burden of malaria, may no longer be acceptable. The recognition that malaria must be reexamined, and new approaches generated, presents an opportunity that must not be lost. It should be the goal of this meeting to present to the sponsors a viable program that can advance the African battle against malaria.

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The Impacts of Development on Malaria in West Africa

A. M. A. Imevbore
Institute of Ecology, Obafemi Awolowo University
Ile-Ife, Nigeria

Abstract

This paper highlights the negative role that malaria has played and will continue to play in West Africa if not controlled. The disease is already highly endemic with a stable epidemiological pattern in the region. This situation has been maintained by the absence of sustained control efforts in most, if not all, countries coupled with the growing resistance of the mosquito vector to insecticides and of the parasites, *Plasmodium spp.*, to antimalarial drugs.

A broad review of the impacts of development on malaria in the region is made, and some suggestions are provided for future control efforts both in the national and in the regional context.

Introduction

West Africa comprises sixteen countries situated between the Equator and the Tropic of Cancer within sub-Saharan Africa. The countries all lie within the humid, semi-arid, and arid regions of the tropics. Although a region of great diversity in terms of relative size, natural resources endowment, physical environment, and ethnic groups, there are many aspects in which the countries are remarkably homogeneous. Their economies are generally small, and average incomes and population numbers are low. The notable exception is Nigeria with a population of nearly 100 million. In most countries in the region, agriculture typically contributes the main source of employment for 70 to 80 percent of the population. Most of their economies are dependent on the export of primary commodities. The growth of GDP per capita in the region, which attained 3.6 percent during 1963, fell to -3.4 percent for the period 1980 to 1986. Population growth is at present about 3 percent per annum but is much higher in urban areas. Death rates are among the highest in the world, and life expectancy is typically only 40 to 46 years. There is a low coverage of the population by any form of modern health care. To take the Nigerian example, only 39 percent of the population has modern health care; life expectancy is 46 years; infant mortality and morbidity rates range from 70/1000 in urban areas to 150/1000 in rural areas (Idachaba, 1988).

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Several preventable, communicable diseases currently account for 99 percent of all ill health and deaths, the most prevalent of which are malaria, tetanus, measles, tuberculosis, meningitis, schistosomiasis, onchocerciasis, filariasis, diarrhea, and intestinal diseases.

Together with malnutrition, these diseases are largely responsible for the high mortality rates and low life expectancies in the region. The factors enhancing disease transmission include suitable environmental conditions (climate and habitat) for both disease pathogens and vectors, malnutrition, inadequate water supply and sanitation facilities, poor hygienic practices (including hazardous cultural practices), overcrowded living conditions, and ill-conceived and improperly implemented development schemes that increase health risks.

Although accurate figures are not available for the number of deaths caused primarily by malaria, it is estimated that the disease is responsible for the death of one million infants and young children each year (TDR, 1984). This paper presents some key issues on the impacts of development on malaria in the region.

Malaria in West Africa

Malaria is endemic in 90 percent of the region and is one of the five most important causes of mortality and morbidity in infants and young children. The disease is responsible for between 15 to 20 percent of all hospital admissions. Stable malaria is rife in most parts at hyper and holoendemic levels. About 200 million people south of the Sahara are believed to be chronically infected, and of these about 100 million suffer acute manifestations of the disease in the course of a year (Najera, 1989). Clyde (1987), in considering the global trends in the epidemiology and control of malaria, classified the situation into the following categories:

1. Areas where malaria never existed or disappeared spontaneously following social and economic development, e.g., Europe.
2. Previous malarious areas where, as a result of successful control and eradication efforts of development and health services that improved relations of people to their environment, endemic malaria and the risk of infection have been eliminated, e.g., U. S. A., Chile.
3. Areas (e.g., Argentina, Costa Rica, Panama, Paraguay) where a reduced level of infection has been maintained by continued application of anti-malarial measures but where a threat of increased transmission exists because the general social and health infrastructures are not sufficiently developed to sustain a reduced level of infection.
4. Areas, e.g., West Africa, with few organized control measures and where malaria transmission has remained unchanged except in small localities, for example, in centers of some cities where mosquito breeding sites were eliminated by drainage or by pollution of surface waters.

Edington and Gillies (1976) showed that malaria transmission in the region is stable, is fairly uniform, repeats itself annually with little variation, exhibits resistance, and is difficult to eradicate.

This situation is produced by four parasites that are not infectious for the lower animals: *Plasmodium falciparum*, *P. malaria*, *P. ovale* and *P. vivax*. *P. falciparum* is the parasite responsible for about 90 percent of malaria in the region. The primary vectors are *anopheles gambiae*; *A. arabiensis* and *A. pharoensis* are the secondary vectors (White, 1989). According to Gilles and DeMeillon (1968), the main vectors are those whose existence in an area is necessary to maintain malaria in an endemic form.

The factors that affect the distribution and seasonal abundance of the anopheline vectors include temperature, rainfall, and physical features of the land. In West Africa, larval breeding microhabitats that are utilized by anopheline mosquitoes tend to be abundant during the wet season. At that time shallow sunlight pools (which are abundant) provide ample breeding grounds where mosquito mortality is relatively low because the small size and transient nature of the water bodies prevent successful colonization by other animals (Service, 1971). Anopheline mosquitoes are also known to breed in polluted waters (Gilles & De Meillon, 1968).

Since mosquitoes usually bite at night and are known to have preferences for either indoor or outdoor biting, malaria transmission tends to be pronounced when large numbers of people sleep outdoors during hot weather or in houses that have no protection against invading mosquitoes (Oomen, de Wolf, & Robin, 1991).

Impacts of Development on Malaria

The problem posed by malaria provides an intense challenge to the governments and people in the region. The holo and hyperendemic malaria situation, and the close association between water resource development and malaria, no doubt affect the physical, social, and economic features of the human environment. Since West Africa contains as much as 850,000 km² of wetland — lands subject to excessive wetness and containing soils with impeded drainage — the intensity of breeding of anopheline mosquitoes is bound to be a major feature of water resource development in all situations (Adriesse, 1986). Ejiofor and Okafor (1985), working in rice fields in the Anambra State of Nigeria, found that anopheline breeding was usually highest at the peak periods of the rains. Velayudhan (personal communication) has found that reservoir construction in the Senegal River basin has caused significant malaria transmission in the region as indeed was the case at Kanji. Preliminary findings from a study of several irrigation projects in the Sokoto-Rima River Basin Development Authority area of jurisdiction conducted by a team from the U.K. Hydraulics Research and Obafemi Awolowo University, Ile-Ife, also found that malaria is a problem for floodplain dwellers whether or not they engage in formal irrigation (ODU Bulletin, 1990). Chinery (1984) observed that in Accra, Ghana, *Anopheles gambiae*, the principal malaria vector in the region, adapted to breeding in water-filled domestic containers and in numerous polluted waters.

The resilience and complementary ecology of anopheline mosquitoes has been highlighted in many studies. Chinery (1984) found that *A. arabiensis* is now the predominant species in Accra, replacing *A. funestus* and *A. gambiae* s.s. Okafo (1991), in a study of anopheline mosquitoes within human dwellings in the Obafemi Awolowo University campus and in five peri-urban villages fifteen kilometers west of the campus, found that:

- *A. gambiae* s.s., *A. funestus* and *A. nili* were present on the campus and in the neighboring villages. *A. funestus* was most abundant in both areas, confirming earlier findings that the native *A. gambiae* s.s. forest species tends to be replaced by *A. funestus* when forest clearing results in savannah.
- There were more indoor resting mosquitoes in the villages than within the campus, where windows and doors were protected by mesh wire. Outdoor collection with human bait did not show any significant difference in the density of anopheline between the two areas. This finding clearly indicates adaptive behavior by the mosquitoes to human development.
- Neither of the two principal vectors, *A. gambiae* s.s. and *A. funestus*, was able to maintain malaria in a stable state in any month in either locality. On the other hand, the combined effect of both species was sufficient to maintain malaria throughout the year in both localities.
- There is a need to separate mosquito nuisance from malaria transmission; high mosquito populations do not necessarily signify more malaria in an area.

It would be interesting to study the shift in species dominance in land clearing enterprises for various developments in forest and savannah regions so as to understand the underlying factors for such shifts.

Although the risk of spread of malaria and other parasitic diseases associated with the development of water resources has often been stressed, experience has shown that the failure to give early attention to health considerations in project design and implementation and the lack of effective interaction between project planners and health authorities lie at the root of increased vector-borne transmission (PEEM, 1981; FAO, 1987). In several countries in the region, these shortcomings are due to the absence of explicit policy on the incorporation of environmental and health concerns into socioeconomic programs of development at the planning stages. This lack of policy requiring an assessment of the risk to health associated with the development of water resources has been a particularly prominent omission in the region. In some other cases, e.g., Nigeria, where the National Health Policy established since 1986 explicitly requires intersectoral collaboration among ministries of health, planning, agriculture, and finance, several irrigation projects have nevertheless been built without implementing this policy for intersectoral collaboration at the planning stage. PEEM (1986) found that the following combination of factors tends to come into play in such situations:

- Government bodies responsible for resource development projects make up a lobby for projects and through lack of awareness or desire to promote their project ignore possible health hazards.

- Unless a country has set up an institutional mechanism to ensure that health interests have a voice, they may be neglected.
- Various health departments are ill-informed of the scope and variety of development projects and of their disease implications.

PEEM then proposed the following solutions that are of relevance to the malaria situation:

- Health impact should be recognized as a criterion in project selection.
- Data should be collected on the economic effects of vector-borne diseases.
- Projects as a rule should serve interests of both economic production and vector control.
- Projects should henceforth include funds for monitoring of diseases during project development.
- Several existing projects (especially irrigation) requiring renovation present an opportunity for introducing vector control measures.

Well *et al.* (1990) have also shown that the health problems that arise from development policies may come from the implementation of macro-economic adjustment that in turn often results in major cuts in the health budget. The drastic cut in federal capital expenditures for tertiary health care in Nigeria from =N222.171 million in 1982 to =N67.761 million in 1984 illustrates the extent to which resource allocation for health care can fall short of concerns at the national level (Idachaba, 1988).

In sum it seems that a wide gap exists between the formulation of policies intended to provide long-term solutions to macro-economic problems and the implementation of measures to evaluate or monitor the health consequences of such policies. This is particularly true of structural adjustment policies that include reduction in balance of payment deficits, inflation, and government budgets for various programs.

Perspectives for the Future

Even though malaria is undoubtedly a serious impediment to development in West Africa, few studies have measured its full economic impact. Hunter, Roy, & Scott (1982) pointed out that the general lack of data on the impact of health of development projects is due to:

- The absence of pre- and post-development data or the availability of data that are inadequate for the purpose of comparison.
- Natural reluctance on the part of government agencies to publish reports that indicate that water resource development has caused a deterioration of the health of the local residents, or immigrants.

The authors then concluded that the situation clearly calls for a systematic study of the health hazards associated with new water resource development.

Another important lesson learned from the eradication and control efforts in other parts of world is that no single intervention can provide sustainable malaria control. Sustained efforts of integrated control are required, involving a combination of complementary intervention strategies — antimalarial drugs, environmental management for vector control, and insecticide spraying of targeted or high risk areas. In carrying out these strategies, one should bear in mind Rozendaal's (1989) warning that the control of vectors by house spraying with residual insecticides, although successful in many malarious areas, can encounter serious setbacks for various reasons, among which are exophilic behavior of mosquitoes, poor cooperation by the population, as well as financial and organizational constraints.

Although progress has been made in vaccine development (TDR, 1990), a word of caution must be given: The people of Africa are generally too poor to pay for new vaccines. A general shortage of medical infrastructure can create problems of mass mobilization. Under these conditions, vector control methods such as the reduction of mosquito breeding through environmental management and the use of mosquito nets and repellents as part of primary health strategy need to be emphasized.

Any concerted efforts to apply vector control methods must also admit that the level of current research in the region clearly does not provide adequate basis for formulating a long-term strategy for malaria control in West Africa. Najera's (1989) suggestions for research efforts to improve malaria control are the following:

- the strengthening and orientation of epidemiological service;
- the adoption of a research and development approach to control programs;
- the formulation of national research policies for the solution of national problems; and
- the application of research results to improved disease control through field testing to resolve operational and organizational and logistical problems hampering malaria control, bearing in mind cultural dimensions.

To be successful, research projects aimed at resolving the above-mentioned issues must bear in mind the reality that many factors, e.g., water resources, resettlement, deforestation, migration, and urbanization, are implicated in the breeding of mosquitoes (Litsios, 1987). Accordingly, intersectoral collaboration concerned mainly with preventive action, primarily on a community or area basis with reference to the needs of those at greatest risk, is a necessary prerequisite to successful malaria control efforts. Herein lies the merit of the intersectoral panel for vector control that already exists. This group, the Panel of Experts on Environmental Management for Vector Control (PEEM), which is a collaborative effort of the World Health Organization (WHO), the United Nations Environmental Programme (UNEP), and the United Nations Centre for Human Settlements, has already developed a document entitled *Guidelines for Forecasting the Vector-Borne Disease Implications in the*

Development of a Water Resource Project, (VBC/86.3). PEEM has also already defined its Medium Term Program (1991–1995) to cover the following:

- vector-borne disease problems associated with rice agrosystems, especially those of the West Africa Rice Development Association (WARDA);
- water-borne and water-related vector-borne diseases in relation to irrigation system management;
- vector-borne diseases and other health hazards related to the use of waste water in agriculture and aquaculture; and
- vector-borne disease problems associated with urbanization.

The Panel will no doubt be willing to cooperate in interagency efforts to mount international programs for malaria control in the region.

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Malaria Prevention and Control in Primary Health Care *The Missing Link(s)*

D.C.O. Kaseje
Director, Christian Medical Commission, World Council of Churches
Geneva, Switzerland

Introduction

The background papers provided by the organizers of this important workshop present more than adequate technical information with regard to the prevention and control of malaria in sub-Saharan Africa. Illustrating the fact that there is no scarcity of knowledge about what should be done to prevent and control malaria, there are hardly new techniques yet to be developed. Yet the goal of malaria control, particularly in sub-Saharan Africa where the need is greatest, is still very far from being reached. For this reason, this paper is devoted to what may be considered the missing links that may explain, at least in part, the rather modest achievements in malaria prevention and control efforts in sub-Saharan Africa, in the context of Primary Health Care (PHC). In my view, some of these are:

- inadequate political commitment to real community participation in health care and hence in malaria control;
- inadequate capacity for facilitating, nurturing, and sustaining/managing real community participation;
- gross inequalities in access to health care/services: care is worst where the need is greatest, and least available for the most needy;
- wrong view of health: not even understood according to the definition of the World Health Organization (WHO); and
- widespread misunderstanding of the meaning of Primary Health Care (PHC)/Community-Based Health Care (CBHC) and even of development

Many writers suggest that malaria prevention and control must be integrated into PHC without considering what PHC really means. Efforts to integrate these activities can only be fruitful if there is a shared understanding among the multidisciplinary professionals involved in PHC and malaria control. Hopefully, this workshop will contribute to this shared understanding.

Primary Health Care

“Primary” in Primary Health Care is not a vision of the essential elements of health care but the principle of community participation that requires that the communities themselves are involved in determining their health care priorities and activities. Partnerships among communities, families, and individuals, taking primary responsibility for their own health care, and with health and other sectoral professionals who provide the appropriate support and guidance are needed; however, these relationships should be based on the principles of self-reliance and self-determination.

PHC is an approach that:

- recognizes the strengths and resources of the community;
- seeks to facilitate and enhance these strengths;
- recognizes that communities have always been responsible for their own health, even without the interference/intervention of health professionals;
- recognizes the mother as the most important and knowledgeable health provider, present in every home; and thus
- seeks a mutually supportive, reciprocal relationship among those involved in order to improve health care and hence health status in a given community.

It is a process of self-discovery for all involved, a process of solidarity among partners in which each member is aware of his or her strengths, weaknesses, and limitations and hence the unique contribution that each can make.

In general, professionals are perceived as experts in doing things for helpless others. They are trained to see health problems in medical terms and hence design medical, technological solutions to problems that are not just medical and therefore are unlikely to respond adequately to uniquely medical prescriptions alone, however appropriate. We are too often surprised at how little has been achieved by medical interventions and hasten to blame the subjects of these interventions, who must be, “lazy, uniformed, backward, or too traditional to change.” Malaria is not just a medical problem. It is also a political, social, and economic problem and thus cannot be solved by medical technology alone.

I should clarify that the CBHC approach is often presented as an alternative to PHC. CBHC is actually a term coined to bring the focus of PHC back to its primary and most revolutionary factor, the community involvement. In this paper, I use the term PHC only, with the understanding that it embodies, as originally intended, the community-based approach.

A PHC program should comprise the following elements:

Principles	Process	Outcome Goals
Equity	Community participation	Self-reliance
Socioeconomic development	Appropriate technology	Social justice
Self-reliance	Intersectoral collaboration	Empowerment of the powerless
	Orientation and training of all actors	Human development

Three approaches to PHC can be identified:

Institutional Approach (Primary Medical Care)

In this approach, the PHC project is grafted onto a hospital or other health institution. The community health workers (CHWs) are recruited, often as volunteers, to extend the work of the institution in the community. This approach has many operational problems (involving logistics, communications, and supervisory support). Community involvement is limited to making contributions in cash or kind. This kind of project rarely becomes self-supporting. The drop-out rate of CHWs is high, with those who remain often becoming fee-for-service practitioners. Program management is top down, and there is little regard for existing culturally based systems of care, participation, and organization. The project tends to be imposed on the community and adopted according to a predetermined blueprint. The program implementers, consciously or subconsciously, find community participation threatening and hence limit participation to activities determined by the implementers.

The operational process is dominated by professionals who may not be fully committed to community participation and who thus block real community participation. The training of the leaders and CHWs often reflects the biases and concerns of the providers, and hence high attrition rates and issues such as insufficient remuneration of CHWs become a massive problem.

Community Health Care/Technology Approach

This approach assumes that there is a relationship between improved health services and improved health. It therefore emphasizes outreach to the community. There is, however, a deliberate effort to meet the needs of professionals and donors rather than of the community. It is often biased towards the selective PHC approach centering around the use of predeter-

mined “appropriate medical technology,” e.g., the use of bednets and mosquito repellents, source reduction, spraying, chemotherapy, and chemoprophylaxis.

The program may even include education, agriculture, and water development, for example, with these activities undertaken on an extension basis. However, their inclusion is determined by the professionals.

The community is expected to identify its own problems and possible solutions and to participate in the planning and implementation of selected interventions to meet identified needs, but the community is given inadequate “space” to do so.

There is typically strong support for the program among locally elected leaders, but there is limited community participation beyond the involvement of CHWs and local leaders. Real dialogue with the providers continues, but mainly through the locally elected leaders. The CHWs are seen by the providers as the representatives of the community, extenders of services, and “change agents.”

Although respected by the community, CHWs do not fully understand their role and tend to rely heavily on the service-delivery aspects of their work. They tend to identify with program implementers, not with the community. Many of them become frustrated and resign because they feel that their efforts are not adequately rewarded.

This approach allows for greater awareness of and sensitivity to local needs than the first model but remains focused on the local elite: The majority of the community is excluded from participation and hence the intended impact on morbidity and mortality is not achieved.

Community-Based Approach

This type of program addresses health issues on the basis of a broader understanding of health and how it can be sustained and improved. Seen in the context of human dignity, development, and total well-being, health action becomes an entry point to social action and holistic development. The community-based program focuses deliberately on the disadvantaged majority. It assumes that these people would take action to improve their own health if they could. It also aims to address existing social and economic injustices, which are the root causes of ill health.

In this model the root cause of health problems is seen as being mainly political. The approach aims to deal with the oppressive system by enabling people to contribute resources, labor, ideas, and share in power.

The planners see outside funding as dependency creating and self-reliance as key. Therefore, avenues of generating local funds are used, such as drug sales and contribution and insurance schemes, but these are designed and developed by the community in consultation with outside resource people, upon request of the community.

This approach is not without its unique problems. It does not immediately deliver health services, which is what people expect. In fact, the expectation of the people is normally

charity, not empowerment. This disappointment leads to conflict that can prove costly to both the facilitators and the community — the community expecting care/cure and the providers delivering organization/education. The rhetoric of the support system may not coincide with the people's view of reality.

The planners realize that the target group is barely able to feed itself, let alone have money and time for health activities. Thus, they take into account economic realities that modify self-reliance and community involvement ideals.

The community is in the forefront, analyzing its own problems, seeking solutions, and then taking the required individual and collective action. The providers are invited to participate in the community's programs. This way, the providers are more likely (than in previously discussed models) to tackle the real causes of the malaria problem, factors which have less to do with prevention and control technology than with social, political, and economic injustices caused by human greed. An effective program must address inequity in the distribution of the resources of a nation.

Health depends on the behavior, attitude, and practices of the people, all of which may be based on their knowledge and experience. It is the people who can create and maintain a healthy environment, community, family, and body. The task of the health professional is not to take over this responsibility but to enable the people to care for their own health, as they already do to a greater or less degree. This enabling, however, must be done in a way that does not create dependency, but encourages and allows initiative, affirms, and hence enhances their dignity.

Factors Impeding Community Involvement in Primary Health Care

Quick intervention packages

Quick and easy intervention packages that are intended to work wonders are more effective in creating dependency than in solving problems. A purely technological approach to malaria control can act to preserve the existing inequalities and powerlessness of the people, as it keeps the decisions and control in the hands of central authorities, businessmen, and foreign experts. It focuses on products rather than process, on survival rather than quality of life, on social marketing rather than awareness raising, on compliance rather than collective action, and on courting the support of institutions and leaders in the support system rather than on the poor majority.

Poverty (economic reality)

Can the people in greatest need afford to be involved in malaria control activities? The priority target groups are the least likely to be involved in the partnership for malaria control described in this paper. How can they be empowered to participate? Their agenda is already full, struggling to survive from one day to the next.

Community “shock”

Large inputs of resources channelled too rapidly into the community can actually lead to community shock. This may create a permanent disability in participation.

Since it is difficult to overcome the apathy and despair of the people after generations of poverty, it takes time to initiate the process of dialogue that will lead to a real empowered participation. Many of us, health professionals controlled by external factors, are too impatient to wait for the community. We thus take shortcuts that undermine self-reliance and lead to various degree of dependency. Thus, the community only participates as cheap labor to extend services determined by outsiders.

Lack of political commitment and experience

Commitment and political will devoted to PHC are grossly inadequate, as reflected by the gap between the rhetoric and the practice of Alma-Ata PHC ideals. Institutional, provider-focused services continue to consume the lion's share of national health budgets, yet remain accessible primarily to a minority elite. The reallocation of resources necessary for PHC has thus been rendered impossible, leading to the chronic underfunding that has compromised PHC implementation. This is compounded by the absence of a structure that could enhance community participation, intersectoral collaboration, and progress towards self-reliance.

Scarcity of knowledgeable, skilled, and experienced (hence credible) leadership for PHC has hampered changes at the policymaking levels. This shortcoming has led to a distortion of PHC strategies and practices, turning them into fragmented, “quick-fix” technical interventions, planned and managed from the top, in contradiction to the basic principles of the Alma-Ata declaration and the ultimate goal of the PHC approach, which is people's empowerment and health for all.

The PHC Implementation Process

In this process, we as facilitating partners ought to remember that communities are not homogeneous entities able to agree on a common course of action to enhance equitable distribution of scarce resources, efforts, and benefits. The majority of a community may not see health, as medically understood, as a priority. One should therefore not assume that people are ready and waiting to participate in malaria control activities, at least not as they may be defined by us.

Community participation is only meaningful when people have determined their own priorities and have designed program activities in accordance with these priorities. This way, people are not simply participating in the providers' activities but in their own. We have to accept that improvement of health status may not be linked to health services alone, but also to general improvement in level of basic education, living conditions, and lifestyle.

The following activities are often necessary in the process:

- Identifying, developing, and supporting current and potential leadership at all levels (community, district, national, and international). This can be done through appropriate training activities, which are functional and practical, thus producing competent leadership for advocacy and creativity, and in turn, influencing resource allocation for health development;
- cultivating the skills and attitudes among individuals strategically placed to mobilize others for involvement in activities, thereby enhancing the process of empowerment for popular participation;
- providing existing health workers and those in related sectors with orientation to malaria control in PHC;
- developing a network of interested government sectors, NGOs, and districts in a network of collaboration, to enable sharing of innovations, mutual support, and encouragement;
- developing appropriate organizational mechanisms for collaboration and for fostering political commitment and will; and
- initiating and supporting a program aimed at mobilizing a critical mass of people to influence and motivate others to direct their national development process towards the PHC approach. In every community, district, or nation there is a need to develop leadership that can generate the necessary collective force.

The process should lead to a change in what people know, feel, and can do. One must be aware of what people need to learn in order to participate, play a role, or undertake an assignment.

Opportunity for individual and/or collective reflection is necessary for social transformation. Group interaction may be a major motivation for change and may allow for the sharing of risks associated with action and change. The role of the facilitator is to be a mirror for the people to take a fresh look at their situation, consider its root causes and consequences, and decide on practical action that would have tangible results. In this sense the facilitator is also a midwife to help the people give birth to their own ideas.

