EcoHealth 2, 11–16, 2005
DOI: 10.1007/s10393-004-0088-4

ECOHEALTH

Profile

Systemwide Initiative on Malaria and Agriculture: An Innovative Framework for Research and Capacity Building

Clifford M. Mutero,[1] Felix Amerasinghe,[2] Eline Boelee,[3] Flemming Konradsen,[2,4] Wim van der Hoek,[2] Tendani Nevondo,[1] and Frank Rijsberman[2]

[1]*International Water Management Institute (IWMI), Private Bag X813, Silverton 0127, Pretoria, South Africa*
[2]*IWMI, P.O. Box 2075, Colombo, Sri Lanka*
[3]*IWMI, c/o ILRI-Ethiopia Campus, Wereda 17, Kabele 21, Addis Ababa, Ethiopia*
[4]*Department of International Health, Institute of Public Health, Blegdamsvej 3, DK-2200 Copenhagen N, Denmark*

Abstract: The Systemwide Initiative on Malaria and Agriculture (SIMA) is an initiative of international agricultural research centers to promote research and capacity building on the links between malaria and agriculture and to validate innovative interventions that would strengthen and complement existing malaria-control strategies in clearly defined settings. Knowledge regarding the nature and dynamics of agroecosystems is particularly needed for the purpose of developing appropriate farmer-managed preventive measures against malaria. SIMA research aims to make use of new and existing information on biomedical and socioeconomic determinants of malaria risks in formulating and evaluating the feasibility of integrated strategies. The initiative is especially interested and proactive in promoting and facilitating transdisciplinary and participatory research in relation to malaria. The convening institute for SIMA is the International Water Management Institute at its Africa Regional Office in Pretoria, South Africa. This article outlines SIMA's objectives and scope of activities and also highlights achievements, challenges, and opportunities for future collaboration.

Key words: malaria, agriculture, Consultative Group on International Agricultural Research, systemwide initiative on malaria and agriculture, ecosystem approach to human health

INTRODUCTION

With an estimated 300–500 million people getting sick with malaria every year and more than 1 million deaths occurring as a result of this disease over the same period, malaria is one of the most important causes of morbidity and mortality globally. The vast majority of malaria cases (90%) are in Africa, where the disease is also associated with economic losses estimated at up to US$12 billion annually (Gallup and Sachs, 1998; World Health Organization, 2000). The disease has a devastating effect on the development potential of African nations as a whole and mostly affects the underprivileged and economically vulnerable groups, which in many African countries still consist of subsistence farmers. Against this background of a deteriorating malaria situation and severe economic hardships, particularly in Africa, there is an urgent need to develop sustainable methods for control of the disease.

In many areas where malaria is endemic, agriculture is valued because of its many benefits, including household food security, improved nutrition, health, and socioeco-

Published online: January 31, 2005
Correspondence to: Clifford M. Mutero, e-mail: c.mutero@cgiar.org

Table 1. Summary of Milestones during the SIMA Stakeholder Consultation Process

Date	Event	Outcome
December 2000	Launching of SIMA at IWMI, Colombo	Working paper on the links between malaria and agriculture
February to April 2001	Electronic conference	Synthesis report of views from a wide cross-section of stakeholders
May 2001	First SIMA stakeholder workshop, Nairobi	Draft SIMA action plan
October 2001	Proposal development	Draft SIMA proposal
May 2002	First capacity-building and proposal-development workshop	Draft preproposals for eastern and southern Africa
November 2002	External review	SIMA framework document

SIMA, Systemwide Initiative on Malaria and Agriculture; IWMI, International Water Management Institute.

nomic well-being. Very often agriculture is the only economic activity that rural communities can rely on for cash income with which to seek treatment for malaria and other diseases or to purchase self-protection devices such as mosquito nets. However, agriculture can also contribute to an increase in malaria risks. Thus, agricultural development has the potential to affect the health of rural and periurban communities negatively, either directly or indirectly, through various activities and practices. For instance, irrigating land for rice cultivation, livestock keeping, and the use of pesticides for crop protection are all known to play a role in malaria transmission risks (World Health Organization, 1982, 1986; Lacey and Lacey, 1990; Birley, 1995).