Unfortunately, it must be realized that sincere and honest facilitation of the truly community-based process that seeks the best for all could conflict with existing local leadership. Not every member of a community can be involved in group or community activities at the same time, and each member will consciously or unconsciously have his or her own agenda. The first group to respond is likely to be those who are able or willing to risk being involved in the process of change. These are not the people who are the most needy, but those who assume that they know more than the rest of the community and often suppose to be speaking for the community, reflecting their needs, problems, and concerns. They have economic security and are the easiest to work with because they will come to the providers, they will volunteer, and can adopt/speak the providers' language. Eventually most of them will be

disappointed and disappointing, as their real individual concerns will not be addressed in the way they thought they would be. They discover that their imagination of possible opportunities was unrealistic and personal gain is limited. They become increasingly demanding and eventually give up. However, there is always a great temptation to work with them.

The poor in the community often cannot afford risks and can only make attempts when protected. Many of them will not even avail themselves of new opportunities because they have lost hope in themselves and in the possibility of change. They accept lack of access to resources. There is a culture of silence. These people will not take steps or may do so but with maximum caution—their economic reality also prevents their participation. They need patience, loving, and understanding care. Providers will need to walk by them and with them for a long time to maximize their self-esteem.

Often one has to start with a nucleus of community members, people who are willing to come together to work on common problems. Even small successes should be celebrated and those involved appreciated, i.e., given appropriate feedback. It always pays to start small and grow.

The assessment of the process should also be participatory. The community should participate in determining what to access and how to do it. Members should have the freedom to invite outside help according to their needs.

Evaluation should expose strengths, weaknesses, indicate any need for change, and, where necessary, result in development of alternative strategies. The role of the facilitator is to enable the community to “see” its own progress. Evaluation should also consider attitudes, relationships, fears, motivations, communication barriers, and priorities. This process enhances goal-setting, perception of identity, and purpose. Also to be documented and examined would be leadership patterns and requirements; perceptions of ownership and responsibility for sharing of findings; diversity of views and interests, conflicts, and tensions; and health outcomes.

In the evaluation process, the people should be the final judges of excellence. Indicators should highlight self-reliance and change in community coverage rather than sophistication. The practitioner should be a listener and willing learner, encouraging two-way communication to elicit informed participation rather than blind following of instructions. The preoccupation should not be with what is done but how it is done, thus favoring empowerment and not dependency.

(For a relevant case study, please see Kaseje, D. C. O. & Sempebwa, K. N. (1989). An integrated rural health project in Saradidi, Kenya. *Social Science and Medicine*, 28 (10), 1063-1071.)

Irrigation Development and Malaria Incidence in Zanzibar

Abdisalaam I. Khatibu

National Project Director of Smallholder-Oriented Irrigated Rice Production
Ministry of Agriculture
Zanzibar, Tanzania

Background Information

Since the nineteenth century, cloves have been the pillar of Zanzibar economy. It has been expedient to concentrate on the growing of cloves, which was a high-income producing commodity, rather than rice, which is the preferred staple food. Clove production reached a peak in 1958 at 28,000 tons; thereafter production has been declining. On the other hand, the population on Zanzibar rose from 476,111 in 1978 to 623,000 in 1987. The bill for food imports rose steadily, with rice imports alone increasing from an average of some 7,400 tons between 1970 and 1973 to 43,000 tons in 1987. It consumes nearly half of the total foreign exchange earnings.

The decline in clove production, coupled with a reduced world market demand and eroding commodity prices, had left the Zanzibar government without the necessary foreign exchange for imports of food and inputs for domestic food production such as equipment, fuel, spare parts, fertilizer, and pesticides.

In order to meet this problem, the government was forced to adopt a broad agricultural policy designed to achieve an economically efficient balance between export production and import substitution. The main thrust of the crop production program is on the attainment of self-sufficiency in rice and an increased production of cassava, sweet potatoes, and bananas. There is a deliberate increased emphasis on rice.

Prior to the introduction of irrigated rice production, rice was produced in rainfed fields only. A major effort to increase production then was the provision of mechanized services such as ploughing, seeding, and pest control. These investments eased the heavy work load of farmers but did not necessarily increase yields.

Consequently, the government requested assistance in 1973 from the United Nations Development Programme (UNDP) in examining the possibilities of reducing the food deficit and, in particular, of diminishing the large requirements for imported rice. A project with the Food and Agriculture Organisation (FAO) as executing agency became operational in 1975.

During the first phase of the project, it was envisaged that irrigation development would focus on the three main streams of Zanzibar and the various ones in Pemba. In Zanzibar the Kipange, Mto Mawe (Kinyasini), and Mwera rivers were to be developed for irrigated rice cultivation. In the island of Pemba more sites were to be developed. All those areas were believed to have perennial streams with adequate water for irrigation. Hence the first development activities started in the Mtwango and Mwera valleys for the Mwera river; and Kipange for the Kipange river. However, water proved to be inadequate for each respective project site to irrigate the potential area. Whereas at Mwera the valleys were flooded most of the year, the Kipange river flowed to the sea. In Pemba almost all valleys that were to be developed for irrigation were swampy and flooded throughout the year.

Results from the initial development were very encouraging with respect to rice production and the possibility of having two crops per year. Hence groundwater studies were initiated to explore possibilities of expanding irrigation development for the potential rice-growing areas.

Intersectoral Cooperation

During the planning phase the only problem analyzed was water exploration for irrigation in the potential rice-growing areas in Zanzibar, hence the involvement of the Ministry of Water, Energy and Housing. Active participation by the Water Department was contributed, and that staff worked in close collaboration with staff members of the Irrigation Division of the Ministry of Agriculture and Livestock Development. For both divisions the workplan focused on water exploration for both irrigation and rural water supply. For rural water supply the emphasis was on the provision of clean domestic water to the peasant farmers around the project areas.

Assistance was therefore sought from the United Nations Capital Development Fund (UNCDF) for capital equipment to develop 960 hectares for irrigation as well as for other equipment necessary for the drilling rigs for water exploration, and pumping sets for various project sites. A large labor force was employed for land development.

Both manual and mechanical land development techniques were used. The Kipange valley was later abandoned because of inadequate engineering and technical competency available at the time. Hence the Mtwango and Mwera valleys were among the first where production was implemented.

Vector-Borne Disease Problems in Rice Fields

While rice growing does not necessarily cause a vector problem, cultivation practices may introduce health risks. The most usual method of rice production with surface flooding and soil saturation provides an ideal environment for many vector mosquito larvae or for the snail intermediate host of schistosomiasis. Consequently, vector-borne disease problems have been experienced in most of the hydromorphic rice-growing valleys. With the expansion of rice production, in such areas (especially in Pemba), where some of the permanently flooded valleys have been reclaimed and developed for irrigation with improved drainage,

one could hardly determine whether the development has aggravated the malaria situation or not. This uncertainty is mainly due to nonsystematic data collection prior to the commencement of the project. It was very unfortunate that during the project-planning phase for such endemic areas for malaria, no attention was drawn to the need and the possibilities for systematic action nor was there any indication of where research, collaboration and assistance could be most effective.

During 1984 the irrigation project was approached by the Malaria Control Project of Zanzibar and cautioned on the excessive use of insecticides that are also suitable for mosquito control. Apparently, pesticide resistance was bound to be a major problem in the chemical control of mosquitoes. This danger was observed in the Mwera irrigation site. It was at this time that collaboration between the malaria and the irrigation projects started. Both parties agreed that control of such disease vectors is of paramount importance if such agricultural systems are to succeed. Irrigated rice cultivation, with its characteristic surface flooding and soil saturation, provided an ideal environment for the propagation of mosquitoes.

A fact-finding mission was organized jointly by the FAO and Swiss Federal Institute of Technology to collect more information on the presence of vector-mosquito larvae, and snail intermediate hosts in the paddy fields of two pilot project sites in Zanzibar. The preliminary survey indicated that:

- The presence and, to some extent, the density of mosquito larvae of the genus *Anopheles* were directly related to the irrigation regime: in paddies with continuous flooding there was a high density (of up to 125 larvae/litre of standing water in the field), whereas the counts in fields under intermittent irrigation were less (varying from 0 to 15).
- Within a given irrigation regime, the larvae population varied with physical, chemical, and biological factors, such as turbidity, salinity, pH, algae growth, etc.
- In irrigation and drainage canals, where the flow of water was swift and weed growth minimal, no mosquito larvae were found; however, where the flow stagnated, there was clear evidence of mosquito breeding.

Apparently, the paddy fields can develop into a major breeding area for vectors of malaria if water management in paddy fields and effluent irrigation systems are not modified to mitigate conditions favorable to vector propagation. In order to obtain more reliable information, in-depth studies were carried out under the malaria control project in collaboration with other external funding agencies and institutions.

Malaria Control Research Activities in Irrigated Rice Fields

Insecticide use in irrigated rice fields was minimized or eliminated altogether where malaria control trials were undertaken. The trials were run concurrently with the irrigated rice trials using different rice varieties that would respond to different water regimes as required for the vector control trials. Trials on the use of chemical and biological insecticides commenced

in July 1985 (Rogers, 1985) at Mwera. Other researchers on different aspects of population dynamics, species identification, and control followed suit.

Rogers (1985) observed that there was a significant reduction of *anopheles* larvae in the control plots, a decrease he attributed to the reduction in fertilizer applied in the field plots. However, this could also be attributed to the intermittent irrigation practice that was adopted, as well as the rice variety introduced, one that is tolerant to different water regimes.

Environmental Management Strategies within Integrated Vector Control

The irrigation project undertook specific measures such as redesigning systems to accommodate the following: manipulation of physical features, development of rice varieties whose high yield would not be adversely affected by low soil moisture regime, as well as introduction of biological weed control and biofertilizer.

Environmental management included the permanent or long-term modification of land, water, or vegetation and recurrent manipulations to produce temporary conditions unfavorable to vector breeding. The main means to reduce water loss (and ponding) in each scheme is to line all primary irrigation canals.

Such engineering practices fit well within the environmental modification and manipulation components of environmental management.

Measures such as drainage, filling, land levelling, vegetation clearance, and water management in irrigation systems, including intermittent irrigation practices, could form important and cost-effective components of an integrated vector control strategy. In some project areas we have devised a second crop other than rice for the farmers in order to minimize both vector breeding and water use.

With the exception of Mtwango and Mwera, all other developed areas use pump irrigation. This is a very costly enterprise, and it has not been difficult to convince farmers to minimize pumping. The size of the command area for each pump unit was very important to ensure appropriate management: the smaller the command area, the better the management of the scheme and hence the management of the irrigation water. It was much easier to control the practice of alternate wetting and drying of rice fields. This latter approach is highly effective in mosquito-breeding control in rice fields provided the drying cycle is long enough to destroy the larvae and the wetting period is short enough to prevent mosquitoes from multiplying. A number of investigations have shown that significant water savings can be achieved using this approach when compared with the standard continuous shallow submergence practice (Hill & Cambournac, 1941; Sandhu, B. S., Khera, K. L., Prihar, S. S., & Singh, B., 1980; Jha, K. P., Chandra, D. C., & Chailaiah, 1981; Luh, 1984).

In some cases in which short-term drought-tolerant rice varieties are grown, soil saturation is maintained, especially during the short rainy season. Where this practice is successful, it eliminates mosquito reproduction in rice fields.

In some areas where drainage water accumulates at the edge of an undeveloped site, rainfed rice farming is encouraged to utilize the drainage by conveying it to the cropped plots. Such a practice, in addition to enabling the farmer to produce more, also facilitates rapid water use, keeps the soil at saturation, and reduces flooding. Many farmers seem to have adopted this technology.

Azolla Studies

Azolla, a free-floating fern, was introduced from the Philippines as a bio-fertilizer in the rice fields. The fern lives in association with a blue-green algae symbiont that has the capacity of fixing atmospheric nitrogen in sufficient quantities to allow for a rapid growth of the fern.

This symbiont is *Anabaena azolla*, and it lives in the cavities of the fern's upper lobes. The combination of characteristics of the two species makes *Azolla* a valuable source of organic fertilizer, of particular interest in rice cultivation. It has been used to a varying extent in China and in several other countries as a means of improving the fertility of rice-field soils and of animal-fodder.

Azolla, because of its coverage of the water surface, has been observed to suppress weed growth as well. This characteristic was of particular interest to the project. The question as to whether the coverage of standing water by *Azolla* could negatively affect mosquito breeding has been raised. Again in collaboration with the Malaria Control Project, one expert carried out studies to test this hypothesis. It was observed that in plots with a good coverage of *Azolla* there was a significant reduction in larvae population (Jo Lines, personal communication, 1989). Lines said "New growing practices are likely to affect mosquito production, and the recent introduction of the floating fern *Azolla*, intended for weed control and as a natural fertilizer, may offer as a side effect, a promising candidate for biological control [of mosquitoes] in rice."

Azolla is already used to a considerable extent in various countries in association with rice cultivation and its application; its cultivation is greatly encouraged by agricultural organizations. The use of *Azolla* might additionally be considered as an environmental control method, and could in the future provide an important component of integrated mosquito control in rice fields. In Zanzibar, we introduced *Azolla* in some perennial ponds in town, to observe whether people would notice changes in mosquito population through visual observations.

Summary and Conclusions

Irrigation development in Zanzibar was initiated with the objective of increasing rice production in the isles thereby reducing the import bill for rice.

During the planning period of the irrigation project, the major considerations were the provision of machinery and equipment for land development and groundwater exploration and exploitation. Research activities concentrated on rice agronomy and production constraints.

Irrigation is a completely new technology in Zanzibar, and farmers had to be trained in irrigated rice production with emphasis on flood irrigation to control weeds and increase yields through the use of high-yielding varieties and other inputs. Both the agronomic practices and the engineering designs adopted for surface irrigation favored mosquito breeding.

Intersectoral cooperation with the health authorities resulted in the incorporation of the vector control measures. This change entailed the revision of all engineering designs as well as agronomic practices that would reduce the breeding of mosquitoes in the rice fields.

For any future agricultural development it is necessary that intersectoral collaboration be initiated from the beginning. An interdisciplinary panel should encourage the development of systems and techniques for monitoring and evaluating the effects of agricultural development and practices, through the assessment of physical and demographic changes, alterations in vector species (their abundance and their natural enemies), changes in human diseases, and changes in the social and organizational structure of the area under study.

The panel should also investigate means of presenting information effectively on health effects and on appropriate environmental control measures associated with agricultural changes.

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Capacity Building Related to Malaria Prevention and Control in Africa

A Case Study (Tanzania)

W. L. Kilama
Director, National Institute for Medical Research
Dar es Salaam, Tanzania

Introduction

The successful prevention and control of malaria in Africa will rely on the ready availability of appropriately trained national manpower working at various levels of the health care systems. This criterion naturally calls for the existence of appropriate local training institutions. Starting at the community or peripheral level, all people will have to be encouraged through health education to participate in all aspects of malaria control, especially in personal protection measures, source treatment, source reduction, and reduction of human vector contact.

Similarly, some recognized and better informed community leaders (e.g. village teachers, traditional birth attendants, traditional healers, etc.) may be further trained and entrusted with greater responsibilities in malaria prevention and control, for example, providing simple diagnosis and early treatment of malaria, if a safe and effective anti-malarial is readily available. The population at the peripheral level should learn to recognize simple clinical signs of malaria and seek appropriate early treatment, at a village health post, nearby dispensary, or health center. In case there is treatment failure the unresponding case should be referred to a district hospital where there are much better facilities and greater experts. Rarely should a malaria case be referred to a regional or referral hospital. It is noted in Table 1 that each level has its particular staffing, as well as differing available anti-malarials; they range from the relatively safe and cheap chloroquine to the newer ones, some of which are still undergoing evaluation.

Malaria being the leading cause of attendance, admissions, and deaths in most health care facilities, this paper assumes that it features prominently in training courses for personnel responsible for its management at the dispensary, health center, and district and regional hospital levels; that is generally the case in Tanzania. This paper will therefore examine possible existing gaps in staffing related to malaria prevention and control, and highlight some of the recent measures undertaken in Tanzania in order to fill the observed gaps. The paper will also examine the role of national health research institutions and their contributions to improving malaria prevention, control, and training.

Table 1. Personnel and Anti-Malarial Drugs Available at Various Health Units in Tanzania

Health Unit	Personnel	Drugs Available
Village Health Post	Rural Medical Aide (RMA) Nurse B Maternal and Child Health Aide (MCHA)	Chloroquine t, s
Dispensary	Medical Assistant (MA) RMA, Nurses B & A Laboratory Auxiliary MCHA	Chloroquine t, s, i Quinine t, i (some)
District Hospital	Medical Doctor Assistant Medical Officer MA, Nurses A & B Laboratory Technician Pharmaceutical Assistant	Chloroquine t, s, i Quinine t, i Fansidar R (some)
Regional and Referral Hospital	Specialist Doctor Medical Doctor Nurses A & B Nursing Officer Laboratory Technician Pharmacist	Chloroquine t, s, i Quinine t, i Fansidar R Metakelfin R Mefloquine (some) Holofantrine (some)

Key: t = tablet, s = syrup, i = injection

Malaria Prevention and Control: From the Community to the District Level

Although Tanzania has only one medical school to train medical doctors and various specialists, there are 14 schools training rural medical aides, 7 training medical assistants, 2 for assistant medical officers, 16 for maternal and child health aides, 35 for training nurses, 1 for pharmaceutical assistants, 1 for pharmacists, 7 for health officers and health assistants, 1 for laboratory technicians and technologists, etc. The Tanzania Ministry of Health has a strong training directorate that ensures that the training for each group is appropriate to the needs and interests not only of the students, but also of the communities served. This directorate, besides ensuring the quality of the training, also makes sure that the output meets the staffing needs of the country. Table 2 shows some of the numbers of staff employed in Tanzania's health care delivery system. Although training in malaria may be adequate initially, the current challenge is to update all these personnel on a field that has changed greatly over the last few years (especially its treatment). Currently, health workers are updated through government circulars, newsletters, seminars, workshops and conferences, and supervisory visits, among other means.

Table 2. Distribution of Select Health Workers by Type of Health Institution (1987)

Occupation	Hospitals	Health Centers	Dispensaries	Ministry of Health	Total
Specialist	255	—	—	17	272
Medical Officer (General)	557	7	—	40	604
Assistant Medical Officer	231	8	—	43	282
Medical Assistant	1,223	388	171	59	1,841
Rural Medical Aide	223	526	2,327	3	3,079
Pharmacist	110	1	—	46	157
Pharmaceutical Assistant	135	18	—	12	165
Pharmaceutical Auxiliary	126	27	44	—	197
Laboratory Technician	314	4	—	26	344
Laboratory Assistant	337	99	—	4	440
Laboratory Auxiliary	64	146	81	—	291
Health Officer	264	32	—	28	324
Health Assistant	294	347	557	58	1,258
Nursing Officer	2,320	1-5	—	196	2,621
Nurse (B) Total	4,372	587	665	29	5,653
Nurse Assistant	5,428	1,162	4,100	—	10,690
MCH Aide	174	4	1,793	—	2,441

The Need for Preventive Courses

As is evident from Table 2, the number of nonclinical personnel who could be engaged in malaria prevention and control (e.g. health auxiliaries, health officers) is abysmally low. A Ministry of Health review carried out in 1983 partly attributed malaria control failures to the shortage of personnel with adequate knowledge and skills in malaria control — the course of malaria assistants was discontinued in the mid-1960s when the malaria eradication concept was discarded. By 1983 all the malaria assistants who had been trained before that time were due to retire (Kilama, 1983). The same review showed that there were no malariologists, medical entomologists, or malaria engineers in the service of the Ministry of Health; all these positions had previously been occupied by expatriate staff.

Given the need for staff to replace the former malaria assistants, malariologists, medical entomologists, and malaria engineers, Tanzania developed two rather unique courses: the Diploma in Vector Control and the degree of Master of Science in Tropical Diseases Control.

(MSc TDC). In both of these courses a whole range of similar health problems (including malaria) is covered instead of the narrow spectrum that characterized the malaria eradication era.

Diploma in Vector Control

The Tanzania Ministry started the Diploma of Vector Control in July 1986 after realizing that:

- the health officer (i.e., sanitation, health inspector) cannot adequately manage vector control programs because they are becoming increasingly complex;
- the supply of postgraduate medical entomologists is bound to fall very short of the needs of such a large country; and
- the currently available postgraduate medical entomology courses have obvious shortfalls.

The one-year Diploma in Vector Control is intended for experienced health officers, and aims at improving and raising their knowledge and technical skills, so as to ameliorate the quality and coverage of vector control activities in the country (Ndawi, 1988). The comprehensive training course offers unique opportunities to prepare health officers who can plan, organize, implement, coordinate, monitor, and evaluate vector control activities at the level of the district or in a large urban area (Ministry of Health, undated).

Table 3. Arrangement of Blocks in the Diploma in Vector Control Curriculum

Block 1		
Unit	Subject	Hours
I	Biology and ecology of vectors and freshwater snails	230
III	Vector-borne diseases and laboratory diagnosis	120
IV	Research methodology, epidemiology, and biostatistics	170
		Total 520
Block Examinations		
Two Week Breather		
Block 2		
Unit	Subject	Hours
II	Control of vectors and snails	300
V	Sociology, health education, and primary health care	150
VI	Management	60
		Total 510
Block Examinations		
Block 3		
	Six weeks for field project and report writing	
	Two weeks for final examinations	

Table 3 shows the arrangements of teaching blocks in the course curriculum, and Table 4 is a more detailed presentation of the course content. In general there is equal allocation of time for theory and practice; time is also set aside for experience in ongoing vector control programs. Candidates for the course should have the following qualifications:

- National Form IV Certificate (i.e., O Level) or above
- Diploma in Environmental Health
- at least two years of service as a health officer
- should not be more than 45 years of age.

Table 4. Diploma in Vector Control Course Content

	Subject	Hours
1	Introduction to entomology	20
2	Mosquitoes	60
3	Tsetse	35
4	Ticks	30
5	Other vectors: fleas, blackflies, sandflies, biting midges, tabanids, houseflies, myiasis, sucking lice, cockroaches, bedbugs, redviid bugs, venomous arthropods	35
6	Freshwater snails	60
7	Principles of vector and snail control	20
8	Environmental management	80
9	Chemical control	80
10	Biological control	20
11	Control methods for specific vectors and snails	100
12	Vector-borne diseases and diagnosis	120
13	Research methodology	70
14	Epidemiology	60
15	Biostatistics and demography	60
16	Sociology	30
17	Health education	70
18	Primary health care	50
19	Management	60

A full write-up on the course may be obtained from:

The Principal
Vector Control Training Centre
P.O. Box 1475
Tanga, Tanzania

or

The Director of Training
Ministry of Health
P.O. Box 9083
Dar es Salaam, Tanzania

MSc, Tropical Diseases Control

The lack of well-trained workers to design, plan, organize, and manage tropical diseases control programs appropriate to the local situation led the Faculty of Medicine at the University of Dar es Salaam, working in close consultation with the Ministry of Health, to launch the Master of Science degree course in Tropical Diseases Control, called MSc(TDC) for short.

According to a Faculty of Medicine (undated) document, graduates from the course would be employed as members of multi-disciplinary teams in ministries of health, and in research and teaching institutions, where they would play a leading role in:

- carrying out community diagnosis and identification of priority health problems for relevant research and control;
- carrying out scientific investigations on specific aspects of endemic and epidemic tropical diseases;
- designing, implementing, and evaluating appropriate disease control programs in epidemic situations and in endemic areas; and
- mobilizing the population in question for community participation in control and/or prevention programs.

The initial groups of graduates have generally been employed at the national level.

The MSc(TDC) is an interdisciplinary course conducted by the departments of behavioral sciences, community health, epidemiology/biostatistics, microbiology/immunology, and parasitology/entomology. Although this course draws heavily from the relevant biomedical disciplines in order to provide students with a thorough knowledge of the etiology, pathology, and resulting disabilities, as well as the underlying principles of tropical diseases control, it also includes aspects of behavioral sciences, community health, and health economics so as to provide a comprehensive understanding of the social and economic conditions that can lead to success or failure of control programs. In order to equip students

with the necessary tools and skills to do research, evaluate control programs, and assess research reports, teaching in research methodology and in biostatistics features prominently.

The MSc(TDC) course takes two years, the first year being predominantly devoted to course work (theory, practicals, and field work). Students must take one major option in either parasitology or epidemiology; they also spend two months attached to ongoing relevant control and/or research projects within Tanzania. The second year of the MSc(TDC) course is devoted to research projects, data analysis, and writing of a dissertation.

The course, which was launched in July 1986 with support from the World Health Organization's Special Program for Research and Training in Tropical Diseases (WHO/TDR), admits only university graduates from various disciplines. Previous students have held first degrees in medicine, natural or social sciences, engineering, etc. Students for the course have been drawn from several African countries; some have undertaken research on malaria for their compulsory dissertations.

Diploma in Public Health Engineering

This course is offered by the Ardhi Institute in Dar es Salaam, and is open to Form VI leavers (i.e., those with an A Level) with a scientific background. Graduates from this three-year course are employed by local governments, the Ministry of Health headquarters and its training institutions, and some development projects.

Diploma in Public Health

This one-year postgraduate course offered at the Faculty of Medicine, Muhimbili Medical Centre, is open only to medical graduates, especially those wishing to pursue a career in the administration and management of health services. The course has a significant malaria component. Many of its graduates administer health services at a district or even regional level. A few eventually become decisionmakers at the national level.

Master of Medicine in Community Health

This three-year postgraduate course is open only to medical graduates who wish to have a career in public health. Some candidates for this degree have written their dissertations on malaria.

Lower Level Preventive Courses

Although the Tanzanian Ministry of Health offers several lower level preventive courses, two are particularly relevant to malaria prevention and control: those for health officers and for health assistants.

The prerequisite for the health officers' course is secondary school, with 12 years of science subjects. The three-year course produces very broad-based workers who are capable of working on the control of mosquitoes and other vermin. After some experience, they are

capable of leading vector control teams. Candidates for the Diploma in Vector Control are drawn from such personnel after several years of experience.

Health assistants are usually primary school leavers, although some are secondary school graduates. The preservice health assistants course is also broad based, producing workers who are competent in routine malaria vector control. Since the majority of health assistants are deployed at the peripheral level, they are the ones who are most likely to interact closely with target communities, to offer health education, and to elicit desirable outcomes.

A health assistant, even if based at a dispensary, has to cover several villages. Ideally each village would have a voluntary Village Health Worker (VHW) with whom the health assistant works closely. The VHW would play a crucial role in the treatment of simple malaria, in providing chemoprophylaxis to vulnerable groups, and in malaria vector control. VHWs, who are normally primary school leavers, are trained mostly on practical aspects, within their districts of employment.

Research Institutions

Several institutions in Tanzania undertake research on various aspects of malaria. They include the National Institute for Medical Research (NIMR), the Muhimbili Medical Centre, and the Zanzibar Ministry of Health, as well as the Swiss Tropical Institute Field Laboratory at Ifakara, and other institutions. This paper will review only the role played by NIMR by outlining some of the malaria research activities undertaken by the Institute and the other roles it has played especially in malaria training, research promotion, and research coordination.

National Institute for Medical Research

The National Institute for Medical Research (NIMR), which became operational in 1980, is responsible for carrying out, controlling, coordinating, and promoting medical research in Tanzania.

Malaria being the most important disease of humans in Tanzania, it has been accorded foremost priority in the Institute's research agenda. Although early studies focused mainly on biomedical problems, as the Institute gained experience, greater prominence was accorded to epidemiological and intervention studies. For example, some of the recent studies undertaken by NIMR have focused on:

- factors accounting for malaria control failures in urban Tanzania;
- detection, measuring, mapping, and monitoring of the sensitivity of *Plasmodium falciparum* to anti-malarial drugs;
- optimum treatment schedules for *P. falciparum* in areas of chloroquine resistance;
- noncompliance to chemoprophylaxis;
- malaria chemosuppression in pregnant women;

- field evaluation of new diagnostic techniques; and
- field trials of vector control using:
 - new residual pyrethroids (inside of homes),
 - pyrethroid-treated textiles/fabrics, and
 - biological control.

The studies outlined above have contributed Tanzania's malaria control efforts in various ways:

- Recommendations from the study of malaria control failures led directly to the launching of the Diploma in Vector Control course, improved staffing of the Ministry of Health's Malaria Control Unit, and increased funding of malaria control activities. The founding of the MSc(TDC) course was partly a response to these studies.
- The studies of malaria parasite sensitivity to anti-malarials led the Ministry of Health to revise malaria treatment schedules, including the introduction of a three-dose treatment with chloroquine, diversification of anti-malarials made available, and the adoption of drug combinations in treatment.
- Results concerning noncompliance to malaria chemoprophylaxis contributed to changes in malaria chemoprophylaxis policy.
- The ongoing study of chemoprophylaxis in pregnant women may influence future decisions about the provision of chemoprophylaxis to such vulnerable groups.
- Studies on field trials of vector control have led to the provision of pyrethroid-treated mosquito bednets to pregnant women and young children by UNICEF (Tanzania) in Zanzibar and the Pemba Islands, and in one large area on the Tanzania mainland. A new pyrethroid tested by the Institute (WHOPES III) is being considered for adoption by the Ministry of Health in mosquito malaria control.

The early years of the Institute were mostly devoted to capacity-building in terms of personnel directly involved in research. Effective as of July 1991, the Institute started a Health Research Coordinating Unit, which, among other things, will:

- produce a national health research newsletter;
- organize annual scientific conferences;
- organize a Tanzanian Essential National Health Research workshop;
- facilitate networking of researchers working on similar research problems;

- undertake inventories of research activities underway, and specialized research facilities; and
- strengthen the NIMR Medical Research Coordinating Committee.

Also to be established in the near future is the Health Systems Research Unit within the Institute. The Institute, by establishing the two units, will better communicate research results, avoid duplication of scarce resources, promote networking of researchers, and in general optimize research activities within Tanzanian institutions.

The National Institute for Medical Research (NIMR) is also involved in training. NIMR staff are the main teachers on:

- the Diploma in Vector Control course;
- the International Training Course on Basic Malariology and Malaria Control (a WHO course for all Anglophone African countries, held in 1988 and 1990); and
- the International Course on Epidemiology and Control of Filariasis (supported by DANIDA, the Danish International Development Agency, during 1990 and 1991).

NIMR staff also teach some courses at the Muhimbili Medical Centre, and elsewhere in the country. Such teaching helps to propagate some of NIMR's research results, and to strengthen links between researchers and research clients.

Conclusion

The author, using Tanzania as a case study, has attempted to show that many categories of workers involving thousands of employees in the health sector deal with malaria, especially in clinical settings. He has also indicated that there are a few categories of staff deployable for malaria prevention and control outside the clinical setting.

Unfortunately, these workers lack managerial capabilities and can only deal with malaria control at the periphery. In Tanzania considerable efforts have been invested in developing human resources capable of managing malaria control and preventive teams at the national level (the MSc-TDC graduate) and at the district level (the holder of the Diploma in Vector Control). These trainees, although specialized, are capable of attacking many major health problems, unlike the anti-malarial cadres of the malaria eradication era who only specialized in malariology and malaria control.

The role of a national research institution has also been cited as making valuable inputs into decision- and policymaking. Research results have been used at various levels of the health care system, whether in malaria chemotherapy, chemoprophylaxis, or malaria mosquito vector control. The paper further presents the vision of a national health research institution trying to reach out beyond its own boundaries.

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Malaria Control in Tanzania and the Role of the Ministry of Community Development, Women Affairs and Children

Bernadette C. Kinunda
Community Development Officer
Dar es Salaam, Tanzania

Foreword

The existing data show that malaria affects an estimated 270 million people in the world and causes one to two million deaths every year, primarily among children and pregnant women. It is one of the leading causes of deaths, disability, and illness in the world. Therefore, control of this disease calls for multisectoral collaboration as indicated in the American Association for the Advancement of Science workshop objectives.

The problem of malaria in Tanzania has been and continues to be the most challenging of health problems. Available statistics suggest that malaria has always accounted for the great majority of outpatient attendance and hospital admissions and many deaths in health institutions. The total burden of malaria can be appreciated in its true perspective if one also takes into account other factors such as costs of equipment and supplies including drugs, hospitalization, medical personnel emoluments, and other social and economic indirect losses, such as time wasted by family members while attending their sick. Malaria therefore is a number one public health problem for this country and in fact remains the most important communicable disease the government of Tanzania has dealt with.

Previous efforts to control this disease in Tanzania have met a number of challenges, including the following:

- inadequacy of necessary resources including skilled manpower, due to the unfavorable economic environment that has prevailed in the country;
- lack of clear and up-to-date technical guidelines in the control of malaria, partly resulting from incomplete and therefore inadequate information and data;
- technical complexities, such as increasing parasite resistance to drug and vectors to chemicals, costly and ineffective vector control methods, improper drug use in malaria suppression and treatment, as well as absence of malaria vaccine;

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- absence of an integrated approach to malaria control, lacking intersectoral collaboration and community participation; and
- lack of legislative support in malaria vector control activities because of antiquated laws and by-laws.

In an effort to address this serious situation, the government has finally decided to develop a specific five-year program for malaria control. In the formulation of the program the following key points have been considered:

- strong national commitment primarily for adequate resource allocation;
- clear and up-to-date technical guidelines on malaria control;
- adequate management capabilities including proper manpower development;
- an integrated and coordinated approach to malaria control; and
- proper community mobilization and participation.

The government believes that the current malaria control program, which incorporates the above points, will go a long way toward directing and consolidating the successful control of this disease. While it is appreciated that malaria control is an expensive venture, the government of Tanzania will continue to avail itself of opportunities for resource development necessary for success.

Introduction

This paper is an attempt to discuss the problem of malaria in Tanzania. The paper is organized into four sections. Section one deals with background information on Tanzania, which includes geography, population, language, religion, administration, and economic activities. Section two presents the National Health Policy in Tanzania and its strategy for implementation. The magnitude of the problem of malaria and previous efforts to control the disease are discussed in section three. Section four is the discussion of the role of the communities in malaria control.

Background

Geography

The United Republic of Tanzania is a unitary state located on the eastern coast of Africa and lies between 1° and 2° south of the equator and 30° and 40° east longitude. It shares borders with Kenya and Uganda to the north; Zambia, Malawi, and Mozambique to the west; and the Indian Ocean to the east. It has an area of 945,050 km² (including 59,050 km² of water) all of which, except 900 m of coastline, lies at an altitude of over 300 m above sea level. In the north, Mount Kilimanjaro rises to about 6,000 m while a low-lying highland runs southwest from the coast to Lake Tanganyika and Zanzibar. It lies between 1° and 2° south of the equator and 30° and 40° east longitude. It shares borders with Kenya and Uganda to the north; Zambia, Malawi, and Mozambique to the west; and the Indian Ocean to the east. It has an area of 945,050 km² (including 59,050 km² of water) all of which, except 900 m of coastline, lies at an altitude of over 300 m above sea level. In the north, Mount Kilimanjaro rises to about 6,000 m while a low-lying highland runs southwest from the coast to Lake Tanganyika and Zanzibar.

Usambara Mountains behind Tanga to the highlands around the tip of lake Nyasa. Most of the country, however, is in the form of plateau of about 1,000 m high.

The rivers draining the land flow into the Indian Ocean or the great lakes (Victoria, Nyasa, and Tanganyika). The predominant vegetation is woodland, bushland, and wooded grassland. The above-quoted geographical information has a significance for the prevalence and incidence of communicable disease, especially malaria.

Population

According to the 1988 census, Tanzania has a total of population of 23 million.

Language and Religion

Kiswahili is the national and official language spoken by almost all the people. Tanzania has three major religious groupings: Christian, Muslim, and Traditionalist.

Administrative Organization

Tanzania has 20 regions and 106 districts. Each district usually divided into four to five divisions, which, in turn, are composed of three to four wards, each with four to five villages. There are about 8,500 villages.

Economic Activities

The economy of Tanzania is characterized by distinct economic structures, consisting of a large, traditional rural sector. This sector is essentially concerned with the growing of food and cash crops, the latter entailing also manufacturing and service activities.

Health Policy

The National Health Policy stems from the Arusha Declaration of 1967. The policy aims to extend basic services to the whole country equally using available resources. The following strategies have been adopted in order to implement the health policy:

- Formulate and implement promotive and preventive health programs.
- Build health centers, each to serve 50,000 people, and a dispensary for every 10,000 people.
- Train adequate numbers of mid-level health workers.

Generally the policy has been well implemented, and, as a result, between 1972 and 1980 the number of health centers rose from 100 to 239, while the number of dispensaries rose from 1,500 to 2,600. These dispensaries play an important role in the treatment and control of malaria.

As for vector manpower development, the government of Tanzania opened in Tanga a postgraduate health officer Vector Control Training Centre with an emphasis on malaria vector control. Research in malaria control activities is carried out at Amani Medical Research Centre, Tanga, under the National Institute of Medical Research. Other institutions involved are the Muhimbili Parasitology/Entomology Department and the Swiss Tropical Institute Field Laboratory (STIFL).

Control of Communicable Disease

In most of the developing world, Tanzania inclusive, communicable diseases remain the leading cause of morbidity and mortality. This is especially true in the vulnerable groups, which include children under five years and pregnant women. The major causes of morbidity and mortality in Tanzania are the communicable diseases mostly associated with poor sanitation and water supply, poor nutrition, and inadequate knowledge.

Historical Background of Malaria in Tanzania

The Malaria Situation in Tanzania

Malaria is among the leading public health problems in Tanzania, remaining the most challenging of all communicable disease in the country. It is the major cause of morbidity; it is also one of the top causes of deaths. Hospital figures show that 10 to 15 percent of all outpatient attendance and up to 10 percent of total admissions are due to this disease (see appendix).

A. the health centers and dispensary level, malaria has accounted for 28 to 30 percent of all outpatient attendance between 1935 and 1988. A death rate of up to 5 percent has been attributed to malaria in admitted cases in hospitals. The disease is particularly dangerous to children and pregnant women. In the latter the disease may lead to gross anemia, miscarriage, still birth, or low birth-weight babies.

Efforts to Control Malaria

Malaria control in Tanzania started in the early 1900s. The attack on malaria parasites was carried out through a mass administration of quinine, while malaria mosquito larvae were destroyed by the application of kerosene on stagnant water. Adult mosquitoes were killed by the application of pyrethrum spray on inside surfaces of houses. Later, during the 1920s, swamps were drained.

The Research and Training Institute for Malaria was established after World War II. In 1963 mosquito control activities were integrated into the general urban health services to improve implementation. The Tanganyika Malaria service, later transformed into the Malaria Unit, initially only undertook advisory and technical responsibilities, but, through time, as it lost most of its trained and experienced manpower, its role became limited to procurement of spraying equipment and insecticides. The unit's activities have, however, been very greatly

hampered by the inadequate number of personnel such as medical officers, entomologists, and sanitary engineers.

Decentralization of government machinery to the regional and district levels was another blow to anti-malaria vector activities. Responsibility for urban centers and minor settlements was taken over by divisional and sub-divisional authorities thus usurping townships' and minor settlements' control over anti-mosquito breeding activities. Furthermore this decentralization provided the new authorities with inadequate funding and therefore allowing them to undertake only the lowest level activities.

In 1973 to 1979, the Ministry of Health, with a World Health Organization (WHO) inter-country team, organized a country-wide anti-malaria program that implemented indoor residual insecticide spraying in malarious, rural areas, and larviciding in urban areas coupled with chemosuppression for the vulnerable groups. It was termed a "Concurrent Multipath Approach Method." The program covered six regions before being withdrawn in 1980 because of financial constraints.

In 1979 the Commonwealth Regional Health Secretariat, based on Arusha, organized a workshop in Dar es Salaam for all countries of East Africa on other possibilities of controlling malaria through an integrated approach. This was another attempt by concerned authorities to address the problem of malaria in Tanzania.

Earlier on, during 1984 and 1985 to 1985 and 1986, the Ministry of Health, in collaboration with the Dar es Salaam and Tanga urban councils, conducted a small-scale pilot project with the aim of promoting environmental sanitation through community participation, as a malaria control measure in urban areas.

For vector manpower development, the Ministry in 1987 opened a postgraduate health officers vector control training center in Tanga, with emphasis on malaria vector control. Recently, the government of Tanzania, through a grant from Japan, started an urban malaria control program operating in Dar es Salaam and Tanga. Experiences gathered in this year-long project will greatly contribute to current efforts to revive and reorganize the anti-vector component of malaria control in Tanzania.

From the above efforts we realize that mosquito control in Tanzania has been mainly confined to urban areas. The programs have a tendency to be vertical and specialized, divorced from the other activities of health care delivery system and community participation.

Currently a national malaria control program has been revived in the country; it aims to strengthen clinical services, improve information, education, and communication, to promote vector control with emphasis on personal protection, source reduction, and treatment through community support. Management and organization services are included to address managerial problems. Research on malaria and its vectors continues to be performed by the National Institute for Medical Research Centres.

However, the prevailing malaria control situation described above has a number of shortcomings with respect to proper control. Deficiencies are seen in both technical and operational areas. A.1 uncondusive socioeconomic environment coupled with sectoral problems have resulted by and large in malaria slowly getting out of hand. Repeated efforts to address the situation have achieved only minimal results, basically because of insufficient resources and uncoordinated efforts.

The Role of Community Development and Other Sectors

The goal of good health cannot be attained by the efforts of the health sector alone. Other sectors like economic planning, agriculture, water, sanitation, environmental protection, community development, land planning, and communication all contribute to health and have the same goal of improving the quality of life of the general population.

The need for sectoral coordination results from the recognition by organizations that malaria, by undermining the health and working capacity of all age groups, interferes with education, affects the output of a rural population engaged in agriculture, and represents a serious obstacle to industrial development in most countries of the developing world. Intersectoral activities need to be coordinated at all levels.

The Role of the Ministry for Community Development, Women Affairs and Children

Awareness of a given phenomenon in a community is indeed the most important step in winning the willingness and support of the people to participate effectively in intervention programs designed to deal with a community's socioeconomic problems.

Therefore, the success of community-based programs such as malaria control depends on the extent to which the people (beneficiaries) are knowledgeable about the cause and magnitude of the malaria problem in their respective environments.

In Tanzania the Ministry for Community Development, Women Affairs and Children is responsible for ensuring that communities are involved in program implementation from the initial stage. This means communities have to become involved in problem identification, assessment, analysis, implementation, and evaluation.

As far as malaria control is concerned, the Ministry has the following responsibilities:

- Organize advocacy meetings to create awareness about the problems of malaria among the top leadership of the Party and the government in order to secure necessary will, commitment, and support for the program.
- Organize public meetings at the community level for the purpose of creating awareness among the communities about the problem of malaria.
- Involve the community in planning for activities concerning control of malaria.
- The Department for Training and Mass Media within the Ministry will prepare radio programs to carry malaria messages to the community.

- At the village level the community development extension workers will implement the following tasks:
 - Strengthen cooperation among community and malaria workers.
 - Advise the community to select appropriate building sites away from large and permanent breeding areas of mosquitoes.
 - Promote the use of repellents, bednets, and house screening.
 - Encourage the community to undertake peri-domestic sanitation within their localities.
 - Carry out intermittent emptying of water containers, filling up drying ponds, draining pools and plant water, drying trees, and removing weeds from water sources.

The Role of Women

Women are the primary health care providers. They attend to the sick in their families. They take children to clinics for preventive services and for outpatient treatment for sickness that they cannot cure. For a long time women have played a crucial role in control of malaria, especially during pregnancy. At the household level, they are the ones who dispense chloroquine to the sick. Therefore, women should be given proper training in malaria control, and supported during its implementation. The department for Women Affairs and Children within the Ministry will implement the following:

- Persuade women to take chloroquine for prophylaxis during pregnancy.
- Educate women on the importance of protecting children from mosquito bites, particularly at night.
- Train women to recognize usual malaria fever symptoms.
- Assist women to seek prompt care/treatment as well as post-illness care.
- Ensure that sick persons, e.g., children, take prescribed drugs correctly.
- Involve women's groups in implementing the anti-malarial activities in their homes and communities at large.

Development Factors Relating to Malaria Prevention Positively or Negatively

There are various development factors that sometimes affect malaria control. Such effects may be positive or negative. The following are a few examples of such factors.

Agriculture

Due to land scarcity or soil infertility, people from one area tend to migrate to another area for cultivation. Sometimes people migrate from malarious zones to non-malarious zones or

vice versa. This action can affect malaria transmission, and make malaria control difficult. Irrigation schemes can also have a negative impact on malaria control.

Education and Employment

Education systems in most African countries have a tendency of drawing students from one area and sending them to others. In many cases, such students, especially those from malaria-free zones, become affected by malaria. The same situation applies to employment.

Transportation System

Transportation systems within the country also have the impact of ferrying mosquitoes from one area to another. This phenomenon compounds the difficulty of controlling malaria.

Development of Towns

Poor town planning often results in poor sewage systems that are ideal spreading grounds for mosquitoes.

Policymaking

How to Influence National and Local Governments and Donors

- Organize sensitization seminars and meetings for government officials and donors, to create awareness of the magnitude of the problems.
- In these meetings or seminars, concrete data and specific examples of the impact of malaria on the development of the community should be thoroughly discussed.

Recommendations

The control of malaria in Tanzania poses quite a significant challenge. This challenge should be addressed at several levels, including:

The national commitment

For a successful malaria control program both party and government commitments at the highest levels are essential. A firm national commitment is paramount in order to allow the necessary deployment of resources required.

Policy guidelines

Malaria control requires terms of reference, and these can be found in a clear policy statement and/or valid guidelines, which are not confined only to the health sector but implemented by all sectors involved.

A community-based approach

Full-fledged community participation will be required since malaria is actually a community problem.

Legislative support

Finally, the use of legislative support is necessary to promote community cooperation in anti-malarial activities in that community. It is critical for the community to receive legislative support in order to sustain malaria control efforts.

Health Committee on Water Resources Development, Ghana

E. Laing
Chairman, Health Committee on Water Resources Development
Accra, Ghana

Summary

This paper reviews the establishment and functioning of the Health Committee on Water Resources Development (HCWRD) of the Ministry of Health, Ghana. We attempt to distill from the experiences of HCWRD lessons on how to implement and sustain cross-sectoral collaboration.

Origins

The development of water resources began in Ghana in the early sixties; however, with the increase in human population and the need to improve agricultural production, water development efforts have been intensified, primarily to provide water for human and animal consumption, for irrigation and food production, and for provision of energy or hydro-electric power. These developments inevitably bring with them health hazards, for example, increases in incidence of malaria, bilharzia, and river blindness. (Ayalde, 1990; Birley, 1989; Clyde, 1987; FAO, 1987; Haworth, 1987; Najera, 1989; Regional Committee for Africa, 1986). These diseases are already endemic in our part of the world. But there are appropriate methods of combatting them through sound planning, design, construction, and operation of water development projects and also through various public health measures (Hunter, Rey, & Scott, 1982; Litsios, 1987).

The ecological nature of the problems raised by water resource development necessitates close collaboration and cooperation of health personnel, agriculturists, economists, planners, and engineers (and other specialists) together with informed cooperation on the part of communities, at all stages of water resource development, from the planning to the operation of projects (Bos, 1990; Litsios, 1987; PEEM, 1990; Tiffen, 1989; WHO, 1982). Prevention of such environmental problems is much cheaper than cure. It was to ensure the early identification of possible health hazards at each stage of the development of water resource projects that the Ministry of Health, after consultation with other Ministries, established the Health Committee on Water Resources Development.

The Committee was inaugurated in Accra by the Commissioner of Health, on August 21, 1979, with the press in attendance.

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Terms of Reference

The Commissioner spelled out the responsibilities:

- to examine the health implications of proposed water development projects and to make appropriate recommendations. The Committee was to examine immediately and advise on the health implications of the Kpong, Weija, Tono, and Veia among other existing water projects;
- to determine the resources required for improving the health of those who have been adversely affected as a result of ongoing water development projects;
- to encourage, promote, and stimulate research by appropriate agencies on the health problems arising from water resource development;
- to disseminate information on those health problems to the appropriate agencies and to indicate the action to be taken;
- to monitor the implementation of any recommendation from the Committee; and
- to undertake any other relevant duties as necessary.

Composition

In view of the complex ecological, health, and socio-economic implications of water resource development, the Committee was made multisectoral and multidisciplinary, with representation from the following institutions:

- Ministry of Health
- Irrigation Development Authority
- Volta River Authority
- Ministry of Finance and Economic Planning
- Environmental Protection Council
- Institute of Aquatic Biology, Council for Scientific and Industrial Research
- Water Resources Research Institute, Council for Scientific and Industrial Research
- Environmental Quality Division, Civil Engineering Department, School of Engineering, University of Science and Technology, Kumasi
- Ghana Water and Sewerage Corporation
- Department of Community Health, University of Ghana Medical School

Coopted members were drawn from:

- The Schistosomiasis Unit, Ministry of Health
- World Health Organization
- Ghana Water and Sewerage Corporation
- University of Ghana Medical School
- Food and Agriculture Organization

Activities

In the early years the Committee held monthly meetings, which enabled members to familiarize themselves with the kinds of problems in their remit. Discussions centered on background papers offered by members or specially requested by the Committee. Other items for discussion arose out of relevant documents that came to the notice of individual members.