Convinced that malaria and agricultural development were closely intertwined, the Consultative Group on International Agricultural Research (CGIAR) in 2000 proposed a new initiative, called the Systemwide Initiative on Malaria and Agriculture (SIMA), as a platform upon which knowledge gaps in the complex interrelationships could be addressed. In particular, it was envisaged that SIMA would spearhead the search for opportunities to reduce malaria risks through research partnerships relying on expertise from agriculture, health, and other relevant sectors. The research, it was hoped, could address the development of intervention strategies targeting the mosquito–human host interface, including those that were dependent on a general improvement in the socioeconomic status of rural communities.

This article has two purposes: 1) to introduce SIMA and CGIAR to a wider audience of malaria and agricultural researchers with the aim of stimulating mutual exploration of opportunities for cross-sectoral and transdisciplinary research collaboration and 2) to review the program's achievements and challenges for the initial 3-year period from 2001 to 2003.

Scope of SIMA Activities

SIMA conducted an exhaustive consultation with stakeholders between December 2000 and November 2002 to formulate an appropriate research and capacity-building agenda (Table 1). The consultation reinforced the widely held view that malaria is a complex, multidimensional health problem with a host of interacting variables, including the parasite, mosquito vectors, human hosts, local health-care delivery systems, land use, and global climate change. It was generally agreed that a balance was needed in research and interventions in relation to the physical, biomedical, socioeconomic, and institutional determinants of malaria. Ultimately, it was agreed that the purpose of SIMA would be to promote the research and capacity building needed to increase the understanding of the links between malaria and agriculture and to validate innovative interventions that would strengthen and complement existing malaria control strategies in clearly defined settings.

The need for research-based evidence to help determine the effect of agriculture on malaria can be illustrated by a recent debate on the link between rice irrigation and malaria in Africa. Irrigation has conventionally been associated with an increase in malaria burden. However, recent studies conducted in rice schemes in East Africa have

shown that whereas the numbers of *Anopheles* spp. mosquitoes increase with irrigation of rice fields, the incidence of malaria itself tends to get significantly reduced in the irrigated areas, compared with adjacent nonirrigated areas where mosquito populations are much smaller (Ijumba and Lindsay, 2001; Mutero et al., 2004). Further research is needed to unequivocally elucidate the factors underlying the "paddies paradox," as this phenomenon has come to be known, in view of its significance for policies related to malaria control in situations of expanding rice irrigation, especially in Africa.

Information on the effects of malaria on agricultural productivity exists but is largely inadequate (Goodman, 2000). We need to know more about the direct negative effects of malaria on farming households' food security, nutrition, and livelihood. SIMA research will be undertaken in different geographic areas to effectively guide future interventions and policy developments for a wide variety of social and agricultural production systems.

The latest wake-up call for research on the effects of major human diseases on productivity among farming households is in connection with human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS) (Shannon, 2003). Recent reports suggest that the HIV/AIDS pandemic in certain countries of Africa will adversely influence the selection of crops and cultivation practices, depending on labor input requirements and the financial resources available to the families. Already there is speculation that families affected by the disease in certain cases turn from growing high-yielding staple food crops such as maize and rice to the less-labor-demanding and lower-yielding cassava. The effect of diseases such as HIV/AIDS and malaria on livelihood and agricultural productivity could be reduced depending on the agricultural and health support systems available to affected households. Scientific evidence on the nature and extent of the effects of malaria is needed to enable health and agricultural policy makers to make informed decisions.