Reports discussed by the Committee included:

- The WHO Schistosomiasis Research Project on the Volta Lake
- Small-Scale Survey on the Weija Dam
- The Tono Dam Irrigation Area, Upper Region
- The Health Implications of the New Weija Dam
- Report from the Environmental Protection Council on Combatting of Certain Hazards from Water Resources Development
- Schistosomiasis and Water Development with Record of Some Infested River Basins in Ghana
- Water Resources Development and Health
- A Brief Description of Irrigation Projects of the Irrigation Development Authority
- Ghana Water and Sewerage Corporation: Report on Weija Water Project
- Draft Water Pollution Decree
- Environmental Impact Statement Questionnaires
- Possible Evaluation Criteria for Activities of the Health Committee
- Upper Region Agricultural Development Programme: Annual Report, 1978

- Health Impact of Irrigation Development
- Draft Health Services Bill
- Report of a Reconnaissance Survey of the Weija Lake, 1980
- Report on Workshop on Education for Protection against Schistosomiasis and Onchocerciasis, 1980
- Law and Integrated Environmental Management
- Participatory Planning Process — A Community Planning Project in Sweden

The Committee addressed recommendations arising from its discussion to the following agencies and individuals:

- the Ghana Water and Sewerage Corporation, on Health Aspects of the Weija Reservoir Project;
- the Director of Medical Services, on:
 - The Involvement of the Ministry of Health in the Irrigation Projects at Kpong and Asutsuare
 - Health Services for the Weija Resettlement Area
 - Health Committee on Water Resources Development: Some Guidelines for Health Effect Assessment
 - Request for Schistosomiasis Survey on the Dawhenya and Ashiaman Irrigated Farms; and to
- the Irrigation Development Authority on the proposal for Health Education on Schistosomiasis for Irrigation Workers/Farmers at Ashiaman and Dawhenya and the Women's Mud Plot at Dawhenya.

The Committee also paid visits to the Weija Water Works and resettlement area, and to the Ashiaman and Dawhenya irrigation sites.

The Committee has held various workshops and seminars. The most important were:

- Some Important Aspects of Water Resource Development and Use in Ghana, August 1981

Papers prepared:

- Health Policy on the Health of People Affected by Water Resources Development
- Health Problems Related to Water Resources Development
- Hydrobiological Consequences of Impoundments
- Programmes for Irrigation (Past, Present, and Future)

- The Environmental Impact of the Weija Lake, October 1981

Papers prepared:

- Management of the Weija Reservoir
- Water Quality and Some Limnological Studies of the Weija Lake
- The Fishery Potential of the Weija Lake
- Health Aspects of the Weija New Dam
- The Impact of the Weija Lake on Resettlement
- Aquatic Weed Control on the Weija Lake
- Some Ecological Impacts of the Akosombo Dam on the Lower Volta Basin

Various people, especially university students of community health and ecology, have found the reports of the symposia useful.

In the late 1980s the whole country faced harsh economic conditions. The Committee found it difficult to arrange formal meetings, although members often met at other venues, such as meetings arranged by the Institute of Aquatic Biology. (The Committee was particularly constrained by inadequate secretarial assistance.) Plans are afoot to resume formal meetings.

In the interim, members of the Committee have been performing related activities for other Committees, some of which we recount below. In February 1990 the Committee hosted Dr. Anne Mills of the London School of Economics and the London School of Hygiene and Tropical Medicine. Dr. Mills gave a seminar to the Department of Economics, University of Ghana, on cost effectiveness analysis (Mills, 1990) and discussed a draft of her manuscript on cost effectiveness assessment (Philips, Mills, & Dye, 1990) with some members of the Committee. In November 1990 the Committee hosted Dr. R. Bos, the Secretary of the Panel of Experts on Environmental Management for Vector Control (PEEM). Dr. Bos introduced some members to the work of PEEM and discussed possibilities for cooperative research with various research groups in Ghana.

With the cooperation of the Vice-Chancellor of the University of Science and Technology (Kumasi), the Dean of the School of Engineering, and the Head of the Department of Civil Engineering, the Committee played a catalytic role in the Department introducing health aspects of water resource development into the course for engineers in the Department of Civil Engineering during the 1988 to 1989 academic year.

The Committee has served as an avenue for the distribution of publications of PEEM to various units within Ghana.

Recent Developments

The Environmental Protection Council has recently been discussing various proposals for an Environmental Action Plan for Ghana. The discussions have involved both professionals and representatives of District Assemblies and of NGOs from all parts of the country; some members of the Committee have played active roles in these discussions, especially in the

areas of environmental and health impact assessment, environmental education, and health education. Similarly, Sectoral Technical Committees for Natural Sciences, for Social Sciences, and for Health, and the Council for Scientific and Industrial Research have drawn up proposals for a National Science and Technology Policy and Plan, with components covering water resource development, water supply and sanitation, and environmental and health education. Members have been involved in these committees as well. An important suggestion in these discussions concerns the establishment of a Water Resources Council to oversee and coordinate all aspects of water resources in the country.

An interesting and welcome development in the management of a common water resource was initiated in 1989 by the Institute for Aquatic Biology, with the support of the Commonwealth Science Council. All the agencies and district authorities in the Densu River Basin (around and just to the north of Accra) were invited to share their experiences and information on constraints in the management of water and waste in their respective territories, and to learn how the scientific and executive agencies could help them to manage better. The collaboration has been fully accepted by the communities and their leaders, and there are already signs of improvement in the healthier and more environmentally sound management in the Densu River Basin. The success so far encourages the hope that the approach will be extended to other river basins in Ghana.

Role of District Assemblies and Their Planning Committees

By Local Government Law, 1988 (PNDCL 207) (Ghana Government, 1989), a District Assembly exercises political and administrative authority in the district and provides guidance and gives direction to and supervises all other political and administrative authorities in the district. In short, it exercises deliberative, legislative, and executive functions. This includes, among other things, preparing and submitting to the government the development plan and budget for the district, ensuring effective use of the resources of the district, social development, development of basic infrastructure (which should include water and health amenities), and management of human settlements and the environment (Section 6). The role the district assembly plays in the area of mitigation of adverse impacts of water resource development is thus clear.

The Planning Committee is to guide and coordinate local communities and all other agencies (Section 15 Development, Planning and Budgeting Unit of Assembly). The assembly is empowered to seek technical advice from professionals in the district. With the necessary collaboration of all concerned, then, the Planning Committee should be able to incorporate adequate public health and other preventive measures in developmental projects and in other activities of the community. However, as has been observed by Woode (1989), the low status accorded local government in the eyes of the public should be corrected; other attitudinal improvements are needed as well to recruit well-qualified persons for the service, to reward service adequately, and to let the community appreciate better the vital community health services local government provides for their benefit.

Role of Community Participation

Many developing country communities inevitably require community participation to supplement the efforts and actions of government. The public, particularly, has a contribution to make in the management or proper use of amenities for housing, water supply, and sanitation. Further, sustained good management by the community requires some commitment on its part, which comes when members are involved in decision-making and implementation in the provision of the desired facilities (Coker, 1986; Werner, 1984). Local knowledge, values, and practices may determine acceptability of facilities intended to help the community. Continued interaction and communication between government officials and the beneficiaries of the social projects are thus important.

Role of NGOs

Similarly, assistance in various ways by NGOs is welcome to supplement local resources. The usual multiplicity of such NGO efforts, however, needs careful coordination and guidance for full effectiveness. In the area of water resource development in Ghana, the Water Resources Research Institute is entrusted with coordination of the contributions of NGOs.

Lessons

A few lessons emerge from the experience of the Health Committee on Water Resources Development as to how to implement and sustain cross-sectoral collaboration.

- The collaboration itself should be as adequately funded as the concerns of the individual agencies or participants in the collaboration (Laing, 1989); it appears that without adequate funding, collaboration immediately breaks down when financial resources become scarce, and participants jealously guard their own resources. As a corollary, successful collaboration should be included in the criteria for evaluating the performance of both the group and the individual collaborators.
- For respectability, authoritativeness, and fuller commitment, the highest officers in the collaborating agencies should be involved in the collaboration (Hunter, Rey, & Scott, 1982; Litsios, 1987).
- Certain attitudinal attributes promote cross-sectoral collaboration, and need to be cultivated or inculcated in those individuals likely to be assigned collaborative and coordinative roles. Such attitudes as the following may be conducive to the interdisciplinary approach: willingness to experience the working of an interdisciplinary team, tolerance of other points of view, willingness to listen, encouragement of exploratory ideas, and faith in the possibilities of communal or group learning. To inculcate such attitudes, we propose that opportunities should be given to students (and other trainees) in their formative stages to experience interdisciplinary discussions and to transfer lessons of informal group learning to the formal interdisciplinary situation (Laing, 1991).

Health Impact Assessment in Ghana

E. Laing

Chairman, Health Committee on Water Resources Development
Accra, Ghana

Summary

This note briefly assesses the experience of health impact assessment in Ghana, lessons learned, and the potential of health impact assessment and other key measures for averting or mitigating harm caused by increased malaria transmission.

Health Impact Assessment in Ghana

Ever since the feasibility studies of the Volta Hydro-Electric Project in the early 1960s, health impact assessment at the planning stage of developmental projects has been recognized as essential. As a rule, large developmental projects have had health impact assessment incorporated in them. Consequently, a hydro-electric project and its associated irrigation project (both 25 km downstream from the Volta Dam) included appropriate Health Impact Assessments in the planning stage.

To illustrate, the Kpong irrigation project feasibility report provided recommendations on health considerations. It devoted sections to the state of public health in the area; it fully recognized the endemic prevalence of schistosomiasis, onchocerciasis, malaria, and other diseases in the area. It explicitly pointed out the very high risk for the spread of malaria that might accompany the implementation of the project. It also reviewed the health facilities that would be needed for communities that would inhabit the project area and its broader vicinity. The practice of health impact assessment may then be said to be reasonably established for large developmental projects. Unfortunately, the same cannot be said for smaller projects at the local community level, especially in remote areas where projects may be implemented without proper authorization. The Ghana Investment Code (1985) adequately provides for an environmental impact assessment at the feasibility stage.

Since 1988 the Environmental Protection Council has been assembling proposals for an Environmental Action Plan; this year it has also, partly as a derivative from the Environmental Action Plan, drafted a National Report for the forthcoming United Nations Conference on Environment and Development (1992, Brazil). All these documents make health impact assessment part of environmental impact assessment. Although the general importance of health impact assessment is generally recognized, there are occasions when the subject under discussion definitely requires explicit reference to health but this need is ignored. It is recognized that as these drafts of Environmental Action Plans are more widely

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discussed, health personnel and others sensitive to the importance of health will ensure that these omissions are redressed, and that explicit health aspects are introduced.

Health Impact Assessment in Other Sub-Saharan African Countries

Almost the same picture emerges in accounts of feasibility and other planning stage considerations of developmental projects in other sub-Saharan African countries. It has been suggested that some other countries (e.g. Egypt, Côte d'Ivoire) may well be stricter than Ghana in their regulatory measures to reduce deleterious human-water contact. Thus there are clear preventive measures being built into irrigation and other projects. Such examples are the Gezira Scheme in Sudan, and others in Tanzania, Burkina Faso, Malawi, and Kenya. (Some of these are reviewed in FAO, 1987; Haworth, 1987; PEEM, 1988.)

Lessons Learned

Some notable lessons from experience with health impact assessment and other preventive measures are:

- The health impact assessment must be scrupulously carried out, even when it is embedded in an environmental impact assessment; where inadequate provision is made for it in an environmental impact assessment, scientists and other personnel undertaking the feasibility study should make sure it is introduced.
- Health impact assessment is called for with respect to large developmental projects, but it should not be limited to those; the concepts are equally important in smaller projects and in the everyday activities of various communities, even in rural settings.
- Measures at the implementation stage that follow feasibility studies are equally important for the efficient control of vectors of water-related diseases. Thus monitoring activities need to be serious and sustained.

Potential of Health Impact Assessment for Mitigating Harm from Increased Malaria Transmission

The potential of health impact assessment and other key measures for averting or mitigating the effects of increased malaria transmission is certainly high, once the important principle of integrated control is recognized fully. This means not depending exclusively on one of the complementary measures for control and treatment, but sensitively managing the various factors with the means available. The principle of the weakest link in the chain applies here, as neglect of an important contributory factor in the disease situation may promote the disease.

A number of the key measures for vector control require collaboration by the community; some measures may need modification of the behavior of members of the community.

Depending on the traditions of the particular community, appropriate incentives or penalties may contribute to the total effort at vector control. Such methods as residual house spraying, anti-larval measures, biological control, self-help methods, and integrated control have their roles just as do elaborate public health initiatives and culturally appropriate health education methods, possibly related to the community's knowledge of mosquitoes (Haworth, 1987).

Conclusion

A number of the measures for vector control require fundamental changes in the attitudes of members of the community, and possibly also on the part of professional persons, policymakers, and funding agencies. Successful vector control may call for combined approaches, partly dependent on regulation, partly on education, and partly on actual provision of the health-promoting necessities — safe drinking water or sanitation facilities. All those concerned with the control activity need to be involved. The control measures need to be practicable and affordable enough for the community to make them sustainable. Purely economic criteria need to be sensitively balanced against social welfare criteria in the evaluation of projects. Perhaps it would be possible, in some instances, for the larger society to view the occasion for the health impact assessment at the feasibility stage more as an opportunity for improving the health status of the community, rather than simply not exacerbating the prevailing poor health condition.

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Le Rôle de l'Education Sanitaire dans la Prévention et la Lutte contre la Malaria

Madame Mululebwe Issiki
Association Zaïroise du Bien Etre Familial
Kinshasa, Zaïre

Introduction

Le maintien du programme de prévention et de lutte contre le paludisme dépend des efforts déployés par les individus et les communautés pour se protéger contre cette maladie. A cet égard, la prise de conscience du problème de la malaria et la volonté des individus de lutter contre ce dernier revêtent une importance capitale pour le succès des programmes de lutte contre le paludisme. L'information et l'éducation au niveau des ménages et des villages doivent, par conséquent, être une activité prioritaire. Ceci est d'autant plus vrai que le problème de la malaria, comme la plupart des problèmes de santé, a un rapport plus ou moins étroit avec le comportement des individus. Ce comportement est, lui-même, influencé par l'échelle des valeurs des individus ou des groupes de personnes.

Or, l'éducation sanitaire représente essentiellement une action exercée sur les individus et qui a pour but de les amener à modifier leur comportement. D'une manière générale, l'éducation sanitaire vise à faire acquérir et conserver des habitudes de vie saines, à apprendre à ces individus à mettre judicieusement à profit les services sanitaires qui sont à leur disposition, et à les conduire à prendre eux-mêmes, isolés ou collectivement, les décisions qui mèneront à l'amélioration de leur état de santé et de salubrité du milieu où ils vivent.

Dès lors, l'éducation sur la malaria vise l'élimination des comportements défavorables à la santé par la promotion des connaissances, des pratiques et le changement des attitudes des individus et des communautés.

Situation de Prévention et de Lutte contre la Malaria en Afrique

Les résultats obtenus dans le cadre de la lutte contre la malaria en Afrique, où vivent 80% des personnes affectées, font état de succès partiel enregistré dans quelques rares pays comme l'Ile Maurice, l'Ile de la Réunion, l'Algérie et le Cap Vert.

En effet, la malaria a été éradiquée en 1973 et en 1979 respectivement dans les îles Maurice et de la Réunion. La Réunion est parvenue à empêcher le rétablissement de la transmission; l'île Maurice, par contre, a connu un retour de la maladie en 1975 à la suite d'un cyclone, désastre qui fût associé à un relâchement des mesures de surveillance dans le domaine

sanitaire. On suppose également que l'accroissement du nombre des visiteurs en provenance des pays limitrophes impaludés en est une autre raison.

En Algérie, l'interruption de cette maladie est effective. Mais il est à craindre la possibilité de la transmission dans la partie méridionale du pays du fait de la mise en oeuvre de la route transsaharienne. Fort heureusement des mesures de surveillance efficaces ont jusqu'ici permis d'éviter le rétablissement de la transmission.

Les Efforts des Années Cinquante et Soixante au Zaïre

Au Zaïre, comme un peu partout ailleurs en Afrique, l'effort de la lutte contre la malaria s'est essentiellement accrue entre les années cinquante et soixante par la destruction des foyers de vecteurs. Parmi les moyens retenus pour venir à bout des moustiques on peut noter:

- les mesures de salubrité de l'environnement rendues effectives grâce à la signature d'un arrêté vers la fin des années cinquante visant le maintien de la propreté et prévoyant des sanctions à l'endroit des contrevenants;
- l'aspersion d'insecticides dans les installations sanitaires des domiciles et tout autour des habitations;
- l'aspersion de mazout sur les flaques d'eau;
- la distribution de la quinine dans les écoles.

Cet effort mené entre autre et surtout par le service de l'hygiène s'est soldé par une régression vite interrompue du taux de morbidité. En effet, en 1974 ce taux était de 17% contre 29% en 1977.

On ne connaît pas très bien la part réservée à l'éducation sanitaire dans la prévention contre le paludisme au Zaïre dans le passé.

Mais actuellement, à moins de se tromper, peu d'effort est entrepris dans ce domaine mis à part une boîte à images produite par les Editions du Bureau d'Etudes et de Recherches pour la Promotion de la Santé (Kangu - Mayumbe), quelques rares spots publicitaires à la télévision produits par le Projet Santé Pour Tous Kinshasa (SPTK).

La Recrudescence de la Malaria au Zaïre

A notre sens, la malaria est tellement négligée qu'elle fait très peu l'objet de causeries éducatives à l'intention des femmes enceintes comme le démontre une étude sur les connaissances, attitudes et pratiques vis-à-vis de la malaria pendant la grossesse publiée en Novembre 1986. Dans cette étude le temps consacré à la malaria dans 4 causeries de 73 minutes chacune organisées en juillet 1986 à l'intention des femmes enceintes en consultation prénatale dans le Centre de Santé de Kikimi (Kinshasa) est de 8 minutes seulement.

La conséquence de cette négligence se traduit par la recrudescence de la malaria au Zaïre. D'autres causes de recrudescence de la malaria sont à noter:

- le peu d'importance accordée au problème de la malaria par le pouvoir public se traduit par le délaçement des mesures efficaces de lutte contre le paludisme;
- la pauvreté de l'Etat qui rend la lutte contre la malaria incapable de faire face aux coûts d'insecticides et autres dépenses d'entretien de l'environnement;
- la pauvreté de la population qui se traduit par son incapacité à faire face aux frais de soins de santé, à l'achat des moustiquaires, etc;
- l'accroissement rapide de la population qui favorise la promiscuité et le développement des quartiers satellites ou urbanisés propices à l'éclosion des vecteurs;
- les soins inadéquats aux malades, l'abus des anti-malariens, l'absence ou le non respect de cure sont à l'origine de la forte mortalité enregistrée ces dernières années.

Le Rôle du Peuple dans le Contrôle de la Malaria

Comme on peut se l'imaginer, la contribution de l'homme dans le succès si partiel soit-il de la lutte contre la malaria dans certaines contrées africaines est déterminante. La prise de conscience de l'intérêt que représente l'éradication de la malaria n'a sûrement pas été étranger à ce succès. Ce n'est probablement pas un hasard si l'île Maurice et l'île de la Réunion sont parmi les pays qui ont plus ou moins réussi dans cette lutte contre la malaria. L'explication pourrait être, dans le cas d'espèces, la forte dépendance de ces îles du point de vue du tourisme pour leur économie. Or, la malaria constitue un frein à cette activité. Il est donc possible que cet aspect ait incité ces pays et leur population à prendre les mesures efficaces qui s'imposaient et à les respecter afin de sauvegarder le tourisme, et donc leur économie.

En prenant l'exemple du Surinam, pays des Caraïbes, une action menée dans les années cinquante et visant l'élimination des foyers de vecteurs au moyen de l'aspersion d'insecticides à base de DDT, s'était soldé par un échec. Ceci simplement parce que la population s'y était opposée par crainte des conséquences de ces produits sur les vies humaines et végétales d'une part. Et d'autre part, la même population était insatisfaite des salaires attribués aux travailleurs oeuvrant dans le cadre de cette action.

L'étude des cas présentés ci-dessus nous permet de tirer quelques leçons pour aider à la réussite d'une action d'éducation sanitaire sur la malaria. Il s'agit notamment de:

- L'importance de placer le peuple au centre de la lutte contre la malaria en tant que bénéficiaire et artisan de sa propre santé. C'est une démarche essentielle car la population seule permet de vérifier si les activités éducatives sont appropriées, souhaitables et réussies.
- C'est pourquoi il est important d'étudier le public à atteindre, les facteurs environnementaux et psychologiques qui vont influencer sur la manière dont le public va se comporter vis-à-vis de ces nouvelles idées et pratiques. La connaissance du peuple oriente le programme sur la malaria, et permet de noter les raisons qui font qu'une pratique donnée persiste, et permet également de déterminer le meilleur moyen

d'introduire un autre comportement, comment le présenter, et comment l'encourager de manière à ce qu'il soit adopté.

- L'organisation de la communauté et sa participation à la lutte contre la malaria sont une garantie, une assurance de l'adoption durable des pratiques sanitaires. Cette participation comprend aussi bien l'éducation de la population, la contribution aux financements des activités, la distribution des anti-malariens, la planification, la mise en oeuvre des activités de prévention de la malaria ainsi que leur surveillance.
- Cette approche s'est révélée momentanément payante au Zaïre dans sa phase de mise en oeuvre de travaux collectifs d'intérêt communautaires - le Salongo. Non seulement celui-ci a favorisé l'éveil de sentiment d'appartenance au groupe mais aussi celui d'être concerné par le maintien de cette propriété. Plus tard, ce Salongo a malheureusement souffert du manque d'organisation et d'engagement effectif des responsables et donc de modèle. Ceci fait qu'il a été perçu par la suite comme une contrainte plutôt qu'une action profitable à la communauté.
- La collaboration intersectorielle est un gage de survie et d'intégration du programme de la lutte contre la malaria dans le système global des soins de santé. Bien que le Ministère de la Santé soit le principal responsable de la distribution des médicaments, de l'organisation des services médicaux et de la formation du personnel soignant, la réussite n'est possible qu'avec l'aide des autres ministères (de l'Information, de l'Education, de l'Agriculture, des Travaux Publics...), des professionnels sanitaires médecins, infirmiers, éducateurs sanitaires, et des entreprises privées, des médias, des donateurs internationaux, des représentants officiels et des dirigeants d'opinion.
- Cette approche permet ainsi de partager les responsabilités entre les ministères et les experts, mais aussi d'alléger la charge financière du Ministère de la Santé grâce à la contribution des autres services, notamment les entreprises publiques et les donateurs.

Stratégie de Mise en Oeuvre d'un Programme d'Education Sanitaire sur la Malaria

L'approche la plus appropriée dans la lutte contre la malaria devra être une approche globale axée sur la planification d'ensemble des différentes interventions. Cela signifie que l'action éducative devra être la plus réaliste possible. Pour se faire, elle devra se fonder sur les recherches faites antérieurement dans ce domaine. Par ailleurs, étant donné la complexité des éléments en cause dans l'épidémiologie de la malaria, l'approche fragmentaire devra être évitée au profit de l'approche multidimensionnelle. Ainsi donc, les actions devront se mener à travers les activités suivantes:

- une éducation sanitaire visant le changement de comportement et des attitudes. Elle se fera au moyen de la communication interpersonnelle, de la radio, de la télévision, des journaux, des affiches, des dépliants, des chansons, des sketches, du théâtre, etc. Etant entendu que l'utilisation des médias dans un milieu devra se baser sur les habitudes de la population en rapport avec les médias mais aussi sur l'impact de ces médias et bien entendu sur son coût.

habitudes de la population en rapport avec les médias mais aussi sur l'impact de ces médias et bien entendu sur son coût.

- des travaux individuels ou collectifs visant la destruction des foyers de vecteurs (l'aspersion d'insecticides intradomiciliaires et environnementales, le désherbage, le récurage des caniveaux, l'enlèvement des immondices et l'enfouissement des boîtes vides) qui seront menés par les individus, la communauté et les services officiels des travaux publics. L'éducation et la formation des responsables sanitaires, des gestionnaires des services médicaux, des infirmiers, des éducateurs sanitaires, des vulgarisateurs agricoles, des journalistes, etc., devront également jouer un rôle primordiale.

Structure d'un Bureau de Coordination

Cette démarche devra être précédée par la création ou le renforcement d'un bureau dont la structure de coordination devra être appropriée à la lutte contre la malaria. Ce bureau dépendra du Ministère de la Santé Publique et devra bénéficier de l'appui total du gouvernement en matière de financement, mais également sur le plan moral. Les moyens de ce bureau pourraient également provenir des entreprises privées ou des donateurs nationaux et internationaux dans le cadre d'un projet par exemple.

Ce bureau serait avant tout une structure d'appui des activités qui seront menées par les différents secteurs (organisations non gouvernementales, ministères, associations de femmes et de jeunes, écoles, presse, etc.).

Il serait chargé de:

- Organiser une campagne de prévention contre la malaria avec la collaboration des différents secteurs;
- Améliorer la qualité et la quantité des services médicaux pour un meilleur traitement contre la malaria;
- Susciter la collaboration et l'appui des entreprises, des organisations non gouvernementales, des organisations internationales, etc;
- Susciter et appuyer la recherche sur la malaria;
- Former le personnel soignant, les gestionnaires, les agents vulgarisateurs.

Soutien d'un tel Programme

Dans la mesure du possible, le programme de prévention et de lutte contre la malaria devra répondre à un mandat national. Malheureusement, dans beaucoup de pays, il n'est pas possible de réaliser des programmes nationaux par faute de ressources suffisantes. Il serait souhaitable, dans le cas d'espèces, de prévoir des programmes moins ambitieux, décentralisés et relativement faciles à exécuter. Ceux-ci iront de la formation du personnel soignant de deux heures par jour pendant une période donnée, l'envoi de conférenciers dans

les écoles, les entreprises, les associations, en passant par des travaux d'intérêts collectifs exécutés par des volontaires (scouts, étudiants, membres de la communauté).