Capacity Building

SIMA targets the building of research capacity among young people from a range of nationalities but emphasizes developing countries and a balance between men and women. To adequately address the social, economic, and ecologic underpinnings of the two-way effects of malaria and agriculture, an ecosystem approach to human health (Forget and Lebel, 2001) is emphasized during capacity-building activities. This approach focuses on improvement of human health through sustainable management of the environment. Its key pillars include transdisciplinary and participatory research, with special reference to gender issues. *Transdisciplinarity* refers to collaboration by researchers from complementary disciplines through a process that allows them to exceed their own discipline to generate new logical frameworks, new methods, and new intuitions born from the synergy that ensues from this collaboration (Lebel, 2003; Dakubo, 2004).

It is worth noting that despite increased awareness regarding the complexity of malaria determinants in Africa and elsewhere in the tropics, piecemeal reductionist approaches continue to be the most commonly used to address the disease. Most malaria control projects do not sufficiently deal with the socioeconomic and sociocultural dimensions of target communities and are often devoid of the anthropogenic considerations essential for sustaining disease control interventions.

One method adopted by SIMA to build research capacity has been to conduct workshops that are linked to competitive development of proposals. The first such workshop took place in Nairobi in 2002. It brought together health, agriculture, and environment researchers from national programs of five eastern and southern African countries, researchers from CGIAR centers operating in the region, and facilitators from the International Development Research Centre. The training workshops included theoretical presentations, group discussion sessions, and field visits.

Model Project

Most current SIMA projects primarily target the reduction of malaria transmission risks through improved water, livestock, and general environmental management. The actual method being applied to initially characterize social/ecological systems at different study sites is illustrated below with the completed phase of an International Development Research Centre–funded SIMA project in Kenya.

The objective of the project was to investigate the links between malaria and crop/livestock systems in localities with and without rice irrigation in Mwea, Kenya (Mutero et al., 2004) [Kabutha et al., unpublished data]. The research process used both qualitative and quantitative

methods. The choice of the two methods was based on the growing recognition of their complementarity and importance in enhancing the understanding of the dynamics involving the interaction of biophysical, social, and economic factors.

The research involved the following components, which the community and researchers followed up with action plans: 1) in-house training of members of the research team in the principles and tools of the ecosystem approach; 2) qualitative participatory description and mapping of the Mwea ecosystem; 3) quantitative measurement of problems identified through the qualitative assessment; 4) transdisciplinary interpretation of research data and development of research agenda; 5) quantitative testing of the action-research hypotheses; 6) dissemination of preliminary results to the community and other stakeholders; and 7) a new round of qualitative and quantitative inquiry.

These steps benefited from one another and from the overall synergy inherent in the process. Qualitative data were generated through consultations with stakeholders and subsequent participatory needs assessments in all the study villages. Quantitative data were gathered through questionnaires, mosquito abundance, and malaria parasitologic surveys, all by using sampling frames derived from the qualitative data. The qualitative analysis used a wide range of tools, including maps, time-use calendars, focus group discussions, essays, key informants, gender, and institutional analysis.

The results of the study demonstrated the significant role of participatory approaches in understanding the complexity and links between health and agriculture. The qualitative data withstood the test of accuracy and objectivity and, on this strength, shaped the research agenda and provided the basis for interpretation of the quantitative results.

The core research team consisted of professionals with expertise in medical entomology, parasitology, public health, crop and livestock science, medical anthropology, sociology, and biostatistics. There was some initial resistance to the participatory process because it took natural scientists into unfamiliar and seemingly irrelevant social areas that are traditionally viewed as a realm for social scientists and anthropologists. The resistance, however, declined as researchers recognized the credibility of qualitative results, reinforced by the fact that the project team leader was professionally a natural scientist. The Kenyan research model is, in view of its apparent success, being applied to SIMA projects in Uganda and Zimbabwe.