L'exemple de ce genre de décentralisation a eu lieu au Zaïre dans le cadre du Projet Tipps (Informations Techniques sur la Planification Familiale pour les Secteurs Privés).

Une enquête avait été préalablement menée par le projet en collaboration avec l'Ecole de Santé Publique en 1986 et en 1988 auprès de la Banque Commerciale Zaïroise (B.C.Z.) et l'Usine Textile Africaine (UTEXAFRICA) pour démontrer l'impact des maternités anarchiques sur les dépenses inhérentes aux soins médicaux. La B.C.Z. avait accepté de financer une campagne à l'intention de ses agents et de leurs épouses. La campagne avait été précédée d'une formation d'animateurs recrutés parmi les agents de la B.C.Z. ayant répondu aux critères de sélection. Par la suite, ceux-ci devaient assurer l'exécution des activités de sensibilisation selon un programme arrêté de commun accord avec l'Administrateur Délégué, les responsables des services social, médical, de formation, du personnel, ainsi que les animateurs.

On ne dispose pas d'informations sur l'impact de la campagne en question. Toutefois, elle constitue un modèle de collaboration et de participation des entreprises privées et d'autres secteurs à l'effort d'éducation pour la lutte contre le paludisme. Non seulement cette participation permettrait de réduire la charge financière du pouvoir public, mais aussi l'impact dans la lutte serait plus important dans la mesure où plusieurs intervenants l'adopteraient.

Conclusion

En partant du postulat que les solutions les plus valables et durables sont les résultats d'un effort collectif, l'éducation sanitaire pour la prévention et la lutte contre la malaria devra s'atteler à mobiliser toutes les couches de la population en vue des solutions des problèmes solubles. Ceci exigera la création ou le renforcement d'une structure de coordination qui jouira d'un statut prioritaire (comme l'est le Programme de lutte contre le SIDA aujourd'hui) et d'un appui financier et moral conséquents du pouvoir public, des organisations non-gouvernementales, des organisations internationales, des entreprises privées, etc. Ce n'est que dans ces conditions que l'éducation sanitaire pourra jouer valablement son rôle dans la lutte contre la malaria dans nos pays.

Economic Development and Malaria Prevalence

An Empirical Analysis with Reference to Kenya

Germano M. Mwabu
Economics Department, Kenyatta University
Nairobi, Kenya

Abstract

This paper studies the interactions among economic development, malaria, environmental conditions, and sociocultural factors. It is argued that economic growth and malaria prevalence tend to be influenced in the same direction by a common set of factors. Consequently during the initial stages of economic development, increases in income and high rates of malaria prevalence are likely to coexist. However, at a certain threshold level of income, there occurs a reversal in the positive relationship between incomes and malaria prevalence because of favorable income effects on implementation (by governments) and adoption (by households) of malaria control measures.

Sociocultural factors also affect public implementation of malaria control programs as well as the response of households to these programs.

Information on dynamic interdependence among economic, environmental, and sociocultural factors, and malaria is required for design and implementation of successful malaria control programs.

Introduction and Background

The relationship between economic development and malaria in tropical developing countries is well documented in the socioeconomic literature on malaria control (Herrin & Rosenfield, 1986; Conly, 1975; Castro & Mokate, 1986; Fernandez & Swayer, 1986; Packard, 1984; Abdulla, 1985; WHO, 1984; Wang'ombe & Mwabu, 1988).

Much of the economic literature is devoted to the difficult problem of determining the effects of malaria on productivity, so that on the basis of such information economic viability of malaria control programs can be assessed, mainly through a cost-benefit calculation. The hypothesized negative impact of malaria on economic development, however, particularly on agricultural productivity, has been hard to find, because of the pervasive phenomenon of exchange of tasks among farm-household members in the event of a serious malaria episode. The task of confirming a negative impact of malaria on labor productivity in agricultural communities is further complicated by the "herd immunity" of the agricultural labor force

(repeatedly exposed to malaria attacks), and by the tendency of malaria sufferers in such communities to continue to work in spite of their illnesses. Because of the above difficulties, the intuitive negative impact of malaria on short-run agricultural production has not been conclusively established by economic studies, particularly those employing econometric methods.

Another focus of economic and historical research on malaria has been an attempt to answer the reverse question, i.e., what is the impact of economic development on malaria? Specifically, how does the structural transformation of an economy that raises per capita income affect malaria morbidity and mortality? Except for Packard's study in Swaziland, this issue has received little attention in sub-Saharan Africa. At first sight, the impact of economic development (i.e., sustained increase in per capita income) on malaria prevalence appears straightforward. Higher incomes enhance the purchasing power of governments and individuals, permitting increased consumption of health care products and services. In the context of malaria control, economic growth permits increased consumption of malaria prophylaxis and treatments at the household level, and an expansion of anti-malaria campaigns at the community level. In this simple model of malaria control, economic development provides the wherewithal for combatting malaria; malaria prevalence should therefore decline as the economy grows. However, this inverse relationship between malaria prevalence and economic development is not supported by ordinary observations in much of sub-Saharan Africa. Areas with higher cash incomes, such as irrigation schemes and fishing villages, are frequently also areas with high malaria morbidity and mortality. Causal evidence in these and other circumstances appears to lend support to the existence of a positive relationship between indicators of economic development and measures of malaria prevalence in the population.

I interpret this relationship to mean that malaria prevalence and economic growth have the same underlying causes, rather than that one is the cause of the other. However, beyond a certain threshold level of income, economic growth is hypothesized to begin reducing malaria prevalence in the population. Thus, there are two important processes to be understood in the control of malaria. The first type of process is one that gives rise both to higher incomes, and to increased rates of malaria prevalence in the initial stages of structural changes in the economy. The second set of processes causes a decline in malaria prevalence during the advanced stages of economic transformation.

The remainder of the paper is organized as follows. Section II presents a conceptual framework for analyzing relationships between income and malaria prevalence at different stages of economic transformation. The framework is an adaptation of that developed by Rosenfield, Golladay, and Davidson (1984). Section III describes the data used to examine the relationships among malaria prevalence, malaria control measures, and economic development. Section IV presents the empirical results. Conclusions are in Section V.

Conceptual Framework

The observed levels of malaria prevalence in a population can be conceptualized as an outcome of processes of socioeconomic transformation and environmental changes brought about by individuals and/or public authorities in pursuit of self-interest or social objectives. Social changes, such as internal or rural-urban migrations, evolution of new settlement patterns, increased social mobility, etc., while creating opportunities for higher incomes, also create social conditions favorable for transmission of malaria. For instance, the population movements involved in these changes intensify interactions between healthy individuals and malaria vectors thereby increasing chances of malaria transmission, and eventually of malaria infection in the population. Likewise, economic changes, such as introduction of irrigation schemes in order to increase agricultural production, also create habitats for malaria vectors. Furthermore, formation of social overhead capital, such as communication and transportation facilities, in addition to stimulating economic activities, may assist in transmission of malaria parasites. Thus, socioeconomic transformations that stimulate growth may have spillover effects that increase malaria prevalence in the population.

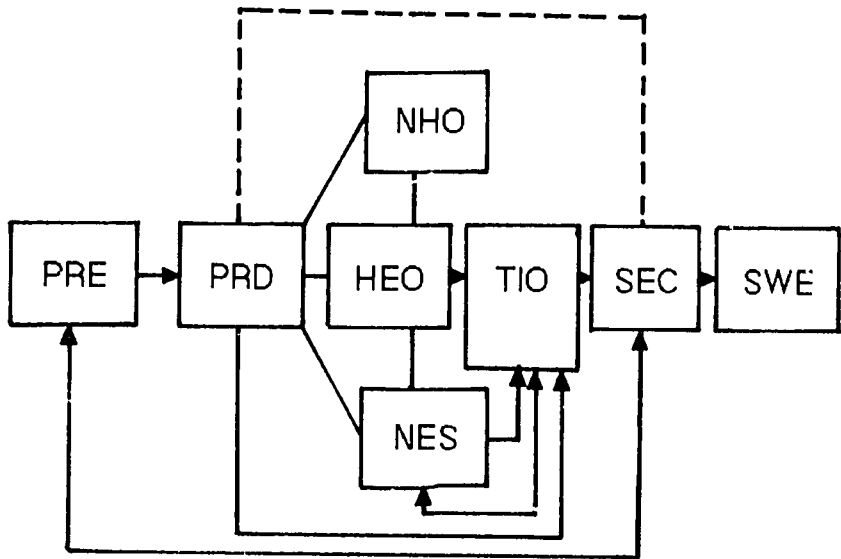
In the early stages of economic development, the negative spillover effects of growth strategies (in terms of their impact on malaria prevalence) are unmanageable for the following reasons:

- behavioral patterns that expose the population to risks of adverse spillover effects;
- inability of the population to anticipate or plan for ways and means of dealing with adverse effects of growth strategies; and
- inability of the population to afford the necessary investments or measures required for effective management of the spillover effects.

As income grows over time, however, the investment constraint is relaxed by the higher rates of saving that the population is able to afford. Moreover, planning, behavioral, and cultural constraints are overcome by experience and learning. Thus, at a certain threshold level of per capita income, the population is able to manage effectively the potentially malaria-enhancing effects of growth strategies. Beyond this critical level of income, malaria prevalence in the population declines with economic growth.

To organize the various dynamic interactions among malaria prevalence, structural transformations of the economy, environmental changes, and sociocultural factors, a simple framework of these interactions is presented in Figure 1.

FIGURE 1

**LEGEND**

PRE- Preconditioning factors of the social, economic, and physical environment

PRD- Proximate determinants of health outputs, non-health outputs and negative spillover effects

HEO- Health outputs

NHO- Non-health outputs

NES- Negative spillover effects

TIO- Transformation of intermediate outputs into social and economic outcomes

SEC- Social and economic outcomes

SWE- Social welfare of the population

In Figure 1, PRE constitutes the socioeconomic structure of any country. The elements in this structure (Herrin & Rosenfield, 1986) include individual household and community characteristics or endowments. Individual endowments consist of unobserved biological endowments, age and sex, education, preferences, beliefs, and attitudes. Household endowments in turn include their age-sex composition and human capital and household assets such as land, housing, and working capital. Community characteristics include: the physical environment, structure of commodity and factor markets, size and structure of the population, social structure and organization, and physical and health infrastructures. PRE factors determine the quantity and quality of health and non-health outputs and also determine the magnitude of negative spillover effects.

PRD refers to proximate determinants of health outputs (HEO), non-health outputs (NHO), and negative spillover effects (NES), e.g., malaria vectors. PRD factors are behaviorally determined by preconditioning factors. For example, given the prevailing preconditioning factors, individuals might choose a certain level of exposure to a malarious environment, decide on certain consumption patterns, and choose certain production techniques.

TIO refers to transformation of intermediate outputs, i.e., NHO, HEO, and NES, into social and economic outcomes (SEC). The social and economic outcomes include incomes, savings, physical and human capital, further production of market and non-market goods, health consumption, and social interactions. Note that NES might be viewed as an undesirable output of the interaction between PRE and PRD factors. It can be proxied by malaria prevalence, as measured by the number of self-reported malaria cases per thousand persons. Malaria vectors, induced by an irrigation scheme, are a typical example of NES.

Exposure to malaria can also be brought about by establishing settlement schemes in an area infected by malaria vectors. The ability of a community to manage adverse consequences of NES, such as the morbidity and mortality due to malaria, depends on its income, savings, and behavioral patterns with regard to exposures to malaria risks.

SWE refers to the social welfare of the population. This factor is assumed to depend directly on elements in SEC.

Study Sites, Field Research Methodology, and Data

Research Sites

To conduct an empirical examination of the conceptual relationships depicted in Figure 1, and described in Section II, I use data from irrigated and non-irrigated areas in Kenya. These data were collected from three administrative districts. The field research in irrigated areas was carried out in the Mwea and West Kano schemes in Kisumu and Kirinyaga districts, respectively. Field work in non-irrigated areas was done in the Busia district.

The irrigation schemes in Kenya are managed by a state corporation, the National Irrigation Board (NIB); Mwea and West Kano are among the seven schemes that have been developed by the NIB. Mwea in Central Kenya is currently the largest scheme. About 3,150 families

have been settled in the scheme, but the actual population in the scheme is approximately 26,680. Kano, a much smaller scheme in Nyanza Province, has 553 families, with a population of about 4,680. The NIB develops irrigation schemes in a uniform manner. Each scheme is divided into farm units; each unit consists of a number of villages. The residential villages are constructed on selected sites away from irrigated land. NIB provides social and physical infrastructures in the villages.

Busia district, the site for field work in non-irrigated areas, is in the western part of Kenya. At the time of the field survey, the district had four administrative units, with a total of about 55,000–56,000 families, and a population of approximately 300,000.

The survey covered three of these administrative units in Busia. Unlike in the irrigation schemes, the pattern of settlements in Busia is not determined by a government body. The settlement patterns in the district (except in the Bunyala irrigation scheme, which was not covered by the survey), are determined by residential choices of individual families. Ironically, settlement patterns in the Busia district tended to be very dense in areas with the greatest risk of malaria, i.e., near swamps and edges of Lake Victoria.

The food crops in Busia include cassava, sorghum, green vegetables, maize, and beans. Except for cassava, these food crops are also grown in irrigation schemes near the residential villages. These crops are grown to supplement rice, which is the principal cash crop of the schemes. Cash crops in Busia (the non-irrigated areas) include cotton, sunflower, and tobacco. Livestock is also kept in scheme and non-scheme areas.

In all the study sites, the environmental conditions are ideal for the breeding of malaria vectors. The flat lowlands on which the schemes lie flood easily during the rainy season, forming stagnant pools of water. Regular flooding of rice paddies provides additional breeding sites, especially when the flooding occurs outside of the rainy season. In the case of non-irrigated areas, the edge of Lake Victoria forms permanent breeding points for mosquitoes. The large swamps that characterize some parts of Busia are also permanent breeding sites for malaria vectors.

The geographic areas described in this section form excellent research sites for an empirical study of interactions among environmental, sociocultural, and economic development factors, and malaria.

Field Research and Sampling Strategy

The field work was designed to cover areas in which either public interventions, or voluntary actions of households, were thought to be responsible for high rates of malaria prevalence in the population. Irrigation and non-irrigation schemes were selected as such areas. Data-collection instruments were administered in research sites already described. The information gathered included data on:

- reported rates of malaria prevalence;
- responses to malaria, both at the household level and the community level;

- malaria coping strategies;
- land use patterns;
- household incomes and assets;
- agricultural activities and other occupational choices;
- malaria control programs and efforts; and
- environmental conditions.

In the irrigation schemes, data instruments were administered to a random sample of 350 household heads. Systematic sampling was used to select these respondents from a list of tenants kept by the National Irrigation Board.

In the non-scheme area (Busia district) 400 heads of households were selected using a stratified sampling method. The study site was first divided into three clusters of villages, according to the severity of the malaria problem, as perceived by the District Health Management Team. From each village cluster, two to three villages were selected by simple random sampling. For each set of villages thus selected, a sampling frame was compiled with the help of village elders. A systematic sampling procedure was then applied to this frame to select the required number of households. Of the selected households, data were processed for only the 302 households that responded.

Results

Because of the limitations, only a few of the theoretical relationships sketched out in Figure 1 have been examined in the light of the available data. The relationships examined are:

- the probable effect of malaria on household production and income (i.e., on economic development);
- the probable effect of increases in household income on malaria;
- the probable relationships between malaria and
 - social structure
 - household-level characteristics
 - settlement patterns;
- the effect of malaria on morbidity and mortality; and
- the probable interactions between government malaria control programs, community-level organizations, and household characteristics.

Analytical Results

Simple regressions of family income and cassava production on malaria morbidity, controlling for family size, revealed no effect of malaria, either on family income or on cassava production. Only family labor, proxied by family size, turned out to be an important determinant of family income. Family income is the total income of a family unit over a period of three months prior to the interview.

Family income (which is statistically unaffected by malaria) is an important determinant of demand for malaria treatments, for mosquito nets, and for malaria prophylaxis.

Table 1, extracted from Wang'ombe and Mwabu (1988), shows possible empirical relationships between growth in incomes and household responses to malaria. The table also shows the estimated effect of malaria on cassava production, a dominant food crop in one of the study sites.

Preparedness for illness is a dummy variable that takes a value of "1" if a family unit had accumulated reserves (in-kind or cash), to pay for the future cost of illness, including the cost of malaria treatment.

In addition to the results already noted, it is interesting to observe the cross effect of the cost of malaria treatments on the use of mosquito nets and malaria prophylaxis. Increases in costs of malaria treatments in modern health facilities tend to influence strongly household use of mosquito nets and prophylactic drugs, perhaps in an effort to avoid malaria.

The positive sign, however, of the effect of the cost of malaria treatments on demand for these services in modern health facilities was unexpected. Education affects malaria avoidance behavior at the household level. As education of the family head rises, use of malaria mosquito nets and malaria prophylaxis increases. Also noteworthy is the strong negative impact of income on malaria prophylaxis.

The "null effect" of malaria on cassava production and on family income is surprising because 99 percent of the respondents in non-irrigated areas reported illnesses (most of which were malaria) that had interfered with productive work. It appears that work substitution within the family, in the event of a serious malaria episode explains this phenomenon.

The tasks of about 85 percent of family members who were unable to work because of malaria were performed by other family members. The tasks of sick family members, taken up by the healthy ones, were mainly farming and cooking. In terms of social relationships within and outside the family, duties of the sick individuals were performed by the family head, the wife, a co-wife, daughter, son, employee, neighbor, in-laws, and grandparents.

Table 1. Empirical relationship between family income, food production, and malaria

Explanatory	Estimated		Relationships		
	1	2	3	4	5
Variables	Visits to clinics for malaria treatments	Use of mosquito nets	Use of prophylactic drugs	Cassava production	Family income
Constant term cost	-0.38	0.14	0.31	0.05	1.84
Cost for malaria treatment	0.56 (2.25)	0.05 (2.0)	0.91 (3.38)		
Education of family head		0.15 (3.84)	0.12 (2.76)		
Family size				0.6 (0.22)	0.61 (2.21)
Accessibility to clinics (km)	0.16 (3.94)				
Family income	0.94 (4.75)		-0.06 (-2.58)		
Preparedness for illness		0.13 (2.37)			
Malaria				0.11 (0.22)	
R ² (see sample)	0.16 0.73 302	0.06 0.47 302	0.07 0.48 273	0.03 0.23 302	

Note: The T-Ratios are in parentheses

The discussion of results reported in Table 1 can be concluded as follows:

1. Malaria prevalence may have no effect on production and incomes in a community in which the social structure and relationships insure against productivity losses of individuals debilitated by malaria. In such a community, high rates of malaria prevalence (measured by self-reported cases of malaria per thousand population) can be observed simultaneously with rising levels of agricultural output and incomes.

2. Economic development proxied by a sustained increase in family income enables households to undertake measures such as effective treatments of malaria. Furthermore, the particular malaria control measure undertaken by the household is determined by the cost of that measure, and of other affordable measures. This finding has an important policy implication. Administrators of malaria control programs can induce desirable behavioral

change in the population, with regard to adoption of certain malaria control measures, by altering costs of these measures. Specifically there is a need to coordinate curative health care financing strategies, especially those with an element of cost-sharing, with malaria control strategies to ensure consistency in the overall health care strategy.

3. Bearing in mind the remarks in (2) above, sufficiently high levels of income should help a community to bring down rates of malaria morbidity and mortality. Thus, coexistence of high rates of malaria prevalence with non-decreasing output or incomes appears to be a characteristic of the initial stages of economic development.

Descriptive Results

Housing site selection

It has been noted in the previous section that households respond to changes in the economic environment. The elements of this environment can therefore be altered to induce a behavioral change that contributes to the success of a malaria control program. People's knowledge, attitudes, and practices (KAP), insofar as malaria is concerned, can also be changed to induce them to act in a manner that contributes to the success of a malaria control program.

In study areas, changes in KAP may be a key input in the control of malaria. There was a very high awareness about the cause of malaria in the communities studied, including knowledge about the malaria vector. But people's settlement patterns seemed to contradict the knowledge and attitudes they held about malaria.

About 98 percent of the respondents reported that they could tell when a person had malaria. As for the cause of malaria, 93.3 percent mentioned mosquitoes. When asked where mosquitoes breed, 86.4 percent mentioned ponds or pools of water; 7.8 percent mentioned edges of the lake; 3.1 percent said mosquitoes breed in swamps.

As can be seen from their responses, the households were correctly informed about the cause of malaria and about the breeding points of the vector for this disease. Nevertheless, they had chosen to settle in areas with the highest risk of contracting malaria. Ninety-six percent of the households interviewed (290 out of 302), said that they lived about 1 to 2km from the lake, river, or swamp — areas that they knew had malaria vectors. Furthermore, once high-risk residential areas were chosen, they were rarely changed. Only three people among those who were interviewed reported having moved because of threat of illness. Four people were reported by others as having changed their residence in an attempt to avoid malaria. Of the 17 people who were known to have changed residence to reduce risk of illness, 11 had done so to avoid contracting sleeping sickness, smallpox, or measles. The conclusion drawn here, on the basis of this very preliminary analysis, is that malaria prevalence did not have any effect on settlement patterns in the study sites. This tentative conclusion should not, however, be interpreted to mean that households in the study sites did not suffer from malaria. Rather, the losses they suffered from malaria were outweighed by the benefits they perceived from living in malarious areas. For example, the swamp, close to which

households tended to locate homesteads, were a source of pasture and fish. The households protected the swamps from destruction by government malaria control teams, even though they knew these same areas were malarious. This behavior can best be understood in light of recent research that has demonstrated that "local commons," such as the swamps in study sites, serve the purpose of a "safety net" for the poor. See Dasgupta and Maler (1990) for an excellent exposition of types of benefits derived from the poor from local commons, such as fishing ponds and fuelwood forests.

Perception of malaria's effects

In an earlier section, it was shown that malaria has no detectable effect on economic development. Malaria, however, has an unambiguous effect on social welfare because of the suffering and anxiety it brings to a household. Of the 55 deaths that were reported to have occurred over the one-year period prior to the interview, six (or 10.9 percent) were thought to be due to malaria. Malaria, as a perceived cause of death in the study area, was second only to measles, which had claimed 10 lives. Since these are annual figures, the cumulative effect of malaria in terms of loss of human life is immense. Moreover, malaria morbidity reduces a household's ability to accumulate human and health capital because it interferes with schooling of children. Schooling was mentioned frequently (42 percent of the time) as an activity that was not carried out because of malarial illness. Thus, although the short-run agricultural production of a household may not be affected by malaria because of the phenomenon of intrahousehold reallocation of labor in the event of a malaria attack, long-run labor productivity is in all probability impaired. It is this impairment of future labor productivity that could detain a malaria-endemic community in the initial stages of growth where increases in incomes have a negligible or no effect on malaria prevalence.

Perceived prevalence of malaria

On the average each household studied had experienced two to three episodes of malaria within the two months prior to the interviews for the study. However, a malaria episode is not a random event in the population. About 60 percent of those who were reported to have contracted malaria over the period in question were females. Moreover, the relative frequency of malaria attacks in the population declines with the age and educational level of an individual. Forty percent of those who had a malaria illness (296), were aged 11–20 years old; 12 percent were aged between 21 and 30 years; 17 percent were above 30 years.

A similar distribution pattern emerges for education. Over 50 percent of the cases were in individuals who had no education; 28 percent had 1–5 years of schooling; 16 percent had 6–10 years of schooling; 3 percent had more than 10 years of schooling.

The distribution of malaria episodes was also uneven among occupational categories of the population studied. About 50 percent of those who had malaria two months before the interviews were farmers; 42 percent were school children; 3 percent were fishermen; the rest were from other occupational types. Some 60 percent of those who had malaria had been away from home for a period of about one week. People who had visited certain areas, especially areas near the Uganda border, reported malaria attacks relatively more frequently.

Since malaria is unevenly distributed among the population and over geographic areas, malaria control programs need to be targeted both to certain social groups and to particular geographic locations.

Prevention and control measures taken

The population in the study areas recognized malaria as a problem needing their attention, and tried to do something about it, independently of the government malaria control program that existed there.

About 90 percent of the respondents, i.e., 276 respondents, said that they undertook routine malaria prevention measures in their homes. The malaria prevention measures undertaken by households were as follows (relative frequencies are in parentheses):

- bush clearing (75.4 percent);
- use of mosquito coils (10.5);
- removal of water containers from home (2.2);
- use of mosquito nets (2.2);
- spraying (2);
- prophylaxis (3.3); and
- others, including burning local grass or dung, closing windows early, use of mosquito proofs, draining water, etc. (4.4)

The households mainly sought treatment for malaria from government health facilities. Government dispensaries were used more frequently than government hospitals. Most patients (50 percent) travelled 1 to 5km to seek treatment for malaria. Those who sought malaria treatment outside their home spent an average of ksh. 60.00 per person.

The above discussion suggests that some communities are already actively undertaking malaria control strategies of their own. Government malaria control programs should attempt to strengthen the malaria control measures already in existence in communities. Or, at the very minimum, they should take cognizance of such measures. However, even where government malaria control teams are willing to integrate their control efforts with those of communities, they may face hardships if community organizations such as village health committees or councils of village elders do not exist to facilitate the intended integration.

Environmental conditions affecting households

The environmental conditions surrounding household units have an effect on malaria prevalence. Homesteads of 284 of the respondents who participated in this study were identified to have attributes that were conducive to malaria transmission. These attributes, in order of frequency of occurrence in the homesteads, are:

- wet cattle *bomas* (sheds);
- water receptacles;
- high crop vegetation;
- small ponds or depressions; and
- bushy compounds.

Government malaria control programs need to pay attention to household-level environmental conditions that are conducive to malaria transmission, in addition to community-level conditions such as swamps and dikes.

Conclusion

This paper has examined interactions among malaria, economic development, environmental conditions, and sociocultural factors. At low levels of income, malaria prevalence and growth rates of income are likely to be positively correlated because they are strongly influenced in the same direction by a common set of factors. These factors include government interventions such as irrigation schemes. They are also influenced by settlement patterns intended to maximize use of local commons such as swamps and fishing ponds.

As incomes rise above a certain threshold level, however, a reversal in the positive relationship between income and malaria prevalence appears highly likely. This is because growth in income induces behavioral changes in the community that are conducive to the success of malaria control programs; it also strengthens a government's ability to implement effective malaria control programs.

Success of malaria control programs depends on the extent to which both the design and the implementation of malaria control programs are informed by interactions between economic development and malaria.

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Population Migration and Malaria Transmission in Ethiopia

Assefa Nega, M.D.

National Program for the Control of Malaria and other Vector-Borne Diseases
Ministry of Health
Addis Ababa, Ethiopia

Fisseha H. Meskal

National Research Institute of Health
Addis Ababa, Ethiopia

Abstract

Under normal circumstances the distribution of malaria in Ethiopia is dependent mainly upon topographic features, being absent in the cold highlands and highly endemic in the warm and moist lowlands. Human movements from the densely populated, drought-affected highlands to the sparsely populated fertile lowlands appear to upset the long established pattern of malaria distribution. The case of malaria in Pawic district is used to illustrate the pattern of malaria transmission in settlement schemes. Labor migration affecting urban malaria is illustrated by the case of the town of Arba Minch.

Background

Situated in the middle of the horn of Africa, Ethiopia lies between the 4th and 18th parallels and between 34° and 48° longitude. With a coast line of over 1000 km along the Red Sea, Ethiopia is bordered by Djibouti in the northeast, Somalia in the east and southeast, Kenya on the south, and Sudan on the west. The characteristic topographical features of the country are the mountain ranges and the central plateaus of the northern and southern central highlands, which lie on either side of the Great East African Rift Valley, and the vast stretch of lowland plains in the eastern, southern, and western parts of the country. The climate corresponds with the topography. Thus 8 percent of the land surface that lies above 2500m constitutes the cold zone locally known as *dega*. Here the average temperature is 15° C, and mean annual rainfall ranges from 1000 to 1600 mm. Areas with altitudes from 1500 to 2500m form the temperate zone locally known as *woina dega*, with 48 percent of the land falling in this category and having an average temperature of 20° C. Mean annual rainfall varies from 400 to 2400 mm. The remaining area lies in the *kola*, or warm zone, at altitudes below 1500 mm. Here the mean annual temperature and rainfall range from 20 to 30° C and 100 to 900 mm respectively. According to 1990 estimates, the population just exceeds 50 million (growing at an annual rate of 2.9 percent), 80 percent of which lives in the 54 percent of the land that lies above 1500m.

Malaria in Ethiopia

The earliest scientific records on malaria in Ethiopia come from Italian investigators like Lega, Raffaele, and Canales in 1937 and Corradetti in 1938 and 1939. Soon after World War II British scientists like Mara (1950) and Sir Gordon Covell (1952) contributed greatly to our knowledge of the epidemiology of the disease in Ethiopia. Upon the recommendations of Sir Gordon Covell, the first pilot project on malaria control in Ethiopia was initiated in 1955. In 1958 there was a severe outbreak of malaria that affected 3 million people, of whom about 150,000 died (Fountaine, Najjar & Prince, 1961). This condition, among others, prompted the establishment of a National Malaria Eradication Service in 1956 (Gebremariam, 1984). The methods of control included intradomiciliary spraying of DDT as well as detection and treatment of cases. Following extensive evaluations by independent teams, the eradication program was converted to a control program with eradication retained as a long-term goal (Demissie, Tekeste, Ayalew, Kouzentsov & Rao).

Malaria still ranks number one among the most highly communicable disease in the country. According to parasitological data available in the Malaria Control Programme of the Ministry of Health, the mean annual number of cases of malaria increased from 43,545 during the period 1980 to 1984, to 235,592 from 1985 to 1989, an increase of more than five times over the earlier period. The mean annual parasite rate during the same period increased from 8.9 percent to 33.3 percent, which is about four-fold. Figure 1 shows the cumulative annual distribution of malaria cases in the 1980s, whereas the sharp increase in incidence in the latter half of the decade is clearly noticeable in Figure 2.

The distribution of malaria in Ethiopia appears to follow the topographic features of the country. Altitudes above 2000m seem to be too cold for the malaria vector to survive and breed, and there is no known indigenous transmission above 2500m. Some transmission takes place in the temperate zone (1500 to 2000m) where endemicity is low and unstable. In this region "when transmission occurs it is the form of outbreaks with a high rate of morbidity and mortality, due to lack of communal immunity" (Nega, 1989).

Malaria is endemic in the lowlands of Ethiopia (under 1500 m), which extend over the Rift Valley, the Ogaden region in the east, the Eritrean lowlands in the north, and some deep gorges created by the Abay, Tekeze, and Baro rivers. Transmission is perennial in the highly endemic lowlands like the Gambella, Metekel, Metema, and the Setit-Humera districts (Figure 3). In other areas transmission is highly seasonal, occurring immediately after the light rainy season of March and April as well as after the long rains of June through September.

This pattern of malaria distribution in time and space appears to have influenced human settlements in the past thousand years of Ethiopian history. Thus, as indicated earlier, most of the human settlement is concentrated in the highlands and plateaus where malaria is either absent or of low prevalence. The lowlands are traditionally feared as malarious and are still least preferred for human habitation, although natural resources are much more abundant here than in the highlands. This limitation of human habitation appears to have caused over-population, over-cultivation, soil erosion, and environmental degradation, thus leading to extensive droughts and famines in the central highlands. The severe famine condition of

Fig.1 Annual distribution of cases of malaria seen by detection and treatment posts in Ethiopia

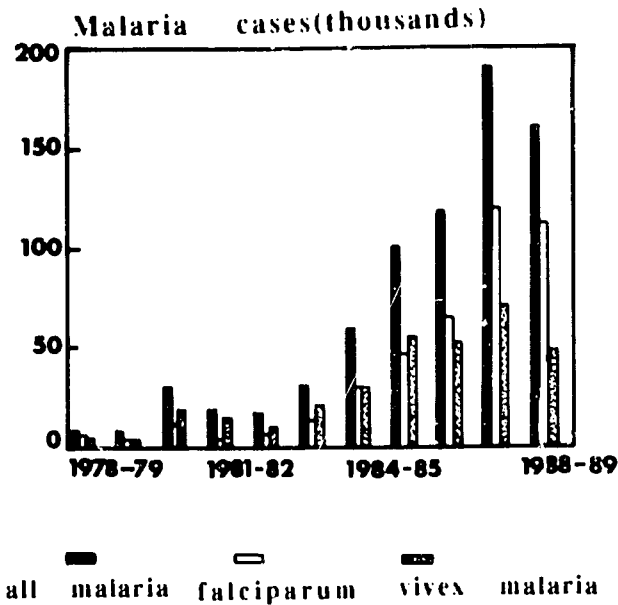
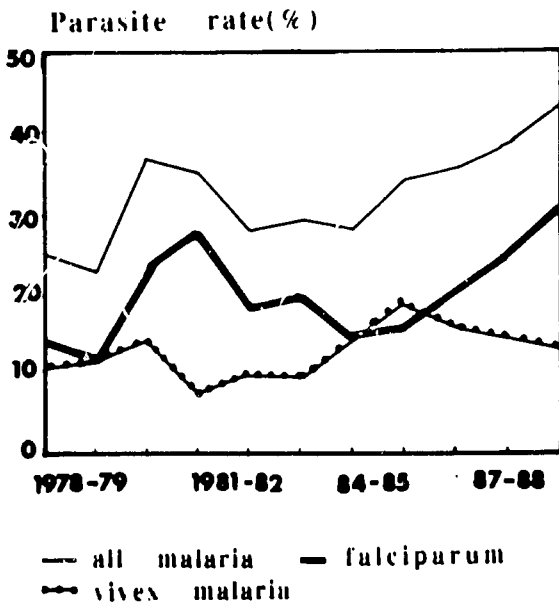
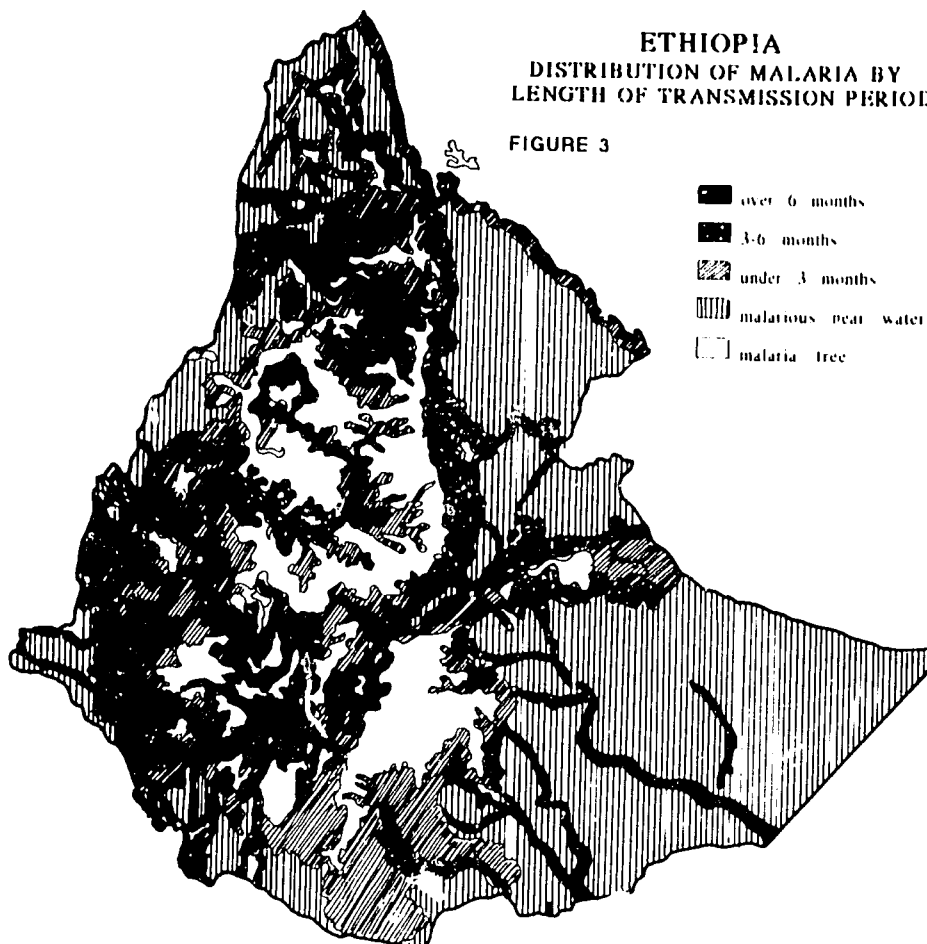


Fig.2 Trends in the annual incidence of malaria in Ethiopia in areas with detection and treatment posts.



ETHIOPIA DISTRIBUTION OF MALARIA BY LENGTH OF TRANSMISSION PERIOD

FIGURE 3



the early 1980s prompted the Ethiopian government to undertake massive relocation of the affected highland population to the warm, moist, and fertile lowlands. The process of migration and the types of settlement schemes in turn appear to disturb the long-established pattern of malaria transmission in the country. This phenomenon will be illustrated using the cases of the Pawie resettlement scheme and development activities in the area of the township of Arba Minch.

Malaria in the Pawie Settlement Scheme

The Pawie settlement is located in the Metekel district of western Ethiopia and borders the Sudan. The area lies between 1000 and 1700m and enjoys rain through seven months of the year with a peak of about 313 mm during the month of July, high humidity between 70 and 80 percent during the month of August, and its highest temperature close to 30° C in April. The Pawie settlement was originally planned to hold 300,000 people, but by 1989 there were

only 80,000 people settled. The settlers originally came from the densely populated, drought- and famine-stricken provinces of Wello, Shewa, and Gojjam.

Although malaria has been known to be endemic in the Pawie area, the magnitude of the problem was not of major concern to the Malaria Control Programme, which had been operating in the area for more than two decades before 1985, because the indigenous Shankilla, Agew, and Shinasha population did not show much morbidity even during the peak transmission months.

From 1981 to 1985 over 78,000 people from the drought- and famine-stricken regions of Wello, Gojjam, and Shewa were brought by the Ethiopian government and settled in 44 newly established villages in the Pawie district.

Aware of the dangers of malaria expected as a result of introducing non-immune highlanders into the endemic malarious area, the Malaria Control Programme of the Ethiopian government carried out comprehensive control activities that included:

- one weekly chemoprophylaxis;
- establishment of 44 detection and treatment posts and 19 diagnostic centers;
- training of 116 community health agents;
- organization of health committees consisting of members from construction, agriculture, health, and education as well as community leaders;
- establishment of a task force at headquarters to assess the weekly malaria situation in the settlements and to recommend appropriate control measures;
- introduction of weekly health days to carry out environmental management activities including filling burrow pits, clearing of water-retaining rubbish, and draining of unnecessary water, as well as oiling and larviciding with Abate; and
- biannual intradomiciliary spraying of 75 percent WDP DDT at a dose of 2 g/m².

In spite of this effort, a disappointing and progressive rise was experienced in the parasite rate, annual parasite index, and number of episodes during the three years between 1985 and 1988. A total of 150,027 slide-confirmed cases was established in these three years. Figure 2 shows the rise in annual incidence of malaria during this period. The rise in malaria during 1985 to 1986 was attributed partly to the difficulty of complete coverage with weekly prophylaxis, and in 1986 to 1987 more emphasis was placed on case detection and treatment. With a continued increase in prevalence, the control program introduced a method of bi-weekly house-to-house surveys of fever cases that only doubled the number of reported cases.

Some of the factors hindering the success of control efforts included:

- walls of most settlement *tukuls* were not plastered, thus rendering residual insecticides ineffective;
- *tukuls* were in close proximity to breeding sites (often not exceeding 100 meters);
- outdoor sleeping is a common practice, particularly among men in order to guard crops from wild animals; and
- there has been an emergence of chloroquine resistant *Plasmodium falciparum*.

Development Activities, Population Movement, and Malaria Transmission

Major development areas indicated in the 1984 to 1993 ten-year development plan of Ethiopia lie in the south and west of the country, areas that are known to be malarious (Figure 3). These fertile lowland plains have become the center of attention for agricultural experts. Some of the development projects include the Amibara cotton plantation in the Awash valley, the Ethio-Korean project in the Omo Valley, the Baro-Akobo irrigation scheme in Gambella, and the Wabe Shebele settlement project in the Ogaden area.

Development activities attracted people to these places from all over the country. This phenomenon appears to have upset the well-established pattern of malaria transmission in urban areas. We shall consider the case of malaria in the town of Arba Minch to explore the impact of population migration on the epidemiology of malaria.

Malaria in Arba Minch

Arba Minch is the capital town of the Upper Omo Administrative region. It lies within the Rift Valley at altitudes between 1400 and 1440m. In 1989 the population was estimated at 34,500. The major rainy season is during the months of April, May, and June.

Although malaria is endemic in Arba Minch, it had been brought under control by the Malaria Control Programme that has been operating in the area for more than two decades. However, in the five years between 1985 and 1989 a resurgence was observed in the town and surrounding localities.

Major changes in the physical and biological environments in the area that took place during this period are those associated with rural development, including:

- establishment of an institute for water development and another one for teacher training. First student enrollment in 1984 included students all over the country, mostly from the highlands with no experience of malaria infection and no protective devices (window screens, bed nets) to prevent exposure to mosquito bites.

- a textile factory was recently completed, resulting in about 1000 laborers migrating from all over the country, living in barracks near mosquito-breeding sites.
- two cotton plantations a few kilometers away from town, irrigated state enterprises, about 3000 laborers, poorly maintained canals passing through camps.
- military troops recruited from surrounding districts, trained and dispatched several times during the period in question.

All these activities involved the migration of unprecedented numbers of people from all over the country and their passing through or settling in and around the township of Arba Minch.

Epidemiological changes of malaria in Arba Minch and surroundings included:

- an increase in malaria from 3310 cases in 1986 to 6163 in 1988;
- a rise in incidence from 4.12 percent in July 1985 to 8.6 percent in July 1987;
- the relative frequency of *P. falciparum* increased from 47.8 percent in 1985 and 1986 to 79.2 percent in 1986 and 1987;
- more males were infected (2.7 : 1) in the 1985 and 1986 infections; and
- people over 10 years of age were more affected (87 percent, 78 percent, 76 percent) during the three years.

In general the recent changes in malaria transmission in and around Arba Minch appear to be associated with the high influx of people from all over the country including a non-immune majority from the highlands.

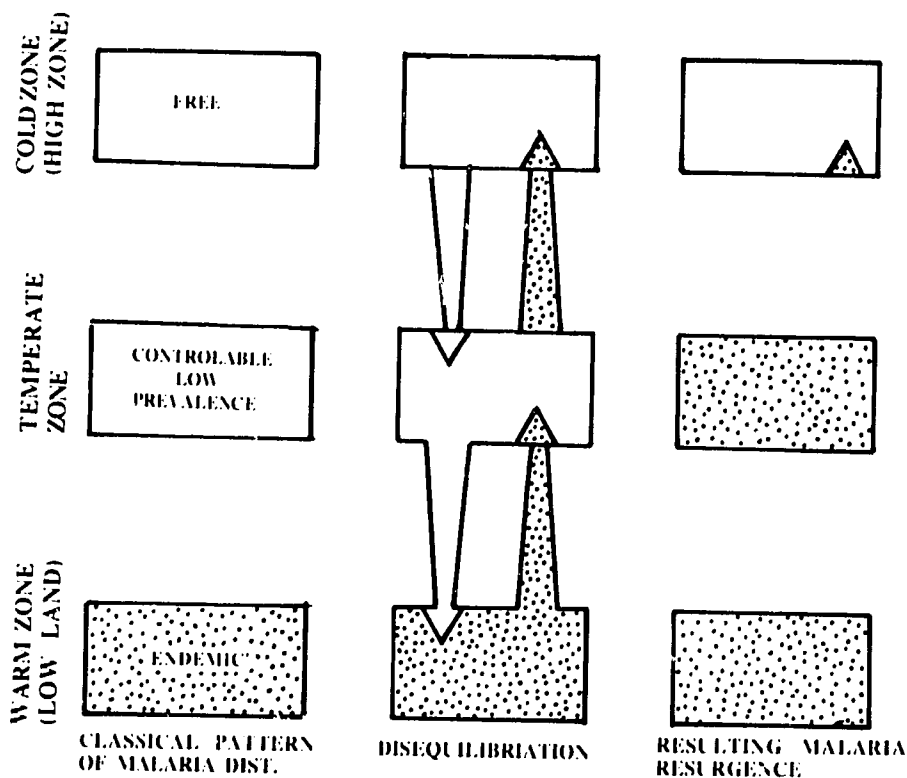
Conclusion and Recommendation

One of the major changes associated with and favoring increased transmission of malaria during 1984 to 1989 was the introduction of more than half a million non-immune highlanders into the malaria-endemic lowlands. The other change include establishing large farms, factories, etc., in endemic areas without incorporating necessary measures to prevent the spread of malaria. Highlanders migrating to and from endemic regions and passing through urban centers have promoted resurgence of malaria in previously controlled regions (Figure 4).

- Settlement-related malaria deserves special attention on the part of planners. Consideration should be given to the need for an integrated preventive method that includes site selection, setting a minimum housing standard, chemoprophylaxis, environmental modification, larviciding, and residual spraying.
- Local research capabilities, including manpower development, physical support, and encouragement of collaboration with external institutions, need to be strengthened.

- Large-scale water development schemes supported by international financiers should receive attention, at least in principle, to avert the health impact of development activities. Closer examination should be made of the implementation of such support, particularly during the operation and maintenance phases.
- Small-scale water development schemes appear to expose larger surface water and cause greater health damage, yet there is no concerned body (local or international) to look into this problem. Due consideration should be given to such problems that have not been adequately recognized.
- Control of malaria in settlement and development areas requires a coordinated effort among agricultural experts, health workers, construction personnel, political authorities, and community representatives.

FIG. 4
POPULATION MIGRATION AND MALARIA DISSEMINATION



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The Malaria Situation in Sub-Saharan Africa

K.M. Paluku
Coordinator, Malaria Activities, PEV/CCCD
Kinshasa, Zaïre

Background

In most of sub-Saharan Africa, malaria is responsible for the largest number of parasitic illnesses. It is also one of the five most important causes of mortality and morbidity, especially among infants, children under five years of age, and pregnant women.

It is estimated that five percent of children die of direct or indirect effects of malaria before reaching the age of five years. Malaria during pregnancy is correlated with low birth weight, miscarriages, stillbirth, and premature birth.

Infants and children under five constitute more than 50 percent of cases. Approximately 750,000 children's deaths are due to malaria each year. In 1988, among an estimated incidence of 110 million cases each year worldwide, 90 million were in Africa.

Transmission in Africa remains extremely intensive, with a high rate of reinfection and superinfection. It is estimated that the number of infective bites per person per year ranges between 40 and 140. This situation is unlike any other in the world.

Estimates during studies measuring knowledge, attitude, and practice (KAP) studies in Zaïre show an average of five episodes and a median of seven episodes (between three to eighteen episodes) annually of fever (malaria) among children under five years. Among older children and adults, the illness manifests itself through a loss of energy and reduced performance for workers. Severe malaria is associated with infection, demonstrated by the appearance of anemia, which augments the importance of malaria as a health problem. A study conducted in a large hospital center in Zaïre showed that 10 percent of children who came for hospitalization were anemic and required a blood transfusion, thereby increasing the risk of contracting the HIV virus.

In recent years, the situation in sub-Saharan Africa has been aggravated by the appearance of mortal epidemics in several areas of irregular transmission, such as: Madagascar, Rwanda, Zimbabwe, Botswana, Namibia, Zambia, and Zaïre. The progression of chloroquine resistant *P. falciparum* through the region has complicated treatment.

The malaria situation in sub-Saharan Africa is not homogeneous; it varies according to the principal phytogeographic facies: from the central African forest, to the Sahara — between

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which lie the degraded forest and savannah (Mouchet & Carnevale, 1981). In these conditions, we consider four principal epidemiological modalities of malaria:

Group I: Endemic malaria characterized by permanent transmission with a seasonal variation only in intensity

The rate of inoculation is significantly higher than 30 infective bites per person per year. In response to the constant reinfections, all subjects carry parasites and, depending on the epidemiological situation, develop a strong protective immunity more or less quickly. (Carnevale & Mouchet, 1980). Therefore, adults and even adolescents, (not young children) do not experience clinical illness although parasites are always present in the blood at a rate of several thousands of parasites per cubic millimeter. These individuals are known as asymptomatic carriers. Moreover, adults maintain a lower average density of parasites than do children.

Group II: Endemic malaria with seasonal transmission during the rainy season (which can be six months long)

The annual rate of inoculation is typically relatively light (approximately 30 infective bites per person per year) but with great variations according to local situations. Transmission is conducted by *An. gambiae* s.l. during the rainy season and by *An. funestus* s.l. at the beginning of the dry season. The immunity is developed later in areas of seasonal transmission than in zones of permanent transmission where children (5-9 years of age) are protected. The adult subjects of those zones show great resistance to malaria but are not altogether free from clinical episodes.

The usual signs of malaria (plasmodic and splenic symptoms) show well-defined seasonal variations, consistent with the dynamics of the transmission. These symptoms are found in only approximately 50 percent of children aged 2-9 during the dry season, but during the rainy season, surveys reveal a parasitemia of *P. falciparum* among 80 to 90 percent of pre-school and school-age children (Choumara, et al., 1959; Gazin, et al., 1983). These signs vary also according to age with a regression of splenic signs among adults, demonstrating the acquisition of the immunity. In fact, the annual regularity of transmission, despite seasonal fluctuations, makes malaria endemic with little risk of epidemics, except in the case of drastic modifications of biotope, be they "natural," for example, the result of several years drought or "artificial," such as the construction of dams and their human implications (e.g., population transfer).

Group III: Occasional, annual malaria transmission during a very short (two-month) period

Transmission can effectively take place each year, but it is concentrated during the short period of rain, and transmission is practically non-existent during the other ten months of the year. The annual average rate of *Anopheles* inoculation is very low; it is, for example, three to four infective bites per person per year in Podor, Senegal (Parent, et al., 1983).