Information Dissemination

Since 2002, SIMA has organized forums aimed at drawing the attention of the international scientific community to the importance of the agricultural and socioeconomic dimensions of malaria control. Linked to this have been educative messages on the relevance of ecosystem approaches. The more notable special sessions have been held at international meetings, including the Third Multilateral Initiative on Malaria Pan-African Conference in Arusha, Tanzania, in November 2002. Toward the end of 2002, SIMA proactively facilitated a process that eventually led to the formal publication of 15 thematic articles in a special issue of the international peer-reviewed journal *Acta Tropica* (volume 89, issue 2, January 2004). The publication effectively set the stage for other publications on the theme of malaria and agriculture, primarily with an ecosystem approach. Equally important, it was hoped that the publication would stimulate further interest among researchers on the necessity to assess and understand malaria in the broader context of health and sustainable development.

Challenges and the Way Forward

SIMA has experienced several challenges; the main ones are highlighted below. In the first instance, bringing together people in different research disciplines with the view of developing common hypotheses regarding malaria and agriculture is still a daunting task. All too often, researchers are conditioned to working within the disciplines that formed the basis of their university education. Apparently many biomedical and natural scientists acknowledge the relevance of participatory research approaches, but they do not have enough insight to inspire them to routinely incorporate such approaches in their work. Furthermore, even traditional malaria researchers themselves usually segregate depending on whether they trained as molecular biologists, parasitologists, social scientists, or vector specialists. Innovative ways need to be sought to encourage specialists from different disciplines to integrate their thinking and achieve the synergy required for effective ecosystem approaches to health. Donor agencies may have a particularly important role to play in this regard in view of the influence their financial support has on research decisions by government departments and private organizations.

Table 2. CGIAR Centers as of 2004

Center	Head office
CIAT—International Centre for Tropical Agriculture	Cali, Colombia
CIFOR—Centre for International Forestry Research	Bogor, Indonesia
CIMMYT—International Maize and Wheat Improvement Centre	Mexico City, Mexico
CIP—International Potato Centre	Lima, Peru
ICARDA—International Centre for Agricultural Research in the Dry Areas	Aleppo, Syrian Arab Republic
ICRISAT—International Crops Research Institute for the Semi-Arid Tropics	Patancheru, India
IFPRI—International Food Policy Research Institute	Washington, DC
IITA—International Institute of Tropical Agriculture	Ibadan, Nigeria
ILRI—International Livestock Research Institute	Nairobi, Kenya
IPGRI—International Plant Genetic Resources Institute	Rome, Italy
IRRI—International Rice Research Institute	Los Banos, Philippines
IWMI—International Water Management Institute	Colombo, Sri Lanka
WARDA—West Africa Rice Development Association	Bouake, Cote d'Ivoire
ICRAF—International Centre for Research in Agroforestry (World Agroforestry Centre)	Nairobi, Kenya
ICLARM—International Centre for Living Aquatic Resources Management (World Fish Center)	Penang, Malaysia

CGIAR, Consultative Group on International Agricultural Research.

Another related challenge has been the fact that the concept of ecosystem approaches to health is not widely understood. Many researchers seem unfamiliar with certain important aspects, including specific research methods needed to integrate qualitative social science and largely quantitative biophysical data sets. Thus, the prospect of ending up with poorly designed studies and invalid data analysis is, intuitively, a disincentive to researchers who would otherwise be interested in applying such approaches. There simply are not enough formally published examples of malaria or other health research projects applying ecosystem approaches, particularly in Africa. This situation could perhaps also be partly explained by the inability among researchers to publish relevant findings because most mainstream peer-reviewed journals are still oriented to single-disciplinary or sectoral issues.

In the case of Africa, the apparent shortage of expertise in transdisciplinary and participatory research approaches to human health calls for enhanced collaboration to formally build the necessary capacity. This could be achieved by incorporating the relevant subject material in university curricula or through appropriate short courses for practicing researchers. Either way, north–south collaboration would be beneficial in sharing experiences. It is worth noting that such approaches already have a relatively higher degree of popularity among universities and researchers in non-African countries, including Canada, the U.S., and Australia. Equally important, there is an opportunity for journals with an ecohealth slant to create awareness and ultimately publish more results from case studies in Africa.