In this region of occasional transmission, from one year to the next, we notice great variations in plasmodic and splenic indications, which increase among children and adults during the transmission period. Also noteworthy is an increase of splenic signs according to age, signaling the "susceptibility" of adolescents and adults to clinical episodes.

The cessation of transmission during ten months is effectively accompanied by a significant loss of anti-malaria antibodies key to maintaining immunity. The proliferation of mosquito vectors caused by rain may cause intensive transmission of malaria among individuals with little or no immunity. Clinical malaria may then appear in the form of seasonal epidemics and will affect all age groups. This kind of unstable malaria is found in the Saharan zones and those of moderate altitude.

Group IV: Sporadic transmission, resulting from particular circumstance (e.g., floods) in zones where malaria is generally non-existent

In such places, as in plateaux of high altitude, malaria appears as an epidemic in the form of explosion or sporadic exacerbation. These epidemics, although limited in time and space, can take on characteristics of extreme gravity with high mortality and therefore necessitate intense antivector and therapeutic operations. Between these epidemic attacks, there is no evidence of the maintenance of malaria at low levels of transmission. Such epidemics can occur in regions where malaria appeared to have been eradicated or at least well-contained and can indicate control of vectors and parasites.

Other types of epidemiological situations can be identified:

- lagoonal/coastal regions
- oases

In the coastal regions of west Africa, the species *An. melas* of the *An. gambiae* complex is preponderant. These species breed well in the salty water of the mangroves and afflict the people living in these areas. *An. melas* has long been known (Barber & Olinger, 1931; Blacklock & Wilson, 1941) to be an important vector of human malaria, but its relative importance with respect to *An. gambiae* is still to be determined. *An. melas* may be less efficient than *An. gambiae*, but this weakness could be temporarily overcome by a greater density.

The Saharan oasis also represents a unique epidemiological region (see Ramsdale & de Zulueta, 1983, for details).

Conclusion

A differentiation among forest, savannah, and sahel regions, or at least among regions of permanent transmission, seasonal transmission, and episodic transmission, can be made with information on epidemiological and entomological conditions. These conditions have different clinical and parasitological consequences in West Africa (Escudie & Hanon, 1961)

than in Central Africa (Charmot & Roze, 1978). The prevalence of malaria and the parasite burden have appeared higher in the savannah than in the forest. Differences in childhood morbidity attributed to malaria are also found: Mortality is more severe during the seasonal peaks in the savannah than in the forest, where transmission is constant. All these idiosyncrasies and differences, even within the same epidemiological group or phytogeographic climate, confirm the extraordinary polymorphism of malaria. This polymorphism is encountered at the level of each of the links in the epidemiologic chain: host-parasite-vector and at the level of their interrelations in each epidemiologic setting. These interrelations appear directly influenced by the abiotic and biotic factors of the biotope and by the ecology of the vector. In addition, humans, vectors, and parasites all adapt to local conditions. This recognition of the epidemiologic polymorphism of malaria leads back to the problem of the validity of current classifications (hypo, meso, hyper, and holoendemic malaria) that take into account one parameter (plasmodic or splenic signs) and that seem inadequate to characterize a multifaceted, dynamic situation like that of malaria in sub-Saharan Africa.

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Lutte contre le Paludisme en Afrique

Approche Multisectorielle (Cas du Rwanda)

Dr. A. Rwamakuba
Directeur de l'Environnement, Ministère du Plan
Kigali, Rwanda.

Contexte

Le paludisme dans le monde, tel qu'il est présenté par l'Organisation Mondiale de la Santé (O.M.S) dans son rapport publié en 1990 "Etat de la Situation du Paludisme dans le Monde en 1988" est une maladie qui sévit sur tous les continents mais à des degrés divers. A la lumière des chiffres dont dispose l'O.M.S, sur une population mondiale de 5.011 millions, 2.055 millions (41%) vivent en zone endémique; sur les 90 millions des cas de paludisme déclarés, environ 80 millions sont localisés en Afrique sub-saharienne soit plus de 80% du total des cas inventoriés dans le monde. A partir de ce tableau, il en ressort que le paludisme est le problème majeur de santé publique en Afrique sub-saharienne. Cependant, les régions épidémiologiques qui ont pu éradiquer le paludisme sont menacés par sa réinvasion (cfr. figure 1).

Sur les cinq sous-régions que compte la zone africaine, le paludisme sévit dans trois d'entre elles avec une acuité telle qu'une étude approfondie s'avère nécessaire. Ces trois sous-régions sont: l'Afrique Centrale, l'Afrique de l'ouest et l'Afrique de l'est.

La sous-région de l'Afrique du Nord avec ses 1.061 cas accuse une situation moins alarmante que les trois sous-régions citées ci-dessus, tandis que la sous-région de l'Afrique Australe est relativement moins affectée que les deux autres.

La situation épidémiologique en Afrique Centrale.

La sous-région de l'Afrique Centrale présente une situation épidémiologique très particulière car le paludisme est la première cause de morbidité et de mortalité dans les pays de cette sous-région. Ces pays sont: l'Angola, le Burundi, le Cameroun, le Congo, le Gabon, la Guinée Equatoriale, la République Centrafricaine, le Rwanda, Sao Tomé et Principe, le Tchad et le Zaïre.

Ces pays comptent plus de 75,7 millions d'habitants sur une superficie de 6.667 million de km^2 , soit 13,5% de la population entière de l'Afrique répartie sur 24% de la superficie de l'Afrique. Il apparait ainsi que la densité de la population est très faible avec une densité moyenne de 11 habitants au km^2 . Cependant il faut noter que deux pays se démarquent avec

REPARTITION GEOGRAPHIQUE DU PALUDISME EN AFRIQUE, 1990

- ☐ Zones dans lesquelles le paludisme
a disparu, a été éradiqué ou n'a jamais servi
- ☐ Zones à risque limité
- ☒ Zone où il y a transmission de paludisme

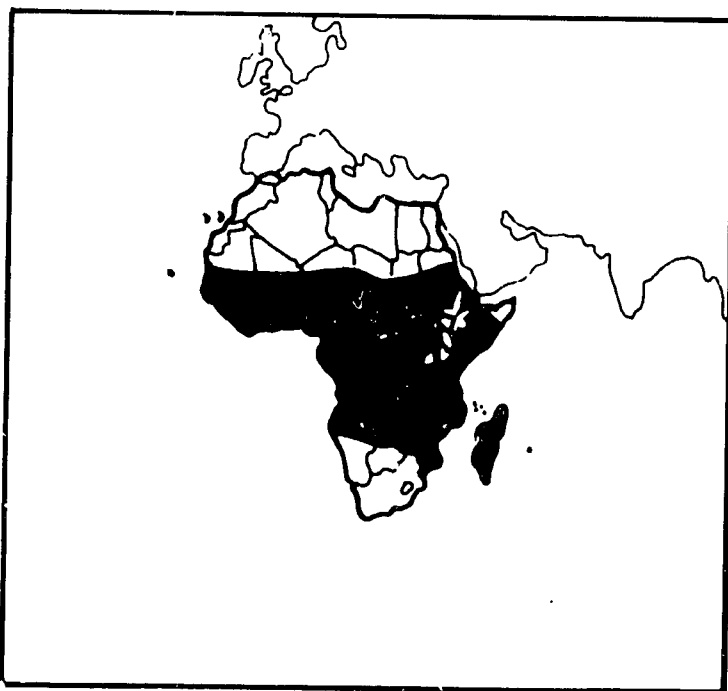


FIGURE 1

une densité de population très élevée à savoir le Burundi et le Rwanda qui ont respectivement 180 et 280 habitants au km².

En Afrique Centrale, le produit national brut (PNB) par habitant est en dessous de la moyenne africaine pour la plupart des pays sauf pour trois pays, le Cameroun, le Congo et le Gabon qui ont largement plus de 561 dollars USA par habitant. De même pour l'espérance de vie à la naissance, seules les populations de trois pays, le Cameroun, le Congo et Sao Tomé et Príncipe ont une espérance de vie à la naissance au-delà de 53 ans, ce qui est la moyenne pour toute l'Afrique.

Il est toutefois remarquable que les pays de la sous-région de l'Afrique Centrale disposent de potentialités importantes quant aux ressources naturelles. La moitié de la forêt humide et des terres boisées de l'Afrique se trouvent dans cette sous-région. Sept pays sur onze sont situés sur le littoral de l'Océan Atlantique, tandis que les quatre pays continentaux sont totalement enclavés (le Tchad, la République Centrafricaine, le Burundi et le Rwanda).

Les ressources en eau sont très abondantes car les pays ont une pluviométrie assez régulière et élevée à l'exception du Tchad qui est un pays sahélien. De plus, beaucoup de rivières et de fleuves parcourent les bassins du Zaïre, du Tchad et même celui du Nil pour le versant de l'est.

Le Rwanda en tant qu'Exemple

Le Rwanda partage presque le même tableau épidémiologique et les mêmes caractéristiques socio-géographiques et économiques que la majorité des pays de la sous-région de l'Afrique Centrale. De même, les facteurs du milieu, les facteurs sociaux et économiques favorables à l'entretien de l'endémicité du paludisme sont les mêmes. C'est pourquoi, les mesures de lutte ou d'éradication, les méthodes et les outils mis en oeuvre dans ce pays ne diffèrent pas de ceux utilisés dans d'autres pays.

Présentation du Rwanda

Situé en Afrique Centrale, le Rwanda est un pays enclavé, limité au nord par l'Uganda, au sud par le Burundi, à l'est par la Tanzanie et à l'ouest par le Zaïre.

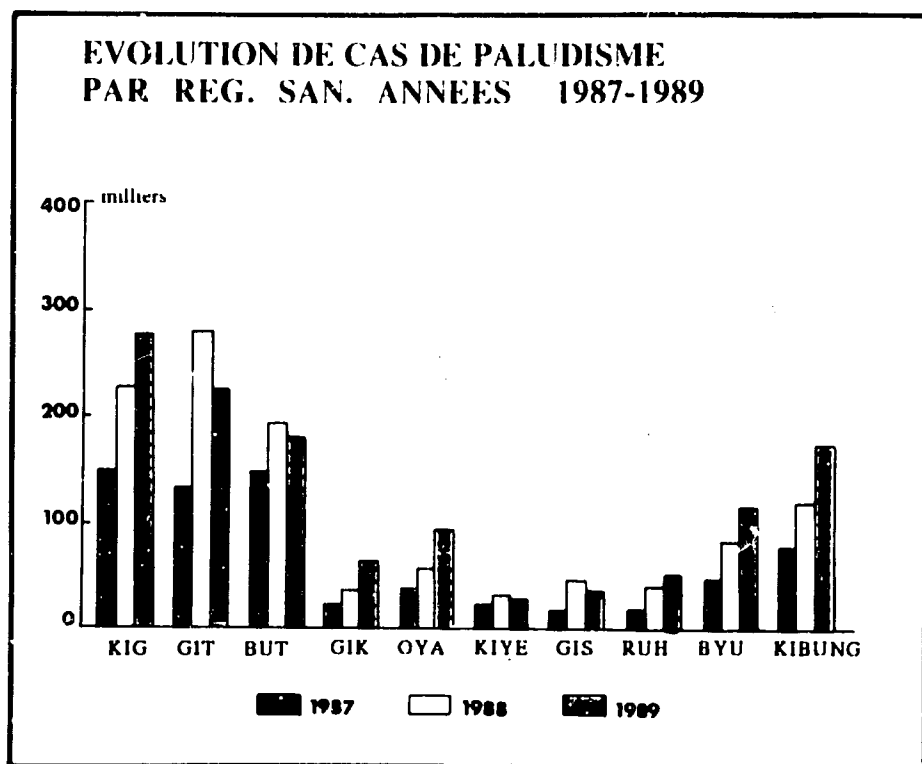
Avec une superficie de 26.338 km² et une population de plus de 7,5 millions, le Rwanda est l'un des pays les plus densément peuplés de l'Afrique (plus de 280 habitants/km²). Mais, compte tenu des terres arables (seulement environ 50% du territoire), la densité réelle s'élève déjà à 500 habitants par km² ou même plus dans certaines régions. Le taux d'accroissement de la population qui atteint actuellement 3,7% par an est l'un des plus élevés de l'Afrique. La pression démographique conjuguée avec l'exploitation intensive des ressources naturelles (plus de 90% de la population active œuvrant dans le secteur agricole) constitue une préoccupation primordiale dans le contexte environnemental.

Pays tropical au relief accidenté, son climat est sensiblement tempéré; la température moyenne s'élève à 20 °C sans écart significatif. Une alternance de deux types de saisons,

pluvieuses et sèches, fait du Rwanda le pays au printemps perpétuel: d'où une flore luxuriante allant de la forêt équatoriale à la savane baissée avec tout ce qu'elle comporte comme marais à papyrus et lacs marécageux couverts de touffes végétales. De nombreux cours d'eau sillonnent le pays et alimentent les rivières et les fleuves dont le Nil qui prend ses sources au Rwanda.

Evolution du paludisme au Rwanda

Depuis les années 1960, le paludisme tend à la hausse dans tout le pays en général malgré les mesures de lutte entreprises à l'époque coloniale et même après l'indépendance. Cependant, la situation s'est exacerbée ces quatre dernières années où le taux d'incidence annuel s'est accru de 35 à 40% comme l'indique l'évolution des cas de paludisme répertoriés les années 1987, 1988 et 1989 (cfr. figure 2).



Les facteurs du milieu

Le vecteur

Plusieurs espèces d'anophèles ont été trouvées et parmi elles les vecteurs: *A. Gambiae*, *A. Funestus*. Leur distribution diffère du nord au sud.

- La zone première est celle des hautes montagnes et se situe à une altitude de 2.000 à 3.000 mètres. Elle dispose d'un climat tempéré dont les températures oscillent entre 8 C et 20 C. Ce climat n'est pas défavorable à la prolifération du vecteur. Cette zone première se situe dans la région de la Crête Zaïre-Nil qui correspond aux entités administratives de Ruhengeri, Gisenyi, Kibuye, Cyangugu et Gikongoro. La pluviométrie est de 2.000 mm par an en moyenne. L'indice plasmodique de cette région est d'environ 2%.
- La deuxième zone est celle du bassin versant du Nil qui se situe dans le plateau central et la région des plaines et des lacs -de l'est du pays- L'altitude est de 1.000 à 1.500 mètres. Les températures oscillent entre 14,3 et 25 C, la pluviométrie est de 1.100mm/an et l'indice plasmodique varie entre 10 à 40%. Les entités administratives sont les préfectures de Kigali, Gitarama, Butare, Kibungo et Byumba.
- La troisième zone se situe dans le bassin du Zaïre qui couvre la région du lac Kivu et la plaine de la rivière Rusizi. La température de la zone est d'environ 20 C, l'indice plasmodique tourne autour de 10 à 40% également. La pluviométrie, assez abondante, varie entre 1.400 mm à 2.000 mm par an.

La population

La pression démographique est tellement importante que la population est obligée de migrer vers les zones jusqu'alors considérées comme impropres à l'habitat et à l'agriculture. C'est ainsi que les Rwandais, habitués à s'installer sur les hauteurs des collines à l'abri des moustiques, ont été obligés de descendre vers les marais qui constituent 7% du territoire avec 180.000 hectares de dimension. Les aménagements hydro-agricoles de plus en plus nombreux constituent des gîtes d'anophèles. La pression démographique a également engendré un autre phénomène, l'exode rural: la population rurale s'est dirigée vers les villes qui ne disposent pas de structures d'accueil suffisantes. Elle s'est spontanément installée dans des quartiers dénués de tout système d'assainissement des eaux usées et des eaux pluviales.

Il est important de signaler que la pauvreté de la population est telle qu'elle est très vulnérable à la malnutrition. Environ 27% de la population n'a pas suffisamment de nourriture et cette catégorie de personnes n'est pas en mesure de se procurer les médicaments essentiels et nécessaires au traitement du paludisme.

Les activités économiques dans les marais

Les aménagements hydro-agricoles dans les marais se sont développés. Les rizières et la culture de la canne à sucre ont pris de l'expansion. Le problème du paludisme est le résultat du mauvais aménagement et du mauvais entretien des périmètres agricoles et du manque de traitement pour les populations environnantes.

Suite au développement des villes, les activités artisanales se sont accrues dans les marais. La recherche d'argile, de sable et de gravier pour la construction laisse des trous où s'accumulent des nappes d'eau stagnante. De même les exploitations aurifères dans les marais provoquent les mêmes dégâts sur l'environnement et favorisent la prolifération des moustiques.

Stratégie de Lutte contre le Paludisme

Pour l'OMS, l'objectif final de la lutte contre le paludisme est sans nulle doute son éradication. Cependant pour atteindre cet objectif, il faut passer par des objectifs immédiats, à savoir:

- la réduction du niveau de transmission du paludisme dans les zones endémiques;
- la réduction de la morbidité et de la mortalité;
- la prévention de la montée du paludisme dans la zone non encore atteinte par le paludisme;
- l'assistance pour le processus de mise en oeuvre des programmes de développement socio-économiques dans les zones affectées par le programme.

Les pays de la sous-région de l'Afrique Centrale, dont fait partie le Rwanda, face à ce grand objectif de l'OMS le considère comme un rêve vu la montée du paludisme dans les pays depuis ces derniers temps. La hausse de la morbidité et de la mortalité dues au paludisme est directement proportionnelle au niveau de pauvreté qui n'a pas cessé d'augmenter dans ces pays. Toutefois, ceux-ci ont tous appliqué, chacun à sa façon, la stratégie préconisée par l'OMS dans le cadre de la lutte contre la malaria. La stratégie a été orientée dans le sens d'appliquer les soins de santé primaires. Bien que les résultats ne soient pas dans l'ensemble satisfaisants, des efforts ont été déployés dans la sous-région. C'est ainsi qu'en plus des stratégies nationales appliquées dans les différents pays, une surveillance épidémiologique a été amorcée dans les pays membres de la Communauté Economique des Pays des Grands Lacs (le Burundi, le Rwanda et le Zaïre). Ces pays ont entrepris des contacts avec l'Uganda et la Tanzanie en vue d'échanger des informations relatifs à la sanitation.

Bien que le paludisme soit la première cause de morbidité dans ces pays, il n'existe pas encore l'approche harmonisée de lutte épidémiologique conjointe, ni du paludisme en particulier.

Au Rwanda, une personne sur six a le paludisme chaque année. La stratégie de lutte contre le paludisme a été orientée vers deux axes:

Le traitement du Paludisme

Etant donné que la personne malade constitue un réservoir de plasmodium, il fallait lutter contre la maladie pour empêcher que la personne infectée ne soit une source inépuisable. C'est pourquoi des mesures ont été prises dans le sens de:

- renforcer l'infrastructure et l'équipement sanitaire; depuis 1960, plus de 180 centres de santé sont à la disposition des populations habitant 145 communes. La population fait aujourd'hui moins de 15 km pour atteindre le centre de santé le plus proche; et chaque commune dispose d'un centre de santé;
- la population ayant triplée en 30 ans, de 2.500.000 habitants en 1960, elle est estimée à 7.500.000 habitants en 1991. Les ressources humaines ont également augmenté: d'un médecin pour plus de 200.000 habitants en 1960, le Rwanda compte aujourd'hui un médecin pour 25.000 habitants et un paramédical pour 3.000 habitants;
- la fourniture de médicaments antipaludéens s'est accrue mais pas à la même vitesse que la montée des cas de paludisme et de la population;
- en plus du budget annuel d'1 million de dollars USA que l'Etat Rwandais a alloué à l'achat de médicaments de tout genre y compris des antipaludéens, le Rwanda a bénéficié de l'appui de l'OMS, de l'UNICEF, de l'USAID (Combatting Childhood Communicable Disease, C.C.C.D. de 1985-1987) qui l'ont aidé matériellement, techniquement et financièrement.

La Prévention contre le Paludisme

Egalement importante, la prévention contre le paludisme suivait les étapes suivantes:

- l'éducation de la population sur le paludisme (le parasite et le vecteur);
- la chimioprophylaxie n'était conseillée qu'aux étrangers qui n'avaient pas de prémunition. Elle n'était pas généralisée pour la population rwandaise ayant été abandonnée quand on a remarqué une résistance du plasmodium à la chloroquine d'environ 50% vers l'année 1987;
- la lutte chimique à large échelle contre le vecteur s'est avérée impossible car l'utilisation de pesticides dans les marais pour lutter contre les anophèles avait des risques majeurs sur la faune et la flore aquatique. C'est ainsi que l'utilisation d'insecticide à domicile est à la discrétion de la population;
- la lutte contre le vecteur par l'assainissement du milieu est très limitée. En effet, les secteurs chargés de l'assainissement urbain et de l'assainissement dans les périmètres hydro-agricoles relèvent des autorités différentes.

Approche Multisectorielle de la Lutte contre le Paludisme

La Stratégie Nationale de l'Environnement et le Plan d'Action Environnemental

Suite à la réflexion menée depuis 1985, lors du premier séminaire national sur l'environnement qui a recommandé la mise en oeuvre d'une Stratégie Nationale de l'Environnement (SNER), un groupe de travail multidisciplinaire et multisectorielle a été créé. Le groupe s'est penché sur l'étude de la SNER/PAE qui comporte huit thèmes:

- La population, l'aménagement du territoire, l'eau, l'assainissement, la santé et le bien-être;
- L'agriculture, l'élevage, la pêche et les forêts;
- Les milieux naturels, le tourisme, le climat et les catastrophes;
- L'énergie, les activités industrielles et le transport;
- L'éducation, l'information et la recherche;
- La femme et l'environnement;
- La coopération internationale;
- Le cadre juridique et institutionnel.

Ainsi une Stratégie Nationale de l'Environnement au Rwanda et un Plan d'Action Environnemental ont été élaborés par des experts nationaux en collaboration avec des experts expatriés, ainsi qu'avec le concours de la Banque Mondiale, de l'Agence Internationale pour le Développement, du Programme des Nations Unies pour le Développement, du Programme des Nations Unies pour l'Environnement et d'autres organismes.

Les études d'impacts environnementales dans la lutte contre les maladies, et le paludisme en particulier, ont été envisagées dans le secteur agricole. C'est ainsi que la vision globale des problèmes a remplacé l'approche parcellaire, sectorielle qui prévalait avant la mise en oeuvre de la SNER/PAE. Deux études ont été menées dans le périmètre hydro-agricole: l'une au Mutara avec le concours financier et technique du Canada, l'autre est celle du plan directeur de mise en valeur de la Nyabarongo.

Le Ministère de la Santé a produit un document concernant un programme national chargé du contrôle de la malaria. Cependant, ce programme rencontre d'énormes difficultés du point de vue des besoins financiers et des ressources matériels. Au Rwanda, ce programme chargé du contrôle de la malaria a un besoin véritable d'une approche multisectorielle qui aurait pour but d'aider le Ministère de la Santé à être soutenu et aidé par les autres ministères. Ainsi, un centre de contrôle de la malaria est nécessaire au niveau national. Il serait également utile de créer un centre régional africain qui fournirait des conseils et des informations récentes sur le contrôle de la malaria en Afrique et ailleurs dans le monde.

Water Resource Development and Malaria In Kenya

An Environmental Perspective

W. N. Thitai
Head, Research Division, Ministry of Water Development
Kenya

Abstract

Water resource development projects have both benefits for and unfavorable effects on the hydrological regime, on the environment in general, and on the health and living conditions of the populations concerned. Irrigation schemes and hydropower reservoirs in Kenya are known to have created breeding habitats for malaria vectors and to have changed the disease prevalence. Rational water resource development should include taking into account both the favorable and the unfavorable effects of development.

This paper offers an environmental perspective on water resource development in relationship to malaria control. It recommends that all water resource development projects, including domestic water supply, irrigation, hydropower projects, flood control, wetlands development, and effluent treatment, should incorporate a public health component at the planning, design, construction, and operational phases of project development.

Environmental Impact Assessment (EIA) of the project should be undertaken and should include a sound health component, including malaria control strategy. Moreover, the budget for the construction as well as for the operational phase of a project should include funds for the implementation of the EIA recommendations.

Intersectoral collaboration at all phases of the project development will ensure environmentally sound management of the project and possible reduction of the incidence of malaria infection.

Background Information

The Republic of Kenya is in East Africa between 3°N and 5°S and stretches from 35°E to 41°E. It is bordered in the east by the Indian Ocean, in the northeast by Somalia, in the north by Ethiopia, in the west by Uganda, in the northwest by Sudan, and in the south by the Republic of Tanzania.

Kenya is entirely within the tropical zone, but its topography, particularly the Rift Valley, creates considerable climatic differences that are important for the distribution of the country's water resources as well as for certain disease patterns.

The country is divided into five major drainage basins: Lake Victoria, Rift Valley, Tana River, Athi River, and Ewaso Nyiro basins.

The basic policy of the Government of Kenya is to provide water of reasonable quality and quantity for human and livestock consumption and for sustenance of other economic development programs such as irrigation, pisciculture, wildlife conservation, industry, and hydropower generation.

The Ministry of Water Development, established in 1974, has overall responsibility for the development, monitoring, and quality control of Kenya's water resources, including pollution control. Other entities such as the recently created National Water Conservation and Pipeline Corporation, regional development authorities, local authorities, and NGOs all carry primary authority for development and exploitation of water utility.