By initiating and spearheading SIMA, CGIAR has opened up numerous collaborative opportunities. CGIAR is the largest publicly and privately funded agricultural research consortium serving developing countries (CGIAR, 2004). Launched in 1971, CGIAR currently supports a system of 15 agricultural research centers (Table. 2; CGIAR, 2004). Many of the centers have well-established field sites and research networks in malaria-endemic areas of Africa. Overall, the facilities can readily provide valuable information on environmental, demographic, socioeconomic, and farming-system parameters that is needed in the application of ecosystem approaches to human health. As outlined in this profile, the objectives, scope, and initial accomplishments of SIMA represent an important new collaborative initiative for CGIAR. New opportunities will arise when current achievements are reinforced by further collaboration and informed by results from ongoing projects. This consolidation will significantly enhance the validation, acceptance, and, subsequently, wider application of ecosystem approaches in CGIAR, Africa, and beyond.

Acknowledgments

The authors thank the many individuals and organizations who have participated in various activities that have led to

SIMA's achieving remarkable progress within 3 years of its launching. Some members of the Interim Steering Committee from 2001 to 2002 were from the following CGIAR centers: International Water Management Institute, International Livestock Research Institute, International Institute of Tropical Agriculture, West Africa Rice Development Association, and International Plant Genetic Resources Institute. Other members were from the former International Service for National Agricultural Research; the International Centre of Insect Physiology and Ecology; the University Lake Kariba Research Station, Zimbabwe; and the Danish Bilharziasis Laboratory. We are particularly grateful to the following partners for both financial and technical support: Canadian International Development Research Centre, African Development Bank, Netherlands Government, World Bank, United States Agency for International Development, and Environmental Health Project. The International Water Management Institute Regional Director for Africa, Dr. Doug Merrey, has kindly provided wise counsel to SIMA since its inception.

References

Birley MH (1995) *The Health Impact Assessment of Development Projects,* London: HMSO

Consultative Group on International Agricultural Research (2004) CGIAR online. Available: http://www.cgiar.org [accessed 5 September 2004]

Dakubo C (2004) Ecosystem approach to community health planning in Ghana. *EcoHealth* 1:50–59

Forget G, Lebel J (2001) An ecosystem approach to human health. *International Journal of Occupational and Environmental Health* 7(2 Suppl):S3–S36

Gallup JL, Sachs JD (1998) *The Economic Burden of Malaria,* Cambridge, MA: Centre for International Development at Harvard University

Goodman C (2000) An overview of economics of malaria. In: *Malaria Control in Africa*, Copenhagen: The ENRECA Health Network, Institute of Public health, pp 132–126

Ijumba JN, Lindsay SW (2001) Impact of irrigation on malaria in Africa: paddies paradox. *Medical and Veterinary Entomology* 15:1–11

Lacey LA, Lacey CM (1990) The medical importance of riceland mosquitoes and their control using alternatives to chemical insecticides. *Journal of the American Mosquito Control Association* 6:1–93

Lebel J (2003) *Health: An Ecosystem Approach,* Ottawa, Canada: International Development Research Centre

Mutero CM, Kabutha C, Kimani V, Kabuage L, Gitau G, Ssennyonga J, et al. (2004) A transdisciplinary perspective of the links between malaria and agroecosystems in Kenya. *Acta Tropica* 89:171–186

Shannon SC (2003) *Measuring Impacts of HIV/AIDS on Rural Livelihoods and Food Security,* Rome: Food and Agriculture Organization

World Health Organization (1982) *Manual on Environmental Management for Mosquito Control, with Special Emphasis on Malaria Vectors (WHO Offset Publications, No. 66),* Geneva: World Health Organization

World Health Organization (1986) *Intersectoral Action for Health: The Role of Intersectoral Cooperation in National Strategies for Health for All,* Geneva: World Health Organization

World Health Organization (2000) *WHO Expert Committee on Malaria, Twentieth Report*, Geneva: World Health Organization