Water Resource Development Scenario

Water resource development can be subdivided into national and regional projects with implications for the level of decisionmaking. Each project can further be divided by purpose: irrigation development, water conservation, hydropower generation, domestic water supply, flood control, improving a river's navigational potential, aquaculture, recreation and nature conservation, effluent treatment, and disposal, or a combination of any two or more of the above.

A major health problem associated with water resource projects is the creation of mosquito breeding habitats by the accumulation of stagnant water, thus increasing the prevalence and incidence of malaria. Malaria currently accounts for over 20 percent of reported outpatient morbidity cases in government health facilities. Malarial infections are highest in Nyanza and the western and coastal provinces.

Case Studies Relating Occurrence of Malaria to Irrigation and Hydropower Projects

Studies carried out by the Division of Vector-Borne Diseases of the Ministry of Health have revealed the following evidence:

- The Kano and Ahero irrigation schemes are known to have created ideal breeding habitats for *Anopheles gambiae* leading to increased intensity of malaria in the area.
- The Mwea irrigation scheme has changed malaria transmission from seasonal to perennial. Now the scheme serves as a vector-borne disease transmission site for the

local and migrant populations that come into the area during the harvest season in search of work.

- The hydropower reservoirs of Masiga, Kindaruma, Gitaru, Kamburu, and Kiambere, all along the river Tana, have changed the ecology of the area, and modified the topography and hydrological features, resulting in an increase in the prevalence of malaria.
- The Hola-Bura irrigation scheme has resulted in an increase in malaria prevalence and, because of an increase in breeding sites, malaria transmission is no longer seasonal but now perennial. Analysis has shown that the economic objectives of the project may not have been achieved because of health problems. This failure is suggested by the impairment of health and productivity within the community, in particular the high rates of mortality from malaria.
- The Pekera irrigation scheme has resulted in malaria's becoming endemic within the area because of the creation of breeding sites for *A. gambiae* as a result of irrigation of pastures.

Malaria Control Program

The Sixth National Development Plan (1989 to 1993) stipulates that the solution to the control of malaria vectors lies in the destruction of their habitat. This responsibility should involve the participation of the government and the public at large.

Within the irrigation schemes managed by the National Irrigation Board (NIB), the following malaria control programs are in operation:

- regular distribution of anti-malarial drugs to all children under the age of 10 years, to pregnant women, and to all the NIB staff and families living in the schemes;
- selective application of larvicides;
- treatment of detected cases; and
- regular spraying of both rice and cotton fields with agrochemicals thus reducing the vector mosquito population.

Water Management Methods for Malaria Control

Rural Areas

The most suitable type of water management method for mosquito control will depend largely on the type and size of the water body involved. The methods aim to render water collections unfavorable for vector breeding. The following methods are available for various bodies of water:

- For large bodies of water such as lakes, reservoirs, marshes, and swamps:
 - straightening of the shoreline and removing or filling in side pockets;
 - controlling water levels allowing for alternating flooding and drying of marginal vegetation; and/or
 - draining and filling in of swamps and marshes.
- Small collections of water such as temporary rainwater pools are best dealt with by grading and filling in.
- In rice fields intermittent irrigation is the preferred means of preventing mosquito breeding by allowing surface water to remain for less time than the aquatic life cycle of the mosquito.
- In areas with running water, breeding is confined to grassy margins and quieter backwaters. The straightening and clearing of edges in a general process of canalization helps. Various automatic means of alternating can be used to flush out marginal breeding.
- In springs and irrigation channels, drainage, filling in, and repair of leaks in embankments are called for.
- Man-made containers such as wells, cisterns, and water tanks can be either covered to prevent access to egg-laying female mosquitoes or emptied at frequent intervals. Wells should be provided with concrete aprons with drain pipes leading to a suitable soakage arrangement.
- In wastewater lagoons and fishponds, the embankments can be lined with concrete slabs and the depth of the lagoons controlled to prevent development of emergent vegetation.

Urban areas

Problems of urban vectors result from the deterioration of the environment and of its management. Therefore, environmental management practices can best provide a permanent solution. Such practices are more efficient, more economical in the long term, and ecologically more sound than chemical control methods.

Table 1 shows the environmental management measures applicable for the control of vectors in different habitats in urban areas. In implementing the recommended vector control measures, biologists and engineers should work together on all aspects of the project.

Environmental Impact Studies of Water Resources Development Projects

Environmental Impact Studies have not been a common feature in water resource development projects in Kenya. There are, however, a few cases where such studies have been undertaken, and these are cited in Table 2. Since 1980, approximately 150 small dams, with a total capacity of about 3000 m³, have been constructed without any form of EIA, and activities in this area are likely to expand.

The National Master Water Plan, which is in the final stages of preparation, has emphasized the need for incorporation of EIA into the proposed water development projects. Intersectoral collaboration is essential in order to ensure incorporation of the recommendations of EIAs in all phases of project development.

Intersectoral Collaboration

The main institutions active in the water sector in Kenya are:

- Ministry of Water Development (MOWD)
- National Water Conservation and Pipeline Corporation (NWCPC)
- Ministry of Health (MOH)
- Ministry of Energy (MOE)
- Ministry of Regional Development (MORD) with the constituent Regional Development Authorities:
 - Tana and Athi River Development Authority (TARDA)
 - Lake Basin Development Authority (LBDA)
 - Kerio Valley Development Authority (KVDA)
 - Uaso Nyiro North Development Authority (UNNDA)
 - Uaso Nyiro South Development Authority (UNSDA)
 - Coast Development Authority (CDA)
- Ministry of Agriculture (MOA)
- National Irrigation Board (NIB)
- Ministry of Planning and National Development (MOPND)
- Treasury

- Non-Governmental Organizations (NGOs)
- District Development Committees (DDCs)

The involvement of the various institutions depends on the type and magnitude of the project that may fall under any of the following categories:

National Water Projects

These are interdistrict water projects for which technical implications cannot be handled at the district level. The planning and implementation of such projects are carried out by the MOWD headquarters. The DDCs of the concerned districts play a supervisory role. The NWCPD is now also implementing such projects. These projects are normally contracted out.

District Projects

These are the water supply projects for which the limits of water supply are within the district and for which the level of technology does not call for special skills. They are implemented by the respective DDC.

Self-Help Water Project

These are community-specific projects. They are either government Rural Development Fund (RDF)-aided projects or exclusively community-financed projects. The District water engineer provides technical advice and supervises the project on behalf of the DDC.

NGO Water Projects

In the past, some NGOs planned and implemented water projects independently, without involvement of other entities with water interests in the area, resulting in conflicts and duplication of effort. Today, all the NGOs are required to submit their water project proposal to DDCs for approval. The DWE supervises projects for the DDC.

It is apparent that the Ministry of Planning and National Development ideally should coordinate the relevant sectors to ensure incorporation of EIA studies into the national projects. For the district-based water projects, the DDC is the obvious meeting point for the representatives of all the relevant sectors to ensure environmentally sound planning and implementation of water projects. The recently established District Water Board within the DDCs will be the main actors on water affairs in the District.

Recommendations

1. In the future, all water resource development projects in Kenya should have a public health component, and the health sector should be involved in such projects from the earliest planning stages onwards.
2. Environmental Impact Assessment of water resource development projects should have a sound health component, and the budget for construction as well as that for the operational phase should include funds for implementation of the EIA recommendations.
3. Retrospective studies of existing water projects should be carried out to understand the nature and magnitude of the problem and identify structural or operational factors contributing to a lowered health status (if any), with the objective of correcting these.
4. Intersectoral collaboration in water resource project development must be ensured, and special attention should be given to the transfer of expertise and technology in the field of environmental management for vector control to the community level. The District Development Committee (DDC) has a great responsibility to ensure such collaboration and the transfer of expertise and technology.

Acknowledgement: The author acknowledges the Director of Water Development for approving the paper for presentation.

Table 1 Environmental management measures for vector control in different habitats of urban areas

Type of habitat or condition	Environmental modification		Environmental manipulation		Modification or manipulation of human habitation or behavior																								
	Draining (all types)	Total earth filling	Deepening and filling	Land grading	Velocity alteration	Impoundment	Cleaning of quarries	Design modification	Cleaning of quarries	Recycling of water	Shoreline improvement	Moving outside city limits	Providing water supply	Providing sewerage	Refuse collection and disposal	Improving sanitation	Improving housing	Screening	Sealing	Installing pump	Installing syphon	Regular emptying and drying of water containers	Providing cover	Repairing fixtures	Good housekeeping	Collection and recycling	Health education	Legislation	
Canals					X		X	X				X							X										
Storm-water canals					X	X	X	X		X				X														X	X
Cement water tanks																												X	X
Rooftop water tanks																		X	X									X	X
Domestic water containers																		X	X				X					X	X
Water wells	X												X					X	X									X	X
Step wells								X					X						X	X								X	X
Springs and ponds	X										X		X						X	X								X	X
Ornamental and recreational pools											X		X						X	X								X	X
Refuse water receptacles																												X	X
Flower vases																X	X										X	X	X
Manholes	X							X										X										X	X
Distribution boxes	X							X											X									X	X
Water collections or pipe leakages																			X									X	X
Construction sites		X																						X	X			X	X
Open drains					X		X	X		X											X					X		X	X
Sewage systems						X	X	X		X															X			X	X

Table 1 (Continued)

Type of habitat or condition	Environmental modification					Environmental manipulation					Modification or manipulation of human habitation or behavior																	
	Draining (all types)	Total earth filling	Deepening and filling	Land grading	Velocity alteration	Impoundment	Cleaning of quarries	Design modification	Clearing of quarries	Recycling of water	Shoreline improvement	Moving outside city limits	Providing water supply	Providing sewerage	Refuse collection and disposal	Improving sanitation	Improving housing	Screening	Sealing	Installing pump	Installing syphon	Regular emptying and drying of water containers	Providing cover	Repairing fixtures	Good housekeeping	Collection and recycling	Health education	Legislation
Cesspools	X						X		X					X							X				X		X	X
Cesspits	X						X	X																X		X	X	
Coirpits	X						X	X																X		X	X	
Septic tanks	X						X	X						X											X		X	X
Unsanitary latrines							X							X		X		X	X								X	X
Marshy swamps	X	X		X		X																		X		X	X	
Depressions	X	X		X			X																			X	X	
Quarries	X	X																								X	X	
Ant traps								X														X				X	X	
Refuse collection sites															X	X							X		X	X	X	
Refuse dumps			X												X	X									X	X	X	
Slaughterhouses							X						X	X	X	X									X	X	X	
Food stores																									X	X	X	
(warehouses)							X							X	X		X		X						X	X	X	
Food establishments							X						X	X	X	X	X	X							X	X	X	
Sewage treatment plants							X	X	X						X										X	X	X	
Poor housing							X						X	X	X	X	X	X						X	X	X	X	
Animal shelters											X													X	X	X	X	
Poor personal hygiene													X	X	X										X		X	

TABLE 2 PROJECTS FOR WHICH EIAs HAVE BEEN UNDERTAKEN

Project	Purpose	Size	Status	Environmental Impact Study	Vector-borne Disease Aspect
Masinga Dam	Multipurpose Dam	1560x10 ⁶ m ³	Implemented	Yes	Yes
Kiambere	Hydropower and river control	850x10 ⁶ m ³	Implemented	Yes	Yes
Munyu/ Kimbwezi	Hydropower Irrigation Conservation	625x10 ⁶ m ³	Being planned	Yes	Yes
Nairobi Water Supply and Sewerage	Public water supply	about 9m ³ /sec	Under implemen- tation	Yes	None
Tana Delta	Irrigation	1200 ha	Being planned	Yes	None
Bura	Irrigation	2500 ha	Under implemen- tation	Yes	None

TABLE 2 (continued)

Project	Purpose	Size	Status	Environmental Impact Study	Vector-borne Disease Aspect
Smallholders Irrigation Schemes	Irrigation	4750 ha	Implemented	None	None
Small Dams, Impoundments, and Reservoirs No. 150	Domestic Water Supply and Conservation	2000-3000 m ³	Implemented	None	None
Kirandich Dam for Kabarnet Water Supply	Public Water Supply	--	Planned	Yes	Yes
Greater Nakuru (East) Water Supply	Public Water Supply	--	Planned	To be undertaken	

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Impact of Population Movements on Malaria Transmission in Somalia

M. Warsame, M.D.

Lecturer, Faculty of Medicine, Somali National University
Mogadishu, Somalia

Abstract

Malaria presents great health problems in Somalia because of three main factors: patterns of transmission, internal population movement, and chloroquine resistance.

The patterns of malaria transmission in the country vary from unstable malaria with cyclical epidemics in some regions to more stable conditions with varying degrees of endemicity in others. This variation has resulted in a mixture of non- and semi-immune populations. The problem is aggravated by intense domestic population migration, mainly nomadism and resettlement programs.

The agricultural resources of the riverine areas and the political instability in the middle and north of the country have created significant population migration to the south. This influx of non-immune immigrants to the malaria endemic areas has resulted in increased malaria incidence with high frequency of severe cases. Such impact was clearly demonstrated in the Balcad epidemic. Furthermore, population movements have greatly enhanced the development and spread of chloroquine resistance in the country.

It is clear that in such regions with varying endemicity and intensive migration an effective control strategy through primary health care, including prompt diagnosis and treatment of malaria cases together with adequate vector control measures, is of special importance.

Malaria in Somalia

Malaria presents a great health problem in Somalia. The transmission pattern of the disease is greatly influenced by the climatological and geographical conditions of the country. In the arid zone of the middle and northern parts of the country, transmission is unstable with cyclical epidemics in years of substantial rains (WHO, 1984). In the riverine and inter-riverine areas of the south, transmission is stable, varying from hypo to mesoendemic with hyperendemic pockets. The coastal area is considered free of malaria transmission. This peculiar pattern of malaria transmission has resulted in different degrees of immunity among populations living in the same country. The situation is aggravated by the intensive domestic population movements.

Plasmodium falciparum is the predominant species that causes more than 95 percent of all infections. It is followed by *P. malariae* and *P. vivax* respectively, and very few cases of *P. ovale* have been reported (WHO, 1984). The different patterns of migrations and their impact on malaria will be reviewed in this paper.

Nomadism

The total population of the country was estimated in 1986 at 8.5 million (Ministry of National Planning and Jubba Valley Development, 1989). More than 70 percent of the population living in the middle and north of the country is nomadic, people in continuous movement in search of water and pasture. This proportion decreases in the southern part of the country. The nomads avoid settling along rivers because of the presence of animal diseases like nagana and trypanosomiasis.

The nomadic population has little immunity to malaria since their exposure to the disease is limited to the cyclic epidemics that may occur every 3-5 years or even less frequently. Most of the time such outbreaks are focal, i.e., the transmission may occur near natural and artificial water reservoirs filled by the rains. These reservoirs attract not only large numbers of people but also mosquitoes for breeding. With the presence of parasite reservoirs in the human population and vectors in the area, an epidemic can be initiated. People who have visited malaria-endemic areas function as parasite reservoirs. The affected persons in such epidemics, if unable to obtain chloroquine from the nearest town (often several hundred kilometers away), may die. This type of epidemic is difficult to control since the nomads are continually moving. Fortunately, most epidemics are naturally interrupted by the long dry season and/or drought.

Resettled Population

In 1974 there was a long drought (*daba-dheer*) in the country, affecting most severely the arid savannah areas. In this region, more than 70 percent of the population is nomadic. During the drought many people lost their animals and many died. The government then adopted a campaign to resettle the population that had lost its livestock. They were moved to four agricultural and coastal areas, three of which were located in the agricultural riverine areas of the Shabelle and Jubba rivers where malaria transmission was high, varying from mesoendemic to hyperendemic. Thus, the resettled population, which had been organized into farming and fishing cooperatives, was exposed to a disease to which they were highly vulnerable. The mass chemotherapy strategy of weekly chloroquine (5mg base/kg of body weight) was adopted by the National Malaria Control Programme to protect this high-risk group. Information on the duration of chemoprophylaxis as well as data on compliance and morbidity in this group are lacking. Generally these individuals are expected to develop some degree of immunity but at the cost of severe illness and death among the population. Moreover, these people frequently visit their original areas of residence in the middle and north of the country, during or shortly after the rainy season. In addition, their (non-immune) relatives visit them and stay temporarily in this area of high transmission. This has created a steady stream of migration between endemic and non-endemic areas. Such a situation affects the malaria transmission and incidence in two ways: First, the newcomers from the non-malarious areas in the endemic areas are highly susceptible to the disease, a vulnerability

that will result in high morbidity and mortality. Secondly, individuals from the endemic areas visiting their original relatively malaria-free areas carry parasites, which, in these recipient areas, may initiate malaria transmission and thus provoke an outbreak.

Migrations for Economic or Political Reasons

Recently, there has been extensive internal population migration mainly from the arid areas in the north and middle of the country, either attracted by the agricultural resources of the south or, lately, because of political instability in the north. Within this context, the malaria situations in three localities, all along the river Shabelle, and all with originally similar environmental conditions but different emerging patterns of immunity and population migration, are worth discussing.

Malable Area

This area is located 132 km south of Mogadishu, on the Shabelle river. The area consists of one main village (Malable) and two satellite villages (Buulo-Arundo and Sigaale) with a total population of about 1500 people. The main occupation is farming. The area has a settled population with limited population movements.

Balcad Town

This town is situated along the main road of the country, 40 km north of Mogadishu, the capital. The town has about 10,000 inhabitants and a textile factory employing a maximum of about 1000 workers. The town being easily accessible, agriculturally fertile, and home to the textile factory, provides substantial opportunities for employment and has attracted numerous non-immune immigrants, mainly from the arid non-malaria endemic areas.

Basra Village

Basra, 12 km from Balcad town, is a typical Somali village in the middle of the agricultural plantation of the Shabelle river. Climatic and geographic conditions are similar to Malable and Balcad. It has also a stable population of a few hundred people.

Malaria Situation in These Localities

In the Malable area, almost everyone with malaria infection is asymptomatic except very small children who show clinical manifestations of malaria. During our annual visits to the area from 1986 to 1989 (Warsame, Wernsdorfer, Willcox, Asli, & Björkman, 1990) most children ages 2-13 were free of severe symptoms of malaria and most of them had very low parasitemia. This is the expected malaria picture in a semi-immune population.

On the other hand, an outbreak of falciparum malaria was reported in Balcad in 1988 (Warsame, Wernsdorfer, Ericsson, & Björkman, 1990). A retrospective study in 1989 showed a progressive increase in annual Slide Positivity Rates (SPR) from 1986, reaching up to 11 times and 22 times the 1986 rate in 1987 and 1988, respectively (Warsame, Wernsdorfer, Hu'dt, & Björkman, unpublished). One of the contributing factors to the

outbreak was a regular influx of non-immune immigrants into the area, thereby resulting in a low herd immunity in this community. The low levels of immunity could well explain the severe malaria symptoms frequently seen as well as the very high parasitemia and mortality rates due to cerebral malaria, observed not only among children but also in adults. The retrospective study also interviewed 109 randomly selected workers of the textile factory in Balcad and found that 95 of them were immigrants from non-endemic areas.

As a comparison, 113 children (2-12 years) inhabiting Basra village (along the Shabelle river, with a distance of only about 12 km from Balcad) were screened for malaria parasites at the same time. This comparative survey revealed that only 2 of 113 children were infected with *P. falciparum*. Therefore, the increase of malaria cases with severe symptoms into Balcad town was observed neither in the neighboring village, Basra, nor in Malable. This can be partly explained by the frequent influx of non-immune immigrants in Balcad town, individuals who are more susceptible to malaria infection and therefore will make the outbreak more severe. The epidemic was also associated with high prevalence (89 percent) and degree of chloroquine resistance.

Chloroquine Resistance and Migration

Another important aspect of malaria in relation to population movement is the spread of chloroquine-resistant *P. falciparum*. It has been shown in Thailand (Pinichpongse & Doberstyn, 1984) that population migration has greatly affected the development and spread of chloroquine-resistant *P. falciparum*. This is true for any area with high potential for migration and, thus, of great importance and concern for malaria control in Somalia. Chloroquine-resistant *P. falciparum* was first reported from Somalia in 1986 at very low levels (Warsame, Lebbad, Ali, Wernsdorfer, & Björkman, 1988). Two years later, an *in vitro* study showed high prevalence and degree of chloroquine resistance in patients who had contracted their infections in malarious areas throughout the country (Warsame, Wernsdorfer, Payne, & Björkman, 1991). This rapid spread of chloroquine resistance throughout the country is likely to have been enhanced by the intensive domestic population movements.

Malaria Control

Malaria control in Somalia deserves special attention. The varying degrees of malaria transmission, the intensive population migration, and the wide distribution of *P. falciparum* resistant to chloroquine all make the control strategy more complex. Effective control measures through the primary health infrastructure, including prompt diagnosis and treatment of malaria cases together with adequate vector control measures, are needed. Within this context the locally prevailing social and economic conditions in each region should be considered. Community participation in malaria control is a realistic approach provided that specific competence and highly skilled technical services are available at all levels.

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Panel of Experts and Other Contributors

Panel of Experts

Dr. R. Barlow *

Professor of Economics
University of Michigan
Ann Arbor, MI 48109-1220

Dr. E.G. Beausoleil *

House # F206/5, 2nd Norla Street
Labone, Accra, Ghana

Dr. N. Etkin *

Associate Professor
University of Hawaii at Manoa
Department of Anthropology
Porteus Hall 346
2424 Maile Way
Honolulu, Hawaii 96822

Dr. K.D. Gbetoglo

Unité de Recherches Démographiques
B.P. 12971
Lomé, Togo

Dr. R. Gearheart *

Professor, Environmental Resources
Engineering Department
Humboldt State University
Arcata, CA 95521

Dr. R. Gwadz *

Head, Medical Entomology Unit
Malaria Section
LPD, NIAID, NIH
Building 4, Room 126
Bethesda, MD 20892

Dr. A.M.A. Imevbore

Director
Institute of Ecology
Obafemi Awolowo University
Ile Ife, Nigeria

Dr. J. Jensen *

Professor of Microbiology
Director
Benson Agriculture and Food Institute
B-49
Brigham Young University
Provo, UT 84602

Dr. D.O. Kaseje

Director
Christian Medical Services
World Council of Churches
P.O. Box 2100
Route de Ferney 150
CH1211, Geneva 2, Switzerland

Dr. A.I. Khatibu

National Project Director
Ministry of Agriculture
P.O. Box 3003
Zanzibar, Tanzania
or
Agriculture & Rice Division
FAO Project
c/o Ministry of Agriculture in Zanzibar
P.O. Box 159
Zanzibar, Tanzania

*Indicates member of the Steering Committee

Previous Page Blank

Dr. W. Kilama
 Director General
 National Institute for Medical Research
 P.O. Box 9653
 Dar es Salaam, Tanzania

Mrs. B. Kinunda
 Department of Community Development
 P.O. Box 70032
 Dar es Salaam, Tanzania

Professor E. Laing
 Chairman, Health Committee on Water
 Resources Development
 University of Ghana
 Department of Botany
 P.O. Box 55
 Legon, Ghana

Dr. F.H. Meskal
 General Manager
 National Research Institute for Health
 P.O. Box 1242
 Addis Ababa, Ethiopia

Mrs. I.B. Mululebwe
 Association Zairoise du Bien Etre Familial
 B.P. 15313
 Kinshasa 1, Zaïre

Dr. E. Nangawe *

Head of Health Department
 Lutheran Diocese in Arusha
 P.O. Box 3164
 Arusha, Tanzania

Ms. P. Ochola
 Community-Based Health Care Support
 Unit
 African Medical and Research Foundation
 P.O. Box 30125
 Nairobi, Kenya

Dr. K.M. Paluku *

Coordinator, Malaria Activities
 PEV-CCCD
 B.P. 9638
 Kinshasa 1, Zaïre

or
 c/o Project Officer
 ACSI-CCCD Project 698-0421-60
 American Embassy/USAID
 APO New York 09662-0006

Dr. F. Rivière
 Directeur
 Institut Pierre Richet
 OCCGE
 Bouake 01, Côte d'Ivoire

Dr. A. Rwamakuba
 Directeur de l'Environnement
 Ministère du Plan
 P.O. Box 46
 Kigali, Rwanda

Dr. W. Sawyer *

President
 China Medical Board of New York
 750 Third Avenue, 23rd Floor
 New York, New York 10017

Dr. W.N. Thitai
 Head of Research
 Ministry of Water Development
 P.O. Box 30521
 Nairobi, Kenya

* Indicates member of Steering Committee.

Other Contributors

Dr. A.A. El Gaddal
Manager, Blue Nile Health Project
P.O. Box 101
Wad Medani, Sudan

Dr. A. Gayibor
Médecin-Chef
Service National du Paludisme
B.P. 1974
Lomé, Togo

Dr. R.T. Guiguemde
Organisation de Coordination et de
Coopération pour la Lutte contre
les Grandes Endémies
B.P. 153
Bobo Dioulasso, Burkina Faso

Dr. D. Helitzer-Allen
Division of Health Systems
Department of International Health
School of Hygiene and Public Health
Johns Hopkins University
615 N. Wolfe Street
Baltimore, MD 21205

Dr. M. Warsame Yusuf
c/o Roslagstull Hospital
Stockholm, Sweden